# Autonomous Vehicle Revenue Implications For Portland, Tigard, and Tualatin

## School of Planning, Public Policy, and Management
## Public Budgeting • Fall 2017


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UNIVERSITY OF OREGON

TRIMET

SCI Sustainable Cities Initiative

SCYP Sustainable City Year Program

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## About SCI

The Sustainable Cities Initiative (SCI) is a cross-disciplinary organization at the University of Oregon that promotes education, service, public outreach, and research on the design and development of sustainable cities. We are redefining higher education for the public good and catalyzing community change toward sustainability. Our work addresses sustainability at multiple scales and emerges from the conviction that creating the sustainable city cannot happen within any single discipline. SCI is grounded in cross-disciplinary engagement as the key strategy for improving community sustainability. Our work connects student energy, faculty experience, and community needs to produce innovative, tangible solutions for the creation of a sustainable society.

## About SCYP

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

## SCI Directors and Staff

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# About TriMet

The Tri-County Metropolitan Transportation District of Oregon was created by the Oregon Legislature in 1969 to operate and oversee the mass transit of the Portland Metropolitan region. This public entity was formed by the legislature as a municipal corporation to replace the multiple private interest mass transit companies that previously operated in Multnomah County, Clackamas County, and Washington County; the counties that make up TriMet.

In addition to operating bus lines, light rail, and paratransit in the defined Tri-Metropolitan district, TriMet also connects to external mass transit services to provide wider blanket coverage for the region. TriMet's nationally recognized transit system provides more than 100 million rides annually, and carries 45% of rush hour commuters going into the Downtown Portland area. TriMet not only moves people, but helps build sustainable cities by improving public health, creating vibrant, walkable communities, supporting economic growth, and working to enhance the region's livability.

Several civic leaders have been highlighted as key figures in the creation, establishment, and ultimate success of TriMet. Governor Tom McCall is credited with the initial call for the creation of the public corporation; other key contributors include Congressman Earl Blumenauer, Rick Gustafson, Dick Feeney, and Mayor Neil Goldschmidt. All were instrumental in shaping the organization itself, as well as the land use, civic development, and transformation policies that make TriMet the success that it is today.

The vision and efforts of these individuals and countless others have borne fruit. Recently, TriMet celebrated the second anniversary of the opening of the most recent light rail line. Since its inauguration the 7.3-mile MAX Orange Line has experienced continued growth, having a 6% year-to-year increase in ridership. Illustrating the holistic approach that has been a part of TriMet from its inception, there have been wider community benefits such as a positive impact on employment and a focus on sustainable practices such as bio-swales, eco-roofs, a first-in-the-nation eco-track segment, solar paneling, and regenerative energy systems.

TriMet is a key partner in the region's Southwest Corridor Plan and Shared Investment Strategy. Eleven partner agencies are participating in planning for a new 12-mile light rail line in southwest Portland and southeast Washington County that will also include bicycle, pedestrian, and roadway projects to improve safety and access to light rail stations. Southwest Corridor stakeholders include Metro (the regional government), Washington County, Oregon Department of Transportation, and the Cities of Beaverton, Durham, King City, Portland, Sherwood, Tigard, and Tualatin. This collaborative approach strives to align local, regional, and state policies and investments in the Corridor, and will implement and support adopted regional and local plans. These initiatives and outcomes from participation with the UO's Sustainable City Year Program will help develop ideas that are cost-effective to build and operate, provide safe and convenient access, and achieve sustainability goals while supporting the corridor's projected growth in population and employment.

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# Executive Summary

TriMet is known for maintaining a robust transportation network in the Portland, Oregon region. Beyond the transportation services, TriMet works with municipalities in the region to make the area a better place to live. The Portland region is expected to grow by 400,000 people in the next 20 years. As the community grows, so will the cost of providing efficient transportation services. In order to continue providing the level of service transit riders expect, TriMet and cities served by TriMet need additional and new revenue.

The City of Portland is known for innovative transportation strategies and sustainable living. The City of Tigard has the long-term vision of becoming the most walkable city in the nation. The City of Tualatin has the vision of a transportation system that supports mobility, connectivity, and accessibility for all modes. The city goals indicate a shared interest in creating an equitable transportation system. Of particular interest for this report is the rapidly expanding recognition and legislation of the use of autonomous vehicles (AVs) and shared vehicles. As researchers look to the near future of the use of AVs and shared vehicles, policy makers in Portland, Tigard, and Tualatin need to better understand the impact of such technology on not only the environment, but on their respective budgets as well.

Interested in all of the possible innovative funding options at the city's disposal, TriMet partnered with Dr. Rebecca Lewis' Public Budget Administration class. Graduate students in the School of Planning, Public Policy, and Management collaborated with TriMet and city staff in researching and evaluating several possible funding strategies.

Dedicating over 4,000 hours collectively, students worked both individually and as groups. Students were assigned teams based on interests, background, and experience. Ultimately, there were three Portland groups, two Tigard groups, and two Tualatin groups. First, students in each group analyzed what transportation revenue would be impacted by shifts in technology. The transportation revenue impact assumptions were primarily based on an Eno Center for Transportation report (Fagnant and Kockelman, 2015). The revenue impacts helped students understand the municipalities' transportation funding structure and develop a baseline need as a result of the shifting technology. Next, students worked to develop innovative revenue options to meet the anticipated revenue gap due to shifting technology. Each group created at least three revenue packages, evaluated those packages based on industry criteria, and recommended one of those funding packages.

Finally, TriMet was presented with seven different funding packages, three focused on Portland, two on Tigard, and two on Tualatin. This report summarizes the seven funding packages into common recommendation themes. Appendicies A, B, and C contain detailed summaries of current transportation revenue sources, potential new revenue sources, as well as the calculations used to inform each recommendation. The report also includes a compilation of each group's original full report.

The funding packages utilized new funding solutions and traditional sources. The most common new funding solution was a Vehicle Miles Traveled (VMT) tax and the most common traditional revenue source was restructuring or increasing vehicle registration fees. In the future, each city and TriMet will have to address the desires and needs of their citizens, and hopefully these recommendations will provide a useful starting point.

# Introduction

TriMet services connect people to the community, ease traffic congestion, and reduce air pollution, serving a population of 1.5 million and covering 533 square miles. Planning has started for the Southwest Rail Expansion that will connect Portland, Tigard, and Tualatin. Throughout this process, TriMet will be working extensively with each municipality. This report focuses on how shifts in technology may affect city budgets, specifically the three cities located on the Southwest Rail Expansion.

A recent study conducted by the University of Oregon found that AVs have the potential to significantly impact "land use planning, transit use, [and] government revenues" (Clark et al., 2017). The Rethinking Transportation 2020-2030 report, predicts that by 2030, 95% of US passenger miles will be traveled not by personal vehicle, but by "on-demand autonomous electric vehicles owned by fleets, not individuals…" (Airbib et al., 2017). AV technology has the potential to impact modal choice and transportation funding. Of particular interest for this report is the rapidly expanding recognition and legislation of the use of AVs and shared vehicles. As researchers look to the near future of the use of AVs and shared vehicles, policy makers in Portland, Tigard, and Tualatin need to better understand the impact of such technology not only on the environment, but also on their respective budgets.

To address these considerations, each group utilized a 2013 Eno Center for Transportation report containing a comprehensive list of predictions regarding the impacts of automated vehicles on U.S. transportation systems. These were broken down into three different impact levels: 10%, 50%, and 90%. Each team selected an impact level to frame projections for future revenue gaps.

Each municipality maintains some of their own transportation revenues, but also rely on pass-through revenues. The three cities analyzed vary in size, therefore their transportation budgets vary in size and structure. The estimated impact on transportation revenues varied based on the Eno Center for Transportation report impact level selected and the structure of the localities transportation revenue.

In collaboration with TriMet, Portland, Tigard, and Tualatin staff, graduate students in the Public Budget Administration class were tasked with researching, evaluating, and recommending new funding strategies. Operating and capital budget needs were considered jointly by student groups. Three groups focused on Portland, two on Tigard, and two on Tualatin.

Graduate students collaborated with city staff to identify ways that each city could better fund transportation as a result of the projected loss of revenue due to the adoption of AVs. Then, within their Portland, Tigard, or Tualatin budget groups, students developed at least three innovative funding packages, analyzed them against industry criteria, and recommended one of those packages. In the following report, innovative funding package recommendations are summarized and original reports can be found in (Appendix D). These recommendations will provide TriMet, Portland, Tigard, and Tualatin with a foundation to develop innovative funding schemes to meet the projected budget impacts of AVs.

# Transportation Revenue Structure and Projected AV Revenue Impacts

While the Portland Bureau of Transportation (PBOT), City of Tigard, and City of Tualatin sustain many of their own transportation revenue resources, they rely heavily on support from pass-through revenues from the county, state, Oregon Department of Transportation (ODOT) and federal funding. Local transportation resources vary within each municipality examined in this report. To analyze the impact of AVs on transportation budgets each group utilized a 2013 Eno

Center for Transportation report containing a comprehensive list of predictions regarding the impacts of AVs on U.S. transportation systems. These were broken down into three different impact levels: 10%, 50%, and 90%. Each team selected an Eno Center for Transportation report impact level to frame projections for future revenue gaps. It is important to note that some of the assumptions discussed in the Eno Center for Transportation report were left out because groups did not have enough information for estimates.

| ENO Assumptions | 10% | 50% | 90% |
|---|---|---|---|
| Number of AVs Operating in U.S. | 12.7 million | 63.7 million | 114.7 million |
| Freeway Congestion Benefit | 15% | 35% | 60% |
| Fuel Savings | 13% | 18% | 25% |
| VMT increase | 2% | 7.5% | 9% |
| Change in Total # Vehicles | -4.7% | -23.7% | -42.6% |
| Parking Savings | $3.2 million | $15.9 million | $28.7 million |

*Figure 2: Summary of ENO assumptions for given impact levels.*
*Source: Eno Center for Transportation 2015*

## Portland Current Transportation Funding

Using the 2016-2017 budget cycle as a baseline, the groups examined the projected impact of autonomous vehicles on the Portland Bureau of Transportation (PBOT's) annual budget revenues.

Portland collects transportation revenues from eight main funds:

| Fund Name | FY 2017-18 Funds |
|---|---|
| **Local Revenue Sources** | |
| City General Fund | $14.6 million |
| Parking | $60.2 million |
| Fees | $40.4 million |
| Bonds | $31 million |
| Fixing Our Streets Tax | $13.2 million |
| **Pass Through Revenue** | |
| Gas Taxes (Oregon and Multnomah) | $63.4 million |
| Grants and Donations | 32.2 million |
| **Other** | |
| Other Revenue Sources- City agencies | $35 million |
| Total without intergovernmental transfers and beginning fund balance | $290 million |
| Total with intergovernmental transfers and beginning fund balance | $371 million |

*Figure 3: Portland transportation revenues FY 2016-2017.*
*Source: Portland Budget FY 2016-27*

Portland's total transportation budget for 2016-2017 came from a mixture of sources including federal, state, county, and local resources. The adopted budget states that total funding equaled $376.5 million, while a separate report puts total funding at $371 million. Based on the $371 million in funding for transportation, pass-through resources equal approximately 26% of total funding sources. Portland Group C calculations excluded intergovernmental transfers and the beginning fund balance equating to $290 million.

General Transportation Revenue is comprised of two sources: State Highway Fund and the city's parking revenues (Appendix A) (Portland Bureau of Transportation, 2016-2017). State, county, and local gas tax, and local parking revenues from meters and fines contribute to 47% of PBOT's total earnings.

| Group | ENO Assumption | Dollar Amount | Percent |
|---|---|---|---|
| Portland A | 50% | $35.7 million | 9.6% |
| Portland B | 50% | $20.2 million | 5.4% |
| Portland C | 50% | $43.4 million | 15.0% |

*Figure 4: Portland groups transportation funding impact estimates.*
**Portland C excluded intergovernmental transfers and the beginning fund balance. The total revenues for this budget cycle based on these assumptions was $290 million.*
**Portland A and C percentages based on $371 million.*

There is adequate research to support the conclusion that gas taxes and parking revenues would be impacted by the adoption of AVs. With an assumed 50% overall adoption rate for AVs, as described above, the groups determined PBOT would lose approximately between 5.4% and 15% of its revenue sources, the majority being lost gas tax revenues.

## Tigard Current Transportation Funding

Tigard transportation is funded by pass-through and local revenue sources. Tigard collects transportation revenues from the following funds:

| Fund Name | FY 2017-18 Funds |
|---|---|
| State Motor Vehicle Fund | $3,000,000 |
| City Gas Tax | $650,000 |
| Washington County Gas Tax | $200,000 |
| Traffic Fines | $715,000 |
| "Distracted Driver" Education course | $8,500 |
| Vehicle Release Fees | $13,500 |
| Transportatoin Development Tax | $2,642,669 |
| System Devlopment Charge | $988,140 |
| Street Maintenance Fee | $2,234,898 |
| Major Streets Transportation Improvements Plan (MSTIP) | $3,500,000 |
| Regional Flexible Funding Appropriations (RFFA) | $680,000 |
| All Roads Transportation Safety (ARTS) | $300,000 |
| Connect Oregon | $500,000 |
| Nature in Neighborhoods (NIN) | $75,000 |
| Total | $15,507,707 |

*Figure 5 Tigard transportation revenues FY 2017-2018*
**Source: Tigard Budget FY 2017-18*
**Adapted from Tigard A and Tigard B Tables*
** Tigard A and Tigard B transportation funding calculations used varied. Tigard A did not include traffic fines, vehicle release fees, and the "Distracted Driver" education course. Tigard A included beginning fund balances and interest earnings. Tigard B did not include Major Streets Transportation Improvement Plan (MSTIP), Regional Flexible Funding Appropriations (RFFA), All Roads Transportation Safety (ARTS), Connect Oregon, or Nature in Neighborhoods. Tigard B focused their analysis on local transportation funds and some pass-through funds.*

Tigard transportation is funded by pass-through and local revenue sources (Appendix A). The total transportation revenue was calculated to be $15,507,707 for FY 2017-18 (Figure 5) not including balance transfers and interest. Tigard Group A, accounted for all resources in the forecast, including beginning fund balance, interest, fees, intergovernmental transfers, and interfund transfers. Tigard Group B, did not include beginning fund balances, which is reflected in Figure 5.

| Group | ENO Assumption | Dollar Amount | Percent |
|---|---|---|---|
| Tigard A | 10% | $1.8 million | 12% |
| Tigard B | 50% | $2.3 million | 15% |

*Figure 6: Tigard groups transportation funding impact estimates.*
**Percent of Figure 5 total revenue.*
**Tigard B assumed funding would reduce by 50% for all funding sources*

For Tigard Group B, assumptions were based on an adoption rate of 50% AVs in the foreseeable future, which would result in approximately $2.3 million in lost revenues or 12% of the transportation revenues, based on current sources. Tigard Group B, looked at the decrease in revenue sources that rely on gas taxes or human-driver error. This did not include the transportation development tax (TDT), transportation system development charge (TSDC), or the Street Maintenance Fee which do not rely on gas taxes or human-driver error.

Tigard Group A took a different approach expanding the Eno Center for Transportation assumptions. In Tigard Group A, assumptions were based on an adoption rate of 10%. Tigard Group A expanded the assumptions to include a best and worst-case scenario. The best case scenario assumed a shared fleet, a 2.1% increase in the total number of electric vehicles, and a 7% increase in ride-hailing. The worst case scenario assumed a shared fleet, a 5% increase in electric vehicles, a 21% increase in ride hailing, and a 20% drop in development fees. The Tigard A revenue assumptions were calculated to have a best case scenario impact of $1.8 million in lost revenue and a worst-case scenario of $6 million in lost revenue on Tigard's local funding sources. The assumptions were found to have a minimal impact on pass-through revenue sources. The best case scenario is reflected in Figure 6. The best case scenario would decrease the current transportation revenues by 12%.

## Tualatin Current Transportation Funding

Tualatin transportation is funded by pass-through and local revenue sources. Tualatin collects transportation revenues from these main funds:

| Fund Name | FY 2017-18 Funds |
|---|---|
| Road Utility Fee Fund | $1,524,170 |
| Transportation Development Tax | $7,966,500 |
| Core Area Parking District Fund | $215,355 |
| Road Operating Fund | $5,026,750 |
| Total | $14,732,775 |

*Figure 7: Tualatin transportation revenues FY 2017-2018*
*Source: Tualatin Budget FY 2017-18*

These funding sources are a mix of intergovernmental and city own sources. Revenues from the Road Utility Fund, Transportation Development Tax Fund, and Core Area Parking District Fund are all local sources. Revenues from the Road Operating Fund, which include state and county gas taxes are pass-through sources. The total revenue related to transportation for the City of Tualatin is $14,732,775, which is 16% of the total operating budget for FY 2017-2018.

| Group | ENO Assumption | Dollar Amount | Percent |
|---|---|---|---|
| Tualatin A | 50% | $7.3 million | 50% |
| Tualatin B | 90% | $3.7 million | 25% |

*Figure 8: Tualatin groups transportation funding impact estimates.*
**Percent of Figure 7 total revenue.*
**Tualatin A assumed 50% of transportation would be lost for each source*

The Gas Tax and State Highway Trust Fund, Traffic Violation Fees, Washington County TDT, Parking Fees from the Core Area Parking District, and Vehicle Impound Fees are all revenue sources that are expected to be impacted by advancements in AVs and shared use mobility companies. With the assumed 50% and 90% overall adoption rate for AVs, as described above, the groups determined Tualatin would lose approximately between 25% and 50% of its revenue (Figure 8). Tualatin Group A assumed a standard 50% decline for each transportation revenue source and found the total amount of revenue that will potentially be impacted by advancements in AVs to be $7.3 million. While Tualatin Group B, calculated a unique decline rate for each transportation revenue source and found the total amount of revenue that will potentially be impacted by advancements in AVs to be $3.7 million.

## Evaluative Criteria

This section describes the framework used to rate the proposed revenue packages, and the series of individual revenue sources present in our proposed revenue packages. Students evaluated each funding option and funding package against generally accepted criteria used to assess financial budgets (Bland, 2013). The groups selected some or all criteria and a decision-making framework for rating and comparing each package. The exact criteria and rating system methodology by the groups can be found in Appendix D and they include (Bland, 2013):

- Equity: This evaluates who feels the burden of the proposed revenue option and seeks that the distribution of burden be fair among people or businesses in comparable circumstances or that there is a variation in tax burden across the spectrum of income.
- Efficiency/Administration: This evaluates whether the revenue option is easy to implement and administer in relation to yield.
- Productivity: This criterion evaluates how effective and stable the proposed option is in terms of meeting the overall desired capital funds.
- Neutrality: This assesses the impact of each option in terms of community and individual decision making or resource use.
- Political Feasibility: This evaluates whether the proposed option is feasible to implement socially and politically and receive approval at both the government and community levels.
- Certainty: The rules of the fee or tax should be clear and evenly applied.
- Convenience: A fee or tax should be convenient to pay, with billing dates that coincide with income streams.

In addition, to the criteria outlined by Bland, Tualatin B evaluated funding packages using a political feasibility criterion. Political feasibility was evaluated based on whether there was precedent for a similar policy somewhere in the world, and/or if the authors determined that a majority of reasonable citizens would vote in favor of such a practice, and/or politicians who approve such mechanisms would not face political backlash.

# Innovative Funding Solution Themes

Each student group researched innovative funding solutions and developed a minimum of three funding packages. Many packages consider common revenue sources, but packages vary in unique ways to give PBOT, Tigard, and Tualatin the ability to consider different funding strategies. This report will identify a list of innovative revenue recommendation themes. Innovative funding solution descriptions can be found in Appendix B, revenue calculations can be found in Appendix C, and complete group reports can be found in Appendix D. The seven student teams examined 24 different sources for filling revenue gaps after the adoption of autonomous vehicles (Appendix B). This section will outline the recommended funding package from each group. Multiple funding packages may be referred to as Package 1 or Package A, but it is important to note that each group's Package 1 or Package A is unique.

## Recommendation 1: Portland A

In this proposal the primary focus is meeting the anticipated revenue gap created by the adoption of AVs. A 50% adoption rate was the foundation of this group's revenue gap projections. To prepare for the potential impacts of AV adoption, Portland Group A recommends the bureau start evaluating revenue sources that can fill in any gaps that appear. Potential revenue sources are based on these assumptions, as well as the assumption that most AVs will be electric. This is because it is easier for computer to operate electric vehicles, and it is safer and easier to recharge an automated car than to fill one with gas. In total, an estimated $35.7 million dollars, 9.6% of the transportation budget will be impacted by the adoption of autonomous vehicles.

Since the adoption of AVs could potentially endanger such a large portion of revenue, it will take a combination of revenue sources to supplement the losses. Portland should look to gather revenues from AV users, as well as the companies that supply and operate the technology. A variety of innovative funding solutions were considered including a VMT tax, toll roads, registration fees, and a car-share fee. The funding sources considered were compiled into three funding packages. The final recommendation is for PBOT to consider funding Package 2 for capturing new sources of revenue related to the adoption of AVs. Funding Package 2 spreads the burden of new charges in the most equitable manner.

| Fund Name | Amount (millions) |
|---|---|
| VMT Tax (0.2/ mile) | $6.9 million |
| Registration Fee ($3) | $798,000 |
| Bridge Toll ($2 on SB lanes) | $29.2 million |
| Car Share Fee ($2) | $5.8 million |
| Total | $42.8 million |

*Figure 9: Portland A funding package 2 sources.*
*Source: Portland A*

Funding Package 2 uses four revenue sources including a VMT, a Multnomah County registration fee increase, a bridge toll on I-5 and Glen Jackson southbound lanes, and a per ride car sharing fee. A tax on VMT would place some of the burden on AV users, and those who receive the largest benefit would pay the largest share. The framework for a tax exists in Oregon, as the state launched the OReGo program in 2015. A VMT tax would generate a large portion of the projected revenue gap. The VMT tax includes some concerns, VMT taxes are not an equitable revenue source, and are looked at as regressive taxes. Despite these concerns, a VMT tax is a potential revenue source that responds to the assumptions of AV adoption.

A small registration fee increase in Multnomah County could generate extra revenue for the City of Portland. If Multnomah County collected the fee and took a small fee for collection efforts, it may allow for a greater revenue margin instead of Portland setting up their own collection efforts. Only small registration fees were analyzed for the current county registration fee and increases could impose a hardship on drivers with lower incomes.

One example of prime congestion in Portland is the Columbia River crossings of Glen Jackson Bridge (I-205) and the Interstate Bridge (I-5). The Interstate Bridge began reaching capacity during peak hours in the 1990s and the Glen Jackson Bridge began reaching capacity during peak hours in the 2000s. A toll system would generate additional revenue from interstate commuters. The tolls could create neutrality issues in that people may not choose to visit Portland during the weekends due to tolls leading to a loss of business. Equality would also be an issue since this would be a regressive toll. Productivity would also be called into question depending on how much the program would cost to implement.

In Funding Package 2, the effectiveness of the proposed bridge toll in capturing new revenue allowed for flexibility in reducing charges from the VMT, the registration fee, and the car-share fee. The benefits of implementing Package 2 include spreading out the burden from new chargers more equitably, while also capturing the most revenue from the potential sources we've discussed. The proposed package generates 42.8 million, meeting the projected revenue gap.

## Recommendation 2: Portland B

This proposal recognizes Portland as a transportation innovation and sustainable living hub. The strategies used aim to maintain Portland as a transportation innovator and adapt the Portland budget to meet the projected revenue gap created by AV adoption. Applying what we know about PBOT's revenue sources with the assumed a 50% impact of AV market penetration, Portland can anticipate a revenue gap of $20.2 million - a loss of 5.4%. This projection is based largely on our assumptions of decreased parking and fuel tax revenues.

To make up this lost revenue, the group identified three different funding packages, each including strategies for making up this loss. The packages utilized a variety of funding sources including a VMT tax, a heavy vehicle tax, a ride-share tax, a drop-off leasing of available parking spaces fee, a price-neutral parking restructure, congestion taxation, and an increase of gas tax. Each funding package was evaluated using four criteria: equity, neutrality, efficiency, and productivity. These evaluation criteria were first evaluated for each proposed revenue package, assigning a numeric value of 1, 2, or 3, respective to the ratings of "poor," "good," or "very good."

If Portland were to begin implementing one of these strategies soon, Portland B recommends Package A since it has widest consumer base. By spreading its revenue gains out over four areas, it leaves more room to maneuver if one strategy is not politically feasible or faces public resistance. The rates proposed are subject to changes by the city and can be increased if the revenue gap is higher than assumed or one strategy cannot be implemented.

| Fund Name | Amount (millions) |
|---|---|
| VMT Tax (0.2/ mile) | $6.9 million |
| Registration Fee ($3) | $798,000 |
| Bridge Toll ($2 on SB lanes) | $29.2 million |
| Car Share Fee ($2) | $5.8 million |
| Total | $42.8 million |

*Figure 10: Portland B package A funding sources.*
*Source: Portland B*

Package A has two components:

1. Transitioning from the Fuel Tax to VMT Tax
2. Levy on Benefiting Businesses

The centerpiece of this strategy is the proposed VMT tax. While this raises more than two-thirds of the added revenue for Package A, its feasibility has already been tested by the state's trial program. While it may require some political maneuvering and GPS investments by drivers, the tax has positive externalities that add benefits in addition to revenue. In addition to encouraging consumers to be wary of their carbon footprint, being charged for gasoline as well as travel distance may prove a difference maker for many drivers as they weigh their commuting options. According an Eno Center for Transportation assumption, fuel savings are forecasted to increase by 18%, due to the decrease in vehicles on the road – a likely outcome of the ride sharing which will occur with the incorporation of AVs. This change marks the most significant portion of the revenue gaps outlined in figure 10. By increasing Portland's gas tax rate early in the process of AV incorporation, accomplishments will be twofold: 1) make up for these lost revenues; and 2) de-incentivize the use of private, non-automated vehicles. The current gas tax sits at $0.10 per gallon which Portland B recommends increasing to $0.13 per gallon.

The levy on benefiting businesses looks at a heavy vehicle tax and a ride-share services tax. Returning once more to the projected VMT increase of 15%, it is safe to say that a portion of these added miles will come from automated, commercial vehicles traveling throughout the city. As travel to and from the city center becomes safer and easier, businesses are likely to take advantage of these efficiencies. Therefore, this package proposes an increase in the current Heavy Vehicle Tax. On May 11, 2016, this tax was approved for a four-year-period, at a rate of 2.8%. This strategy recommends at least a 1% increase to this rate, thus increasing the rate to 3.8%.

The final piece of this strategy includes an added tax on ride-share services, an idea which has already been incorporated into transportation planning in cities. This strategy recommends a tax on ride-share companies, such as Uber and Lyft, within a similar range, for the city of Portland. While there is lucrative potential in such a levy, it is difficult to predict the growth rate of the ride-share industry in the city; this relies on many variables that are still unknown. Therefore, rather than forecasting revenue benefits for the tax, this report recommends addressing this strategy again at a later time, when more information regarding ride-share infiltration is known.

| Criterion | Package A |
|---|---|
| Equity | Good |
| Neutrality | Good |
| Efficiency | Good |
| Productivity | Good |

*Figure 11: Tigard B funding package A evaluation.*
*Source: Portland B*

The financial benefits from package A totaling $30.4 million more than make up for the revenue gap of $20.2 million dollars. The ideas listed can be tailored to fit the cities' goals during the implementation period. Raising the VMT tax rate can incentivize transit usership while keeping the gas tax at reasonable levels can keep cars on the roads; adding to the VMT revenue. Of the three packages listed, Package A is the most proportional across its various strategies, providing the city with a stable source of revenue.

## Recommendation 3: Portland C

This proposal assesses the impacts of AV adoption on PBOT's annual revenues, and suggests replacement sources of revenue. As the advancement of technology shifts vehicle use from motor-fueled and human-operated to electric and autonomous, PBOT may experience a revenue shortfall of $43.4 million or approximately 15% of PBOT's budget, as adoption of AVs reaches 50% of the automobile market. The impacts of AVs on PBOT's budget will depend on their adoption rate. An adoption rate of 50% was assumed; if actual adoption is lower or higher, the impacts on revenue sources should correspond.

The group looked at three revenue packages for PBOT to consider as it faces revenue shortfalls from AV adoption. Each package design recovers the projected $43.4 million annual revenue shortfall in the 50% adoption scenario. Each revenue package was evaluated using the following criteria: equity, neutrality, administration, productivity, certainty, and convenience.

Each package considers common revenue sources, but varies them in unique ways to give PBOT the ability to consider different tax strategies. The common revenue package sources included a VMT tax, an empty seat tax, a user fee for curbside access, a vehicle registration fee, and a fleet parking fee. As the reality of AVs sets in, PBOT can reconsider these packages in light of the realized revenue impacts and adjust rates as necessary to meet their needs. The authors recommend PBOT consider Package 1 to maintain status quo of current tax incidence. Overall, Package 1 performed best in the evaluative criteria.

| Fund Name | Amount |
|---|---|
| VMT for AVs | $13,338,000 |
| User Fee for Curb Access | $17,184,035 |
| User Fee for Parking | $12,915,965 |
| Total | $43,438,000 |

*Figure 12: Portland C funding package 1 sources.*
*Source: Portland C*

The authors suggest compensating the 18% loss (-$13.3 million) in gas taxes with a **VMT tax**. This tax would only apply to AVs and exclude motor fuel vehicles because those drivers will still contribute 82% of the current gas tax revenue.

The AV adoption will inevitably decrease the amount of needed parking by 50%, assuming that all empty AVs will be programmed to avoid parking. Package 1 proposes to replace unused parking meter spaces with curbside access for passengers to be picked up and dropped off. Furthermore, this package suggests curbside access will require a **curbside access annual flat fee** to recoup the decreased parking meter revenue.

Additionally, rather than seek new sources to replace lost revenues from parking permits, citations, and garages, PBOT could **re-price current pricing for parking** for non-AVs. The updated prices need to increase per parked vehicle, however the exact amount would depend on an analysis conducted by PBOT.

To capture revenue from ride-share vehicles, which are predicted to increase, Package 1 suggests an optional **fleet parking fee** of $35 per AV per month. Although this source is not included in the formal calculations, it could accrue additional funds beyond the annual revenue deficit. However, if the fleet parking fee were included in Package 1's evaluation it would change the equity rating from "good" to "poor."

| Fund Name | Amount |
|---|---|
| VMT for AVs | $13,338,000 |
| User Fee for Curb Access | $17,184,035 |
| User Fee for Parking | $12,915,965 |
| Total | $43,438,000 |

*Figure 13: Package 1 evaluation.*
*Source: Portland C*

As illustrated in Figure 13 above, Package 1 ranks "poor" in neutrality because revenue sources are unlikely to incentivize citizen behavior. However, Package 1 rates "good" and "very good" for all the remaining criteria. Equity, administration, productivity, certainty, and convenience display higher rankings because Package 1 includes horizontally equitable revenue sources while not requiring major technological enhancements making them comparatively easier to administer.

A VMT tax levies AV users who would not otherwise contribute towards transportation operation and maintenance costs through payment of traditional gas taxes. Furthermore, administering a VMT tax is currently being piloted through ODOT's OReGO Pilot program, which implies it could eventually be applied to all Portland residents. Package 1 also rates highly because of the curb access fee. Access to the curb is increasingly critical for future street systems and traffic flow. Designing streets for curb access rather than parking accommodates the need for vehicle passenger "loading zones," while also creating a space to generate revenue through new, innovative uses. Additionally, a curb access fee is easy to administer. It could be similar to California's FasTrak sensor and be paid for at time of vehicle registration (Metropolitan Transportation Commission, 2017). Since the process is similar to existing policy and regulation, this fee will be feasible to administer and be convenient for PBOT and the public. Finally, updating the prices for parking in Portland will be fairly feasible because parking fees are an existing revenue source. The parking analysis may take additional funding and staffing to execute, however it is often a standard evaluation and would allow Portland to adjust pricing as AV adoption continues to impact the market.

Although Package 1 lacks vertical equity because it does not apply a progressive tax structure, nor does it incentivize beneficial behavior, it does yield a sufficient and stable revenue stream beneficial for PBOT's adoption of AVs presence in the market. The financial benefits of Package 1 totaling $43.4 million in new revenue match the projected revenue gap.

PBOT can consider the following steps to implement Package 1:

1. Conduct parking audit and pricing evaluation.
2. Discuss statewide or countywide VMT with other jurisdictions to avoid city/county boundary effects.
3. Hold public hearings to discuss if this package aligns with the community vision.

## Recommendation 4: Tigard A

The overall approach to revenue generation for this group is guided by three main principles:

1. Utilizing an understanding of benefits received as a model for where to look for extracting revenue .
2. Replacing losses with revenue sources that can mimic as reasonably as possible the funding sources becoming less fruitful over time (e.g., replacing gas taxes with VMT fees, which serve as a reasonable stand-in measure of contribution to road wear and tear).
3. Proposing funding schemes that align with the city's values and ultimately bring Tigard closer to its long-term vision of becoming the most walkable city in the nation.

Tigard A aimed to balance these principles in the proposed package. In adopting this approach, the goal is geared toward upholding equity while still bringing Tigard up to and beyond the line of the projected $1.8 million or approximately 12% in lost transportation revenues based on a 10% adoption rate. The three funding packages use at least four of the seven suggested revenue sources. The seven suggested revenue sources are a VMT tax, maintenance fees, registration fees, parking fees, licensing fees, impact fees, and an EV utility charge. Each revenue package is designed to generate local and state resources. The funding packages were evaluated using productivity, efficiency, neutrality, and equity. Tigard A recommends that the city pursue Package 1. Package 1 is designed to incentivize shared vehicle usage using a variety of fees and taxes.

| Fund Name | Amount |
|---|---|
| VMT for AVs | $13,338,000 |
| User Fee for Curb Access | $17,184,035 |
| User Fee for Parking | $12,915,965 |
| Total | $43,438,000 |

*Figure 14 :Tigard A shared vehicle package funding sources.*
*Source: Tigard A*

The Shared Vehicle Package, or Package 1, is designed to incentivize shared vehicle usage through a combination of varied taxes and fees. The balance of taxes and fees particular to this package culminates in a system that should encourage future AVs to be shared. The high **VMT fee** encourages people to use alternatives to single occupancy vehicles. The **registration and maintenance fee** incentivizes residents to use shared fleets. The registration and maintenance fee may impact neutrality, but they create the best environment for an equitable transportation system. In addition, the local sources encourage a shared use fleet. The **electric utility charge** and **parking fees** will impact private owners of autonomous vehicles. The high parking fees encourage walking or cycling to the Tigard Triangle or Highway 99 for current transit options (TriMet WES and bus) and future options (SW Corridor MAX). Incentivizing bicycle/pedestrian options in this manner aligns with Tigard's strategic vision to become the most walkable city on the west coast.

The impact fee is not included in Package 1, which will encourage corporations to bring AV operations to the city. As VMT is projected to increase 7% with AV adoption, this package has the highest VMT tax rate, higher registration fees, and the addition of a maintenance fee. This will help replace lost gas tax revenue from the worst-case scenario of expanded consumer and commercial EV adoption.

The **licensing fee** does increase the cost the per ride cost for shared vehicles, but the fee is a small per use fee. The licensing fee of $0.40 per trip that originates or ends in Tigard is lower than Portland's $0.50 fee, and should not discourage ride hailing operations in the city. The overall goal of discouraging single occupancy trips is reflected in the high parking fee and the high VMT. Fewer single occupancy trips contribute to better air quality and less congestion.

| Fund Name | Productivity | Efficiency | Neutrality | Equity |
|---|---|---|---|---|
| VMT (State) | Excellent | Very Good | Poor | Good |
| Registration Fees (State) | Good | Very Good | Poor | Good |
| Maintenance Fees (State) | Good | Very Good | Poor | Good |
| Licensing Fee (Local) | Good | Excellent | Good | Very Good |
| Licensing Fee (Local) | Good | Excellent | Good | Poor |
| Parking Fees (Local) | Good | Poor | Good | Poor |

*Figure 15: Tigard A shared vehicle funding package evaluation.*
*Source: Tigard A *Numeric Conversion Scale: 5=excellent, 4=very good, 3=good, 2=moderate, 1=poor*

Many of the revenue sources are based on the number of AV vehicles and revenue will increase as AV adoption increases. The revenue package is structured in this way because as new revenue sources increase, traditional revenue sources, such as gas tax, will continue to decrease. The defined revenue sources rates can be adjusted to better meet the city's need as more data are available. This package generates the most revenue and encourages the use of shared vehicles. In total, this package revenues exceed the revenue gap of $1.8 million producing $3.8 million locally and $9.9 million from the state.

## Recommendation 5: Tigard B

The funding packages studied by Tigard B were designed to leverage Tigard's location at the hub of several highway and commuter stops. Where applicable, assumptions were based on an adoption rate of 50% autonomous vehicles in the foreseeable future, which would result in approximately $2.3 million or approximately 15% in lost transportation revenue.

The team developed three funding packages to meet the revenue gap. The funding packages considered a gas tax, electricity consumption tax, street maintenance fee increase, private charging station franchise fee, ride-share franchise fee, and a ride-share registration fee. Based on the analysis of the revenue generated, as well as each package's impact on equity, neutrality, administration, productivity, certainty, and convenience, the group recommends Package 1, which includes the gas tax, electricity tax, and franchise fees for charging stations. Package 1 performed the best based on the evaluative criteria and analysis.

| Fund Name | Amount |
|---|---|
| Gas Tax | $540,000 |
| Electricity Tax | $1,150,000 |
| Franchise Fees for Charging Stations | $197,000 |
| Total | $1,887,000 |

*Figure 16: Tigard B innovative funding sources.*
*Source: Tigard B*

The **gas tax** has low equity as it would have a regressive effect on Tigard citizens who lack means to upgrade their automobile to a newer, cleaner vehicle. However, the tax is productive, certain (once it passes), and convenient. In the short term, adoption of AVs in a small suburban town will be slower than in downtown Portland, and this option may generate significant new revenue. However, taxes need voter approval, and an increased gas tax has already been voted down.

The **electricity tax** is somewhat inequitable as residents and small businesses that cannot upgrade to more energy-efficient structures and appliances will eventually pay proportionally more than other payers. As this tax would be collected and remitted by the utility, it is administratively efficient. Revenues raised from this option exceed $1.85 million, half of the transportation revenue shortfall. A change to current Oregon law may be necessary, and a tax requires a vote. Even so, the strain on PGE's system due to system-wide increased use of the electrical grid may encourage taxpayers to consider a tax on the ballot.

Because increased use of EVs will strain the power grid, **charging franchise fees** that offer companies the right of way to access the grid may work in both directions. Franchising charging stations to a private vendor may be efficient, moving operating responsibility to the private sector. There is not enough data to know. New parking structures planned for along I-5 in Tigard could transition to fleet housing stations leased by AV companies like Uber and Lyft, and fees could run upwards of $1 million. Current charging stations are not operated by private entities; this would require a new model for this market.

| Fund Name | Gas Tax | Electricity Tax | Franchise Fees for Charging Stations |
|---|---|---|---|
| Equity | 1 | 2.5 | 5 |
| Neutrality | 1 | 4 | 2.5 |
| Admin | 2 | 1.5 | 5 |
| Productivity | 4.5 | 5 | 4 |
| Certainty | 5 | 5 | 5 |
| Convenience | 5 | 5 | 3 |
| Total | | | 66 |

*Figure 17: Tigard B funding package evaluation.*
*Source: Tigard B*
**Funding package evaluation was based on a rating scale between 1 (poor) and 5 (excellent).*

Package 1 would raise about $1.8 million in revenue, which would not meet the revenue deficit of $2.3 million. This plan has some issues with political feasibility, but this can be overcome through thoughtful education on the benefits AVs will have for the City of Tigard.

## Recommendation 6: Tualatin A

This proposal outlines innovative new policy concepts to replace anticipated revenue loss. The projected revenue loss was $7.3 million assuming a loss of half of the transportation budget. The following analysis will examine these policy options and recommend a policy package. The three revenue packages individual revenue options included a charging station fee, CAV registration fees, fossil fuel fees, cordon and area pricing, GPS and data fees, local and regional variable lane pricing, a VMT tax, a mobile business tax, a drop-off zone fee, and an automated vehicle development charge. Each package policy is analyzed based on four criteria: equity, neutrality, efficiency, and productivity. Each policy received a score in each category: 0 (poor/nonexistent), 1 (average), 2 (good). Each package received an average score in each category and a total average score. Based on the analysis the group recommends the Innovation Package while also considering state funding sources from the Metro Package.

After an analysis of each package, Tualatin A recommends the Innovation Package, as it is the best performing package that Tualatin can implement within its own borders. Additionally, Tualatin A recommends Tualatin pursue policies within the Metro Package in partnership with regional and statewide stakeholders. Implementing the Innovation Package, with support from Metro Package policies, will ensure Tualatin thrives in the new CAV-based economy.

| Fund Name | Amount |
|---|---|
| GPS Data | $51,000 |
| Registration Fees | $998,580 |
| Regional on-ramps/off ramps | $1,529,715 |
| Statewide Electric VMT | $20,355,630 |
| Pizza Tax (mobile business fee) | $300,000 |
| Total | $23,234,925 |

*Figure 18: Tualatin Metro package funding sources.*
*Source: Tualatin A*

| Fund Name | Amount |
|---|---|
| Charging Stations | $3,540,250 |
| GPS and Data fees | $51,000 |
| Pizza Tax (mobile business fee) | $300,000 |
| Drop off Zones | $3,985,000 |
| Automated Vehicle Development Charge (AVDC) | $623,355 |
| Registration fees | $998,580 |
| Total | $9,498,185 |

*Figure 19: Tualatin innovation package funding sources.*
*Source: Tualatin A*

The Innovation Package identifies and relies on new ideas, infrastructure, and development to help fund transportation-related costs in Tualatin. The package aims to find creative ways to charge businesses and developers operating in the entirely new sphere of automated vehicle-related businesses.

**Electric charging station fees** could set a leasing framework with a wide variety of private companies at a set rate of payment to the city. This would require a consistent payment structure for citizens. Fees for use charging stations burden low income groups disproportionately and expanding the electric charging network will influence market behavior. **GPS and data fees** may have a high initial administrative cost, but benefits from the policy should override administrative costs. The **mobile business tax** will allow cities to collect income tax revenue from mobile businesses. The mobile business tax would be progressive and thus equitable. The **drop-off zone fee** will offset lost on-street parking revenue. The drop-off fee is easy to administer and equitable. **Automated vehicle development charges** are dedicated to AV-related development or connected facilities. This policy is simple to administer, but may impact neutrality if adjacent cities do not implement a similar policy. Finally, a **registration fees** structure could change to charge different rates for fleet vehicles. The registration fees administrative structure already exists and the fee is very efficient.

The Metro Package is a group of policies that would be most productive when implemented regionally. The Metro Package considers an **Electric VMT** and a **local regional variable lane pricing system**. In addition, the Metro Package has a mobile business tax, registration fee, and GPS and data fees, as mentioned in the Innovation Package. This package recognizes the value of Tualatin's regional relationships, its high number of commuters, and the administrative challenges associated with implementing some of these policies at a local level. Many of the policies included in the Metro Package involve large scale agreements with private companies, fees that are already assessed at a regional or state level, and/or are related to activities that occur both within and beyond the city of Tualatin's borders.

| Fund Name | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| GPS Data | 2 | 2 | 1 | 2 |
| Registration Fees | 1 | 2 | 2 | 2 |
| Regional on-ramps/off ramps | 1 | 1 | 2 | 1 |
| Statewide Electric VMT | 2 | 2 | 2 | 2 |
| Pizza Tax (mobile business fee) | 2 | 2 | 1 | 2 |
| Total | 8 | 9 | 8 | 9 |
| Average | 1.6 | 1.8 | 1.6 | 1.8 |

*Figure 20: Tualatin Metro Package evaluation.*
*Source: Tualatin A*

| Fund Name | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| Charging Stations | 1 | 0 | 2 | 2 |
| GPS and Data fees | 2 | 2 | 1 | 2 |
| Pizza Tax (mobile business fee) | 2 | 2 | 1 | 2 |
| Drop off Zones | 2 | 2 | 1 | 2 |
| Automated Vehicle Development Charge (AVDC) | 2 | 1 | 2 | 2 |
| Registration fees | 1 | 2 | 2 | 2 |
| Total | 10 | 9 | 9 | 12 |
| Average | 1.7 | 1.5 | 1.5 | 2 |

*Figure 21 Tualatin Environmental Package Evaluation*
*Source: Tualatin A*

The Metro Package generates $23 million annually for Tualatin, largely due to the statewide VMT tax generating an expected $20 million annually. The Innovation Package generates $9.4 million annually for Tualatin. The highest yielding funding sources in the Innovation Package are the charging stations and Automated Vehicle Development Charges. Both packages exceed the estimated revenue gap.

## Recommendation 7: Tualatin B

Each funding package considered was designed to support Tualatin's Community Goals and provide Tualatin with sufficient resources to create a transportation system that serves all members of their community. Two of these community goals relate directly to the transportation system and its funding:

1. An affordable, livable, family-oriented, healthy, active, and safe community for all incomes, ages, and abilities.
2. A funded transportation system that supports mobility, connectivity, and accessibility in all modes.

The current transportation revenue section identified that Tualatin Group C calculated a $3,746,650 revenue gap, which is 25% of the total transportation budget. Utilizing five criteria (political feasibility, equity, efficiency, neutrality, and productivity) the group analyzed their three funding packages. The packages considered a VMT tax, an advertisement tax, a city registration fee, congestion pricing, a downtown parking fee, a commercial parking fee, and a commuter toll. Tualatin B assumed at the 90% AV adoption rate, 50% of vehicles will be privately owned, while the other 50% will be operated in a shared fleet. Based on the criteria and analysis Tualatin B recommends Package 3, the Innovation Package.

| Fund Name | Revenue Sources |
|---|---|
| VMT | $6,145,322 |
| Congestion Pricing | $1,766,440 |
| Advertisement Tax | $253,498 |
| Total | $8,165,260 |

*Figure 22 Tualatin Group B Innovation Package sources.*
*Source: Tualatin B*

Of the revenue opportunities and packages described, Package 3 is recommended for adoption in Tualatin. A **VMT tax** is the best representation of the "pay for use" principle, and it received the highest evaluation score, ranking high in every category. **Congestion pricing**, although likely to come with backlash from the community initially, is a strong tool for effectively managing the demand for road space. An **advertisement tax** has high political feasibility,

making it a simple method for Tualatin to generate additional revenue that can be used to improve the city's transportation system. Overall, this package is relatively easy to implement and has low administrative costs. This package also best fits Tualatin's goals for creating an active, healthy community and a transportation system that works for all ages, incomes, and abilities, by de-incentivizing private car use and promoting alternative transportation choices in general. Congestion pricing and a VMT tax are especially useful for this purpose.

With an average index of 12.3, Package 3 has a Moderate/High ranking and is the most highly ranked of the three available packages. The low rankings of congestion pricing are the main cause of this moderate score. Evaluated alone VMT and advertising tax have the highest index of evaluation criteria. The reason congestion pricing is included is for its high productivity, moderate equity, and its promotion of active transportation and shared trips. Congestion pricing helps cities manage demand for limited road space.

| Fund Name | VMT | Advertisement Tax | Congestion Pricing |
|---|---|---|---|
| Political Feasibility | High | High | Low |
| Equity | High | High | Moderate |
| Efficiency | High | High | Low |
| Neutrality | High | High | Low |
| Productivity | High | Moderate | High |
| Total | 15 | 14 | 8 |

*Figure 23: Tualatin B Package C funding evaluation.*
*Source: Tualatin B*
*Index: High=3, moderate=2, low=1*

The third package aims to effectively charge for the use of Tualatin's limited road space. The VMT tax charges directly for road use, and congestion pricing assists in managing road use at the busiest time of day in an effort to limit congestion and traffic delays. The advertisement tax is an additional revenue source that charges fleet operators for revenues they receive from having a captive audience for advertisements, essentially charging shared vehicles for annoying their customers. In total, Package 3 is estimated to generate $8,165,261, thus meeting and exceeding the projected revenue gap.

# Conclusion

Moving forward, both traditional state and local revenue sources are expected to be impacted by the transition to AVs. Portland, Tigard, and Tualatin receive pass-through transportation revenues from federal sources and the State of Oregon. Each group estimated a revenue gap, as a result of the adoption of autonomous vehicles. The assumptions were based primarily on the Eno Center for Transportation report that were broken down into three different impact levels: 10%, 50%, and 90%.

