



New Mobility Case Study

Fall 2018
Eugene

Rachel Cohen • Joshua Skov

Management 641

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Eugene

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Contents

4	About SCI
4	About SCYP
5	About Eugene, Oregon
6	Course Participants
7	Appendix A
13	Appendix B
21	Appendix C
35	Appendix D
47	Appendix E
79	Appendix F
87	Appendix G
99	Appendix H
107	Appendix I
119	Appendix J
131	Appendix K
145	Appendix L
157	Appendix M
165	Appendix N

About SCI

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

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

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

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

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

About SCYP

The Sustainable City Year Program (SCYP) is a year-long partnership between SCI and a partner in Oregon, in which students and faculty in courses from across the university collaborate with a public entity on sustainability and livability projects. SCYP faculty and students work in collaboration with staff from the partner agency through a variety of studio projects and service-

learning courses to provide students with real-world projects to investigate. Students bring energy, enthusiasm, and innovative approaches to difficult, persistent problems. SCYP's primary value derives from collaborations resulting in on-the-ground impact and expanded conversations for a community ready to transition to a more sustainable and livable future.

About Eugene, Oregon

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

With a population of just over 160,000 people, Eugene is Oregon’s second largest city and the county seat of Lane County. Located in the heart of the county along the Willamette and McKenzie Rivers, Eugene is recognized for its green landscape, recreational opportunities, and sustainability efforts. The city’s slogan, “A Great City for

the Arts and Outdoors,” reflects its commitment to the arts and culture as well as nature preservation efforts. Eugene is also popular for many nearby recreational opportunities, including Willamette Pass Ski Area, Fern Ridge Reservoir, and hiking and rafting along the McKenzie River.

Course Participants

ANNA BERENBEYM, Master of Business Administration
LORA BOURDO-ULVILDEN, Master of Business Administration
SARAH BRINKER, Master of Business Administration
MIRANDA BROADBENT, Master of Accounting
BRIANA BUCKLES, Master of Business Administration
BROOKS CHONGBIAN, Master of Business Administration
STEVEN CRAVEN, Master of Accounting
MATTHEW DEAN, Master of Accounting
MADELEINE DEBOER, Master of Business Administration
PHIL DENARA, Master of Business Administration
ROBERT DEPPA, Master of Business Administration
JORDIN FRANKLIN, Master of Business Administration
CHARMAINE GUILLORY, Master of Business Administration
MATT HARVEY, Master of Business Administration
PETER HAZELETT, Master of Business Administration
SAM HOLLAND, Master of Business Administration
STEPHEN KAHLER, Master of Business Administration
EMMA LAND, Master of Accounting
BRENNA LEECH, Master of Business Administration
PETER LINDHOLM, Master of Business Administration
ELENA LISAC, Master of Business Administration
JOHN LUNDQUIST, Master of Business Administration
BRETTON MACDONALD, Master of Business Administration
YRIS MITCHELL, Master of Business Administration
JARED MYERS, Master of Business Administration
LINDSEY NAGANUMA, Master of Business Administration
ARJUN PANAMUKKIL, Master of Business Administration
ROBIN PERKINS, Master of Accounting
SAM PHAM, Master of Accounting
PRIM PHATTHANAPHONG, Master of Accounting
BRODY RENNAN, Master of Business Administration
JOURDAN RIVERA, Master of Accounting
TIM RUNYAN, Master of Business Administration
TROY SHERWOOD, Master of Accounting
GIAO TA, Master of Accounting
CHLOE TIRABASSO, Master of Business Administration
KATHY TO, Master of Accounting
VAISHALI VADIVAZHAGAN, Master of Business Administration
ADRIAN VANDER WILLE, Master of Business Administration
NICHOLAS VANZWOL, Master of Business Administration
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IRIS ZHANG, Master of Accounting
TIANNI ZHOU, Master of Accounting
NESS ZOLAN, Master of Business Administration
SYLVIA ZAHARIEV, Master of Accounting

Appendix A

Miranda Broadbent and Steven Craven

Household

The Pike household consists of 3 members: Joe, Kristin, and Charlie. The Pikes live at 5597 Excalibur Lane Eugene, OR. The household income is about \$75,000, 30% higher than the median household income in the area. Joe is a sergeant in the Eugene Police Department and Kristin is a high school teacher at Churchill High School. Charlie is 16 and is currently in high school. The Pike family has 2 cars in the household. Joe drives a 2014 F150, and Kristin drives a 2017 Chrysler Pacifica.

Transportation Habits

Joe	# of Trips	Miles	Total Miles
Work	250	16	4000
Fishing	24	120	2880
Hunting	3	160	480
Family Visits	12	220	2640
Total			10000
Kristin			
Work	250	11	2750
Volunteer	45	12	540
Total			3290
Charlie			
Trips	36	20	720
Other		3290	3290
Total			4010

Figure 1 Total Miles Traveled Per Year

Joe travels 16 miles to work at the police station 5 days a week. On Saturdays twice a month, Joe travels 60 miles to Florence to go fishing. Joe is also an avid hunter during deer season. From early October to late December Joe travels 80 miles to a hunting area outside of Bend, OR once a month. Joe and the family travel 220 miles round trip once a month to visit his parents in Portland.

Kristin is a teacher and an active member of the community. On weekdays she drives 11 miles roundtrip to Churchill HS with Charlie. Kristin volunteers at the Oregon Contemporary Theatre downtown and visits the

Saturday market every weekend. The trip from the Pike household to downtown Eugene is about 12 miles roundtrip.

Charlie just received his provisional license and can only drive with a parent. Kristin or Joe usually coordinate shopping trips with Charlie’s outings to reduce the number of trips they must make. The distance for these trips is approximately 20 miles round trip three times a month.

Cost Breakdown

The following cost breakdown¹ is for the Pike household transportation cost in 2018:

Costs	F-150	Van	Total
Car Payments	\$6,000	\$6,000	\$12,000
Gas	\$1,500	\$952	\$2,452
Oil	\$300	\$150	\$450
Tires	\$140	\$77	\$217
Transmission	\$69	\$42	\$111
Insurance	\$500	\$500	\$1,000
Registration	\$112	\$112	\$224
Totals	\$8,621	\$7,833	\$16,454
Cost per Mile			
Family (Total)	0.951074552		

¹ Based on current market prices for services and products

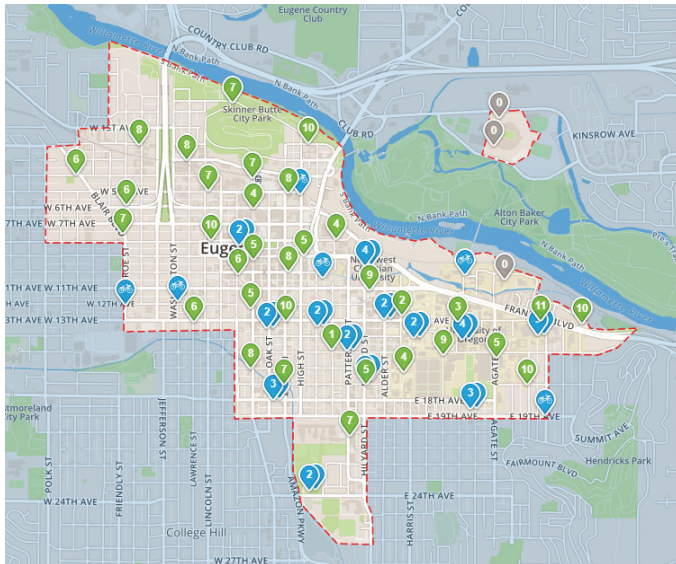


Figure 2 PeaceHealth Rides Service Area

Current Transportation Alternatives

Current alternative transportation options include the Lane Transit District (LTD) bus system, the PeaceHealth Rides bike share, and ride hailing. Additionally, purchasing and using their own bikes (or similar item) as main mode of transport is an alternative option. Walking is an alternative option, but unrealistic for longer trips.

PeaceHealth Rides currently serves the downtown Eugene area seen in Figure 1². The bike system currently has a limited span, but it offers wide access and speed when traveling downtown. Biking also offers the advantage of being direct.

Though the family cannot use the service in their current area, they can use it when the venture to the downtown area.

If the family purchased their own bikes, it would offer them direct access to their regular destinations. However, they would sacrifice the speed of driving. Additionally, biking in a range of weather conditions takes preparation and planning.

LTD offers a wider span than the bike system but it sacrifices directness and speed depending on how far one travels. The public transit system is a low-cost alternative but depending on where one lives the time investment can be significant. The area spanned by LTD can be seen in Figure 2³.

Ride-hailing recently entered the Eugene market. Residents now have the option to use either Uber or Lyft

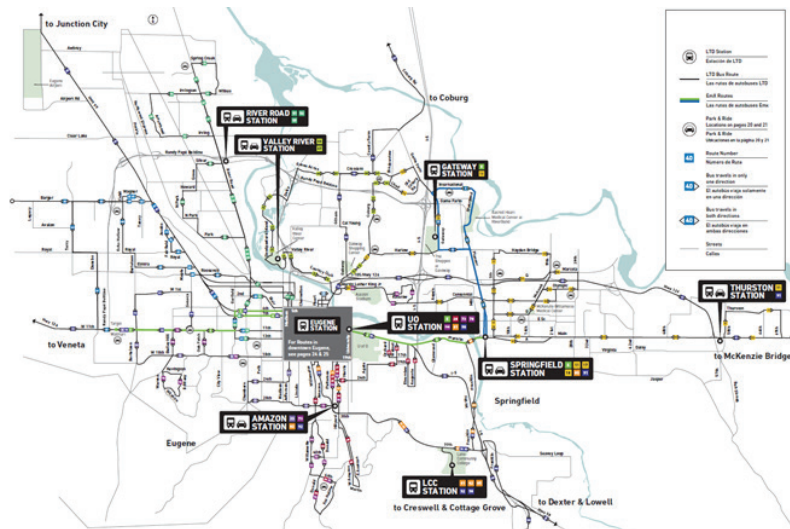


Figure 3 LTD Service Area

² From PeaceHealth Rides <https://www.peacehealthrides.com/>

³ From LTD <https://www.peacehealthrides.com/>

within the city. Ride hailing offers greater span, convenience, and speed than the other two alternatives.

Utilization of Alternatives

Joe

Joe travels more than the other members of the Pike family because he goes hunting and fishing. The areas that Joe travels are remote, because of this he cannot give up his truck. For example, when Joe travels to Florence to go fishing he must tow his boat. Current alternatives neither service the route to Florence nor offer a means to tow a boat. Joe could use his truck in conjunction with other modes of transportation.

Joe can take the bus to work, this will increase the commute time from about 15 min to about 1.5 hours. The trip will cost \$1.13 versus \$5.20 to drive. The bus commute translates to an additional 500 hours of travel time annually compared to using a personal vehicle. The 500 additional hours spends on the bus he could spend doing other things he enjoys or running errands.

Using Uber or Lyft, the commute time would be the same as if he drove, but the cost of the trip would be about \$18-24, or about \$2.19 - 2.14 per mile. Using ride hailing would more than double the current cost for Joe to drive to work. Joe could commute to work on his bike in about 46 minutes, which would be significantly cheaper but 250 hours of additional travel time. Using both the bus and PeaceHealth bike share, the trip would take about 20 minutes less. Alternatively, Joe could avoid transit by carpooling with a coworker. This would reduce the number of miles he drives without sacrificing convenience.

Kristin

Kristin spends \$10.45 per day driving herself and Charlie to Churchill High School and back home again. A monthly LTD pass for her would be \$50 and a monthly pass for Charlie would be \$25. If they used these passes for 20 days, the same trip would be \$2.50 per day. However, the trip would take 50 minutes one way on LTD, as opposed to 15 minutes driving. For Kristin and Charlie, the PeaceHealth bike share would not be an acceptable alternative to commute between their home and Churchill High School as both locations lie outside of the program's range. However, they could use their own bikes, which would be a ride of approximately 30 minutes.

Alternatively, they could use a combination of one or more transportation modes. They could park at Walmart's Park and Ride lot and take LTD to Churchill. They could also bike to Walmart to catch the LTD. The final option would be for Kristin and Charlie to take an Uber or Lyft, which is approximately \$15 for one way, or \$2.73 per mile.

For Kristin's weekend trips to downtown to visit the Saturday market and volunteer with the Oregon Contemporary Theater, the cost of driving is \$11.40 round-trip. Parking garages in downtown Eugene are free on weekends. Taking LTD downtown for these trips is an alternative, as is biking. While downtown, walking between locations or using the PeaceHealth bike share are alternatives to trying to find parking at each specific location.

Charlie

The practice driving trips that Charlie’s parents take him on cost about \$19 per trip. Alternatives to these trips could be Kristin allowing Charlie to practice while driving between home and Churchill High School on weekdays, but the family does need to shop so this trips cannot be eliminated entirely.

For trips with friends, LTD and biking are good alternatives for Charlie to utilize. The have added advantage of giving him some independence from his parents, so he be more motivated to use alternative modes of transportation than either of his parents.

Cost for Using Alternatives.

The cost of using LTD is \$3.50 for a day pass, \$50 for a one-month pass, and \$135 for a 3-month pass⁴. A youth pass for Charlie would be \$1.75 for a day pass, \$25 for a one-month pass, and \$67.50 for a 3-month pass. The PeaceHealth Rides bike share is \$15 per month, which includes 60 minutes of free ride time per day with additional time billed at \$0.10 per minute. One mile driving in their own vehicles costs about \$0.95. Ride-hailing services vary widely but given Joe’s cost of \$2.14-\$2.19 per mile to/from work and Kristin’s cost of \$2.73 per mile to/from work, it averages to about \$2.50 per mile.

Kristin & Charlie - between Churchill High School and home

Given an average month of 21 weekdays, Kristin and Charlie travel 231 miles per month between their home and school.

Transportation mode	Per Mile Cost	Total Cost	Minutes per day	Total minutes
Car	\$0.95	\$219.45	30	630
Ride-Hail	\$2.50	\$577.50	30	630
LTD	\$0.2165	\$50	100	2100
Bike			60	1260

Conclusions and Implications

Based on current transportation alternatives, there is a great tradeoff between convenience and cost. Currently, the most convenient modes of transportation are also the costliest. Though transportation as a service technology is several years from implementation, is could alter the Pikes transportation habits. In the present, the Pike’s transportation modes are unlikely to change. Because of their socioeconomic status, the savings from alternative transportation modes do not outweigh the convenience costs. If the family lived more central to the city center, this would potentially affect their decision making. The time costs would be cut drastically when using alternatives and the monetary saving would likely still be non-trivial, so there would be greater incentive to switch.

⁴ LTD Prices From <https://www.ltd.org/fare-pass-pricing/>

Appendix B

Briana Buckles and Sam Holland

Briana Buckles and Sam Holland
December 1, 2018

New Mobility Case Study and Feasibility Analysis: Eugene, Oregon

Lifestyle Overview

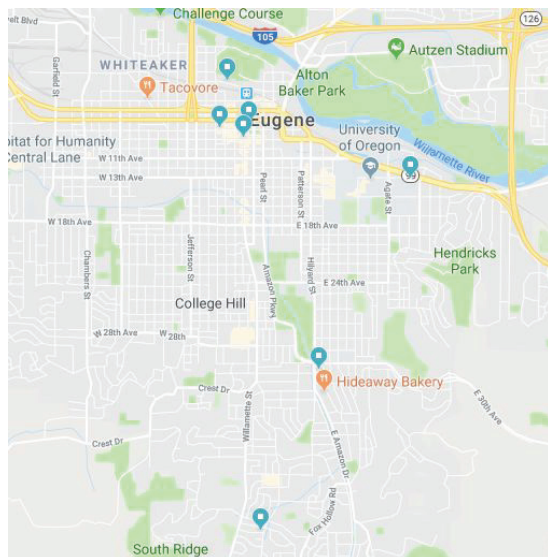
Robert Ingram is a 65 year old male who lives alone in a small home in Southwestern Eugene, OR. His adult children both live in Portland, OR and he makes an effort to go visit them once per month. On weekdays, he works at Hummingbird Wholesale where he earns a modest salary equal to the average salary of Eugene. A couple of times per week he stops at his local Albertsons on his way home to shop for his personal groceries.

Robert is an active gentleman with no limits to his physical mobility. He travels to Bend, OR twice every year for a week-long visit with his old college friends. In the summertime they play golf, and in the winter they ski. Robert fills his spare time by visiting the farmer's market every Saturday morning and volunteering at Food for Lane County afterwards. During the week, he meets friends and co-workers for dinner or drinks about twice per week. As an avid Oregon women's basketball fan, Robert usually purchases season tickets and rarely misses a game.

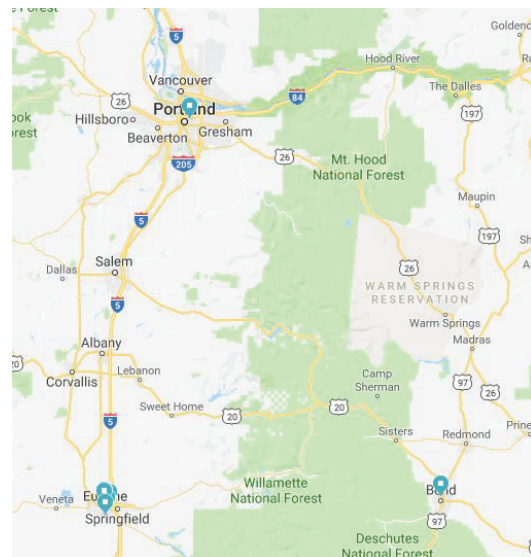
At present, Robert relies almost entirely on his 2008 Subaru Impreza sedan for transportation. Sometimes he will carpool with his friends to Bend, but mostly he enjoys the freedom and independence of driving himself on his own schedule. See Exhibit 1 for a map of Roberts travel locations.

Exhibit 1: Regular and Irregular Travel Locations¹

Regular Travel Locations



Irregular Travel Locations



¹ Maps were created using Google Maps - These maps were also used for calculating distances for various transport modes.

Average Scenario - Prioritizing Convenience and Independence

Rob drives a total of 6162.9 miles each year in his own vehicle in the current scenario. Based on a 2017 article from AAA, the average cost per mile for a sedan is 59.2 cents.² This cost includes gas, maintenance, repair and depreciation. Therefore, Rob is currently spending \$3,648.44 on transportation for driving alone. Additionally, Rob is paying for parking every time he goes to the Barn Light downtown, every time he goes to a women’s basketball game at the Matthew Knight Arena, and every time he goes to Portland. As a result, his total annual parking costs are \$496 (for a detailed cost breakdown see Exhibit 2).

Exhibit 2: Current Annual Mileage and Cost Breakdown³

Trips	Miles	Times Per Year	Total Miles Traveled	Mode of Transport	Cost Per Mile	Annual Trip Cost	Annual Parking Cost
Eugene Trips							
Home to Hummingbird		4.1	250	1025 Personal Vehicle	\$0.59	\$606.80	\$0.00
Hummingbird to Home		4.7	150	705 Personal Vehicle	\$0.59	\$417.36	\$0.00
Hummingbird to Albertsons		3	100	300 Personal Vehicle	\$0.59	\$177.60	\$0.00
Albertsons to Home		1.8	100	180 Personal Vehicle	\$0.59	\$106.56	\$0.00
Home to Farmers Market		3.5	36	126 Personal Vehicle	\$0.59	\$74.59	\$0.00
Farmers Market to FLC*		0.4	36	14.4 Walk	\$0.00	\$0.00	\$0.00
FLC to Home		3.4	36	122.4 Personal Vehicle	\$0.59	\$72.46	\$0.00
Home to Barn Light		3.4	50	170 Personal Vehicle	\$0.59	\$100.64	\$100.00
Barn Light to Home		3.4	50	170 Personal Vehicle	\$0.59	\$100.64	\$0.00
Home to Matthew Knight Arena		4.2	15	63 Personal Vehicle	\$0.59	\$37.30	\$300.00
Matthew Knight Arena to Home		4.2	15	63 Personal Vehicle	\$0.59	\$37.30	\$0.00
Trips to Portland							
Eugene to Portland		118	12	1416 Personal Vehicle	\$0.59	\$838.27	\$96.00
Portland to Eugene		118	12	1416 Personal Vehicle	\$0.59	\$838.27	\$0.00
Trips to Bend**							
Eugene to Bend		139	2	278 Personal Car - Carpool	\$0.59	\$41.14	\$0.00
Bend to Eugene		132	2	264 Personal Car - Carpool	\$0.59	\$39.07	\$0.00
ANNUAL TOTALS			6312.8			\$3,488.00	\$496.00
*Robert will usually park for free in a parkade near the Farmer's Market and walk from the market to Food for Lane County to volunteer							
**Robert usually will take different routes to and from Bend (hence the varying mileage). Assumed that he carools 1/4 of the time.							
Assumptions: Rob stays at the Barnlight for two hours every trip and parking costs \$1 per hour in downtown, he pays \$20 for parking at Matthew Knight Arena, he pays \$8 per day for parking in Portland							

Alternate Scenario #1 – Moderate Adoption of Alternative Transportation Modes

In Alternate Scenario #1, Robert makes some slight changes to his regular modes of transportation. Most notably he downloaded the Lyft app and uses ride hailing services when he is heading out for social events - such as dinner and drink with friends, and the women’s basketball games at Matthew Knight Arena. Rob experienced some benefits right from the first use, he no longer has to spend time searching for parking downtown and around Matthew Knight Arena and he avoids the lofty parking fees.

Robert experiences different benefits when taking Bolt Bus. First of all, the price of a Bolt Bus ticket is much less than filling up a tank of gas on the way up to Portland. Second, Robert likes that he is no longer stuck behind the wheel and now can catch up on some administrative work for Food for Lane County and he can read a book. Although the bus doesn’t take him directly to the coffee shop to meet his kids, one of Robert’s kids now picks him up at the Bolt Bus stop in Portland.

² AAA. (2017). AAA Reveals True Cost of Vehicle Ownership, *AAA Newsroom*. Accessed online at <https://newsroom.aaa.com/tag/driving-cost-per-mile/>, November 30, 2018.

³ For a more detailed look at the mileage and cost breakdowns for all three scenarios visit - <https://docs.google.com/spreadsheets/d/1OgiphQuYzI8xMv3dLBECNdxHnZUp4A8Ot3dDchBFIs/edit#gid=0>

In this scenario, Robert’s total annual transportations costs have been reduced by \$449.32 (for a detailed cost breakdown of Alternate Scenario #1 see Exhibit 3). His overall carbon footprint has been reduced due to an increase in shared transportation options like the Bolt Bus and public transportation. It is however, important to note that the use of ride hailing may have a higher carbon footprint than when he drove himself due to the wayfinding ride hailing cars must do in order to reach the pick up location. This impact can be reduced if Lyft offers ridesharing options in the future. This function is available in the Lyft app, but has not yet been introduced in Eugene. The addition of ridesharing would also decrease Robert’s annual transportation cost with a tradeoff in time and convenience.