Each group created at least three funding packages and evaluated the packages using evaluative criteria. Based on the evaluation each group recommended one funding package for the city to consider.

| Group | Recommended Funding Package Revenue Sources |
|---|---|
| Portland A | VMT Tax, Registration Fee, Bridge Toll, Car Share Fee |
| Portland B | Increased Fuel Tax, VMT Tax, Increased Heavy Vehicle Tax |
| Portland C | VMT Tax on AVs, User Fee for Curb Access, User Fee for Parking |
| Tigard A | VMT Tax, Registration Fee, Maintenance Fee, Rideshare Licensing Fee, Parking Fee, Electric Utility Charge |
| Tigard B | Gas Tax, Electricity Tax, Franchise Fee for Charging Stations |
| Tualatin A | GPS Data Fee, Registration Fee, Regional on-ramp/off-ramp fee, VMT Tax, Mobile Business Fee, Charging Stations Fee, Drop off Zones Fee, Automated Vehicle Development Charge |
| Tualatin B | VMT tax, Advertisement Tax, Congestion Pricing |

*Figure 24: Summary of funding package recommendations.*

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# Appendix A: Current Transportation Revenue Source Descriptions

This section briefly describes all current revenue sources for Portland, Tigard, and Tualatin.

## Portland Current PBOT Revenue FY 2016-2017

### City General Fund - Property Taxes, Business Licenses, Utility License, Franchise Fees - Local

PBOT received $14.6 million in discretionary funds from the city of Portland's General Fund in FY 2016-2017, making up approximately 5% of PBOT's total revenues, excluding the Beginning Fund Balance. (City of Portland, 2016). This funding is sourced from property taxes, business licenses, utility licenses, and franchise fees. The General Funds are distributed to PBOT's for core transportation operations.

The transportation bureau's overall share is 2.4% of the total city's General Fund. The sources of the General Fund are broken out by individual funding source. The local sources are listed in this paragraph.

### Parking - Local

The second largest portion of PBOT's budget, parking revenues, include on-street parking meters (11%), permits (2%), and citations (3%), as well as SmartPark (5%) garage operations, and leases on commercial space. On-street parking fees and fines are unrestricted funds. SmartPark fees are first cost recovery for garage operations; once those needs are met, the remaining revenues are unrestricted (City of Portland, 2013).

### Fees - Local

The revenues from fees for PBOT's "primarily consists of permits issued to builders, developers and private citizens using public space." These fees are limited to cost recovery associated with issuing right-of-way permits or land use reviews. Additional funding comes from Transportation System Development Charges (City of Portland, 2013).

### Fixing Our Streets Tax - Portland's Gas Tax - Local

Portland collects its own local gas tax called the "Fixing Our Streets" tax. Ten cents is collected on each gallon of gas purchased. It is collected on gasoline, diesel, and other fuels for vehicles under 26,000 pounds. Every month, businesses report and pay required fees for fuel consumed at their location within city limits (City of Portland, n.d.). The local tax also applies a Heavy Vehicle Use Tax on City of Portland Business License Tax payers with vehicles over 26,000 pounds subject to Oregon's weight-mile tax.

### Bonds and Notes Proceeds - Local

PBOT receives different bond sales revenue each year. The revenues are combinations of one-time sources paid back with interest over time. The total revenue expected in bonds and notes for 2016-2017 is expected to be $31 million (11%). The Portland Development Commission (PDC), through tax-increment financing, has been a major partner in developing and funding transportation-related projects in PBOT's Capital Improvement Program (CIP). The Portland Development Commission funding sources are difficult to capture beyond the amounts indicated above, therefore the authors exclude projections for Bonds and Notes in the later sections.

### Gas Taxes - Oregon & Multnomah – Pass-through:

Portland also collects gas tax revenue from the Federal Government, the State of Oregon, and Multnomah County. "State Highway Funds are distributed to ODOT, to counties based on vehicle registration, and to cities based on population. The County then transfers a portion of its State Highway Fund and County gas tax receipts according to a set formula" (City of Portland, 2013).

### Other Revenue Sources - City Agencies - Pass-through:

City Agencies Funds not considered local or pass through revenue source. Funding from city agencies represents intergovernmental transfers as a method of cost recovery for services. These include maintenance services for the Bureaus of Environmental Services, Parks and Recreation, and Water, as well as parking contracts with Portland Police.

## Tigard Current Transportation Revenue FY 2017-18 (City of Tigard, 2017)

### State Motor Vehicle Fund - Local:

The Oregon State Motor Vehicle Fund shares revenue with counties and cities in the state. The majority of the State Motor Vehicle Fund comes from gas taxes, vehicle registration fees, and vehicle title fees.

### City Gas Tax Fund/County Gas Tax – Local/Pass-through:

The City of Tigard has a 3-cent gas tax. The majority of the city gas tax revenue funds is directed to pay off the Greenburg Road/Pacific Highway/Main street intersection improvements. Payments for this bond will be completed in FY 2019-20.

Washington County collects a motor vehicle fuel tax on gas sold within the county. The county gas tax is distributed to cities in the county based on population. Tigard received roughly $200,000 for the past five years.

### Transportation Development Tax (TDT) - Local:

The Tigard Transportation Development Tax (TDT) was approved by voters in 2008. The TDT replaced the Traffic Impact Fee (TIF) and is assessed on new developments. Revenues from this tax must be dedicated to capital improvements that expand capacity. Revenue from the TDT can be difficult to forecast because developers can receive credits for major infrastructure projects, and development in the city varies on a yearly basis.

### Transportation System Development Charge (SDC)- Local:

The Tigard System Development Charge (SDC) is a charge collected when building permits are issued for new residential, multi-family, or commercial construction. The Tigard SDC was implemented in 2016, and as a result little data on the Tigard SDC is available. SDC revenue helps provide funds for increased vehicle and transit capacity projects.

### Street Maintenance Fee- Local:

The Street Maintenance fee is a charge on Tigard residents' utility bills and provides a steady revenue source for the maintenance of existing roads. The Street Maintenance Fee revenues cannot be used for capital projects in the city. The street maintenance fee was originally approved in 2003 and the most recent increase went into effect January 2017.

### Major Streets Transportation Improvements Plan (MSTIP, Washington County) - Local:

This program is funded through primarily through a transfer from the Washington County general fund, which is largely funded by property taxes. MSTIP is funded in 5-year budget cycles, with the current cycle ending this year (FY 2017-18). The next cycle will run FY 2018-19 through FY 2022-23. The budget plan was approved by the board of commissioners in October 2016. This plan also sees funding from other intergovernmental revenues. These revenues are expected to decrease, but make up a smaller portion of the total revenues, so they are not expected to have an impact on Tigard's transportation funding. This funding runs through Washington County's capital budget and into Tigard's CIP fund, rather than through either entity's operating budget.

### The Statewide Transportation Improvement Program (STIP) - Pass-through:

The Statewide Transportation Improvement Program is a capital improvement program run by the Oregon Department of Transportation (ODOT) as well as the Oregon Transportation Commission. Projects under this program area derive their support from both state and federal-level funds.

### All Roads Transportation Safety (ARTS - ODOT) - Pass-through:

This program is also funded through the Oregon Department of Transportation, which sees federal funds, fee/license revenue, enterprise revenue, among other sources. Within the ODOT budget, this specific program operates under the Transportation Program Development Division. This federal funding is available for all roads, including non-state-owned roads, in Oregon for the purpose of improving safety for citizens through a data-driven approach. ARTS allocated a total of $166 million to be spent from 2017-2021. Through ARTS, problem areas

with safety issues are identified, then Highway Safety Improvement Program Funds (HSIP) funds may be used to improve these problems. However, Federal HSIP requires non-federal matching funds, or 7.78% for Oregon. For Tigard, this funding equates to $200,000 annually, with a ~10% match.

### Regional Flexible Funding Appropriations (RFFA - Metro) - Pass-through:

This program is also funded through and governed by Oregon Metro. This specific funding operates in conjunction with the Metropolitan Transportation Improvements Program (MTIP), a federally required schedule of transportation investments that operate under Metro, ODOT, TriMet, and SMART. The funding allocated by RFFA is proposed in 4-year cycles, with this funding to continue through 2021. These funds are intended to act as a method of supporting regional collaboration of transportation investments under MTIP.

The funding that has been agreed upon would be supplied in part through an increased bond commitment, but also expects other funding sources to match commitments. It is expected that this project and funding will have a return on bond investments, as well as ongoing commitment for funding from regional sources. Because of this type of funding, it is unlikely that this funding will be impacted by autonomous vehicles.

### Connect Oregon - Pass-through:

As dictated in ORS 367.080 of 2015, the Oregon Transportation Commission was provisioned to fund transportation projects through the establishment of the Connect Oregon Fund. Money from state lottery bonds are to be transferred to the Department of Transportation "in an amount sufficient to provide $45 million" for their funding of select projects (ORS 367.080) under the umbrella of Connect Oregon. As this is a state-wide program, the statute splits Oregon into five different regions; Washington County is part of Region 1, along with Clackamas, Hood River, and Multnomah Counties. Per the statue, 10 percent of the net proceeds of state lottery bonds should be provided to each of the five different regions.

At present, the Connect Oregon Fund is supporting four projects, some of which span more than one of the program's five regions; they are the Mid-Willamette Valley Intermodal Facility, the Treasure Valley Intermodal Facility Rail, expansion in East Beach Industrial Park at the Port of Morrow Brooks rail siding extension.

## Tualatin Current Transportation Revenue FY 2016-2017

### Road Utility Fee Fund – Local:

Fee funds maintenance of 78 miles of city streets' light/tree/frontage.

### Transportation Development Tax (TDT) Fund – Local:

One-time countywide charge that funds transportation capital projects by taxing new developments.

### Road Operating Fund – Pass-through:

Gas tax and fees fund operations through Washington County and Oregon State Gas Tax and State Highway Trust Fund.

### Core Area Parking District Fund -Local:

Funds a parking district in downtown core by taxing downtown businesses.

The first three provide revenue primarily for new projects and maintain the current system. The fourth (the Core Area Parking District Fund) provides special district funding for downtown parking and landscaping improvements.

# Appendix B: Innovative Funding Source Descriptions

This section describes the recommended innovative funding sources.

### Advertisement Revenue Tax

This is a tax to be collected for the city on the revenue that fleet operators make from selling ads displayed within the vehicle. It will be collected at the same time as business income tax. Shared fleet vehicles are likely to display ads inside the vehicles as an additional revenue stream. The revenue calculated is based on assumptions about average ad length and price.

### Annual Fee AV Ownership Fee

The purpose of this fee is to offset the loss of revenue from gas taxes. It has been found that an annual fee is a good option. This will apply for both individual ownership of autonomous vehicles and fleets.

### Automated Vehicle Development Charges (CAVDC)

CAVDCs are similar to SDCs, but are dedicated to AV-related development or connected facilities, structures, and streets. The revenue will go into funds for updating transportation-related city infrastructure. The upfront costs of CAVDCs involve determining charge levels for development.

### Car-share Fee (Flat Fee for pickup or drop off in Portland)

A flat fee could be automatically charged if the pick up or drop off point were inside Portland city limits.

### Charging Station Fee

Fees for charging stations are a pay-for-use system. Vehicles parked at charging stations are often assessed a parking fee in addition to the charging station fee. Cities can incentivize electric CAVs by developing electric-friendly infrastructure with charging stations in cities, rural areas, and along highways and interstates. Smart, connected AV networks can guide cars to the most efficient charging station locations and prevent charging station queue congestion. Electric charging station fees could set a leasing framework with a wide variety of private companies at a set rate of payment to the city. This would require a consistent payment structure for citizens.

### Cordon Pricing (Congestion Pricing)

Cordons are one-time charges to drive within or into a congested area within a city. These are easily adopted through the vehicle-to-infrastructure communications network, which will be available with Coordinated Autonomous Vehicle (CAV) technology (Liu, et al, 2017).

### Commercial Parking Fee

This fee would be assessed annually. Other cities have implemented this fee for the businesses choosing to park their delivery vehicles by designed curbside spaces.

### Commuter Toll

This toll would be charged per commuting vehicles for entering or leaving a city. This will require the use of electronic transponder technology like those used on California toll roads.

### Drop-Off Zone Fee (similar to user fee for curb access)

Assuming that ride-share companies provide autonomous options for travelers; the City of Portland can establish various drop-off and pick-up zones for automated ride-share vehicles. The most efficient zones would be areas of high traffic (downtown, Union Station, PDX airport, the riverfront, etc.) where ride-share companies can be charged for delivering travelers. The ride-share vehicles would have specifically designated zones where they would be allowed to interact with customers and would be required to pay to use the space. In order to preserve space, these zones should be located near existing parking areas and the city should expect compensation similar to what it receives in parking for expected revenue losses.

### Electricity Tax

With the recent passage of SB 978[1], the Oregon Public Utilities Commission has until September 2018 to submit recommended changes to the regulatory system to recognize "changing industry trends," (e.g., AVs and smart roads). Such a tax would service both the general fund and transportation-specific expenditures to reflect changing demands on city infrastructure, inclusive of transportation infrastructure.

### Empty Seat Tax

It is proposed to disincentive users from traveling with empty seats in their vehicle, and to encourage a more economically efficient mode of transportation. To assess the tax, a user's vehicle would have a remote seat occupancy "smart sensor" that could be installed and/or required in vehicles. Then the device would communicate with toll reading sensors or traffic monitors placed throughout the city to calculate the variable rate (rate dependent on the number of occupants) for payment. Similar to OReGO's VMT, at the end of each month drivers would receive invoice statements or it would be linked to an Easy Pass transponder. Much like utility services, riders will be charged consuming space that is not being used efficiently. These "smart meters" will require strict regulations similar to those enforcing odometers.

### EV Utility Charge

The City of Tigard already has a utility charge dedicated to street maintenance. This additional ev utility charge would charge those with electric vehicle charging stations. The additional revenue would be added to the current utility charge dedicated to street maintenance.

### Fleet Parking Fee

A fleet parking fee is an annual permit for the use of storage and parking of fleet vehicles in public parking garages. A fee like this would be necessary if ride-share companies use parking garages as fleet storage facilities. This agreement would help maintain existing buildings and their uses in the short term as cities adjusts to AV adoption.

### Fossil Fuel Fee (FFF)

Car owners registering fossil fuel vehicles pay an additional annual operating fee to account for negative externalities and to disincentivize use of gasoline-based vehicles. The FFF is levied in addition to the Washington County Conditional Vehicle Registration Fee, charging every diesel or gasoline-based vehicle in the Washington County an additional fee per vehicle. Vehicles

achieving fewer than 25 MPG on highways pay an additional fee. It excludes tractors and other vehicles primarily used for agricultural purposes. Hybrid gas/electric vehicles would be excluded if they are primarily electric.

### GPS and Data Fees

Ideally, strides should be made in the ways we approach data storage and sharing before we can adapt to the needs of CAVs, however, data companies stand to make a lot of money in providing this service to the CAV market. As such, charging data corporation partners a monthly fee per CAV, would generate sizable revenue to the city in ways that will still be agreeable to the corporations.

### Heavy Vehicle Tax

An increase in the existing Heavy Vehicle Tax. **Impact Fee (Similar to curb access fee)**

The implementation of autonomous vehicles will change the way we shape our streets. Many ride-share and private autonomous vehicles will need space to pick up passengers. The impact fee would charge shared autonomous vehicle companies to re-allocate street space to pick up and drop off zones.

### Licensing Fee

Private firms like Uber and Lyft stand to benefit tremendously from shifts toward automated vehicles. With automation comes the ability to jettison human drivers (i.e., former employees who required a paycheck), and instead the cars do the driving themselves. No longer needing to expend resources on driver salaries/payments, private on-demand ride-sharing firms like Uber and Lyft will have deeper pockets than before.

From the government's perspective, instituting licensing fees for firms (namely, on-demand ride sharing firms such as Uber and Lyft) who wish to operate autonomous vehicles in their jurisdiction seems like a logical way to claim some of the lost revenues that will result from shifts toward autonomous vehicles — a shift these ride-sharing firms will benefit from. By enacting a licensing fee for these firms to operate in Tigard, some of these lost revenues can be recouped.

### Local- Regional Variable Lane Pricing

Metro has identified several transportation system segments as crucial to the regional system. These areas are also integrated into the 2040 Metro Regional plan, which targets them for regional significance, and are identified in the Tualatin's Transportation Plan as priorities for transportation system management upgrades. These include the West Boones Ferry Road, which has been marked for arterial corridor management; OR 99W from SW 124th Avenue to SW Tualatin-Sherwood Road, that will receive projects which will provide real-time and forecasted regional traveler information; and SW Tualatin and Sherwood Road corridor, which will receive signal systems that adapt to current roadway conditions in line with regional transportation patterns. Each location is a prime area for regional CAV on-ramp and off-ramp lanes.

### Maintenance Fee

This would be a requirement that private autonomous vehicles must be checked once a year and a fee would be attached to the maintenance check. In all likelihood the maintenance fee and registration fee would be charged at the same time. A maintenance check would provide accountability and ensure safety on the road network.

## Mobile Business Tax

It will be important to consider permit and licensing procedures for mobile businesses, especially those serving food that will require periodic health and safety inspections. Jurisdictions may want to reconsider what constitutes zoning and building codes for mobile businesses, and ways in which revenue might be collected from the fees associated with each.

## Registration Fees

Registration fees are an existing revenue source and registration fee increases are leveraging the existing administration structure. Thus, increasing the registration fee is a productive revenue option. The increased registration fee rates less favorably in neutrality and equity. The fee discourages individual ownership and would impact lower income vehicle owners more than high income vehicle owners.

Six of Seven groups identified a registration fee increase as an additional revenue source. The additional registration fee options included local increases, AV registrations, and ride-share vehicles.

| Revenue Source | Increase | Vehicles | Amount Raised (per year) |
|---|---|---|---|
| Portland A | $2 in Multnomah County | All | $532,000 |
| Portland C | $32 in Multnomah County | All | $10,859,500 |
| Tigard A | $172 in Oregon | AVs only | $473,373 |
| Tigard B | $91 in Oregon | Rideshare Vehicles | $233,000 |
| Tualatin A | $20 in Oregon | AVs only | $998,580 |
| Tualatin B | $43 in Tualatin added to current fee | All | $503,659 |

*Figure 25 Registration Fee Options*

## Ride-share Franchise Fee

Franchise fees for ride-share companies and AV fleets would give access to dedicated pick-up zones and ride-share lanes on major thoroughfares as well as access to city transportation data. Using existing electricity franchise fees as a basis to structure this new fee, a ride-share franchise fee would be based on revenues from rides originating in Tigard.

## Toll Roads

There are two ways in which to enact a toll; one way would be to charge a flat rate in which to cross such as the State of Washington does for the Tacoma Narrows Bridge tolling. The fee is paid only on the east bound bridge by pass ($5), cash ($6), or by mail ($7). The other option for a toll system would be that of the New York/New Jersey Outerbridge crossing, which varies prices based on peak hours of travel. During peak hours, the price is two dollars higher than off-peak hours.

## User Fee for Curbside Access

The user fee for curbside access is an annual permit at a set flat fee. Operators using AVs are less likely to need parking – this permit would work much like residential parking permits. Operators pay the fee for the benefits they receive using the curb. It would allow vehicles access to the curbside for loading/unloading and limited duration parking.

## Vehicle Miles Traveled (VMT) Tax

A VMT tax is a road usage charge (pay per mile) that transportation departments can use to overcome the limitations of the fuel tax and address potential future operations and funding concerns. In Oregon's pilot program OReGO, drivers plug a device in to their vehicle, which tracks their mileage. At the end of each month, the driver receives a road usage charge invoice

in lieu of paying the fuel tax at the pump. There are multiple other ways to administer VMT tax that provide user friendly options at a low administrative cost.

# Appendix C: Group Innovative Funding Calculations

| Fund Name | Specifics of Fund | Group | Fee | Multiplier | Generated Revenue |
|---|---|---|---|---|---|
| Vehicle Miles Traveled (VMT) tax | All Vehicles | Portland A | $0.57 per mile | VMT/year | $19,795,445 |
| | All Vehicles | Portland B | $0.15 per mile | VMT/year | $21,600,000 |
| | For AVs | Portland C | $0.00706 per mile | VMT/year | $13,338,000 |
| | All Vehicles | Portland C | $0.0066 per mile | VMT/year | $21,719,000 |
| | Individual AV owners | Portland C | $0.010 per mile | VMT/year | $18,905,102 |
| | All Vehicles | Tigard A | $0.2 per mile | VMT/year | $9,138,674 |
| | All Vehicles | Tualatin A | $0.15 per mile | CAV miles and Non CAV VMT | $20,355,630 |
| | All Vehicles | Tualatin B | $0.2 per mile | VMT/ year | $6,145,322 |
| Rideshare Fee | All rideshare vehicles | Portland A | $4 per ride | Number of Rideshare rides | $11,680,000 |
| | All rideshare vehicles | Tigard B | 5% franchise fee | Work days | $1,355,000 |
| | All rideshare vehicles | Tigard A | $0.50 per ride | All rides | $3,581,640 |
| Parking Fee | Parking Restructure | Portland B | N/A | All parking | N/A |
| | Fleet Parking | Portland C | $35 per month | Total AV in PDX | $7,217,295 |
| | User Fee | Portland C | TBD by PBOT | Total cars in PDX | $12,915,965 |
| | Downtown | Tigard A | $20 per day | downtown parking spaces | $817,440 |
| | Downtown-Private | Tualatin B | $7 per day | Private vehicles | $779,275 |
| | Commercial-Fleet and Private | Tualatin B | $195 per business | Number of licensed businesses | $121,446 |
| Registration Fee | County | Portland A | $3 per vehicle | Number of Vehicles | $798,000 |
| | AV Owners | Portland C | $38 per registration | Total cars in PDX | $5,876,928 |
| | Fee Increase | Portland C | $31.60 per registration | Total AV in PDX | $10,859,500 |
| | AVs Vehicles - increase -package 1 | Tigard A | $172 per year | AVs registered | $473,373 |
| | Rideshare drivers | Tigard B | $91 for full time drivers | Number of rideshare drivers | $232,782 |
| | CAV fee | Tualatin A | $87 per registration | Total number of vehicles | $998,580 |
| | Fleet and Private | Tualatin B | $43 per registration | Total Vehicles | $503,659 |
| Congestion Pricing | Local-Regional Lane Pricing | Tualatin A | $2 on ramp off ramp charge | Daily on ramp off ramp use | $1,529,715 |
| | Cordon Pricing | Portland B | $2.5 per crossing | Commuters | $200,000,000 |
| | Cordon and Area Pricing | Tualatin A | $1 per cordon charge | Daily vehicles | $2,737,500 |
| | Fleet and Private - congestion | Tualatin B | $2 per day (certain times) | Tualatin vehicles | $1,766,440 |
| | Fleet and Private - commuter toll | Tualatin B | $0.25 daily | Daily Commuters | $448,630 |
| | Bridge Toll | Portland A | $2 per SB crossing | Crossings | $29,200,000 |
| Drop off zones | Drop off leasing of parking spaces | Portland B | $10,000 per space per year | Per parking space | $5,000,000 |
| | Avs curb access fee | Portland C | Flat Fee | Curb Parking Spaces | $17,184,035 |
| | impact fee on curb access | Tigard A | $1000 per zone | Total pick up zones | $150,000 |
| | AVs | Tualatin A | $1 per drop off | Number of drop offs | $623,355 |
| Empty Seat Tax | All Vehicles | Portland C | $0.0966 per empty Seat | Empty Seats | $10,859,500 |
| | Individual AV owners only | Portland C | $0.50 per empty seat | Empty Seats | $19,694,927 |
| Charging Station | Charging station monthly fee | Tualatin A | $10 per charging station | Charging stations | $3,540,250 |
| | Franchise Fee for private charging | Tigard B | 5 % franchise fee | Number of charging stations | $588,048 |
| Heavy Vehicle Tax | Increase to existing charge | Portland A | 1% increase | Heavy Vehicles | $2,525,000 |
| Fossil Fuel | In city | Tualatin A | $15 per low mileage vehicle | Fossil fuel cars | $58,650 |
| Maintenance Fee | State | Tigard A | $100 per AV | AV registrations | $275,200 |
| Electricity Tax | In city | Tigard B | $0.003 per kWh | kWh used | $1,779 |
| Street Maintenance Fee | In city | Tigard B | Two zone varied percentages | Electric Bill | $2,682,000 |
| Gas Tax increase | In city | Tigard B | $0.08 per gallon | Gallons | $866,666 |
| Gas Tax increase | in city | Portland B | $0.13 per gallon | Gallons | $4,800,000 |
| Mobile Business Tax | In city | Tualatin A | 6% Tax | Corporate Income | $300,000 |
| Advertisement Tax | Fleet | Tualatin B | 5% per AD | Ads per vehicle | $253,498 |
| Automated Vehicle Development Charges | In City | Tualatin A | Fixture charge | Fixture type | $3,985,000 |
| GPS and Data Fees | In city | Tualatin A | $1500 (0.05 tax) per CAV | CAVs on the road | $51,000 |

*Figure 26: Group innovative funding calculations.*
** Detailed calculation descriptions can be found within each group report*
** Some groups looked at multiple rates for the same fee. Only the highest rate is displayed here.*

# Appendix D: Full Group Reports

## Portland Group A: Revenue Options for the Future, Autonomous Vehicles in Portland

Ben Haley • Stefan Golos • Sarah Lawlis

## Introduction

While exciting, the prospect of autonomous vehicles forces cities to reexamine their transportation revenues (Maciag, 2017). Currently, many cities use revenue from parking tickets and traffic citations to fund transportation services and improvements (Maciag, 2017). The rise of autonomous vehicles imperils these sources, as they could change vehicle use and ownership patterns (Maciag, 2017).

Fagnant and Kockelman (2013) prepared a report that describes the potential economic impacts of autonomous vehicles adoption. They use adoption rates to organize their assumptions, and state the potential effects of 10%, 50% and 90% autonomous vehicle adoption.

We use their description of the effects of a 50% adoption rate as the foundation of our revenue source recommendations. Fagnant and Kockelman (2013) state that 50% adoption would lead to a 23.7% decrease in total number of vehicles. Additionally, an 18% decrease in fuel consumption is anticipated, as well as a 13% reduction in fuel costs for non-AVs due to declining congestion (Fagnant and Kockelman, 2013). They also anticipate a .75 per AV crash reduction rate, as well $15.9 million decrease in parking revenue (Fagnant and Kockelmen, 2013).

## Current Revenue

Portland's total transportation budget for 2016-2017 came from a mixture of sources including federal, state, and county resources. The adopted budget states that total funding equaled $376.5 million, while a separate report puts total funding at $371 million (Transportation, 2016; "Where the Money Comes From" 2016). Based on the $371 million in funding for transportation stated, pass-through resources equal approximately 26% of total funding sources (See Chart 1). General Transportation Revenue is comprised of two sources: State Highway Fund (comprised of motor fuels tax, vehicle, titling, and registration fees, and weight-mile tax imposed on trucks) and the city's parking revenues (Portland Bureau of Transportation, 2016-2017). Both Federal and state grant dollars have been declining and while there are new opportunities to receive competitive grants, federal funds for general transportation projects have remained stagnant and offer little assurance to local municipalities who apply since proceeds are allocated to the statewide funding stream (Portland Bureau of Transportation, 2016-2017). General Transportation Revenue projections hypothesize there will be very little growth within these revenues (Portland Bureau of Transportation, 2016-2017).

## Transportation Capital Budget

Out of the $371 million budgeted for transportation, approximately $90 million is to fund the Capital Improvement Plan for 2016-2017. Much of that $90 million will come from grants, contracts, developer fees and other external sources, approximately 92% in FY 2016-17.

General Transportation Revenue funding makes up the remaining eight percent (Portland Bureau of Transportation Forecast 2016-2021). There was a $4 million, one time contribution from the city's General Fund to support Transportation Capital Projects (Portland Bureau of Transportation, 2016-2017). While there are no specific numbers, federal and state grants make up most outside funding for Capital Projects (City of Portland Adopted Budget, 2016-2017). These funding sources are facing declining income from the gas tax and debt service payments for the Oregon Transportation Investment Act (City of Portland Adopted Budget, 2016-2017). Local matching funds are also needed to ensure being selected to receive grants (City of Portland Adopted Budget, 2016-2017).

## The Effect on the Budget

By applying the previously mentioned assumptions to the Portland Bureau of Transportation (PBOT)'s revenue yield we are able to gauge how existing revenue streams will be impacted. For example, in 2016 PBOT received $63.4 million in revenue from gas taxes (Portland Bureau of Transportation, 2016). This represented 17% of total revenues (Portland Bureau of Transportation, 2016). If Fagnant and Kockelman's prediction holds, declining fuel consumption would see gas tax revenues fall 31% to around $43.75 million. Additionally, the 23.7% decline in total number of vehicles would decrease parking citation, permit and meter revenues, as well as revenues from Portland's Smartpark garages. Together, these revenues make up 16% of PBOT's revenues (Portland Bureau of Transportation, 2016). This means that if Portland saw a 50% AV adoption rate, almost half of its transportation revenues would be degraded although we cannot quantify the entirety of this outcome.

In order to prepare for the potential impacts of AV adoption, the bureau should start evaluating revenue sources to fill in gaps that appear. Potential revenue sources should be based on these assumptions, as well as the assumption that most autonomous vehicles will be electric. This is because it is easier for a computer to operate electric vehicles, and it is safer and easier to recharge an automated car than to fill one with gas (Gardner, 2016).

Since the adoption of AVs could potentially endanger such a large portion of revenue, it will take a combination of revenue sources to supplement the losses. Portland should look to gather revenues from AV users, as well as the companies that supply and operate the technology.

## VMT Tax

Fagnant and Kockelman's report anticipates that there will be a 15% increase in vehicle miles travelled (VMT) per autonomous vehicle (Fagnant and Kockelman, 2013). They attribute this to an increase in the number of people using cars to get around, as those who cannot drive can use AVs to get from point A to point B (Fagnant and Kockelman, 2013). A tax on VMT would place some of the burden on AV users, and those who receive the largest benefit would pay the largest share. The framework for a tax exists in Oregon, as the state launched the OReGo program in 2015 (Jones and Bock, 2017). The program allows OReGo volunteers to forgo the fuels tax and pay 1.5 cents per mile travelled (Jones and Bock, 2017). OReGO is administered by the Oregon Department of Transportation, and relies on private partners to provide mileage reporting devices (Jones and Bock, 2017). The program is still in its first phase, which is limited to 5,000 cars and light commercial vehicles (Jones and Bock, 2017).

If the OReGO program is universally adopted, Portland may be able to recoup revenues lost due to the adoption of AVs. In 2015, Portlanders drove a total of 30,199,000 miles (Murillo, 2017). If Fagnant and Kockelman's assumption holds, this number would rise to 34,728,850 miles with 50% AV adoption. In order to replace fuel tax revenues, the tax on these miles should be set at a rate that generates enough revenue to cover a portion of the $19.65 million in lost fuel tax revenue. To raise that amount, Portland must set the tax rate at $0.57 per mile travelled.

A $0.57 rate raises neutrality concerns, as the high rate could force drivers to use other modes of transportation in situations when they would normally use a vehicle. Portland drivers currently pay $0.514 per gallon in gas taxes (Oregon Department of Transportation). The Bureau of Transportation Statistics estimates that the average light duty vehicle got 22 miles per gallon (Bureau of Transportation Statistics). If we applied this estimate to Portland, it would mean that Portland drivers are used to paying $0.023 per mile in taxes. Neutrality issues would arise if the increase in per mile tax rate is reflected in the price AV users pay to operate the vehicles, and makes Portland drivers look towards other transportation methods.

The high rates also raise productivity concerns, as it may affect the stability of the revenue coming from a VMT tax. On the flip side, if the tax rate is set at the OReGO rate, or the current per mile gas tax rate, it would not yield enough revenue to fill in the gaps.

Additionally, there is a concern that VMT taxes are not an equitable revenue source, and are looked at as regressive taxes (Yang et al., 2016). Low-income drivers are more sensitive to increases in driving costs and are more likely to be forced off the road due to VMT taxes (Yang et al., 2016). There are concerns with administrative efficiency as well, as the OReGO program required managers who oversaw hardware and software installation, payment, reporting, and other administrative tasks (Jones and Bock, 2017). An expansion of this program would lead to more administrative costs (Jones and Bock, 2017).

Despite these concerns, a VMT tax is a potential revenue source that responds to the assumptions of AV adoption. We recommend a VMT tax set at $0.10 per mile. This would bring in around $3,472,885 in revenue. This rate may need to be altered to match adoption trends and mitigate any neutrality, equity, or productivity issues that stem from operating costs exceeding current costs for gas powered vehicles. We believe that the tax must be mandatory and applied to personal and shared vehicles to prevent a shift to other options.

### Toll Roads

AVs will be a great asset in lowering congestion in and around Portland. Fagnant and Kockelman put the decline in congestion at 35% with 50% AV adoption rate (2013). This would be due to the ability to drive at faster speeds with the automobiles being closer together. However, the increase of miles traveled may negatively affect areas that already struggle with congested traffic patterns since roadway supply will remain scarce in comparison to travel demand in the short run (Fagnant and Kockelman, 2013; Vickrey,1969). This does allow for a revenue opportunity to begin to address such congestion.

An example of prime congestion in Portland would be the Columbia River crossings of Glen Jackson Bridge (I-205) and the Interstate Bridge (I-5). The Interstate Bridge began reaching capacity during peak hours in the 1990s (Southwest Washington Regional Transportation Council, 2017). The Glen Jackson began reaching capacity during peak hours in the 2000s (Southwest Washington Regional Transportation Council, 2017). Total bridge crossings have reached 300,000 a day (Southwest Washington Regional Transportation Council, 2017). Graph 1 shows total bridge traffic while 2 and 3 show the peak hours of travel on both bridges. Graph 2 shows the increased southbound travel on I-5 into Portland in the morning while “spreading” occurs in the afternoon. Spreading “leads to a flattening and longer peak period as trips shift to times immediately before and after the peak demand” (Southwest Washington Regional Transportation Council, 2017). Graph 3 shows the peak times on the Glen Jackson Bridge as people drive into Portland in the morning and away from Portland in the afternoon.

There are two ways in which to enact a toll; one way would be to charge a flat rate in which to cross such as the State of Washington does for the Tacoma Narrows Bridge tolling (Washington State Department of Transportation, 2017). The fee is paid only on the eastbound bridge by pass ($5), cash ($6), or by mail ($7). This approach has equity and productivity issues. If this were applied to either bridge over the Columbia, those traveling daily for employment would be most sensitive to this type of toll. Those low-income drivers would also be paying a larger amount of their income toward such a payment. Productively, costs to administer the program would need to be less than revenues from the toll. If prices are too high, then traffic may be stymied more than desired. This would limit revenues and prevent costs from being met which would lead to a “death spiral” and further decreases in traffic as tolls continue to rise. However, if Tacoma Narrow Bridge toll schedule (Figure 6) was enacted for the Columbia River Crossings, over $1,000,000 a day could be reached in revenue (not

accounting for program costs).

The other option for a toll system would be that of the New York/New Jersey Outerbridge crossing which varies prices based on peak hours of travel. During peak hours, the price is two dollars higher than off-peak hours. Peak hours for EZ Pass holders are Monday through Friday, 6 a.m. to 10 a.m.; 4 p.m. to 8 p.m.; and Saturdays and Sundays from 11 a.m. to 9 p.m. Those without an EZ Pass pay a higher cash rate regardless of time period (Port Authority, 2017). These times are slightly more expansive then the peak times of crossing over the Interstate Bridge or Glen Jackson (Figure 7). However, between both Columbia crossing bridges, they could raise $705,000 in one hour of peak time. Using expansive peak times could create neutrality issues in that people may not choose to visit Portland during the weekends due to tolls leading to a loss of business. Equality would also be an issue since this would be a regressive toll. Productivity would also be called into question depending on how much the program would cost to implement.

### Registration Fees

For the citizens living in Multnomah County, vehicle registration costs are a part of life. Multnomah County added an extra $19 to each car registered in order to pay for Sellwood Bridge upkeep. An option would be to levy an additional Portland registration fee on top of the Multnomah County fee. There are 564,483 passenger cars registered in Multnomah County. Assuming 350,000 of those are in the Portland area and applying the assumption that there will be a 23.7% drop in ownership with a 50% AV adoption rate, that leaves 266,000 passenger cars in the Portland area (not counting multi-axle vehicles). If a $2 dollar registration fee is added to the Multnomah county registration fee, it would generate $532,000 in extra revenue for the City of Portland. If Multnomah County collected the fee and took a small fee for collection efforts, it may allow for a greater revenue margin instead of Portland setting up their own collection efforts. A $3 dollar increase would garner $798,000 and a $4 dollar increase would allow for a $1,064,000 revenue increase. Further increases were not analyzed for the reason that the initial $19 increase for the county could already impose a hardship on drivers with lower incomes. We wanted to look at an increase that wouldn't be so harshly felt. An increase beyond $4 dollars may be more prudent to implement after the Sellwood Bridge project is done being paid for and the county registration fee is no longer needed.

### Car-share Fee

According to the Portland Bureau of Transportation (2015), 8,000 car-share rides occur each day in Portland. A fee could be automatically charged if the pick-up or drop-off point were inside Portland city limits. If a $2 dollar fee were charged, that could bring in $5.84 million in revenues. A $3 fee would bring in $8.76 million in revenues, and $4 would create $11.68 million in revenues. The good aspect of this fee is the collection mode is already in place with the development of apps used to specifically collect payment from car-share users. This would allow the fee to be levied based on the destination of pick-up or drop-off and collected by the company and then paid to the city. This would also combat border city effects should a driver or user attempt to avoid the fee by avoiding Portland. If an address is in Portland, the fee is added through the driver's app.

## Discussion of Funding Packages:

*Funding Package #1*

Funding package #1 (Figure 8) combines a vehicle registration fee, a VMT tax, and a car-share fee. The VMT tax is the primary revenue generator in this package, as it is set at $0.57 per mile and will generate $19.795 million in revenue. Additionally, it includes a $4 vehicle registration fee, which will be added to the Multnomah County registration fee, and will generate $1.064 million in revenue, and a $4 car-share fee, which will bring in $11.68 million in revenue. Funding package #1 will generate $32,539,445.00 in total revenues, which is $3 million dollars short of the amount needed to replace the revenue shortage created by 50% adoption of AVs. Figure 34 shows the breakdown of fees and revenues for this package

This shortage highlights the productivity issues that come with funding package #1, as the package does not generate enough revenue. Funding package #1 also rates poorly in terms of equity, as low-income vehicle users will be particularly affected by the high VMT tax. Additionally, if they avoid the VMT fee by turning to car-share services, they will meet the high car-sharing fee. This package also raises neutrality concerns, as the high VMT rate could shift consumer behavior towards other transportation options. Finally, establishing a system that tracks and processes a VMT tax will have high upfront costs, which raises efficiency concerns. That being said, we anticipate that the costs will decrease over time.

*Funding Package #2*

Funding package #2 (Figure 9) uses four revenue sources to fill the revenue gap created by AV adoption. It sets the VMT tax at $0.20 per mile, which will raise $6.946 million in revenue. The package adds a $3 registration fee to the Multnomah County fee. This will bring in $798,000. Funding package #2 includes a $2 bridge toll on South bound crossings of the Glen Jackson and Interstate Bridges. These tolls will bring in an estimated $29,.2 million in revenue. Finally, the package includes a $2 per ride car-sharing fee, which will bring in $5.84 million in revenues. The package generates $42.784 million in total revenues, which exceeds the amount lost due to AV adoption. Figure 35 shows this funding package.

*Funding Package #3*

Funding package #3 (Figure 10) is the final package in our proposal. It sets the bridge tolls at $4 in order to take advantage of their productivity. This rate nets $58.4 million in revenues. Package #3 includes a $0.10 per mile VMT tax, which will bring in $3.473 million. Additionally, $2 is added onto the Multnomah County registration fee. This will bring in $532,000 in revenues. Finally, a $3 car-sharing fee is included, which will bring in $8.76 million in revenue. Funding package #3 nets $71.165 million in total revenues.

Funding package #3 rates high in terms of productivity, as the amount of revenue it generates far exceeds the amount lost due to AV adoption. That being said, it raises equity concerns, as the high bridge tolls will have a greater effect on those who live outside of Portland. This raises vertical equity concerns, as it places a burden on those who live outside of the city due to lower housing costs, as well as concerns with horizontal equity, as people who live outside of the city will shoulder more of the burden than those who are in the same income bracket, but live in Portland. Additionally, the high bridge tolls and car-sharing fees also raise neutrality concerns, as people may avoid these bridges and services in order to dodge the fees. Finally, we anticipate some efficiency issues due to costs associated with establishing tolling systems and VMT systems but anticipate that these will decrease over time.

### Recommendation

We are recommending that the City of Portland consider funding Package #2 for capturing new sources of revenue related to adoption of autonomous vehicles. The effectiveness of the proposed bridge toll in capturing new revenue allowed for flexibility in reducing charges from the VMT, the registration fee, and the car-share fee. The benefits of implementing Package #2 over funding Package #1 or #3 lies in the way it spreads out the burden from new charges more equitably, while also capturing the most revenue from the potential sources we've discussed. In Package #1, the VMT tax is the primary source of revenue. This is a limiting factor on equity, because VMT has been seen to disproportionately impact low-income drivers (Yang et al, 2016). That being said, too much of a reduction on one of the charges is likely to impact user habits to favor the option with less burden, which decreases neutrality of the charge. For this reason, Package #2 again is a better balance than Package #3, which leans much more on car-share fees rather than VMT tax. This could put an unintended incentive on private vehicle ownership.

### Conclusion

The City of Portland is going to have the majority of their transportation revenue affected with the implementation of AVs. Between lost parking revenues and gas tax revenues, the City of Portland will need to make up around $35 million in revenues. That being said, the revenue sources and funding packages described above have the potential to alleviate the revenue decline in a number of ways.

## Appendix A: VMT Calculations

### VMT Increase:

Total Number of Miles Driven in 2015: 30,199,000 (Murillo, 2017)

Increase with AV Adoption: 30,199,000 * 1.15 (Fagnant and Kockelman, 2013)

= 34,728,850

### Rate Necessary to Close Gas Revenue Gap:

34,728, 850 * $0.015 (Jones and Bock, 2017)/100=$520,932.75

63,400,000 (Portland Bureau of Transportation) *.31 (Fagnant and Kockelman, 2013)
=19,654,000 (Amount that decreases due to AV)

19,654,000/34,728,850=$0.57

### Current Per Mile Tax Rate

$0.514 (Oregon Department of Transportation)/22 (Bureau of Transportation Statistics) =$0.023

### Revenue Generated at $0.10 Tax Rate

$34,728,850 * $0.10= $3,472,885

## GRAPHS AND TABLES

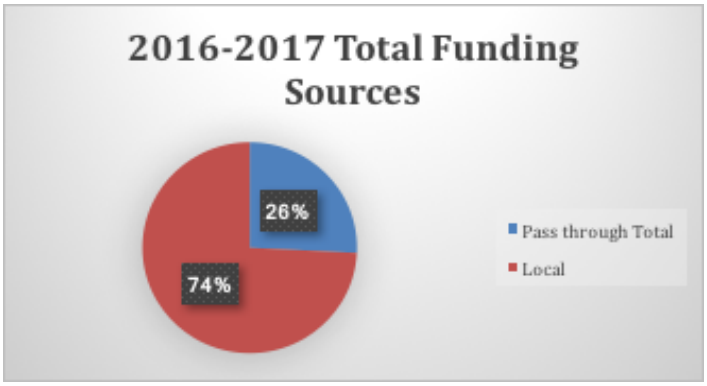


*Figure 1: 2016-2017 Total Funding Sources*

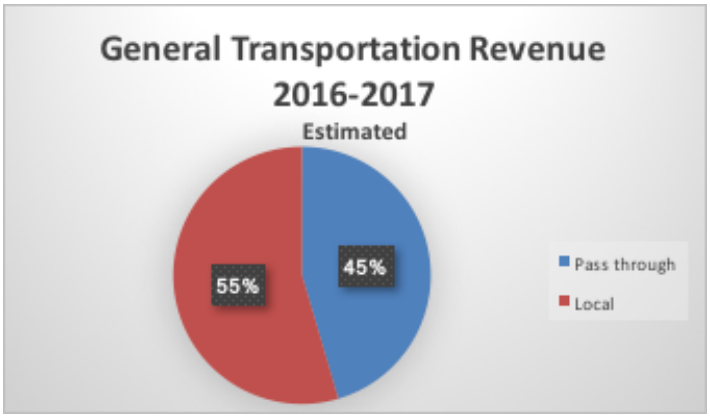


*Figure 2: General Transportation Revenue 2016-2017*

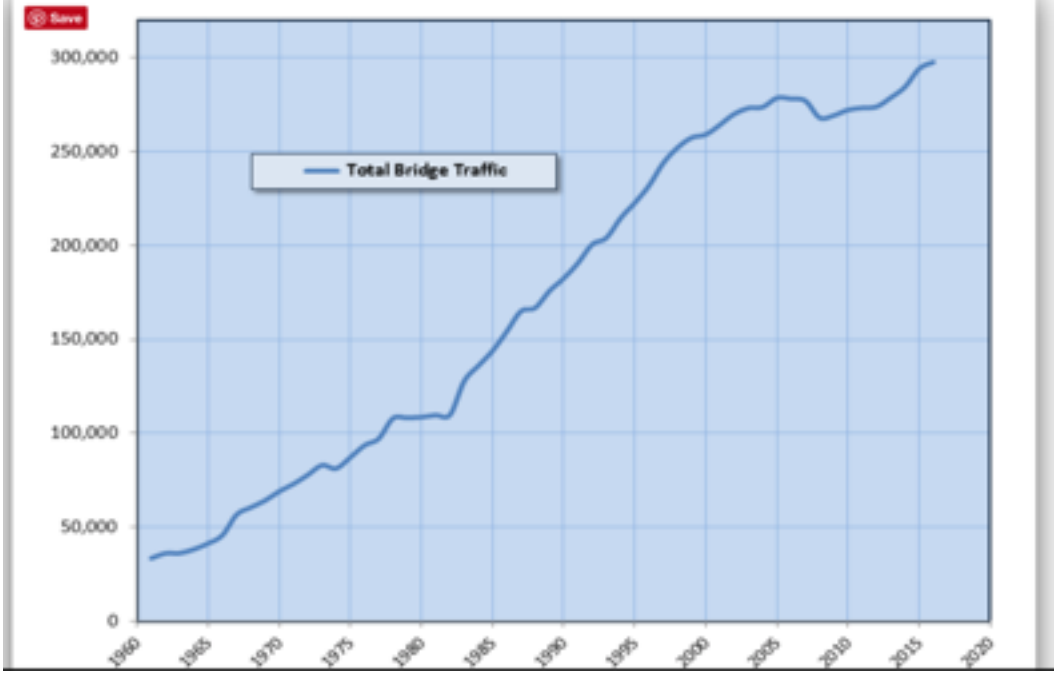


*Figure 3: Total Bridge Traffic 1960-2020*
*Source:Southwest Washington Regional Transportation Council, 2017*

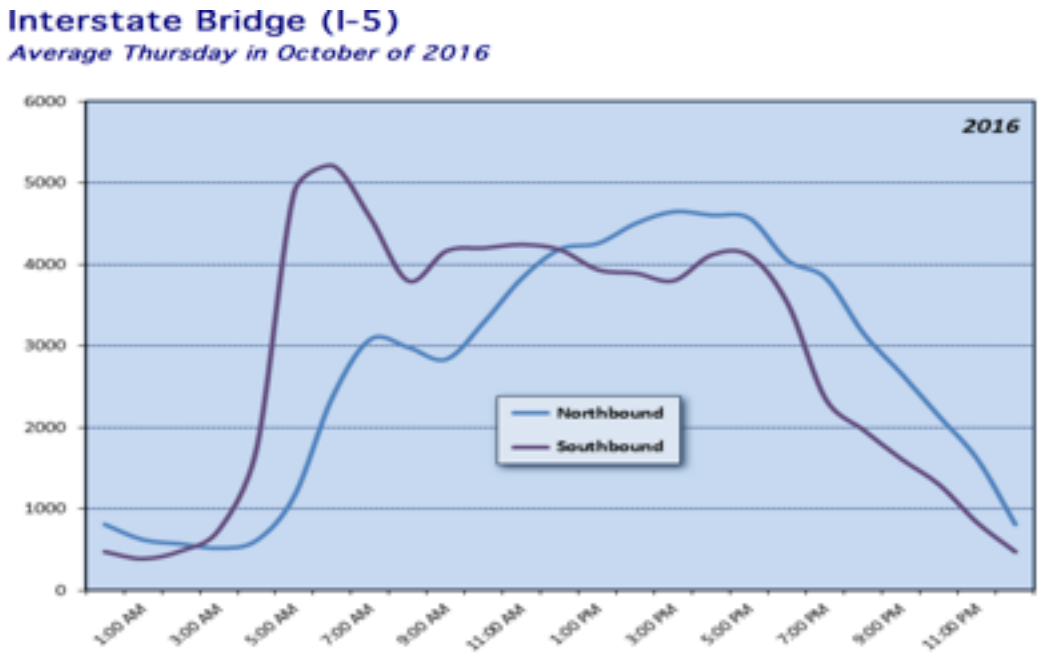


*Figure 4: Average Daily Travel Interstate Bridge*
*Source: Southwest Washington Regional Transportation Council, 2017*

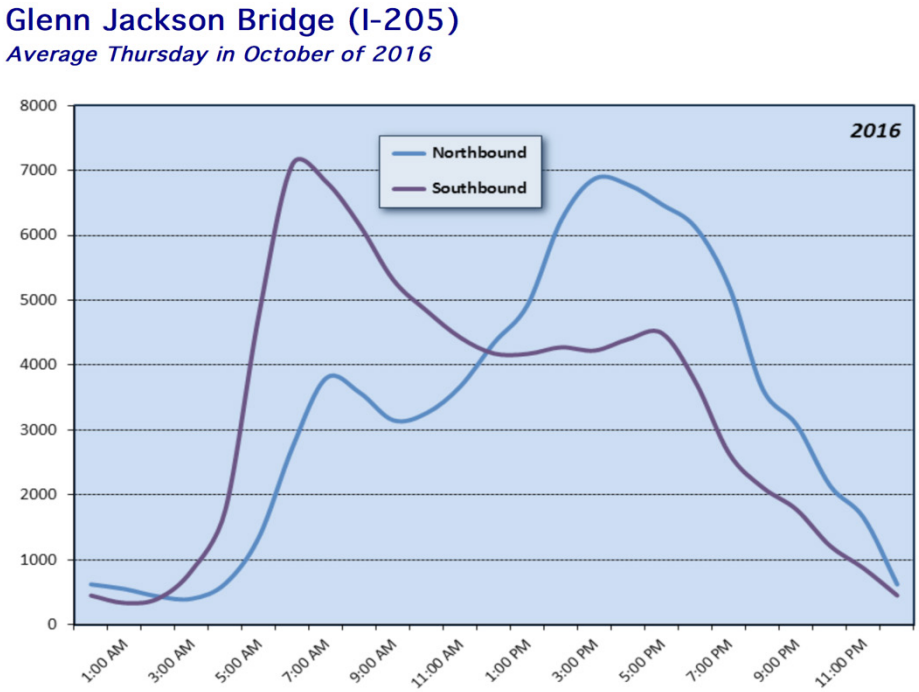


*Figure 5: Glen Jackson Bridge Average Daily Travel*
*Source: Southwest Washington Regional Transportation Council, 2017*

**Current Tacoma Narrows Bridge Toll Rates Effective July 1, 2015**

Note: rates on the Tacoma Narrows Bridge are fixed and do not vary by time of day or day of week.
WAC 468-270-070

| Vehicle Axles | *Good To Go! Pass 1* | Cash 1 | Pay By Mail 1 | Pay By Plate 2 | Short Term Account 3 |
|---|---|---|---|---|---|
| 2 | $5.00 | $6.00 | $7.00 | $5.25 | $6.50 |
| 3 | $7.50 | $9.00 | $10.50 | $7.75 | $10.00 |
| 4 | $10.00 | $12.00 | $14.00 | $10.25 | $13.50 |
| 5 | $12.50 | $15.00 | $17.50 | $12.75 | $17.00 |
| 6 | $15.00 | $18.00 | $21.00 | $15.25 | $20.50 |

*Figure 6: Current Tacoma Narrows Bridge Toll Rates*

Using the minimum charged, $5, and assuming that only those traveling southbound would be charged and that 1/3 of the 300,000 daily passengers were round trips, that would still bring in $1.005 million a day between both Interstate and Glen Jackson Bridges.