Exhibit 3: Alternate Scenario #1 Annual Mileage and Cost Breakdown

Trips	Miles	Times Per Year	Total Miles Traveled	Mode of Transport	Cost Per Mile	Annual Trip Cost	
<i>Eugene Trips</i>							
Home to Hummingbird		4.1	250	1025	Personal Vehicle	\$0.59	\$606.80
Hummingbird to Home		4.7	150	705	Personal Vehicle	\$0.59	\$417.36
Hummingbird to Albertsons		3	100	300	Personal Vehicle	\$0.59	\$177.60
Albertsons to Home		1.8	100	180	Personal Vehicle	\$0.59	\$106.56
Home to Farmers Market		3.5	36	126	Personal Vehicle	\$0.59	\$74.59
Farmers Market to FLC*		0.4	36	14.4	Walk	\$0.00	\$0.00
FLC to Home		3.4	36	122.4	Personal Vehicle	\$0.59	\$72.46
Home to Barn Light		3.4	50	170	Ride Hail	N/A	\$578.50
Barn Light to Home		3.4	50	170	Ride Hail	N/A	\$578.50
Home to Matthew Knight Arena		4.2	15	63	Ride Hail	N/A	\$196.05
Matthew Knight Arena to Home		4.2	15	63	Ride Hail	N/A	\$196.05
<i>Trips to Portland</i>							
Home to Bus Stop		3.9	12	46.8	Bus	N/A	\$21.00
Eugene to Portland Bolt Bus Stop		111	12	1332	Bolt Bus	N/A	\$204.00
Portland Bolt Bus Stop to Coffee Shop		3.8	12	45.6	Kid's Personal Vehicle	\$0.00	\$0.00
Coffee shop to Portland Bolt Bus Stop		3.8	12	45.6	Kid's Personal Vehicle	\$0.00	\$0.00
Portland Bolt Bus stop to Bus Stop		111	12	1332	Bolt Bus	N/A	\$204.00
Bus Stop to Home		3.9	12	46.8	Bus	N/A	\$21.00
<i>Trips to Bend**</i>							
Eugene to Bend		139	2	278	Personal Car - Car Pool	\$0.59	\$41.14
Bend to Eugene		132	2	264	Personal Car - Car Pool	\$0.59	\$39.07
ANNUAL TOTALS				6329.6			\$3,534.69
*Robert will usually park for free in a parkade near the Farmer's Market and walk from the market to Food for Lane County to volunteer							
**Robert usually will take different routes to and from Bend (hence the varying mileage)							

Anticipated Barriers to Adoption	Recommended Solutions
<p>Bolt Bus Schedules - Having to stick to a strict schedule can limit Robert’s ability to be spontaneous when visiting Portland.</p>	<p>A little bit of planning ahead can save a lot of money on this type of trip. Establishing new routines for recurring trips is an attainable goal.</p>
<p>Ride Hailing Costs - It is hard to justify the costs of ride hailing when I am already paying for gas and insurance for my current vehicle.</p>	<p>The cost of ride hailing is offset by the amount of money saved on parking and the added gas required to search for parking. Additionally, the use of ride hailing after social events eliminates the possibility that Robert could get a DUI which would incur a significant amount of related expenses.</p>
<p>Decrease in Gas Prices - If gas prices begin to drop, the convenience of driving my own car will trump the cost savings of ride hailing and the Bolt Bus.</p>	<p>Regardless of low gas prices, you will still be adding unnecessary wear and tear on your vehicle. Additionally, planning for consistent and relatively unchanged costs (like a Bolt Bus ticket) can create strong financial stability by removing risk associated with reliance on fluctuating gas prices.</p>

Alternate Scenario #2 - Aggressive Adoption of Alternative Transportation Modes

In Alternate Scenario #2 Robert has completely overhauled his daily transportation habits by maximizing his use of alternative and cooperative transportation in an effort to reduce the carbon footprint of his regular and irregular transportation. In this scenario, Robert has sold his car and signed up for four new transportation services to fill the void:

- Monthly Lane Transit District Pass
- Peacehealth Bike Share
- Bird scooters
- Car2Go

Adopting this scenario would save Robert \$1,084.01 each year in transportation costs compared to his current transportation habits (for a detailed cost breakdown of Alternate Scenario #2 see Exhibit 4). However, there are significant sacrifices in time, efficiency, and flexibility related to this scenario. For example, his current commute to work by car takes approximately 13 minutes. If Robert begins taking the bus to the city center and then biking from there to Hummingbird Wholesale, his commute time is anywhere from 39 minutes to 56 minutes depending on the bus schedule.

Alternatively, he could bike the entire route and it would only take him approximately 25 minutes and he would save money on public transit costs. However, there is a large hill that could hinder his ability to

bike home. Additionally, because he lives towards the outside edge of town, the streets near his neighborhood are far less bike friendly.

At this time, the Peacehealth Bike Share program does not service the neighborhood that Robert lives in.

⁴ There are also no scooter sharing programs available in Eugene. Full adoption of this scenario would require one of those systems to be available for Robert. Until that time, the scenario remains relatively unchanged if he were to purchase and use his own bike in place of a bike share option.

Exhibit 4: Alternate Scenario #2 Annual Mileage and Cost Breakdown

Trips	Miles	Times Per Year	Total Miles Traveled	Mode of Transport	Annual Trip Cost
Eugene Trips					
Home to Eugene Station	3.3	250	825	Bus	\$0.00
Eugene Station to Hummingbird	0.9	250	225	Bike/Scooter Share	\$0.00
Hummingbird to Eugene Station	0.9	250	225	Bike/Scooter Share	\$0.00
Eugene Station to Home	3.3	250	825	Bus	\$0.00
Hummingbird to Albertsons	2.7	100	270	Bike/Scooter Share	\$0.00
Albertsons to Home	1.9	100	190	Bus	\$0.00
Home to Eugene Station	3.3	36	118.8	Bus	\$0.00
Eugene Station to Farmers Market	1	36	36	Bike/Scooter Share	\$0.00
Farmers Market to FLC	0.4	36	14.4	Walk	\$0.00
FLC to Home	3.8	36	136.8	Bus	\$0.00
Home to Barn Light	3.4	50	170	Ride Hail	\$578.50
Barn Light to Home	3.4	50	170	Ride Hail	\$578.50
Home to Matthew Knight Arena	4.2	15	63	Ride Hail	\$196.05
Matthew Knight Arena to Home	4.2	15	63	Ride Hail	\$196.05
Trips to Portland					
Home to Bus Stop	3.9	12	46.8	Bus	\$0.00
Eugene to Portland Bolt Bus Stop	111	12	1332	Bolt Bus	\$204.00
Portland Bolt Bus Stop to Coffee Shop	3.8	12	45.6	Kid's Personal Vehicle	\$0.00
Coffee shop to Portland Bolt Bus Stop	3.8	12	45.6	Kid's Personal Vehicle	\$0.00
Portland Bolt Bus stop to Bus Stop	111	12	1332	Bolt Bus	\$204.00
Bus Stop to Home	3.9	12	46.8	Bus	\$0.00
Trips to Bend**					
Home to Bend	139	2	278	car2go/carpool	\$111.45
Bend to Home	132	2	264	car2go/carpool	\$111.45
Annual Upfront Costs					
Lane Tranist District Pass					\$540.00
Peacehealth Bike Plan					\$180.00
ANNUAL TOTALS			6722.8		\$2,900.00

⁴ PeaceHealth Rides. (2018). Map. Accessed online at <https://www.peacehealthrides.com>, November 30, 2018.

Anticipated Barriers to Adoption	Recommended Solutions
<p>Disruption to the Routine - Robert would not be able to bring his breakfast and coffee on the go if he were to start using the bike share regularly because he may spill his coffee.</p>	<p>Robert would have to slightly change his routine - perhaps having his breakfast and coffee a little earlier in the morning or investing in a spill proof mug for his morning commute.</p>
<p>Time and Distance - riding the bus and a bike will take much longer to get places than taking his personal car.</p>	<p>There is a ten minute time increase between driving to work and biking to work. Although biking takes longer, Robert can avoid uncertainty in his commute time related to traffic. Eugene also has a great bike lane system that Robert can take advantage of.</p>
<p>Variable Weather Conditions - It rains for majority of the year in Eugene and Robert may get soaked on his way to and from work.</p>	<p>Eugene has a bike commuter culture⁵ that Robert can tap into for advice. As well, REI sells a variety of equipment that will help Robert battle the elements.⁶</p>

Summary

Overall, it is apparent that adopting a mobility strategy that includes a combination of transit and alternative transport modes is the most cost effective means of travel. However, the feasibility of such a strategy is questionable. The current transportation options available in Eugene, residents must balance convenience, cost and sustainability impact. It is up to each individual to decide which of these aspects will be optimized when fulfilling daily transportation needs. At this time, there is no opportunity to fully optimize cost and convenience while minimizing emissions impacts. These conflicts are especially apparent for residents who live on the edge of town with less access to convenient public transit routes, bike friendly infrastructure, and existing bike sharing programs.

⁵ WeBikeEugene. (2018). Home, Accessed online at <http://www.webikeeugene.org>, November 29, 2018.

⁶ REI. (2018). Bike Commuting/Urban Checklist, *Expert Advice*. Accessed online at <https://www.rei.com/learn/expert-advice/cycling-commuting-checklist.html>, November 29, 2018.

Appendix C

Charmaine Guillory and Chloe Tirabasso

THE SANTANA FAMILY



URBAN MOBILITY

MGMT 641

CHARMAINE GUILLORY & CHLOE TIRABASSO

FALL 2018

EXECUTIVE SUMMARY

Smart urban mobility infrastructure is directly correlated to the health and wellness of societies. While it's easy to get caught up considering mobility in terms of megacities and big data, creating solutions for straightforward scenarios is fruitful as well. Our family, the Santanas, have a simple need: to transition between the many points of their busy lives without the crippling expense of a car. Improved public transit, carpooling, and car-share can make this possible. Yet, while their need is simple, their lives are complex, with many obligations. Thus, the Santanas' solution has widespread implications for Eugene mobility; it applies to families that do not have many luxuries or freedoms when considering transit alternatives. It can apply to lifestyles that are often not at the center of the diaspora of mobility.

MEET THE FAMILY

Meet the Santana family: Sabine, Sam, Sheera and Seven. An Oregonian family living in Bethel-Danebo, they rent a two bedroom home. Between the two working parents they have an annual income of \$38,324 which falls within the 60% poverty level for the area. While their finances are limited, they strive for a happy and stable home by being active members of their communities and spending quality time together.

<p>Sabine:</p> <ul style="list-style-type: none"> • 32 years old • Associate degree • Office Specialist I at University of Oregon Law School (full-time) • Recent workforce re-entrant due to raising children 	<p>Sam:</p> <ul style="list-style-type: none"> • 37 years old • Lane Community College student (no degree) • Night-shift worker at Seneca Sawmill (part-time) • Recovering addict attending AA
<p>Sheera:</p> <ul style="list-style-type: none"> • 6 years old • Attends Malabon Elementary School • Plays youth soccer 	<p>Seven:</p> <ul style="list-style-type: none"> • 4 years old • Attends pre-school at UO Olum Center

CURRENT TRANSIT

The Santana family has two cars that they rely on heavily to transport them between their regular and irregular destinations (A-1). This is a significant burden for them as the family struggles to afford car maintenance, insurance and parking fees. Yet, with their disparate destinations and small children, there are no other practical transit solutions that work. Taking the bus is impractical or impossible, as it's an hour ride for Sabine and is not available for Sam's swing shift. As the family lives in an industrial area, cycling at night and with children is unsafe. Ride-hailing is cost-prohibitive.

AVERAGE WEEKDAY SCHEDULE

Time	Activity
11:30pm	Sam drives to Seneca Sawmill for 12am shift
6:30am	Sam drives to First Christian Church for AA
7:30am	Sabine walks Sheera to a neighbor's (who walks their kids to school), then drives with Seven to UO
8am	Sam drives home from First Christian Church
2:15pm	Sam walks Sheera home from school
5pm	Sabine + Seven drive back from UO
5:30pm	Sam drives to LCC for 6pm class
9pm	Sam drives from LCC home

ENVISIONED TRANSIT

As car ownership is one of the Santanas's highest expenses (Appendix B), they would welcome alternative transit. Yet, considering the constrained fullness of their lives with shift-work, children, and school, alternative transportation can't impose on the family significantly.

The following considerations are most important to any alternate transportation:

- 1) **Cost:** must be at or below current costs
- 2) **Time investment:** must be relatively the same time commitment
- 3) **Safety:** must feel safe for the entire family, especially Sabine and kids

While Eugene does not currently offer alternate transportation options that meet the above criteria for the Santanas, the following solutions eliminate the Santanas's reliance on their cars while meeting their needs. The envisioned scenario accomplishes this through relying on an expansion of existing services and introducing new services to the market as follows:

- 1) Improved Lane Transit District services
- 2) Carpooling
- 3) Car-sharing

LANE TRANSIT DISTRICT & THE EMX

For a medium-sized town in a semi-rural location, the Lane Transit District ([LTD](#)) is a surprisingly wide-reaching transit system. However, as it stands, LTD is inefficient. With only one rapid transit line through town (EmX), it can currently take over an hour and require multiple transfers to simply get downtown. Off-hours schedules are very limited, making it unfeasible for Sam's commute to work. Moreover, it's [unsafe](#), with high crime around transfer stations. For a low-income family with young children and multiple obligations across town, current LTD services are simply not reasonable.

This changes, however, with the proposed LTD [MovingAhead](#) expansion project that would increase the efficiency of its services. LTD plans to capitalize on the EmX's success by creating four [new lines](#), including one on the Hwy 99 corridor, blocks from the Santanas house. With this LTD expansion, at minimum, Sabine, Seven, and Sam can use the EmX for their commutes to work, school and AA meetings. And through their UO/LCC affiliations, the Santanas are allotted free bus passes, making it extremely cost-effective. This presupposes that MovingAhead will work with the City of Eugene to increase safety at transfer stations, but this is a fair assumption as it's an essential measure for transit buy-in.

CARPOOLING

Looking to Portland as a local case study, the introduction of carpooling services to Eugene can prove a useful and viable solution for the Santanas family for some of their weekly activities. [Waze](#) has rolled out a carpooling feature on its app that allows drivers to connect with riders on a single roundtrip. While the platform works to build traction, costs are held low at simply the federal per-mile rate, making it convenient and affordable. Intended for commutes to work, this feature can also be applied to commutes to church or school functions. Sam's night shift hours are likely not conducive to using a carpooling app like Waze however. Instead he will need to coordinate with co-workers on the same shift to carpool and split gas costs. Informal carpooling will become easier in Eugene as the mode becomes more visible and buy-in increases.

CAR-SHARING

While LTD services and carpooling will take care of much of the Santanas regular destination transportation, they will still need access to a vehicle for their one-off trips, such as to the grocery store or dentist, and especially for times when they need to haul items. While some car-sharing platforms may not be realistic for the Santanas or Eugene (Car2Go has only 2 seats and pulled out of the area some time

ago), owner-to-renter platforms such as [Getaround](#) would make a viable solution for the Santanas. The Santanas can rent a car when they need it at the cost of a 3% booking fee, hourly rate and the cost of gas. In its 6th year in Portland, expanding Getaround's offering to the Eugene market should be both feasible and realistic through a strong marketing push in partnership with the city, complementing the existing ride-hailing services.

FAMILY ADJUSTMENTS

Fully realizing the envisioned transit scenario requires no significant or unreasonable lifestyle changes for the Santanas. However, they will need to increase efficiency in scheduling their healthcare appointments and the like, consolidating them to the same day and timeframe to streamline trips. The family will also need to plan to include walking times in their transit, adding an average of 15 minutes to their trip time when using LTD. Sam will have to be proactive in coordinating carpooling for work and kids' activities. Finally, Sabine will need to enroll in self-defense classes offered free at UO and carry mace to feel more comfortable using LTD services.

NOTE ABOUT THIS TRANSIT SCENARIO

We recognize that the rise of automated vehicles (AVs) may void our analysis. If RethinkX is even remotely accurate, the Santanas will have virtually free transportation within the next 5-8 years. However, we believe the RethinkX study has a bit of the *Deus ex Machina* to it. While AVs may save us all, we found it a much more fruitful exercise to analyze how the Santanas could replace their cars with current platforms and pending transit changes.

FINANCIAL ANALYSIS

As stated, the Santana family is living on a limited budget of \$38,324 annually. Monthly income for the family is fixed at \$3194 with expenses averaging \$3184. By moving the family from a two-car to a no-car household, \$587 is saved per month in expenses. See B-1 for a detailed analysis. Note the following about the Santana finances:

1. Do not qualify for food stamps at their income level
2. Qualify for Medicaid, but receive higher quality insurance through UO
3. Qualify for the EIC/EITC credits
4. Qualify for financial aid grants
5. Qualify for Free and Reduced Lunch
6. Supplement groceries with visits to the church food pantry
7. Receive scholarships for day-care and soccer

To note, our analysis shows that the Santanas would also save the same amount of money monthly if they were to keep one car and not use carpooling or car-sharing (see B-1). However, the Santanas have very little in savings and it would be a challenge for them to buy a new car when their current car inevitably dies. Therefore, we think it more reasonable for them financially to transition to a carless household.

CONCLUDING THOUGHTS

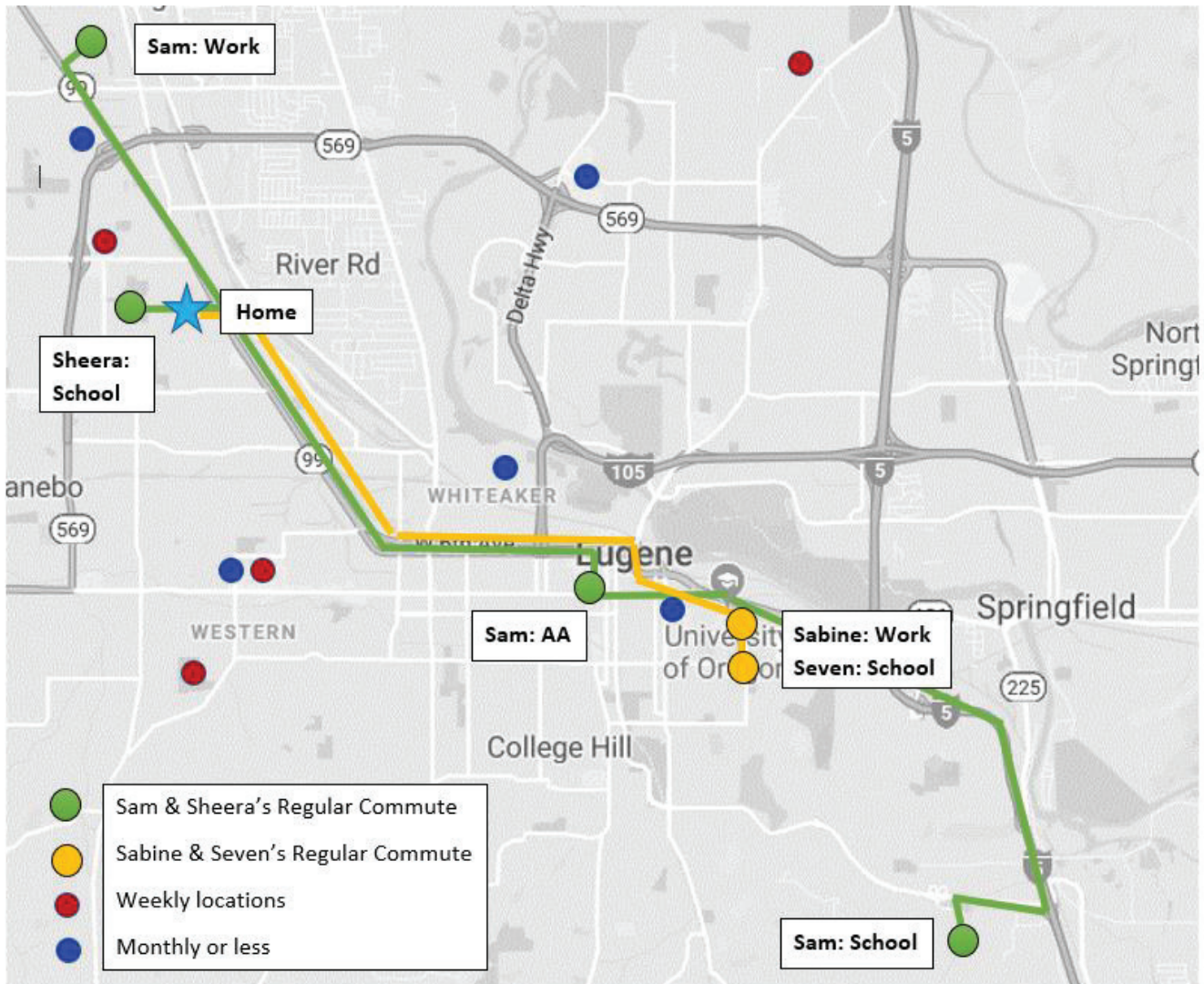
The development of the Santana family's transit scenarios factor in what would affect everyday life for a family in financial straits and is based on real-life scenarios for a large portion of the population. This is crucial as we consider not only how sustainable urban mobility works for a family or community, but what realistic and meaningful transit could mean for the disadvantaged. With increased financial security as their top priority, the Santanas are now able to increase their financial stability and provide more for their children. Furthermore, their opportunity to network, engage with their community, be more physically active, and, of course, reduce emissions comes to fruition as they begin to realize the emerging vision of new mobility.

APPENDIX

A-1 TRANSIT SCHEDULE

Regular Frequent Destinations	Frequency	Family Member	Current Transit	Envisioned Transit
Home: 3680 Pattison in Eugene	Daily	All	—	—
University of Oregon Law School	Mon – Fri	Sabine	Car	EmX
Seneca Sawmill	Wed – Sat	Sam	Car	Carpool
Lane Community College (main)	Mon – Thu	Sam	Car	EmX
Malabon Elementary School	Mon – Fri	Sam/Neighbor + Sheera	Walk	Walk
AA Meetings at First Christian Church	2-3 times a week	Sam	Car	EmX
Echo Hollow Park	2-3 times a week	One parent + kids	Walk	Walk
Gas station (Fred Meyer on 11th)	2 times a week (1/car)	Sam & Sabine	Car	Car-share
Grocery store (WinCo)	1x/week	All	Car	Car-share
First Baptist Church	1x/week	All	Car	Carpool
Library (Bethel)	1x/week	All	Walk	Walk
Irregular Destinations	Frequency	Family Member	Transit Method	Transit Method
Soccer Practice and Games (Kennedy)	2-3 times a week (during season)	Sheera + One Parent usually Sam	Car	Carpool
Family night	1x/month	All	Car	EmX/Car-share
Date night	1x/month	Sabine + Sam	Car	EmX/Car-share
Clothes, house shopping (Goodwill)	Varies; 1x/1-3mos	All	Car	Car-share
Hardware store (Jerry's)	Varies; 1x/1-3mos	Sabine or Sam	Car	Car-share
Car maintenance (Joe's Garage)	Varies; 1x/1-3mos	Sabine or Sam	Car	N/A
Doctor's Visit (Sacred Heart)	5+x/yr. (once per family member for annual check-up, plus additional as needed)	All	Car	EmX; shifting to 2-3x/yr.
Dental Visit (Willamette Dental)	6+x/yr. (once per adult, twice per child per year)	All	Car	Car-share; shifting to 2x/yr.
Grandparents for the holidays (Medford)	1-2 times a year	All	Car	Car Rental or Greyhound

A-2 TRANSIT MAP



B1-4 FINANCIAL ANALYSIS SPREADSHEETS

SEE ATTACHED EXCEL FILE

REFERENCES

1. Google Maps: www.google.com/maps
2. Lane Transit District:
 1. <http://www.movingahead.org/>
 2. MovingAhead Alternative Analysis Report: http://www.movingahead.org/wp-content/uploads/2018/09/LTD%20MovingAhead%20AA_Draft-08242018_HighRes.pdf
 3. Proposed EmX Route: http://www.movingahead.org/wp-content/uploads/2015/03/Level2_Corridor_EnviroAnalysis_Basemap_VicinityExtent_EmX-DOWNTOWN.pdf
 4. <https://www.ltd.org/fare-pass-pricing/>
3. Carpool:
 1. Waze: <https://www.cnet.com/how-to/getting-started-with-waze-carpool/>
 2. Waze: <http://fortune.com/2018/10/10/waze-carpool-launches/>
 3. Price breakdown: https://support.google.com/waze/carpool/answer/6257576?hl=en&ref_topic=6211343
4. Car-share:
 1. Getaround: <https://www.getaround.com/terms/fees>
 2. Getaround comparison: <https://medium.com/@dddadarby/city-car-share-vs-getaround-vs-relay-rides-vs-zipcar-vs-straight-up-ownership-d33d46f14f08>
 3. Getaround eligibility: <https://help.getaround.com/hc/en-us/articles/204371514-Am-I-eligible-to-book-with-Getaround->
 4. Car2Go in Eugene: <https://oregonbusiness.com/article/item/12428-car2go-bailing-out-of-eugene>
5. General Information:
 1. Income level: https://www.hudexchange.info/resource/reportmanagement/published/HOME_Income_Lmts_State_OR_2018.pdf
 2. Crime: <https://www.crimereports.com/agency/eugene-police-department-or#>
 3. Mileage rates: <https://www.irs.gov/newsroom/standard-mileage-rates-for-2018-up-from-rates-for-2017>
 4. Used car information: <https://repairpal.com/cars/honda/civic/2000>

Budget Overview

Balance

Scenario 1	(S1 minus expenses)	(\$0)
Envisioned	(S2 minus expenses)	\$586
Difference	(S2 minus S1)	\$586

Income

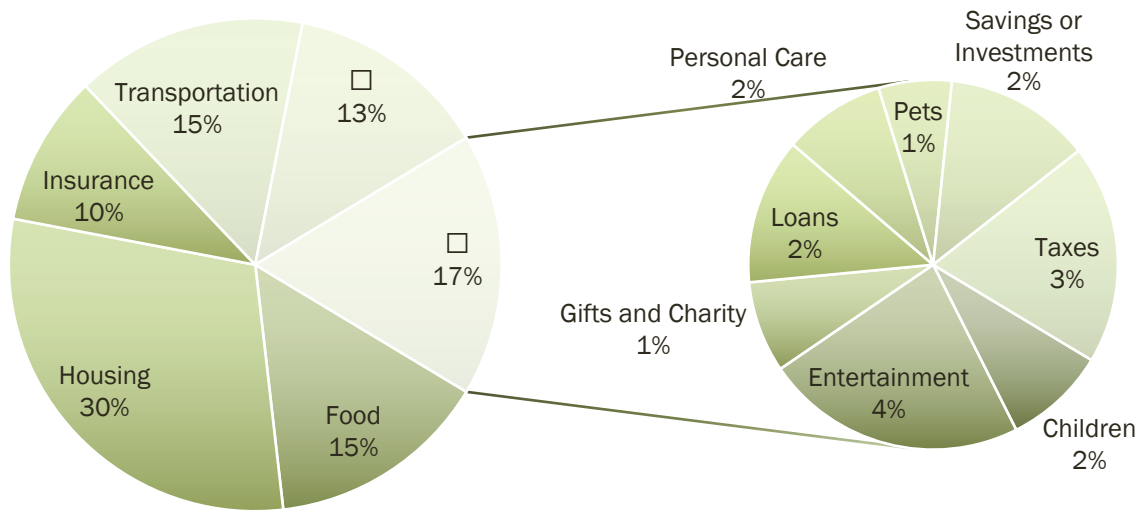
Envisioned (S2)	Sam's Income	\$932
	Sabine's Income	\$2,262
	Total income	\$3,194

Expenses

Envisioned \$2,608

Scenario 1 (S1)	Sam's Income	\$932
	Sabine's Income	\$2,262
	Total income	\$3,194

Scenario 1 \$3,194



Budget Summary

Category	Current	Envisioned	Difference
Food	\$619	\$619	\$0
Entertainment	5	5	0
Food	\$420	\$420	\$0
Gifts and Charity	20	20	0
Housing	\$910	\$910	\$0
Insurance	\$169	\$169	\$0
Loans	\$190	\$190	\$0
Personal Care	\$22	\$22	\$0
Savings or Investments	\$73	\$73	\$0
Taxes	0	0	0
Transportation	\$766	\$180	\$586

Monthly Expenses

Description	Category	Current	Envisioned	Difference	Actual Cost Overview
Daycare	Children	\$600	\$600	\$0	
Medical	Children	\$10	\$10	\$0	
Family Night	Children	\$5	\$5	\$0	
School Supplies	Children	\$4	\$4	\$0	
Movies	Entertainment	\$5	\$5	\$0	
Groceries	Food	\$400	\$400	\$0	
Dining Out	Food	\$20	\$20	\$0	
Church tithe	Gifts and Charity	\$20	\$20	\$0	
Gift 1	Gifts and Charity			\$0	
Mortgage or Rent	Housing	\$700	\$700	\$0	
Cable/Internet	Housing	\$50	\$50	\$0	
Phone (Cellular)	Housing	\$50	\$50	\$0	
Electric	Housing	\$30	\$30	\$0	
Water and Sewer	Housing	\$30	\$30	\$0	
Waste Removal and Recycle	Housing	\$20	\$20	\$0	
Gas	Housing	\$15	\$15	\$0	
Supplies	Housing	\$15	\$15	\$0	
Maintenance	Housing	\$0	\$0	\$0	
Home	Insurance	\$105	\$105	\$0	
Health	Insurance	\$60	\$60	\$0	
Life	Insurance	\$4	\$4	\$0	
Student	Loans	\$110	\$110	\$0	
Credit Card- Sam	Loans	\$50	\$50	\$0	
Credit Card- Sabine	Loans	\$30	\$30	\$0	
Clothing	Personal Care	\$15	\$15	\$0	
Medical	Personal Care	\$7	\$7	\$0	
Retirement account	Savings or Investments	\$68	\$68	\$0	
Savings account	Savings or Investments	\$5	\$5	\$0	
Federal	Taxes	\$0	\$0	\$0	
State	Taxes	\$0	\$0	\$0	
Shared Transit Costs	Transportation	\$0	\$169.22	▼ (\$169)	
Licensing /Registration	Transportation	\$10	\$10	\$0	
Fuel	Transportation	\$66.11	\$0	▲ \$66	
Insurance	Transportation	\$100.00	\$0	▲ \$100	
Maintenance	Transportation	\$133.33	\$0	▲ \$133	
Parking fees	Transportation	\$456.00	\$0	▲ \$456	
Vehicle payment	Transportation	\$0	\$0	\$0	
Total		\$3,194	\$2,608	\$586	

Transportation Expenses

Recurring Costs (Monthly)

	Scenario 1 Two Cars	Bonus Scenario 1 Car	Scenario 2 No Cars
Car Payments	\$ -		
Car Maintenance	\$ 133.33	\$ 66.67	
Car Insurance	\$ 100.00	\$ 50.00	
Parking Pass	\$ 456.00		
Gas Expense			
Sam Work Commute	\$ 8.48	\$ 4.24	
Sabine Work Commute	\$ 16.24	-	
Sam School/AA	\$ 26.34	\$ 7.46	
Weekly Errands	\$ 11.89	\$ 8.90	
Monthly Errands	\$ 3.16	\$ 2.63	
Bus Pass	\$ -	\$ -	\$ 3.00
Car-Pooling Expense			
Sam Work Commute			\$ 30.23
Church			\$ 26.58
Soccer			\$ 15.62
Car-Share Expense			
One Time Set-up Fee			\$ 1.67
Weekly Errands			\$ 37.39
Monthly Errands			\$ 18.02
Grandparents			\$ 36.71
Total Cost	\$ 755.44	\$ 139.89	\$ 169.22

Cost Savings	\$ 615.55	\$ 586.22
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One-Time Costs

	Scenario 1	Bonus Scenario	Scenario 2
Car (cash payment)	\$ 6,000	\$3,000	
Title	\$ 186.00	\$93	
Car-Share			\$ 20.00

Mileage Cost/Mile	\$ 0.076
-------------------	----------

	Miles/Month	Miles/Roundtrip
--	-------------	-----------------

Sam Work Commute	110.9	6.4	
Sabine Work Commute	212.3	10.4	
Sam School/AA	344.5	19	
Weekly Errands	155	6	8.6
Weekly Errands	90.4	1	1
Monthly Errands	41.28	24.5	10.8
Monthly Errands	4.7	2	1.5

Carpool Cost/Mile	\$ 0.545
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One Time Set-up Fee	\$ 10.00
Car-Share Cost/Hour	\$ 7.50
Car-Share Cost/Mi	\$ 0.545
Car-Share Per Ride Fee	3%

Appendix D

Elena Lisac and Vaishali Vadivazhagan

Elena Lisac
Vaishali Vadivazhagan
MGMT 641
December 1, 2018

Mobility Case Study and Feasibility Analysis

Problem overview

Our project aims to create sustainable alternative solutions for a household travel needs with a focus on overall environmental impact, time commitment, money, availability, and convenience.

We assess the viability of different new mobility scenarios for a household located in Springfield, OR (49th Place) with regular trips to Eugene, OR and Portland, OR.

Household description

Household members include Andrei, 38 years old, white male, self-employed, and Elena, 32 years old, white female, graduate student and part-time employee at the University of Oregon. Andrei operates his own business, he provides installation services of professional audio visual and home automation systems for residential and commercial users. He uses his home office for paperwork, but he does most of the projects in the places where his clients live or work, mostly in Portland, OR and Vancouver, WA. That is, he drives at least 4 - 5 times a week from Springfield to Portland/Vancouver and back home. He should always take his tools and equipment while driving to the client's place which includes at least 3 big tool-bags and sometimes more. Occasionally, he has projects to be done in Marshall, TX and he flies to this destination. In order to keep on new trends in the industry, Andrei participates in professional events in Las Vegas, NV, and Los Angeles, CA 3 - 4 times a year as a total and he flies to these destinations.

Elena has classes at the Lundquist College of Business 4 times a week and she works at the University of Oregon the same days when she has classes. She goes shopping at the Market of Choice (Franklin Blvd) 1 - 2 times a week and at the Saturday Farmers market 2 - 3 times a month. Occasionally, she may visit some other places in Eugene.

Andrei and Elena enjoy spending free time traveling along the West coast most frequently in Oregon with occasional trips to Seattle, San Francisco, Los Angeles, and Sacramento.

They own a car, Volkswagen Beetle, which Andrei uses for his regular trips to clients and whenever they travel together. He also drives Elena to the university in the morning, however, they need to adjust their schedules to each other. Elena uses transit for her regular trips from Eugene to Springfield.

Household income is around the median.

Current monthly household transportation costs include gas (\$650 — \$900), vehicle insurance (\$90), parking & tolls (up to \$50), and car wash services (\$40). The car is still under warranty so the costs for vehicle repair and maintenance are relatively low (up to \$500 a year). Elena does not pay for transit because she uses her Student ID as a free pass. These costs do not include occasional flights mentioned above.

While choosing the transport mode for their needs, Andrei and Elena assess the following factors: time which is of the most value due to the fact that they both extremely busy, money which is less important than time, however, is still significant, distance, and convenience (parking, weather, availability of particular transport and so forth).

Andrei and Elena are both from Eastern Europe, they used to satisfy their transportation needs in a different way in their home country and while traveling to other European countries including walking, public transport, transit, high-speed trains, subway, and bikes.

Alternative mobility scenarios

For the purpose of this project we are going to evaluate the following scenarios based on time commitment, money, convenience, and overall environmental impact:

- A. The household will use their existing car for all regular and irregular trips, assuming that Andrei will drive Elena to/from the university and they will go shopping together.
- B. The household can change their car for Tesla to use it for Andrei’s regular trips to Portland and Vancouver. Andrei will also drive Elena to/from the university and they will go shopping together as well as they can use Tesla for their regular trips along the coast.
- C. Elena can purchase a bike to use it as an addition to LTD bus for her regular trips to/from the university and moving around Eugene. Andrei can use a bus to visit his clients. The household can use their existing car for leisure trips in Oregon and they can use the currently available Amtrak train for their regular trips along the coast.
- D. Elena can use BRIDJ/Chariot alternative for her regular trips to/from Eugene (not currently available in Eugene). Andrei will use Tesla to visit his clients. The household will also use Tesla for leisure trips in Oregon and they will use a high-speed train for their regular trips along the coast (not currently available in Eugene).

Scenarios analysis

We conducted our analysis of the different scenarios using cost per mile, total variable cost and time as the indicators of the efficiency of a particular transportation mode. The time frame we consider for the analysis is 1 year.

Fig.1 represents the cost calculations for the two vehicles under consideration.

<u>VW Beetle</u>			
Fixed Costs		Variable Costs	
Car Payments*	\$ 2,400	Fuel/gallon	\$ 3
Insurance costs	\$ 1,080	Maintenance	\$ 895
Tire/year	\$ 564	Parking expenses	\$ 300
Total	\$ 4,044	Total	\$ 1,195
<u>Tesla</u>			
Fixed Costs		Variable Costs	
Car Payments*	\$ 9,200	Price/KWh**	\$ 0.12
Insurance costs	\$ 1,080	Maintenance	\$ 520
Tire/year	\$ 800	Parking expenses	\$ 300
Total	\$ 11,080	Total	\$ 820

* Car payment is a cost of the car per year under the assumption that the car is totally depreciated in 5 years.
 ** Average price per kWh

Fig. 1: Cost Calculation

The Cost per Mile was calculated using the formulas:

$$\text{Cost per Mile (VW Beetle)} = (\text{Total Fixed Cost} + \text{Maintenance} + \text{Parking} + \text{Fuel Cost} * \text{Fuel Required(gallons)}) / (\text{Total Miles})$$

$$\text{Cost per Mile (Tesla)} = (\text{Total Fixed cost} + \text{Maintenance} + \text{Parking} + \text{Electricity required (kWh)} * \text{Price per kWh}) / (\text{Total Miles})$$

$$\text{Cost per Mile (other modes of transport)} = (\text{Total Variable Cost}) / (\text{Total Miles})$$

The Total Variable Cost was calculated using the formulas:

$$\text{Total Variable Cost (VW Beetle)*} = \text{Fuel Cost} * \text{Fuel Required(gallons)} + \text{Maintenance} + \text{Parking}$$

Scenario D.

	No. of times/year	Address	Miles (one way)	Miles (two way)	Total Miles	Electricity required (KWh)	Mode of Transport	Time (mins) - one way	Total Variable Cost	Cost per mile
LCB	208	955 E. 13th Ave, Eugene, OR 97403	7	15	3,037		BRIDJ	20	\$ 1,290	\$ 0.42
MOC	104	1960 Franklin Blvd. Eugene, OR 97403	6	13	1,310		BRIDJ	18	\$ 645	\$ 0.49
Farmer's market	24	Oak St & E 8th Ave, Eugene, OR 97401	10	21	494		BRIDJ	20	\$ 149	\$ 0.30
Client's office	260	Portland, OR	115	230	59,800	22,923	Tesla	120	\$ 2,751	\$ 0.24
Client's houses	260	Vancouver, WA	123	246	63,960	24,518	Tesla	150	\$ 2,942	\$ 0.23
Florence	24	Florence, OR	75	150	3,600	1,380	Tesla	90	\$ 166	\$ 3.35
Dexter State Park	24	Dexter State Recreation Site, Dexter, OR	13	25	605	232	Tesla	15	\$ 28	\$ 19.72
Friends	12	Portland, OR	115	230	2,760	1,058	Tesla	120	\$ 127	\$ 4.36
Cannon Beach	12	Cannon beach, OR	187	374	4,488	1,720	Tesla	180	\$ 206	\$ 2.70
Crater Lake Natior	3	Klamath County, Oregon	158	316	948	363	Tesla	163	\$ 44	\$ 12.60
Bend	6	Bend, OR	121	242	1,452	557	Tesla	135	\$ 67	\$ 8.24
Mount St. Helens	4	Skamania County, WA	184	368	1,472	564	Tesla	191	\$ 68	\$ 8.13
Seattle	6	Seattle, WA	287	574	3,444		High Speed train	108	\$ 420	\$ 0.12
San Francisco	6	San Francisco, CA	522	1,044	6,264		High Speed train	196	\$ 420	\$ 0.07
Sacramento	4	Sacramento, CA	467	934	3,736		High Speed train	175	\$ 280	\$ 0.07
Los Angeles	6	Los Angeles, CA	864	1,728	10,368		High Speed train	324	\$ 420	\$ 0.04
Grand Total					167,738	53,316			\$ 10,841	
Average										\$ 3.82

Conclusion and recommendations

Our analysis shows that based on time commitment the most effective scenarios are Scenario A, B, and D. Taking into account that time is the most valuable feature for the household, we consider Scenario C as the most inappropriate alternative. Moreover, the total variable cost for this scenario is the highest even with the fact that Elena will not pay for transit and bike (assuming one-time payment for purchasing the bike). However, the cost of bus and train trips are high. This scenario is also not viable due to the fact that Andrei has at least three large tool-bags with him every time he visits his client. Although, we should recognize that the cost per mile is the lowest one because the household doesn't need to own any transport except bike which is relatively cheap.

Scenario A and B are the same according to the time-commitment per trip. The total variable cost in case of using Tesla is significantly lower than in case of using VW Beetle, however, the cost per mile is higher due to the higher cost of Tesla itself in comparison with the cost of used VW Beetle. Moreover, the household has already paid for VW Beetle, while if they decide to buy Tesla they would need to pay a loan every month. Anyway, scenario B is still valuable due to its commitment to decrease greenhouse gas emission.

Scenario D looks to be the most favorable one with low time-commitment per trip, low total variable cost and relatively low cost per mile. This scenario will also contribute to the solution of such issues like congestion, greenhouse gas emission, and parking. The only problem so far is that both BRIDJ/Chariot alternative and cost-efficient high-speed train are not currently available in Eugene.

VW Beetle

Fixed Costs

Car Payments*	\$	2,400
Insurance costs	\$	1,080
Tire/year	\$	564
Total	\$	4,044

Variable Costs

Fuel/gallon	\$	3.20
Maintenance	\$	895
Parking expenses	\$	300
Total	\$	1,195

Tesla

Fixed Costs

Car Payments*	\$	9,200
Insurance costs	\$	1,080
Tire/year	\$	800
Total	\$	11,080

Variable Costs

Price/KWh**	\$	0.12
Maintenance	\$	520
Parking expenses	\$	300
Total	\$	820

* Car payment is a cost of the car per year under the assumption that the car is totally depreciated in 5 years.

** Average price per kWh

	No. of times/year	Address	Miles (one way)	Miles (two way)	Total Miles	Electricity required (KWh)	Mode of Transport	Time (mins) - one way	Total Variable Cost	Cost per mile
LCB	208	955 E. 13th Ave, Eugene, OR 97403	7	15	3,037		BRIDJ	20	\$ 1,290	\$ 0.42
MOC	104	1960 Franklin Blvd. Eugene, OR 97403	6	13	1,310		BRIDJ	18	\$ 645	\$ 0.49
Farmer's market	24	Oak St & E 8th Ave, Eugene, OR 97401	10	21	494		BRIDJ	20	\$ 149	\$ 0.30
Client's office	260	Portland, OR	115	230	59,800	22,923	Tesla	120	\$ 2,751	\$ 0.24
Client's houses	260	Vancouver, WA	123	246	63,960	24,518	Tesla	150	\$ 2,942	\$ 0.23
Florence	24	Florence, OR	75	150	3,600	1,380	Tesla	90	\$ 166	\$ 3.35
Dexter State Park	24	Dexter State Recreation Site, Dexter, OR	13	25	605	232	Tesla	15	\$ 28	\$ 19.72
Friends	12	Portland, OR	115	230	2,760	1,058	Tesla	120	\$ 127	\$ 4.36
Cannon Beach	12	Cannon beach, OR	187	374	4,488	1,720	Tesla	180	\$ 206	\$ 2.70
Crater Lake Nation:	3	Klamath County, Oregon	158	316	948	363	Tesla	163	\$ 44	\$ 12.60
Bend	6	Bend, OR	121	242	1,452	557	Tesla	135	\$ 67	\$ 8.24
Mount St. Helens	4	Skamania County, WA	184	368	1,472	564	Tesla	191	\$ 68	\$ 8.13
Seattle	6	Seattle, WA	287	574	3,444		High Speed train	108	\$ 420	\$ 0.12
San Francisco	6	San Francisco, CA	522	1,044	6,264		High Speed train	196	\$ 420	\$ 0.07
Sacramento	4	Sacramento, CA	467	934	3,736		High Speed train	175	\$ 280	\$ 0.07
Los Angeles	6	Los Angeles, CA	864	1,728	10,368		High Speed train	324	\$ 420	\$ 0.04
Grand Total					167,738	53,316			\$ 10,841	\$ 3.82
Average										

High speed train 160 miles/hour

Appendix E

Peter Hazelett and John Lundquist



Urban Mobility Project

MGMT641
1 December 2018
Peter Hazelett
John Lundquist



Table of Contents

Description	Page
Executive Summary	3
Household Description	4-5
Assumptions	6-10
Scenario One	11-12
Scenario Two	13-14
Scenario Three	15-16
Scenario Four	17-18
Aggregated Results	19
Conclusion	20
References	21



Executive Summary

The purpose of this document is to explore existing and hypothetical modes of transportation available to residents of Eugene, Oregon. Currently existing modes, like a personal vehicle, walking, bike share, a personal bike, and ride-hail were considered. In addition, hypothetical options that may be available to residents of Eugene in the future like Car2Go, Transportation as a Services (TaaS), and Electric Scooter Sharing were also taken into account.

A theoretical resident of Eugene, Oregon named Rick was created to embody the essence of a living person. Multiple scenarios were examined to illustrate the difference between transportation modes in terms of time and price commitment and preference. According to Rick's changing preferences for transport, he will use different modes to get from point A to B throughout his day. The three scenarios examined are as follows:

- Scenario 1 : Typical American today, who drives their personal vehicle the majority of the time. He drives to most of his monthly destinations but takes alternative transport to the bars, where he imbibes a few adult beverages.
- Scenario 2: Rick is worried about his cost of transportation. He wants to be as frugal as possible and avoid driving when he can.
- Scenario 3: Rick values his time more than anything. He wants to get from place to place as fast as possible with no regard for cost.
- Scenario 4: Rick chooses to leverage several modes of transportation. His decisions are based on a balance of cost and time. This case is meant to represent a futuristic optimal mix of transportation.

To evaluate the different scenarios, a model was built using several assumptions. Excel Solver was employed to come up with the most realistic situation for Rick. Then constraints were built into the model to coincide with Rick's changing monetary and temporal preferences.

Household Description

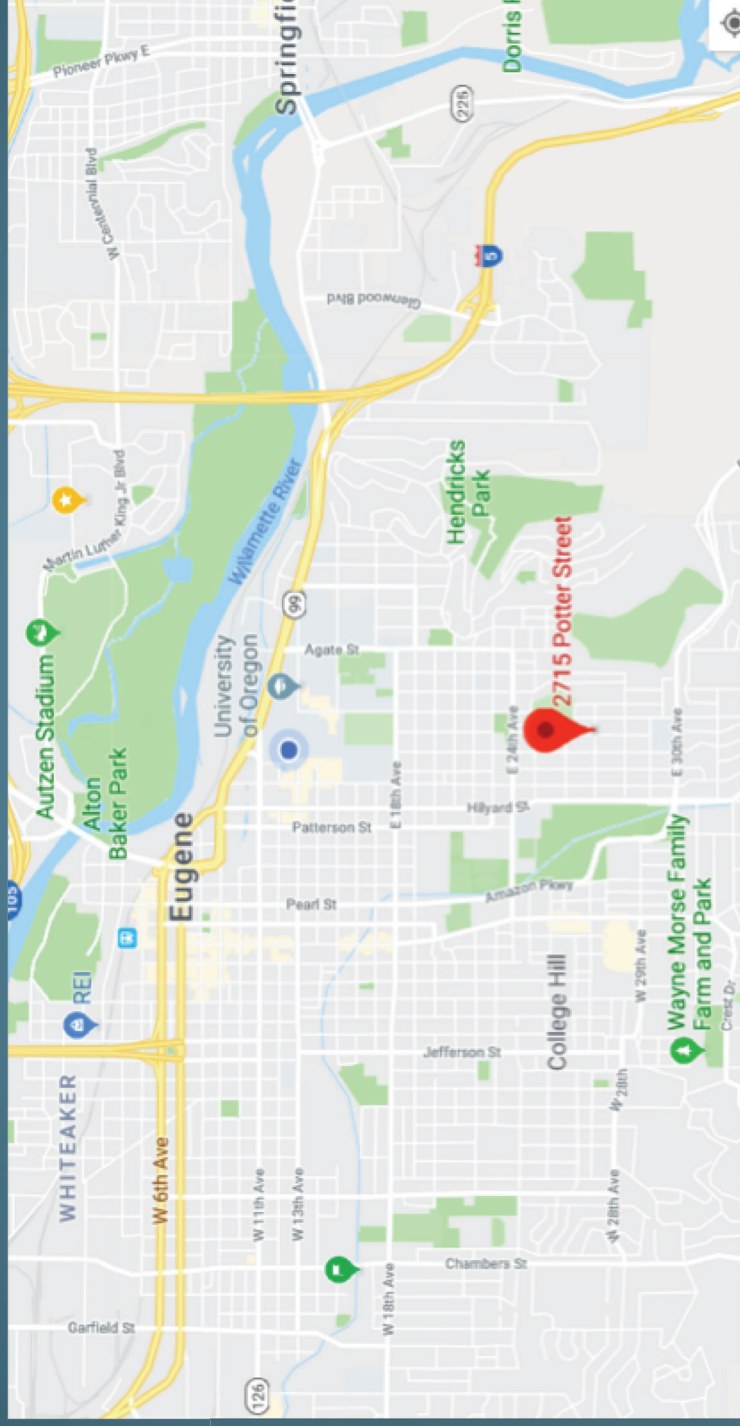
Meet Rick: Rick is a 36 year old single male. He lives at 2715 Potter St. Eugene, OR 97403 with several roommates. In our base case scenario Rick drives his 2007 Subaru Outback to work and other places around town. Rick has been living in Eugene for many years.

Employment: Rick works at REI in Eugene. In his free time he likes to go to the climbing gym and explore in the mountains. He takes a few trips a month to Mt. Bachelor as well as other outdoor recreation areas in Oregon and the Pacific Northwest.

Salary: Rick makes \$44,000 per year which translates to about \$22/hour assuming he works 40 hours per week and 50 weeks per year.



Home Address: 2715 Potter St. Eugene, OR



Car Assumptions - Personal Car

We made assumptions around Rick's personal vehicle, so we could break down how much it costs per mile driven. Assumptions include the original MSRP of the car, total car life, miles driven per year (which was based on different scenario models), and other typical car costs like routine maintenance and oil changes. We also considered yearly insurance costs in the price of the car as well as fuel charges. See Car Assumptions table to the right.