**The New Jersey crossings (PA)**
Links: Staten Island and New Jersey
One-Way Tolling on Staten Island side only (Tolls effective December 2014)

**Bayonne Bridge**: Links Staten Island and Bayonne
**Goethals Bridge**: Links Staten Island and Elizabeth
**Outerbridge Crossing**: Links Staten Island and Perth Amboy

- Off-peak E-ZPass toll: $9.75
- Peak E-ZPass toll: $11.75
- Cash fare: $14
- Staten Island Bridges Plan (NY/NJ SIB Plan) - 3 or more trips per calendar month, that are not already discounted by another Port Authority Plan: $6*

Motorcycles:

- Off-peak E-ZPass: $8.75
- Peak E-ZPass toll: $10.75
- Cash fare: $14

* All E-ZPass tags on the account count toward the minimum trip requirement. Carpool and Green Pass trips do not qualify toward the monthly three-trip threshold.

A "Green Pass" is offered to drivers of select low-emissions vehicles. The special green tag offers drivers a $6.25 toll rate during off-peak hours and $11.75 during peak hours on Port Authority crossings.

*Figure 7: New Jersey Crossing Rates*

During the hours of 6 a.m. and 7 a.m., approximately 12,000 people cross both the Interstate and the Glen Jackson crossings. If the peak EZ pass rate was applied, this would generate a revenue of $705,000 in that one hour. That could be a revenue of over $3.5 million per week based on that one hour, five days a week.

| Revenue Source | Rate ($) | Total Yield ($) |
|---|---|---|
| VMT Tax | .57 per mile | 19,795,445 |
| Registration Fee | 4.00 | 1,064,000 |
| Bridge Toll | 0.00 | 0 |
| Car Share Fee | 4.00 | 11,680,000 |

*Figure 8: Funding Package #1*

| Revenue Source | Rate ($) | Total Yield ($) |
|---|---|---|
| VMT Tax | .20 per mile | 6,945,770 |
| Registration Fee | 3.00 | 798,000 |
| Bridge Toll | 2.00 | 29,200,000 |
| Car Share Fee | 2.00 | 5,840,000 |

*Figure 9: Funding Package #1*

| Revenue Source | Rate ($) | Total Yield ($) |
|---|---|---|
| VMT Tax | .10 | 3,472,885 |
| Registration Fee | 2.00 | 532,000 |
| Bridge Toll | 4.00 | 58,400,000 |
| Car Share Fee | 3.00 | 8,760,000 |

*Figure 10: Funding Package #1*

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# Portland Group B: City of Portland Budget Recommendations

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Malissa Schenter

## Executive Summary

Portland, OR is known for innovative transportation strategies and sustainable living. The city reports various plans to lead the region into creating more “livable neighborhoods,” limiting greenhouse gas emissions, and “expanding sustainable commuting” to include a plan to convert 70% of the city’s commuters to “walking, biking, transit, carpool, or telecommute by 2030.” Of particular interest for this report is the rapidly expanding recognition and legislation of the use of shared and autonomous vehicles (AV). As researchers look to the near future of the use of autonomous and shared vehicles, policy makers in Portland need to better understand the impact of such technology not only the environment, but also their respective budgets.

In a recent study conducted by the University of Oregon, Clark et. al write that AVs have the potential to significantly impact “land use planning, transit use, [and] government revenues.” James Airbib and Tony Seba of the Rethinking Transportation 2020-2030 report predict that by 2030, 95% of U.S. passenger miles will be traveled not by personal vehicle but by “on-demand autonomous electric vehicles owned by fleets, not individuals.” In fact, Portland already anticipates significant impacts to funding resources through a decline in the use of automobile travel through programs such as Vision Zero.

To address these considerations, our group utilized a 2013 ENO report containing a comprehensive list of predictions regarding the impacts of automated vehicles on U.S. transportation systems. These were broken down into three different impact levels: 10%, 50%, and 100%. Our team chose to assume ENO’s 50% impact level to frame our projections for future revenue gaps, outlined in the 2016-2017 Revenue Table (Appendix A, Table A). Using our knowledge of Portland transportation revenues, and assuming a 50% impact level, we would expect to see a total revenue gap of $20.2 million—a loss of 5.4% of the Portland Bureau of Transportation’s budget. It is important to note that some of the assumptions discussed in the ENO report were left out because we felt we did not have enough information for our estimate. This report details three packages that can make up the revenue lost from the rise of AVs.

## Current Revenue

The Portland Bureau of Transportation (PBOT) receives funding from a variety of sources. While the city collects revenues from its own sources–parking fees, permitting, taxation, etc.–pass-through revenues are collected through state and federal grants and tax revenue. PBOT requested $248.5 million from the city’s net budget, or 12.0% of the overall 2016-2017 adopted city budget. However, in an infographic provided by PBOT officials (Appendix B, Table B), the department received an estimated $371.1 million in total resources, slightly different than the department’s 2016-2017 adopted budget total resources of $376 million. To better understand where some of these resources might originate or may be organized, the authors have separated each of these categories by resource areas using the figures provided by the infographic (Figure 8).

Additionally, Volume II of the 2016-2017 adopted budget breaks the transportation operating fund into two categories: external revenues (gas taxes, parking fees and fines, intergovernmental revenues) and internal revenues (reimbursement for services from other City funds and operations). While the PBOT sustains many of its own resources, it relies heavily on support from the Oregon Department of Transportation (ODOT) and federal grant monies. Using the infographic as a framework for dividing resource areas by category, we can evaluate where each category originates based on information within the adopted budget shown in Figure 7.

The two categories which contain pass-through revenue sources are the gas taxes (from sources feeding the State Highway Fund within the General Transportation Fund) and donations and grants. While the 2016-2017 infographic states that PBOT receives only $14.6 million (of $371.1 million) in city general fund revenue, it is known that there are state-shared revenues in the form of liquor, cigarette taxes, and lottery funds as well.

## Making up Lost Revenue

Applying what we know about PBOT's revenue sources with the assumed 50% impact of AV market penetration (based on information found in the 2013 ENO report), we find that Portland can anticipate a revenue gap of $20.2 million—a loss of 5.4%. This projection is based largely on our assumptions of decreased parking and fuel tax revenues. To make up this lost revenue, our group identified three different funding packages when each include strategies for making up this loss. These strategies are based on the list of assumptions from Table 2 of the 2013 ENO report (Figure 11). We chose to evaluate these particular impacts based on the data made available to us through our program, the City of Portland, and reasonable research. It is important to note that there were other assumptions which were not included, as we did not feel we had enough information with which to make an educated evaluation.

The group evaluated each of these packages by four criterion: equity, neutrality, efficiency, and productivity. Using our knowledge of these evaluation criterion we first evaluated each proposed revenue source, assigning a numeric value of 1, 2, or 3, respective to the ratings of "poor," "good," or "very good." We should note that this rating is subjective to our understanding of the revenue source and evaluative criteria and may be rated differently by city officials. We then weighted each revenue source to determine the funding package's overall rating. Lastly, we combined each of these ratings into a single table (Figure 12), which we use to make our final recommendation.

### Funding Package A

Despite revenue decreases in areas related to parking and fuel use, incorporation of AVs also present opportunities for alternative revenue streams, and have potential for increasing public safety. Package A proposes the following funding strategies to make up for revenues lost to the implementation of AVs.

#### Strategy 1: Transitioning from the Fuel Tax to VMT Tax [Assumption(s) Addressed: 3, 4]

According to our third assumption, fuel savings are forecasted to increase by 18% due to the decrease in vehicles on the road. This is a likely outcome of the ride-sharing that will occur with the incorporation of AVs. This change marks the most significant portion of the revenue gaps outlined in our table. By increasing our gas tax rate early in the process of AV incorporation, our accomplishments will be twofold: we can attempt to make up for these lost revenues, and we can de-incentivize the use of private, non-automated vehicles. The current gas tax sits at $0.10 per gallon, which we recommend increasing to $0.$0.13 per gallon. According to our calculations, which apply the 50% impact rates on fuel tax, this increase will bring in an additional $4.8 million in revenues.

This strategy should be layered with an added Vehicle Miles Traveled tax, which addresses our fourth assumption, and projects a 15% increase in miles traveled for every new AV on the road. This switch has been considered by policy makers across various states a method for de-incentivizing fuel consumption. Langer et al. (2017) discuss the benefits of this method of taxation over that of a fuel tax, concluding that a VMT is a more sustainable funding strategy as

it can be implemented to vary based on different traffic volumes, different roads, and different times of day.

According to a table provided by the U.S. Department of Transportation's Office of Highway Policy Information, Portland's total estimated vehicle miles traveled in 2009 sat at approximately 34.3 million. Applying a $0.015/mi VMT tax rate (according 2015 estimates on VMT averages in Portland) would come to $18.7 million in revenues. However, by applying Assumption 4 (a 15% increase in VMT) this number increases to $21.6 million.

### Strategy 2: Levy on Benefiting Businesses [Assumption(s) Addressed: 4, 5]

Returning once more to the projected VMT increase of 15%, it is safe to say that a portion of these added miles will come from automated, commercial vehicles traveling throughout the city. As travel to and from the city center becomes safer and easier, businesses are likely to take advantage of these efficiencies. Therefore, this package proposes an increase in the current Heavy Vehicle Tax. On May 11, 2016, this tax was approved for a four year period, at a rate of 2.8%. This strategy recommends at least a 1% increase to this rate. Revenues generated from this tax at its current rate are $2.5 million. A 1% increase would come to $2.525 million.

The final piece of this strategy includes an added tax on ride-share services, which has already been incorporated into transportation planning in cities in Maryland, Massachusetts, Nevada, Pennsylvania, South Carolina, and New York at rates ranging from 1.4% to 4%. New York (at the 4% rate) expects to bring in approximately $24 million annually through their levy. This strategy recommends a tax on ride-share companies, such as Uber and Lyft, within a similar range, for the city of Portland. While there is lucrative potential in such a levy, it is difficult to predict the growth rate of the ride-share industry in the city; this relies on many variables which are still unknown. Therefore, rather than forecasting revenue benefits for the tax, this memo recommends readdressing this strategy at a later time, when more information regarding ride-share infiltration is known.

### Benefits: Funding Package A

Based on our limited information, it is difficult to provide complete approximations of the revenue benefits associated with these strategies. However, we expect that these alterations to the current tax structure will generate at least $30 million, which can go towards filling our estimated $20.4 million revenue gap.

### Revenue Benefits Package A

| Revenue Benefits: Package A | |
|---|---|
| Redirected Vision Zero Funds | $1.5 Million |
| Increased Fuel Tax ($0.13/gallon) | $4.8 Million |
| VMT Tax ($0.015/mi) | $21.6 Million |
| Increased Heavy Vehicle Tax | $2.525 Million |
| Total Revenue Benefits | $30.425 Million |

*Figure 1: Revenue Benefits Package A*

| Funding Package A | |
|---|---|
| Equity | Good (2) |
| Neutrality | Good (2) |
| Efficiency | Good (2) |
| Productivity | Good (2) |

*Figure 2: Overall Package Evaluation*

## Funding Package B

The second funding package is centered around the goal of utilizing the existing commuting infrastructure as a means to de-incentivize travel to downtown Portland by car. Portland has a wide variety of commuting transportation options that include bus, light rail, pedestrian, and bike travel. Transit options throughout the Metro area are continually increasing as exemplified by the planned additions to the existing light rail network that can reach even more individuals. Autonomous vehicle usage poses a threat to transit usage figures as commuters can read, draft emails, and even work from the comfort of their own cars. While it is understood that current road usage is priced well below the marginal social cost and that levying based on congestion is an efficient way of subsidizing public transit, the strategies in this package use added revenues to close an expected revenue gap. Using assumptions outlined above, the $20.2 million dollar revenue gap caused by a 50% autonomous vehicle impact scenario could easily be gained back without sacrificing AV usage by incentivizing mass transit over alternative means as part of normal commuting patterns.

### Strategy #1: Drop-off Leasing of Available Parking Spaces.

To be successful when incentivizing mass transit, the city of Portland should not have to fight any battles against autonomous vehicles. Rather, more monetary gains can be made from partnering with autonomous vehicle providers and incentivizing drop-offs in key areas. Assuming that ride-share companies provide autonomous options for travelers, the city of Portland can establish various drop-off and pick-up zones for automated ride-share vehicles. The most efficient zones would be areas of high traffic (Downtown, Union Station, PDX airport, the Riverfront, etc.) where ride-share companies can be charged for delivering travelers. The ride-share vehicles would have specifically designated zones where they would be allowed to interact with customers and would be required to pay to use the space. In order to preserve space, these zones should be located near existing parking areas, and the city should expect compensation similar to what it receives in parking for expected revenue losses.

As one option, several spots located in the high traffic areas should be rented out to private firms on a yearly rate. Using the downtown price of two dollars per hour for metered spaces and assuming 15 hours of daily use, each space makes in excess of $10,000 per year. This should be the minimum compensation expected by the city from ride-share firms for using the drop-off zones. If mandatory drop off spaces replace just 1/30th (500) of the 15,000 metered parking spaces in the city limits that raises $5 million in additional parking revenue. When applying this thought to incentivizing mass transit, there needs to be a reason for people to take transit over relying on ride-sharing and personal vehicles. Making the drop-off zones at bus and light rail stops free of charge would incentivize companies to use those spaces more, but it may not add any additional consumer traffic. What could add consumer traffic would be pricing changes in the parking structure.

### Strategy #2: Price-Neutral Parking Restructure

One of the issues facing the MAX right now is its pricing is not competitive with the costs associated with driving. A monthly pass costs $100, translating to $5 a day on weekdays for normal commuters. At this price, ridership has been shown to be less appealing to commuters, and according to our SCYP contact at the city, ridership levels have dropped. To swing the pendulum back towards more of an equilibrium, the parking price system can be re-structured. One way to do this is by making parking spaces adjacent to MAX stops free for commuters, adding incentive for commuters to use the train as a part of their commuting pattern. The term “adjacent” is left up to the city of Portland to define; the distance between station and parking spots at which free parking is offered is at their discretion. However, this would not represent a loss of revenue. To further incentivize travel by alternate means, the losses suffered by making some parking spots free can be made up by raising the prices at other locations. If 1,000 parking spots are made free around transit stops, this represents a loss of $10 million in estimated revenue if each spot makes $10,000 annually. This amount can be made back (with extra) by raising the price of the remaining 13,500 metered parking spots by $0.25. Autonomous ride-share spots were not included in the price rise as their parking space pricing is being held constant from the earlier proposal. Now the cost of parking downtown has increased while parking near mass transit has become free and more attractive. This $0.25 rise represents the minimum level needed to remain revenue neutral. The city can raise parking prices at other locations above this level if they wish to create revenue. Other gains can be made from the externalities that stem from the restructuring process. Making park-and-ride options cheaper can incentivize ridership of public transit as people can write an email just as easily on the train as in the backseat of a car. In this case, added revenue stems from increased user fees. The revenue increase will ultimately still depend on consumer choices as the city has to find the point at which the commuter is willing to change commuting patterns. However, the stronger the incentive or forbidding the alternative, the more likely people will change their habits.

### Strategy #3: Congestion Taxation [Assumptions Addressed: 1, 2, 3]

To add further incentive, Proposal B advocates for the installation of a congestion tax imposed on vehicles entering and leaving the Portland city limits. This is an example of cordon pricing and is most efficient when long-distance commutes are common among workers. Over 235,000 individuals entered Portland daily to work during 2015. Similarly, over 100,000 workers lived in the city but commuted out. If the employment within the city grows or remains constant, similar numbers of people will be subject to a congestion tax in future. This tax can be enforced by means similar to those used by toll booths across the nation. License readers placed at the points where roads and the city limit meet can detect vehicle passages. For a more advanced method, geo-fencing boundaries can be established. These are invisible boundaries that are detectable by a GPS system within a vehicle or mobile device.

To be effective at decreasing overall congestion and incentivizing mass transit, this tax needs to be strong. While the final amount will again be at the discretion of the city, two options are discussed here. The weaker, priced at $0.25 a trip, would completely account dollar for dollar for the $20.2 million projected revenue gap. This amount would be assessed every time a vehicle with a GPS, transponder, or mobile device crossed the geo-fencing boundary; for normal commuters, this would be assessed twice daily. However, this is incredibly low compared to tolls from cities around the nation. Chicago for example, charges travelers upwards of four dollars for using its electronically-monitored tollways unless they buy into a commuter payment system (I-pass). In the case of Portland, as the tax goes up,

revenues will rise, but mass transit will become more appealing as commuters are forced to take stock of the costs of traveling to and from the city by car.

The stronger option, set at $1.25 each time a vehicle crosses the city limit, would greatly increase revenues. Assuming that each of the 335,000 commuters above crossed the boundary twice a day on their way to and from work 260 days out of the year, the resulting total revenue would equal over $390 million. Even after assuming 50% of commuters don't have GPS locators or find ways around the system, that still raises close to $200 million. What is more, mass transit has become a truly cheaper travel alternative. Excluding costs of car maintenance, electrical charging, or gasoline, at $2.50 a day, working a 260-day work year would cost consumers $1,250. The alternative, twelve monthly passes for the MAX, would only cost $1,200.

### Revenue Benefits: Funding Strategy B

| Revenue Benefits: Package B | |
|---|---|
| Parking Leases | $5.0 Million |
| Price-Neutral Parking | Variable |
| Light Congestion Tax ($0.25) | $ 21.0 Million |
| Heavy Congestion Tax ($2.50) | $200 Million |
| Total Revenue Benefits | $26 - 205 Million |

*Figure 3: Revenue Benefits: Funding Strategy B*

| Funding Package B | |
|---|---|
| Equity | Good (2) |
| Neutrality | Good (2) |
| Efficiency | Good ( 2) |
| Productivity | Very Good (3) |

*Figure 4: Overall Package Evaluation*

### Funding Package C

The third funding strategy, Funding Strategy C, seeks to capitalize on the increase of Portland visitors, as assumed by greater access to AV over time. These revenue sources include an increased gas tax revenue (as more folks will have access to vehicles who could not before drive themselves) and cordoning fees to capture revenue from those benefiting from Portland infrastructure and business.

### Strategy #1: Increase of Gas Tax and Heavy Vehicle Use Tax [Assumption Addressed: 3]

According to Koin, a temporary $0.10 per gallon gas tax has been approved by Portland voters. This tax will be used for fixing and improving city crossings, existing streets, and protecting bike lanes. At present, this plan will generate $16 million per year for the city. Raising the $0.10 per gallon tax to $0.13 per gallon, will increase the total to $20.8 million. Based on a fact sheet from the Portland Mercury, the city of Portland has mandated heavy vehicles not

accounted for in the gas tax should pay their fair share of 13.3% of the total revenue gained from the combined gas tax and heavy vehicle use tax. As of now, that amount is $2.5 million. Using the same method as earlier, we can determine the heavy vehicle use tax will increase to $3.25 million. When adding these new figures of the gas tax and heavy vehicle use tax we are generating additional revenue equaling $5.55 million.

### Strategy #2: Cordon Fee

Using the same statistics as the congestion tax method from Package B, revenue from a cordon fee can raise the remaining revenue needed to the fill the $20.2 million gap. According to U.S. Census Bureau, more than 409,000 individuals work in Portland. Out of this number, 335,000 commute over the Portland city limit each day for work. The majority (57%) are coming in from neighboring cities to work within Portland. Using the same metrics as above, 260 working days per year and 520 trips crossing city boundary per individual per year, there are a total of 174,200,000 total trips available for taxation. This number excludes those made by freight vehicles as well as tourism related trips. By implementing a $0.09 per trip cordon fee, assessed via GPS locators or other monitoring technology, the city can generate approximately $15.7 million in revenue. This assumes limited loss of revenue due to travelers leaving the city limits by alternate routes. If lost revenue becomes an issue, the city can increase the tax to levels noted above.

We should note that Package C is weighted differently than Packages A and B and therefore may not be an equal comparison. Our initial draft was weighted equally, but we miscalculated a revenue source and found it best to eliminate the alternative altogether. However, this is why

### Revenue Benefits: Funding Strategy C

| Revenue Benefits: Package C | |
|---|---|
| Increased Fuel Tax | $5.55 Million |
| Parking Fee Increases | $3.95 Million |
| Light Congestion Tax ($0.25) | $ 12.2 Million |
| Total Revenue Benefits | $21.7 Million |

*Figure 5: Revenue Benefits Package C*

### Overall Package Evaluation

| Funding Package C | |
|---|---|
| Equity | Good (2) |
| Neutrality | Good (2) |
| Efficiency | Good (2) |
| Productivity | Very Good (3) |

*Figure 6: Funding Package C Evaluation*

Package C is evaluated more favorably. We did not replace the alternative with another, as we still found Package A to be the most reasonable and politically feasible of our options.

## Supporting Case Studies

According to Clark et al. (2017), the implementation of autonomous vehicles not only threatens to decline public transportation revenues, but such cuts are likely to have disproportionately negative effects on those of lower socioeconomic status. In turn, they suggest that governments either find ways to subsidize access to AVs, or implement AV fleets of their own which provide comparable services and coverage to those of their current public transportation systems. Likewise, our report recommends that some of the options outlined in Package B remain on the table for future revenue considerations.

The City of Portland should consider the potential effects of lowered parking space demand on property value. Fagnant et al. forecast the replacement of 9.34 conventional vehicles for every new SAV and a decrease in parking demand by approximately 8 vehicle spaces per SAV. Clark et al. note that parking spaces currently make up between 14-25% of land use in cities and that a decreased need for parking will lead to an increase in property value resulting from the influx of new business development in these spaces. Additionally, the city should consider rider perceptions and attitudes toward AVs, and how this will help or hinder the goals of all of the previous recommendations and strategies outlined in this report. Yap et al. studied the perceptions of current public transportation users and their preferences for using AVs as the "final leg" or "last mile" transport in the future. While using AVs as egress of train trips was valued positively amongst first-class train travelers, they found that their respondents did not recognize that travel time disutility would be lowered in AVs. The most important factor affecting the positive perceptions of AV use were related to their contributions to environmental health, while factors of efficiency and utility were minimized. The City of Portland might consider exploring further qualitative data and community input as decisions are made to accommodate this new technology- as the effectiveness of our revenue packages are contingent on a certain level of buy-in from consumers. It is recommended that any new transportation budgeting plans be constructed flexibly, preparing multiple strategy options to account for different levels of AV impact and to incentivize user buy-in accordingly.

## Recommendation

If the city of Portland were to begin implementing one of these strategies soon, our team would recommend Package A (Figures 1-2). All three packages have their strengths and weaknesses, but Package A has the widest base. By spreading its revenue gains out over four areas, it leaves more room to maneuver if one strategy is not politically feasible or faces public resistance. The rates proposed are subject to changes by the city and can be increased if the revenue gap is higher than assumed or one strategy cannot be implemented.

The centerpiece of this strategy is the proposed VMT tax. While this raises more than two-thirds of the added revenue for Package A, its feasibility has already been tested by the state's trial program. While it may require some political maneuvering and GPS investments by drivers, the tax has positive externalities that add benefits in addition to revenue. In addition to encouraging consumers to be wary of their carbon footprint, being charged for gasoline as well as travel distance may prove a difference maker for many drivers as they weigh their commuting options. McMullen et al. provide example scenarios for VMT rate structures which aim to avoid conflicts with fuel-efficient vehicle adoption goals. These scenarios include a tax structure which maintains a fuel tax for those vehicles with fuel efficiency lower than 20 mpg, and a flat $0.012 per mile rate for vehicles with fuel efficiency higher than 20 mpg- minimizing the benefits of "gas guzzling." This provides a valuable model for the City of Portland to consider.

The financial benefits from package A more than make up for the revenue gap of $20.2 million. The ideas listed can be tailored to fit the city's goals during the implementation period. Raising the VMT tax rate can incentivize transit usership similar to Package B, while keeping the gas tax at reasonable levels can keep cars on the roads, adding to the VMT revenue. Of the three packages listed, Package A is the most proportional across its various strategies, providing the city with a stable source of revenue.

## Appendix A:

**2016-2017 Revenue Table**

| Resource Area | Category | Amount | 50% Impact | $ Change | % Change |
|---|---|---|---|---|---|
| | Beginning Balance | 81.1 | 81.1 | 0.0 | 0.0% |
| | [1] Portland General Fund | 14.6 | 14.2 | 0.4 | -2.7% |
| **General Transportation Fund** | | **96.3** | **83.8** | **12.5** | **-13.0%** |
| | [2] Gas Tax* | 36.1 | 29.6 | 6.5 | -18.0% |
| | [3] Parking Meters | 32.6 | 29.3 | 3.3 | -10.1% |
| | [3] SmartPark Garages | 14.4 | 13.0 | 1.4 | -9.7% |
| | [3] Parking Citations | 8.0 | 7.2 | 0.8 | -10.0% |
| | [3] Parking Permits | 5.2 | 4.7 | 0.5 | -9.6% |
| **Intergovernmental** | | **94.6** | **89.7** | **4.9** | **-5.2%** |
| | [4] City Agencies ** | 35 | 35 | 0.0 | 0.0% |
| | [4] Grants and Donations*** | 32.3 | 32.3 | 0.0 | 0.0% |
| | [2] Multnomah County Gas Tax | 27.3 | 22.4 | 4.9 | -17.9% |
| **Fees** | | **40.4** | **40.4** | **0.0** | **0.0%** |
| | System Developent Charges | N/A | | | |
| | Permits | N/A | | | |
| | Charges for Services | N/A | | | |
| **Fixing Our Streets** [2, 5] | | **13.2** | **10.8** | **2.4** | **-18.2%** |
| | Local Motor Vehicle Tax | N/A | | | |
| | Heavy Vehicle Tax | N/A | | | |
| **Bond and Notes Proceeds** | | **31.0** | **31.0** | **0.0** | **0.0%** |
| | Sellwood Bridge | N/A | | | |
| | LED Street Light Upgrades | N/A | | | |
| | Internal Loan Repayment | N/A | | | |
| **Total** | | **371.2** | **351.0** | **20.2** | **-5.4%** |

1: Subject to assumed 3% loss of source revenue.
2: Subject to assumed losses from fuel savings.
3: Subject to assumed 10% sharing among AV users..
4: Assumed to remain constant as infrastructure repairs may shift sources but not amount.
5: Program ends after the 2019-2020 FY.

* Gas Tax incorporates state motor fuel sales, weight mile + vehicle registration fees.
** City Agencies include services and projects.
*** Includes Federal, State, Local, Portland Development Comission, and Private Donations.

*Figure 7: 2016-2017 Revenue Table*

*Figure 8: PBOT Table*

| 2016-2017 Infographic Table (in Millions) | | |
|---|---|---|
| | | |
| **Resource Area** | **Category** | **Amount** |
| Beginning Balance | | 81.1 |
| General Fund | | 14.6 |
| | City General Fund | |
| General Transportation Fund | | 36.1 |
| | Gas Tax (Assumed State motor fuels, weight mile + vehicle registration fees) | |
| | Parking Meters | 32.6 |
| | SmartPark Garages | 14.4 |
| | Parking Citations | 8 |
| | Parking Permits | 5.2 |
| Intergovermental | | 35 |
| | City Agencies (Services and Projects) | |
| | Grants and Donations (Federal, State, Local, Portland Development Commission, Private Donations) | 32.3 |
| | Multnomah County Gas Tax | 27.3 |
| Fees | | 40.4 |
| | System Development Charges | |
| | Permits | |
| | Charges for Services | |
| Fixing our Streets | | 13.2 |
| | Local Motor Vehicle Fuel Tax | |
| | Heavy Vehicle Fuel Tax | |
| Bond and Notes Proceeds | | 31 |
| | Sellwood Bridge | |
| | LED Street Light Replacement | |
| | Internal Loan Repayment | |
| **Total:** | | **371.2** |

*Figure 9: 2016-2017 Infographic Table*

| 2016-2017 Infographic Table (in Millions): Own Source Vs. Pass Through Resources | | |
|---|---|---|
| | | |
| **Resource Area** | **Category** | **Own Source or Pass Through** |
| Beginning Balance | | |
| General Fund | | |
| | City General Fund | Own Source, Pass Through |
| General Transportation Fund | | |
| | Gas Tax (Assumed State motor fuels, weight mile + vehicle registration fees) | Pass Through |
| | Parking Meters | Own Source |
| | SmartPark Garages | Own Source |
| | Parking Citations | Own Source |
| | Parking Permits | Own Source |
| Intergovermental | | |
| | City Agencies (Services and Projects) | Own Source |
| | Grants and Donations (Federal, State, Local, Portland Development Commission, Private Donations) | Pass Through |
| | Multnomah County Gas Tax | Own Source |
| Fees | | |
| | System Development Charges | Own Source |
| | Permits | Own Source |
| | Charges for Services | Own Source |
| Fixing our Streets | | |
| | Local Motor Vehicle Fuel Tax | Own Source |
| | Heavy Vehicle Fuel Tax | Own Source |
| Bond and Notes Proceeds | | |
| | Sellwood Bridge | Own Source |
| | LED Street Light Replacement | Own Source |
| | Internal Loan Repayment | Own Source |

*Figure 10: 2016-2017 Own Source vs. Pass-through Resources*

| | |
|---|---|
| **Assumption 1:** Freeway Congestion Benefit | 35% |
| **Assumption 2:** Arterial Congestion Benefit | 10% |
| Assumption 3: Fuel Saving | 18% |
| **Assumption 4:** VMT Increase per AV | 15% |
| **Assumption 5:** % of AVs Shared across Users | 10% |

*Figure 11: ENO Report Assumptions*

| Evaluation Criteria | Package A | Package B | Package B |
|---|---|---|---|
| **Equity** | Good | Good | Good |
| **Neutrality** | Good | Good | Good |
| **Efficiency** | Good | Good | Good |
| **Productivity** | Good | Very Good | Very Good |

*Figure 12: Package Evaluation Criteria*

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# Portland Group C: Adapting with Autonomous Vehicles in Portland, Oregon

Marshall Curry • Aiden Forsi • Paige Portwood
Justin Sandoval

## Executive Summary

The purpose of this report is to assess the impacts of autonomous vehicle adoption on the Portland Bureau of Transportation's (PBOT) annual revenues and to suggest replacement sources of revenue. As the advancement of technology shifts vehicle use from motor-fueled and human-operated to electric and autonomous, PBOT may experience a revenue shortfall of $43.438 million as adoption of autonomous vehicles reaches 50% of the automobile market. The shortfall, in the analysis presented here, comes from lost gas tax and parking earnings, which make up 47% of PBOT's annual revenues.

This paper suggests three packages of new revenue sources for PBOT to recover the projected annual shortfall. Packages 2 and 3 purposefully use tax structures to encourage a particular type of transit future. The packages are evaluated based on standardized budget criteria. Package 1 is recommended for PBOT as it recovers the shortfall revenue and performs best using the evaluative criteria.

### Introduction

Using the 2016-2017 budget cycle as a baseline, the authors examined the projected impact of autonomous vehicles on PBOT's annual budget revenues. Calculations excluded intergovernmental transfers and the beginning fund balance. The total revenues for this budget cycle were $290 million. State, county, and local gas tax and local parking revenues from meters and fines contribute to 47% of PBOT's total earnings (Appendix A, Figure 4).

Clark et al. (2017) state, "Autonomous vehicles (AVs) are already being used and their proliferation is inevitable." Due to the rapid changes in technology, little is known about the specific adoption patterns of AVs (Barnes & Turkel, 2017), which will directly influence their impact on city budgets. Not enough supporting evidence exists to suggest AVs will impact PBOT's revenues from fees, bonds, grants, donations, interagency transfers, and discretionary funding from Portland's General Fund. While we can assume that there will be impacts on these revenue streams with more AVs on the road, without a definitive source demonstrating those impacts the authors chose to exclude them from our analysis.

There is adequate research to support the conclusion that gas taxes and parking revenues would be impacted with the adoption of AVs. With an assumed 50% overall adoption rate for AVs, as described below, the authors of this report determined PBOT would lose approximately 15% of its revenue sources, the majority being lost gas tax revenues. If Portland's "Fixing Our Streets" gas tax is discontinued, the revenue gap will be even greater.

## Assumptions and Impact - PBOT's Annual Revenue

The impacts of AVs on PBOT's budget will depend on their adoption rate. An adoption rate of 50% was assumed. If actual adoption is lower or higher, the impacts on revenue sources should correspond. This report uses the assumptions from "Preparing A Nation For Autonomous Vehicles: Opportunities, Barriers, and Policy Recommendations" by Fagnant & Kockelman (2015) as a baseline for all assumptions in our AV adoption scenarios (Appendix B, Figure 5). The authors created three scenarios of different AV adoption rates (10%, 50%, and 90%). The authors reference other research to alter the baseline assumptions to Portland's context when appropriate. This report presents the 50% adoption scenario.

The assumptions used to calculate the impacts of a 50% adoption scenario are:

- AV ownership is divided between ride-sharing services (fleet) (10%) and private owners of AVs (90%) (Fagnant & Kockelman, 2015)
- Ownership of conventional vehicles is 50% of total vehicles (Barnes & Turkel, 2017)

- As ownership of AVs increases, the percentage of vehicles that are electric vehicles (EVs) increase as well (Leimenstoll, 2017)
- When AVs are introduced, average vehicle miles traveled (VMT) will increase by 7.5% (Fagnant & Kockelman, 2015)
- AVs decrease gas consumption by 18% (Fagnant & Kockelman, 2015)
- Additional users previously unable to operate vehicles, such as retirees, minors, and para-transport consumers, will begin to enter the AV market (Isaac, 2016; Barnes & Turkel, 2017)
- Parking and citations will change at the same rate as the rate of adoption of AVs
- Empty AVs will be programmed to avoid parking if possible

Under these assumptions, PBOT can expect annual revenues to decrease by $43.438 million, or approximately 15%. This loss is attributed to adoption of EVs impacting gas revenues, and an increased avoidance of metered parking impacting parking revenues (Appendix B, Figure 6). With 15% of the budget affected, PBOT needs to consider different revenue sources to improve financial resilience. Presented below are three revenue packages to aid PBOT's consideration.

## Evaluation Criteria

This section describes the framework used to rate the proposed revenue packages and the series of individual revenue sources present in our proposed revenue packages. The authors selected criteria (Figure 1) and a decision making framework for rating and comparing each package (Appendix C).

| | |
|---|---|
| **Equity:** | What percent of Portland population will incur tax incidence?<br>How much does it rely on benefits received or ability to pay? |
| **Neutrality:** | Does the tax incentivize socially beneficial behaviors the market *does not*?<br>Does it minimize market distortions? |
| **Administration:** | Will the number of transactions (and thus cost) decrease?<br>How hard is it to administer the tax/fee? Is the technology currently available? |
| **Productivity:** | Does the proposal generate sufficient funds?<br>Does the proposal generate funding that is not impacted by technology changes? |
| **Certainty:** | Is the policy easy for the population to understand? |
| **Convenience:** | Is the policy easy for PBOT to adopt? Is policy and/or technology currently in use? |

*Figure 1: Evaluation Criteria for PBOT*
*Source: (Curry, Forsi, Portwood, and Sandoval, 2017)*

## Common Revenue Recommendations

Each package considers common revenue sources but varies them in unique ways to give PBOT the ability to consider different tax strategies. The commonalities of these revenue sources are described first. Then, the different applications of these common revenue sources are described within each package.

### Vehicle Miles Traveled Tax

A VMT tax is a road usage charge (pay per mile) that transportation departments can use to overcome the limitations of the fuel tax and address potential future operations and funding concerns (Council of State Government, 2010). In Oregon's pilot program OReGO, drivers plug a device in to their vehicle, which tracks their mileage. At the end of each month, the driver receives a road usage charge invoice in lieu of paying the fuel tax at the pump (Oregon Department of Transportation, 2017). There are multiple other ways to administer VMT that provide user friendly options at a low administrative cost (Council of State Governments, 2010).

### Empty Seat Tax

The empty seat tax is a congestion charge (sumptuary tax). It is proposed to disincentivize users from traveling with empty seats in their vehicle and to encourage a more economically efficient mode of transportation. To assess the tax, user's vehicle would have a remote seat occupancy "smart sensor" that could be installed and/or required in vehicles. Then the device would communicate with toll reading sensors or traffic monitors placed throughout the city to calculate the variable rate (rate dependent on the number of occupants) for payment (McCoy and Garrett, 2014). Similar to OReGO's VMT, at the end of each month drivers would receive invoice statements. Much like utility services, riders will be charged for consuming space that is not being used efficiently. These "smart meters" will require strict regulations similar to those enforcing odometers.

### User Fee for Curbside Access

The user fee for curbside access is an annual permit at a set flat fee. Operators using AVs are less likely to need parking—this permit would work much like residential parking permits. Operators pay the fee for the benefits they receive using the curb. It would allow vehicles access to the curbside for loading/unloading and limited duration parking.

### Vehicle Registration Fee

When vehicles are bought in Oregon, the state requires the owner to register with the DMV. The determined rates are fixed by the type of vehicle and in some cases by vehicle weight. These revenues are typically used to cover the costs of the state's highway fund or a specific improvement project. PBOT could establish their own vehicle registration fee much like Multnomah County's current $19 annual fee, potentially working with Multnomah County to facilitate this additional fee to replace the shortfall in PBOT's budget.

### Fleet Parking Fee

A fleet parking fee is an annual permit for the use of storage and parking of fleet vehicles in public parking garages. A fee like this would be necessary if PBOT allowed ride-share companies to use their parking garages as fleet storage facilities. This agreement would help maintain existing buildings and their uses in the short term as PBOT adjusts to AV adoption.

## Revenue Packages

Figure 2 outlines three proposed revenue packages for PBOT to consider as it faces revenue shortfalls from AV adoption. Each package design recovers the projected $43.438 million annual revenue shortfall in the 50% adoption scenario. Package 1 seeks to maintain the "status quo" by replacing the impacted gas tax and parking revenues with sources similar mechanisms and incidence. Packages 2 and 3 depart from the existing tax structure to establish systems that encourage equitable access to transit and discourage individual AV ownership, respectively.

| Maintain "Status Quo" | | Equitable Access to Transit | | Discourage Individual AV Ownership | |
|---|---|---|---|---|---|
| **Package 1** | | **Package 2** | | **Package 3** | |
| Criterion | Overall Rating | Criterion | Overall Rating | Criterion | Overall Rating |
| Equity | Poor | Equity | Good | Equity | Poor |
| Neutrality | Poor | Neutrality | Good | Neutrality | Good |
| Administration | Good | Administration | Poor | Administration | Poor |
| Productivity | Good | Productivity | Good | Productivity | Good |
| Certainty | Very Good | Certainty | Very Good | Certainty | Very Good |
| Convenience | Very Good | Convenience | Good | Convenience | Good |

*Figure 2: Package Overall Ratings*
*Source: (Curry, Forsi, Portwood, and Sandoval, 2017)*

As the reality of AVs sets in, PBOT can reconsider these packages in light of the realized revenue impacts and adjust rates as necessary to meet their needs. In particular, the authors note VMT tax in all packages is lower than the rate in the OReGO VMT pilot program (Oregon Department of Transportation, 2017). This suggests there is a higher ceiling available for VMT than represented here.

## Package 1: Maintain market by similar revenue generation

Portland residents and city officials may advocate for familiar revenue generation strategies as society transitions into an ambiguous AV future. Package 1 proposes taxes with similar incidence to PBOT's current budget while integrating new and/or updated sources to accommodate AV adoption.

### Package 1 Revenue Options:

- Vehicle Miles Traveled Tax - All AVs ($0.00706 per mile per)
- User Fee for Curb Access ($100 per year)
- User Fee for Parking (rate TBD)
- Optional Alternative - Fleet parking fee ($35 per AV per month)

The authors suggest compensating the 18% loss (-$13.3 million) in gas taxes with a VMT tax. This tax would only apply to AVs and exclude motor fuel vehicles because those drivers will still contribute 82% of the current gas tax revenue.

The AV adoption will inevitably decrease the amount of needed parking by 50%, assuming that all empty AVs will be programed to avoid parking. Package 1 proposes to rplace unused parking meter spaces with curbside access for passengers to be picked up and dropped off

(Bliss, 2017; Sisson, 2017). Furthermore, this package suggests curbside access will require an annual flat fee of $100 to recoup the decreased parking meter revenue.

Additionally, rather than seek new sources to replace lost revenues from parking permits, citations, and garages, PBOT could reprice current pricing for parking for non AVs. The updated prices need to increase per parked vehicle, however the exact amount depends on an analysis conducted by PBOT. Updated parking rates need to generate approximately $12.9 million.

To capture revenue from ride-share vehicles, which are predicted to increase, Package 1 suggests an optional fleet parking fee of $35 per AV per month. Although this source is not included in the formal calculations, it could accrue additional funds beyond the annual revenue deficit (approximately $7 million dollars). However, if the fleet parking fee were included in Package 1's evaluation it would change the equity rating from "good" to "poor."

### Package 1 Evaluation

As illustrated in Figure 48 above, Package 1 ranks "poor" in neutrality because revenue sources are unlikely to incentivize citizen behavior. However, Package 1 rates "good" and "very good" for all the remaining criteria. Equity, administration, productivity, certainty, and convenience display higher rankings because Package 1 includes horizontally equitable revenue sources while not requiring major technological enhancements making them comparatively easier to administer. Package 1 also raises sufficient funds and the policy of the revenues are familiar to PBOT and the public. More details of evaluation indicators and ratings are showcased in Appendix D.

## Package 2: Encourage accessibility to effective transit

While AVs are expected to increase miles traveled as a result of individuals opting to use ride-sharing services, it is also expected to increase traffic in cities while simultaneously decreasing ridership on public transit (Barnes & Turkel, 2017). Package 2 attempts to generate revenue while encouraging equitable access to transportation. Streets continue to be a public domain, and this structure serves to encourage effective usage of the streets while allowing a broader base to pay for the benefits-received. Additionally, this package attempts to not distort AVs market. Use of AVs can provide easier last-mile connections to the public transit systems for better connectivity.

### Package 2 Revenue Options:

- Empty Seat Tax - All Vehicles ($0.0966 one occupant, variable rate)
- Vehicle Miles Traveled Tax ($0.0066 per mile)
- Multnomah County Vehicle Registration Fee Increase ($32)

The empty seat tax, much like Seattle's tolls for congestion pricing, will vary depending on real-time traffic conditions (Washington State Department of Transportation, 2017). Each additional passenger in the vehicle per ride will decrease the rate of the tax. Additionally, this tax also has the capability for PBOT to alter the rates based on peak congestion as well as the potential to not charge riders during non-peak hours. Based on total commutes to and from work, a daily revenue of $29,758.82 is expected (Oregon Metro, 2016) (Appendix E Figure 18). This could be something PBOT considers in the future to adjust revenue. With this tax, more efficient use of roads is expected while helping to pave the way for PBOT to use technology to improve quality of life (Portland Bureau of Transportation, 2017).

Much of gas taxes has historically been dedicated to infrastructure and maintaining roads. As adoption of AVs are assumed to be electric vehicles (EV), PBOT will need to find an additional source of revenue connecting individuals to the benefits they receive from using roads. We

propose a VMT tax within Portland at a rate of $0.0066 per mile. Based on the assumptions, Portland's registered vehicles will drive roughly 3.6 billion miles per year (Fagnant and Kockelman, 2015). This tax will be implemented for all vehicles in Portland. Thus, it is indiscriminate, and it incentivizes efficient use of Portland's roads.

With the already established Multnomah county vehicle registration fee, the authors are proposing to increase the vehicle registration by approximately $32. Based on a 50% adoption rate, it is assumed that there will be a 23.7% decrease in vehicles on the road currently (450,433). Additionally, working with Multnomah County will help PBOT strategize about limiting the city/county boundary effects created by any of their revenue changes. This collaboration may lead to a more neutral tax structure. Currently, PBOT does not get any funding from vehicle registrations, but if PBOT is able to gain their share of the vehicle registration fee, it will be able to recoup a significant portion of their revenue that is lost. For complete details and calculations for all the revenue options, refer to Appendix E.

### Package 2 Evaluation:

As illustrated in Figure 48 above, Package 2 ranks "good" in neutrality. This package incentivizes users to choose a more efficient modes of transportation. However, the empty seat tax would distort the market as vehicles in outside jurisdictions would not be required to have devices in their vehicle. Comparably, equity is ranked as "good" because the revenue sources have mechanisms spreading incidence to larger percentages of the population. Regarding administration, the package ranked "poor" due to high transaction costs for all revenue options. Productivity ranked as "good" because revenue is predicted to be stable and could raise sufficient funds. Lastly, our evaluation ranked certainty as "very good" and convenience as "good" as the revenue sources are easy for the public to understand and something that PBOT would be capable to implement once the "smart sensor" technology is ready for installation.

## Package 3: Discourage individual AV ownership

The purpose of Package 3 is to use new fees and taxation policies to discourage individual ownership of AVs, hopefully leading to decreased congestion and road maintenance costs. This package focuses on generating new revenue sources only from individual AV owners. Package 3 includes options designed to shift tax incidence from general consumers, to individuals owning an AV. These options allow PBOT to consider a non-neutral revenue structure.

### Package 3 Revenue Options:

- Empty seat tax - Individual AV owners only
- Vehicle miles traveled tax - Individual AV owners only
- Vehicle registration fee increase - Individual AV owners only

Aside from businesses using AVs for ride-sharing, the first adopters of AVs will likely be affluent individuals who can afford to purchase them (Litman, 2017). Based on the projected cost of the Tesla S3 AV, affluent individuals are defined as those who can afford a car worth $35,000 or more. In comparison, the affordable cost of a car for the majority of Americans today is $34,000 (Carrns, 2016). Since the price of AVs is not expected to be more than the cost of the average new vehicle today, this package assumes 90% of AV owners will be individuals. Based on the estimated number of current vehicle registrations in Portland, the authors project 171,840 AVs will be adopted in Portland; therefore, the number owned by individuals for personal use will be 154,656. As more individual owners enter the market, the authors assume there will be more empty cars on the road. For example, as owners are dropped at their final destination, the AV will drive home or to a parking area.