Note, for the base case scenario we assumed that the cost per mile was around \$0.34. This was consistent with assumptions in the RethinkX, Rethinking Transportation 2020-2030 report.

Car - Assumptions		Calculations	
Car Make/Model	Subaru Outback Wagon	Total Life of Car (years)	16.67
Car MFG Year	2007	Car Life Remaining (years)	5.67
Car MSRP (\$USD)	22,620	Car Depreciation(\$USD)/mile	0.113
Car Life (miles)	200,000	Oil Change (\$USD)/mile	0.015
Miles Driven/year	12,000	Maintenance (\$USD)/mile	0.055
Oil change (synthetic) \$USD	75	Gas (\$USD/Mile)	0.127
Miles pe oil change	5,000	Insurance (\$USD/Mile)	0.033
Average Maintenance/year (\$USD)	657		
Fuel Economy: Miles/Gallon	22		
Gas Price: \$/Gallon	2.79		
Insurance Cost Per Year	400		
		Total Cost/Mile	0.343

Car Assumptions – Car2Go

Car2Go is a car share program similar to bike sharing that allows members to pick up and drop off cars within the operating area. Car2Go is not yet available in Eugene but it is in operation currently operating in about ten US cities including Portland, Seattle, and Denver. The price of fuel is built into you cost per unit of time.

Assumption: Cost per mile = \$0.45



\$ **from \$0.41 - \$0.47 per minute**

Perfect for short trips and that last mile home.

\$ **from \$15 - \$19 per hour**

For running errands, driving across town or grabbing lunch.

\$ **from \$89 - \$129 per day**

Your car, all day. Keep it for the whole day (24 hours from when your rental starts).



Grab any available car

Cars are available on the street and in designated lots around the city. A live map is available on our app.



Point A, meet Point B

You can hop in a car whenever, wherever (with no reservations required) and leave it in the Home Area (operating area) - no need to return it where you grabbed it from.



Park and go

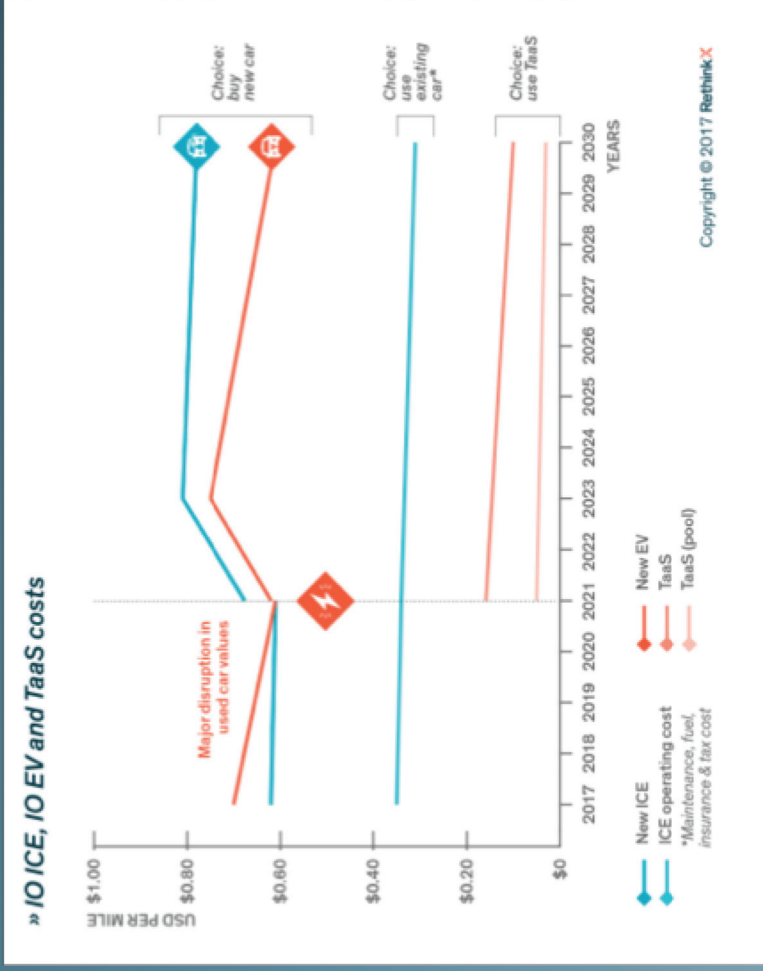
Where you go in between starting and stopping is your adventure. Done with your trip? Park in any approved legal spot and go - no need to refuel.

Car Assumptions – TaaS

Based on RethinkX central case, we assumed the TaaS cost per mile to be \$0.16. TaaS is not an option in Eugene now, but could be in the future.

Box 4: Sensitivity analysis for 2021 TaaS vehicle (in cents per vehicle mile for TaaS)

	CONSERVATIVE CASE	CENTRAL CASE	UPSIDE CASE
Upfront cost (depreciation) – increase/decrease of \$10k per vehicle	+2.0c	6.0c	-2.0c ¹
Vehicle lifetime	+1.0c ²	500,000 miles	-2.4c ³
Maintenance	+0.7c ⁴	2.0c	-1.5c ⁵
Insurance - conservative	+1.3 ⁶	0.9c	-0.0c
Tax	+1.0c ⁷	0.3c	-0.0c
Platform fee	+1.3c ⁸	2.6c	-2.6c ⁹
Fuel	+0.0c	1.8c	-0.0c
Finance	+1.3c ¹⁰	1.3c	-0.6c ¹¹
Total cost per vehicle mile	24.5c	15.9c	6.8c



https://static1.squarespace.com/static/585c439be6594202bb9b7b591a2e4be62e1c13df930c5/149488803959/RethinkX+Report_051517.pdf

Distance and Time Assumptions Explained

Place	Distance from Home (miles)	Trips/Month (one way)
Work	3.0	40
Downtown Bars (Sizzle Pie)	2.4	16
Climbing Gym	3.0	16
Grocery Store (Albertson's)	0.7	8
Mountains (Outdoor rec)	140	2
Mt. Bachelor	137	4



Distance and Time Assumptions Explained

Assumptions were made regarding the locations that Rick might travel to. Time to travel from point A to B based on mode was also considered. Reasonable locations that Rick would travel to include:

- Work: REI Eugene; 306 Lawrence St, Planing Mill Bldg, Eugene, OR 97401
- Downtown: Bar's and nightlife around Sizzle Pie; 910 Willamette St, Eugene, OR 97401
- Climbing Gym: Elevation Climbing Gym; 348 Lincoln St, Eugene, OR 97401
- Grocery Store: Albertson's; 3075 Hillyard St, Eugene, OR 97405
- Mountains: Devil's Lake/South Sister Trailhead; Cascade Lakes National Scenic Byway, Bend, OR
- Mt. Bachelor: The Main Lodge; Mt. Bachelor, Bend, OR

Rick is an outdoor enthusiast. It is reasonable to assume that he would travel to the mountains and Mt. Bachelor a total of three round trips per month. Obviously, he would vary his outdoor activity locations but for the purpose of our model, both Mt. Bachelor and the Devil's Lake Trail head were roughly 140 miles from Rick's home in Eugene. In the winter we assume that Rick would spend more time at Mt. Bachelor and in the Summer he would spend more time hiking and camping around the Sisters. But, since each is roughly the same distance monthly variation differences would be minimal.

Google maps was used to estimate distance from point to point for vehicle and bike travel. For Car2Go options we assumed two minutes would be added to trip time if the Car2Go was not parked directly outside Rick's home. For other assumptions, reference the accompanying Excel model sheet. Bike share and bus times are consistent with existing options in Eugene as of November 2018.

Scenario 1 (Baseline): Description

In this scenario, we assumed Rick was a typical Eugene resident that uses a mix of current modes of travel. His main destinations around the greater Eugene area include: going to work, the grocery store, the climbing gym, night life, and outdoor recreational activity areas.

We wanted to make this baseline scenario as realistic as possible. Considering that he drives frequently, we assume he travels 12,000 miles per year in his car. This plugs into our cost per mile for his vehicle travel.



Scenario 1 (Baseline): Results

Rick's baseline case is our control scenario. The first chart conveys which modes Rick is using, the second chart represents cost, and the third represents time.

Given the modes of travel Rick normally chooses, he spends roughly \$302 a month on travel, which accounts for 35 hours of travel time. Travel costs account for 11.8% of Rick's monthly after tax budget.

	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor
Car	20	0	10	8	2	2
Bike	20	4	6	0	0	0
Bus	0	2	0	0	0	2
Walk	0	2	0	0	0	0
Ride-hail	0	0	0	0	0	0
Scooter	0	0	0	0	0	0
Bike-share	0	8	0	0	0	0
Car2Go	0	0	0	0	0	0
TaaS	0	0	0	0	0	0
Total Trips (one-way)	40	16	16	8	2	4

	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	Total Cost
Car	\$20.58	\$0.00	\$10.29	\$1.92	\$96.04	\$93.98	\$222.81
Bike	\$4.20	\$0.67	\$1.26	\$0.00	\$0.00	\$0.00	\$6.13
Bus	\$0.00	\$3.50	\$0.00	\$0.00	\$0.00	\$60.00	\$63.50
Walk	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Ride-hail	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Scooter	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Bike-share	\$0.00	\$9.92	\$0.00	\$0.00	\$0.00	\$0.00	\$9.92
Car2Go	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
TaaS	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Total Cost	\$24.78	\$14.09	\$11.55	\$1.92	\$96.04	\$153.98	\$302.37

	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	Total Time (hrs)
Car	200	0	90	32	310	298	15.5
Bike	360	56	102	0	0	0	8.6
Bus	0	52	0	0	0	400	7.5
Walk	0	82	0	0	0	0	1.4
Ride-hail	0	0	0	0	0	0	0.0
Scooter	0	0	0	0	0	0	0.0
Bike-share	0	120	0	0	0	0	2.0
Car2Go	0	0	0	0	0	0	0.0
TaaS	0	0	0	0	0	0	0.0
Total Time	560	310	192	32	310	698	35.0

Scenario 2 (Low Cost): Description

In this scenario, we assumed Rick is trying to keep transportation costs low. He only drives if he has to, and prefers walking or biking if at all possible. He walks to most destinations but is not willing to walk to and from work. He also is only willing to walk half of the total trips to and from the bars, climbing gym and grocery store. Since Albertsons is the closest, he chooses this destination to bike to. This way he doesn't incur the cost of biking to the farther distances of the bar and climbing gym.



Scenario 2 (Low Cost): Results

Rick is frugal when it comes to transportation. He saves cash, but spends more time travelling.

In this scenario, Rick spends roughly \$200 and 51 hours on travel. This accounts for 7.8% of Rick's monthly travel budget.

It should be noted, that in this scenario he has no need for a car because it is too expensive. This outcome was a result of our solver program preferring longer travel times over higher costs.

	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor
Car	0	0	0	0	0	0
Bike	40	12	0	8	0	0
Bus	0	0	0	0	0	4
Walk	0	4	16	0	0	0
Ride-hail	0	0	0	0	0	0
Scooter	0	0	0	0	0	0
Bike-share	0	0	0	0	0	0
Car2Go	0	0	0	0	0	0
TaaS	0	0	0	0	2	0
Total Trips (one-way)	40	16	16	8	2	4

	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	Total Cost
Car	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Bike	\$8.40	\$2.02	\$0.00	\$0.39	\$0.00	\$0.00	\$10.81
Bus	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$120.00	\$120.00
Walk	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Ride-hail	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Scooter	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Bike-share	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Car2Go	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
TaaS	\$0.00	\$0.00	\$0.00	\$0.00	\$70.00	\$0.00	\$70.00
Total Cost	\$8.40	\$2.02	\$0.00	\$0.39	\$70.00	\$120.00	\$200.81

	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	Total Time (hrs)
Car	0	0	0	0	0	0	0.0
Bike	720	168	0	32	0	0	15.3
Bus	0	0	0	0	0	800	13.3
Walk	0	164	880	0	0	0	17.4
Ride-hail	0	0	0	0	0	0	0.0
Scooter	0	0	0	0	0	0	0.0
Bike-share	0	0	0	0	0	0	0.0
Car2Go	0	0	0	0	0	0	0.0
TaaS	0	0	0	0	0	0	0.0
Total Time	720	332	880	32	316.2	800	51.3

Scenario 3 (Time Efficiency): Description

In this scenario, Rick drives almost everywhere. Rick values his time over his cash. His credit card is always in hand or linked to his apps. Rick is still a responsible adult as he takes alternative transportation to bars and nightlife options in downtown Eugene.



Scenario 3 (Time Efficiency): Results

Rick loves his car. He can leave his skis and work stuff in it as long as he wants. Aside from going to the bars and the climbing gym, it is his mode of choice.

We can see from the adjacent tables, that he spends \$353 and 27 hours on travel. In this scenario, Rick spends 13.8% of his after tax earnings on travel.

	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor
Car	40	0	16	8	2	4
Bike	0	0	0	0	0	0
Bus	0	0	0	0	0	0
Walk	0	0	0	0	0	0
Ride-hail	0	0	0	0	0	0
Scooter	0	0	0	0	0	0
Bike-share	0	0	0	0	0	0
Car2Go	0	0	0	0	0	0
TaaS	0	16	0	0	0	0
Total Trips (one-way)	40	16	16	8	2	4

	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	Total Cost
Car	\$41.16	\$0.00	\$16.46	\$1.92	\$96.04	\$187.96	\$343.55
Bike	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Bus	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Walk	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Ride-hail	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Scooter	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Bike-share	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Car2Go	\$0.00	\$9.60	\$0.00	\$0.00	\$0.00	\$0.00	\$9.60
TaaS	\$0.00	\$9.60	\$16.46	\$1.92	\$96.04	\$187.96	\$353.15
Total Cost	\$41.16	\$9.60	\$16.46	\$1.92	\$96.04	\$187.96	\$353.15

	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	Total Time (hrs)
Car	400	0	144	32	310	596	24.7
Bike	0	0	0	0	0	0	0.0
Bus	0	0	0	0	0	0	0.0
Walk	0	0	0	0	0	0	0.0
Ride-hail	0	0	0	0	0	0	0.0
Scooter	0	0	0	0	0	0	0.0
Bike-share	0	0	0	0	0	0	0.0
Car2Go	0	130.56	0	0	0	0	0.0
TaaS	0	130.56	144	32	310	596	2.2
Total Time	400	130.56	144	32	310	596	26.9

Scenario 4 (Future Optimization): Description

In this scenario, we look to implement an ideal mix of different modes of travel options. The goal is to keep costs down for Rick, while also being efficient. It is possible in this scenario for Rick to take one mode of travel to a destination, and a different mode for the return trip.



Scenario 4 (Future Optimization): Results

As you can see, Rick does not have or use a car. His bike is still a common mode he relies on.

For long drives to destinations with no bus service, Rick uses Car2Go. For a flat rate, he can have the car for 24 hours. This allows him to travel to some remote areas in the mountains.

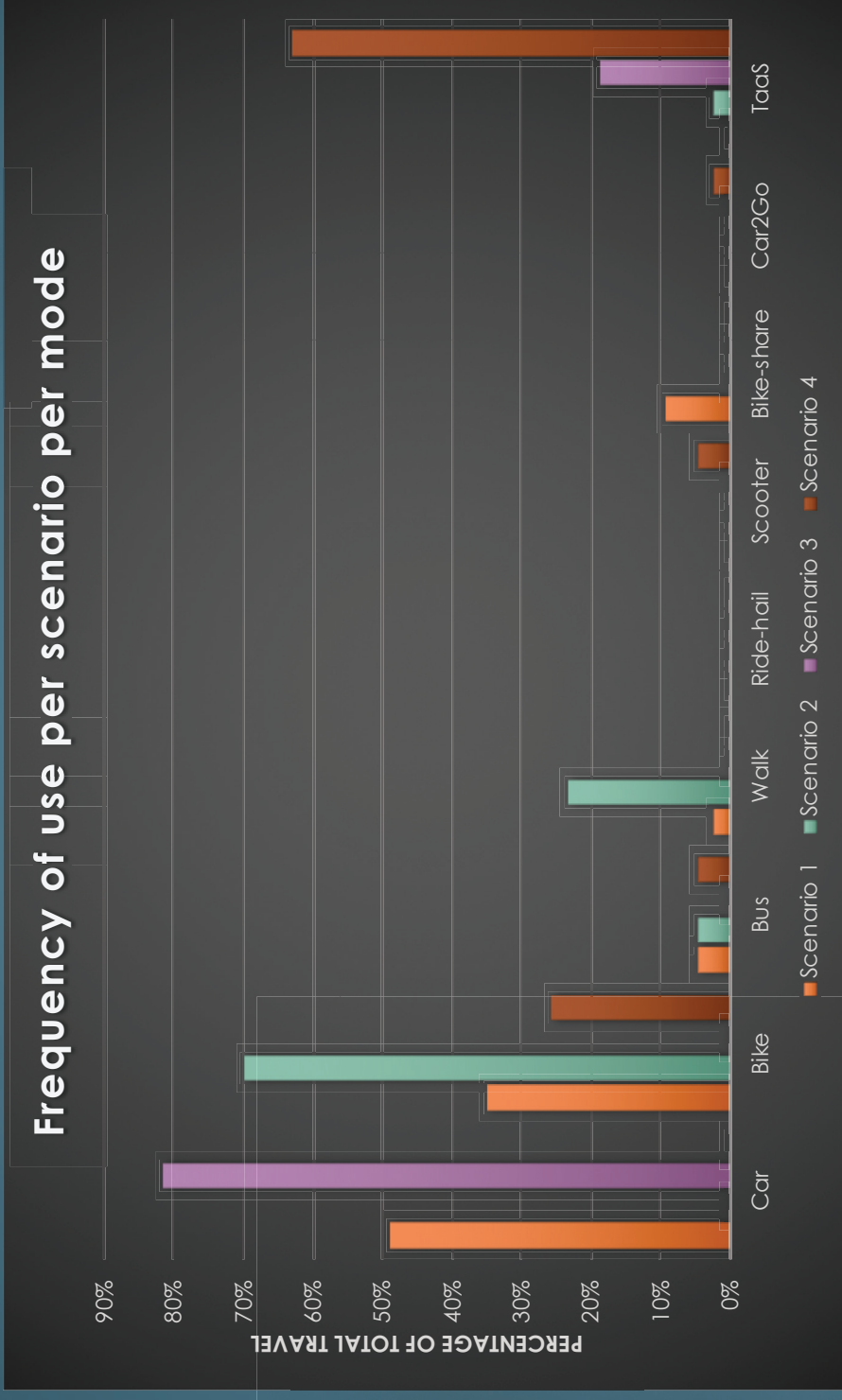
Rick, spends \$276 and 34 hours on travel. Compared with the baseline, he spends less money and time on transportation. Rick will spend 10.8% of his total budget on transportation in this scenario.

	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor
Car	0	0	0	0	0	0
Bike	10	0	12	0	0	0
Bus	0	0	0	0	0	4
Walk	0	0	0	0	0	0
Ride-hail	0	0	0	0	0	0
Scooter	0	0	4	0	0	0
Bike-share	0	0	0	0	0	0
Car2Go	0	0	0	0	0	2
TaaS	30	16	0	8	0	0
Total Trips (one-way)	40	16	16	8	8	2

	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	Total Cost
Car	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Bike	\$2.10	\$0.00	\$2.52	\$0.00	\$0.00	\$0.00	\$4.62
Bus	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$120.00	\$120.00
Walk	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Ride-hail	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Scooter	\$0.00	\$0.00	\$5.76	\$0.00	\$0.00	\$0.00	\$5.76
Bike-share	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Car2Go	\$0.00	\$0.00	\$0.00	\$0.00	\$110.00	\$0.00	\$110.00
TaaS	\$22.50	\$9.60	\$0.00	\$1.40	\$0.00	\$0.00	\$33.50
Total Cost	\$24.60	\$9.60	\$8.28	\$1.40	\$110.00	\$120.00	\$273.88

	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	Total Time (hrs)
Car	0	0	0	0	0	0	0.0
Bike	180	0	204	0	0	0	6.4
Bus	0	0	0	0	800	0	13.3
Walk	0	0	0	0	0	0	0.0
Ride-hail	0	0	0	0	0	0	0.0
Scooter	0	0	96	0	0	0	1.6
Bike-share	0	0	0	0	0	0	0.0
Car2Go	0	0	0	0	0	314	5.2
TaaS	306	130.56	0	32.64	0	0	7.8
Total Time	486	130.56	300	32.64	800	314	34.4

Aggregated Results



Conclusion

The purpose of this document was to explore existing and hypothetical modes of transportation available to residents of Eugene, Oregon. Four separate scenarios were examined taking into account different transportation preferences that a hypothetical 36 year old single male might have.

The overall results of this analysis show that scenario four, which implements an optimal mix of future urban mobility modes like TaaS and Car2Go, is the cheapest and most efficient. The reasoning behind this is that Rick is more dependent on TaaS for his travel needs which is cheaper than a personal vehicle and takes roughly the same amount of time to get from point A to B. When looking at TaaS, we took a nominal approach to the price per mile. If, in the future, TaaS becomes even cheaper than our assumptions, scenario four will become ever more favorable for Rick.

Overall, we examined many transportation options that currently exist in Eugene. But, looking to the future, if Eugene can adopt urban mobility modes like TaaS, Car2Go, and electric scooter sharing, residents will benefit both monetarily and temporally.

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Car - Assumptions**Calculations**

Car Make/Model	Subaru Outback Wagon	Total Life of Car (years)	16.67
Car MFG Year	2007	Car Life Remaining (years)	5.67
Car MSRP (\$USD)	22,620	Car Depreciation(\$USD)/mile	0.113
Car Life (miles)	200,000	Oil Change (\$USD)/mile	0.015
Miles Driven/year	12,000	Maintenance (\$USD)/mile	0.055
Oil change (synthetic) \$USD	75	Gas (\$USD/Mile)	0.127
Miles pe oil change	5,000	Insurance (\$USD/Mile)	0.033
Average Maintenance/year (\$USD)	657		
Fuel Economy: Miles/Gallon	22		
Gas Price (\$/Gallon)	2.79		
Insurance Cost Per Year	400		
Total Cost/Mile			0.343

Dave

Hours worked/week	40	Wage(\$USD)/hour	22
Weeks worked/year	50		
Salary(\$USD)/year	44,000		

Scooter Price Per Mile

Flat rate per ride (\$USD)	1	Cost Per trip to work	1.45
Cost per mile (\$USD)	0.15	Cost Per mile to work	0.483333
Max Speet (MPH)	15		
Average Speed	7		

Distances

Home to work	3
Home to store	1

Source

<https://www.consumerreports.org/cro/news/2014/03/10-best-cars-to-last-200-000-miles/index.htm>
<https://www.kbb.com/subaru/outback/2007/>

Assumptions:

Car - cost per mile		\$0.34
Personal bike - cost per mile		\$0.07
Bike share - cost per mile		\$0.10
Bus - cost per trip		\$1.75
Avg. scooter speed (mph)		7.5
Scooter - cost per mile		0.48
Walk speed (mph)		3.1
Car2Go - cost per min	\$	0.45
Car2Go - cost per day	\$	110.00
TaaS - cost per mile	\$	0.25
TaaS additional time vs car		2%
Ride-hail additional time vs car		3%

Work	Cost	
Distance (mi)	3	
Time (min) - car	10.0	\$1.03
Time (min) - bike personal	18.0	\$0.21
Time (min) - bus	40.0	\$1.75
Time (min) - walk	57.0	\$0.00
Time (min) - ride-hail	10.3	\$13.00
Time (min) - scooter	24.0	\$1.44
Time (min) - bike share	19.0	\$1.30
Time (min) - Car2Go	12.0	\$4.50
TaaS	10.2	\$0.75

Downtown Bars (SizzlePie)	Cost	
Distance (mi)	2.4	
Time (min) - car	8	\$0.82
Time (min) - bike personal	14	\$0.17
Time (min) - bus	26	\$1.75
Time (min) - walk	41	\$0.00
Time (min) - ride-hail	8.2	\$14.50
Time (min) - scooter	19.2	\$1.15
Time (min) - bike share	15	\$1.24
Time (min) - Car2Go	10	\$3.60
TaaS	8.2	\$0.60

Albertsons	Cost	
Distance (mi)	0.7	
Time (min) - car	4	\$0.24
Time (min) - bike personal	4	\$0.05
Time (min) - bus	12	\$1.75
Time (min) - walk	13	\$0.00
Time (min) - ride-hail	4.1	\$7.00
Time (min) - scooter	5.6	\$0.34
Time (min) - bike share	5	\$1.07
Time (min) - Car2Go	6	\$1.80
TaaS	4.1	\$0.18

Climbing Gym	Cost	
Distance (mi)	3	
Time (min) - car	9	\$1.03
Time (min) - bike personal	17	\$0.21
Time (min) - bus	38	\$1.75
Time (min) - walk	55	\$0.00
Time (min) - ride-hail	9.3	\$7.00
Time (min) - scooter	24	\$1.44
Time (min) - bike share	18	\$1.30
Time (min) - Car2Go	11	\$4.05
TaaS	9.2	\$0.75

Mountains/Camping (South Sister)	Cost	
Distance (mi)	140	
Time (min) - car	155	\$48.02
Time (min) - bike personal	685	\$9.80
Time (min) - bus	200	\$0.00
Time (min) - walk	2220	\$0.00
Time (min) - ride-hail	159.7	\$275.00
Time (min) - scooter	1120	\$67.20
Time (min) - bike share	660	\$15.00
Time (min) - Car2Go	157	\$70.65
TaaS	158.1	\$35.00

Mt. Bachelor	Cost	
Distance (mi)	137	
Time (min) - car	149	\$46.99
Time (min) - bike personal	728	\$9.59
Time (min) - bus	200	\$30.00
Time (min) - walk	2580	\$0.00
Time (min) - ride-hail	153.5	\$340.00
Time (min) - scooter	1096	\$65.76
Time (min) - bike share	728	\$14.70
Time (min) - Car2Go	151	\$67.95
TaaS	152	\$34.25

Assumptions

Home to work/week 5
 Work to home/week 5
 Home to Downtown bars
 Downtown bars to Home

Total Cost \$302.37
 Total Time 2102

	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor
Car	20	0	10	8	2	2
Bike	20	4	6	0	0	0
Bus	0	2	0	0	0	2
Walk	0	2	0	0	0	0
Ride-hail	0	0	0	0	0	0
Scooter	0	0	0	0	0	0
Bike-share	0	8	0	0	0	0
Car2Go	0	0	0	0	0	0
TaaS	0	0	0	0	0	0
Total Trips (one-way)	40	16	16	8	2	4

Cost	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	Total Cost
Car	\$20.58	\$0.00	\$10.29	\$1.92	\$96.04	\$93.98	\$222.81
Bike	\$4.20	\$0.67	\$1.26	\$0.00	\$0.00	\$0.00	\$6.13
Bus	\$0.00	\$3.50	\$0.00	\$0.00	\$0.00	\$60.00	\$63.50
Walk	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Ride-hail	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Scooter	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Bike-share	\$0.00	\$9.92	\$0.00	\$0.00	\$0.00	\$0.00	\$9.92
Car2Go	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
TaaS	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Total Cost	\$24.78	\$14.09	\$11.55	\$1.92	\$96.04	\$153.98	\$302.37

Time (min)	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	Total Time (hrs)
Car	200	0	90	32	310	298	15.5
Bike	360	56	102	0	0	0	8.6
Bus	0	52	0	0	0	400	7.5
Walk	0	82	0	0	0	0	1.4
Ride-hail	0	0	0	0	0	0	0.0
Scooter	0	0	0	0	0	0	0.0
Bike-share	0	120	0	0	0	0	2.0
Car2Go	0	0	0	0	0	0	0.0
TaaS	0	0	0	0	0	0	0.0
Total Time	560	310	192	32	310	698	35.0

Constraints:

40 equals 40
 16 equals 16
 16 equals 16
 8 equals 8
 2 equals 2
 4 equals 4

 0 equals 0

 2 <= 20

Assumptions

Home to work/week 5
 Work to home/week 5
 Home to Downtown bars
 Downtown bars to Home

Total Cost \$200.81
 Total Time 3080.2

	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	
Car	0	0	0	0	0	0	0
Bike	40	12	0	0	8	0	0
Bus	0	0	0	0	0	0	4
Walk	0	4	16	0	0	0	0
Ride-hail	0	0	0	0	0	0	0
Scooter	0	0	0	0	0	0	0
Bike-share	0	0	0	0	0	0	0
Car2Go	0	0	0	0	0	0	0
TaaS	0	0	0	0	0	2	0
Total Trips (one-way)	40	16	16	8	2	2	4

Cost	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	Total Cost
Car	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Bike	\$8.40	\$2.02	\$0.00	\$0.39	\$0.00	\$0.00	\$10.81
Bus	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$120.00	\$120.00
Walk	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Ride-hail	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Scooter	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Bike-share	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Car2Go	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
TaaS	\$0.00	\$0.00	\$0.00	\$0.00	\$70.00	\$0.00	\$70.00
Total Cost	\$8.40	\$2.02	\$0.00	\$0.39	\$70.00	\$120.00	\$200.81

Time (min)	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	Total Time (hrs)
Car	0	0	0	0	0	0	0.0
Bike	720	168	0	32	0	0	15.3
Bus	0	0	0	0	0	800	13.3
Walk	0	164	880	0	0	0	17.4
Ride-hail	0	0	0	0	0	0	0.0
Scooter	0	0	0	0	0	0	0.0
Bike-share	0	0	0	0	0	0	0.0
Car2Go	0	0	0	0	0	0	0.0
TaaS	0	0	0	0	316.2	0	5.3
Total Time	720	332	880	32	316.2	800	51.3

Constraints:

40 equals 40
 16 equals 16
 16 equals 16
 8 equals 8
 2 equals 2
 4 equals 4

 0 equals 0

 20 <= 20

Assumptions

Home to work/week 5
 Work to home/week 5
 Home to Downtown bars
 Downtown bars to Home

Total Cost \$353.15
 Total Time 1612.56

	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	
Car	40	0	16	8	2	4	
Bike	0	0	0	0	0	0	
Bus	0	0	0	0	0	0	
Walk	0	0	0	0	0	0	
Ride-hail	0	0	0	0	0	0	
Scooter	0	0	0	0	0	0	
Bike-share	0	0	0	0	0	0	
Car2Go	0	0	0	0	0	0	
TaaS	0	16	0	0	0	0	
Total Trips (one-way)	40	16	16	8	2	4	

Cost	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	Total Cost
Car	\$41.16	\$0.00	\$16.46	\$1.92	\$96.04	\$187.96	\$343.55
Bike	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Bus	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Walk	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Ride-hail	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Scooter	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Bike-share	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Car2Go	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
TaaS	\$0.00	\$9.60	\$0.00	\$0.00	\$0.00	\$0.00	\$9.60
Total Cost	\$41.16	\$9.60	\$16.46	\$1.92	\$96.04	\$187.96	\$353.15

Time (min)	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	Total Time (hrs)
Car	400	0	144	32	310	596	24.7
Bike	0	0	0	0	0	0	0.0
Bus	0	0	0	0	0	0	0.0
Walk	0	0	0	0	0	0	0.0
Ride-hail	0	0	0	0	0	0	0.0
Scooter	0	0	0	0	0	0	0.0
Bike-share	0	0	0	0	0	0	0.0
Car2Go	0	0	0	0	0	0	0.0
TaaS	0	130.56	0	0	0	0	2.2
Total Time	400	130.56	144	32	310	596	26.9

Constraints:

40 equals 40
 16 equals 16
 16 equals 16
 8 equals 8
 2 equals 2
 4 equals 4

 0 equals 0

 0 <= 20

Assumptions

Home to work/week 5
 Work to home/week 5
 Home to Downtown bars
 Downtown bars to Home

Total Cost \$273.88
 Total Time 2063.2

	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	
Car	0	0	0	0	0	0	0
Bike	10	0	12	0	0	0	0
Bus	0	0	0	0	0	4	4
Walk	0	0	0	0	0	0	0
Ride-hail	0	0	0	0	0	0	0
Scooter	0	0	4	0	0	0	0
Bike-share	0	0	0	0	0	0	0
Car2Go	0	0	0	0	2	0	0
TaaS	30	16	0	8	0	0	0
Total Trips (one-way)	40	16	16	8	2	4	

Cost	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	Total Cost
Car	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Bike	\$2.10	\$0.00	\$2.52	\$0.00	\$0.00	\$0.00	\$4.62
Bus	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$120.00	\$120.00
Walk	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Ride-hail	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Scooter	\$0.00	\$0.00	\$5.76	\$0.00	\$0.00	\$0.00	\$5.76
Bike-share	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Car2Go	\$0.00	\$0.00	\$0.00	\$0.00	\$110.00	\$0.00	\$110.00
TaaS	\$22.50	\$9.60	\$0.00	\$1.40	\$0.00	\$0.00	\$33.50
Total Cost	\$24.60	\$9.60	\$8.28	\$1.40	\$110.00	\$120.00	\$273.88

Time (min)	Work	Downtown Bars	Climbing Gym	Grocery Store	Mountains	Mt Bachelor	Total Time (hrs)
Car	0	0	0	0	0	0	0.0
Bike	180	0	204	0	0	0	6.4
Bus	0	0	0	0	0	800	13.3
Walk	0	0	0	0	0	0	0.0
Ride-hail	0	0	0	0	0	0	0.0
Scooter	0	0	96	0	0	0	1.6
Bike-share	0	0	0	0	0	0	0.0
Car2Go	0	0	0	0	314	0	5.2
TaaS	306	130.56	0	32.64	0	0	7.8
Total Time	486	130.56	300	32.64	314	800	34.4

Constraints:

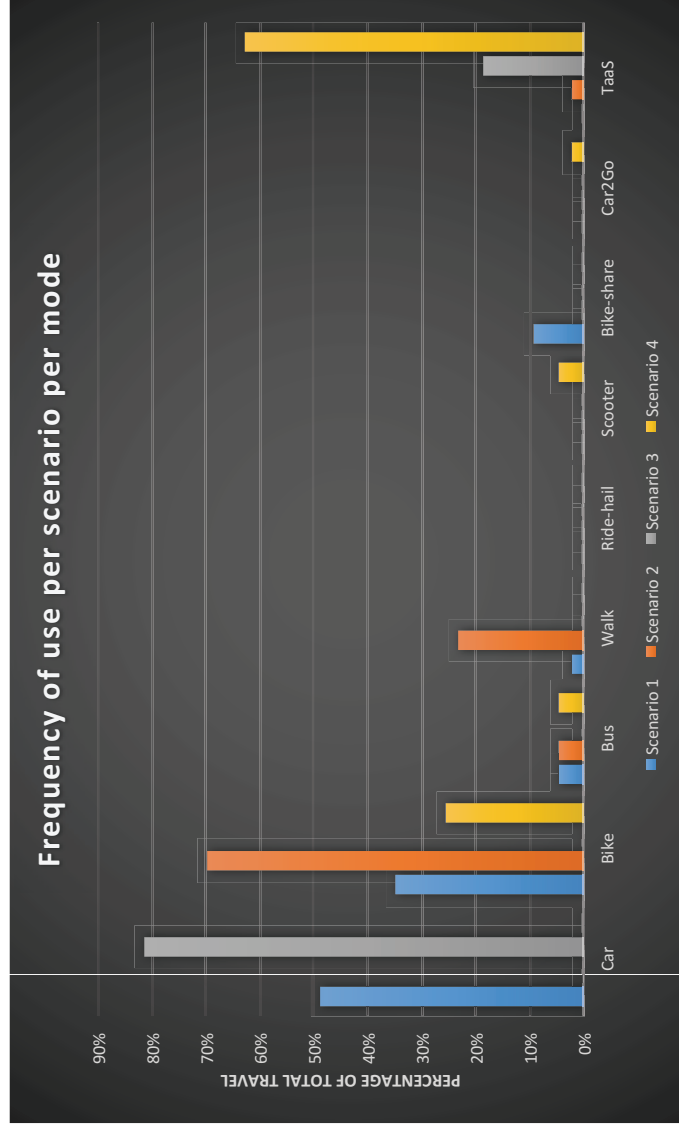
40 equals 40
 16 equals 16
 16 equals 16
 8 equals 8
 2 equals 2
 4 equals 4

 0 equals 0

 0 <= 20

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Car	49%	0%	81%	0%
Bike	35%	70%	0%	26%
Bus	5%	5%	0%	5%
Walk	2%	23%	0%	0%
Ride-hail	0%	0%	0%	0%
Scooter	0%	0%	0%	5%
Bike-share	9%	0%	0%	0%
Car2Go	0%	0%	0%	2%
TaaS	0%	2%	19%	63%

Total trips 86



Appendix F

Brooks Chiongbian and Jared Meyers

Group Mobility Case Study and Feasibility Analysis

Brooks Chiongbian and Jared Myers

Introduction | Tom and Peggy Quillen are a 30-something married couple living in the Whitaker neighborhood (Figure 1) of Eugene, Oregon with their Labrador Retrievers, Batman and Robin. Peggy is a teacher at Spencer Butte Middle School, and Tom is a banker at the Wells Fargo branch down the street from their house at 955 W. 4th Ave. They are fairly well-off, making a combined 120% of median income for the area, approximately \$74,000 per year. Since meeting at the University of Oregon, they have fallen in love with the local culinary scene, culture, and nightlife. They chose to buy a home close to the experiences that they value most.

“The Whit” is rich with businesses serving most needs within a convenient distance, including grocery stores, restaurants, breweries, entertainment, and shopping (Figure 2). On a 100 point scale, WalkScore.com assesses the area as an 83 for walking (“most errands can be accomplished on foot”), 51 for transit (“many nearby public transportation options”), and 100 for biking (“flat as a pancake, excellent bike lanes”). Figure 3 illustrates typical distances for different modes of travel possible within 20 minutes of Tom and Peggy’s home. They own one car, but are concerned about climate change and interested in reducing their impact where possible.

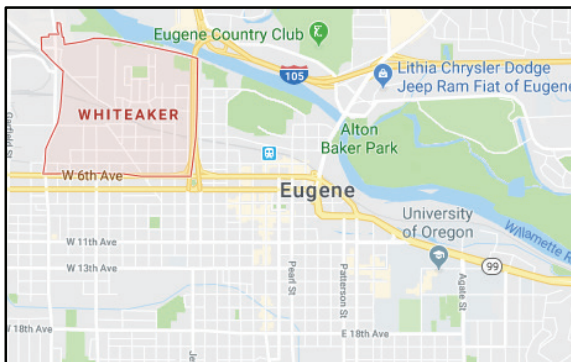


Figure 1 - Whitaker neighborhood

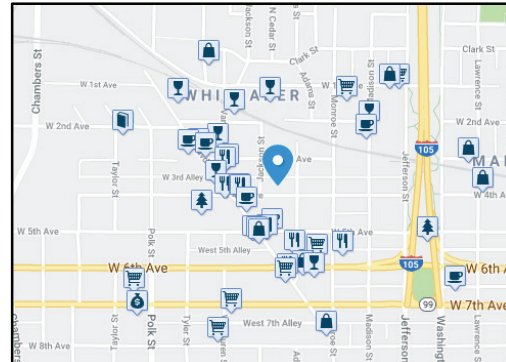


Figure 2 - Whitaker businesses

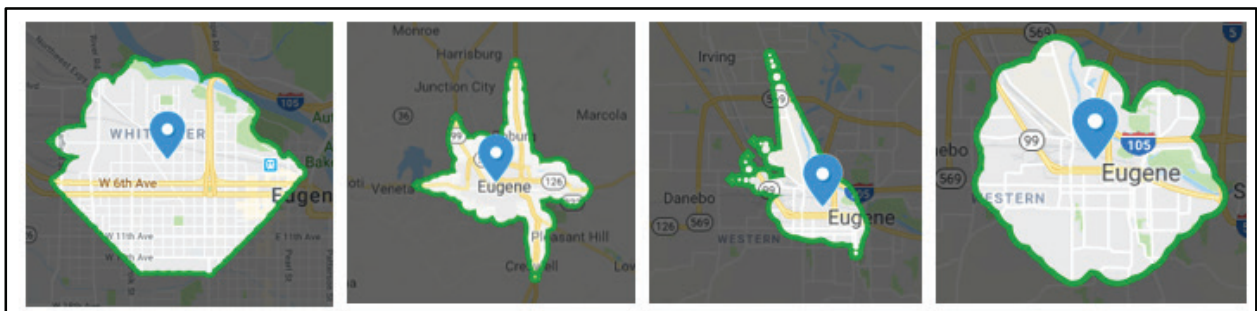


Figure 3 - 20 Minute radius for bike, car, bus, and walking from Tom and Peggy home

The One Car Status Quo | (see figures 4, 5, and 6) | Peggy is the main user of the family vehicle, traveling to her job at Spencer Butte Middle School 4.2 miles away (31.59 miles per

week). Although Peggy knows she could take a bus or bike, she values the convenience of her own vehicle with its on-demand availability. Both Tom and Peggy also use it jointly to get to the gym thrice weekly before work (7.2 miles per week). On the weekend, the couple takes their dogs to hike local trails at Spencer Butte and Mount Pisgah, and also to Alton Baker Dog Park, driving an weekly total of 16.8 and 6.6 miles per week for each respectively.

Aside from weekly trips, car use over other modes (public transit, ride-hailing, biking, and walking) continues. Although the Whit has great options, they also visit dining and entertainment establishments across town during their twice-weekly evenings out. These trips add another 8.25 miles per week to their odometer.

Tom and Peggy also use their car 1-2 times per month to reach Costco, Trader Joes, REI, Valley River Center, The Shops at Gateway Mall, and the dog wash station for less-frequent but lifestyle-fulfilling needs. Still less frequently, trips to the dentist and doctor add to the mileage. Together, these trips total another 11.38 miles per week.

Peggy loves wine, and Tom loves good food, so trips to wineries are a regular part of their lives, about once a month on average. These wineries, just outside of Eugene, aren't very frequent, but their distance adds another 6.54 miles to their weekly driving.

Peggy and Tom like to get away with mini-vacations to Portland, Bend, and Florence, about every other month. Like many Oregonians, the family dogs are a fixture wherever possible, meaning the car is a must for these destinations. Throughout the year, these less frequent trips add another 23.23 miles per week. Still less frequent uses include trips to Matthew Knight Arena for concerts (quarterly), which amount to less than a mile per week (.38). In the winter, they like to hit the slopes, around 5 times per year, nudging up weekly mileage another 20.48 miles.

Tom works just down the street at the local Wells Fargo, and is not a big shopper, so he rarely goes out alone, unless he's getting a gift for Peggy. He is a man of routine and loves food, so he walks to the nearby grocery stores to select local organic produce and other items to impress Peggy. When the two aren't consuming Tom's cuisine or traveling across town, they stroll to their favorite local spots: Blairally Arcade, Meiji, and Mi Tierra.

Altogether, Tom and Peggy drive around 6,894.66 miles in their 2004 Subaru Forester, which they own outright and perform routine maintenance on. Between gas (\$940.36), maintenance (\$1,200), and insurance (\$876), they spend about \$3,016.36 per year for the convenience and reliability of their own transportation mode.

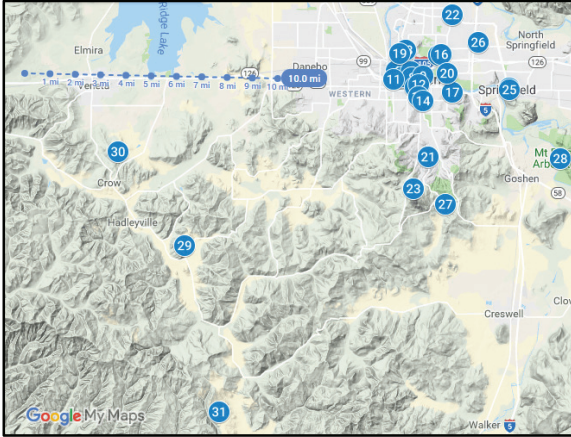


Figure 4 - Routine destination around Eugene

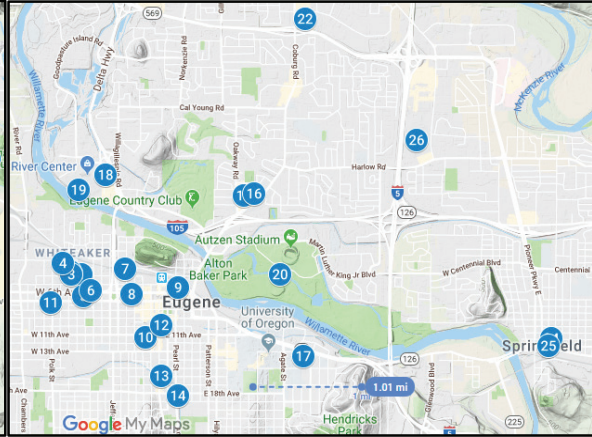


Figure 5 - Detailed view of in-city destinations

Map #	Location	Category	Who	Category Frequency	Distance	Round Trip	Travel Mode	Average Category Mileage per Period		
								Weekly	Monthly	Annually
4	Bialaly Vintage Arcade	Dining and Entertainment	Both	2x week	0.2	0.4	Walk	9.43	40.97	490.29
2	Izakaya Meiji Company									
5	Taqueria Mi Tierra									
15	Gabal Cafe & Bar									
25	Plank Town Brewing									
24	PublicHouse									
13	The Bier Stein									
17	Matthew Knight Arena	Dining and Entertainment	Both	Every three months	2.5	5	Drive	0.38	1.67	20.00
20	Alton Baker Dog Park	Dog Park	Both	1x week	3.3	6.6	Drive	6.60	28.68	344.14
10	Suds 'Em Yourself	Dog Wash	Either/Both	1x month	1.1	2.2	Drive	0.51	2.20	26.40
22	Costco Wholesale	General Shopping	Both	1x month ea	5.6	11.2	Drive	3.87	16.80	201.60
16	Trader Joe's									
7	REI									
19	Valley River Center	General Shopping	Either/Both	1x month ea	3	6	Drive	4.51	19.60	235.20
26	The Shops at Gateway									
6	Bruno's Apple Market	Grocery	Either/Both	1x week	0.2	0.4	Walk	N/A	N/A	N/A
3	Red Barn Natural Grocery									

12	Downtown Athletic Club	Gym	Both	3x week	1.2	2.4	Drive	7.20	31.29	375.43
18	Aspen Dental	Dental Care	Both	4 visits per year	2.6	5.2	Drive	0.40	1.74	20.86
14	OMG Southtowne	Health Care	Both	6 visits per year	2	4	Drive	0.46	2.01	24.07
28	Mount Pisgah Arboretum	Hiking	Both	1x week	10.8	21.6	Drive	16.80	73.00	876.00
23	Spencer Butte			6	12					
9	Gervais Salon & Day Spa	Peggy Hair	Peggy	Every 3 months	1	2	Drive	0.15	0.67	8.02
21	Spencer Butte Middle School	Peggy Work	Peggy	5x week	4.2	8.4	Drive	31.59	137.25	1647.01
11	Wells Fargo Bank	Tom Work	Tom	5x week	1.1	2.2	Walk	N/A	N/A	N/A
8	H & H Veterinary Care	Veterinarian	Either/Both/Total per dog	4x per year	0.7	1.4	Drive	0.11	0.47	5.60
29	Sweet Cheeks Winery	Winery	Both	1x per month	13.8	27.6	Drive	6.54	28.40	340.80
30	King Estate Winery				20.8	41.6				
31	Sarver Winery				14.6	29.2				
27	Abbelone Vineyard				7.6	15.2				
NA	Mount Bachelor	Skiing	Both	5x year total	141	282	Drive	20.48	88.99	1067.93
NA	Willamette Pass				72	144				
NA	Portland	Vacation/Visits	Both	6x year total	112	224	Drive	23.23	100.94	1211.32
NA	Bend				130	260				
NA	Florence				60	120				
Mileage Totals								132.26	674.87	8894.88
Gallons @ 22 MPG city for 2004 Subaru Forester								8.01	28.12	313.46
Cost of Gas @ \$3.00/GAL Average								\$18.03	\$78.38	\$840.38
Vehicle Maintenance Costs @ \$100 per month								\$23.01	\$100.00	\$1,200.00
Vehicle Insurance Costs								\$18.80	\$73.00	\$878.00
Total Vehicle Costs								\$67.86	\$261.38	\$3,018.38

Figure 6 - Chart of Destinations, Distances, and Cost for One-Car Status Quo

The Paradigm Shift: Going Car-less (Reference Figure 7 for comparison to status quo) | Weighing a move from a one car household to a no car household is a harder decision than you might think. In Tom and Peggy's case, because of their location being centrally located in the Whitaker District, it is easy to get around on foot, via bus routes, and utilizing the Lyft subscription model.