The empty seat tax is provided with an assumption that "smart sensor" technology described in Package 2 exists. The empty seat tax is a variable sumptuary tax that is meant to disincentivize AVs from creating more congestion within the City of Portland. Package 3 incentivizes efficient use of vehicles by encouraging higher occupancy ridership when traveling within the city, which may benefit PBOT more than current tax policy. The mechanism for this tax could be administered by ride-share companies based on the ridership occupancy of each trip.

The VMT tax is designed to discourage individual ownership of AVs. Metro found that the average household makes 9.2 car trips per day for an average distance of 4.4 miles (Oregon Metro, 2016). Individually-owned AVs are predicted to increase VMTs, causing daily trips to potentially increase higher than this rate. Having disincentivizing tax structures for AVs may keep Portland's streets available for those in higher occupancy vehicles. The technology to assess this tax exists but would need to be widely adopted for this tax to be administered effectively.

Lastly, we propose an AV-specific vehicle registration fee, applied to individual owners of AVs. This fee is set at double the existing vehicle registration rate in Multnomah County. While this small fee will likely not be the determining factor in an individual's decision to own an AV, it will still generate a significant amount of revenues. For complete details and calculations, refer to Appendix F.

### Package 3 Evaluation

Portland authorities can use Package 3 revenue options to increase vertical equity while decreasing incentive for individual AV ownership. Overall scores are presented in Figure 2. Equity is rated "poor" because the revenue options have smaller taxable populations. This low score is expected because the revenue options were designed to target small affluent populations of Portland. Neutrality and productivity rate "good" because of incentive for beneficial behavior, and stability of using road-use fees instead of fuel-based fees, respectively. The adoption of VMT best practices from case studies and smart sensor technology led to higher ratings of administration and certainty.

### Recommendations

The authors recommend PBOT consider Package 1 to maintain status quo of current tax incidence. Overall, Package 1 performed better in the evaluative criteria than Package 2 and 3; it ranks "very good" in certainty and convenience as well as "good" in equity, administration, and productivity. This package consists of a VMT tax, an annual curb access fee, and updated pricing for parking fees primarily for motor fuel vehicles.

A VMT tax levies AV users who would not otherwise contribute towards transportation operation and maintenance costs through payment of traditional gas taxes. Furthermore, administering a VMT tax is currently being piloted through ODOT's OReGO Pilot program, which implies it could eventually be applied to all Portland residents. Package 1 also rates highly because of the curb access fee. Access to the curb is increasingly critical for future street systems and traffic flow (Boston Transportation Department, 2017). Designing streets for curb access rather than parking accommodates the need for vehicle passenger "loading zones," while also creating a space to generate revenue through new, innovative uses. Additionally, a curb access fee is easy to administer. It could be similar to California's FasTrak sensor and paid for at time of vehicle registration (Metropolitan Transportation Commission, 2017). Since the process is similar to existing policy and regulation, this fee will be feasible to administer and be convenient to PBOT and the public. Finally, updating the prices for parking in Portland will be fairly feasible because parking fees are an existing revenue source. The parking analysis may

take additional funding and staffing to execute, however it is often a standard evaluation and would allow Portland to adjust pricing as AV adoption continues to impact the market. Although Package 1 lacks vertical equity because it does not apply a progressive tax structure, nor does it incentivize beneficial behavior, it does yield a sufficient and stable revenue stream beneficial for PBOT's adoption to AVs presence in the market.

PBOT can consider the following steps to implement Package 1:

- Conduct parking audit and pricing evaluation
- Discuss statewide or countywide VMT with other jurisdictions to avoid city/county boundary effects
- Hold public hearings to discuss if this package aligns with the community vision

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# Appendices

## Appendix A: Current PBOT Revenue FY 2016-17

PBOT Local Revenue Sources

To project the amount of revenues impacted by AVs, it is important to understand how much revenue comes from local sources in comparison to those coming from county, state, or federal sources. The impact on either fund will be determined by their relationship to automotive use and ownership (Barnes & Turkel, 2017, p. 21). In Figure 4, the PBOT local revenue sources are presented in more detail.

City General Fund - Property Taxes, Business Licenses, Utility License, Franchise Fees $14.6 Million (5%)

PBOT received $14.6 million in discretionary funds from the City of Portland's General Fund in FY 2016-2017, making up approximately 5% of the Bureau's total revenues, excluding the Beginning Fund Balance (City of Portland, 2016c). This funding is sourced from property taxes, business licenses, utility licenses, and franchise fees. The General Funds are distributed to the Bureau for core transportation operations.

The transportation bureau's overall share is 2.4% of the total City's General Fund. The sources of the General Fund are broken out by individual funding source. The local sources are listed in this paragraph.

Parking - $60.3 Million (21%)

The second largest portion of PBOT's budget, parking revenues, include on-street parking meters (11%), permits (2%), and citations (3%), as well as SmartPark (5%) garage operations and leases on commercial space. On-street parking fees and fines are unrestricted funds. SmartPark fees are first cost recovery for garage operations; once those needs are met, the remaining revenues are unrestricted (City of Portland, 2013).

Fees - $40.4 Million (14%)

The revenues from fees for the Bureau "primarily consists of permits issued to builders, developers and private citizens using public space." These fees are limited to cost recovery associated with issuing right-of-way permits or land use reviews. Additional funding comes from Transportation System Development Charges (City of Portland, 2013).

Fixing Our Streets Tax - Portland's Gas Tax - $13.2 Million (5%)

Portland collects its own local gas tax called the "Fixing Our Streets" tax. Ten cents are collected on each gallon of gas purchased. It is collected on gasoline, diesel, and other fuels for vehicles under 26,000 pounds. Every month, businesses report and pay required fees for fuel consumed at their location within city limits (City of Portland, n.d., p. 1). The local tax also applies a Heavy Vehicle Use Tax on City of Portland Business License Tax payers with vehicles over 26,000 pounds subject to Oregon's weight-mile tax (City of Portland, 2016c; City of Portland, n.d.).

Bonds and Notes Proceeds - $31 Million (11%)

The Bureau of Transportation receives different bond sales revenue each year. The revenues are combinations of one-time sources paid back with interest over time (City of Portland, 2016c). The total revenue expected in bonds and notes for 2016-2017 is expected to be $31 million (11%). The Portland Development Commission (PDC), through tax-increment financing,

has been a major partner in developing and funding transportation-related projects in PBOT's Capital Improvement Program (CIP). The Portland Development Commission funding sources are difficult to capture beyond the amounts indicated above, therefore the authors exclude projections for bonds and notes in the later sections.

PBOT Pass-through Revenue Sources

The amount of PBOT revenue is also dependent on pass-through funds. In Figure 3, the PBOT pass-through revenue sources are described in more detail. Although the line-item grant revenues are omitted from the discussion, the authors included the aggregate total and their specific names in the table below.

| Portland Bureau of Transportation Revenue Sources 2016-2017 | |
|---|---|
| **Pass Through Revenue Sources (County, Region, State, or Federal)** | **Current Revenue** |
| Oregon | $36,100,000 |
| Multnomah | $27,300,000 |
| **Gas Tax** | **$63,400,000** |
| ODOT: STIP & JTA 2009 Revenue | |
| Federal: Regional Flexible Funds Allocation (RFFA) | |
| Federal: Regional Economic Opportunity Fund (REOF) | |
| **Grants and Donations** | **$32,200,000** |
| **Pass Through Subtotal** | **$95,600,000** |

*Figure 3: 2016-2017 PBOT Pass-through Revenue Sources: (City of Portland, 2013, 2015b, 2016c)*

Gas Taxes - Oregon & Multnomah $63.4 Million (22%)

Portland also collects gas tax revenue from the Federal Government, the State of Oregon, and Multnomah County. "State Highway Funds are distributed to ODOT, to counties based on vehicle registration, and to cities based on population. The County then transfers a portion of its State Highway Fund and County gas tax receipts according to a set formula." (City of Portland, 2013; City of Portland, 2016c).

Other Revenue Sources - City Agencies - $35 Million (12%)

City Agencies Funds not considered local or pass-through revenue source. Funding from city agencies represents intergovernmental transfers as a method of cost recovery for services. These include maintenance services for the Bureaus of Environmental Services, Parks and Recreation, and Water, as well as parking contracts with Portland Police (City of Portland, 2016c). These are also excluded from calculations.

*NEI = Not Enough Information

| Portland Bureau of Transportation Revenue Sources 2016-2017 | |
|---|---|
| **Revenue Sources** | **Current** |
| **Local Revenue** | |
| **City General Fund** | |
| Business Licenses | *NEI |
| Utility Licenses | *NEI |
| Franchise Fees | *NEI |
| **Total City General Fund** | **$14,600,000** |
| **Fees** | |
| Permits (for using public space) | *NEI |
| Transportation SDCs | *NEI |
| **Total Fees** | **$40,400,000** |
| **Parking** | |
| Parking Meters | $32,600,000 |
| Parking Permits | $5,200,000 |
| Parking Citations | $8,000,000 |
| SmartPark Garages | $14,400,000 |
| **Total Parking** | **$60,200,000** |
| **Fixing Our Streets** | |
| Ten Cent Motor Fuels Tax (under 26,000 lbs.) | $10,700,000 |
| Heavy Vehicle Use Tax (over 26,000lbs.) | $2,500,000 |
| **Total Fixing Our Streets** | **$13,200,000** |
| **Bonds** | |
| **Total Bonds** | **$31,000,000** |
| **Local Subtotal** | **$159,400,000** |
| **Pass Through Revenue** | |
| **Gas Tax** | |
| Oregon | $36,100,000 |
| Multnomah | $27,300,000 |
| **Total Gas Tax** | **$63,400,000** |
| **Grants and Donations** | |
| **Total Grants and Donations** | **$32,200,000** |
| **Pass Through Subtotal** | **$95,600,000** |
| **Other Revenue Sources** | |
| **City Agencies** | |
| Bureau of Environmental Services, Bureau of Parks and Recreation, Water Bureau, Police Bureau | *NEI |
| **Total City Agencies** | **$35,000,000** |
| **Other Revenue Subtotal** | **$35,000,000** |
| **Total Revenue** | **$290,000,000** |

*Figure 4: Current PBOT Revenue (No AV Adoption)*
*Sources: (City of Portland, 2013, 2015b, 2016c) Made with edits by the authors*

## Appendix B: AV Scenario Assumptions and Projected Impact

| | 10% | 50% | 90% |
|---|---|---|---|
| **Crash Cost Savings from AVs** | | | |
| Lives Saved (per year) | 1,100 | 9,600 | 21,700 |
| Fewer Crashes | 211,000 | 1,880,000 | 4,220,000 |
| Economic Cost Savings | $5.5 B | $48.8 B | $109.7 B |
| Comprehensive Cost Savings | $17.7 B | $158.1 B | $355.4 B |
| Economic Cost Savings per AV | $430 | $770 | $960 |
| Comprehensive Cost Savings per AV | $1,390 | $2,480 | $3,100 |
| **Congestion Benefits** | | | |
| Travel Time Savings (M Hours) | 756 | 1680 | 2772 |
| Fuel Savings (M Gallons) | 102 | 224 | 724 |
| Total Savings | $16.8 B | $37.4 B | $63.0 B |
| Savings per AV | $1,320 | $590 | $550 |
| **Other AV Impacts** | | | |
| Parking Savings | $3.2 | $15.9 | $28.7 |
| Savings per AV | $250 | $250 | $250 |
| VMT Increase | 2.0% | 7.5% | 9.0% |
| Change in Total # Vehicles | -4.7% | -23.7% | -42.6% |
| Annual Savings: Economic Costs Only | $25.5 B | $102.2 B | $201.4 B |
| Annual Savings: Comprehensive Costs | $37.7 B | $211.5 B | $447.1 B |
| Annual Savings Per AV: Economic Costs Only | $2,000 | $1,610 | $1,670 |
| Annual Savings Per AV: Comprehensive Costs | $2,960 | $3,320 | $3,900 |
| Net Present Value of AV Benefits minus Added Purchase Price: Economic Costs Only | $5,210 | $7,250 | $10,390 |
| Net Present Value of AV Benefits minus Added Purchase Price: Comprehensive Costs | $12,510 | $20,250 | $26,660 |
| **Assumptions** | | | |
| Number of AVs Operating in U.S. | 12.7 M | 63.7 M | 114.7 M |
| Crash Reduction Fraction per AV | 0.5 | 0.75 | 0.9 |
| Freeway Congestion Benefit (delay reduction) | 15% | 35% | 60% |
| Arterial Congestion Benefit | 5% | 10% | 15% |
| Fuel Savings | 13% | 18% | 25% |
| Non-AV Following-Vehicle Fuel Efficiency Benefit (Freeway) | 8% | 13% | 13% |
| VMT Increase per AV | 20% | 15% | 10% |
| % of AVs Shared across Users | 10% | 10% | 10% |
| Added Purchase Price for AV Capabilities | $10,000 | $5,000 | $3,000 |
| Discount Rate | 10% | 10% | 10% |
| Vehicle Lifetime (years) | 15 | 15 | 15 |

*Figure 5: Baseline Assumptions*
*Source: (Fagnant & Kockelman, 2015)*

| Portland Bureau of Transportation Revenue Sources 2016-2017 | | | |
|---|---|---|---|
| **Revenue Sources** | **Affected by AVs (Y/N)** | **Medium Impact - 50% Adoption** | |
| | | **Projected Impact** | **Net Change** |
| **Local Revenue** | | | |
| **City General Fund** | | | |
| Business Licenses | *NEI | *NEI | |
| Utility Licenses | *NEI | *NEI | |
| Franchise Fees | *NEI | *NEI | |
| **Total City General Fund** | **No Change** | **$14,600,000** | **$0** |
| **Fees** | | | |
| Permits (for using public space) | *NEI | *NEI | |
| Transportation SDCs | *NEI | *NEI | |
| **Total Fees** | **No Change** | **$40,400,000** | **$0** |
| **Parking** | | | |
| Parking Meters | Decrease | $16,300,000 | -$16,300,000 |
| Parking Permits | Decrease | $2,600,000 | -$2,600,000 |
| Parking Citations | Decrease | $4,000,000 | -$4,000,000 |
| SmartPark Garages | Decrease | $7,200,000 | -$7,200,000 |
| **Total Parking** | **Decrease** | **$30,100,000** | **-$30,100,000** |
| **Fixing Our Streets** | | | |
| Ten Cent Motor Fuels Tax (under 26,000 lbs.) | Decrease | $8,774,000 | -$1,926,000 |
| Heavy Vehicle Use Tax (over 26,000lbs.) | No Change | $2,500,000 | $0 |
| **Total Fixing Our Streets** | **Both** | **$11,274,000** | **-$1,926,000** |
| **Bonds** | | | |
| **Total Bonds** | **No Change** | **$31,000,000** | **$0** |
| **Local Subtotal** | | **$127,374,000** | **-$32,026,000** |
| **Pass Through Revenue** | | | |
| **Gas Tax** | | | |
| Oregon | Decrease | $29,602,000 | -$6,498,000 |
| Multnomah | Decrease | $22,386,000 | -$4,914,000 |
| **Total Gas Tax** | **Decrease** | **$51,988,000** | **-$11,412,000** |
| **Grants and Donations** | | | |
| **Total Grants and Donations** | **No Change** | **$32,200,000** | **$0** |
| **Pass Through Subtotal** | | **$84,188,000** | **-$11,412,000** |
| **Other Revenue Sources** | | | |
| **City Agencies** | | | |
| Bureau of Environmental Services, Bureau of Parks and Recreation, Water Bureau, Police Bureau | No Change | *NEI | |
| **Total City Agencies** | **No Change** | **$35,000,000** | **$0** |
| **Other Revenue Subtotal** | | **$35,000,000** | **$0** |
| **Total Revenue** | | **$246,562,000** | **-$43,438,000** |

*Figure 6: 2016-2017 PBOT Impact of AVS (50% Adoption)*

# Appendix C: Evaluation Criteria and Rating Framework

## Evaluation Criteria Definitions

Equity, when relating to taxes, can be described as the “distribution among persons or businesses in comparable circumstances (horizontal), or the variation in tax burden across spectrum of income” (Bland, 2013). Equity can be operationalized by how the tax impacts horizontal equity and vertical equity. Both are scored because omission of analysis of both can

lead to outcomes that are conflicting or erroneous (Litman, 2002; Camporeale et al., 2017). Scoring for horizontal equity relies on the a calculation of the proposed population projected to incur the tax incidence. Vertical equity is scored by predicting how much subsidy may be provided to disadvantaged populations. The neutrality of a tax should be considered by PBOT so they intentionally incentivize desired behaviors, while limiting impact on other behaviors (Bland, 2013) (Furman, 2001). Neutrality is scored based on level of incentivization for beneficial behaviors, and any behavior. The criteria for administration costs is operationalized in two categories: 1. Transaction costs, and 2. Technology costs. Each are scored based on how much costs are expected to increase or decrease with each revenue proposed. Productivity, the yield of a tax, is also used as a criterion. “Taxes should produce sufficient, stable revenue to meet locally desired levels of expenditures” (Bland, 2013). The revenue packages presented are rated on their ability to raise sufficient funds, while providing stable revenues as technology changes. Certainty measures new revenue sources presentation. New taxes should be presented in a manner clear enough for the general population to understand. They should also apply these rules of taxation evenly to the population (Bland, 2013). Tax revenues of the future should always be convenient for users to pay and for the city to apply (Bland, 2013). With technology and online applications embedded in current ride-sharing and transit use-fees, it should be easy for cities to score highly on convenience criteria. However, some new technologies or tax structures may still cause difficulties.

## Methodology for Scoring

To provide a clear, and replicable score for each proposed revenue source, the following section describes the evaluation methods. A complete table of scoring is found in Figure 13. Each revenue package evaluation is presented in the paper in the format seen in Figure 7.

| Package 1 | |
|---|---|
| Criterion | Overall Rating |
| Equity | Poor |
| Neutrality | Poor |
| Administration | Good |
| Productivity | Good |
| Certainty | Very Good |
| Convenience | Very Good |

*Figure 7: Example Overall Package*
*Source: (Curry, Forsi, Portwood, and Sandoval, 2017)*

Ratings were generated from average scores given to the operationalized indicators of each criterion. The scoring guide for each rating is described in Figure 8. Each indicator is presented with decision making rules for scoring on a scale of 1-5, one being the least desirable, five being the most (Figure 9). It is used to decide scores for each indicator.

| Score Rating Guide | |
|---|---|
| **Rating** | **Score** |
| Very Good | 4.0 - 5.0 |
| Good | 3.0 - 3.9 |
| Poor | 2.0 - 2.9 |
| Very Poor | 1.0 - 1.9 |

*Figure 8: Scoring Guide for Generating Ratings*
*Source: (Curry, Forsi, Portwood, and Sandoval, 2017)*

| Criteria Decision Making Rubric | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Criterion** | **Indicator** | **Scoring Question** | **1** | **2** | **3** | **4** | **5** |
| Equity | Horizontal | What percent of Portland population will incur tax incidence? | 20% or less | 21-40% | 41-60% | 61-80% | 81-100% |
| | Vertical | How much does it rely on benefits received or ability to pay? | Only benefits-received | Mostly benefits received* | Both | Mostly ability to pay | Only ability to pay |
| Neutrality | Incentivizes beneficial behaviors | Does the tax incentivize socially beneficial behaviors that the market **DOES NOT** incentivize (e.g. healthcare)? | No | May not happen | Inconclusive | May happen | Yes |
| | Limit impact on behaviors | Minimize market distortions? | No | May not happen | Inconclusive | May happen | Yes |
| Administration | Transaction Costs | Will the number of transactions (and thus cost) decrease? | No | May not happen | Inconclusive | May happen | Yes |
| | Technology Costs | How hard is it to administer the tax/fee? Is the technology currently available? | Really Hard Tech does not exist | Somewhat Difficult Tech may exist, but not sure | Inconclusive | Somewhat Difficult Tech probably exists | Easy Tech esists |
| Productivity | Raise sufficient funds | Does the proposal generate sufficient funds? | No | May not happen | Inconclusive | May happen | Yes |
| | Provide stable funding | Does the proposal generate funding that is **NOT** impacted by technology changes? | No | May not happen | Inconclusive | May happen | Yes |
| Certainty | Easy for Public | Is the policy easy for the population to understand? | No | Not really | Inconclusive | May happen | Yes |
| Convenience | Easy for PBOT | Is the policy easy for PBOT to adopt? Is policy and/or technology currently in use? | Neither tech nor policy are currently used | Tech or policy are currently piloted | Tech may exist, policy may currently be used | Both tech and policy have been used, but may not fit PBOT context | Tech and policy are in use |

*If tax or fee is currently a flat rate, but the current market only allows high income earners to afford access to use the good, then the revenue source received a vertical equity score of 2 instead of 1.
This is most likely a short term consideration and will need to be revisited as access to the new markets becomes cheaper.

*Figure 9: Decision Making Rules*
*Source: (Curry, Forsi, Portwood, and Sandoval, 2017)*

Each indicator is scored 1-5. Those indicator scores are then averaged by indicator in two ways for comparison. Visualizations of each individual revenue source (Figure 10) and each overall package (Figure 11) by average indicator scores assist in digging into the details of potential impacts of each package.

| Package 1 | VMT Tax All AVS | | User Fee for Curb Access All Vehicles | | User Fee for Parking All Vehicles | |
|---|---|---|---|---|---|---|
| Criterion | Rating | Score | Rating | Score | Rating | Score |
| Equity | Poor | 2.5 | Good | 3.5 | Good | 3.5 |
| Neutrality | Good | 3.5 | Poor | 2.5 | Poor | 2 |
| Administration | Poor | 2 | Good | 3 | Very Good | 4.5 |
| Productivity | Very Good | 4 | Very Good | 4 | Poor | 2.5 |
| Certainty | Very Good | 4 | Very Good | 4 | Very Good | 5 |
| Convenience | Very Good | 4 | Very Good | 4 | Very Good | 4 |

| Package 2 | Empty Seat Tax All Vehicles | | VMT Tax All Vehicles | | Vehicle Registration Fee Increase All Vehicles | |
|---|---|---|---|---|---|---|
| Criterion | Rating | Score | Rating | Score | Rating | Score |
| Equity | Good | 3.5 | Good | 3 | Good | 3.5 |
| Neutrality | Good | 3 | Good | 3.5 | Good | 3 |
| Administration | Poor | 2.5 | Poor | 2 | Good | 3 |
| Productivity | Good | 3.5 | Very Good | 4 | Good | 3.5 |
| Certainty | Good | 3 | Very Good | 4 | Very Good | 5 |
| Convenience | Poor | 2 | Very Good | 4 | Very Good | 5 |

| Package 3 | Empty Seat Tax Individual AV Owners Only | | VMT Tax Individual AV Owners | | Vehicle Registration Fee Increase Individual AV Owners | |
|---|---|---|---|---|---|---|
| Criterion | Rating | Score | Rating | Score | Rating | Score |
| Equity | Good | 3 | Poor | 2 | Good | 3.5 |
| Neutrality | Good | 3.5 | Good | 3.5 | Good | 3 |
| Administration | Poor | 2.5 | Poor | 2 | Good | 3 |
| Productivity | Good | 3.5 | Very Good | 4 | Good | 3.5 |
| Certainty | Good | 3 | Very Good | 4 | Very Good | 5 |
| Convenience | Poor | 2 | Very Good | 4 | Very Good | 5 |

*Figure 10: Individual Revenue Sources by Averaging Indicators*
*Source: (Curry, Forsi, Portwood, and Sandoval, 2017)*

| Package 1 | | Proposed Revenue | Average Indicator Evaluation | |
|---|---|---|---|---|
| Criterion | Overall Rating | Indicator | Rating | Scores |
| Equity | Good | Horizontal | Good | 3.5 |
| | | Vertical | Poor | 2 |
| Neutrality | Poor | Incentivizes beneficial behaviors | Poor | 2.25 |
| | | Minimize market distortions | Good | 3.25 |
| Administration | Good | Transaction Costs | Poor | 2.75 |
| | | Technology Costs | Very Good | 4.25 |
| Productivity | Good | Raise sufficient funds | Very Good | 4 |
| | | Provide stable funding | Poor | 2.75 |
| Certainty | Very Good | Easy for Public | Very Good | 4.5 |
| | | | | |
| Convenience | Very Good | Easy for PBOT | Very Good | 4 |

| Package 2 | | Average Indicator Evaluation | | |
|---|---|---|---|---|
| Criterion | Overall Rating | Indicator | Rating | Scores |
| Equity | Good | Horizontal | Very Good | 5.0 |
| | | Vertical | Very Poor | 1.7 |
| Neutrality | Good | Incentivizes beneficial behaviors | Very Good | 4.0 |
| | | Minimize market distortions | Poor | 2.3 |
| Administration | Poor | Transaction Costs | Very Poor | 1.3 |
| | | Technology Costs | Good | 3.7 |
| Productivity | Good | Raise sufficient funds | Very Good | 4.0 |
| | | Provide stable funding | Good | 3.3 |
| Certainty | Very Good | Easy for Public | Very Good | 4.0 |
| | | | | |
| Convenience | Good | Easy for PBOT | Good | 3.7 |

| Package 3 | | Average Indicator Evaluation | | |
|---|---|---|---|---|
| Criterion | Overall Rating | Indicator | Rating | Scores |
| Equity | Poor | Horizontal | Poor | 2.7 |
| | | Vertical | Good | 3.0 |
| Neutrality | Good | Incentivizes beneficial behaviors | Very Good | 4.0 |
| | | Minimize market distortions | Poor | 2.7 |
| Administration | Poor | Transaction Costs | Very Poor | 1.3 |
| | | Technology Costs | Good | 3.7 |
| Productivity | Good | Raise sufficient funds | Very Good | 4.0 |
| | | Provide stable funding | Good | 3.3 |
| Certainty | Very Good | Easy for Public | Very Good | 4.0 |
| | | | | |
| Convenience | Good | Easy for PBOT | Good | 3.7 |

*Figure 11: Package by Averaging Indicator Scores*
*Source: (Curry, Forsi, Portwood, and Sandoval, 2017)*

| Package 1 | | |
|---|---|---|
| Criterion | Overall Evaluation Rating | Overall Evaluation Score |
| Equity | Good | 3.1 |
| Neutrality | Good | 3.0 |
| Administration | Very Good | 4.1 |
| Productivity | Very Good | 4.0 |
| Certainty | Very Good | 5.0 |
| Convenience | Good | 3.0 |

*Figure 12: Example Package Averaging Criteria Scores*
*Source: (Curry, Forsi, Portwood, and Sandoval, 2017)*

To increase readability, final package evaluations will be presented with the omissions of scores as demonstrated in Figure 7.

| Master Calculation Table | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Package 1 | | Proposed Revenue | VMT Tax All AVS | | User Fee for Curb Access All Vehicles | | User Fee for Parking All Vehicles | |
| Criterion | Overall Rating | Indicator | Rating | Score | Rating | Score | Rating | Score |
| Equity | Good | Horizontal | Good | 3 | Very Good | 5 | Very Good | 5 |
| | | Vertical | Poor | 2 | Poor | 2 | Poor | 2 |
| Neutrality | Poor | Incentivizes beneficial behaviors | Very Good | 4 | Very Poor | 1 | Very Poor | 1 |
| | | Minimize market distortions | Good | 3 | Very Good | 4 | Good | 3 |
| Administration | Good | Transaction Costs | Very Poor | 1 | Poor | 2 | Very Good | 4 |
| | | Technology Costs | Good | 3 | Very Good | 4 | Very Good | 5 |
| Productivity | Good | Raise sufficient funds | Very Good | 4 | Very Good | 4 | Very Good | 4 |
| | | Provide stable funding | Very Good | 4 | Very Good | 4 | Very Poor | 1 |
| Certainty | Very Good | Easy for Public | Very Good | 4 | Very Good | 4 | Very Good | 5 |
| | | | | | | | | |
| Convenience | Very Good | Easy for PBOT | Very Good | 4 | Very Good | 4 | Very Good | 4 |
| Package 2 | | Proposed Revenue | Empty Seat Tax All Vehicles | | VMT Tax All Vehicles | | Vehicle Registration Fee Increase All Vehicles | |
| Criterion | Overall Rating | Indicator | Rating | Score | Rating | Score | Rating | Score |
| Equity | Good | Horizontal | Very Good | 5 | Very Good | 5 | Very Good | 5 |
| | | Vertical | Poor | 2 | Very Poor | 1 | Poor | 2 |
| Neutrality | Good | Incentivizes beneficial behaviors | Very Good | 4 | Very Good | 4 | Very Good | 4 |
| | | Minimize market distortions | Poor | 2 | Good | 3 | Poor | 2 |
| Administration | Poor | Transaction Costs | Very Poor | 1 | Very Poor | 1 | Poor | 2 |
| | | Technology Costs | Very Good | 4 | Good | 3 | Very Good | 4 |
| Productivity | Good | Raise sufficient funds | Very Good | 4 | Very Good | 4 | Very Good | 4 |
| | | Provide stable funding | Good | 3 | Very Good | 4 | Good | 3 |
| Certainty | Very Good | Easy for Public | Good | 3 | Very Good | 4 | Very Good | 5 |
| | | | | | | | | |
| Convenience | Good | Easy for PBOT | Poor | 2 | Very Good | 4 | Very Good | 5 |
| Package 3 | | Proposed Revenue | Empty Seat Tax Individual AV Owners Only | | VMT Tax Individual AV Owners | | Vehicle Registration Fee Increase Individual AV Owners | |
| Criterion | Overall Rating | Indicator | Rating | Score | Rating | Score | Rating | Score |
| Equity | Poor | Horizontal | Good | 3 | Poor | 2 | Good | 3 |
| | | Vertical | Good | 3 | Poor | 2 | Very Good | 4 |
| Neutrality | Good | Incentivizes beneficial behaviors | Very Good | 5 | Very Good | 4 | Good | 3 |
| | | Minimize market distortions | Poor | 2 | Good | 3 | Good | 3 |
| Administration | Poor | Transaction Costs | Very Poor | 1 | Very Poor | 1 | Poor | 2 |
| | | Technology Costs | Very Good | 4 | Good | 3 | Very Good | 4 |
| Productivity | Good | Raise sufficient funds | Very Good | 4 | Very Good | 4 | Very Good | 4 |
| | | Provide stable funding | Good | 3 | Very Good | 4 | Good | 3 |
| Certainty | Very Good | Easy for Public | Good | 3 | Very Good | 4 | Very Good | 5 |
| | | | | | | | | |
| Convenience | Good | Easy for PBOT | Poor | 2 | Very Good | 4 | Very Good | 5 |

*Figure 13: Master Calculation Table*
*Source: (Curry, Forsi, Portwood, and Sandoval, 2017)*

## Appendix D: Package 1 and Calculations

| | |
|---|---|
| Revenue To Recoup | $43,438,000 |
| Total Cars PDX | 343,681 |
| Total AV PDX | 171,840 |
| VMT/Year per AV | 11,002 |
| VMT/Year per non-AV | 10,234 |
| Total VMT/Year | 3,649,194,240 |

*Figure 14: Important Numbers*
*Source: (Curry, Forsi, Portwood, and Sandoval, 2017)*

| Package 1: Maintain Status Quo | | | | |
|---|---|---|---|---|
| Proposed Tax | Pricing | Source Being Replaced | Revenue to Replace | Generated Revenue |
| Vehicle Miles Traveled for AVs | $0.00706 per mile | Gas Tax (includes Fixing Our Streets gas tax) | $13,338,000 | $13,338,000 |
| User Fee for Curb Access | Flat Fee | Parking Meters | $16,300,000 | $17,184,035 |
| User Fee for Parking | TBD by PBOT | Parking Permits, Citations, Garages | $13,800,000 | $12,915,965 |
| New/Updated Revenue | | | | $43,438,000 |
| Total Lost Revenue | | | $43,438,000 | |
| Remaining Amount | | | | $0 |

*Figure 15: Package 1 Revenue Options*
*Source: (Curry, Forsi, Portwood, and Sandoval, 2017)*

| Package 1: Alternatives Maintaining Status Quo | | | | |
|---|---|---|---|---|
| Fleet Parking Fee | $35/month | $7,217,295 | N/A | Other option to replace parking |

*Figure 16: Package 1 Alternative Revenue Option*
*Source: (Curry, Forsi, Portwood, and Sandoval, 2017)*

As an alternative revenue source, PBOT could also consider introducing a flat monthly fee for AV Fleet parking alongside user charges for parking garages. Although empty AVs will typically avoid parking, permits are still relevant for AVs during non peak hours as fleets may need storage for their vehicles. The calculation of the flat annual fee revenue is based on Portland's current price of the Monthly Reduced Rate Swing Shift for a single vehicle (Portland Bureau of Transportation, 2016).

Package 1 Key Calculations

- Vehicle Miles Traveled for AVs
  This rate was determined by dividing the projected gas tax revenue shortfall by the estimated total vehicle miles traveled by AVs in the scenario.

- User Fee for Curb Access
  Rate was determined by dividing the assumed deficit in parking revenues in the 50% AV adoption scenario by the total number of expected AVs. We adjusted the rate up slightly to $100 to make calculations cleaner.
- User Fee for Parking
  We know the remaining amount of revenue to recoup based on the previous two calculations. As PBOT currently sets variable parking rates based on location and duration parked across Portland, we leave this calculation to PBOT.
- Fleet Parking Fee
  This is proposed as an alternative to the User Fee for Parking. $35 per month is the Reduced Rate Swing Shift (off-peak hour) fee for monthly parking in SmartPark garages downtown (Portland Bureau of Transportation, 2016). Our calculation assumes that all fleet vehicles (approximately 10% of AVs in our scenario) pay this fee for access to storage facilities while not in use.

| Package 1 | | Proposed Revenue | VMT Tax All AVS | | User Fee for Curb Access All Vehicles | | User Fee for Parking All Vehicles | | Fleet Parking Fee Company Rideshare Vehicles | | Average Indicator Evaluation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Criterion | Overall Rating | Indicator | Rating | Score | Rating | Score | Rating | Score | Rating | Score | Rating | Scores |
| Equity | Good | Horizontal | Good | 3 | Very Good | 5 | Very Good | 5 | Very Poor | 1 | Good | 3.5 |
| | | Vertical | Poor | 2 | Poor | 2 | Poor | 2 | Poor | 2 | Poor | 2 |
| Neutrality | Poor | Incentivizes beneficial behaviors | Very Good | 4 | Very Poor | 1 | Very Poor | 1 | Good | 3 | Poor | 2.25 |
| | | Minimize market distortions | Good | 3 | Very Good | 4 | Good | 3 | Good | 3 | Good | 3.25 |
| Administration | Good | Transaction Costs | Very Poor | 1 | Poor | 2 | Very Good | 4 | Very Good | 4 | Poor | 2.75 |
| | | Technology Costs | Good | 3 | Very Good | 4 | Very Good | 5 | Very Good | 5 | Very Good | 4.25 |
| Productivity | Good | Raise sufficient funds | Very Good | 4 | Very Good | 4 | Very Good | 4 | Very Good | 4 | Very Good | 4 |
| | | Provide stable funding | Very Good | 4 | Very Good | 4 | Very Poor | 1 | Poor | 2 | Poor | 2.75 |
| Certainty | Very Good | Easy for Public | Very Good | 4 | Very Good | 4 | Very Good | 5 | Very Good | 5 | Very Good | 4.5 |
| Convenience | Very Good | Easy for PBOT | Very Good | 4 | Very Good | 4 | Very Good | 4 | Very Good | 4 | Very Good | 4 |

*Figure 17: Package 1 Evaluation Indicators*
*Source: (Curry, Forsi, Portwood, and Sandoval, 2017)*

# Appendix E: Package 2 and Calculations

| Package 2: Encourage Accessibility to Effective Transit | | | |
|---|---|---|---|
| Proposed Tax | Rate | Priority (% of Revenue) | Generated Revenue |
| Vehicle miles traveled tax - In city | $0.0066 | 50% | $21,719,000 |
| Empty Seat Tax - All Vehicles | $0.0966 | 25% | $10,859,500 |
| Vehicle Registration Fee Increase | $31.60 | 25% | $10,859,500 |
| New Revenue | | | $43,438,000 |
| Total Lost Revenue | | $43,438,000 | |
| Remaining Amount | | | $0 |

*Figure 18: Package 2 Revenue Options E.1*
*Source: (Curry, Forsi, Portwood, and Sandoval, 2017)*

## Empty Seat Tax - All Vehicles

The number of daily commutes to and from work were multiplied by the ratio of commutes with 1, 2, 3, and 4 or more occupants to determine how many of those commutes would be subject to an empty seat tax (53%, 31%, 10%, 5% respectively) (Oregon Metro, 2011, 2016). The tax rate was set as a lower percentage/priority compared to the vehicle miles traveled tax to recoup part of the remaining revenue losses from 50% AV adoption.

## Vehicle Miles Traveled Tax

We wanted this tax to make up the majority of this revenue package as it was the most stable and most effectively met our goal of encouraging transit. We first decided that we wanted this source to make up 50% of the recouped revenue. With that number, we set the tax rate by dividing the goal revenue by the average VMT of all cars in Portland annually.

## Vehicle Registration Fee Increase

This fee increase was calculated based on recouping the remaining 25% of lost revenues in this adoption scenario. We divided the goal revenue by the number of vehicles in Portland, including both AV and non-AV, to get the desired annual revenue per vehicle registration.

| Package 2 | | Proposed Revenue | Empty Seat Tax All Vehicles | | VMT Tax All Vehicles | | Vehicle Registration Fee Increase All Vehicles | | Average Indicator Evaluation | |
|---|---|---|---|---|---|---|---|---|---|---|
| Criterion | Overall Rating | Indicator | Rating | Score | Rating | Score | Rating | Score | Rating | Scores |
| Equity | Good | Horizontal | Very Good | 5 | Very Good | 5 | Very Good | 5 | Very Good | 5.0 |
| | | Vertical | Poor | 2 | Very Poor | 1 | Poor | 2 | Very Poor | 1.7 |
| Neutrality | Good | Incentivizes beneficial behaviors | Very Good | 4 | Very Good | 4 | Very Good | 4 | Very Good | 4.0 |
| | | Minimize market distortions | Poor | 2 | Good | 3 | Poor | 2 | Poor | 2.3 |
| Administration | Poor | Transaction Costs | Very Poor | 1 | Very Poor | 1 | Poor | 2 | Very Poor | 1.3 |
| | | Technology Costs | Very Good | 4 | Good | 3 | Very Good | 4 | Good | 3.7 |
| Productivity | Good | Raise sufficient funds | Very Good | 4 | Very Good | 4 | Very Good | 4 | Very Good | 4.0 |
| | | Provide stable funding | Good | 3 | Very Good | 4 | Good | 3 | Good | 3.3 |
| Certainty | Very Good | Easy for Public | Good | 3 | Very Good | 4 | Very Good | 5 | Very Good | 4.0 |
| Convenience | Good | Easy for PBOT | Poor | 2 | Very Good | 4 | Very Good | 5 | Good | 3.7 |

*Figure 19: Package 2 Evaluation Indicators E.3*
*Source: (Curry, Forsi, Portwood, and Sandoval, 2017)*

## Appendix F: Package 3 and Calculations

| Package 3: Discourage Individual AVS Ownership | | | |
|---|---|---|---|
| Proposed Tax | Rate | Priority (% of Revenue) | Generated Revenue |
| Vehicle Miles Traveled - Individual AV Owners Only | $0.010 | 43.52% | $18,905,102 |
| Vehicle registration fee increase - Individual AV Owners Only | Flat Fee, $38 | 13.53% | $5,876,928 |
| Empty Seat Tax - Individual AV Owners Only | $0.50 | 45.34% | $19,694,927 |
| Revenue | | | $44,476,958 |
| Total Lost Revenue | | $43,438,000 | |
| Remaining Amount | | | $1,038,958 |

*Figure 20: Package 3 Evaluation Indicators*
*Source: (Curry, Forsi, Portwood, and Sandoval, 2017)*

### Package 3 Key Calculations

- Empty Seat Tax - Individual AV Owners Only
  We started with the number of individually owned, non-fleet AVs in the 50% adoption scenario. We assumed that these rides would match the same commute occupancy ratios as above in Package 2. The tax rate was set so that we incentivized higher occupancy rides and was adjusted in tandem with the other proposed revenue sources to recoup expected lost revenues in the scenario.
- Vehicle Miles Traveled - Individual AV Owners Only
  We multiplied the total vehicle miles traveled for all individually-owned AVs in Portland by the VMT rate for the OReGO pilot program in Oregon. This was adjusted in tandem with the other proposed revenue sources to recoup expected lost revenues in the scenario.
- Vehicle registration fee increase - Individual AV Owners Only
  The tax is set as double the current registration fee for vehicles in Multnomah County. It is a fee paid annually by all individual owners of AVs. Fleet vehicles used for ride-share services are exempt.

| Package 3 | | Proposed Revenue | Empty Seat Tax Individual AV Owners Only | | VMT Tax Individual AV Owners | | Vehicle Registration Fee Increase Individual AV Owners | | Average Indicator Evaluation | |
|---|---|---|---|---|---|---|---|---|---|---|
| Criterion | Overall Rating | Indicator | Rating | Score | Rating | Score | Rating | Score | Rating | Scores |
| Equity | Poor | Horizontal | Good | 3 | Poor | 2 | Good | 3 | Poor | 2.7 |
| | | Vertical | Good | 3 | Poor | 2 | Very Good | 4 | Good | 3.0 |
| Neutrality | Good | Incentivizes beneficial behaviors | Very Good | 5 | Very Good | 4 | Good | 3 | Very Good | 4.0 |
| | | Minimize market distortions | Poor | 2 | Good | 3 | Good | 3 | Poor | 2.7 |
| Administration | Poor | Transaction Costs | Very Poor | 1 | Very Poor | 1 | Poor | 2 | Very Poor | 1.3 |
| | | Technology Costs | Very Good | 4 | Good | 3 | Very Good | 4 | Good | 3.7 |
| Productivity | Good | Raise sufficient funds | Very Good | 4 | Very Good | 4 | Very Good | 4 | Very Good | 4.0 |
| | | Provide stable funding | Good | 3 | Very Good | 4 | Good | 3 | Good | 3.3 |
| Certainty | Very Good | Easy for Public | Good | 3 | Very Good | 4 | Very Good | 5 | Very Good | 4.0 |
| Convenience | Good | Easy for PBOT | Poor | 2 | Very Good | 4 | Very Good | 5 | Good | 3.7 |

*Figure 21: Package 3 Evaluation Indicators F.3*
*Source: (Curry, Forsi, Portwood, and Sandoval, 2017)*

## Appendix G: Future Considerations

- The recommended package, Package 1, ranks “poor” in vertical equity for curb access fees and parking fees. These revenue streams also rank “very poor” in neutrality. PBOT could explore revenue sources from Package 2 or 3 if either of these criteria are of higher priority to their budget decisions.
- Outside the scope of the evaluation, authors speculate this package would have a relatively higher political feasibility than Package 2 or 3 because it includes revenues that are implemented in current policy.
- The authors organized a supplemental package, which PBOT may also find useful. Package 4 includes revenues based on radical technological advancements. It primarily incorporates revenues through automated recording sensors. Refer to Appendix H for more detail.
- This analysis focuses on new or updated revenue sources from locals; in the future PBOT may want to consider capitalizing on revenues generated from commuters for work or tourists.

## Appendix H: Package 4 Preparing roads and data as limited resource public utility and the elephant in the room (private vs. public data)

Autonomous vehicles are dependent on data collection, connectivity, and use. If allowed to develop their own systems, private companies will create different systems. Managing one system is going to be complex enough for cities. Using revenue generation in a particular way may encourage public oversight and efficiency. Package 4 presents revenue options supporting public ownership and management of data and the sensors used to collect data. Without this type of an approach PBOT and other Oregon cities may find themselves in a similar space as healthcare providers working with different electronic records management systems.

### Package 4 Revenue Options:

- Quasi-ownership of data censors to afford costs
  Partner with private companies to install where they want to build networks
  Company bears cost
- Curb space and access fee
  Company bears cost
  Individuals bear cost
  Uniform charge
- Individual user fee for using AV Sensors
  Every time a car passes one
  Possibly only where PBOT wants to dissuade access to certain roads due to congestion
  Individuals bears fee as desired
- Business user fee for accessing data of sensor
  Charge use fee for companies wanting to access data
  Types of data collected managed by government
  Allow individuals free access

- Empty seat/empty space % tax
  Individually owned cars
  Individual bears
- Empty seat/empty space percentage tax
  Fleet owned cars
  Company bears

## Appendix I: State and City AV Case Studies

In United States there is minimal legislation concerning AV adoption, however, according to the National Conference of State Legislatures, thirty-three states have passed autonomous vehicle legislation of some kind—twenty states in 2016 alone. Currently, Oregon has yet to enact legislation, issue an executive order for research or policy, or formally integrated AVs into statewide long range plans (NCSL, 2017). Oregon is the only state to implement a VMT tax, through its OReGO pilot program (Morris, 2015; Oregon Department of Transportation, 2017). While each state is at different stages of AV adoption, the section below describes some innovative case studies of how cities and/or states are integrating AVs into policy or planning visions of implement the AV technology shift in the coming years.

### Florida

Florida is the only state that has adopted legislation that fully legalizes autonomous vehicles. Florida's House Bill 7027 allows an autonomous vehicles to drive without a human in the car. However, the AV must be able to signal to the operator when there is a technology failure and bring itself safely to a stop in the event that the operator cannot do it themselves (Coren, 2016). This vehicle meets the National Highway Traffic Safety Administration's description of a "Level 4" autonomous vehicle, where the "safety-critical" functions of driving are successfully managed by the vehicle with limited human intervention (Automated Vehicles for Safety, 2017). Florida hopes that by moving forward with autonomous vehicles, they can set the standard for AV policy (Coren, 2016).

### Michigan

Michigan has also approved legislation to allow AVs. It differs from Florida policy because AVs are not allowed to be operated without a human riding in the vehicle. The Senate Bill 995 establishes that The Michigan Council on Future Mobility within the State Department of Transportation will lead the state to determine AV policy, advise on how to refinance the budget, and conduct general research of AV impact throughout the state to ensure Michigan is among the leaders in AV technology and adoption. The council consists of 21 members. Eleven are appointed by the governor, and all members represent city and state agencies such as individuals with insurance interest, senators, police, department of transportation, technology and management, and financial services (State of Michigan, 2016). The council's final recommendations are expected to be presented within the 2017 calendar year.

### Massachusetts

Last March, state lawmakers in Massachusetts developed a bill in preparation of less desirable consequences of AVs specifically to discourage the number of passenger-less vehicles, also known as "zombie cars." The bill proposes a vehicle miles traveled tax and suggests a VMT base rate of $0.025 per mile. The bill also proposes the AV be zero-emission vehicles if it is less than 8,500 pounds and also regulates that the data be under the Massachusetts Registry of Motor Vehicles (Muoio, 2017). Furthermore, the bill incorporates factors that might influence

the base rate to be higher or lower depending on traffic, the amount of passengers, or size of the car. For instance, the base rate may go up during times of peak hours to prevent increased traffic congestion due to zombie cars. The technology to enact this type of tax, however, does not exist yet (Tiernan, 2017).

The City of Boston, specifically, has drafted a long range transportation initiative called Go Boston 2030 (Boston Transportation Department, 2017). It describes Smart Signal Corridors and Districts helping existing drivers navigate through the city efficiently, a technology that could be easily applied to autonomous vehicles. The plan specifically notes that they expect autonomous vehicles to be focused on ride-share systems, reducing congestion and removing the need for parking downtown, allowing Boston to re-envision what their downtown could be. They are developing an autonomous vehicle policy around that vision for the future. Research into these initiatives is funded by a grant through the World Economic Forum.

# Tigard Group A: Tigard Revenue Analysis, Impact of Autonomous Vehicles

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Justin Peterson

# Part I: Funding Assessment and Revenue Forecast

## A. Revenue Overview

The City of Tigard is interested in better understanding the impact of autonomous and shared fleet vehicles on the transportation budget. Tigard's transportation budget is funded by both local and pass-through sources. This report will outline each local and pass-through source and analyze the potential impact of autonomous and shared fleets for each transportation revenue source. Traditional transportation revenue sources vary and include (but are not limited to) gas taxes, registration fees, and property taxes. Autonomous vehicle adoption will affect each revenue source differently and some more than others. Autonomous vehicle adoption rates vary among researchers. One report estimates that by 2030, 95% of all U.S. passenger miles will be served by autonomous fleets (Airbib, 2017). The exact impact of autonomous vehicles is unknown, but cities should prepare additional transportation revenue streams to mitigate for diminished traditional sources.