When looking at the everyday stops Tom and Peggy need to make, they have everything within walking distance. They have two local grocers, Bruns Apple Market and Red Barn Natural Grocery within walking distance. Most of their favorite restaurants and, (i.e. Izakaya Meiji, Tacovore, Grit) are all also closeby. All of their favorite local breweries (i.e. Hop Valley, Ninkasi, Oakshire, etc.) are centrally located and very close. Tom works just a mile away at Wells Fargo, so he walks or bikes daily. This situation is unique to Tom and Peggy, being located in the Whit,

however, it is one of the up and coming neighborhoods in the Eugene area and going to be a popular choice for many.

One of the areas that got a little tricky was strategizing how Peggy would get to work. We decided it would be best for her to utilize Lyft's subscription model. In the subscription, you are allowed 30 rides up to \$15 for a flat fee of \$300/month. When we mapped out the price for Peggy to get to work, Lyft estimated that it would cost \$12-14 so the route was under the limit. The trouble was only having 30 rides available for the roughly 40 rides needed each month. Luckily, Peggy also likes to supplement her workout routine with riding her bike to school on some occasions, so she could ride her bike on days where the weather is nice and take Lyft on those Oregon rainy days.

The other area of concern when getting rid of cars in the household would be longer trips to take together and with friends. Tom and Peggy enjoy the beautiful Pacific Northwest and go hiking around Oregon. They also enjoy going skiing at nearby resorts, (Willamette Pass, Mt. Bachelor, Mt. Hood), going out to Eugene wineries, and enjoy taking weekend excursions to the coast, Bend, and Portland. This is where it convenient that Tom and Peggy have many friends in Eugene that have the same passions as them! Especially when it comes to hiking and visiting vineyards, they could carpool with friends as often as possible. Carpooling to go hiking and to the wineries would help keep their friendships strong while also saving them money along the way. It is also easy for them to rent cars from either Costco or down the street at Enterprise. It costs \$15-20 to rent per day so is relatively cheap for the occasional solo trip.

Map #	Location	Category	Who	Category Frequency	Distance	Round Trip	Travel Mode	Average Category Mileage per Period			Ride-Hall Miles
								Weekly	Monthly	Annually	
4	Blairally Vintage Arcade	Dining and Entertainment	Both	2x week	0.2	0.4	Walk Ride-Hall/Bike	9.43	40.97	490.29	440.29
2	Izakaya Meiji Company				0.1	0.2					
5	Taqueria MI Tierra				0.2	0.4					
15	Sabal Cafe & Bar				2.2	4.4					
25	Plank Town Brewing				6.4	12.8					
24	PublicHouse				6.3	12.6					
13	The Bier Stein				1.6	3.2					
17	Matthew Knight Arena	Dining and Entertainment	Both	Every three months	2.5	5	Ride-Hall	0.38	1.67	20.00	20
20	Alton Baker Dog Park	Dog Park	Both	1x week	3.3	6.6	walk	6.60	28.68	344.14	0
10	Suds 'Em Yourself	Dog Wash	Either/Both	1x month	1.1	2.2	Ride-Hall	0.51	2.20	26.40	26.4
22	Costco Wholesale	General Shopping	Both	1x month ea	5.6	11.2	Ride-Hall	3.87	16.80	201.60	191.6
16	Trader Joe's				2.3	4.6	Ride-Hall				
7	REI				0.5	1	Bike/Walk				

19	Valley River Center	General Shopping	Either/Both	1x month ea	3	6	Ride-Hall	4.51	19.60	235.20	235.2
26	The Shops at Gateway				6.8	13.6					
6	Brun's Apple Market	Grocery	Either/Both	1x week	0.2	0.4	Walk	N/A	N/A	N/A	0
3	Red Barn Natural Grocery				0.1	0.2					
12	Downtown Athletic Club	Gym	Both	3x week	1.2	2.4	Ride-Hall/Bike	7.20	31.29	375.43	100
18	Aspen Dental	Dental Care	Both	4 visits per year	2.6	5.2	Ride-Hall	0.40	1.74	20.86	20.86
14	OMG Southtowne	Health Care	Both	6 visits per year	2	4	Ride-Hall	0.46	2.01	24.07	24.07
28	Mount Pisgah Arboretum	Hiking	Both	1x week	10.8	21.6	Ride-Hall/Carpool	16.80	73.00	876.00	450
23	Spencer Butte				6	12					
9	Gervais Salon & Day Spa	Peggy Hair	Peggy	Every three months	1	2	Ride-Hall	0.15	0.67	8.02	8.02
21	Spencer Butte Middle School	Peggy Work	Peggy	5x week	4.2	8.4	Ride-Hall/Bike/Bus	31.59	137.25	1647.01	549
11	Wells Fargo Bank	Tom Work	Tom	5x week	1.1	2.2	Walk	N/A	N/A	N/A	0
8	H & H Veterinary Care	Veterinarian	Either/Both/Total per dog	4x per year	0.7	1.4	Ride-Hall	0.11	0.47	5.60	5.6
29	Sweet Cheeks Winery	Winery	Both	1x per month	13.8	27.6	Ride-Hall/Carpool	6.54	28.42	341.01	170
30	King Estate Winery				20.8	41.6					
31	Sarver Winery				14.6	29.2					
27	Abbelone Vineyard				7.6	15.2					
NA	Mount Bachelor	Skiing	Both	5x year total	141	282	Rental Car/Carpool	20.48	88.99	1067.93	\$20/Day
NA	Willamette Pass				72	144					
NA	Portland	Vacation/Visits	Both	6x year total	112	224	Rental Car/Carpool	23.23	100.94	1211.32	\$20 Gas
NA	Bend				130	260					
NA	Florence				60	120					
Mileage Totals								132.26	574.69	6894.88	2241.04
Price of Ride-Hailing with Subscription										\$2,700	
Cost of Rental Vehicles and Gas										\$440	
Total Costs of Scenario Two (No Cars)										\$3,100	

Figure 7 - Chart of Destinations, Distances, and Cost for No-Car Scenario

Conclusion | In conclusion, there was little difference in the price of owning one car and living with no cars after going through our financial analysis. However, each scenario comes with its own pro's and con's. Living in the centrally-located Whitaker gave us advantages. There were plenty of basic needs met within walking distance from the house, major bus lines located nearby, and close to throughways so Lyft drivers were never further than a few minutes away. In our one car scenario, it was convenient for long trips that the couple wanted to make, going to the wineries, hiking, and for getting Peggy to and from work. Along with the vehicle already being paid off, it is not much of a cost to have it available when they needed it. Nevertheless, being located in a convenient place for ride hailing and other public modes of transit, and the total annual cost of owning a car versus not having any vehicles, we conclude that it would be best not to own a vehicle. If the price is going to be in the same ballpark, the benefit of not having any liability or unexpected major repair could potentially affect finances and would be a reason to go carless. Tom and Peggy could easily reduce their carbon footprint and would not be left with a stranded asset once TaaS arrives, also further solidifying our position.

Appendix G

Stephen Kahler and Lindsey Naganuma



URBAN MOBILITY ASSESSMENT

ABSTRACT

Urban mobility options of a middle-class nuclear family living in Eugene, Oregon is analyzed. A base case is set indicating the family uses two vehicles for all their transportation needs. Iterations upon this base case show possible lifestyle and financial impacts of utilizing less conventional urban mobility options.

Stephen Kahler & Lindsey Naganuma
MGMT 641 – Industrial Ecology

GEOGRAPHY AND DEMOGRAPHICS

The family assessed in this new urban mobility analysis report is a nuclear family that consists of four members:

- Karen (Mother) - age 38
- Thomas (Father) - age 42
- Katy (Daughter 1) - age 13
- Anna (Daughter 2) - age 10

For the remainder of this analysis the family will be referred to as The Smiths. Their annual household income of \$130k/year is 200% the mean income of a family in Springfield/Eugene Oregon.¹

The home address of The Smiths is 2425 Skyline Boulevard Eugene, OR 97403. Assuming a generally acceptable debt-to-income (DTI) ratio of 36% (calculated from gross income), The Smiths monthly debt payments should not exceed \$3,900. The Smiths assume home is currently listed on Zillow.com with an estimated price of \$437,000.² Assuming a current (11/18) average 30-year fixed mortgage rates of 4.6% with a 20% down payment the estimated mortgage payment would be 1,790/month for principal and interest with \$487 allotted for taxes and insurance.

The family has two cars financed. These cars are:

- 2012 used Subaru Outback with leather interior, sunroof, front heated seats that was bought for \$12,600. This car was financed at 4.4% APR with \$0 down on a 60-month loan. The monthly payment for this vehicle is \$253/month.
- 2015 used Toyota 4Runner with 4-wheel drive, navigation, sunroof, leather interior, heated seats. The car was bought for \$27,500. This car was financed for 4.4% APR with \$2,750 down payment (for 72 months). The monthly payment for this vehicle is \$400/month.

Considering \$653/month of vehicle payments and additional monthly payments of \$850/month (Karen's graduate school loans and credit card debt) the family can take on additional debt to finance future urban mobility projects.

¹ 2018 Adjusted Home Income Limits [Chart]. (n.d.). In *U.S. Department of HUD State: Oregon*. Retrieved November 24, 2018, from

https://www.hudexchange.info/resource/reportmanagement/published/HOME_IncomeLmts_State_OR_2018.pdf

² Zillow, Inc. (n.d.). 2425 Skyline Blvd, Eugene, OR 97403 | Zillow. Retrieved from

https://www.zillow.com/homedetails/2425-Skyline-Bldv-Eugene-OR-97403/48389400_zpid/

SCENARIO ANALYSIS (ACTIVITIES AND NEEDS):

The family's home is in Eugene's Fairmount Neighborhood (2425 Skyline Boulevard Eugene, OR 97403). The home's walkscore is 50 designating that some errands can be accomplished on foot. The home's bike score is 66 indicating very steep hills but excellent bike lanes. Transit score is 38 meaning few nearby public transportation options.³

Regardless of scenario there will be several constant constraints to consider:

1. The two adults in the household have work full time (40 hours per week) jobs.
2. Karen Smith works as a Scientist 3 at Thermo Fisher Scientific. She earns \$73k/year. Her office is located 7 miles from home.
3. Thomas Smith works as a millwright for Roseburg Forest Products in Roseburg, Oregon. He earns \$53k/year. His work is located 80 miles from home.
4. Anna Smith attends Edison Elementary School located 1.7 miles from home.
5. Katy Smith attends Roosevelt Middle School located 2.3 miles from home.
6. The Smiths go grocery shopping at Market of Choice (twice a week)
7. Anna Smith takes karate (once a week)
8. Katy Smith takes violin lessons (once a week)
9. The Smiths take part in several regular but infrequent activities:
 - a. Doctor appointments
 - b. Dentist appointments
 - c. School events (for kids)
 - d. Violin recitals
 - e. Karate demonstrations
 - f. Fun parties at a friend's house
 - g. Shopping at Costco
 - h. Haircuts
 - i. General shopping
10. The family enjoys taking part in several unique activities together:
 - a. Camping/Fishing
 - b. Oregon State Fair
 - c. Vacation
 - d. Portland Blazer games

³ 2425 Skyline Boulevard. (n.d.). Retrieved from <https://www.walkscore.com/score/2425-skyline-blvd-eugene-or-97403>

BASE SCENARIO

In this scenario The Smiths use their two vehicles for everything. They do not ride bicycles often and never use public transport. The family uses ride-hailing services infrequently (only when unable to drive). In this scenario the monthly car payments of \$253 /month and \$400/month are easily justified by Karen and Thomas as necessary for the family's transportation needs.

Between violin, karate, grocery shopping and other regular but infrequent activities The Smiths use their vehicles for 8 trips out of a week. Summer camping trips and longer trips to Portland to see the Blazers play are fun and easy when utilizing The Smith's SUV. Owning two cars is incredibly convenient for the family.

The Smiths have a net present value (NPV) \$38,236 over the next seven years for their current transportation habits. These habits will also produce about 21.4 metric tons (tonne) of CO₂ equivalent (CO₂e). In order to calculate this we assumed:

- 8887 gCO₂e are produced per gallon of gasoline⁴
- The Subaru gets 24 miles per gallon⁵
- The 4Runner gets 18 miles per gallon⁶

A series of proformas detailing this base case and highlighting the implications of moving from the base case to each alternative scenario are available in Appendix B and labeled as Tables 1-6.

ALTERNATIVE SCENARIO 1 (1 Car and Bike)

In this scenario the family downgrades from two cars to a one car family. Thomas drives the Toyota 4Runner to his job every day. There is not consistent public transport from Eugene to Roseburg and considering Thomas must travel 80 miles every day The Smiths determine it is reasonable for him to continue driving a vehicle.

Keeping the larger car will be useful for the unique activities the family likes to do together. It will be more comfortable to travel to the Oregon State Fair, Portland Blazer games and vacations in the larger vehicle. Also, it is necessary for a family of four to have a larger SUV for camping/fishing trips.

The remaining three family members begin using bicycles to travel to and from school and work. Karen takes kids to work on bicycle and uses bicycle to travel to work

⁴ Greenhouse Gas Emissions from a Typical Passenger Vehicle (10 May 2018). Retrieved from: <https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle>

⁵ Compare Side-by-Side (26 Nov 2018). Retrieved from: [Fueleconomy.gov](https://www.fueleconomy.gov)

⁶ Et al.

herself. Maps highlighting possible bike routes to the children's schools and to Karen's workplace are included in Appendix A and labeled as Figures 1, 2 and 3.

The main challenge of a biking-based scenario will be completing the children's activities, grocery shopping and other regular but infrequent trips. Although he does not commute on bicycle Thomas does buy a bicycle and is able to complete some infrequent trips. Being a 1 car family is going to increase the amount of planning that goes into these infrequent trips.

The cost of an adult bicycle is \$600 while the cost of a child's bicycle is \$150. By eliminating the costs associated with driving two cars, The Smiths will save a NPV of \$28,964 over the next 7 years. They will also reduce their carbon footprint by about 7.87 tonne CO_{2e}.

ALTERNATIVE SCENARIO 2 (Multi-Modal w/ Bicycle and Public Transport)

In this scenario Thomas continues driving the Toyota 4Runner to work every day. Like Scenario 2 most of the commuting to and from school and work will be done on bicycle.

In this scenario is that Karen will take the bus to work on some days. If she leaves her home around 6:59 AM and walks .7 miles to EmX Walnut Station. There is an inbound bus leaving from that station that leaves 7:14 AM. That bus will arrive at the Willow Creek Facility at 7:50 AM. Once arriving at Willow Creek, it is another .7 mile walk to Thermo Fisher Scientific. A diagram of this route is shown in Appendix A in Figure 4.

In this scenario Karen will use bicycles to take the children to school most days. But on days when Karen decides it is impractical to ride a bike the children have the option of riding the school bus to school.⁷

The Smiths will once again be eliminating the costs associated with driving two cars but will be incurring additional costs depending on how often Karen elects to ride the bus. The cost of a monthly bus pass is \$135. The cost of a daily bus pass is \$3.50. If Karen elects to buy a monthly bus pass for 4 or 3 months out of each year the NPV of the family's savings over the next 7 years would be \$25,514 and \$26,376 respectively. If Karen elects to use the bus to travel to work only 30 times per year the NPV of savings over the next 7 years is \$28,293. This would reduce their carbon footprint by 7.86tonne CO_{2e}, which is only 0.01tonne CO_{2e} less than if she had chosen only to bike.

⁷ School Bus Services and Other Options. (n.d.). Retrieved from <https://www.4j.lane.edu/transportation/busservices/>

ALTERNATIVE SCENARIO 3 (Multi-modal with School Bus and Lyft)

The family does not adopt biking in this scenario. The children ride the school bus every day and Karen uses Lyft to get to work every day. All regular weekly activities will be done either on foot or using the families one car. Between violin, karate, grocery shopping and other regular but infrequent activities The Smiths will still be taking part in approximately 8 trips out per week.

At 7:30 AM on a weekday a Lyft to Thermo Fisher from home would cost \$18.64 with only a 5-minute wait. At 6:00 PM on a weekday a Lyft home from Thermo Fisher would cost \$19.18 after a 12-minute wait. Assuming an average of 20 work days per month it would cost \$606/month for the Karen to travel to and from work.

The ride hailing option Lyft will be available to take Karen to and from Thermo Fisher every week day. On average 20 days a month's equating to 40 rides. Lyft offers an All-Access pass that offers a discount on up to 30 rides every 30 days. For \$299 a \$15 discount is given off each ride. If Karen were to maximize her available discounts every month, she saves \$150 per month on ride hailing services.

This scenario is the most inconvenient for The Smiths. The main challenge of a ride hailing based scenario will be completing the children's activities, grocery shopping and other regular but infrequent trips at a reasonable price. Considering The Smith's home has a walkscore is 50 only some errands can be accomplished on foot. The Toyota 4Runner will have to be utilized to do daily errands and activities.

Financially becoming a 1 car family and relying on ride hailing is The Smiths most expensive option. When expenses from ride hailing are added and expenses associated with driving a car are cut out the NPV shows a loss of \$19,443 over the next 7 years, and an increase in carbon footprint of 2.99 tonneCO_{2e}. The carbon emissions produced from Lyft were calculated using the miles per gallon of the average passenger vehicle, since Karen will not be able to pick the type of vehicle she drives in.⁸

CONCLUSION

After looking at a couple different proformas, the best case scenario is to sell one car and bike everywhere they can. Although this family is affluent, their struggle is with the flexibility of different transportation habits. Yet, a change as simple as selling one car, and taking public transit to work can save up to \$28,293 and reduce their carbon footprint by 7.86 tonneCO_{2e}.

⁸ Greenhouse Gas Emissions from a Typical Passenger Vehicle (10 May 2018). Retrieved from: <https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle>

APPENDIX A (MAPS):

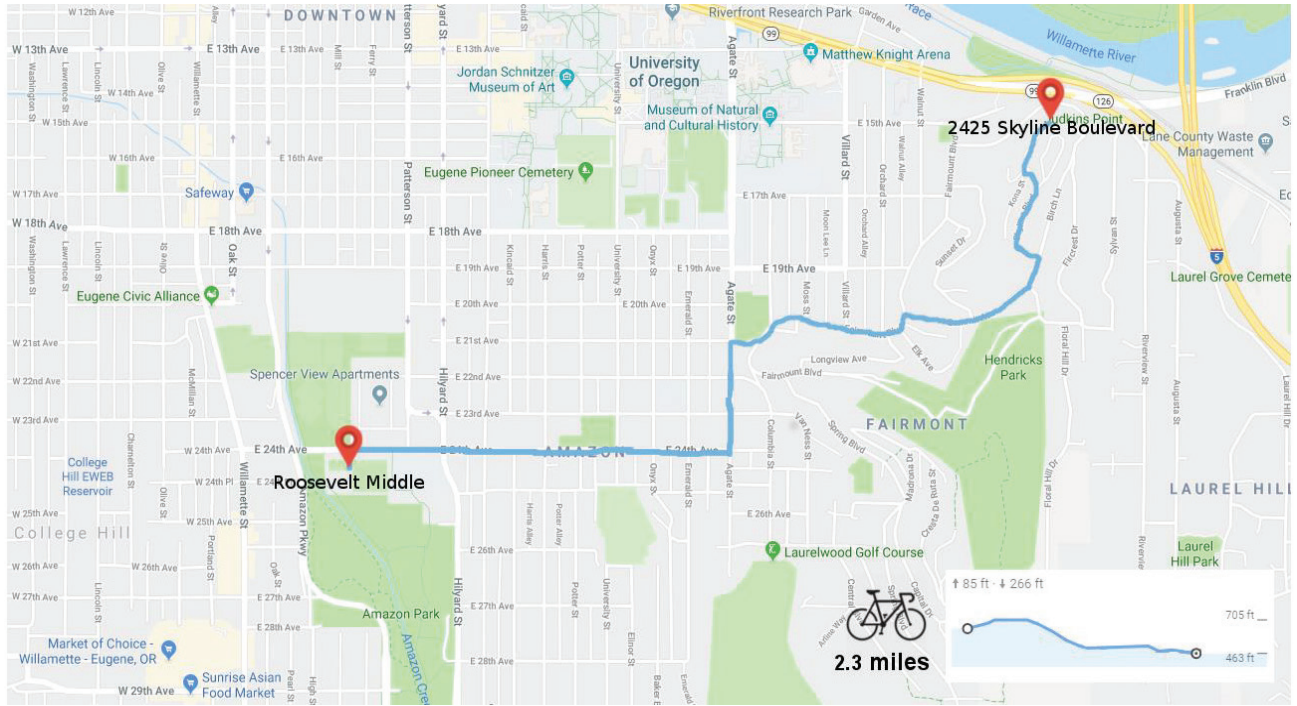


Figure 1 - Bike Ride to Middle School

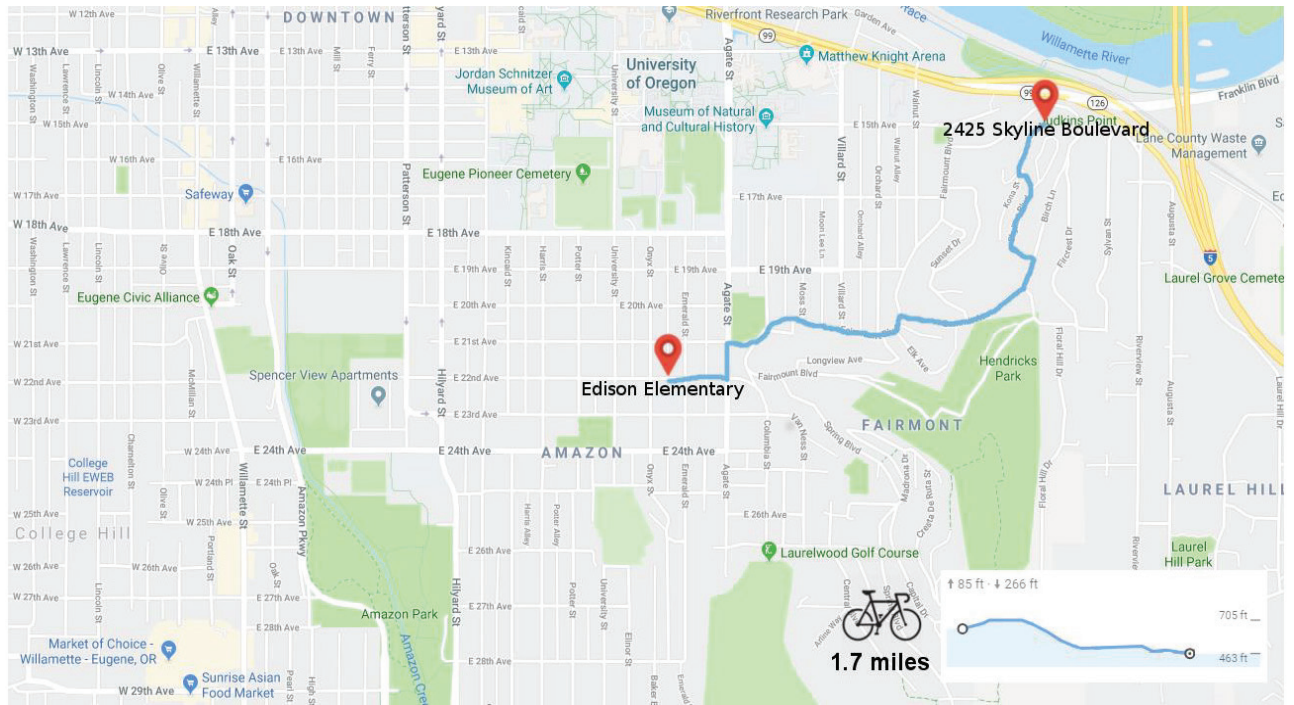


Figure 2 - Bike Ride to Elementary School

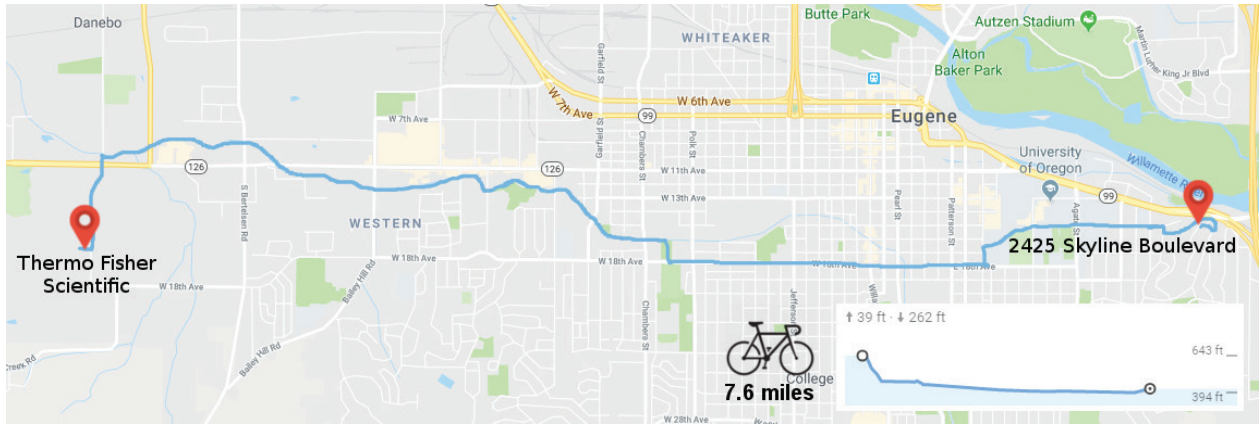


Figure 3 - Bike Ride to Thermo Fisher

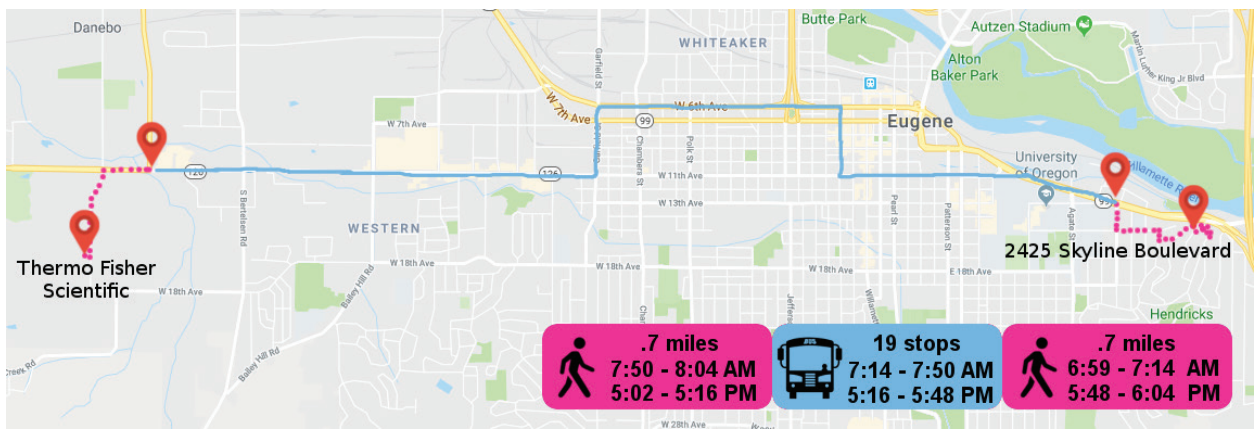


Figure 4 - Multimodal Bus Ride and Walk to Thermo Fisher

APPENDIX B (PROFORMAS)

Table 1 - Base Case Costs

Year		0	1	2	3	4	5	6	7	
Revenues	Scientist III	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	
	Mill Wright	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	
Expenses	Mortgage	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	
	Subaru Outback	\$ 3,816.00	\$ 3,816.00	\$ 3,816.00	\$ 3,816.00	\$ 3,816.00	\$ 3,816.00	\$ 3,816.00	\$ 65.00	
	Toyota 4Runner	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 65.00	
	Gas	\$ 3,950.00	\$ 3,950.00	\$ 3,950.00	\$ 3,950.00	\$ 3,950.00	\$ 3,950.00	\$ 3,950.00	\$ 3,950.00	
Impact	CO2 Emissions (gCO2)	21,411,745.33	21,411,745.33	21,411,745.33	21,411,745.33	21,411,745.33	21,411,745.33	21,411,745.33	21,411,745.33	
	CO2 Emissions (tonneCO2)	21.41	21.41	21.41	21.41	21.41	21.41	21.41	21.41	
Total	Total Available	\$ 4,690.00	\$ 4,690.00	\$ 4,690.00	\$ 4,690.00	\$ 4,690.00	\$ 4,690.00	\$ 8,441.00	\$ 13,956.00	
	DCF	\$ 4,690.00	\$ 4,383.18	\$ 4,096.43	\$ 3,828.44	\$ 3,577.98	\$ 3,343.91	\$ 5,624.59	\$ 8,691.10	
Discount Rate		7.00% (compounded annually)								
Total Available		\$ 38,235.62								
TOTAL CO2 Emissions		171.29 tonneCO2								

Table 2 - Scenario 1 Savings Analysis

Year		0	1	2	3	4	5	6	7	
Revenue	Scientist III	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	
	Mill Wright	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	
Expenses	Mortgage	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	
	Toyota 4Runner	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 65.00	
	Bicycle Cost	\$ 1,443.96	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
	Gas	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	
Impact	CO2 Emissions (gCO2)	20,428,250.67	20,428,250.67	20,428,250.67	20,428,250.67	20,428,250.67	20,428,250.67	20,428,250.67	20,428,250.67	
	CO2 Emissions (tonneCO2)	20.43	20.43	20.43	20.43	20.43	20.43	20.43	20.43	
Total	Total Available	\$ 8,762.04	\$ 10,206.00	\$ 10,206.00	\$ 10,206.00	\$ 10,206.00	\$ 10,206.00	\$ 10,206.00	\$ 15,721.00	
	DCF	\$ 8,762.04	\$ 9,538.32	\$ 8,914.32	\$ 8,331.14	\$ 7,786.11	\$ 7,276.74	\$ 6,800.69	\$ 9,790.25	
Comparison	DCF	\$ 4,072.04	\$ 5,155.14	\$ 4,817.89	\$ 4,502.70	\$ 4,208.13	\$ 3,932.83	\$ 1,176.09	\$ 1,099.15	
Discount Rate		7.00% (compounded annual)								
Total Saved		\$ 28,963.98								
TOTAL CO2 Emissions		163.43 tonneCO2								
Saved CO2 Emissions		7.87 tonneCO2								

Table 3.1 - Scenario 2 Savings Analysis

Year		0	1	2	3	4	5	6	7	
Revenue	Scientist III	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	
	Mill Wright	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	
Expenses	Mortgage	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	
	Toyota 4Runner	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 65.00	
	Bicycle Cost	\$ 1,443.96	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
	LTD Pass (4 3-Month Passes)	\$ 540.00	\$ 540.00	\$ 540.00	\$ 540.00	\$ 540.00	\$ 540.00	\$ 540.00	\$ 540.00	
	Gas	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	
Impact	CO2 Emission (gCO2)	20,446,031.48	20,446,031.48	20,446,031.48	20,446,031.48	20,446,031.48	20,446,031.48	20,446,031.48	20,446,031.48	
	CO2 Emission (tonneCO2)	20.45	20.45	20.45	20.45	20.45	20.45	20.45	20.45	
Total	Total Available	\$ 8,222.04	\$ 9,666.00	\$ 9,666.00	\$ 9,666.00	\$ 9,666.00	\$ 9,666.00	\$ 9,666.00	\$ 15,181.00	
	DCF	\$ 8,222.04	\$ 9,033.64	\$ 8,442.66	\$ 7,890.34	\$ 7,374.15	\$ 6,891.72	\$ 6,440.86	\$ 9,453.96	
Comparison	DCF	\$ 3,532.04	\$ 4,650.47	\$ 4,346.23	\$ 4,061.90	\$ 3,796.17	\$ 3,547.82	\$ 816.27	\$ 762.87	
Discount Rate		7.00% (compounded annual)								
Total Saved		\$ 25,513.76								
TOTAL CO2 Emissions		163.57 tonneCO2								
Saved CO2 Emissions		7.73 tonneCO2								

Table 3.2 - Scenario 2 Savings Analysis

Year		0	1	2	3	4	5	6	7	
Revenue	Scientist III	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	
	Mill Wright	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	
Expenses	Mortgage	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	
	Toyota 4Runner	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 65.00	
	Bicycle Cost	\$ 1,443.96	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
	LTD Pass (3 3-Month Passes)	\$ 405.00	\$ 405.00	\$ 405.00	\$ 405.00	\$ 405.00	\$ 405.00	\$ 405.00	\$ 405.00	
	Gas	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	
Impact	CO2 Emissions (gCO2)	20,441,586.28	20,441,586.28	20,441,586.28	20,441,586.28	20,441,586.28	20,441,586.28	20,441,586.28	20,441,586.28	
	CO2 Emissions (tonneCO2)	20.44	20.44	20.44	20.44	20.44	20.44	20.44	20.44	
Total	Total Available	\$ 8,357.04	\$ 9,801.00	\$ 9,801.00	\$ 9,801.00	\$ 9,801.00	\$ 9,801.00	\$ 9,801.00	\$ 15,316.00	
	DCF	\$ 8,357.04	\$ 9,159.81	\$ 8,560.57	\$ 8,000.54	\$ 7,477.14	\$ 6,987.98	\$ 6,530.82	\$ 9,538.04	
Comparison	DCF	\$ 3,667.04	\$ 4,776.64	\$ 4,464.15	\$ 4,172.10	\$ 3,899.16	\$ 3,644.07	\$ 906.23	\$ 846.94	
Discount Rate		7.00% (compounded annual)								
Total Saved		\$ 26,376.31								
TOTAL CO2 Emissions		163.53 tonneCO2								
Saved CO2 Emissions		7.76 tonneCO2								

Table 3.3 - Scenario 2 Savings Analysis

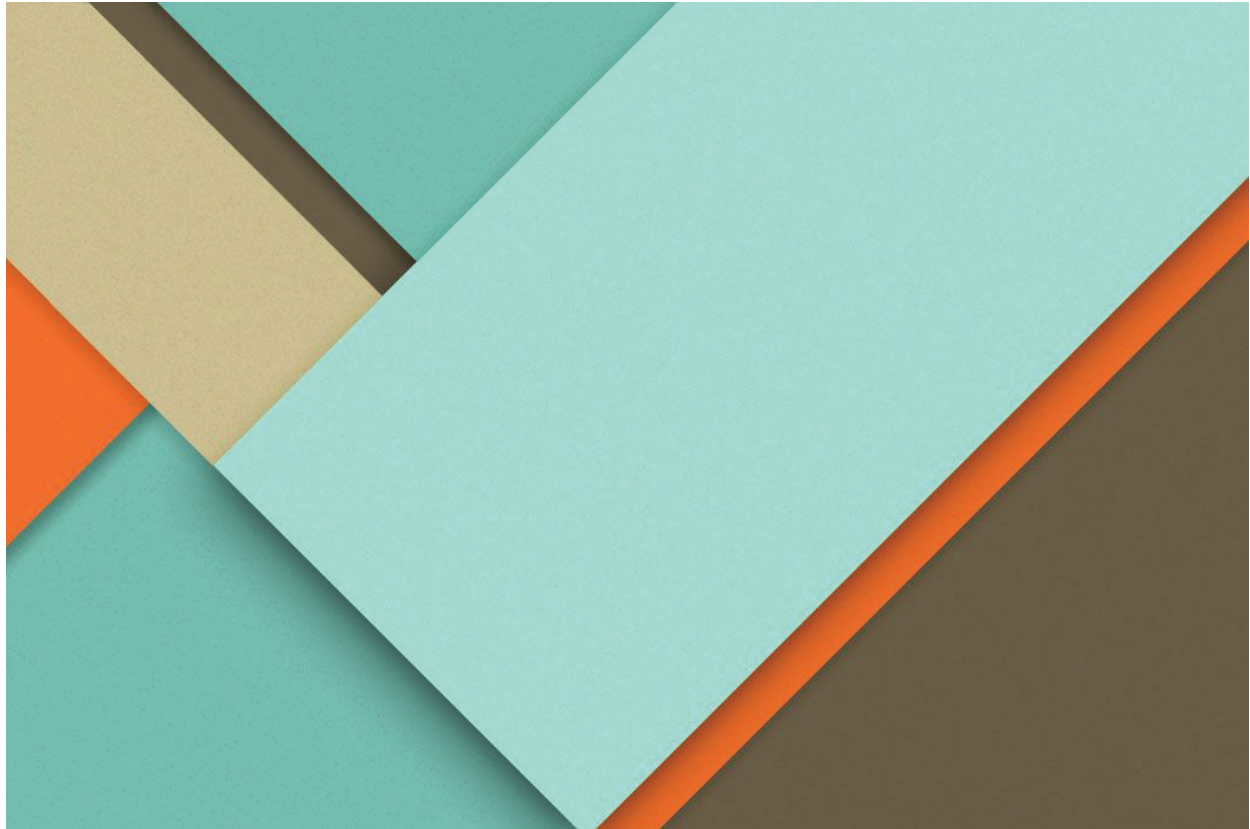
Year		0	1	2	3	4	5	6	7	
Revenue	Scientist III	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	
	Mill Wright	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	
Expenses	Mortgage	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	
	Toyota 4Runner	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 65.00	
	Bicycle Cost	\$ 1,443.96	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
	LTD Rides (30 Daily Pass)	\$ 105.00	\$ 105.00	\$ 105.00	\$ 105.00	\$ 105.00	\$ 105.00	\$ 105.00	\$ 105.00	
	Gas	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	
Impact	CO2 Emissions (gCO2)	20,429,732.40	20,429,732.40	20,429,732.40	20,429,732.40	20,429,732.40	20,429,732.40	20,429,732.40	20,429,732.40	
	CO2 Emissions (tonneCO2)	20.43	20.43	20.43	20.43	20.43	20.43	20.43	20.43	
Total	Total Available	\$ 8,657.04	\$ 10,101.00	\$ 10,101.00	\$ 10,101.00	\$ 10,101.00	\$ 10,101.00	\$ 10,101.00	\$ 15,616.00	
	DCF	\$ 8,657.04	\$ 9,440.19	\$ 8,822.60	\$ 8,245.42	\$ 7,706.00	\$ 7,201.87	\$ 6,730.72	\$ 9,724.86	
Comparison	DCF	\$ 3,967.04	\$ 5,057.01	\$ 4,726.18	\$ 4,416.99	\$ 4,128.03	\$ 3,857.97	\$ 1,106.13	\$ 1,033.76	
Discount Rate		7.00% (compounded annual)								
Total Saved		\$ 28,293.10								
TOTAL CO2 Emissions		163.44 tonneCO2								
Saved CO2 Emissions		7.86 tonneCO2								

Table 4 - Scenario 3 Savings Analysis

Year		0	1	2	3	4	5	6	7	
Revenue	Scientist III	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	\$ 73,000.00	
	Mill Wright	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	\$ 53,000.00	
Expenses	Mortgage	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	\$ 27,324.00	
	Toyota 4Runner	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	\$ 5,580.00	
	Lyft All-Access	\$ 3,588.00	\$ 3,588.00	\$ 3,588.00	\$ 3,588.00	\$ 3,588.00	\$ 3,588.00	\$ 3,588.00	\$ 3,588.00	
	Added Costs	\$ 3,676.80	\$ 3,676.80	\$ 3,676.80	\$ 3,676.80	\$ 3,676.80	\$ 3,676.80	\$ 3,676.80	\$ 3,676.80	
	Gas	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	\$ 2,250.00	
Impact	CO2 Emissions (gCO2)	21,785,537.94	21,785,537.94	21,785,537.94	21,785,537.94	21,785,537.94	21,785,537.94	21,785,537.94	21,785,537.94	
	CO2 Emissions (tonneCO2)	21.79	21.79	21.79	21.79	21.79	21.79	21.79	21.79	
Total	Total Available	\$ 2,941.20	\$ 2,941.20	\$ 2,941.20	\$ 2,941.20	\$ 2,941.20	\$ 2,941.20	\$ 2,941.20	\$ 2,941.20	
	DCF	\$ 2,941.20	\$ 2,748.79	\$ 2,568.96	\$ 2,400.90	\$ 2,243.83	\$ 2,097.03	\$ 1,959.85	\$ 1,831.63	
Comparison	DCF	\$ (1,748.80)	\$ (1,634.39)	\$ (1,527.47)	\$ (1,427.54)	\$ (1,334.15)	\$ (1,246.87)	\$ (3,664.75)	\$ (6,859.46)	
Discount Rate		7.00% (compounded annual)								
Total Saved		(\$19,443.44)								
TOTAL CO2 Emissions		174.28 tonneCO2								
Saved CO2 Emissions		(2.99) tonneCO2								

Appendix H

Robert Deppa and Arjun Panamukkil



Urban Mobility Project

12.01.2018

MGMT 641


Robert Deppa and Arjun Panamukkil

MGMT 641

OMBA, 2019

Overview

In this project we will assess the urban mobility options for a family of four. The project will outline the basic needs of a typical family in a small city, demonstrating the



frequency and distance of the trips they take. We will demonstrate the financial costs incurred with a status quo that is reliant on the car, and then demonstrate a scenario that applies alternative methods of transportation to various trip requirements. It will demonstrate the financial benefits by choosing better transportation options.

Goals

1. Properly account for the family transportation needs that occur in their daily lives, and analyze them geographically.
2. Use the geographic analysis to develop three distinct transportation scenarios that demonstrate the financial impact on the family.

Family Description

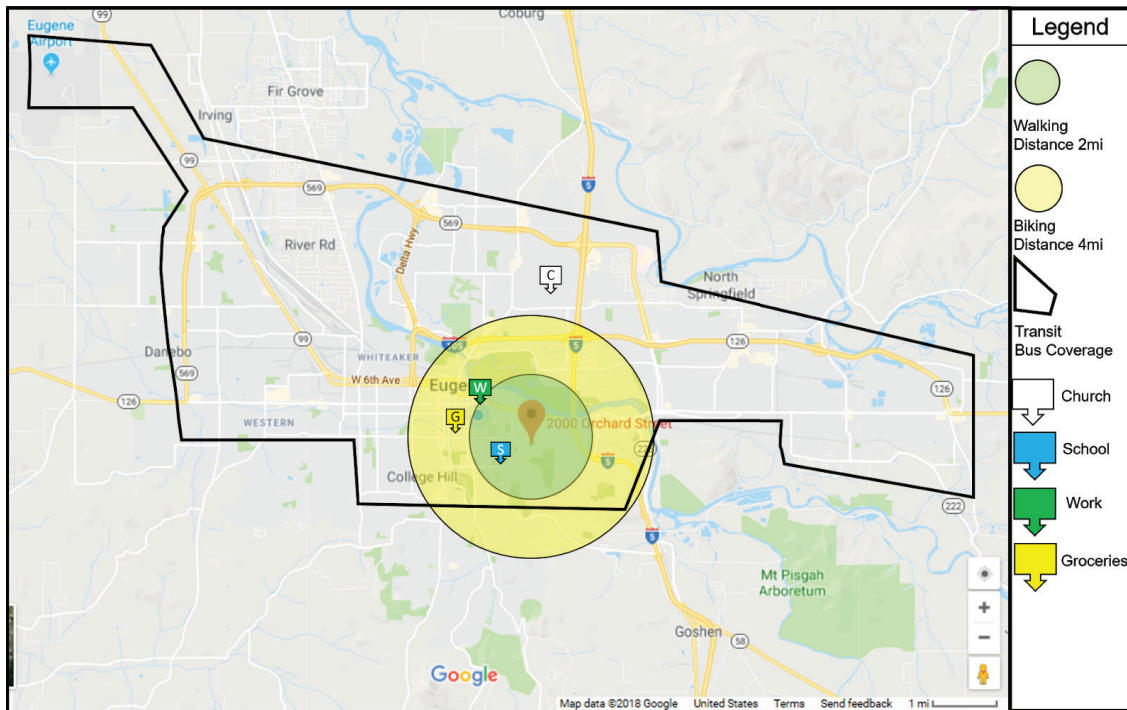
Our family has four members, a mother, father, and two children. The parents are 35 years old and the children are 6 and 8 years old. They live at 2000 Orchard Street, Eugene, Oregon. The household income is \$70,500 per year. Their largest expense by far is their rent, so transportation costs are a concern for them.

The father works as a professor of English at Northwest Christian University, near the University of Oregon campus. The mother stays at home with the kids and earns a side income ghostwriting for business websites. Both children attend Edison Elementary School in South Eugene, and the mother routinely drives them back and forth. She also makes trips to the local Safeway for groceries, although they live near a Market of Choice that is good for limited shopping runs.

They are regular church goers and attend a Sunday mass service at a local parish in North Eugene. The family is involved in some activities outside of work, to include youth sports, such as soccer, the practices for which are located at the church they attend. For fun they like to go on hikes, or bike trips around the neighborhood to local parks. They occasionally walk to Autzen Stadium or Matthew Knight Arena for Ducks Football and Basketball games. Sometimes the mother and father like to go out to local restaurants that are scattered throughout downtown and their neighborhood. The family also occasionally makes trips to Portland to see extended family.

Geography in Detail

The map below is a visual that we will use to demonstrate the different scenarios for the mobility of this family. It shows some of the most frequent locations that they go, along with the location of their home. It also has three different layers that show reasonable walking and bike distances, as well as the area covered by regular transit bus routes.



The map demonstrates that many of the family's needs fall within either walking or biking distance, which will be discussed more in the mobility scenarios. There are some important elements that are not as easy to see. For example, most of the bars and restaurants that this family is likely to visit are inside of the biking circle, which is roughly a distance of four miles, this is important because later we will refer to these generally as entertainment. Many of the parks they hike or bike at are also in the yellow circle, and they attend sporting events that are inside of the walking distance circle, which is two miles in diameter. Not depicted are the trips to Portland, which are about 210 miles round trip.

Scenario #1: The Status Quo

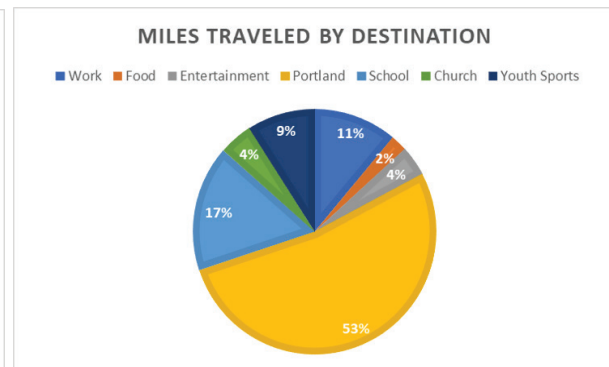
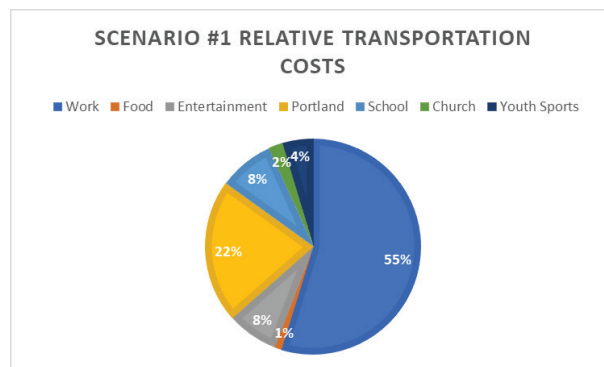
In this scenario the family is a classic two car owning family. They own one vehicle outright, their minivan, but still incur maintenance costs. They also own a pickup truck that is primarily used by the father for travel to work. They incur fixed costs of a \$350 car payment for the truck, and around \$25 a month in maintenance. Keep in mind that maintenance is not generally a monthly cost, but the baseline is a \$75 oil change at minimum every three to four months. Insurance is also \$100 a month for both cars.

The family typically drives everywhere which incurs both a fuel cost and at times a parking expense. Parking passes in their neighborhood are free, so there is no additional cost there. Some exceptions to driving are quick trips to the Market of Choice on their street for

unplanned grocery needs, trips to sporting events at Autzen Stadium and Matthew Knight Arena, and trips to parks in their neighborhood that they often walk or bike to.

The following table shows the variable costs associated with each vehicle use, dependent on the necessary cost variables, such as MPG and the price of gas. The total monthly cost reflects the fixed costs assumed above. We will also assume that trips are not made in tandem, that is they are not all part of the same errand. This is since it is difficult to calculate for all trips that are spontaneous, so we are doing this to provide a good average.

Two Car Solution (Status Quo)								
	Work	Food	Entertainment	Portland	School	Church	Youth Sports	
Transportation Method	Truck	Van	Van	Van	Van	Van	Van	Van
MPG	12	18	18	22	18	18	18	18
Miles Travelled (round trip)	4	3.5	4	210	6	9	9	9
Cost (fuel)	\$3.20	\$3.20	\$3.20	\$3.20	\$3.20	\$3.20	\$3.20	\$3.20
Parking cost	\$6	0	\$2	0	\$0	\$0	\$0	\$0
Frequency	22	5	8	2	22	4	8	8
Monthly cost	\$155.47	\$3.11	\$21.69	\$61.09	\$23.47	\$6.40	\$12.80	
Total Trans cost per month	\$759.02	Per Year	\$9,108.29	%Household Income				13%



Scenario #2: A Cost Effective Solution

Scenario 2 utilizes the geographic and financial analysis to determine a more cost-effective strategy for the family. We will use what is currently available in the Eugene area, as well as some methods that may not be in full effect yet. This scenario will look at reducing the highest costs, and needless harmful environmental impacts. The first problem is the truck. It has a payment on it which is over half of the monthly costs, but is rarely used, and when it is it is costly. Selling the truck eliminates some of the fixed cost, cutting the maintenance in half, and eliminating the \$350 car payment.