## B: Summary of Current Revenues, FY 2017-2018:

Tigard transportation is funded by pass-through and local revenue sources. Each pass-through and local revenue source is detailed in the appendix. Many of the pass-through and local revenue sources are expected to decline.

| Transportation-Linked Fund | Passed Through: | Revenue Source(s) | Outlook (Pos/Neu/Neg) |
|---|---|---|---|
| *State Motor Vehicle Fund* | State | State gas taxes, vehicle registration fees, bicycle sales tax | Negative |
| *County Gas Tax* | State and County | Gas sales | Negative |
| *City Gas Tax* | Local | Gas sales | Negative |
| *TDT* | Local | Transportation Development Tax | Neutral |
| *Transportation SDC* | Local | System Development Charge | Neutral |
| *Street Maintenance Fund* | Local | Utility Bill Fee | Neutral |

*Figure 1: Local Funding Sources - Impact Table*
*Source: Tigard FY 2016-2017*

| Transportation-Linked Fund | Passed Through: | Revenue Source(s) | Outlook (Pos/Neu/Neg |
|---|---|---|---|
| *STIP* | State and Federal | At a state level, Oregon State Highway Fund; At federal level, a mix of federal fuels taxes and heavy truck taxes passed through ODOT. | Negative |
| *NIN* | State | Oregon Metro (enterprise activities; property taxes; other sources) | Neutral |
| *CDBG* | Federal | US HUD | Neutral-to-Negative |
| *Connect Oregon* | State | Oregon State Lottery Bonds | Neutral |
| *MSTIP* | County | Primarily property taxes and a smaller portion from intergovernmental transfers | Neutral |
| *RFFA* | State and Regional | Oregon Metro (enterprise funds, property taxes, and other sources) | Neutral |
| ARTS/HSIP | Federal | ODOT | Neutral - Negative |

*Figure 2: Outside Funding Sources - Impact Table*
*Source: ODOT Revenue Forecasts, Washington County Budget, Metro Budget*

## C: Forecast of Revenues with AV Impact, FY 2018-2019:

Best case scenario: 10% AV Adoption for Tigard/statewide (Shared fleet, minimal private AV) +2  0.1% EV + 7% ride hailing

- Current Oregon EV ownership rate remains 2.1% (ODOT, 2017)
- Ride hailing maintains current 7% rate in the suburbs (Clewlow et al, 2017)
- 13% reduction in gas tax revenue.(Eno Center for Transportation, 2013)
- 10% reduction in car registrations
- For these reasons, State Motor Vehicle fund and local gas tax revenues decline 13%

Worst case scenario: 10% AV Adoption for Tigard/statewide (Shared fleet, minimal private AV) + 5% EV + 21% ride hailing + 20% drop in development fees

- EV adoption rises from 2.1% of private vehicles to 5.0% due to State of Oregon tax credit (Enrolled House Bill 2017, 2017) and increased range of EVs
- Ride hailing increases in suburbs from present 7% to 21% adoption
- 18% reduction in gas tax revenue
- 20% reduction in car registration revenue (not all ride-share users will forgo ownership)
- For these reasons, State Motor Vehicle fund and local gas tax revenues decline 19%
- 20% reduction in development fees after slowdown in construction due to increased costs, labor shortages

All resources are accounted for in this forecast, including beginning fund balance, interest, fees, taxes, intergovernmental transfers, and interfund transfers. Tigard's Transportation CIP Fund is the only fund that receives intergovernmental transfers, much of which comes from outside or pass-through funds.

Pass-through revenues in Oregon will be increasing as a result of HB 2017, but the impact is yet to be determined. In FY 2018-2019, the worst-case decline in revenue is 7% less than the best-case scenario. Autonomous vehicle adoption will have less of an impact in FY 2018-2019 than compared to future budget cycles, but the year-to-year model serves to show the potential budgetary impact.

| Transportation-Linked Fund | 2015-2016 Actual | 2016-2017 Revised | 2017-2018 Adopted | 2018-2019 Best-Case w/ 10% AV adoption | Revenue Source(s) |
|---|---|---|---|---|---|
| *Gas Tax Fund (State Motor Vehicle Fund, County)* | $5,037,415 | $5,432,116 | $5,642,937 | $4,909,355 | $4,570,779 |
| *City Gas Tax Fund* | $812,317 | $1,084,276 | $1,301,414 | $1,132,230 | $1,054,145 |
| *Transportation Development Tax (TDT) Fund* | $3,811,250 | $3,075,569 | $8,517,753 | $8,517,753 | $6,814,202 |
| *Transportation SDC Fund* | $989,629 | $1,668,750 | $4,116,115 | $4,116,115 | $3,292,892 |
| *Street Maintenance Fee Fund* | $3,639,820 | $3,752,753 | $4,518,636 | $4,518,636 | $3,614,909 |
| *Total Transportation Funds (Operating)* | $14,290,431 | $15,013,464 | $24,096,855 | $23,194,089 | $19,346,928 |
| Transportation Capital Improvement Program (CIP) Fund | $1,724,293 | $8,117,865 | $6,303,130 | $5,381,763 | $5,042,504 |
| Total Transportation Funds (Operating and Capital) | $16,014,724 | $23,131,329 | $30,399,985 | $28,575,852 | $24,389,432 |

*Figure 3: Local Funding Estimates (under shared assumptions):*
*Best-Case/Worst-Case Decline in Revenue YTY: ($1,824,133)/($6,010,533)*

## Part II: Additional Revenue Sources

The overall approach to revenue generation in this report is guided by three main principles:

1. Utilizing an understanding of benefits-received as a model for where to look for extracting revenue (in other words, we aim to extract new City of Tigard revenues from the places benefiting from shifts toward automated vehicle usage)

| Outside Funding Sources | Annual Revenue (2016) | Best-Case Scenario | Worst-Case Scenario |
|---|---|---|---|
| *Major Streets Transportation Improvements Plan (MSTIP)* | $3,500,000 | $3,605,000 | $3,500,000 |
| *Regional Flexible Funding Appropriations (RFFA)* | $680,000 | $700,400 | $680,000 |
| *All Roads Transportation Safety (ARTS)* | $200,000 | $109,908 | $185,606 |
| *Statewide Transportation Improvement Program (STIP)* | $300,000 | $286,363 | $278,409 |
| *Community Development Block Grants (CDBG)* | $150,000 | $150,000 | $0 |
| *Nature in Neighborhoods (NIN)* | $75,000 | $75,000 | $75,000 |
| *Connect Oregon* | $500,000 | $500,000 | $500,000 |
| *Total* | $5,405,000 | $5,426,671 | $5,219,015 |

*Figure 4: Pass-through Funding Estimates (under shared assumptions):*
*Pass-through Funds - Best-Case/Worst-Case Revenue Shortfall: +$21,671/($207,656)*

2. Replacing losses with revenue sources that can mimic as reasonably as possible the funding sources becoming less fruitful over time (e.g., replacing gas taxes with VMT fees, which serve as a reasonable stand-in measure of contribution to road wear and tear)

3. Proposing funding schemes that align with the city's values and ultimately bring Tigard closer to its long-term vision of becoming the most walkable city in the nation.

We aim to balance these principles in the packages this document will propose. In adopting this approach, our goal is geared toward upholding equity while still bringing the City of Tigard up to, and beyond the line of projected revenues lost (detailed above).

The remainder of this document is organized into the following sections:

- An overview of all revenue sources to be seen in funding packages
  Introduction to and description of each revenue source
  An evaluation of each revenue source along our four-prong criteria matrix, which includes equity, neutrality, productivity, and efficiency
- Package 1: Prioritize Shared Vehicles
- Package 2: Prioritize Private Autonomous Vehicles
- Package 3: City Does Not Prioritize Autonomous or Shared Vehicles
- Evaluation of Funding Packages
- Recommendation: Why Package 1 Gets Our Support

## D. Evaluation of Potential Revenue Sources

Outside Revenue Sources (state and federal):
Moving forward, both traditional state and local revenue sources are expected to be impacted by the transition to autonomous vehicles. The City of Tigard receives pass-through transportation revenues from federal sources and the State of Oregon. Traditional pass-through revenues are expected to decline slightly but at a lower percentage than local revenue sources. Two of these funding sources come from federal funds transferred through Oregon Department of Transportation to the City of Tigard (ODOT, 2015; 2017c). These funds are declining because a small portion comes from federal gas taxes, licenses, and registration. As fuel efficiency increases and single occupancy vehicles decreases, these sources will continue to decrease. However, other outside funding sources are reliant upon property taxes, lottery funds, and funds that are not immediately reactive to transportation changes (Washington County, 2017). These sources are expected to continue as a stable revenue source.

To meet the pass-through revenue gap, Tigard, the State of Oregon, and the federal government must look towards new innovative revenue sources. In total, three revenue source ideas were developed to meet the revenue gap. The sources were a vehicle miles traveled (VMT) fee, registration fee increases, and a maintenance fee. The VMT fee is designed to meet revenue gaps as tradition motor vehicle funds decline. The VMT follows the benefits-received principle, and the more you drive the more you pay. In essence, users pay per mile that they drive. The registration fee increase specifically for autonomous vehicles will help offset the expected decline in vehicle registrations. A registration fee already exists in Oregon, and the administrative costs for this revenue source would be minimal. Finally, the maintenance fee is designed to ensure autonomous vehicle safety on the roads. The maintenance fee will be charged at the same time as the registration fee on a yearly basis. The maintenance fee will allow qualified autonomous vehicle mechanics to check the safety of the vehicle. Overall, the new state pass-through revenues rates will vary between packages, but the packages are designed to meet expected revenue gaps.

## Local Revenue Sources:

In addition to state revenue sources the City of, Tigard generates local revenue for transportation. Local revenue sources are anticipated to decline like state revenue sources with the implementation of autonomous vehicles. The analysis found that local revenue sources will be impacted to a greater degree than state pass-through revenues. The City of Tigard, in anticipation of revenue declines, should diversify local revenue sources.

Local transportation revenue is becoming increasingly important as federal sources decline. In total, four local revenue sources were developed to meet the local funding gap. The sources

| Criterion | VMT Fees | Maintenance Fees | Registration Fees |
|---|---|---|---|
| *Productive* | Excellent | Good | Good |
| *Efficient* | Very Good | Very Good | Very Good |
| *Neutral* | Poor | Poor | Poor |
| *Equitable* | Good | Good | Good |

*Figure 5: Evaluation of Funding Strategies (state):*
*Numeric Conversion Scale: 5=Excellent, 4=Very Good, 3=Good, 2=Moderate, 1=Poor*

included parking, licensing fees, impact fees, and an electric utility charge. The parking fee will be applied in downtown Tigard to encourage alternative transportation modes. Currently, the City of Tigard does not charge for parking. Implementing a parking fee will generate additional revenue and disincentivize driving to downtown. Next, Tigard can implement a licensing fee on shared autonomous vehicles. From the Tigard government's perspective, instituting licensing fees for firms (namely, on-demand ride-sharing firms such as Uber and Lyft) who wish to operate autonomous vehicles in their jurisdiction seems like a logical way to claim some of the lost revenues that will result from shifts toward autonomous vehicles—a shift these ride-sharing firms will benefit from. By enacting a licensing fee for these firms to operate in Tigard, some of these lost revenues can be recouped. In addition, Tigard can charge impact fees on autonomous vehicle companies for reallocation of space to pickup and drop-off zones. The implementation of designated pick-up and drop-off zones will improve safety and the impact fee will charge autonomous vehicle companies to use the convenient pickup and drop-off zones. The final local revenue source is an electric utility charge for private owners and companies that own autonomous vehicle charging stations. The City of Tigard already has a utility charge dedicated to street maintenance. This additional electric vehicle utility charge would charge those with electric vehicle charging stations. The additional revenue would be added to the current utility charge dedicated to street maintenance. Overall, the local revenue charges will vary between packages, but sources are designed to meet the funding gap caused by the shift to autonomous vehicles.

| Criterion | Parking Fees | Licensing Fees | Impact Fees | EV Utility Charge |
|---|---|---|---|---|
| *Productive* | Good | Good | Good | Good |
| *Efficient* | Poor | Excellent | Very Good | Excellent |
| *Neutral* | Good | Good | Good | Poor |
| *Equitable* | Poor | Very Good | Very Good | Good |

*Figure 6: Evaluation of Funding Strategies (local):*
*Numeric Conversion Scale: 5=Excellent, 4=Very Good, 3=Good, 2=Moderate, 1=Poor*

## E. Potential Funding Packages

The three revenue packages suggest innovative options to replace revenue lost because of the adoption of autonomous vehicles. The funding packages were designed to meet the projected revenue gap and incentivize a specific future. Package one incentivizes shared vehicles, package two incentivizes private ownership, and package three focuses primarily on meeting the revenue gap. Each funding package uses at least four of the suggested revenue sources. The following sections will outline each funding package in detail.

### Package 1: Prioritize Shared Vehicles

This package is designed with the intent of incentivizing shared vehicle usage through a combination of varied taxes and fees. The balance of taxes and fees particular to this package (the highest rate on a proposed VMT tax of any package, the creation of high parking fees, and a new maintenance fee) culminates into a system that should encourage future AVs to be shared. The high VMT fee encourages people to use alternatives to single occupancy vehicles. The registration and maintenance fee incentivize residents to use shared fleets. The registration and maintenance fees may impact neutrality, but they create the best environment for an equitable transportation system. In addition, the local sources encourage a shared-use fleet. The electric utility charge and parking fees will impact private owners of autonomous vehicles. Those using public transit, biking, walking, and using shared autonomous vehicles will not be impacted by these fees. The licensing fee does increase the cost the per ride for shared vehicles, but the fee is a small per use fee. Overall, this package generates the most revenue and encourages the use of shared vehicles. Figure 7 details the terms of this package option.

| | Charge | Multiplier | Total Revenue |
|---|---|---|---|
| *VMT (state)* | $0.02 per mile | 456,933,725 Tigard Miles | $9,138,674 per year |
| *Registration Fees (state)* | $172 per year, per autonomous vehicle | 2,752 Autonomous vehicle registrations | $473,373 per year |
| *Maintenance Fees (state)* | $100 per year, per autonomous vehicle | 2,752 Autonomous vehicle registrations | $275,200 per year |
| *Licensing Fee (local)* | $0.40 per ride | 596,940 rides per month | $238,776 per month ($2,865,312 per year) |
| *Electric Utility Charge (local)* | $6 Per Month | 2,487 Vehicle Charging Stations | $14,992 per month ($179,064 per year) |
| Parking Fees (local) | $20 per day | 131 downtown parking | $68,120 per month ($817,440 per year) |
| Total (local) | | | $3,861,816 per year |
| Total (state) | | | $9,887,247 per year |

*Figure 7: Prioritize Shared Vehicles:*
**See appendix for calculation details*

### Package 2: Prioritize Private Autonomous Vehicles

This package is designed with the intent of incentivizing private vehicle usage through a combination of varied taxes and fees. The balance of taxes and fees particular to this package (a modest VMT tax rate, continuing free parking throughout Tigard, and the omission of any required maintenance-related fees) culminates into a system that should encourage, at least to some extent, the private ownership of AVs. Since this package does not have a maintenance check or charge for parking, the package encourages private autonomous vehicle use. This package impacts the purchasing of private autonomous vehicles less than package 1, but is less equitable overall. Figure 8 details the terms of this package option.

| | Charge | Multiplier | Total Revenue |
|---|---|---|---|
| *VMT (state)* | $0.015 | 456,933,725 Tigard Miles | $6,854,006 per year |
| *Registration Fees (state)* | $172 per year (change from current 2 year) | 2,752 Autonomous vehicle registrations | $473,373 per year |
| *Licensing Fee (local)* | $0.50 per ride | 596,940 rides per month | $298,470 per month ($3,581,640 per year) |
| *Impact fee (local)* | $1000 per year | 50 pick up / drop off zones | $150,000 per year |
| Total (local) | | | $3,731,640 per year |
| Total (state) | | | $7,327,379 per year |

*Figure 8: Prioritize Private Autonomous Vehicles:*
**See appendix for calculation details*

### Package 3: City Does Not Prioritize Autonomous or Shared Vehicles. Only wants a steady revenue source.

This package is not designed with the intent of incentivizing either shared or private vehicle usage and instead uses a combination of varied taxes and fees to generate revenue in a fairly neutral manner. The balance of taxes and fees particular to this package (a modest VMT tax rate, but the inclusion of parking fees, as well as an electric utility charge) culminates into a system that should maintain relative neutrality as AV trends develop. Figure 9 details the terms of this package option.

| | Charge | Multiplier | Total Revenue |
|---|---|---|---|
| *VMT (state)* | $0.015 | 456,933,725 Tigard Miles | $6,854,006 |
| *Registration Fees (state)* | $172 per year (change from current 2 year fee) | 2752 Autonomous vehicle registrations | $473,373 per year |
| *Licensing Fee (local)* | $0.40 | 596,940 rides per month | $238,776 per month ($2,865,312 per year) |
| Electric Utility Charge (local) | $6 per month | 2,487 Vehicle Charging Stations | $14,992 per month ($179,064 per year) |
| Parking Fees (local) | $5 per day | 131 downtown parking spaces | $17,030 per month ($204,360 per year) |
| Impact Fee (Local) | $500 per year | 50 pickup/ drop-off zones | $75,000 per year |
| Total (Local) | | | $3,323,736 |
| Total (State) | | | $7,327,379 |

*Figure 9: Package 3 Steady Revenue:*
**See appendix for calculation details*

## F. Evaluation of Funding Packages

The evaluation will include a numeric scale with two levels of analysis. The packages were designed to incentivize shared ownership, private ownership, and filling the revenue gap. The analysis will evaluate the effectiveness of each revenue package.

Using the numeric conversion scale, package 1 beats out packages 2 and 3 with a score of 14, compared to scores of 8 and 13, respectively. These calculations result from converting the nominal ratings in the table below to their numeric counterparts and then tallying across all four of the criteria in our framework (Figure 10).

| Funding Package | Productivity | Efficiency | Neutrality | Equity |
|---|---|---|---|---|
| *I. Shared Vehicle Prioritization* | Very Good | Good | Good | Very good |
| *II. Private Vehicle Prioritization* | Poor | Good | Good | Poor |
| *III. Steady Revenue Prioritization* | Good | Good | Very Good | Good |

*Figure 10: Evaluation of Funding Package Options:*
*Numeric Conversion Scale: 5=Excellent, 4=Very Good, 3=Good, 2=Moderate, 1=Poor*

Adding a second level of analysis — one that uses a weighted framework — the outcome differential between package 1 and the other two packages grows even more. Our weighted framework, depicted below, represents one that values equity and productivity 1.5 times as much as the other two criteria. Productivity and Equity were weighted higher because a revenue package that encourages an equitable future and meeting the revenue gap were determined to be the most important criteria. According to this weighted scale, which better represents the values of our investigation, package 1 ranks at a total score of 18, compared to package 2 with a score of 9, or package 3 with a score of 16. A depiction of this weighted scale, along with added description of the ways in which package 1 excels, is provided below (Figure 11).

| Funding Package | Productivity (x1.5) | Efficiency (x1.0) | Neutrality (x1.0) | Equity (x1.5) |
|---|---|---|---|---|
| *I. Shared Vehicle Prioritization* | Very Good | Good | Good | Very good |
| *II. Private Vehicle Prioritization* | Poor | Good | Good | Poor |
| *III. Steady Revenue Prioritization* | Good | Good | Very Good | Good |

*Figure 11: Weighted Evaluation of Funding Package Options:*
*Numeric Conversion Scale: 5=Excellent, 4=Very Good, 3=Good, 2=Moderate, 1=Poor*

### G. Suggested Funding Package: Prioritize Shared Vehicles

We recommend the adoption of package 1, which prioritizes shared vehicles. Using the numeric conversion scale, package 1 beats out packages 2 and 3 with a score of 14, compared to scores of 8 and 13, respectively. These calculations result from converting the nominal ratings in the table above to their numeric counterparts and then tallying across all four of the criteria in our framework. In addition, in the weighted scale, which better represents the values of our investigation, package 1 ranks at a total score of 18, compared to package 2 with a score of 9, or package 3 with a score of 16.

The impact fee is not included in package 1, which will encourage corporations to bring AV operations to the city. As VMT is projected to increase 7% with AV adoption, this package has the highest VMT tax rate, higher registration fees, and the addition of a maintenance fee. This will help replace lost gas tax revenue from the worst-case scenario of expanded consumer and commercial EV adoption. Most AVs are anticipated to be primarily EVs (SAFE, 2017).

The licensing fee of $0.40 per trip that originates or ends in Tigard is lower than Portland's $0.50 fee (Lyft 2017) and should not discourage ride-hailing operations in the city. The overall goal of discouraging single occupancy trips is reflected in the high parking fee and the high VMT. Fewer single occupancy trips contribute to better air quality and less congestion. The high parking fees also encourage walking or cycling to the Tigard Triangle or Highway 99 for current transit options (TriMet WES and bus) and future options (SW Corridor MAX). Incentivizing bicycle/pedestrian options in this manner aligns with Tigard's strategic vision to become the most walkable city on the West Coast.

Many of the revenue sources are based on the number of AV vehicles, and revenue will increase as AV adoption increases. The revenue package is structured in this way because as new revenue sources increase, traditional revenue sources, such as gas tax, will continue to decrease. The defined revenue sources rates can be adjusted to better meet the city's need as more data is available.

This package is the most equitable, most in line with Tigard's values and mission, and stands to generate considerable revenue for the city that will meet and surpass the shortfalls anticipated elsewhere in the current budget.

# Appendix A: Current Revenues - Description and Outlook (Assignment 1)

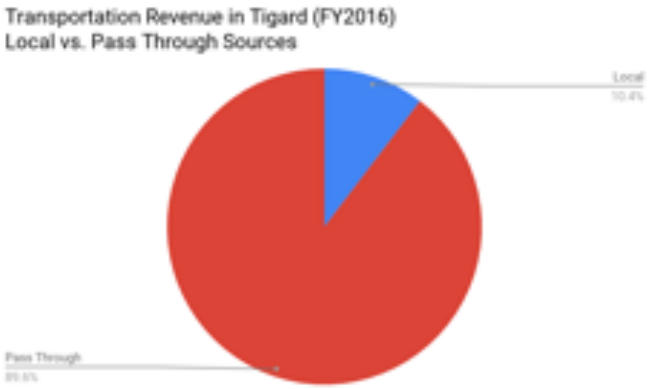


*Figure 12: Transportation Revenue (FY 2016):*

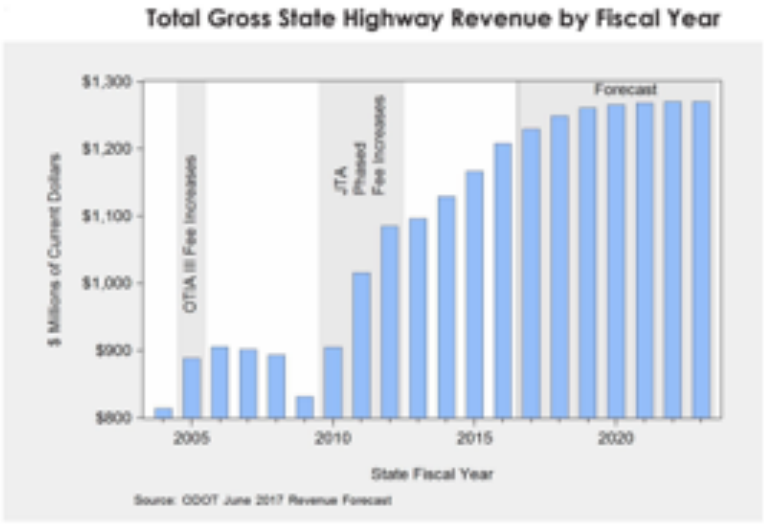


*Figure 13: Total Gross State Highway Revenue by Fiscal Year*
*Source: ODOT, June 2017 Revenue Forecast.*


*Figure 14: Tigard / Washington County Population Forecast*
*Source: Metro, 2016*

| | Annual revenue (2018) | Available for capital expenses (2018) | |
|---|---|---|---|
| State Motor Vehicle Fund | $3,000,000 | 25% | $750,000 |
| County Gas Tax | $200,000 | 25% | $50,000 |
| City Gas Tax | $619,511 | 100% | $619,511 |
| Transpo. Development Tax (TDT) | $1,701,000 | 100% | $1,701,000 |
| Transportation SDC | $1,155,000 | 100% | $1,155,000 |
| Street Maintenance Fees | $2,851,058 | 0% | $0 |
| Total | $9,526,569 | | $4,275,511 |

*Figure 15: Local Funding Sources.*

### State Motor Vehicle Fund:

The Oregon State Motor Vehicle Fund shares revenue with counties and cities in the state. The majority of the State Motor Vehicle Fund comes from gas taxes, vehicle registration fees, and vehicle title fees. (City of Tigard Budget, 2017, pg. 63).

**Outlook: Negative.** The State Motor Vehicle Fund will be impacted by autonomous vehicles (AVs). The State Motor Vehicle Fund relies on registration fees, title fees, and state gas taxes. Autonomous vehicles have the potential to reduce the number of registered vehicles in the state and reduce the number of miles traveled.

The 2017-2019 Oregon Governor's budget anticipates $351 million being transferred to cities (ODOT, 2017). The state revenue sharing is allocated based on each city's population. Tigard anticipates that their share will remain about the same as FY 2016-17 (City of Tigard Budget, 2017, pg. 63). Gas tax expenditures are restricted by Article IX, section a of the Oregon Constitution. Funds can be used for capital and maintenance projects. City's Street maintenance division is largely funded by gas tax revenues (City of Tigard Budget, 2017, pg. 364).

House Bill 2017 will provide additional funding to local cities. HB 2017 will increase registration fees and gas taxes over the course of several years. Tigard is estimated to receive, in addition to current State Motor Vehicle Funds, $1.1 million for funding year 2017-19, $2 million FY 2019-21, $2.5 million FY 2021-23, $3 million FY 2023-25, and $3.2 million FY 2025-27 (HB 2017 Revenue Report, 2017).

**Best-case scenario:** The best-case scenario would be the State Motor Vehicle Fund remaining stable and that the HB 2017 projections of additional funding are accurate.

**Worst-case scenario:** The worst-case scenario would be a rapid decline in state gas tax revenue despite the higher tax and Tigard's share declining along with state total vehicle miles declining. Fewer locally registered vehicles would also cause a decline in revenue.

### City Gas Tax Fund/County Gas Tax:

The City of Tigard has a $0.03 gas tax. The majority of the city gas tax revenue funds is directed to pay off the Greenburg Road/Pacific Highway/Main street intersection improvements. Payments for this bond will be completed in FY 2019-20 (City of Tigard Budget, 2017, pg. 327).

Washington County collects a motor vehicle fuel tax on gas sold within the county. The county gas tax is distributed to cities in the county based on population. Tigard received roughly $200,000 for the past five years (City of Tigard Budget, 2017, pg. 69).

**Outlook: Negative.** The city and county gas tax will be impacted by autonomous vehicles. Increased autonomous vehicle use will likely decrease the number of vehicle miles traveled.

**Best case scenario:** The best-case scenario would be the city and county gas tax revenue remaining stable. The populations of Washington County and Tigard are both expected to increase, with Tigard staying between 9 and 10 percent of Washington County. Even with autonomous vehicle use, total driver trips could stay stable if the population does increase yearly, up 40% by 2040. Limited adoption of AVs would take some of those gasoline drivers off the road but not a huge decrease.

**Worst case scenario:** The worst-case scenario would come from a combination of substantial early AV adoption, increased fuel efficiency, fewer road miles driven, and a continued turn to mass transit and electric vehicles. Even with an increase of drivers, motor vehicle Corporate Average Fuel Economy (CAFE) standards were toughened under the Obama administration, making gas-powered vehicles more fuel efficient. Also, electric vehicles are increasing their range and their sales. Washington Square in Tigard is home to the Tesla dealership for the Portland metropolitan area. AV adoption would accelerate the decline in gas tax revenue.

### Transportation Development Tax (TDT):

The Tigard Transportation Development Tax (TDT) was approved by voters in 2008. The TDT replaced the Traffic Impact Fee (TIF) and is assessed on new developments. Revenues from this tax must be dedicated to capital improvements that expand capacity (City of Tigard Budget, 2017, pg. 372). Revenue from the TDT can be difficult to forecast because developers can receive credits for major infrastructure projects, and development in the city varies on a yearly basis (City of Tigard Budget, 2017, pg. 51).

**Outlook: Neutral.** The TDT will not be impacted by autonomous vehicle use. TDT revenue relies on new development, and new development is not directly linked to autonomous vehicle use. Collaborating with developers, the city has planned River Terrace, a new neighborhood with 2,600 single family units. 1,500 units are already approved and many are complete. (Miller, 2016)

**Best case scenario:** The best-case scenario would be the River Terrace Subdivision development continuing and other development activities in the city continuing to increase.

**Worst case scenario:** The worst-case scenario would be an economic recession causing development to abruptly slow down, thus reducing TDT revenues.

### Transportation System Development Charge (SDC):

The Tigard System Development Charge (SDC) is a charge collected when building permits are issued for new residential, multi-family, or commercial construction. The Tigard SDC was implemented in 2016, and as a result, little data on the Tigard SDC is available. SDC revenue helps provide funds for increased vehicle and transit capacity projects (City of Tigard, 2017, pg. 373).

**Outlook: Neutral.** The Tigard SDC will not be impacted by autonomous vehicles. The SDC relies on new development and is not directly linked to autonomous vehicle use.

**Best case scenario:** The best-case scenario would be levels of development and revenues continuing to increase, much like the TDT.

**Worst case scenario:** The worst-case scenario would be development declining as a result of an economic recession.

### Street Maintenance Fee:

The Street Maintenance fee is a charge on Tigard residents' utility bills and provides a steady revenue source for the maintenance of existing roads. The Street Maintenance Fee revenues cannot be used for capital projects in the city. The street maintenance fee was originally approved in 2003 and the most recent increase went into effect January 2017. (City of Tigard Budget, 2017, pg. 370).

**Outlook: Neutral.** The Street Maintenance fee would not be impacted by autonomous vehicles. The Street Maintenance fee is collected from utility bills which are not directly linked to autonomous vehicle use.

**Best case scenario:** The best-case scenario would be a continued steady increase in the street maintenance fee revenues as a result of new development.

**Worst case scenario:** The worst-case scenario would be for street maintenance fees to remain stable as a result of no new development in the city.

### Pass-through Revenue Sources:

| Outside Funding Sources | Annual revenue (2016) | Available for capital expenses (2016) | |
|---|---|---|---|
| Major Streets Transportation Improvements Plan (MSTIP) | $35,000,000 | 10% | $3,500,000 |
| Regional Flexible Funding Appropriations (RFFA) | $17,000,000 | 4% | $680,000 |
| All Roads Transportation Safety (ARTS) | $200,000 | 100% | $200,000 |
| Statewide Transportation Improvements Program (STIP) | $300,000 | 100% | $300,000 |
| Community Development Block Grants (CDBG) | $150,000 | 100% | $150,000 |
| Nature in Neighborhoods (NIN) | $75,000 | 100% | $75,000 |
| Connect Oregon | $500,000 | 100% | $500,000 |
| Total | $53,225,000 | | $5,405,000 |

*Figure 37: Passed Through Revenue Sources.*

Major Streets Transportation Improvements Plan (MSTIP, Washington County)

This program is funded primarily through a transfer from the Washington County general fund, which is largely funded by property taxes. MSTIP is funded in 5-year budget cycles, with the current cycle ending this year (FY 2017-18). The next cycle will run FY 2018-19 through FY 2022-23, and the budget plan was approved by the board of commissioners in October of 2016. This plan also sees funding from other intergovernmental revenues. These revenues are expected to decrease but make up a smaller portion of the total revenues, so they are not expected to have an impact on Tigard's transportation funding. This funding runs through Washington County's capital budget and into Tigard's CIP fund rather than through either entity's operating budget (Washington County, 2017).

**Outlook: Neutral.** The population in Washington County is expected to see continuing growth and as a result, growth in property tax revenue. This revenue has seen consistent growth for multiple years and does not show any vulnerability to autonomous vehicle initiative impacts for the coming year.

**Best case scenario:** This funding would stay the same or see some growth as Tigard is expecting an increase in population at approximately the same rate as Washington County and therefore an increase in assessed value which increases property tax revenue (Metro, 2016).

**Worst case scenario:** In the event of a downturn in the housing markets, a decrease in the property tax revenue would have a negative effect on the funding in MSTIP (Washington County, 2017).

### The Statewide Transportation Improvement Program (STIP):

The Statewide Transportation Improvement Program is a capital improvement program run by the Oregon Department of Transportation (ODOT) as well as the Oregon Transportation Commission. Projects under this program area derive their support from both state and federal-level funds (ODOT, Transportation Funding in Oregon).

At the federal level, monies acquired through federal fuels taxes and heavy truck taxes are passed onto STIP programs. At the state level, funds come through the Oregon State Highway Fund, which pulls its resources from three main places: (1) Taxes on motor fuels, including gas tax and diesel tax; (2) Taxes on heavy trucks, including the weight mile tax and truck registrations; and (3) Driver and vehicle fees, including licenses and vehicle title and registration (ODOT, Transportation Funding in Oregon).

**Outlook: Negative.** In the coming years, it is likely that this funding source may be able to provide less and less money toward capital improvement projects in Tigard. Unlike other outside funding sources that are consolidated into single revenue streams, the multi-component revenue streams coming into the STIP make for a more tenuous outlook than other pass-through sources (for example, the committed lottery bonds that fund Connect Oregon). While some of the major components contributing to the STIP revenue stream are fairly stable and unlikely to be affected by changes related autonomous vehicles, there is uncertainty surrounding the continued reliability of some resources moving forward, in particular with motor fuels and vehicle registration trends open to fluctuation (ODOT, Transportation Funding in Oregon). On the whole, ODOT expects to see total gross state highway revenues experience only very modest gains, so the ability of ODOT to provide extra money to STIP is not guaranteed (ODOT, June 2017 Revenue Forecast).

**Best case scenario:** Tigard continues to see around $300,000 per year in funding. It is possible that even if some revenues are no longer available (for example, population growth slows and vehicle sales are low or ODOT's budget suffers for other reasons), a positive scenario could see other areas of the varied funding streams maintain or pick up slack for those that dip. Additionally, making adjustments to some policies surrounding user fees or taxes could be leveraged as a strategy to make up for losses in other areas.

**Worse case scenario:** Available funds decrease due to changes in transportation patterns and general population trends, resulting in fewer revenues associated with fuels taxes, special vehicle fees, and registration fees, which currently make up much of the revenue that is transferred on to Tigard projects under the STIP (ODOT, Transportation Funding in Oregon). It seems as though the more strain there is on ODOT's budget overall, the less likely it is STIP will see funds continue to stream in for big projects.

### All Roads Transportation Safety (ARTS - ODOT):

This program is also funded through the Oregon Department of Transportation, which sees federal funds, fee/license revenue, and enterprise revenue, among other sources. Within the ODOT budget, this specific program operates under the Transportation Program Development Division (ODOT, 2015). This federal funding is available for all roads, including non-state-owned roads, in Oregon for the purpose of improving safety for citizens through a data-driven approach. ARTS allocated a total of $166 million to be spent from 2017-2021 (ODOT, 2015a). Through ARTS, problem areas with safety issues are identified, then Highway Safety Improvement Program Funds (HSIP) funds may be used to improve these problems. However, Federal HSIP requires non-federal matching funds, or 7.78% for Oregon. For Tigard, this funding equates to $200,000 annually, with a ~10% match (ODOT, 2015a).

**Outlook: Neutral - Negative**. This funding is unlikely to be affected by autonomous vehicles in the near future because it is being allocated at the federal level, which will largely not feel the economic effects of shifts occurring in the Portland metro area. Generally speaking, ODOT revenues are stabilizing and potentially shrinking in the future due to fuel efficiency and declining vehicle sales, which may have some observable effect on this funding (ODOT, 2017).

**Best case scenario:** Funding will continue at the current level with a 10% match by local/regional sources.

**Worst case scenario:** ODOT revenues decline, and therefore funding is cut accordingly. Necessary match funding cannot be found, and therefore funding is cut.

### Community Development Block Grants (CDBG):

Community Development Block Grants (CDBG) are federal funds that are awarded to local governments in the service of infrastructure building and other projects related to development. Congress created this transfer/grant program in 1974 under the Housing and Community Development Act. As such, projects typically funded through CDBG are geared toward community building and anti-poverty efforts. The U.S. Deptartment of Housing and Urban Development (HUD) administers the program at the federal level and determines the amount of money in each grant (using a particular formula that takes into account community needs); once funds are granted, CDBG projects are then operated and managed at the local level.

**Outlook: Neutral - Negative.** The revenue sources associated with CDBG-funded projects are unlikely to change as a result of autonomous vehicles as the flow of money into the U.S. Department of Housing and Urban Development (HUD) is broad and far removed from particular changes in a given community.

**Best case scenario:** Tigard continues to receive another $150,000, or thereabouts, in the upcoming fiscal year. If this source were to provide Tigard with more funding than $150,000, it would come as a surprise to many and would likely have to do with shifts occurring at the federal level as part of a broader restructuring process brought on by the new administration led by Donald Trump (U.S. President) and Ben Carson (HUD Secretary).

**Worse case scenario:** Tigard is awarded $0 in these block grants moving forward, and/or all existing funds are pulled from CDBG projects by their parent body, HUD. If this were to occur, it would most likely be due to HUD scaling back its expenditures across all of their programming, which is something they are positioned to do. These changes - both positive and negative - are not directly tied to autonomous vehicles in any particular way at this point in time.

### Nature in Neighborhoods (NIN):

This program is funded through the Oregon Metro, a regional government for Multnomah, Clackamas, and Washington counties that funds a variety of projects related to parks, transit, and venues. The Metro acquires its money through a variety of different sources: enterprise activities and property taxes, with smaller flows coming through grants and various excise taxes (Metro, Finances and Funding).

Enterprise activities comprise 51% of Metro revenues, acquired through user fees associated with solid waste disposal (two locations), as well as visitor charges at various venues around the state (Oregon Convention Center, Oregon Zoo, and well as two popular properties in Portland: the Expo Center, and the Portland Center for Performing Arts) (Oregon Metro, FY 2017-18 Budget Document). The second largest contributor to Metro funds are property taxes at 26% of total revenue (Metro, FY2017-18 Budget Document).

**Outlook: Neutral.** Because the majority of Metro funding is spread across a broad portfolio of relatively stable sources that are not likely to change drastically as a result of autonomous vehicle initiatives, the anticipated impact at this point is neutral.

**Best case scenario:** Transportation projects through NIN continue to see approximately $75,000 (or more) in funding per year as relatively little will change to Metro's ability to fund their work.

**Worst case scenario:** The Oregon Metro fund suffers in some way as a result of autonomous vehicles, and funding to Metro-funded programs (of which NIN is just one small part) becomes restricted.

### Regional Flexible Funding Appropriations (RFFA - Metro):

This program is also funded through and governed by Oregon Metro. This specific funding operates in conjunction with the Metropolitan Transportation Improvements Program (MTIP), a federally required schedule of transportation investments that operate under Metro, ODOT, TriMet, and SMART. The funding allocated by RFFA is proposed in 4-year cycles, with current funding to continue through 2021. These funds are intended to act as a method of supporting regional collaboration of transportation investments under MTIP (Metro, 2016a; Metro, 2017).

The funding that has been agreed upon would be supplied in part through an increased bond commitment but also expects other funding sources to match commitments. It is expected that this project and funding will have a return on bond investments, as well as ongoing commitment for funding from regional sources. Because of this type of funding, it is unlikely that this funding will be impacted by autonomous vehicles (Metro, 2016a; Metro, 2016b).

**Outlook: Neutral**. Since these funds are not reliant upon revenues or market behaviors, this funding should not be reactive to autonomous vehicle initiatives.

**Best case scenario:** Tigard transportation projects funded through RFFA continue to see funding as outlined in the 2018-2021 Policy Report.

**Worst case scenario:** This funding may be delayed through a formal process but has carryover protocol to roll funding over to the following year. It is unlikely that this funding will fluctuate given the regulations and requirements for bond issuance (Metro, 2017a).

### Connect Oregon:

As dictated in ORS 367.080 of 2015, the Oregon Transportation Commission was provisioned to fund transportation projects through the establishment of the Connect Oregon Fund. Money from state lottery bonds are to be transferred to the Department of Transportation "in an amount sufficient to provide $45 million" for their funding of select projects (ORS

367.080) under the umbrella of Connect Oregon. As this is a state-wide program, the statue splits Oregon into five different regions: Washington County is part of Region 1, along with Clackamas, Hood River, and Multnomah Counties. Per the statue, 10 percent of the net proceeds of state lottery bonds should be provided to each of the five different regions (State of Oregon, ODOT, Connect Oregon).

At present, the Connect Oregon Fund is supporting four projects, some of which span more than multiple regions. These are the Mid-Willamette Valley Intermodal Facility, the Treasure Valley Intermodal Facility Rail expansion in East Beach Industrial Park at the Port of Morrow Brooks rail siding extension (State of Oregon, ODOT, Connect Oregon).

**Outlook: Neutral.** An ongoing commitment written into law (ORS 367.090, updated 2015) dictates that these funds should remain available via transfer from lottery bonds for the coming years. Lottery bonds are not expected to see any rapid decrease in their availability.

**Best case scenario:** Currently Tigard is receiving $500,000 per year in funding, and a best case would see this amount continue or perhaps rise slightly in the coming year. The lottery fund acquires its money through a process not meaningfully tied to autonomous vehicles, so the rise of autonomous vehicles is unlikely to affect occurrences here.

**Worst case scenario:** If due to some unforeseeable reason the state lottery fund is no longer able to provide the transfer of monies to the Connect Oregon Fund, then this source of funding may decrease.

## Appendix B: Description of Additional Revenue Fees (Assignment 2)

### 1. Road user charge (VMT fee)

VMT fees refer to a charge on “vehicle miles traveled” for each automobile on the road. In the absence of gas taxes, this stands to be a highly-effective way of generating revenue in a manner that adheres to the principles outlined above. The notion that vehicles must pay a simple fee per how much they utilize a roadway is an intuitive and straightforward one but one that has not yet been implemented en masse due to the availability of gas taxes serving in its place and also due to concerns related to privacy and tracking. A VMT fee would require the mileage of automobiles to be tracked by government agencies who then assess and charge these fees, which some have seen as an impingement of privacy. However, as automobiles become more autonomous, the tracking of vehicle movements no longer seems like a threat to privacy and seems more like an important security necessity in order to keep tabs on the powerful machines traversing our public spaces. Furthermore, it may be possible to levy VMT fees on only autonomous vehicles, which will neatly contain any privacy concerns to the realm of AV and also directly target electric vehicles (which AVs will be) that will not contribute to gas tax funds.

- Productivity: As shifts to autonomous vehicles unfold, VMT fees will almost certainly represent the largest source of revenue for cities like Tigard moving forward. The implementation of VMT fees will require the creation of new policies via law, which will likely operate at the state level.
- Efficiency: This is an efficient form of taxation as it affects directly those who utilize government-funded infrastructure (namely, roads). By assessing a fee per mile traveled, the government can reclaim some revenues lost in other areas of the budget, like the gas tax, and put this money toward maintaining the roadways that citizens who pay into the VMT fund are using.
- Neutrality: This is not an especially neutral policy change. It will affect the transportation decisions of individuals, since every mile traveled will now have a dollar amount attached

to it. Individuals may choose to travel less via personal automobiles in order to evade VMT fees, but this does not represent a problem of any real sort.

- Equity: The VMT tax will impact populations who have to commute further distances more than others. In many instances lower income residents have to live further from their jobs to find affordable housing. The VMT would impact some lower income residents more than others.

### 2. Maintenance Checks for Autonomous Vehicles (State)

This would be a requirement that private autonomous vehicles must be checked once a year and a fee would be attached to the maintenance check. In all likelihood, the maintenance fee and registration fee would be charged at the same time. A maintenance check would provide accountability and ensure safety on the road network.

- Productivity: A maintenance fee for autonomous vehicles on its own would not generate enough revenue to match the impact of an autonomous vehicle on the road network.
- Efficiency: A maintenance fee similar to registration would be easy to administer. The maintenance check and registration fee could be administered simultaneously.
- Neutrality: The extra maintenance fee for autonomous vehicles discourages ownership of an autonomous vehicle.
- Equity: A maintenance fee would not adjust for personal income, and thus it is not equitable. However, if the city decides to prioritize a shared autonomous fleet, equity concerns can be minimized.

### 3. Registration Fees on Autonomous Vehicles (State)

By imposing higher registration fees for autonomous vehicles (any autonomous—both private and shared), the city can regain some revenues lost elsewhere in their budget. This would be a one-time registration fee (like traditional vehicle registration fees) but would simply require autonomous vehicles to pay double the fee required for regular vehicles.

- Productivity: A registration fee charge on its own would not match the impact of autonomous vehicles on the road network. Registration fees should be used in coordination with other taxes.
- Efficiency: Administering the registration fee is efficient. The registration fee would happen once every year or two years.
- Neutrality: A registration fee is not neutral because it discourages individuals and the community to buy a autonomous vehicle.
- Equity: A registration fee is not equitable. Lower income and high income individuals would pay the same amount for registration.

### 4. Parking Charge and Parking Tickets (Local)

Currently, the city of Tigard does not charge for parking. Implementing a parking fee strategy would generate additional revenue and disincentivize the use of human-driven automobiles. By installing kiosks or parking meters, Tigard can begin charging for parking in the downtown area, with modest rates (e.g., ~$1.50/hour) having the potential to generate considerable revenue when multiplied across the 131 current parking spaces in the jurisdiction.

- Productivity: The productivity of the parking charge would depend on the exact cost of parking. Ideally the parking charge and tickets would be greater than the expenditures (which may be minimized by utilizing kiosks, of which only three or four may be needed, instead of installing physical parking meters at each space).

- Efficiency: Administration of parking would require additional staff to monitor parking meters. However, integrating technology with parking meters reduces the need for parking meter maids. Advanced parking meters can detect whether a car is parked in a space.
- Neutrality: Charging for parking alters the behavior of consumers, thus it is not a neutral taxation policy. However, charging for parking is a form of transportation demand management (TDM). TDM strategies encourage alternatives to driving and in this case driving human driven automobiles.
- Equity: This is not an equitable funding source because low income individuals would pay the same as high income individuals.

### 5. Licensing Fees on Private Firms (Local)

Private firms like Uber and Lyft stand to benefit tremendously from shifts toward automated vehicles. With automation comes the ability to jettison human drivers (i.e., former employees who required a paycheck), and instead the cars do the driving themselves. No longer needing to expend resources on driver salaries/payments, private on-demand ride-sharing firms like Uber and Lyft will have deeper pockets than before.

From the Tigard government's perspective, instituting licensing fees for firms (namely, on-demand ride-sharing firms such as Uber and Lyft) who wish to operate autonomous vehicles in their jurisdiction seems like a logical way to claim some of the lost revenues that will result from shifts toward autonomous vehicles—a shift these ride-sharing firms will benefit from. By enacting a licensing fee for these firms to operate in Tigard, some of these lost revenues can be recouped.

- Productivity: The licensing charge for autonomous vehicle companies would not equal the impact to the local road network from autonomous vehicles. The licensing charge would need to be used in conjunction with a VMT charge or other taxation.
- Efficiency: The licensing charge for autonomous vehicles is very efficient. Autonomous vehicle companies would be charged a licensing charge per trip. The administration cost for this charge is minimal.
- Neutrality: The licensing charge is mostly neutral because it targets the autonomous vehicle companies and not the individuals or community. Autonomous vehicle companies could choose to pass the charges to customers.
- Equity: The licensing charge impacts the autonomous vehicle companies. Companies could choose to pass down charges to customers, however the initial licensing charge is equitable.

### 6. Impact Fees for Street Zoning Changes (Local)

The implementation of autonomous vehicles will change the way we shape our streets. Many ride-share and private autonomous vehicles will need space to pick up passengers. The impact fee would charge shared autonomous vehicle companies to reallocate street space to pick-up and drop-off zones.

- Productivity: Impact fees are somewhat productive. They should produce enough revenue to maintain the pick and drop off zone.
- Efficiency: The impact fee would be a one time charge and thus easy to administer.
- Neutrality: The impact fee is somewhat neutral because it reallocates street space from parking spaces to pick-up and drop-off spaces. This alteration is encouraging the community to use autonomous vehicles over personal vehicles.

- Equity: Impact fees have high equity because they impact the company and not individuals. Additionally, these impact fees are to be used to pay for requisite changes in public spaces (roadways and parking areas) that will need to adapt to new transportation modes.

### 7. Electric Vehicle Utility Charge (Local)

The city of Tigard already has an utility charge dedicated to street maintenance. This additional electric vehicle utility charge would charge those with electric vehicle charging stations. The additional revenue would be added to the current utility charge dedicated to street maintenance.

- Productivity: An electric utility charge on its own could not cover the cost of road maintenance. However, an electric utility charge would cover some road maintenance costs.
- Efficiency: An electric utility charge would be very efficient and an additional line on the existing utility charge would need to be added. No additional staff would be needed to administer this tax.
- Neutrality: An electric utility charge only impacts owners of electric charging stations and may distort the decision of whether or not to buy an electric autonomous vehicle.
- Equity: An electric utility charge would only impact private autonomous vehicle owners and autonomous vehicle companies.

## Appendix C: Funding Package Calculations and Assumptions (Assignment 2)

### VMT Calculations

The VMT calculation assumed that vehicle miles traveled in Tigard is roughly proportional to the city's percentage of the state population. The VMT number from 2016 was estimated to increase based on the Eno Report. The final per mile charge was based on the current OReGO pilot program. The package per mile charges varied, but were roughly proportional to the OReGO pilot program. In terms of administration the VMT tax would be most efficient if administered by the state and revenues were passed down to cities based on population.

- 36,719,200,000: 2016 Vehicle Miles Traveled in Oregon (ODOT, 2017, pg. 1).
- Projected 2% VMT increase with a 10% AV adoption (Eno, 2013, pg. 8).
- Tigard accounts for 1.22% of the Oregon Population (ODOT, 2017a, Attachment C).
- OReGO pilot program charges 1.5 cents per mile. The 2 cents charge and 1.5 cents charge are on par with the OReGO pilot (OReGO, 2017).

### Registration Fee Calculation

The registration fee calculation assumed that the number of vehicle registrations would decline based on the Eno Report. The number of registrations for Washington County was retrieved and Tigard was assumed to account for a proportional number of vehicle registrations compared to the percentage of the county population. Next, it was assumed that 10% of new vehicle registrations would be AV. The registrations for AVs is this assumption is changed to every year compared to the current every two year system and the fee is increased.

- 465,791 vehicles registered in Washington County (ODOT, 2016).
- Tigard accounts for 6.2% of Washington County's population (ODOT, 2016, pg. 1).

- Projected 4.7% decrease in vehicle registrations (Eno, 2013, pg. 8).
- Assume 10% AV adoption (Eno, 2013, pg. 8).
- The registration fee for AVs in these assumptions is doubled and registration is changed to every year (ODOT, 2017b).

### Maintenance Fee

The maintenance fee calculation is similar to the registration fee calculation. The maintenance fee would only be for AVs to ensure safety on the roadway. The maintenance fee would be administered at the same time as the registration fee to increase efficiency.

- 465,791 vehicles registered in Washington County (ODOT, 2016).
- Tigard accounts for 6.2% of Washington County's population (ODOT, 2016, pg. 1).
- Projected 4.7% decrease in vehicle registrations (Eno, 2013, pg. 8).
- Assume 10% AV adoption (Eno, 2013, pg. 8).
- The maintenance fee is assumed to be charged each year.

### Licensing Fee

The licensing fee will be charge on each trip taking in shared autonomous vehicles. The number of shared trips must be assumed.

- 49,475 city of Tigard population (ODOT, 2017a).
- Assumed $0.40 or $0.50 charge per trip depending on package. The charges here are roughly proportional to the current Portland Lyft surcharge of $0.50 (Lyft, 2017).
- Assume 10% AV adoption (Eno, 2013, pg. 8).
- Assume four rides per day for 10% of residents using AV ride-share.

### Electric Utility Charge

The electric utility charge would be an addition to the user's utility bill. Only those with electric vehicle charging stations would be charged the electric utility fee. The electric utility fee is assumed to be $6 per month per charging station. The electric utility charge is similar to the current city of Tigard utility charge on all resident's utility bills. The assumed number of charging station varies between the packages. The shared vehicle package assumes fewer charging stations than the other packages because AV companies can have fewer charging stations and rotate out vehicles.

- 49,745 city of Tigard Population (ODOT, 2017a).
- Assume 10% AV adoption (Eno,2013, pg. 8).
- Assume 50% of AV registrations will have charging stations for shared assumption package. Assume 80% of AV registrations will have charging stations for package three.

### Impact Fee

The impact fee charges for pick-up and drop-off locations. The number of drop-off and pick-up locations in the city of Tigard is difficult to estimate since AV technology is still new. The initial estimate is that there will be 50 pickup and drop off locations in the city of Tigard. Each AV company will have to pay an impact fee to use a pick-up and drop-off location. Essentially if a shared AV company operates in an area with a designated pick-up and drop-off zone they will have to pay the impact fee.

- Assume 50 pick-up and drop-off locations in the city of Tigard.
- Charge $1,000 in package 2 and $500 in package 3 per year per pickup and drop off location. Higher charge in package two because it is designed to prioritize private AV use.
- Assume three AV companies in the city of Tigard. The number of AV companies could increase over time.

### Parking Fees

The city of Tigard currently does not charge for downtown parking. The estimated revenue was calculated by estimating the per day revenue for parking meters and multiplying by the number of downtown parking spaces.

- 131 downtown parking spaces (City of Tigard, 2017).
- $20 and $10 a day per space assumed depending on rate charged.
- Multiple by number of days in a month minus Sundays.

## Appendix D: Innovative Case Studies

San Francisco offers a unique approach to preparing for autonomous vehicles. Opting for a community-based approach, San Francisco is creating a shared mobility future that integrates autonomous vehicles with the sharing economy through apps like Uber and Lyft, bike-share systems, and expanded public transportation. Using technology, they are generating revenue through congestion style pricing via parking fees that uses sensor-collected data. This technology allows citizens to efficiently find parking through the connected smartphone app while the local government can collect revenue based on real-time demand. The long term plan has incorporated small pilot plans with the goal of citywide economic development that looks to increased revenues by public and shared forms of transportation, as well as revenues through EV charging, rather than through gas taxes (SFMTA, 2016a; SFMTA, 2016b).

## Appendix E: Considerations for Future Work

A topic for further research on Tigard's revenue stream will be to include revenue due to HB 2017 into these calculations once the funding has been finalized. The increases in gas tax and registration fees already codified in that law's passage will bring the city of Tigard an estimated $1,000,000 over the next 10 years (ODOT, 2017), but that may change once regional transportation leaders prioritize projects. In terms of reduction of available funds, Community Development Block Grants were eliminated from a recently passed federal budget bill by the House of Representatives, but were preserved in the Senate bill. The city will have to closely monitor both of these potential changes in funding streams.

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# Tigard Group B Sustainable City Year Program

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## Introduction

The city of Tigard has a unique opportunity to revolutionize how they provide and maintain transportation for the region due to the rise of the autonomous vehicle (AV) industry. With new innovative technologies come new opportunity and Tigard is in a great position to seize that opportunity. Tigard's ideal position at the hub of several highways and commuter stops along Metro's Southwest Corridor leaves the city uniquely positioned to become the preeminent location for AV service in the Portland metro area. Through this report, we present findings on how AVs are going to change the way in which transportation is funded and how Tigard can adapt to those changes through sensible budget initiatives. Where applicable, assumptions are based on an adoption rate of 50% autonomous vehicles in the foreseeable future, which would result in approximately $2.3 million in lost revenues, based on current sources (Figure 85). The funding packages presented may produce more funds than necessary to maintain the transportation budget at current levels, and we suggest those excess monies be allocated to Capital Reserves and to a fund to help automotive businesses retool and educate staff to service electric vehicles.

## Impact of Autonomous Vehicles

Estimates project that AVs will account for up to 50% of the vehicles on the road by 2040 and 90% or more by 2060. They are going to be electric, incur no fines or tickets, and many will be shared, reducing revenue streams for cities like Tigard significantly.

Taxes and fees are a major source of funding for transportation budgets, and with a change in the nature of transportation will come a change in how the city must budget in the future. Most of the city's transportation budget is funded through the State Motor Vehicle fund, Gas Tax, Transportation Development Tax (TDT), Tigard Transportation System Development Charge (TSDC), Street Maintenance Fee, City Gas Tax, and the Transportation CIP Fund. The table below shows the decrease in revenue for sources that rely on gas taxes or human-driver error, changing revenue sources AVs will impact. At a 50% adaptation rate Tigard can expect to lose an estimated $2.3 million in revenue for the transportation budget.

**Effects of AVs on Transportation Revenues in Tigard**

| Revenue Source | Current Revenues | 50% reduction |
|---|---|---|
| State Motor Vehicle Fund | $ 3,000,000 | $ 1,500,000 |
| City Gas Tax | $ 650,000 | $ 325,000 |
| Washington County Gas Tax | $ 200,000 | $ 100,000 |
| Traffic Fines | $ 715,000 | $ 357,500 |
| "Distracted Driver" education course | $ 8,500 | $ 4,250 |
| Vehicle Release Fees | $ 13,500 | $ 6,750 |
| **Total** | **$ 4,587,000** | **$ 2,293,500** |

*Figure 1: Effects of AVs on Transportation Revenues*

## Proposed Revenue Sources

We calculated three funding packages from the following revenue sources. The first package consists of a gas tax, electricity tax, and charging stations. The second package consists of the same electricity fee plus fees for ride-share. The third package uses the electricity fee plus increased street maintenance fees. Appendix A contains details breakdowns of each proposed funding package.

### Gas Tax

The City of Tigard currently levies a gas tax of $0.03 per gallon. In 2016, the city proposed Ballot Measure No. 34-2564 to increase the tax to $0.08 per gallon to meet declining revenues from the state gas tax. Although the measure failed that year, we propose that the city continue to press for an increase to the gas tax to not only keep up with inflation, but also make up for the revenues lost by the adoption of AVs.

By increasing the gas tax from $0.03 per gallon to $0.08 per gallon the city can expect to receive $540,000 in revenue per year (Figure 2), which would be 23.4% of Tigard's goal to read $2.3 million. This increase in the city gas tax will also work as a "sin tax", incentivizing people to move toward alternative transportation. The original proposed increase of $0.05 per gallon is still worth considering, as an $0.08 tax is comparable to other city gas taxes in the area, but feasibility studies to compare a $0.05 and $0.03 increases, respectively should be considered. Even at a rate of $0.06 per gallon, an increase in the city gas tax will produce about $650,000 in revenue per year for Tigard (Figure 2). Portland's gas tax is $0.10 per gallon, but only narrowly passed in 2016 (51.6% to 48.4%). Having a tax slightly below this rate may improve the chances of citizens adopting the bill.

| City Gas Tax Increase | | |
|---|---|---|
| Current Rate | $ | 0.03 |
| Proposed Rate | $ | 0.08 |
| **New Revenue** | **$** | **540,000** |

*Figure 2: City Gas Tax Increase*

### Electricity Consumption Tax

With the recent passage of SB 978, the Oregon Public Utilities Commission has until September 2018 to submit recommended changes to the regulatory system to recognize "changing industry trends," (e.g., AVs and smart roads). The city of Tigard must seize this opportunity to advocate for an energy consumption tax to ensure the city can update and maintain its energy grid. Such a tax would service both the general fund and transportation-specific expenditures to reflect changing demands on city infrastructure, inclusive of transportation infrastructure. We recommend allocating one-third of revenue to the general fund and two-thirds to transportation.

We propose a consumption tax at a rate of $0.003/kWh, which is a 100% offset of the current city gas tax. For purposes of this report, this rate would apply to residential, commercial ,and industrial users. This report also assumes that while new technologies are anticipated to reduce energy consumption dramatically, the use of old technologies in tandem will offset the average energy use. For this reason, calculations used current energy use rates8.

Estimated annual revenue from each user would be: residential, $34; commercial, $200; and industrial, $1,550. Utilizing estimates of current residencies (19,897) and industrial users in the Hunziker Industrial Core and 72nd Avenue Industrial Corridor (300), estimated annual revenue from this tax would be $1,150,000 (Figure 2), 50% of the $2.3 million goal.

| Electricity Consumption Tax per User (at $0.003/kWh) | | | | | |
|---|---|---|---|---|---|
| **Users** | **Estimated Monthly Use (kWh)*** | **Estimated Monthly Revenue** | | **Estimated Annual Revenue** | |
| Residential | 957 | $ | 2.87 | $ | 34 |
| Commercial | 5,539 | $ | 16.62 | $ | 199 |
| Industrial | 42,933 | $ | 128.80 | $ | 1,546 |
| **Total** | **49,429** | | **148** | **$** | **1,779** |

* Electricity Local, "Tigard, OR Electricity Rates," Electricity Local, 2017, https://www.electricitylocal.com/states/oregon/tigard/.

*Figure 3: Electricity Consumption Tax per User*

### Street Maintenance Fee Increase

The city of Tigard could generate more revenue and better adhere to the benefits received principle by amending TMC 15.20 to transition its current Street Maintenance Fee structure to a zoned structure, allowing each zone to have different fees and rate increase thresholds. A lower fee for living or owning a business near transit will help incentivize transit use and allow the city to concentrate resources on more densely populated areas.

This action recommends creating two zones based on proximity to transit. The zones would be geo-fenced according to the station area communities identified in the City of Tigard's High Capacity Transit Use Plan for the Southwest Corridor. We make an assumption that each zone comprises 50% of the city of Tigard's chargeable units. However, actual distribution of residential and non-residential units in each zone may be different, and city land use experts could provide more accurate ratios.

At a 50-50 break, this option is expected to generate a total of $2.1 million, adding nearly $1,000,000 in new revenue, 43% of the goal to reach $2.3 million (Figure 4). Of note: for residents in Zone 2, this is a regressive fee that will affect lower-income residents.

| Street Maintenance Fees Per Unit: Zone 2, Transit Distant | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Revenue Source** | **Current Fee** | | **Proposed Rate Increase** | **New Fee** | | **Annual Total** | |
| Residential | $ | 6.69 | 16% | $ | 8.00 | $ | 96 |
| Non-Residential | $ | 2.19 | 13% | $ | 2.52 | $ | 30 |
| **Total** | **$** | **8.88** | | **$** | **10.52** | **$** | **126** |

*Figure 4: Street Maintenance Fees Per Unit: Zone 1, Close to Transit*

| Street Maintenance Fees Per Unit: Zone 1, Close to Transit | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Revenue Source** | **Current Fee** | | **Proposed Rate Increase** | **New Fee** | | **Annual Total** | |
| Residential | $ | 6.69 | 5% | $ | 7.02 | $ | 84 |
| Non-Residential | $ | 2.19 | 5% | $ | 2.30 | $ | 28 |
| **Total** | **$** | **8.88** | | **$** | **9.32** | **$** | **112** |

*Figure 5: Street Maintenance Fees Per Unit: Zone 2, Transit Distant*

## Private Charging Station Franchise Fee

Another innovative revenue source for the city of Tigard would be to allow private companies to supply charging stations at TriMet's three current park and ride centers: Christ the King Lutheran Church, Tigard Park and Ride, and Tigard Transit Center Park & Ride. Currently there are 353 parking spaces in these locations that could all be equipped with charging stations. If the city imposes a 5% franchise fee on the revenues that private companies receive from these charging stations, we estimate this would add $197,000 to the transportation budget (Figure 2), 25.5% of the $2.3 million goal.

**Charging Station Franchise Fees**

| Number of Stations | PGE Rate (kWh) | AV Battery Capacity (kWh) | Cars/Day | Franchise Fee |
|---|---|---|---|---|
| 1053 | $ 0.09 | 85 | 4 | $ 0.05 |
| Daily Revenue | $32,222 | | | |
| **Gross Annual Revenue** | **$11,760,957** | | | |
| **Total** | **$588,048** | | | |

*Figure 6: Charging Station Franchise Fees*

## Ride-share Franchise Fees

Franchise fees for ride-share companies and AV fleets would give access to dedicated pick-up zones and ride-share lanes on major thoroughfares as well as access to city transportation data. Using existing electricity franchise fees as a basis to structure this new fee, (the greater of 5% of revenue or $4,000), a ride-share franchise fee would be based on revenues from rides originating in Tigard. In this case, 50% adoption is rooted in Tigard's 19,000 residents who commute alone to work. According to a recent news article, Uber earns approximately $11.41 per 30-minute ride. Conservatively estimating that none of those individuals would be among the 14% of employed workers who live and work in Tigard, if the city collects only 1 ride per work-day (250 days per year), 5% of revenue raises $1,355,000 (Figure 3). This would be 57% of the $2.3 million goal.

**Rideshare Franchise Fee Calculation Estimates**

| Rideshare Revenue per Day* | Gross Annual Revenue | Franchise Fee (at 5%) |
|---|---|---|
| $ 108,395 | $ 27,098,750 | $ 1,354,938 |

*"How Much Do Uber Drivers Make in 2017?," Alvia.com (blog), January 6, 2017, http://www.alvia.com/how-much-do-uber-drivers-make/.

*Figure 7: Ride-share Franchise Fee Calculation Estimates*

## Ride-share Registration Fee

Additionally, the city of Tigard could serve residents and employers in the city well by requiring ride-share drivers to register with the city and pay a registration fee (Figure 5). An amount of $91 per year for ride-share drivers who drive 30 or more hours per week is aligned with current business license fees. Ride-share operators who drive 29 hours or less per week would pay half that fee ($45.50). Assuming full-time ride-share driving opportunities would most impact currently unemployed Tigard residents, unemployment would drop to 3% and revenues would

total $197,000. If 3% of the employed workforce drive part-time, registration revenues total $36,000 for total revenues of $233,000. This would be 9% of the revenue goal.

**Registration Fees for Rideshare Drivers**

| | Rideshare Full-time Drivers | Rideshare Parttime Drivers | Rideshare Full-time Registration Fee | Part-time Registration Fee |
|---|---|---|---|---|
| | 2,162 | 792 | $ 91.00 | $ 45.50 |
| Revenue | $196,754 | $36,028 | | |
| **Total** | **$232,782** | | | |

*Figure 8: Registration Fees for Ride-share Drivers*

## Recommendation

Based on our analysis of the revenue generated, as well as each package's impact on equity, neutrality, administration, productivity, certainty, and convenience (Figure 6), we recommend a revenue package the includes the Gas Tax, Electricity Tax, and Franchise Fees for Charging Stations. The combination would raise $1,887,000. The gas tax has low equity as it would have a regressive effect on Tigard citizens who lack means to upgrade their automobile to a newer, cleaner engines. However, the tax is productive, certain (once it passes), and convenient. In the short-term, adoption of AVs in a small suburban town will be slower than in downtown Portland, and this option may generate significant new revenue. Of concern, taxes need voter approval, and an increased gas tax has already been voted down.

The electricity tax is somewhat inequitable as residents and small businesses that cannot upgrade to more energy-efficient structures and appliances will eventually pay proportionally more than other payers. As this tax would be collected and remitted by the utility, it is administratively efficient. Revenues raised from this option exceed $1.85 million, half of the transportation revenue shortfall. A change to current Oregon law may be necessary, and a tax requires a vote. Even so, the strain on PGE's system due to system-wide increased use of the electrical grid may encourage taxpayers to consider a tax if put before them.

Because increased use of EVs will strain the power grid, charging franchise fees that offer companies the right-of-way to access the grid may work in both directions. Franchising charging stations to private vendor may be efficient, moving operating responsibility to the private sector. There is not enough data to know. Mechanisms to collect franchise fees exist, and every 350 stations garners an expected revenue of approximately $200,000. New parking structures planned for along I-5 in Tigard could transition to fleet housing stations leased by AV companies like Uber and Lyft, fees could run upwards of $1 million. Current charging stations are not operated by private entities, this would require a new model for this market.

We estimate this option would raise about $1.8 million in revenue, which would not meet the revenue deficit of $2.3 million, and provide revenue for the Capital Improvement Plan and possibly a business education and innovation fund for the automotive sector. This plan has some issues with political feasibility, but we feel as though this easily overcome through thoughtful education on the benefits AVs will have for the city of Tigard.

# Appendix A – Proposed Packages

| Revenue Source | Current Amount (rounded) | 10% reduction | 50% reduction | 90% reduction | Why does it matter? |
|---|---|---|---|---|---|
| **State Motor Vehicle Fund** | $3,000,000 | $2,700,000 | $1,500,000 | $300,000 | The fund is comprised of state gas taxes at $0.30 per gallon, large truck weight-mile fees, and vehicle registration fees. Gas taxes and registration fees will either be eliminated or decreased by AVs and ride-share models. |
| **City Gas Tax** | $650,000 | $585,000 | $325,000 | $65,000 | AVs are projected to be electric, so gas usage will drastically decrease. While currently assessed as a bond measure for specific projects, the gas tax could be revisited in future. |
| **Washington County Gas Tax** | $200,000 | $180,000 | $100,000 | $20,000 | Washington County imposes a $0.01/gallon tax. Forty percent of the gross is redistributed to the cities based on population. This revenue will significantly decline if AVs are electric. |
| **Traffic Fines** | $715,000 | $643,500 | $357,500 | $71,500 | AVs will always obey the law, so they won't pay traffic or parking tickets. |
| **"Distracted Driver" education course** | $8,500 | $7,650 | $4,250 | $850 | A decrease in drivers (and collisions) will make remedial lessons unhelpful. |
| **Vehicle Release Fees** | $13,500 | $12,150 | $6,750 | $1,350 | AVs will be less often be impounded for violations, so towing fees will decline. |
| **Total** | $4,587,000 | $4,128,300 | $2,293,500 | $458,700 | |

*Figure 9. Revenues Lost (FY 2016)*

| Program | Reasoning | Execution | Calculations | Assumptions |
|---|---|---|---|---|
| Franchise fees for private electric charging | Expected income: $588,000 for 1053 charging stations at current franchise rate 5%. | Allow private companies to supply the charging stations at TriMet's 3 current park and ride centers: Christ the King Lutheran Church, Tigard Park and Ride, and Tigard Transit Center Park & Ride. Currently there are 353 parking spaces in these locations that could all be equipped with charging stations. In addition the city can impose franchise fees on two planned mega structures that we estimate will have 700 parking spaces. | 85 Kwh x 4 cars = 340 Kwh / day;<br><br>340 Kwh x 1053 stations = 358,020 Kwh / day;<br><br>358,020 Kwh x $0.09 / Kwh = $32,221 / day;<br><br>$32,221 x 365 days = $11,760,957 / year;<br><br>$11,760,957 x 0.05% = **$588,048 / year** | Battery capacity: 85 Kwh<br><br>Cars / day: 4<br><br>Stations: 1053<br><br>Price / Kwh: $0.09<br><br>Days: 365<br><br>Franchise fee: 5% |
| Increase City Gas Tax (CGT) | We want to incentivize people to move toward electric. "Sin Tax". | Raise it to either $0.08 (an amount previously proposed by city); or to $0.06 (may be more feasible). | $325,000 (50% reduction due to electric AVs) / $0.03 = 10,833,333 gallons / year<br><br>Increase $0.03 to $0.08: 10,833,333 gallons x $0.08 = **$866,666 / year**<br><br>Increase $0.03 to $0.06: 10,833,333 gallons x $0.06 = $649,999 / year | CGT revenue FY 2016: $325,000 (50% reduction)<br><br>Gallons / year: 10,833,333<br><br>CGT rate: $0.08 -OR- $0.06 |
| Electricity Tax | Compensates for lost gas tax revenue and increased strain on the city's electric grid with an electricity consumption tax. Could incentivize homeowners to invest in solar panels, or riders to switch to public transit/ride-share. | The city gas tax raises approx. $650,000 per year. A new electricity consumption tax of $0.003/kWh will raise a nearly equal amount through residential use, alone. Because this tax affects more than transportation, 2/3 would be allocated to Transportation costs, and 1/3 to the General Fund. | $0.003 / kWh<br>Average monthly use per user: Residential 957 kWh<br>Commercial 5,539 kWh<br>Industrial 42,933 kWh | Residential users: 20,000<br><br>Commercial users: unknown<br><br>Industrial users: 300<br><br>Days: 365 |

*Figure 10. Funding Package One*

| Program | Reasoning | Execution | Calculations | Assumptions |
|---|---|---|---|---|
| **Electricity Tax** | Compensates for lost gas tax revenue and increased strain on the city's electric grid with an electricity consumption tax. Could incentivize homeowners to invest in solar panels, or riders to switch to public transit/ ride-share. | The city gas tax raises approx. $650,000 per year. A new electricity consumption tax of $0.003/ kWh will raise a nearly equal amount through residential use, alone. Because this tax affects more than transportation, 2/3 would be allocated to Transportation costs, and 1/3 to the General Fund. | $0.003 / kWh<br>Average monthly use per user: Residential 957 kWh<br>Commercial 5,539 kWh<br>Industrial 42,933 kWh | Residential users: 20,000<br><br>Commercial users: unknown<br><br>Industrial users: 300<br><br>Days: 365 |
| **Ride-share Fees** | Franchise fees would be in exchange for access to dedicated pick-up zones and ride-share lanes on major thoroughfares as well as access to city transportation data. | A ride-share franchise fee would be based on revenues from rides originating in Tigard, targeting the nearly 85% of Tigard residents who commute to work in another city. | 50% adoption: 9,500 ride-share customers<br><br>9,500 x $11.41 x 0.05 = $5,420<br><br>$5,420 x 250 days =$1,355,000 / year | Franchise fee: 5%<br><br>Avg. 30-min Uber ride = $11.41<br><br>Commuters: 9,500 (50%)<br><br>Days: 250 (work days)<br><br>Assuming fee collection from 1 trip / commuter / day |

*Figure 11. Funding Package Two*

| Program | Reasoning | Execution | Calculations | Assumptions |
|---|---|---|---|---|
| **Electricity Tax** | Compensates for lost gas tax revenue and increased strain on the city's electric grid with an electricity consumption tax. Could incentivize homeowners to invest in solar panels, or riders to switch to public transit/ ride-share. | The city gas tax raises approx. $650,000 per year. A new electricity consumption tax of $0.003/kWh will raise a nearly equal amount through residential use, alone. Because this tax affects more than transportation, 2/3 would be allocated to Transportation costs, and 1/3 to the General Fund. | $0.003 / kWh<br>Average monthly use per user: Residential 957 kWh<br>Commercial 5,539 kWh<br>Industrial 42,933 kWh | Residential users: 20,000<br><br>Commercial users: unknown<br><br>Industrial users: 300<br><br>Days: 365 |
| **Street Maintenance Fee Increase** | Change the current Street Maintenance Fee to a 2-tiered structure. A lower fee for living or owning a business near transit will help incentivize transit use and allow the city to concentrate resources on more densely populated areas. | We recommend creating 2 zones based on proximity to transit. The zones would be geofenced according to the station area communities identified in the City of Tigard's High Capacity Transit Use Plan for the Southwest Corridor. Zone 1 would be close to transit, Zone 2 would be transit-distant. | Zone 1 = $1,156,000.<br>Zone 2 = $1,526,000<br>Total expected revenue = **$2,682,000.** | Zone 1: Residential fee increase: 5%, $6.69 to $7.02 / month; $80 to $84 / year<br>Non-residential increase: 5%, $2.30 / month; $26 to $27.60 / year<br>Zone 2: Residential fee increase: 23.6%, $6.69 / month to $8.00 / month; $96 / unit /year<br>Non-residential increase: 15% increase of $2.52 / month / unit; $30.22 / year |

*Figure 12. Funding Package Three*

| | | Revenue | Total |
|---|---|---|---|
| Ride-share Full-time Drivers | 2,162 | $196,742 | $232,778 |
| Ride-share Part-time Drivers | 792 | $36,036 | |
| Ride-share Full-time Registration Fee | $91.00 | | |
| Part-time Registration Fee | $45.50 | | |
| Percent of Workforce Working Part Time as Ride-share Drivers | 3.00% | | |
| Target of Unemployed to Be Employed through Ride-share | 97.00% | | |

Unemployment Source: https://www.census.gov/quickfacts/fact/table/tigardcityoregon/PST045216

*Figure 13. Revenue from Ride-share Driver Registrations*

| | Equity | Neutrality | Admin | Productivity | Certainty | Convenience | Total |
|---|---|---|---|---|---|---|---|
| **Package 1** | | | | | | | 68 |
| **Gas Tax Increase** | 1 | 1 | 2 | 4.5 | 5 | 5 | 20.5 |
| **Electricity Fee** | 2.5 | 4 | 1.5 | 5 | 5 | 5 | 23 |
| **Charging Station Franchise Fee** | 5 | 2.5 | 5 | 4 | 5 | 3 | 24.5 |
| **Package 2** | | | | | | | 57.5 |
| **Electricity Fee** | 1 | 1 | 2 | 4.5 | 5 | 5 | 18.5 |
| **Ride-share Franchise Fees** | 4.5 | 2.5 | 3 | 4 | 4 | 3 | 21 |
| **Ride-share Registration Fees** | 1 | 5 | 3 | 4 | 3 | 2 | 18 |
| **Package 3** | | | | | | | 66.8 |
| **Electricity Fee** | 2.5 | 4 | 1.5 | 5 | 5 | 5 | 23 |
| **Street Maintenance Fee Increase** | 2 | 3.5 | 2 | 5 | 5 | 5 | 21.5 |

*Figure 14. Analysis of Funding Package Options*

## Appendix B - Evaluation Criteria

Each revenue source and package was evaluated according to six criteria on a Likert scale of 1-5, in which 1 is low, poor, or undesirable; 2.5 is neutral; and 5 is high, good, or desirable.

- ***Equity***: How does the revenue source affect vertical or horizontal equity?
- ***Neutrality***: How does the revenue source change behavior?
- ***Administration***: Is the package politically feasible, efficient, and will administration be proportional to revenue?
- ***Productivity***: How sufficient and reliable is the revenue source?
- ***Certainty***: How evenly distributed is the revenue source?
- ***Convenience***: How easy to administer or collect is the revenue source?

## Appendix C - Considerations for the Future

Given its location at the intersection of several major thoroughfares, the city of Tigard is positioned to develop as the EV and AV hub of the Portland Metropolitan area. Existing plans for commuter parking garages can be leveraged to woo AV fleet providers for their overnight charging, cleaning, and maintenance. Education incentives and temporary tax abatements can be offered to the auto service businesses to retool and educate employees on AV and EV maintenance and repair. With planning and foresight, the city of Tigard can play a key role in the Portland Metropolitan area's transition to AV.

## Appendix D - Case Studies

When considering options for assessing local taxes on electricity consumption, the Commonwealth of Virginia and the city of Ashland, Oregon each offer very different opportunities worth exploring. In each of these scenarios, political will on a regional or state level is necessary for successful passage.

The Commonwealth of Virginia assesses a statewide energy consumption tax, special regulatory tax, and allows for local consumption tax in three tiers according to usage, (0-2,500 kWh; 2,501-50,000 kWh; >50,000 kWh). Taxes are collected by the power companies and remitted to the appropriate body. The statewide consumption tax rate ranges from $0.00102 to $0.00050/kWh. Local jurisdictions can assess consumption taxes within a range designated by the state. As technologies improve, revenues from this structure will diminish, much like a gas tax, and like a gas tax, change in technology will make it increasingly inequitable.

The city of Ashland has an Electric Users Tax, adding a 25% tax to all electric accounts. Revenues support city services through the General Fund and the Department of Electricity's budget for use in running and generating electric power. Ashland's average electricity rate is $0.01038/kWh, very close to Tigard's $0.01072/kWh. As a flat tax, this option is only equitable in the short-term, as low-income residents and small businesses will be the last to upgrade to energy efficient residential and commercial products. If adopted, subsidies and other incentives for small businesses and affordable housing units to upgrade infrastructure will be necessary and will not entirely solve the equity problem.

## Appendix E - Transportation Revenue Impacted by AVs

**Gas Fund Revenues**

| Description | 2016 Revised | 2017 Proposed | 2017 Approved | 2017 Adopted |
|---|---|---|---|---|
| Beginning Fund Balance | $1,659,000 | $985,270 | $1,980,000 | $1,980,000 |
| Street Lighting Fees | $4,692 | $12,000 | $12,000 | $12,000 |
| Fee In-Lie Bicycle Striping | $1,180 | $3,009 | $3,009 | $3,009 |
| Gas Tax | $2,880,000 | $2,912,000 | $2,912,000 | $2,912,000 |
| Other Gas Tax | $189,000 | $191,000 | $191,000 | $191,000 |
| Interest Earnings | $55,700 | $55,700 | $55,700 | $55,700 |
| Recovered Expenditures | $63,800 | $63,800 | $63,800 | $63,800 |
| Transfer In from Street Maintenance Fee | $100,000 | $150,000 | $150,000 | $150,000 |
| **Total Resources** | **$4,029,000** | **$5,367,000** | **$5,367,000** | **$5,367,000** |

*Figure 15: Gas Fund Revenues*

**Transportation CIP Fund Revenues**

| Description | 2016 Revised | 2017 Proposed | 2017 Approved | 2017 Adopted |
|---|---|---|---|---|
| Beginning Fund Balance | $379,000 | $167,000 | $167,000 | $167,000 |
| Federal Grants | $0 | $1,526,000 | $1,526,000 | $1,526,000 |
| State Grants | $0 | $1,080,000 | $1,080,000 | $1,080,000 |
| Grants- other | $0 | $41,000 | $41,000 | $41,000 |
| Other Revenue | $0 | $1,526,000 | $1,526,000 | $1,526,000 |
| Transfer In - Gas Tax Fund | $262,000 | $974,000 | $974,000 | $979,000 |
| Transfer In - City Gas Tax Fund | $0 | $330,000 | $330,000 | $330,000 |
| Transfer In - TDT Fund | $517,000 | $70,000 | $70,000 | $70,000 |
| Transfer In - Underground Utility | $319,000 | $245,000 | $245,000 | $319,000 |
| Transfer In - Transportation SDC | $10,000 | $220,000 | $220,000 | $220,000 |
| Transfer In - Stormwater Fund | $19,000 | $97,000 | $97,000 | $102,000 |
| Transfer In - Water Fund | $15,000 | $8,640 | $8,640 | $11,280 |
| **Total** | **$1,523,000** | **$7,549,000** | **$7,549,000** | **$7,637,000** |

*Figure 16: Transportation CIP Fund Revenues*

## Street Maintenance Fund

| | | |
|---|---|---|
| Miscellaneous Fees and Charges | $ | 2,239,103 |
| Interest earnings | $ | 2,043 |
| Miscellaneous (Recovered Expenditure | $ | 1,299 |
| **Total** | **$** | **2,242,445** |

*Figure 17: Street Maintenance Fund*

## City Gas Tax Fund

| | |
|---|---|
| Intergovernmental | 619,514 |
| Interest Earnings | 34,584 |
| Miscellaneous | 32,052 |
| **Total** | **686,150** |
| | |
| Transfers In | 200,000 |
| **Total Resources** | **1,084,276** |

*Figure 18: City Gas Tax Fund*

## Miscellaneous

| | |
|---|---|
| Distracted Driver Education Course | $25 per student; $8,503 total |
| Traffic Fines | $715,528 |
| Vehicle Release Fees | $125 each; $13,610 total |
| **Total** | **$737,641** |

*Figure 19: Miscellaneous*

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# Tualatin Group A: Innovative Revenue Options for Connected Autonomous Vehicles in Tualatin

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## Introduction

This report outlines the potential revenue impacts of connected automated vehicles (CAVs) on the city of Tualatin's transportation budget. It proposes innovative new policy concepts to replace anticipated revenue loss. The following analysis will examine these policy options and recommend a policy package.

This analysis is based on some major assumptions adopted for the purposes of modeling and comparing each policy option. The first assumption is that there will be 50% CAV adoption amounting to 6,800 electric CAVs in Tualatin, and the remaining cars will be traditional automobiles (75% electric and 25% gas) (Appendix B). Second, we assume 85% of the CAVs in operation will be shared, while only 15% of CAVs will be privately owned and operated by individuals or families.

Each policy is analyzed based on four criteria: equity, neutrality, efficiency, and productivity (See Appendix A for criteria definitions and policy analysis matrices) Each policy received a score in each category: 0 (poor/nonexistent), 1 (average), 2 (good). Each package received an average score in each category and a total average score. These numbers are used to compare the packages and their respective strengths and weaknesses.

Proposed revenue policy options fall into three packages (See Appendix B for projected Revenues):

- Environmental Package – $7.3 million in revenue – Promotes sustainable transportation
- Metro Package – $23.2 million in revenue – Regional or statewide implementation
- Innovation Package – $9.4 million in revenue – Capitalizes on innovative new businesses

## Environmental Package - $13.97 Million

The environmental package contains a collection of policies that promote sustainable transportation options by incentivizing electric and shared vehicles. These revenue policies also disincentivize fuel-based vehicles and single-occupancy cars.

### Policy 1: Charging Station Fees

Fees for charging stations are a pay-for-use system. Vehicles parked at charging stations are often assessed a parking fee in addition to the charging station fee (Department of Energy, 2017). Cities can incentivize electric CAVs by developing electric-friendly infrastructure with charging stations in cities, rural areas, and along highways and interstates (Davidov & Pantoš, 2017). Smart, connected AV networks can guide cars to the most efficient charging station locations and prevent charging station queue congestion. Electric charging station fees could set a leasing framework with a wide variety of private companies at a set rate of payment to the city. This would require a consistent payment structure for citizens.

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| **Score** | 1 | 0 | 2 | 2 |
| **Explanation** | Fees for use of charging stations burdens those who use them. Will burden low-income people disproportionately. | Expanding electric charging station infrastructure and encouraging use through smart networks will influence market behavior. | After the initial infrastructure development, fees will be inexpensive to administer and be reliable for consumers. | Charging a flat fee per charging station will result in a high yield per low administrative cost. |

*Figure 1: Charging Station Fees*

## Policy 2: CAV Registration Fees

CAV owners pay a fee for initial car registration, license plates, and tag renewal. Fleet vehicles are charged a different rate and all fleet vehicles can be renewed at the same time. Additional registration fees can be assessed through county ordinance, collected by the state Department of Motor Vehicles, and disbursed through the State Highway Fund (League of Oregon Cities, 2016). These additional fees can fund dedicated CAV infrastructure maintenance and repair. Washington County will begin charging a $30 Conditional Vehicle Registration fee in 2018. The county expects to generate up to $8.1 million annually from the new fee (Washington County, 2013).

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| **Score** | 1 | 2 | 2 | 2 |
| **Explanation** | The burden of registration fees falls on car owners with some cost passed on to consumers. The benefits received structure of this policy is equitably vertical. | This policy has little to no effect on the private marketplace. | Administration of future registration fees will be efficient to implement due to existing fee collection structure. | This policy generates a high revenue at a relatively low administration cost. |

*Figure 2: CAV Registration Fees*

## Policy 3: Fossil Fuel Fees

Car owners registering fossil fuel vehicles pay an additional $15 annual operating fee to account for negative externalities and to disincentivize use of gasoline-based vehicles. The FFF is levied in addition to the Washington County $30 Conditional Vehicle Registration Fee, charging every diesel or gasoline-based vehicle in the Washington County an additional $15 per vehicle. Vehicles achieving fewer than 25 MPG on highways pay an additional $15. It excludes tractors and other vehicles primarily used for agricultural purposes. Hybrid gas/electric vehicles would be excluded if they are primarily electric. The total annual yield of this fee would be $58,650 (Appendix B).

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| Score | 0 | 0 | 2 | 1 |
| Explanation | Burdens fossil- fuel powered vehicle owners. Flat fee is regressive. Reduces negative externalities associated with fossil fuels. | Interferes with the economic market. Disincentivizes fossil-fuel vehicles and subsidies electric vehicles. | Highly efficient. Easy compliance for government and residents. | Yield high compared with cost of implementation. Administrative costs low. |

*Figure 3: Fossil Fuel Fees*

## Policy 4: Cordon- and Area- Pricing

Congestion pricing plans—otherwise known as tolls, variable lane pricing, cordon pricing, and area pricing—build the true cost of road usage into transportation pricing. In a world of CAVs, road congestion will be systematically coordinated. Congestion pricing would be a transportation revenue solution whether or not CAVs increase (as some speculate) or decrease (as others assume) congestion overall. The Federal Highway Administration outlines several forms of congestion pricing (USDOT, 2006). Cordons are one-time charges to drive within or into a congested area within a city. These are easily adopted through the vehicle-to-infrastructure communications network that will be available with CAV technology (Liu, Zhang, Wang, 2017).

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| **Score** | 1 | 2 | 2 | 1 |
| **Explanation** | Follows benefits received-principle. Initially burdens low-income people. | Interferes in the market to reduce congestion. Interference balanced with significant money invested in congestion areas. | Revenue collected through existing systems in CAVs | Significant revenue in large cities. Difficult to implement and productivity in smaller areas unclear. |

*Figure 4: Cordon and Area Pricing*

## Metro Package - $26.33 Million

The Metro Package is a group of policies that would be most productive when implemented regionally. This package recognizes the value of Tualatin's regional relationships, its high number of commuters, and the administrative challenges associated with implementing some of these policies at a local level. Many of the policies included in the Metro Package involve large-scale agreements with private companies, fees that are already assessed at a regional or state level, and/or are related to activities that occur both within and beyond the City of Tualatin's borders.

### Policy 1: GPS and Data Fees

One major technological focus in CAV implementation is the fine-tuning of internal Global Positioning Systems (GPS) and other data-reliant programming. To ensure that CAVs can perform even basic functions related to safe navigation and traffic prediction, each device will initially consume large amounts of data (the CEO of Intel predicts that the average CAV driving just one hour per day will use roughly 4,000 GB of data (Nelson 2016), which will in turn create opportunities for partnership between data industries and cities in which CAVs operate. Tualatin may wish to consider proposing a partnership where a provider is given priority as a data and GPS provider, and in return, they pay a percentage of their revenue to the city. For example, Boston has chosen to strategically share updated traffic light patterns with Waze, who can then alter routes and improve travel efficiency (Stern, 2016). Several other cities have consulted with Waze to inform infrastructure improvements through reports and tips from application users (Waze, 2017)

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| **Score** | 2 | 2 | 1 | 2 |
| **Explanation** | For fees, providers get majority control of local market. | Neutral except through real-time data feedback meant to adjust service delivery to users. | High administrative costs initially, but none for user compliance. | Staff administration necessary, but benefits received from the policy should override administrative costs.. |

*Figure 5: GPS and Data Fees*

### Policy 2: Registration Fees (see Environmental Package)

This policy structure and implementation would remain the same as described in the Environmental Package. There is potential for additional registration fees at the regional level, which could increase revenue for both county and city CAV infrastructure maintenance and development.

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| **Score** | 1 | 2 | 2 | 2 |
| **Explanation** | See Environmental Package | | | |

*Table 109: Registration Fees*

### Policy 3: Local-Regional Variable Lane Pricing ("Regional on-ramps/off-ramps")

Fees can be deducted for use of special local lanes that direct traffic from and to regional transportation systems. Since CAV technology is anticipated to integrate smaller into wider regional transportation networks (Guerra, 2015), variable lane pricing strategies would be a realistic option for local governments receiving regional CAV commuters or freight. Regional transportation planners are testing fleets of automated freight (North Central Texas Council Of Governments, 2017) and Atlanta, San Francisco, and Seattle are modeling and scenario planning for CAVs. Pricing region-enabled lanes allows local governments to partner with regions. Several Tualatin transportation system segments as crucial to the regional system and are identified in the Tualatin's transportation plan, and these could be considered for variable pricing (City of Tualatin, 2013).

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| **Score** | 1 | 1 | 2 | 1 |
| **Explanation** | Based on the benefits-received principle. Oregon policy analysts suggest the burden falls on private vehicles (Cortright, 2017).<br>Intervenes in the market; yet there is market failure in unwanted social and upkeep costs of transit (Dieplinger & Furst, 2014).<br><br>Revenues from congestion pricing systems are efficiently collected from a variety of technologies built into the vehicle itself.<br><br>Local benefits for variable lane pricing regional transportation policy would be pooled with regional governance.. | | | |

*Figure 6: Local-Regional Variable Lane Pricing ("Regional on-ramps/off-ramps")*

### Policy 4: Statewide Electric Vehicle Miles Tax

This policy is currently being tested with 5,000 users by the Oregon Department of Transportation as a method to make up for the expected decline in statewide gas tax revenue (ODOT, 2017). A Vehicle Miles Tax (VMT) is assessed on vehicles per-miles-traveled. The Electric VMT requires owners of electric vehicles to pay for the infrastructure they use. It would be assessed annually by the Oregon Department of Transportation. Car owners report their odometer mileage. The proposed VMT is currently set at 1.5 cents/mile to match (roughly) Oregon's gas tax.

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| **Score** | 2 | 2 | 2 | 2 |
| **Explanation** | The VMT charges vehicles proportionately to their road usage. | This replaces the gas tax that vehicle owners are already accustomed to paying. | After connected infrastructure is in place, and with anticipated vehicle technology improvements, the VMT will be easy to comply with and easy to create. | The VMT has a high yield and, while initially administratively expensive, once the framework is in place the yield will strongly outweigh administrative costs. |

*Figure 7: Statewide Electric Vehicle Miles Tax*

### Policy 5: Mobile Business Tax

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| **Score** | 2 | 2 | 1 | 2 |
| **Explanation** | See Innovation package. | | | |

*Figure 8: Mobile Business Tax*

## Innovation Package - $16.13 Million

The Innovation Package identifies and relies on new ideas, infrastructure, and development to help fund transportation-related costs in Tualatin. The package aims to find creative ways to charge businesses and developers operating in the entirely new sphere of automated vehicle-related businesses.

### Policy 1: Charging Stations (see Environmental Package)

Charging station policy structure will remain the same as in the Environmental Package with one possible addition. Future charging stations may use wireless, drive-over quick charging technology.

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| Score | 1 | 0 | 2 | 2 |
| Explanation | See Environmental Package | | | |

*Figure 9: Charging Stations*

### Policy 2: GPS and Data Fees (see Metro Package)

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| Score | 2 | 2 | 1 | 2 |
| Explanation | See Metro Package | | | |

*Figure 10: GPS and Data Fees*

## Policy 3: Mobile Business Fee ("Pizza Tax")

The advent of CAVs will allow for people to reallocate travel time formerly spent driving (or paying attention to the road) to new experiences. The emergence of this new marketplace allows for cities to collect income tax revenue from mobile businesses. Even if there is no brick and mortar headquarters for the business, workers in this new industry will be taxed in accordance with Oregon statute. As no sales tax exists in Oregon, the collection of income tax will be the primary source of revenue from the emergence of this market.

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| Score | 2 | 2 | 1 | 2 |
| Explanation | Income tax of this kind is progressive, and so would be considered equitable.<br>Taxpayers and consumers would be unlikely to change their behaviors if income tax was generated on mobile businesses.<br>Cost of administering the income tax would not be much different than it is for collecting sales tax from current businesses.<br>Proactively encouraging innovation for mobile businesses is highly productive as an economy-boosting industry emerges. | | | |

*Figure 11: Mobile Business Fee ("Pizza Tax")*

## Policy 4: Drop-Off Zone Fee: Business DOZ Fee and CAV DOZ Fee

In an automated world, on-street parking will mostly be replaced by drop-off and pick-up zones (DOZs) (Clark et al., 2017). Automated vehicles will perform curbside interactions with people and goods. Instead of relying on parking fines and business-funded parking spaces in the downtown core, Tualatin can levy fees on usage of curbside DOZs.

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| Score | 2 | 2 | 1 | 2 |
| Explanation | This fee is highly equitable as it is also proportional to the needs and usage of the DOZ spaces. | DOZ fees are designed to be responsive to the needs for drop off zones. They are unlikely to interfere in the private market in a substantial way. | Businesses are already paying annual fees for parking, so switching to annual DOZ fees instead will not require challenges for the businesses or government. | After the initial costs of infrastructure and administration, DOZ fees are high yield and inexpensive to administer. |

*Figure 12: Drop-Off Zone Fee: Business DOZ Fee and CAV DOZ fee*

## Policy 5: Automated Vehicle Development Charges (CAVDC)

CAVDCs are similar to SDCs, but are dedicated to AV-related development or connected facilities, structures, and streets. The revenue will go into funds for updating transportation-related city infrastructure. The upfront costs of CAVDCs involve determining charge levels for development.

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| Score | 2 | 1 | 2 | 2 |
| Explanation | The CAVDC incidence is on private developers, who are also those that benefit from connected city infrastructure. | Private developers expect to pay SDCs. However, Tualatin could be disadvantaged if other cities in the region are subsidizing CAV-related infrastructure or not charging CAVDCs. | CAVDCs are simple for the government to assess and administer and for developers to pay, since the system is already in place with SDCs. | The policy is simple to administer and brings in a comparatively high yield. |

*Figure 13*: Automated Vehicle Development Charges (CAVDC)

### Policy 6: Registration Fees (see Environmental Package)

The registration fees and fee collection structure would remain the same as described in the Environmental package. An additional fee could be collected through the introduction of electronic "smart" license plates, which would initially be more expensive but would retain the same yearly or bi-annual fee structure.

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| Score | 1 | 2 | 2 | 2 |
| Explanation | See Environmental Package. | | | |

*Figure 14: Registration Fees*

## Summary of Findings

### Revenue generation

The city of Tualatin currently receives approximately $14.63 million in annual transportation-related revenue. If we operate on the assumption that some of this revenue will continue to accrue annually, while some revenue sources will be greatly reduced or eliminated. Using the 50% CAV replacement assumption, we will also assume that the revenue loss will be at least 50%. For this reason, our goal is to create policy packages that yield at least $7.3 million. Annual policy yields and package totals can be seen in Appendix B.

- Environmental Package $7.3 million in revenue
- Metro Package $23.2 million in revenue
- Innovation Package $9.4 million in revenue

### Analysis

Overall, we find the Metro Package and the Innovation Package yield similar results in terms of their policy outcomes. The Metro Package average score is a 6.8/8, and the Innovation Package average score is 6.7/8. The Environmental Package lags behind with an average score of 5/8. Evaluation scores for each policy and package can be found in Appendix A. The Metro Package performed nearly equally well on each category, alternating between scores of 1.6/2 and 1.8/2. This package yields the strongest results overall in both policy analysis (with its highest score and strong results throughout) and in revenue generated. The Metro Package generates $23 million annually for the city of Tualatin, largely due to the Statewide Vehicle Mile Tax generating an expected $20 million annually.

### Recommendation

After an analysis of each package (Appendix A), we recommend the Innovation Package, as it is the best performing package that the city of Tualatin can implement within its own borders. We also recommend that the city of Tualatin pursues policies within the Metro Package in partnership with regional and statewide stakeholders. Implementing the Innovation Package, with support from Metro Package policies, will ensure the city of Tualatin thrives in the new CAV-based economy.

## Further exploration

### Case studies

We came across several case studies in the course of our research for this project. We recommend that staff considering implementing policies contained in this report review these cases, as they provide additional and detailed insight. All cases are cited in the references section of the appendix.

- OReGO - Oregon's vehicle miles tax pilot study with 5,000 participants (ongoing).
- California Road Charge Pilot Program - California's VMT study of 5,000 participants using simulated payments.
- Stockholm's Area Congestion Pricing System - none cordons within the inner city produced an area pricing model adaptable for CAVs.
- Gothenburg's Variable Lane Congestion Pricing System - variable lane pricing coordinated with regional transit authorities (Börjesson & Kristofferson, 2015).
- The Rethinkx Project - envisions the future of highly competitive mobile business opportunities.
- Waze - Boston collaboration with Google GPS system (ongoing).

### Future Research

- Innovative research and pilot projects worth investigating further. All future research cited in references.
- Drive-over quick charge technology - pilot project implemented in Seoul, South Korea (ongoing).
- Las Vegas is piloting automated vehicles for public transportation with a driverless shuttle transporting passengers on the Strip (Akers, 2017).
- Regional Congestion Pricing Models - Regional congestion pricing modeling that would account for local "off-ramps" in a regional system (see De Lara, de Palma, Kilani & Piperno (2013).

## Appendix A: Policy Analysis Matrices

The criteria of equity, neutrality, efficiency, and productivity (ENEP) are defined as follows (Bland, p. 27-28, 40):

- **Equity:** fair distribution of the tax burden and the benefits from public services - it burdens the people it benefits (divided into horizontal equity, or the distribution of tax burden in comparable circumstances, and vertical equity, which varies across the spectrum of income)
- **Neutrality** - Interference of tax policies in private marketplace
- **Efficiency** - Government's cost to administer taxes and the taxpayer's cost to comply with them
- **Productivity** - How much the revenue source yields, especially when compared to administrative costs

Ratings are on a scale of 0-2: 0 (poor/nonexistent), 1 (average), 2 (good)

**ENVIRONMENTAL PACKAGE -** lowest impact with most sharing and least fuel-based vehicles

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| Charging Stations | 1 | 0 | 2 | 2 |
| Registration fees | 1 | 2 | 2 | 2 |
| Fossil Fuel Fees | 0 | 0 | 2 | 1 |
| Cordon Charges/ Electronic Road Pricing | 1 | 1 | 2 | 1 |
| Total | 3 | 3 | 8 | 6 |
| Average | .75 | .75 | 2 | 1.5 |
| **TOTAL VALUE: 5** | | | | |

*Figure 15: Environmental Package*

**METRO PACKAGE -** regional cooperation (things that would be best administered at a state or county or regional level)

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| GPS Data | 2 | 2 | 1 | 2 |
| Registration fees | 1 | 2 | 2 | 2 |
| Regional on-ramps/off-ramps | 1 | 1 | 2 | 1 |
| Statewide Electric Vehicle Miles Tax | 2 | 2 | 2 | 2 |
| Pizza Tax (mobile business fee) | 2 | 2 | 1 | 2 |
| Total | 8 | 9 | 8 | 9 |
| Average | 1.6 | 1.8 | 1.6 | 1.8 |
| **TOTAL VALUE: 6.8** | | | | |

*Figure 16: Metro Package*

**INNOVATION PACKAGE -** relies on new ideas and development to help fund transportation-related costs in Tualatin

| | Equity | Neutrality | Efficiency | Productivity |
|---|---|---|---|---|
| Charging Stations | 1 | 0 | 2 | 2 |
| GPS & data fees | 2 | 2 | 1 | 2 |
| Pizza Tax (mobile business fee) | 2 | 2 | 1 | 2 |
| Drop off zones | 2 | 2 | 1 | 2 |
| Automated Vehicle Development Charge (AVDC) | 2 | 1 | 2 | 2 |
| Registration fees | 1 | 2 | 2 | 2 |
| Total | 10 | 9 | 9 | 12 |
| Average | 1.7 | 1.5 | 1.5 | 2 |
| **TOTAL VALUE: 6.7** | | | | |

*Figure 17: Innovation Package*

## Appendix B: Total Revenue Generated

**Revenue goal:** $7.3 million (based on 50% revenue loss)

| PACKAGE | Revenue option | Revenue generated |
|---|---|---|
| ENVIRONMENTAL PACKAGE | | |
| | Charging Stations | $3,540,250 |
| | CAV Registration | $998,580 |
| | Fossil Fuel | $58,650 |
| | Cordon- and Area- Pricing | $2,737,500 |
| | TOTAL | $7,324,980 |
| METRO PACKAGE | | |
| | GPS/Data | $51,000 |
| | CAV Registration | $998,580 |
| | Local-Regional Variable Lane Pricing | $1,529,715 |
| | Statewide Electric Vehicle Miles Tax | $20,355,630 |
| | Pizza Tax (Mobile Business Fee) | $300,000 |
| | TOTAL | $23,234,925 |
| INNOVATION PACKAGE | | |
| | Charging Stations | $3,540,250 |
| | GPS/Data | $51,000 |
| | Pizza Tax (Mobile Business Fee) | $300,000 |
| | Automated Vehicle Development Charges | $3,985,000 |
| | Drop-Off Zones | $623,355 |
| | CAV Registration | $998,580 |
| | TOTAL | $9,488,185 |

*Figure 18: Revenue generated:*

## Appendix C: Arriving At Assumptions

Assumption: CAVs in Tualatin: 6,800

Total vehicles including trad-autos: 13,600

### STEP 1: Finding number of cars that operate in Tualatin

Number of vehicles registered in Washington County in 2016: 532,117 (OR DMV, 2016)
Number of households in Washington County: 206,426 (QuickFacts, 2016)
Vehicles divided by households = 2.6 vehicles per household in Washington County
10,740 households in Tualatin (QuickFacts, 2016), multiplied by 2.6 vehicles
= 27,924 vehicles in Tualatin = 28,000 rounded

### STEP 2: Finding current percentage of cars in US that operate in Tualatin

Assume 28,000 cars in Tualatin currently
Assume 263.6 M cars in United States currently (Statista, 2016)
263.6M/28,000= 0.0000106 = Tualatin operates .00106% of the cars in USA

### STEP 3: Using CAV assumption from Eno Center for Transportation (Eno, 2013)

Number of CAVs operating in US under this assumption (50%): 63.7 M
x (.0000106) = 6,766 CAVs operating under these assumptions = 6,800 rounded
Annual VMT to Tualatin = (0.015 x total electric miles driven) x (Tualatin portion as a %)
Average U.S. miles per capita in 2014: 10,234 (Federal Highway Administration)
Number of electric vehicles in Tualatin:
6800 CAVs + (6800).50 non-CAVs = 10,200 electric vehicles total
Mileage increase for CAVs, based on Eno assumptions, is 20%
Average CAV miles: 10,234 + (10,234*.2) = 12,281

### Determining vehicle miles traveled (VMT):

Annual VMT to Tualatin = (0.015 x total electric miles driven) x (Tualatin portion as a %)
Average U.S. miles per capita in 2014: 10,234 (Federal Highway Administration)
Number of electric vehicles in Tualatin:
6800 CAVs + (6800).75 non-CAV electrics = 11,900 electric vehicles total
Mileage increase for CAVs, based on Eno assumptions, is 20%
Average U.S. miles per capita in 2014: 10,234 (Federal Highway Administration)
Average CAV miles: 10,234 + (10,234*.20) = 12,281
Yield (See Appendix C for assumptions):
Miles x .015
(Average CAV miles*CAVs + average electric non-CAV miles*cars) x (.015)
((12,281*6800) + (10,234*5100)) x 0.15 = **$20,355,630**

## Appendix D: Revenue Calculations

### Environmental Package Calculations

### Policy 1: Charging Station Fees

Charging fees can be calculated using the following formula:

(X number of charging stations)(number of electric cars)/20 = X charging stations per 20 vehicles

(X charging stations)(20 vehicles)(set rate) = Fee

(595 charging stations)(6800 CAV + 5100 non CAV)/20 = 354,025

(354,025)($10)= $3,540,250

### Policy 2: CAV Registration Fee

CAV registration can be calculated with the following formula:

Fleet Vehicles: (price per vehicle /20)(total number of vehicles)(Washington County Fee) = Registration fee

($87/2)(11,560)($30) = $849,660

Private Vehicles: (price per vehicle /20)(total number of vehicles)(Washington County Fee) = Registration fee

($86/2)(2,040)($30) = $148,920

$849,660 + $148,920 = $998,580

### Policy 3: Fossil Fuel Fee

If we assume that 6,800 non-CAVs are in operation in Tualatin, some percentage of these will be fossil fuel-based vehicles, but that percentage is unknown. For the purposes of this exercise, we will assume that 50% of traditional automobiles are fossil fuel-based, or 3,400. With 3,400 fossil fuel-based vehicles are in operation, the FFF would result in a minimum annual yield of $51,000 ($15 x 3,400). Assuming that 15% (510) of Washington County fossil fuel vehicles operate below 25 MPG, the total annual yield would be $58,650 (($15 x (3400-510))+($30 x 510)).

### Policy 4: Cordon- and Area-Pricing

Collection of congestion pricing fees currently takes place via devices signaling a vehicle's presence in a congestion-priced zone (de Palma, Lindsey, 2011). Fees are collected from accounts connected to registered vehicles. Tualatin's transportation system plan already calculates volume-delay functions between transportation zones throughout the entire city-wide network, and cordons and area pricing establish these zones in physical space to be revenue-generating (City of Tualatin, 2013).

The total cost of Q trips per hour is then TC = c(Q)Q (de Palma & Lindsey, 2011), from which a marginal social cost can be extracted from this measure, while cordons can be set up in segments of road marked in Tualatin's Transportation Plan as "centers" both for employment and residences, where management of demand is a priority, where the city has identified truck routes (11 currently exist), or where heavy vehicles are often used (City of Tualatin, 2013, 55).

The impact on revenue R can be calculated by taking the amount of throughput A and multiplying it by the charge X: A*X = R. This example sets up cordons for entering two of the road segments in Tualatin with the highest-volume traffic at peak hours (specified in City of Tualatin, 2013, Appendix B, page 21), SW Tualatin-Sherwood Road (West of SW 124th Avenue) and SW Boones Ferry Road (North of SW Sagert Street). 26,600 and 14,300 cars pass-through these segments respectively each day. Peak times can be taken from peak hours already specified in the Transportation Plan (4-5pm and 5pm-6pm) or when traffic volume reaches near 1,500 and 1,000 cars per hour in each direction respectively, which currently would leave 10 hours of peak traffic (6-8am and 11am-6pm) x 1,500 and 5 hours of peak traffic (7am-8am and 3-6pm) x 1,000 respectively, or roughly 15,000 + 5,000 or 20,000 cars through these segments. If 50% of these cars were CAVs, assuming $1.00 cordon charge, 7,500*$100 = $7,500 a day yield and $2.74 million per year.

## Metro Package Calculations

### Policy 1: GPS and Data Fees

It is difficult to calculate the value of 4,000 GB of data, considering how integral data will be to the CAVs themselves). Using the baseline AT&T and Verizon cell phone charge of $355 per 50 GB, 4,000 GB of data would cost $26,800 for just one hour of driving per day (Louis, 2013). Obvious strides must be made in the ways we approach data storage and sharing before we can adapt to the needs of CAVs, however, data companies stand to make a lot of money in providing this service to the CAV market. As such, charging data corporation partners a 0.5% monthly fee per CAV, would generate sizeable revenue to the city in ways that will still be agreeable to the corporations.

For this policy we will assume that GPS systems will add an extra $5,000 to the purchase price of each vehicle. Factoring in maintenance for the systems and upgrades, a baseline of $1,000 might be spent on data and GPS features per CAV per year. Assuming that there are 6,800 CAVs on the road in Tualatin, each requiring a data package of some sort to operate, the following calculation determines the amount of potential revenue gained from this policy option:

6,800 x $1,500(.005)= $51,000.

### Policy 2: Registration Fees (see Environmental Package)

### Policy 3: Local-Regional Variable Lane Pricing ("Regional On-ramps/Off-ramps")

Metro has identified several transportation system segments as crucial to the regional system. These areas are also integrated into the 2040 Metro Regional plan, which targets them for regional significance, and are identified in Tualatin's Transportation Plan as priorities for transportation system management upgrades (City of Tualatin, 2013). These include West Boones Ferry Road, which has been marked for arterial corridor management; OR 99W from SW 124th Avenuee to SW Tualatin-Sherwood Road, which will receive projects that will provide real-time and forecasted regional traveler information; and the SW Tualatin and Sherwood Rodd corridor, which will receive signal systems which adapt to current roadway conditions in-line with regional transportation patterns. Each location is a prime area for regional CAV on-ramp and off-ramp lanes.

Methodologies for the yield of congestion pricing revenue have been extensively discussed above. These grow even more precise however when applied to variable lane pricing (de Palma & Lindsey, 2011). Algorithms based in real-time data collection can recommend pricing increases for uses of lanes based on traffic density patterns, as is the case in Minnesota's MnPASS system (Minnesota DOT 2015).

This can be calculated by the following formula:

Assuming simpler lane pricing models, however, like that of California's SR-91, tolls would vary between $1-5.50 depending on usage. At peak times, the calculation for local revenue alone can then be C cars traveling at peak times * toll rate R or C*R. Our analysis will assume $2 toll and would assume the two segments used above in cordon pricing as the two most significantly traveled segments in the local system, SW Tualatin-Sherwood Road west of SW 124th Avenue and SW Boones Ferry Road north of SW Sagert Street, both of which have links to the regional transportation system (City of Tualatin, 2015, Appendix B). Numbers for regional transit are not forthcoming, but we can assume that all freight traffic on these roads travels regionally will at least represent faithfully regional transit figures. Currently 11.5% of 26,000 daily cars and 8.4% of 14,300 daily vehicles travel on these segments, or 2,990 and 1,201 vehicles respectively, or 4,191 total. If 50% of these regional vehicles are CAVS, this yields 2,095 CAVs * $2.00 regional on-ramp (or off-ramp) charge or $4,191 daily and $1,529,715 yearly.

### Policy 4: Statewide Electric Vehicle Miles Tax

This can be calculated by the following formula (see Appendix C for assumptions):

(Average CAV miles*CAVs + average electric non-CAV miles*cars) x (0.015)

((12,281*6800) + (10,234*5100)) x 0.15 = $20,355,630

### Policy 5: Mobile Business Tax

See Innovation Package.

## Innovation Package Calculations

### Policy 1: Charging Stations (see Environmental Package)

### Policy 2: Mobile Business Fee ("Pizza Tax")

It will be important to consider permit and licensing procedures for mobile businesses, especially those serving food that will require periodic health and safety inspections. Jurisdictions may want to reconsider what constitutes zoning and building codes for mobile businesses, and ways in which revenue might be collected from the fees associated with each. At this moment we cannot determine the estimated revenue generated from an income tax of this sort, as the industry and corporate tax rate are likely to be vastly different in the future. For now, based on a 6% tax of $5 million gross corporate income tax, the best assumption to made at present is that income tax revenue will yield $300,000 annually.

### Policy 3: Drop-Off Zone Fee: Business DOZ Fee and CAV DOZ Fee

This can be calculated by the following formula*:*

The second part of the Drop-Off Zone Fee charges CAVs for every drop-off. CAVs are charged $0.50 when entering a DOZ, and after five minutes are charged an additional $1.00 per minute spent in the same drop-off zone. The fees are maintained in an account and paid monthly.

We can assume the Business DOZ Fee generates approximately the same annual revenue as the Core Area Parking District, which is $215,355.

It is difficult to calculate the yields of Drop-Off Zone Fee due to the unprecedented nature of Drop-Off Zones. If we assume that every CAV in operation (6,800) in Tualatin completes at least 10 drop-offs per month, with no charges beyond five minutes, the total annual revenue would be $408,000. This is a highly conservative estimate.

Drop-Off Zone Total Annual Revenue: $623,355

### Policy 4: Automated Vehicle Development Charges (CAVDC)

The yield for this policy is difficult to determine without knowing (1) the types of infrastructure that will need to be accounted for, (2) the assessment standards that will replace the Institute of Traffic Engineers (ITE) Code, and (3) the levels and frequency of development that will take place in Tualatin in the future. The current Transportation Development Tax Fund annual revenue is $7.97M, so if the CAVDC pulls in even half of that revenue, it will yield $3.985M. We will use this number as our best estimate of the CAVDC revenue generation.

This can be calculated by the following formula

(Fixture type 1)(Charge for type 1) + (Fixture type 2)(Charge for type 2) + ....

### Policy 5: Registration Fees

(see Environmental Package)

# Appendix E: Equity, Neutrality, Efficiency, Productivity (ENEP) Analyses

## Environmental Package ENEP Analysis

### Policy 1: Charging Station Fees

Equity - 1

Charging station fees are horizontally equitable and vertically inequitable. Fees for use of charging stations burden those who use or profit from the use of electric vehicles thus are horizontally equitable. Vertical equity is low as low-income people who own private vehicles will be disproportionately burdened by charging station fees.

Neutrality - 0

Increasing electric charging station infrastructure and encouraging use through smart networks will influence market behavior. Increased use of electric vehicles by individuals and fleet owners is likely.

Efficiency - 2

After the initial infrastructure development charging station is installed, fees will be inexpensive to administer and be reliable for consumers.

Productivity - 2

Charging a flat fee per charging station will result in a high yield per low administrative cost.

### Policy 2: CAV Registration Fee

Equity - 1

The burden of registration fees fall on those who own cars with some of the cost being passed on to consumers of shared vehicles through single use or monthly shared car fee. The benefits received structure of this policy is equitable vertically. This policy is somewhat inequitable due to the increased burden of low income consumers paying a larger percentage of their total earnings in registration fees.

Neutrality - 2

This policy has little to no effect on the private marketplace.

Efficiency - 2

Administration of future registration fees will be efficient to implement and operate due to existing registration fee collection structure.

Productivity - 2

This policy generates a high revenue at a relatively low administrative cost.

### Policy 3: Fossil Fuel Fee

Equity - 0

The Fossil Fuel Fee burdens owners of vehicles using diesel or gasoline, who may be lower income than those who have adopted more modern vehicle technologies. It is likely that owners of these types of vehicles will be lower income if they have not adopted the modern technologies. This, combined with a regressive flat fee having greater impacts on small budgets, places a greater burden on lower income individuals (poor vertical equity). Additionally, the Fossil Fuel Fee can be assessed equally on individuals who keep vehicles registered for infrequent use and individuals who use fossil fuel-based vehicles daily.

Additionally, the fee places an undue burden on people who own or maintain a fossil fuel-based vehicle but rarely use it, and does not place a proportional burden on those who drive these types of vehicles frequently (poor horizontal equity). Meanwhile, the policy benefits the entire community if it successfully contributes to reducing negative externalities associated with fossil fuels, so the burden is not evenly distributed among those who benefit.

Neutrality - 0

The policy interferes with the private marketplace by disincentivizing use of gasoline-based vehicles and acting as an electric vehicle subsidy for consumers. Electric vehicle subsidies at the county level are generally considered to create high levels of deadweight loss, compared with other electric vehicle incentive policies (Holland, et. al., 2016). Additionally, a Fossil Fuel Fee could reduce consumer demand for gasoline, impacting gas stations. Due to these market interferences, this policy receives the lowest score for neutrality.

Efficiency - 2

This policy is highly efficient, due to the ease of compliance for the government and residents. Registration fees already exist, and this would require very little additional effort by all parties.

Productivity - 1

The yield is good compared with the cost of implementation, but the overall yield is low due to how few fossil fuel-based vehicles are likely to be in operation. The administrative costs are very low because there is an existing framework for the county to charge annual registration fees. Initial administrative costs may include acquiring or creating a comprehensive list of vehicle types and their associated miles-per-gallon.

### Policy 4: Cordon- and Area-Pricing

Equity - 1

From an economic standpoint, congestion pricing has been seen by economists to have a basis in the benefits received principle, though it has been highly criticized for initially impacting low-income users (Grisolía, López & Ortúzar, 2015).

Neutrality - 1

CAVs will potentially reduce congestion, and increase traffic throughput by the increased use of shared trips. Congestion pricing therefore intervenes in the market to further reduce congestion. However, especially as an area-based fee, it recoups the significant amount of money invested in infrastructure in particular areas, allowing for the possibility that certain road segments will pay more for their use.

Efficiency – 2

The technology to receive revenue via congestion charges will be built into CAVs and is highly effective.

Productivity - 1

The yield from congestion pricing has been significant for areas like Stockholm, and increased funding for transportation investment and maintenance. Its implementation is difficult, from a political and from a technical standpoint. Further, its productivity in smaller areas is less clear.

## Metro Package ENEP Analysis

### Policy 1: GPS and Data Fees

Equity - 2

GPS and data fees would be paid for by big corporations agreed upon by the city of Tualatin

and/or an agreement with Metro or another regional agency. In return for paying this monthly fee, industry leaders in the field would be able to provide most of the technological services required for safe and effective CAV operation while having majority control of the market and enjoying the financial benefits associated with their position.

Neutrality - 2

Behavior of individuals would not be affected by this policy, unless throughout the partnership with a company such as Waze, taxpayers were asked to participate in providing feedback to the city (about transportation, infrastructure, their experience, etc.), which would alter their experience with the service (in a perhaps unfavorable way) and cause them to change their use of CAV technology.

Efficiency - 1

Administrative costs would be high initially. Partnerships with data companies will be beneficial in the long run. Tualatin should implement this tax early in order to provide companies with a mutually beneficial plan from the beginning of CAV adoption. It also would not cost taxpayers anything to comply with this policy, as they would use CAVs regardless of the amount being charged to the companies in control of them.

Productivity - 2

The main costs of administering this policy would occur in the collaboration period with the data and GPS company chosen. It would be necessary to have a liaison on staff to check in with both sides as necessary, but benefits received from the policy should override any minor costs incurred from administration.

### Policy 2: Registration Fees (see Environmental Package)

### Policy 3: Local-Regional Variable Lane Pricing ("Regional On-ramps/Off-ramps")

Equity - 1

From an economic standpoint, congestion pricing has been seen by economists to have a basis in the benefits-received principle. An analysis of its current variable lane pricing applicability in Oregon suggests the burden falls on the users who take more trips in their own private vehicles, and these tend to be higher income road users (Cortright, 2017).

Neutrality - 1

Especially with respect to toll roads and high occupancy lanes, congestion pricing intervenes heavily in a market that has taken un-priced road use to be a social benefit. However, proponents argue that there is significant market failure in failing to take into account unwanted social costs (Dieplinger & Furst, 2014).

Efficiency - 2

As discussed above, revenues from congestion pricing systems are efficiently collected from a variety of technologies built into the vehicle itself.

Productivity - 1

Local benefits for variable lane pricing regional transportation policy would be pooled with regional governance.

### Policy 4: Statewide Electric Vehicle Miles Tax

Equity - 2

The VMT charges vehicles proportionately for their road usage, so those who are charged the most are also those who use the roads the most. This policy is highly equitable.

Neutrality - 2

This policy has low levels of interference with private market forces, as it replaces the gas tax that vehicle owners are already accustomed to paying.

Efficiency - 2

The VMT is relatively straightforward to implement and to comply with.

Productivity - 2

The VMT has a high yield and low administrative costs.

### Policy 5: Mobile Business Tax

See Innovation Package.

## Innovation Package ENEP Analysis

### Policy 1: Charging Stations (see Environmental Package)

There is no expectation that the revenue will change significantly with changes in charging station technology.

### Policy 2: Mobile Business Fee ("Pizza Tax")

Equity - 2

Income tax of this kind is progressive, and so would be considered equitable.

Neutrality - 2

Taxpayers and consumers would be unlikely to change their behaviors if income tax was generated on mobile businesses. They would continue to use the service as they would and do for in-person and online consumption.

Efficiency - 1

Cost of administering the income tax would not be much different than it is for collecting sales tax from current businesses. However, more time will need to be spent deciding on the parameters within which mobile businesses operate according to their respective industry. It can be argued that this is an inevitable marketplace, and as such, administrative costs will eventually need to be allocated to outlining this new structure.

Productivity - 2

Being proactive in welcoming and encouraging innovation for mobile businesses is highly productive as an economy-boosting industry emerges in a space formerly unused.

### Policy 3: Drop-Off Zone Fee: Business DOZ Fee and CAV DOZ Fee

Equity - 2

The DOZ fees burden business owners and CAV owners, who are also the ones that benefit from efficient and easy-to-access drop off zones. This fee is highly equitable as it is also proportional to the needs and usage of these spaces.

Neutrality - 2

DOZ fees are implemented in response to market needs, and are designed to be responsive to the needs for drop off zones. They are unlikely to interfere in the private market in a substantial way.

Efficiency - 1

The policy requires new "connected" infrastructure to monitor drops, a mechanism to monitor

CAV usage, and to maintain and charge owner accounts by tracking individual CAVs. However, when DOZs are created the capital construction costs can include connectability, and CAV account tracking is likely to be a necessity in the new mobile and connected world. Businesses are already paying annual fees for parking, so switching to annual DOZ fees instead will not require challenges for the businesses or government. The policy involves high initial startup costs, but is relatively inexpensive to administer in the long-run.

Productivity - 2

After the initial costs of infrastructure and administration, DOZ fees are high yield and inexpensive to administer.

### Policy 4: Automated Vehicle Development Charges (CAVDC)

Equity - 2

The CAVDC incidence is on private developers, who are also those that benefit from being able to connect to existing city infrastructure. It operates on a benefits-received principle.

Neutrality - 1

The CAVDCs are unlikely to interfere in the private market, as private developers currently expect to pay system development charges. However, this policy does not receive the highest rating because it is possible that it could place Tualatin at a disadvantage if other cities in the region are subsidizing CAV-related infrastructure or not charging CAVDCs.

Efficiency - 2

CAVDCs are simple for the government to assess and administer and for developers to pay.

Productivity - 2The policy is simple to administer and brings in a comparatively high yield.

### Policy 5: Registration Fees (see Environmental Package)

## Appendix F: Tualatin Transportation Funding

Four funds provide transportation funding in Tualatin. These include:

- **Road Utility Fee Fund** - Fee funds maintenance of 78 miles of city streets' light/tree/frontage.
- **Transportation Development Tax (TDT) Fund** - One-time countywide charge that funds transportation capital projects by taxing new developments.
- **Road Operating Fund** - Gas tax and fees fund operations through Washington County and Oregon State Gas Tax and State Highway Trust Fund.
- **Core Area Parking District Fund** - Funds a parking district in downtown core by taxing downtown businesses.

The first three provide revenue primarily for new projects and maintain the current system. The fourth (the Core Area Parking District Fund) provides special district funding for downtown parking and landscaping improvements.

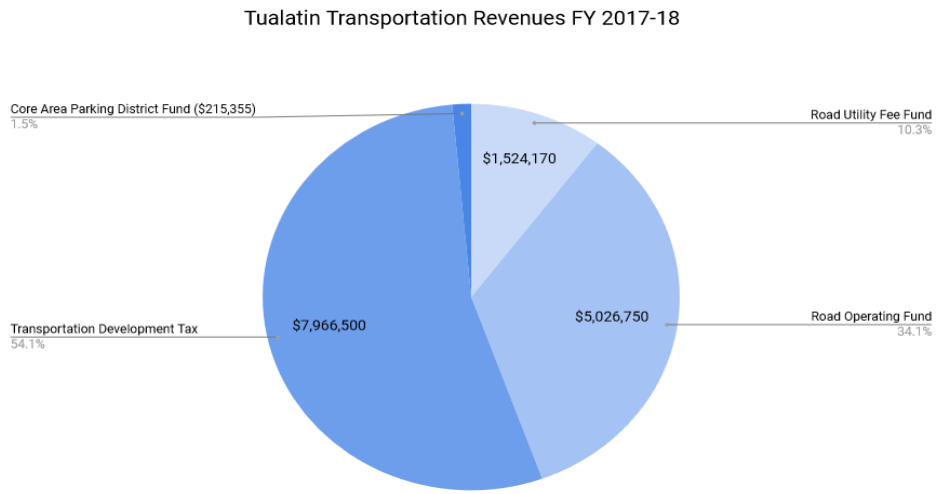


*Figure 19: Total Transportation Revenues (Figure 1)*

| Tualatin Transportation Revenues FY 2017-18 | | |
|---|---|---|
| Fund Name | FY 2017-18 Requirements | Percent |
| Road Utility Fee Fund | $1,524,170 | 10.3% |
| Road Operating Fund | $5,026,750 | 34.1% |
| Transportation Development Tax | $7,966,500 | 54.1% |
| Core Area Parking District Fund | $215,355 | 1.5% |

*Figure 20: Total Transportation Revenues (Table 1)*

## Potential Future Reductions in Revenues

As the graphs below demonstrate, AVs could have a very significant impact on transportation funds. Forecasts of AV implementation predict up to a 90% decrease in automobiles on the road in the coming decades.

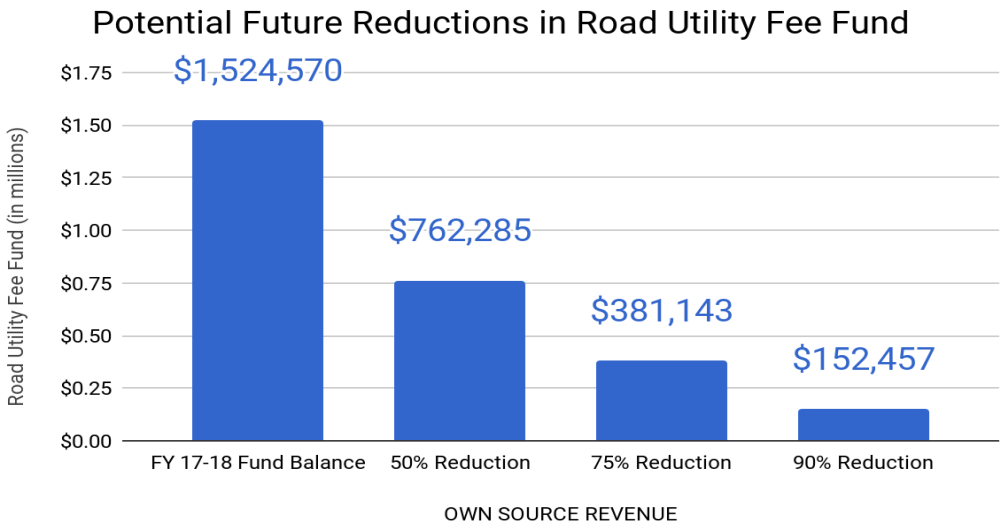


*Figure 20. Potential Future Reductions in Transportation Development Tax Fund*

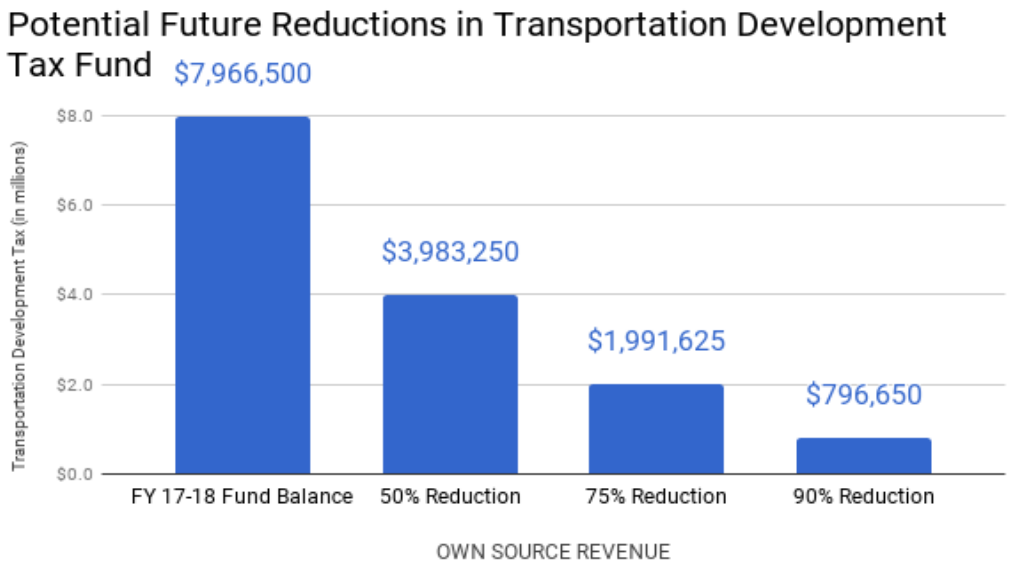


*Figure 21. Potential Future Reductions in Transportation Development Tax Fund*

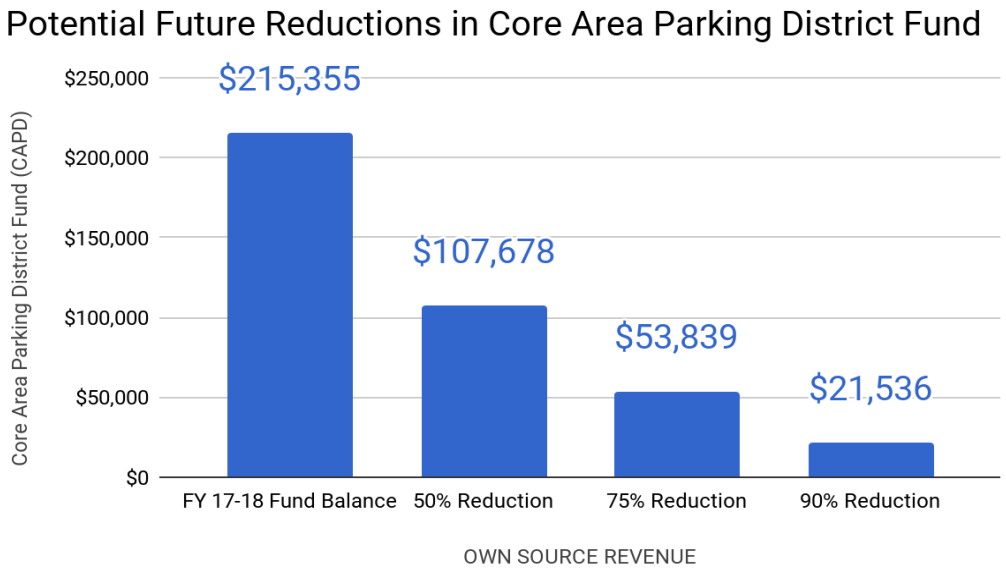


*Figure 22. Potential Future Reductions in Road Utility Fee Fund*

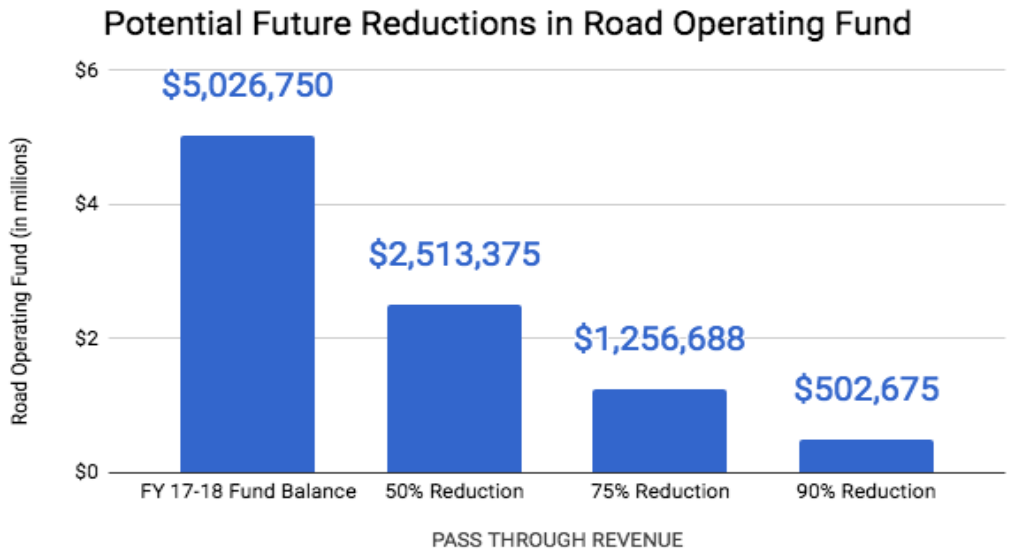


*Figure 23. Potential Future Reductions in Core Area Parking District Fund*

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# Tualatin Group B: Innovative Revenue Packages

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## Introduction

With autonomous vehicles (AVs) set to be operating on city streets as early as 2021 (Laura, 2017), there are multiple questions about what types of impacts they will have on everything from land use, to transportation behavior, to city budgets. The one thing every transportation expert agrees on is that cities need to start preparing for AVs now, so that changes from AVs fit the needs of their community (Fagnant & Kockleman, 2015).

This report examines the potential budget impacts of AVs for the city of Tualatin, Oregon. A city budget, along with outlining how revenue will be raised and spent, is also a declaration of how a city wants to invest in itself. In this sense, a budget is a plan for how a city will achieve community goals. With this in mind, the recommendations outlined in this report aim to take advantage of the changes brought by AVs to make Tualatin's vision of its future a reality.


*Figure 1: Tualatin Community Goals*

At the beginning of the 2017-2018 city budget, Tualatin highlighted the following community goals: Two of these goals relate directly to the transportation system and its funding:

- An affordable, livable, family-oriented, healthy, active, and safe community for all incomes, ages, and abilities.
- A funded transportation system that supports mobility, connectivity, and accessibility in all modes.

The final recommended revenue package was designed to support these goals and provide Tualatin with sufficient resources to create a transportation system that serves all members of their community.

## Background

Tualatin spans two counties, Washington and Clackamas, with a predominant portion of the city residing in Washington County. Washington County approaches transportation with a "three-legged stool" strategy (Washington County, 2016). Each leg represents a transportation goal: maintain current systems, address existing safety and capacity deficiencies, and keep up with growth. Each leg is funded by a different set of sources as shown in Appendix A, Figure 1. Oregon's Measure 5 and Measure 20 greatly limit Oregon localities' reliance on property taxes alone. The residents of Washington County voted for a special Transportation Development Tax, which is a system development charge (SDC) earmarked for transportation. The county, however, has diversified the funding to include a combination of gas tax and other fees to augment their transportation funding.

## Transportation Funding for Tualatin

The city of Tualatin collects transportation revenues from five main funds (see Appendix A, Figure 2):

- Road Utility Fee Fund
- Road Development Fund
- Transportation Development Tax Fund
- Core Area Parking District Fund
- Road Operating Fund

These funding sources are a mix of intergovernmental and city sources. Refer to Appendix A, Figure 3 for a complete list of transportation funding sources and their distinction between own source revenues and pass-through revenue sources.

Revenues from the Road Utility Fund, Transportation Development Tax Fund, and Core Area Parking District Fund are all own source. Revenues from the Road Operating Fund, which include state and county gas taxes, are pass-through sources. The total revenue related to transportation for the city of Tualatin is $14,732,775, which is 16% of the total operating budget for FY 2017-2018.

### Fiscal Impacts of Autonomous Vehicles

The expected benefits of AVs include expanded transportation access, lower costs to consumers, and greater safety for the community. However, these benefits will likely come accompanied with unintended consequences such as job and revenue loss for local governments. It is also expected that some "neutral" or "unknown" impacts will occur related to street redesign, the reshaping of downtown, open spaces instead of parking garages, and with the possibility of the entire sector transitioning from driving to supporting this technology. The Gas Tax and State Highway Trust Fund, Traffic Violation Fees, Washington County TDT,

Parking Fees from the Core Area Parking District, and Vehicle Impound Fees are all revenue sources that are expected to be impacted by advancements in AVs and shared use mobility companies (see Appendix A, Figure 4). The total amount of revenue that will potentially be impacted by advancements in autonomous vehicles is $3,746, 650, which is 25% of the total transportation budget (see Appendix A, Figure 5) (City of Tualatin, 2017-2018).

The effect on revenues is a based on the following assumptions:

Gas Tax

Assuming AVs will be electric, revenues from both state and county gas taxes will disappear. With the automobile industry already making a shift to electric vehicles, this revenue stream will decrease even if AVs are not widely adopted.

Parking Fees in the Core Area Parking District

The use of shared AVs will limit the use of parking lots by business patrons. The use reduction, lowers the benefit the Core Area Parking District businesses receive from paying for the maintenance of the lots, which means they will be unlikely to want to continue paying the current parking tax.

Traffic Violation Fees

Human error causes traffic violations. AVs will automatically follow all traffic rules, resulting in the elimination of current revenue from violations fees.

Vehicle Impound Fees

Impounding and towing of AVs is unexpected as they will never be improperly parked, except for the rare occurrence of a computational malfunction by the autonomous driving software.

State Highway Trust Fund

This fund includes vehicle registration fees. With shared autonomous fleets, fewer people will own cars, and therefore fewer cars will be registered.

Road Development Charges

This fund has not had revenues or expenditures for the past three fiscal years. If this fund is expected to be actively used in the future, the method for calculating these charges should be adapted to the use of AVs.

Washington County Transportation Development Tax (TDT)

AV impacts on this fund are also dependent on how this fee is calculated. Further information is needed to determine the magnitude of impact.

### Autonomous Vehicle Adoption Assumptions

Using AV adoption rate assumptions from the ENO Center for Transportation report ( ENO, 2013), we calculated the revenue impacts at a 10%, 50% and 90% adoption rate. For the purposes of this analysis we will be using the 90% adoption rate to understand potential revenue impacts and new revenue options (see Appendix A, Figure 6). We also will be using the assumption that at the 90% AV adoption rate, 50% of vehicles will be privately owned, while the other 50% will be operated in a shared fleet.

The funding packages proposed are estimated to raise more money than Tualatin currently allocates to transportation. AVs will require a predictable environment to operate effectively (Ng, A & Lin, Y, 2017) so road maintenance will need to be more frequent in the future. Additionally, widespread adoption of AVs provides opportunities to change the use of city streets. AVs will need less space for parking and can operate in narrower lanes, meaning that space can be reallocated for other uses. It is possible that the entire road system can be redesigned to better suit this future transportation system, but implementation will be

expensive. Additional transportation revenue will be necessary to fund both the design and construction.

## Evaluation Criteria

Five criteria were applied to potential revenue generation policies before a recommendation package was finalized. Revenue policies were evaluated based on their political feasibility, equity, efficiency, neutrality, and productivity.

Political feasibility: Revenue is determined politically feasible if there is a precedent for a similar policy somewhere in the world, and/or if the authors determined that a majority of reasonable citizens would vote in favor of such a practice, and/or politicians who approve such mechanisms would not face political backlash.

Equity: Revenue is determined equitable based on the distribution of the financial burden and the benefits received by citizens/businesses (Bland, 2013). Equity is further evaluated in terms of horizontal and vertical equity. Horizontal equity explores the distribution of tax burden among persons/businesses in comparable circumstances, where vertical equity is determined by how the burden varies across economic circumstances.

Efficiency: Revenue is determined efficient if the estimated cost to implement and maintain the revenue policy did not equal or exceed the projected revenue generation (Bland, 2013).

Neutrality: Revenue is determined neutral if the policy does not interfere with the market, regardless of whether the interference is welcomed or not (Ibid).

Productivity: Revenue is determined highly productive if the projected tax/fee and adoption rates result in annual revenues of $1,000,000 or more. Moderately productive sources generate $100,000- $999,999 annually, and revenues determined to have low productivity are estimated to yield less than $100,000 annually (Ibid).

Each of the five criteria was ranked “High”, “Moderate”, or “Low” based on projected revenues, case studies, related research, and the authors’ educated opinions (see Appendix A, Figure 7). Each criterion was ranked independently of the other four criteria, as possible. In order to create an index of the criteria, high was assigned a score of 3, moderate a score of 2 and low a score of 1. Summed scores of 15, 10, and 5 reflect high, moderate, low scores across criteria respectively. Based on these rankings three possible revenue package options are presented. Any additional criteria considered in the recommendation of a package such as behavioral incentives are discussed further in the recommendation section.

| | POLITICAL FEASIBILITY | EQUITY | EFFICIENCY | NEUTRALITY | PRODUCTIVITY | INDEX: High = 3 Moderate = 2 Low = 1 |
|---|---|---|---|---|---|---|
| Vehicle Miles Travelled (VMT) | HIGH | HIGH | HIGH | HIGH | HIGH | 15 |
| Advertisement Tax | HIGH | HIGH | HIGH | HIGH | MODERATE | 14 |
| City Registration Fee | MODERATE | MODERATE | MODERATE | MODERATE | MODERATE | 10 |
| Congestion Pricing | LOW | MODERATE | LOW | LOW | HIGH | 8 |
| Downtown Parking Fee | MODERATE | HIGH | HIGH | LOW | MODERATE | 11 |
| Commercial Parking Fee | MODERATE | MODERATE | HIGH | MODERATE | MODERATE | 10 |
| Commuter Toll | LOW | MODERATE | LOW | LOW | MODERATE | 7 |

*Figure 2. Evaluation Criteria of Innovative Revenue Options*

## Innovative Revenue Options

Described below are innovative revenue opportunities for Tualatin to make up for the loss of revenue associated with the adoption of autonomous vehicles. To see full calculations, refer to Appendix B: Calculations. An in-depth evaluation of each revenue source, including additional sources that were not included in the following revenue packages, can be found in Appendix C.

Vehicle Miles Traveled (VMT) Tax: This tax will charge $0.02 per mile a car is driven, to be collected annually when vehicle registration is updated. Oregon's MyOReGO pilot VMT tax program charges $0.015 per mile (Oregon Department of Transportation, n.d.), and the current gas tax (combined federal and state) is $0.02 per mile, assuming average fuel efficiency of 24 mpg.

Advertisement Revenue Tax: This is a 5% tax to be collected for the city on the revenue that fleet operators make from selling ads displayed within the vehicle. It will be collected at the same time as business income tax. Shared fleet vehicles are likely to display ads inside the vehicles as an additional revenue stream. The recommended tax rate is comparable to Pittsburgh's 7% tax on billboard ad revenue (City of Philadelphia, n.d.). The revenue calculated is based on assumptions about average ad length and price.

Congestion Pricing: This fee would charge private vehicles driving in Tualatin city limits $2 per day Monday-Friday between 6:30-8:30 a.m. This program would require the use of Automatic Number Plate Recognition and closed-circuit television for enforcement (Automatic Plate Number Recognition, n.d.). Users would pay online in advance for driving privileges and be charged a penalty for nonpayment. Exemptions and discounts could be made available for low income workers or to incentivize carpooling (Congestion Charge Zone, n.d.).

Commercial Parking Fee: This fee of $195 would be assessed annually. It is comparable to fees Seattle and other cities have implemented for the businesses choosing to park their delivery vehicles by designed curbside spaces (District Department of Transportation, 2014).

Commuter Toll: This toll of $0.25 would be charged per commuting vehicles for entering or leaving the City of Tualatin. This will require the use of electronic transponder technology like those used on California toll roads (Fast Trak Transponders, n.d.).

City Registration Fee: This fee of $43 (Mistreanu & Simina, 2013) could be added to the current state registration fee for vehicles. The fee would be collected at the DMV at the time of registration and would require coordination with the state for tracking and allocation of the transfer funds.

Downtown Parking Fee: A parking fee would be implemented in the downtown core parking lot areas to generate revenue through a $7 daily parking charge. It will apply to only those who choose to park in the public lots in downtown Tualatin. According to Tualatin geostatistical data (Geostat, 2013), we assume people who commute 60 minutes or longer will be using these parking / charging facilities. The total number of vehicles with that assumption is 609.

Electricity Tax: According to the U.S. Energy Information Administration (EIA, 2017) the average price of electricity to customers for transportation is 9.$0.72 per kWh. The average American drives a total of 13,476 miles annually (Federal Highway Administration, 2016) and it takes an average of 30 kWh for an electric vehicle to drive 100 miles (Office of Transportation and Air Quality, 2017) therefore the average annual cost of electricity for electric vehicles is $404.28. To increase revenue for the city of Tualatin, an option may be a tax on electricity to consumers at charging stations. The electricity vendor or utility company will collect the price of electricity as well as the tax and then will pay the tax collected to the appropriate authority, which in this case would be the city of Tualatin. Tax incentives may be provided for the use of alternative electricity sources such as solar, wind, or hydroelectric (Moloughney, 2016). This

will apply for both individual ownership and fleets. In order to collect the electricity tax, existing technology will be used at each charging station, public and private. The measurement of consumption for taxation purposes is the kilowatt-hour (Lowenthal, Baxter, & Harjinder, 2009).

Annual Fee: The purpose of this fee is to offset the loss of revenue from gas taxes. It has been found that a $100 annual fee is a good option (Loveday, 2017). This will apply for both individual ownership of autonomous vehicles and fleets.

| (Burden) | Revenue Source | Amount |
|---|---|---|
| Both | VMT Tax | $ 6,145,322.55 |
| Private | Downtown Parking Fee | $ 779,275.00 |
| Both | Commercial Parking Fee | $ 121,446.0 |
| Both | City Registration Fee | $ 503,659.00 |
| Fleet | Advertisement Tax | $ 253,498.00 |
| Total Revenue | | $ 7,803,200.55 |

*Figure 3: Revenue Package 1 Detailed Revenue Expected*

## Revenue Packages

### Package 1

The first revenue package includes the five revenue sources that ranked highest overall in the evaluation criteria. These sources are the VMT Tax, Downtown Parking Fee, Commercial Parking Fee, City Registration Fee, and Advertisement Tax. Under this package, private vehicle owners are charged more than people who use a shared vehicle service, which would disincentivize private vehicle ownership.

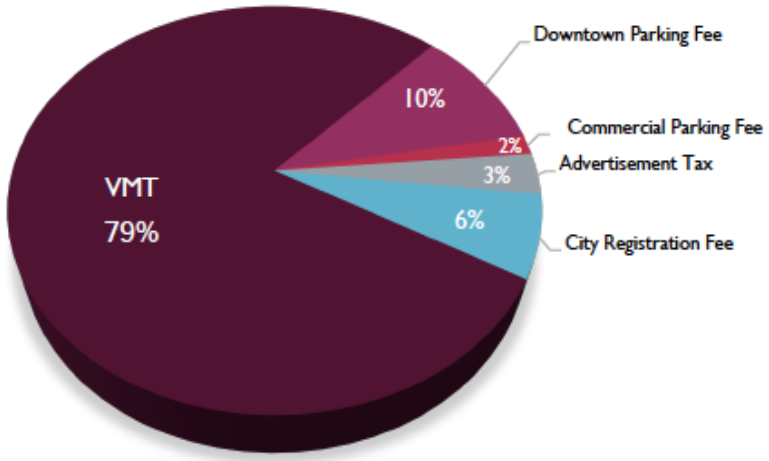


*Figure 4: Package 1 Distribution of Revenues Generated*

### Evaluation of Package One

The average index score of all the revenue sources combined in package one amounts to 12.0, which is Moderate/High. The low neutrality score of the Downtown Parking Fee does not impact the decision to include it in package one. While a parking fee may potentially change the behavior of individuals, the hope is that the change will be positive and encourage ride-share or public transportation options and minimize traffic and individual drivers. While all revenue sources in this package ranked relatively well on evaluation criteria, it was rejected, as it would likely double or triple charge the same users, rather than spread the burden across different kinds of users.

| | POLITICAL FEASIBILITY | EQUITY | EFFICIENCY | NEUTRALITY | PRODUCTIVITY | INDEX: High = 3 Moderate = 2 Low = 1 |
|---|---|---|---|---|---|---|
| Vehicle Miles Travelled (VMT) | HIGH | HIGH | HIGH | HIGH | HIGH | 15 |
| Advertisement Tax | HIGH | HIGH | HIGH | HIGH | MODERATE | 14 |
| City Registration Fee | MODERATE | MODERATE | MODERATE | MODERATE | MODERATE | 10 |
| Downtown Parking Fee | MODERATE | HIGH | HIGH | LOW | MODERATE | 11 |
| Commercial Parking Fee | MODERATE | MODERATE | HIGH | MODERATE | MODERATE | 10 |

*Figure 5: Evaluation Chart of Package 1 (Figure 1c)*

## Package 2

The second package generates revenue from both local vehicles and commuting vehicles. A tax on vehicle miles traveled directly charges for road use, but it is not specific to miles driven on Tualatin streets. The city registration fee captures additional revenue from city residents and from fleet companies that operate in Tualatin. A commuter toll collects revenue from people who use Tualatin's roads to travel to work, but do not pay the other two taxes because they are not city residents.

| (Burden) | Revenue Source | Amount |
|---|---|---|
| Both | VMT Tax | $ 6,145,322.55 |
| Both | Commuter Toll | $ 448,630.00 |
| Both | City Registration Fee | $ 503,695.00 |
| Total Revenue | | $ 7,097,647.55 |

*Figure 6: Revenue Package 2 Detailed Revenue Expected*

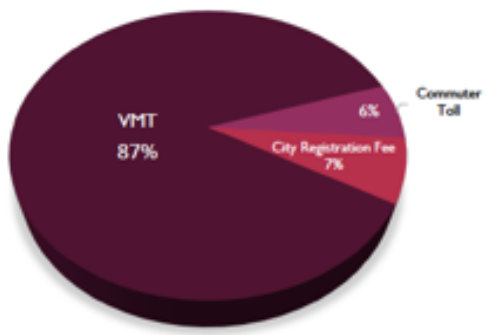


*Figure 7: Package 2 Distribution of Revenues Generated*

## Evaluation of Package 2

The average index score of all the revenue sources combined in package two amounts to 10.7, which is moderate. The lower scores of the commuter toll significantly brought down the average, but it is included as a way to capture a range of users. The commuter toll charges users who don't live within city limits but use Tualatin streets and infrastructure, while the city registration fee is levied on city residents. Due to the low political feasibility and high administrative cost of the commuter toll, along with the only moderate scores of city registration fee, this package was not chosen as the recommended package.

| | POLITICAL FEASIBILITY | EQUITY | EFFICIENCY | NEUTRALITY | PRODUCTIVITY | INDEX: High = 3 Moderate = 2 Low = 1 |
|---|---|---|---|---|---|---|
| Vehicle Miles Travelled (VMT) | HIGH | HIGH | HIGH | HIGH | HIGH | 15 |
| City Registration Fee | MODERATE | MODERATE | MODERATE | MODERATE | MODERATE | 10 |
| Commuter Toll | LOW | MODERATE | LOW | LOW | MODERATE | 7 |

*Figure 8: Evaluation Chart of Package 2*

## Package 3

The third package aims to effectively charge for the use of Tualatin's limited road space. The VMT tax charges directly for road use, and congestion pricing assists in managing road use at the busiest time of day in an effort to limit congestion and traffic delays. The advertisement tax is an additional revenue source that charges fleet operators for revenues they receive from having a captive audience for advertisements, essentially charging shared vehicles for annoying their customers.

| (Burden) | Revenue Source | Amount |
|---|---|---|
| Both | VMT Tax | $ 6,145,322.55 |
| Both | Congestion Pric-ing | $ 1,766,440.00 |
| Fleet | AdvertisementTax | $ 253,498.00 |
| Total Revenue | | $ 8,165,260.55 |

*Figure 9: Evaluation Chart of Package 3 (Figure 3c.)*

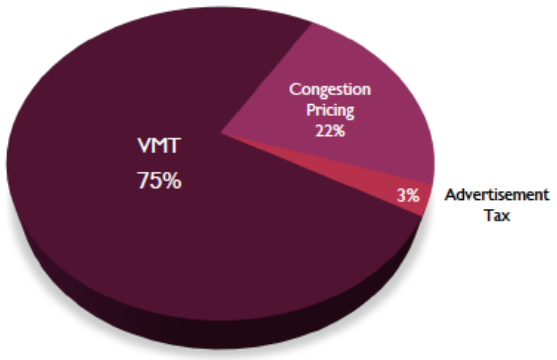


*Figure 10: Revenue Package 3 Detailed Revenue Expected*

### Evaluation of Package 3

With an average index of 12.3, package three has a Moderate/High ranking and is the most highly ranked of the three available packages. The low rankings of congestion pricing are the main cause of this moderate score. Evaluated alone VMT and advertising tax have the highest index of evaluation criteria. With its high productivity, moderate equity and its promotion of active transportation and shared trips, congestion pricing helps cities manage demand for limited road space.

| | POLITICAL FEASIBILITY | EQUITY | EFFICIENCY | NEUTRALITY | PRODUCTIVITY | INDEX: High = 3 Moderate = 2 Low = 1 |
|---|---|---|---|---|---|---|
| Vehicle Miles Travelled (VMT) | HIGH | HIGH | HIGH | HIGH | HIGH | 15 |
| Advertisement Tax | HIGH | HIGH | HIGH | HIGH | MODERATE | 14 |
| Congestion Pricing | LOW | MODERATE | LOW | LOW | HIGH | 8 |

*Figure 11: Package 3 Distribution of Revenues Generated*

## Recommendation

Of the revenue opportunities and packages described, the third package is recommend for adoption in Tualatin. A VMT tax is the best representation of the “pay for use” principle, and it received the highest evaluation score, ranking high in every category. Congestion pricing, although likely to come with backlash from the community initially, is a strong tool for effectively managing the demand for road space. An advertisement tax has high political feasibility, making it a simple method for Tualatin to generate additional revenue that can be used to improve the city’s transportation system. Overall, this package is relatively easy to implement and has low administrative costs. This package also best fits Tualatin’s goals for creating an active, healthy community and a transportation system that works for all ages, incomes, and abilities, by disincentivizing private car use and promoting alternative transportation choices in general. Congestion pricing and a VMT tax are especially useful for this purpose.

## Additional Considerations for the Future

There are many unknowns regarding how AVs will be used and what impacts they will have on our cities. In many cases this is cause for alarm, especially in terms of budgetary impacts, however in others cases the uncertainty creates opportunity. The greatest opportunity is that cities have the power to shape the outcomes of AVs if they take a proactive approach to planning for their arrival. Plans should specifically address how AVscan be managed to achieve community goals through regulations and taxes. Several cities and states have already begun to ask questions about how they want their autonomous transportation system to function, and a variety of private firms and professional organizations are generating ideas meant to guide and inspire these conversations. A collection of these resources can be found in Appendix D. The city of Tualatin is encouraged to review these resources and begin a discussion about autonomous vehicles within their own community.

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## Appendix A

| Stool Leg | Funding Source |
|---|---|
| System maintenance | Gas Tax, User Fees and Urban Road Maintenance District (URMD) {property tax} |
| Existing safety/capacity deficiencies | Countywide Property Taxes |
| Keeping up with growth | System Development Charges (SDCs) - Countywide Transportation Development Tax (TDT) (Washington County, 2017) [Impact fee] for Major Streets Transportation Improvement Program (MSTIP). |

*Figure 12: Three-Legged Stool Transportation Funding Strategy (Figure 1)*

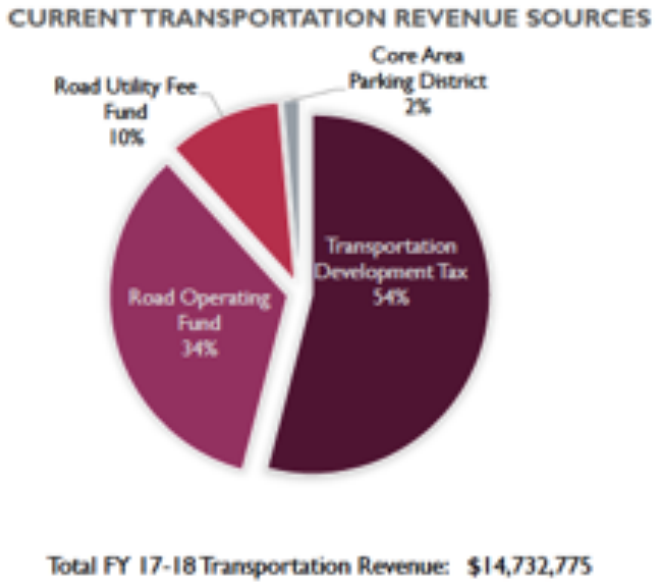


*Figure 13: Transportation revenues for the City of Tualatin*

| Own Source Revenue | | Pass-Through (Intergovernmental) Revenue | |
|---|---|---|---|
| Transportation Development Tax<br>$7,966,500 (8.6%) | | Road Operating Fund<br>$5,026,750 (5.5%)_ | |
| Core Area Parking District<br>$**215,355** (0.2%) | | | |
| Road Utility Fee<br>$1,524,170 (1.7%) | | | |
| TOTAL Own Source Revenue | $9,706,025 (10.5%) | TOTAL Pass-through Revenue | $5,026,750 (5.5%)_ |

*Figure 14: Tualatin Own Source and Pass-Through Revenue (City of Tualatin, 2017)*

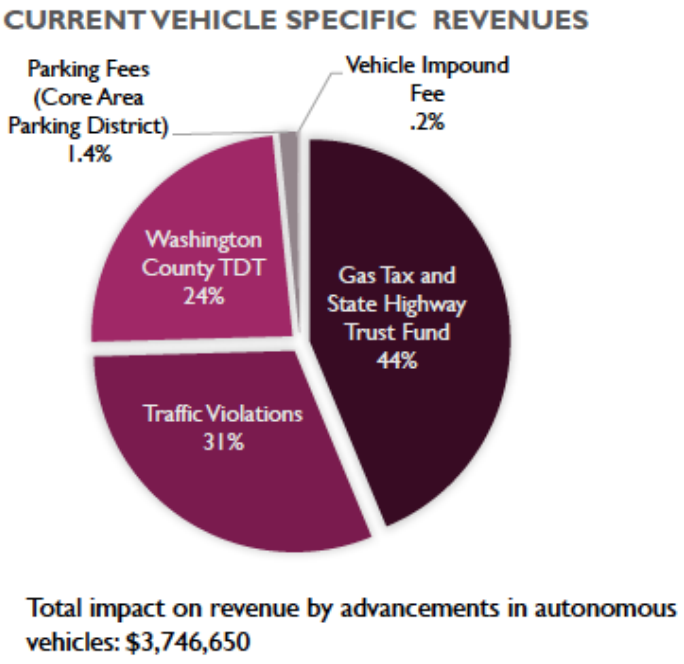


*Figure 15: Current Vehicle Specific Related Revenues for Tualatin*

| Revenue | Amount |
|---|---|
| Gas Tax and State Highway Trust Fund | $1,637,150 |
| Parking Fees (Core Area Parking District) | $52,000 |
| Traffic Violations | $1,150,000 |
| Vehicle Impound Fee | $7,500 |
| Washington County TDT | $900,000 |
| TOTAL | $3,746,650 |

*Figure 16: Current vehicle related revenue breakdown and total affected by advancements in autonomous vehicles (City of Tualatin, 2017)*

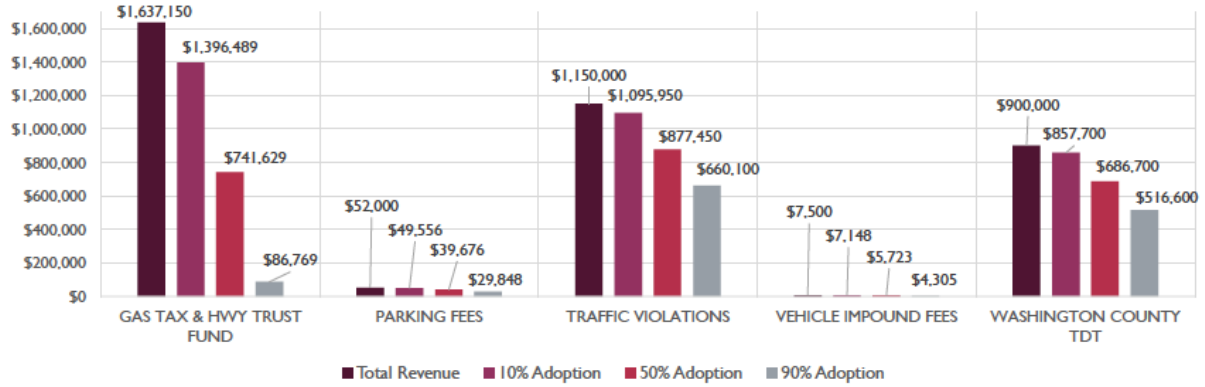


*Figure 17: Transportation revenue impacts at different adoption rates of autonomous vehicles*

| | POLITICAL FEASIBILITY | EQUITY | EFFICIENCY | NEUTRALITY | PRODUCTIVITY | INDEX: High = 3 Moderate = 2 Low = 1 |
|---|---|---|---|---|---|---|
| Vehicle Miles Travelled (VMT) | HIGH | HIGH | HIGH | HIGH | HIGH | 15 |
| Advertisement Tax | HIGH | HIGH | HIGH | HIGH | MODERATE | 14 |
| City Registration Fee | MODERATE | MODERATE | MODERATE | MODERATE | MODERATE | 10 |
| Congestion Pricing | LOW | MODERATE | LOW | LOW | HIGH | 8 |
| Downtown Parking Fee | MODERATE | HIGH | HIGH | LOW | MODERATE | 11 |
| Commercial Parking Fee | MODERATE | MODERATE | HIGH | MODERATE | MODERATE | 10 |
| Commuter Toll | LOW | MODERATE | LOW | LOW | MODERATE | 7 |

*Figure 18: Evaluation Criteria for new revenue sources used in packages (Figure 7)*

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# Appendix B

| Package 1 | Revenue Sources | Amount |
|---|---|---|
| | | |
| Both | Vehicle Miles Travelled (VMT) (15) | $6,145,322.55 |
| Private | Downtown Parking Fee (11) | $779,275 |
| Both | Commercial Parking Fee (10) | $121,446 |
| Both | City Registration Fee (10) | $503,659 |
| Fleet | Ad Revenue (14) | $253,498 |
| | | |
| | TOTAL REVENUE | $7,803,200.55 |

*Figure 19 Package 1 Totals*

| Package 2 | Revenue Sources | Amount |
|---|---|---|
| | | |
| Both | VMT (15) | $6,145,322.55 |
| Fleet | Ad Revenue (14) | $253,498.00 |
| Both | Congestion Pricing (8) | $1,766,440.00 |
| | | |
| | | |
| | | |
| | TOTAL REVENUE | $8,165,260.55 |

*Figure 20 Package 1 Totals*

| Package 3 | Revenue Sources | Amount |
|---|---|---|
| | | |
| Both | Commuter Toll (7) | $448,630 |
| Private | VMT (15) | $6,145,322.55 |
| Both | City Registration Fee | $503,695.00 |
| | | |
| | | |
| | | |
| | TOTAL REVENUE | $7,097,648 |

*Figure 21 Package 1 Totals*

| Revenue Calculations | | | | |
|---|---|---|---|---|
| Revenue | Amount | 10.0% | 50.0% | 90.0% |
| Gas Tax and State Highway Trust Fund | $ 1,637,150.00 | $ 1,396,488.95 | $ 741,628.95 | $ 86,768.95 |
| Parking Fees (Core Area Parking District) | $ 52,000.00 | $ 49,556.00 | $ 39,676.00 | $ 29,848.00 |
| Traffic Violations | $ 1,150,000.00 | $ 1,095,950.00 | $ 877,450.00 | $ 660,100.00 |
| Vehicle Impound Fee | $ 7,500.00 | $ 7,147.50 | $ 5,722.50 | $ 4,305.00 |
| Washington County TDT | $ 900,000.00 | $ 857,700.00 | $ 686,700.00 | $ 516,600.00 |
| TOTAL | $ 3,746,650.00 | $ 3,406,842.45 | $ 2,351,177.45 | $ 1,297,621.95 |
| | NEW REVENUE NEEDED | $ 339,807.55 | $ 1,395,472.55 | $ 2,449,028.05 |

*Figure 22 Revenue Calculations*

*Assumptions: AVs will be electric; Revenues are reduced in proportion to the reduction of cars on the road (4.7%, 23.7%, 42.6%). The total number of cars in Tualatin at the 90% adoption rate is 10,542.Table 151 Downtown Parking Fee

| Flat rate parking | # of private vehilcles* | Daily revenue | Annual revenue |
|---|---|---|---|
| $7 / day | 305 | $2,135 | $779,275 |

*Figure 23 Downtown Parking Fee*

*The number of private vehicles is determined by the number of vehicles that commute for 60 minutes or longer in Tualatin

| License Fee | # of licensed businesses | Revenue from 45% of businesses | Revenue from 75% of businesses |
|---|---|---|---|
| $195 | 1,384 | $121,446 | $202,410 |

*Figure 24 Commercial Parking Fee*

| Monthly Fee for License | Number of Accom & Food Services | Revenue for 40% space allocation for units | Revenue for 70% allocation of space for units |
|---|---|---|---|
| $75 | 80 | $28,800 | $50,400 |

*Figure 25 Mobile Food Units*

| Daily Toll Fee | # of commuter employees in Tualatin* | Annual Revenue |
|---|---|---|
| $0.25 | 4,930 | $448,630.00 |

*Figure 26 Commuter Toll*

*The number of commuters was calculated by finding the total number of employees in Tualatin (13,930) and subtracting the number of local employees (9,000)

| Tax on electricity use | # of vehicles | Avg cost of electricity | Avg miles per vehicle annually* | Avg cost of electricity for EV annually | Avg cost including tax | (Tax amount per vehicle | Annual Revenue |
|---|---|---|---|---|---|---|---|
| 5% | 10,542 | $0.10 (per kWh) | 13,476 | $404.28 | $424.49 | $20.21 | $213,095.99 |

*Figure 27 Tax on electricity use*

*EVs need 30 kWh for 100 miles

**Assumption that technoloy is installed at every charging port privately and publicly that collects usage to calculate tax

| *Calculation for only privately owned vehicles | # of private owned vehicles only at 50% adoption | (Same as above) | Annual Revenue |
|---|---|---|---|
| | 5271 | | $106,547.99 |

*Figure 28 Tax on electricity use (only private owned AVs)*

| Annual Fee | # of vehicles | Annual Revenue |
|---|---|---|
| $100 | 10,542 | $1,054,200 |

*Figure 29 Annual Fee for Electric Vehicle Ownersså*

| Registration Fee | # of vehicles | Annual Revenue |
|---|---|---|
| $43 | 10,542 | $453,306 |

*Figure 30 City Registration Fee*

| | Daily Fee (6:30-8:30 AM) | Tualatin Vehicles | Daily Revenue | Work Days Per Year | Annual Revenue |
|---|---|---|---|---|---|
| Fleet | $2 | 1,699 | $3,398 | 260 | $883,480 |
| 50/50 | $2 | 3,397 | $6,794 | 260 | $1,766,440 |
| Private | $2 | 6,794 | $13,588 | 260 | $3,532,880 |

*Figure 31 Congestion Pricing*

| | Trip Price per Empty Seat | # of Shared Vehicles | # of Private Vehicles | # of Empty Spaces per Trip | Annual Revenue |
|---|---|---|---|---|---|
| Fleet | $0.30 | 7,824 | 869 | 11,300 | $2,474,700.00 |
| 50/50 | $0.30 | 3,912 | 4,781 | 23,036 | $5,044,884.00 |
| Private | $0.30 | 0 | 8,693 | 34,772 | $7,615,068.00 |

*Figure 32 Empty Space Fee*

| | Ad Tax Amount | Ads per vehicle | Total Ads per Day | Annual Company Ad Revenue | Annual City Revenue |
|---|---|---|---|---|---|
| Fleet | 5% | 4320 | 40987296 | $12,296,188.80 | $614,809.44 |
| 50/50 | 5% | 4320 | 20493648 | $6,148,094.40 | $307,404.72 |
| Private | 0 | 0 | 0 | N/A | $0.00 |

*Figure 33 Advertisement Tax*

* assume advertisers will charge similar amount as per view YouTube ads

* $0.30 per ad, ads 20 second long

| | Current VMT | VMT with 90% Adopti | Revenue from $0.02 |
|---|---|---|---|
| Fleet | 281895530 | 307266127.7 | $6,145,322.55 |
| 50/50 | 281895530 | 307266127.7 | $6,145,322.55 |
| Private | 281895530 | 307266127.7 | $6,145,322.55 |

*Figure 34 VMT*

# Appendix C

Revenue Policy Evaluation Criteria Comparison Chart

| | Political Feasibility | Equity | Efficiency | Neutrality | Productivity* | Index<br>High = 15<br>Moderate = 10<br>Low = 5 |
|---|---|---|---|---|---|---|
| VMT | High | High | High | High | High | 15 |
| Advertisement Tax | High | High | High | High | Moderate | 14 |
| Downtown Parking Fee | Moderate | High | High | Low | Moderate | 11 |
| Mobile Food Units Fee | Moderate | High | High | Moderate | Low | 11 |
| Electricity Tax | Moderate | Moderate | Moderate | High | Moderate | 11 |
| Annual Fee | Moderate | Moderate | High | Moderate | Moderate | 11 |
| City Registration Fee | Moderate | Moderate | Moderate | Moderate | Moderate | 10 |
| Commercial Parking Fee | Moderate | Moderate | High | Moderate | Low | 10 |
| Congestion Pricing | Low | Moderate | Low | Low | High | 8 |
| Commuter Toll | Low | Moderate | Low | Low | Moderate | 7 |
| Empty Seat Tax | Low | Low | Low | Low | High | 7 |
| | | | | | | |
| | | LOW | MODERATE | HIGH | | |
| | *Productivity | >$100,000 | $100,000 - $999,999 | <$1,000,000 | | |

## Vehicle Miles Traveled (VMT) Tax

| | Political Feasibility | Equity | Efficiency | Neutrality | Productivity* | Index High = 15 Moderate = 10 Low = 5 |
|---|---|---|---|---|---|---|
| VMT | High | High | High | High | High | 15 |

***Political Feasibility*** - High

VMT taxes charge for use, so they are easily justifiable to the public. The VMT tax should replace the gas tax, in order to avoid the perception of double-charging for road use.

***Equity*** - High

A VMT tax is based on the benefits-received principle. Road users are charged based on how much they utilize the road, measured by how many miles they drive

***Efficiency*** - High

A VMT tax has easy notification, collection, and enforcement. A switch from gas taxes to VMT taxes can be publicized in the local press as well as through letters to registered car owners. Collection can take place at the DMV each year by requiring cars to be registered annually. The county can collect the tax and administer it to cities. Enforcement can be achieved through the enforcement of annual vehicle registration stickers. If the sticker has not been updated, the

***Neutrality*** - High

A VMT tax has a broad base, as all vehicle users will pay it, either on their own vehicle or as a passed-down expense from fleet operators. A flat tax that is charged equally on fleet and private vehicles, coupled with the broad tax base makes a VMT charge neutral. However, if a different rate is charged for fleet and private vehicles, the greater the difference, the less neutral this revenue source becomes. It should be noted, that the intended outcome of charging different rates for private and fleet vehicle road use is to incentivize one form of behavior over the other.

***Productivity*** - High

Estimated annual revenues exceed $1 million

## Advertisement Tax

| | Political Feasibility | Equity | Efficiency | Neutrality | Productivity* | Index High = 15 Moderate = 10 Low = 5 |
|---|---|---|---|---|---|---|
| Advertisement Tax | High | High | High | High | Moderate | 14 |

***Political Feasibility*** - High

There is little resistance expected from the general public, though fleet vehicle operators are likely to oppose this tax as they will be the ones paying it.

***Equity*** - High

All fleet vehicles that display ads will be charged the same rate.

***Efficiency*** - High

Notification, collection, and enforcement can follow the same protocols as existing business income taxes.

***Neutrality*** - High

This tax will not influence consumer behavior. As long as advertisers are still profitable, they are likely to display ads in fleet vehicles.

***Productivity*** - Moderate

Estimated annual revenue is between $100,000 and $1 million.

### Downtown Parking Fee

| | Political Feasibility | Equity | Efficiency | Neutrality | Productivity* | Index High = 15 Moderate = 10 Low = 5 |
|---|---|---|---|---|---|---|
| Downtown Parking Fee | Moderate | High | High | Low | Moderate | 11 |

***Political Feasibility*** - Moderate

A parking fee is not a new concept generally, therefore it is politically feasible to charge for parking infrastructures, especially in new areas that include electric vehicle charging stations. However, parking has never been a charge to visitors/residents in downtown Tualatin, so there may be some backlash at first.

***Equity*** - High

Applies to only those who choose to park in the public lots in downtown Tualatin. It is a benefits-received fee.

***Efficiency*** - High

This fee would be easy to collect, as it is a fee for service and the technology exists. It will not be difficult or overly costly to install.

***Neutrality*** - Low

It will potentially change the economic behavior of people driving in Tualatin, because they may be averse to the parking fee. Our hope is this will affect people's behaviors, however, and people will choose a ride-share or public transportation option as to minimize traffic and individual drivers.

***Productivity*** - Moderate

At a $7 per day parking charge, the city will see a revenue of $779,275. According to our criteria, this is Moderate productivity.

### Mobile Food Units

| | Political Feasibility | Equity | Efficiency | Neutrality | Productivity* | Index High = 15 Moderate = 10 Low = 5 |
|---|---|---|---|---|---|---|
| Mobile Food Units Fee | Moderate | High | High | Moderate | Low | 11 |

***Political feasibility -*** Moderate

Recently the city voted to limit the Mobile Food Units, among other reasons the mortar-and-brick businesses complaints. The city of Vancouver, Washington deployed the Mobile Food

Units' policy (City of Vancouver, n.d.) which has resulted in a harmonious co-existence and expanded choices to public.

***Equitable*** - High
Most of these vendors will be small businesses and will have horizontal pay schemes. The proposal of the flat fee per month is similar to neighboring cities. Currently the few that allowed, the fee is based number of employees the mobile food unit vendor employees.

***Neutral*** - Moderate
Benefit-received principle for the unit owners and more options for the consumers.

***Efficient*** - High
Administration is very good as it will use the same mechanism that exists now for business licensing fees collection and administration.

***Productive*** - Low
Not a very big yield though. But the released curbside space that were allocated for parking are now creatively used as revenue source.

This revenue source was not recommended in any of our packages because the City of Tualatin have passed an ordinance (City of Tualatin, n.d.) to limit their deployment in the downtown core. As the curbside changes with introduction of shared AVs, in future this could be a good way to provide more food options for the city core employees and provide competition with mortar-and-brick restaurants.

## Electricity Tax

| | Political Feasibility | Equity | Efficiency | Neutrality | Productivity* | Index<br>High = 15<br>Moderate = 10<br>Low = 5 |
|---|---|---|---|---|---|---|
| Electricity Tax | Moderate | Moderate | Moderate | High | Moderate | 11 |

### *Political Feasibility* - Moderate

An electricity tax would be implemented and collected from public charging stations as well as private transportation electricity use at a residence. The technology already exists to register the amount of electricity used by electric vehicles at charging ports. It is ranked moderate because it is easy to justify to users at public charging stations, however may face more controversy at private residents.

***Equity*** - Moderate

This tax applies equally to all private vehicle owners and fleet companies. However, it is a regressive tax and impacts low income users more proportionately (similar to a gas tax).

***Efficiency*** - Moderate

Every charging port will need to have the technology installed that will collect the data about electricity use / tax collected. Electricity companies collect all charges and fees and then allocate the tax amount to the governing authority (City of Tualatin). Once implemented it is easy to collect, but installation will be costly and time consuming.

***Neutrality*** - High

As this tax applies to everyone using electricity, it will not change the economic behavior. It is a much lower cost than that of the current gas tax.

***Productivity*** - Moderate

The annual revenue at a 5% tax would be $11,797. According to our criteria, this falls into the

moderate category of productivity.

The electricity tax scored 11 points on our evaluation chart with mostly moderate rankings. Due to the cost and lower efficiency and feasibility of implementation we will not use this revenue source in our packages. It may be a source to consider in the future, but the proper technology will need to be implemented at every charging station for this tax to be collected.

### Annual Fee (on AVs)

| | Political Feasibility | Equity | Efficiency | Neutrality | Productivity* | Index High = 15 Moderate = 10 Low = 5 |
|---|---|---|---|---|---|---|
| Annual Fee | Moderate | Moderate | High | Moderate | Moderate | 11 |

***Political Feasibility*** - Moderate

In states such as North Carolina and Washington an annual fee has been implemented on all owners of electric vehicles. It is successfully generating revenue for these states, however there has been some backlash from electric vehicle users feeling averse to paying this extra fee. The intention is to offset gas tax revenue that electric vehicle owners no longer pay.

***Equity*** - Moderate

Applies to 90% of the population of Tualatin at this adoption rate. It is regressive, and impacts low income drivers more proportionately. Tax incentives may be used for low income populations.

***Efficiency*** - High

Easy to collect; paid at purchase and then annually.

***Neutrality*** - Moderate

It was found that at rates higher than $100 the purchases of electric vehicles declined, but at or under $100 the numbers did not change. At a rate that is too high it will incentivize the use of traditional vehicles to avoid annual fee, but at a lower rate it does not change the economic behavior.

***Productivity*** - Moderate

At an annual rate of $100 for Tualatin, the revenue generated would be $782,400. This is moderate productivity.

Although this fee is easy to implement and collect, it incentives the use of non-autonomous vehicles as electric vehicles are the only users that will be charged for this. We hope to incentivize the use of electric autonomous vehicles, and at the 90% assumed adoption rate, only 10% of the population will not pay this fee, therefore we did not use this revenue source in our presented packages.

## City Registration Fee

| | Political Feasibility | Equity | Efficiency | Neutrality | Productivity* | Index High = 15 Moderate = 10 Low = 5 |
|---|---|---|---|---|---|---|
| City Registration Fee | Moderate | Moderate | Moderate | Moderate | Moderate | 10 |

***Equity - Moderate***

Horizontal equity is high, the fee would apply equally to all private vehicle owners and could be charged regardless of whether a vehicle is autonomous or traditional. However, vertical equity is poor for this policy because it is regressive and impacts low income vehicle owners disproportionately.

***Neutrality*** - Moderate

At rate of $43 annually, there is a small incentive for vehicle consumers to change their vehicle consumption. The incentive would increase with the number of cars in any given household. Likely single car households would maintain their consumption but multi-car households are more likely to reduce consumption.

***Efficient*** - Moderate

Would require a system to be constructed for collection with relatively low revenue gained at the $43 annual rate.

***Productivity*** - Moderate

At a reasonable rate of $43 annual per vehicle, the fee only generates a fraction of the revenue needed.

A city registration fee of $43 (Mistreanu, et al, 2013) (Vehicle Registration Fee, n.d.) could be added to the current state registration fee for vehicles. The fee would be collected at the DMV at the time of registration and would require coordination with the state for tracking and allocation of the transfer.

## Commercial Parking Zone Fee

| | Political Feasibility | Equity | Efficiency | Neutrality | Productivity* | Index High = 15 Moderate = 10 Low = 5 |
|---|---|---|---|---|---|---|
| Commercial Parking Fee | Moderate | Moderate | High | Moderate | Low | 10 |

**Political Feasibility -** Moderate

The city already has the commercial parking permit process, this will be expanded due to more spaces because of less private vehicles.

**Equitable** - Moderate

The benefit-received principle apply for this fee as the business gets the convenience of right-of-way and use their vehicles as adverts. It is regressive as irrespective of business size, they pay the same.

**Neutral** - Moderate

The companies already pay for the commercial parking spots. This simply add the availability of spaces if businesses need them.

**Efficient** - High

Administered and collected with other registration and licenses fees and thus not much overhead is added.

**Productivity** - Low
This revenue stream does not yield much by itself, but can augment other sources. Since curbside parking will be used for private vehicles at the currently levels, the additional spaces can be allocated as commercial vehicle parking. At the fee rate of $175 annually, the city can have raise $121,446 from the expanded spaces. Other cities have taken similar approaches (District Department of Transportation, 2014).

## Congestion Pricing

| | Political Feasibility | Equity | Efficiency | Neutrality | Productivity* | Index High = 15 Moderate = 10 Low = 5 |
|---|---|---|---|---|---|---|
| Congestion Pricing | Low | Moderate | Low | Low | High | 8 |

Congestion pricing would charge private vehicles driving in Tualatin city limits $2 per day during peak hours. This program would require use of Automatic Number Plate Recognition and closed-circuit television for enforcement. Exemptions and discounts could be made available for low income workers or to incentivize carpooling.

***Political Feasibility*** - Low

This fee is reasonable and significantly lower than the rates seen for a similar program in London. London charges $15.21 per day in the downtown area. Seattle charges between $0.75 and $10 (Mapes, 2017). However the authors expect strong citizen and political backlash to proposing citizens be charged to get to and from their jobs.

***Equity/Fairness*** - Moderate

Vertical equity is low. The fee only charges those who drive during morning rush hour and is regressive but exemptions are available to offset some of that regressive nature. Horizontal equity is high because the fee is the same for everyone.

***Neutrality*** - Low

Highly incentivizes lower vehicle consumption - high cost to full time workers $2 per day x 5days per week x 52 weeks per year = $520

***Efficiency*** - Low

Requires implementation and maintenance of Automatic Number Plate Recognition and closed-circuit television or road-rule enforcement camera (Automatic Plate Recognition, n.d.).

***Productivity*** - High

Even at only $2 per day the fee generates over $1,000,000 annually. A higher daily fee could easily yield the entire required amount of revenue without any other revenue sources.

## Commuter Vehicles Toll

| | Political Feasibility | Equity | Efficiency | Neutrality | Productivity* | Index<br>High = 15<br>Moderate = 10<br>Low = 5 |
|---|---|---|---|---|---|---|
| Commuter Toll | Low | Moderate | Low | Low | Moderate | 7 |

***Political Feasibility* -** Low
Even though we propose a 25c per drive, the public is as receptive to road tolls. But this is much cheaper than the Bridge of Gods (Port Cascade Locks, n.d.) in OR/WA border that charges $1 to $15 each way depending on the vehicle axle.

***Equitable*** - Moderate
this a regressive fee as applies equally to all commuters who are using private vehicles irrespective of their income.

***Neutral*** - Low
The fee will influence the commuter's choices. The fee is benefit-based and incentivizes commuters to use mass public transportation or carpooling options, as a desirable goal.

***Efficient*** - Low
The infrastructure to administer this fee need to be implemented, after that is done the toll can continue to be collected without much administration. There are numerous toll systems that use transponders on the number plate in the neighboring state of California (The FastTrak Transponder, n.d.).

***Productivity*** - Moderate
At the initial 25c per trip is cheaper that $2 per trip that is tolled at City of God's OR/WA bridges (for small vehicles) and can be increased to raise additional revenue for road expenditures. The toll will raise the revenue of about $448,630. This was calculated based on the total number of employee in the city of 13,930 (Data USA, n.d.) and total number of local employee of 9,000 (Moving Forward Portland, n.d.).

## Empty Seat Tax

| | Political Feasibility | Equity | Efficiency | Neutrality | Productivity* | Index<br>High = 15<br>Moderate = 10<br>Low = 5 |
|---|---|---|---|---|---|---|
| Empty Seat Tax | Low | Low | Low | Low | High | 7 |

***Political Feasibility*** - Low

This tax is likely to be unpopular. Social norms do not discourage single-occupancy vehicles, so a tax on empty seats may be seen as government overreach.
***Equity*** - Low

Horizontal equity is strong, as people with similar socioeconomic status are likely to chose similar modes of transportation. There is less vertical equity, as higher income people are more likely to use private vehicles and travel alone. This makes the empty seat tax progressive in theory, and slightly matches the ability-to-pay principle, as people that can afford private AVs are likely to have high income.

***Efficiency*** - Low

Notification can be publicized in the local press as well as through letters to registered car owners and people subscribed to fleet vehicle services. Collection is straightforward for fleet vehicles, as fleet operators will collect data on vehicle capacity in order to efficiently provide their service. Collection is difficult for private vehicles, as it would require some form of sensor in the vehicle that tracks capacity. Depending on the type of sensor, there is the potential for vehicle owners to find workarounds, making enforcement equally difficult.

**Neutrality** - Low

This tax is meant to influence user behavior towards high vehicle capacity, making it non-neutral by design. An empty seat tax can be considered a sin tax on single occupancy vehicles.

***Productivity*** - High

Estimated annual revenue exceeds $1 million. Certain transportation experts have suggested the use of a tax on empty vehicle seats to encourage the use of shared vehicles and incentivize fleet operators to maximize the efficiency of their service (Brown, 2016). While such a tax would be straightforward to administer on shared fleet vehicles since ridership data is collected for the purposes of fleet operation, a charge on empty seats would be difficult to impose on private vehicles without the use of potentially invasive sensors or monitors. Due to the difficulty in leveraging an empty seat tax on private vehicles, this revenue source was not recommended in any of the funding packages.

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Vehicle Registration Fee. (n.d.). Retrieved November 16, 2017, from multco.us: *https://multco.us/bridges/vehicle-registration-fee*

# Appendix D

## North Carolina Annual Fee on Electric Vehicle Owners

In 2013, Approximately 1,600 electric vehicles were registered in North Carolina and were required to begin paying an annual fee of $100. The purpose of this fee was to offset revenue lost from gas taxes, which are no longer collected from electric vehicle users. This new law is included in North Carolina's "Green Vehicle Laws." (Department of Motor Vehicles, 2017).

## London's Congestion Charge

London is the largest city to have adopted a central area congestion charging scheme. They adopted the daily charge for driving and parking on public roads within the congestion zone February 2003. The charge is required weekdays between 7 a.m. and 6 p.m. but excluding public holidays and weekends. (Congestion Charge Zone, n.d.).
Impacts of London's Congestion Charge (London's Congestion Charge, 2017):

- Traffic levels inside the charging zone have been cut by 20%, equating to 75,000 vehicles
- Reduced congestion in the zone by around 30% during charging hours
- Switch to public transport and 83% increase in pedal cycle trips across London
- A 16% reduction in road transport CO2 emissions were estimated within the original charging zone

## Autonomous Urbanism

NACTO's Fall 2017 Blueprint for Autonomous Urbanism pointed an immediate need for proactive urban policies that reduces footprint of vehicular travel, ensures transit vehicles support high occupancy trips, and safe spaces for walking and cycling are abundant.
With emphasis on making it easier "to access quick, affordable, equitable and sustainable transportation options throughout cities"(National Association of City Transportation Officials, 2017). The report divides recommendations in three areas: Design for Safety, New Mobility Systems and Curbside Management. We used some of the ideas in the curbside management and suggested flexible curbside design and uses.

### Seattle's Plan for Shaping an Autonomous Future

The city of Seattle is one of the few U.S. cities that has begun to plan for autonomous vehicles before they enter the market. The approach Seattle uses to address the potential opportunities and risks can be duplicated by other cities to make their own plan for the transportation system of the future. Seattle created a New Mobility Playbook (Seattle Department of Transportation, 2017) that establishes Seattle's response to AVs through three steps:

- Sets goals for Seattle's transportation system based on city values and the needs of the entire Seattle population.
- Describes the potential positive and negative outcomes of AVs based on research from transportation experts.
- Outlines a series of steps that Seattle will take (the Playbook) to promote an autonomous future that achieves the positive outcomes that support city goals, rather than the negative outcomes that hinder city goals.

Tualatin can follow the same steps to shape its own autonomous future, starting with community values and goals, and shaping regulations and taxes to ensure AVs help achieve those goals rather than making them harder to achieve.

### List of Additional AV Resources:


Autonomous Vehicles and the Future of Parking

Nelson Nygaard, & Perkins & Will. (2016). Autonomous Vehicles and the Future of Parking. Retrieved November 28, 2017, from http://nelsonnygaard.com/wp-content/uploads/2017/04/AutoVeh_FutureParking_FINAL.pdf

Blueprint for Autonomous Urbanism

National Association of City Transportation Officials. (2017). Blueprint for Autonomous Urbanism. Retrieved October 21, 2017, from https://nacto.org/publication/bau/blueprint-for-autonomous-urbanism/

Urban Mobility System Upgrade: How shared self-driving cars could change city traffic

International Transport Forum and Corporate Partnership Board & Organization of Economic Co-operation and Development (OECD). (2015). Urban Mobility System Upgrade: How shared self-driving cars could change city traffic. Retrieved December 1, 2017 from http://www.itf-oecd.org/sites/default/files/docs/15cpb_self-drivingcars.pdf.

Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations

Fagnant, D. J., & Kockelman, K. (2015). Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations. Transportation Research Part A: Policy and Practice, 77(Supplement C), 167–181. https://doi.org/10.1016/j.tra.2015.04.003

Autonomous Vehicle Implementation Predictions, Implications for Transport Planning

Litman, T., & Victoria Transport Policy Institute. (2017, September 8). Autonomous Vehicle Implementation Predictions Implications for Transport Planning. Retrieved December 1, 2017, from http://www.vtpi.org/avip.pdf

Pedestrians, Autonomous Vehicles, and Cities

Millard-Ball, A. (2016). Pedestrians, Autonomous Vehicles, and Cities. Journal of Planning Education and Research, 0739456X16675674. https://doi.org/10.1177/0739456X16675674.

Driverless Vehicles' Potential Influence on Cyclist and Pedestrian Facility Preferences

Blau, M. A. (2015). Driverless Vehicles' Potential Influence on Cyclist and Pedestrian Facility Preferences. The Ohio State University. Retrieved from https://etd.ohiolink.edu/pg_10?0::NO:10:P10_ACCESSION_NUM:osu1429823345

Discussion Guide for Automated and Connected Vehicles, Pedestrians, and Bicyclists

Pedestrian and Bicycle Information Center. (2017). Discussion Guide for Automated and Connected Vehicles, Pedestrians, and Bicyclists. Retrieved October 14, 2017, from http://www.pedbikeinfo.org/pdf/PBIC_AV.pdf

Planning for Cars That Drive Themselves: Metropolitan Planning Organizations, Regional Transportation Plans, and Autonomous Vehicles

Guerra, E. (2016). Planning for Cars That Drive Themselves: Metropolitan Planning Organizations, Regional Transportation Plans, and Autonomous Vehicles. Journal of Planning Education and Research, 36(2), 210–224. https://doi.org/10.1177/0739456X15613591

Federal Automated Vehicles Policy: Accelerating the Next Revolution in Roadway Safety

United States Department of Transportation. (2016, September). Federal Automated Vehicles Policy: Accelerating the Next Revolution in Roadway Safety. Retrieved November 28, 2017, from https://www.transportation.gov/sites/dot.gov/files/docs/AV%20policy%20guidance%20PDF.pdf

Envisioning Florida's Future: Transportation and Land Use in an Automated Vehicle World

Florida Department of Transportation. (2016, April). Envisioning Florida's Future: Transportation and Land Use in an Automated Vehicle World. Retrieved December 1, 2017, from http://www.floridaplanning.org/wp-content/uploads/2016/05/Envisioning-Floridas-Future-Final-Report.pdf

The Future is Now: The Technology and Policy of Self Driving Cars

Nebraska Legislative Research Office. (2017, September). The Future is Now: The Technology and Policy of Self Driving Cars. Retrieved December 1, 2017, from http://nebraskalegislature.gov/pdf/reports/research/autonomous_vehicles_2017.pdf

Connected and Autonomous Vehicles 2040 Vision

Pennsylvania Department of Transportation. (2014, July 10). Connected and Autonomous Vehicles 2040 Vision. Retrieved December 1, 2017, from http://www.dot7.state.pa.us/BPR_PDF_FILES/Documents/Research/Complete%20Projects/Planning/CMU%20WO%20001%20-%20Connected%20and%20Autonomous%20Vehicles%202040%20Vision%20-%20Final%20Report.pdf

Urban Mobility in a Digital Age: A Transportation Technology Strategy for Los Angeles

Hand, A. Z. (2016, August). Urban Mobility in a Digital Age: A Transportation Technology Strategy for Los Angeles. Retrieved December 1, 2017, from https://static1.squarespace.com/static/57c864609f74567457be9b71/t/57c9059b9de4bb1598eeee49/1472793280502/Transportation Technology Strategy_2016.pdf

New Mobility Playbook

Seattle Department of Transportation. (2017, September). New Mobility Playbook. Retrieved November 28, 2017, from http://www.seattle.gov/documents/departments/transitadvisoryboard/presentations/newmobility_playbookfinal.pdf

Driverless Future Challenge

Driverless Future Challenge. (n.d.). Retrieved October 14, 2017, from http://driverlessfuture.blankspaceproject.com/

What Happens When Lyft Redesigns A Street

Budds, D., Budds, D., & Budds, D. (2017, September 21). What Happens When Lyft Redesigns

A Street. Retrieved October 14, 2017, from https://www.fastcodesign.com/90143465/how-lyft-would-redesign-one-of-l-a-s-busiest-streets

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Case Study: London's Congestion Charge Cuts CO2 Emissions by 16%. (2011, November 3). Retrieved December 2017, from C40Cities: http://www.c40.org/case_studies/londons-congestion-charge-cuts-co2-emissions-by-16

Congestion Charge Zone. (n.d.). Retrieved November 16, 2017, from Transport for London: https://tfl.gov.uk/modes/driving/congestion-charge/congestion-charge-zone?intcmp=2055

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National Association of City Transportation Officials. (2017). NACTO. Blueprint for Autonomous Urbanism. Retrieved from: https://nacto.org/publication/bau/blueprint-for-autonomous-urbanism/

Seattle Department of Transportation. (2017, September). New Mobility Playbook. Retrieved November 28, 2017, from http://www.seattle.gov/documents/departments/transitadvisoryboard/presentations/newmobility_playbookfinal.