In this scenario it makes sense to keep the van. Alternate Solutions for a Portland trip were costly, \$84 for one-way tickets on Amtrak, or \$60 for the Bolt Bus one-way.^{1 2}

¹ <https://tickets.amtrak.com/itd/amtrak>. Accessed on 27 November, 2018.

Additionally, bus fares for the whole family would be around \$12 per trip to areas covered by bus routes, such as sports and church. The convenience of using the van for grocery shopping and the low cost of doing so make it the optimal method for that as well. However; for entertainment or eating out, and school trips that are frequent the van incurs some significant costs. The table below demonstrates some of the choices that the family could make and their financial impact. We also assess that a new fixed cost of \$15 a month, per parent, would be incurred for bike sharing in Eugene.³

One Car Solution With Alternate Transportation Methods							
	Work	Food	Entertainment	Portland	School	Church	Youth Sports
Transportation Method	Bike	Van	Bike/Walk	Van	Bike	Van	Van
MPG	0	18	0	22	0	18	18
Miles Travelled (round trip)	4	3.5	4	210	6	9	9
Cost (fuel)	\$15.00	\$3.20	\$15.00	\$3.20	\$0.00	\$3.20	\$3.20
Parking cost	\$0	0	\$0	0	\$0	\$0	\$0
Frequency	22	5	8	2	22	4	8
Monthly cost	\$15.00	\$3.11	\$15.00	\$61.09	\$0.00	\$6.40	\$12.80
Total Trans cost per month	\$175.90 Per Year		\$2,110.82	%Household Income			3%

Scenario #3: A Greener Future Solution

In this final scenario we considered the potential for two major changes in the urban mobility infrastructure. One is transportation as a service or TAAS, and the other is rail for trips to Portland. In this scenario we would assume that the family no longer owns any cars. Ride hailing itself is becoming obsolete, and in our previous scenarios was not cost effective due to the fees currently charged. The cost of TAAS would be estimated at about 16 cents per mile, as opposed to 34 cents per mile for a paid off vehicle.⁴ While this doesn't result in a huge swing in variable or mileage costs, it reduces fixed costs by over \$800 annually, while also reducing emissions as indicated by the second chart below.

² <https://www.boltbus.com/>. Accessed on 27 November, 2018.

³ <https://www.peacehealthrides.com/>. Accessed 27 November 2018.

⁴ James Arbib & Tony Seb.' Rethinking Transportation 2020-2030.' Page 16. A RethinkX Sector Disruption Report. May 2017.

Green Solution with Future Transportation Methods							
	Work	Food	Entertainment	Portland	School	Church	Youth Sports
Transportation Method	Bike	TAAS	Bike/Walk	TAAS	Bike	TAAS	TAAS
MPG	0	0	0	0	0	0	0
Miles Travelled (round trip)	4	3.5	4	210	6	9	9
Cost (fuel)	\$15.00	\$0.16	\$15.00	\$0.16	\$0.00	\$0.16	\$0.16
Parking cost	\$0	0	\$0	0	\$0	\$0	\$0
Frequency	22	5	8	2	22	4	8
Monthly cost	\$15.00	\$2.80	\$5.00	\$67.20	\$0.00	\$5.76	\$11.52
Total Trans cost per month	\$107.28 Per Year		\$1,287.36		%Household Income		2%

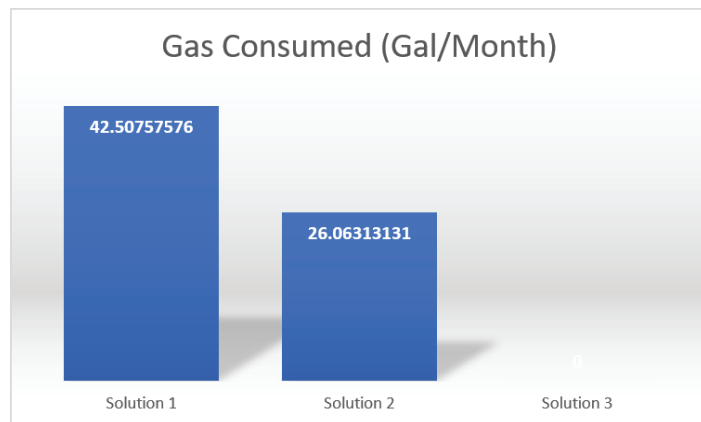
Conclusion

For a family of four to drastically change their transportation plan they would likely have to make some sacrifices, but it is believable that they would make decisions that look like a mix of these solutions.

While we have demonstrated some clear themes, there are also trips that may be spontaneous and utilize ride

hailing or transit. However; they are not more cost effective than the van for frequent trips. Our analysis focuses on frequency. Work, for example was 11% of the mileage, but 55% of the variable cost because of the mode of transportation. By working through this analysis, it is an easy decision to eliminate one vehicle and reduce the overall transportation costs of the household from 13% of annual income to just 3%. With the addition of bike sharing for shorter trips the fuel consumption dropped from 42.5 to 26 gallons per month.

While the individual decisions of a family such as this can reduce cost and emissions with what is available right now, there is also the promise of future solutions that make it more economically viable to depart from car ownership altogether. With the addition of TAAS services costs are a small fee per mile, which is perfect for all the shorter and frequently made trips that keep the van in this family's scenario cost effective. While ride hailing is more of a service of convenience, TAAS is the everyday stopgap for shopping, or family outings. Even more importantly it can effectively answer the family transportation needs while dropping fuel consumption to a nearly negligible level, while also dropping annual transportation costs to 2% of annual income.



Appendix I

Robin Perkins and Adrian Vander Wille

Fall 2018

MGMT 641 - Industrial Ecology

Robin Perkins - 951702762

Adrian Vander Wille - 951724687



UNIVERSITY OF OREGON

Lundquist College of Business

New Mobility Case Study and Feasibility Analysis

Table of Contents

1. Household Characteristics.....	3
2. Mobility Needs.....	3
3. Mobility Case Studies.....	4
3.1 Status Quo.....	4
3.2 Scenario I.....	4
3.3 Scenario II.....	5
3.4 Scenario III.....	6
4. Mobility Analysis.....	7
Appendix.....	8
Table 2.2: Cost of Car Ownership/Use, Status Quo.....	8
Table 3.2: Cost of Car Ownership, Scenario I.....	8
Table 3.3: Total Transportation Costs, Scenario I.....	8
Table 4.2: Total Transportation Costs, Scenario II.....	9
Table 5.2: Total Transportation Costs, Scenario III.....	9

1. Household Characteristics

The household consists of two adult parents, age 32, and two children, ages 6 and 7. The household resides at 324 Banton Avenue in the Santa Clara neighborhood of Eugene, Oregon. Santa Clara is a suburban landscape located close to schools, bus routes, and areas of commerce.

The household's income falls within 80-100% of the Area Median Income of Eugene.¹ Adult 1 is a full-time welder and earns \$41,600 annually, while Adult 2 works as a part-time Certified Nursing Assistant earning \$18,000 annually. Annual household income is \$59,600.

2. Mobility Needs

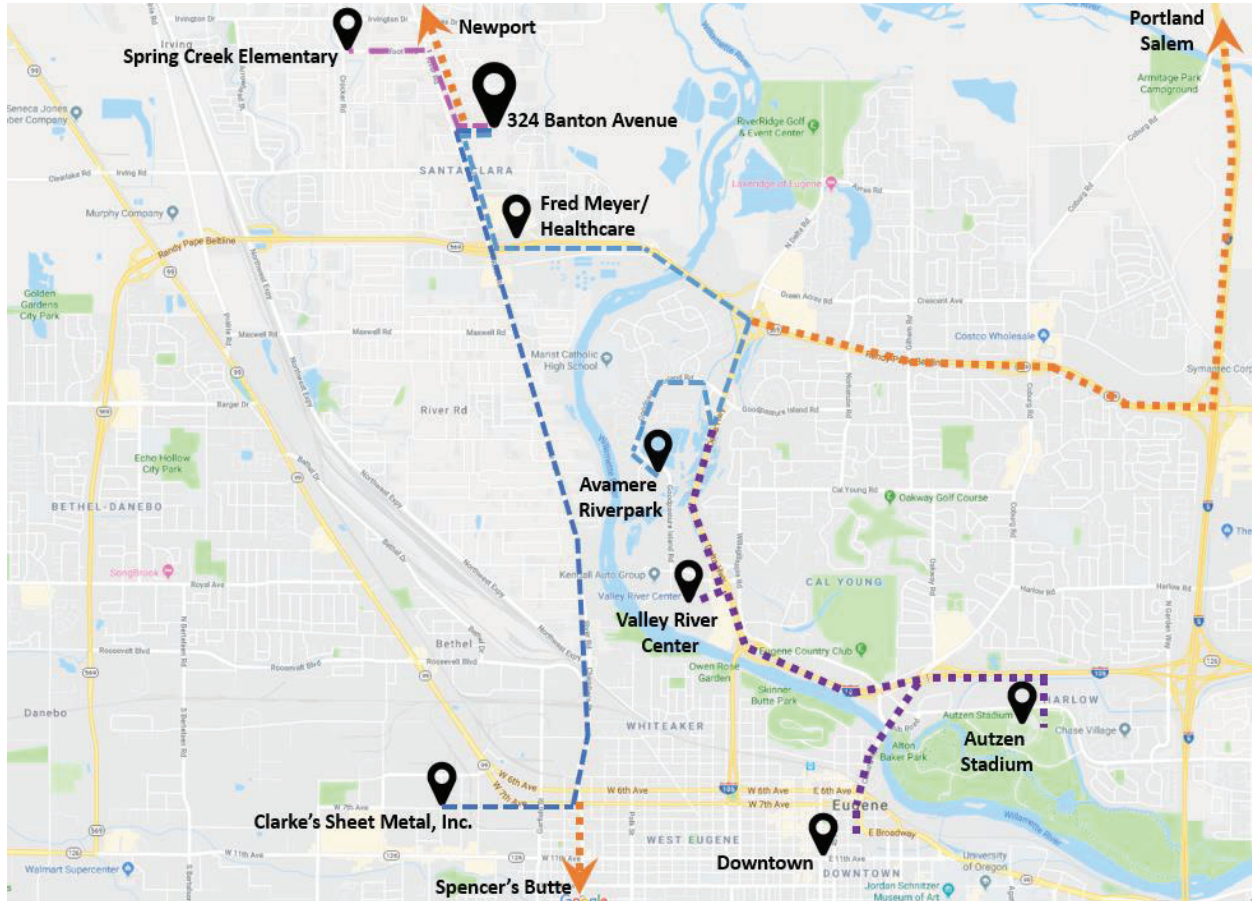
Mobility needs of the household include regular destinations such like the adults' workplaces, Clarke's Sheet Metal Inc. and Avamere Riverpark. Multiple times per year, the household travels to Salem, Portland and Newport to visit relatives and for leisure. All destinations, including additional regular destinations, are visualized in Map 1, and categorized by distance from the residence with annual frequencies in Table 1.

Table 1: Mobility Needs

Location	Category	Distance from Home	Frequency per Year
Clarke's Sheet Metal Inc. (A1)	Employment	5.1 mi.	245
Avamere Riverpark (A2)	Employment	4.3 mi.	147
Spring Creek Elementary	Education	1.2 mi.	173
Fred Meyer (Groceries)	Nutrition	1 mi.	52
Dr. House, MD (Physician)	Healthcare	1.1 mi.	6
NW Eugene Family Dental (Dental)	Healthcare	0.8 mi.	6
Restaurants (Rest)	Leisure	3 mi.	12
Valley River Center/Cinema (Mall)	Leisure	4.6 mi.	12
Downtown Eugene/ Eugene Emeralds (Events)	Leisure	6.4 mi.	5
Spencer's Butte (Hiking)	Leisure	10.4 mi.	4
Newport, Oregon (NP)	Irregular	86 mi.	2
Salem, Oregon (SA)	Irregular	68 mi.	4
Portland, Oregon (PDX)	Irregular	120 mi.	6

¹ [U.S. Department of Housing and Urban Development](#)

Map 1: Mobility Needs



3. Mobility Case Studies

3.1 Status Quo

The household owns and uses two cars for all trips. The children ride the school bus to school. Annual transportation costs total **\$11,856** as calculated in Table 2.2. More than 80% of these costs are fixed. Adult 1 and 2's work commutes last approximately 12 and 10 minutes respectively.

Table 2.1: Summary

	Employment		Nutrition	Healthcare	Leisure	Irregular
	A 1	A 2				
Car	\$11,856					

3.2 Scenario I

We assume electric scooter sharing services have been implemented across Eugene, and scooter docking stations are available near transit connection points and areas of commerce. The household owns only one car, which Adult 1 uses for commuting. Adult 2 commutes to work via bus, bike and/or scooter. Remaining mobility needs are met with the car, per the status quo.

Adult 2 rides the bus on rainy days, defined as days on which rainfall is 0.1 inches or greater. Rainy days are distributed pro rata among Adult 2’s 147 working days, such that Adult 2 rides the bus 37 days of the year. Adult 2 rides a scooter to work when they lack the energy to ride the bike, which we assume to be half of the non-rainy days.

Adult 2’s commute times via scooter, bike and bus are 20, 18 and 64 minutes respectively. Commute time is lower for scooter and bike use, because these modes can utilize trail networks across the Willamette River. The bus transit commute is also longer due to the complex hub and spoke transit system in Eugene. Total annual costs of transportation amount to **\$7,000.12** as calculated in Table 3.2 and 3.3, representing savings of \$4,855.88 (40%) from the status quo.

Table 3.1: Summary

	Employment		Nutrition	Healthcare	Leisure	Irregular
	A 1	A 2				
Car			\$6,403.12			
Bus		\$129.50				
Scooter		\$357.50				
Bike		\$110.00				

3.3 Scenario II

The household does not own any cars. Car share 2.0 is readily available in Eugene and being used for Adult 1’s commute, grocery shopping and hiking. Adult 2’s utilizes the same modes as in Scenario I.

A Zip Car-like pricing model results in annual costs of \$5,454 per table 4.2. Assuming that car sharing is not available approximately 5% of the time, we add \$300 for the spontaneous use of ride hailing services, which is \$30 more than what car sharing would have cost.²

We also considered the use of ride hailing as Adult 1’s primary mode of commute. The Lyft All Access Plan only covers 180 out of 245 round trips, so regular 65 round trips need to be added. Resulting annual cost of \$5,538 are more than the \$4,410 to use car sharing for Adult 1’s commute only.

Public transit becomes the most cost-effective solution for healthcare and most leisure activities with only \$10.40 per round trip for the entire household compared to \$18 via ZIP Car and \$20-\$40 via ride hailing services. Plans like Lyft All Access are not due to the \$15/trip plan limit. Car sharing still needs to be utilized due to lacking transit connections outside of the city limits (hiking). Both car sharing and public transit services are the only options when one more individual (friend, relative) joins the family.

Remaining irregular trips need to be covered via car rentals and Amtrak due to their long-distance nature. Car rentals are slightly more affordable than Amtrak when traveling to Salem.

The household’s annual cost of transportation in Scenario II is **\$8,516.60**. The \$1500 increase above Scenario I costs is due to irregular trips which account for \$2,120.60 – 25% of total annual costs. Scenario II represents a 29% reduction in transportation costs from the status quo.

² [Zipcar Pricing Model](#)

Table 4.1: Summary

	Employment		Nutrition	Healthcare		Leisure				Irregular		
	A 1	A 2	Groceries	Dental	Physician	Rest	Mall	Events	Hiking	NP	SA	PDX
Car												
Bus		\$129.50		\$249.60		\$176.00						
Scooter		\$357.50										
Bike		\$110.00										
Car Sharing	\$4,410		\$936						\$108			
Car Rental										\$600	\$432	
Amtrak												\$1,008

3.4 Scenario III

Contrary to scenario II, scenario III assumes the substitution of car ownership with public transit, micro transit, or services like Waze Carpool.³ All are assumed to be commonly available in Eugene. Utilizing public transit for Adult 1’s commute takes more than one hour and requires more than a mile of walking due to ill-fitting routes and schedules. Thus, we focus on alternative, yet similar, modes of transportation.

Adult 1 pays \$1,225 per year for commuting via micro transit or Waze Carpool per table 5.2. Annual car sharing expenditures of \$538 are necessary to meet nutritional mobility needs. All other costs remain the same.

In Scenario III, the household’s annual cost of transportation is **\$4,933.60**, which is 30% and 42% less than Scenarios I and II respectively, Irregular long-distance trips account for 41% of annual expenditures for transportation in Scenario III. Scenario III costs represent a 59% reduction from the status quo.

Table 5.1: Summary

	Employment		Nutrition	Healthcare		Leisure				Irregular		
	A 1	A 2	Groceries	Dental	Physician	Rest	Mall	Events	Hiking	NP	SA	PDX
Car												
Bus		\$129.50		\$249.60		\$176.00						
Scooter		\$357.50										
Bike		\$110.00										
Car Sharing			\$538.00						\$108			
Micro Transit	\$1,225											
Car Rental										\$600	\$432	
Amtrak												\$1,008

³ [Waze Carpool](#)

4. Mobility Analysis

The financial impact of different modes of mobility is evident. Scenario III reduces annual transportation expenditures from 19.6% of household income to 9%. Substituting one of the two cars with alternative modes reduces annual expenditures for transportation by 40%. Substituting both cars reduces expenditures by only 27% because of the increased costs for irregular long-distance trips, which account for 41% of annual costs in scenario III. Renting a car for a trip to Salem is more affordable than utilizing Amtrak for a household of four. Amtrak rates alone account for up to 19% of annual transportation expenditures by only accounting for 0.09% of annual trips. This could pose a disadvantage for larger families as rental car rates are not as volatile as Amtrak in regard to household size. Amtrak might want to consider special passes for families and groups.

The need for price model changes also applies to public transit. It is somewhat counter-intuitive that purchasing daily passes is more affordable for a part-time commuter than having a quarterly pass. Currently, annual passes are not offered, even though they would create a strong cost-incentive to switch to use public transit for more mobility needs.

Public transit's current routes and schedules create additional disincentives for use. The scenarios show that Adult 2 saves about 90 minutes in commute time each day by using a bike or scooter, which enjoy geographical advantages like paths across the river. Adult 1's commute via bus suffers from inefficient routes and distant bus stops, increasing commute time by a multitude compared to using the car. Unfortunately, these opportunity costs probably outweigh cost-savings caused by the complete substitution of car ownership, because the family is in a financial position to afford car ownership.

Car ownership still poses advantages in regard to convenience and reliability. Utilizing scooters and bikes proves to be difficult during bad weather or periods of physical impairments. A well-working transit system would complement these modes, and makes many alternative modes of transportation truly feasible.

Finally, a household's mobility decisions are influenced by other external factors and cultural norms closely related to mobility trends. Grocery shopping creates demand for car sharing services, as transit would be quite inconvenient. The emergence of grocery delivery services might make the switch to transit much easier. Friends, neighbors, colleagues, and relatives can also fill certain gaps, by either riding together or occasionally lending a car. Having a reliable social system in place could tremendously reduce expenditures for out-of-town trips; further reducing dependence on rental cars and car sharing. Ride hailing services' convenience and reliability allow them to serve as a catalyst to adaptation by filling gaps in mobility. Diversity and complementing services will be key factors to households adapting to more cost-effective modes of transportation with lower carbon footprints.

Appendix

Table 2.2: Cost of Car Ownership/Use, Status Quo

	Rate	Occurrence/Annual Miles	Annual Total
Loans	\$ 750.00	12	\$ 9,000.00
Gas price/mile*	\$ 0.16	6,600 miles**	\$ 1,056.00
Maintenance	\$ 800.00	1	\$ 800.00
Insurance	\$ 500.00	2	\$ 1,000.00
Total Annual Transportation Cost – Status Quo			\$ 11,856.00

*Gas price/mile is calculated based on an assumed 20 Miles Per Gallon and gas price of \$3.20/gallon.

**Annual miles are calculated as the number of times traveled to each destination in Table 1, multiplied by the round-trip miles for the respective destination. The calculation includes an assumed 20 car trips to/from the school.

Table 3.2: Cost of Car Ownership, Scenario I

	Rate	Occurrence/Annual Miles	Annual Total
Loan	\$ 350.00	12	\$ 4,200.00
Gas price/mile*	\$ 0.16	5,332 miles	\$ 853.12
Maintenance	\$ 500.00	1	\$ 500.00
Insurance	\$ 425.00	2	\$ 850.00
Total Cost			\$ 6,403.12

Table 3.3: Total Transportation Costs, Scenario I

Adult 2 Bus/Scooter/Bike Commute Days - Assumptions		
Average days with at least 0.10 inches of rainfall ⁴		93
Total Employment Days		147
Bus Days (93/365 rain days x 147 employment days)		37
Scooter/Bike Days (147 employment days - 37 bus days)		110
Bike Ownership		
Bike*	\$ 100.00	
Maintenance	\$ 10.00	
Total Annual Cost of Bike Ownership		\$ 110.00
Bus		
Total Annual Cost of Bus (\$3.50 Daily rate x 37 bus days)		\$ 129.50
Scooter		
\$1 unlock + \$0.15/minute		
Distance traveled with scooter	2.9 mi.	
Scooter speed	14 mph	
Approx. travel time	15 min.	

⁴ [National Weather Service](#)

Cost of scooter (1 trip): [\$1 + (\$0.15 x 15 min.)]	\$ 3.25	
Daily cost of scooter use (2 trips)	\$ 6.50	
Total Annual Cost of Scooter (\$6.50 x 55 scooter days)		\$ 357.50
Cost of Car Ownership and Use from Table 3.2		\$ 6,403.12
Total Annual Transportation Cost – Scenario I		\$ 7,000.12

*Cost of bike is the upfront purchasing cost of \$300 allocated across 3 years.

**The pricing model for scooter share is based on the current model from Lime scooters. The price of using a scooter is the sum of a \$1 unlocking charge per use and an additional \$0.15 per minute of use.⁵

Table 4.2 – Total Transportation Costs, Scenario II

	Annual Total
Commute – Adult 2 (scenario 1)	\$ 597.00
Commute via Ride Hailing/Lyft All Access Plan – A 1	
<i>Fix Costs - Annual Plan Cost</i>	<i>\$3,588.00</i>
<i>Additional Lyft Rides not Covered by Plan</i>	<i>\$1,950.00</i>
Total Annual Cost of Ride Hailing for Commute – A 1	\$5,538.00
Fix Costs - Annual Plan	\$70.00
Variable Costs - Commute	\$4,410.00
Variable Costs - Nutrition	\$936.00
Variable Costs - Hiking	\$108.00
Total Annual Cost of Car Sharing - Household	\$5,454.00
Total Annual Cost of Bus - Healthcare and Leisure***	\$425.00
Total Annual Cost of Car Rentals - Irregular Trips***	\$1,032.00
Total Annual Cost of Amtrak - Irregular Trips***	\$1,008.00
Total Annual Cost of Regular Trips	\$6,509.00
Total Annual Cost of Irregular Trips	\$2,040.00
Total Annual Transportation Cost – Scenario II	\$ 8,549.00

***Calculations assume actual costs per roundtrip per the Lane Transit District, Enterprise Car Rentals, and Amtrak multiplied with trip frequencies from Table 1.

Table 5.2 – Total Transportation Costs, Scenario III

	Annual Total
Commute – Adult 2 (scenario I)	\$ 597.00
Total Annual Cost of Irregular Trips (scenario II)	\$2,040.00
Total Annual Cost of Car Sharing – Nutrition & Hiking	\$646.00
Total Annual Cost of Micro Bus – Commute A 1	\$ 1,225.00
Total Annual Cost of Transit – Mall & Events***	\$176.00
Total Annual Cost of Transit – Healthcare and Restaurants***	\$249.60
Total Annual Transportation Cost – Scenario III	\$ 4,933.60

***Calculations assume actual costs per roundtrip per the Lane Transit District, Enterprise Car Rentals, and Amtrak multiplied with trip frequencies from Table 1.

****We assume a cost of \$2.50/trip for micro transit, based on costs in other cities.

⁵ [Electric Scooter Sharing](#)

Appendix J

Prim Phatthanaphong and Giao Ta

Kim's New Mobility Plan

Kim is a high school teacher who teaches online French classes. She is sixty-five years old living with her beloved cat at 888 E 28th Avenue, Eugene, OR. Her annual income is \$67,000, which is 150% of Eugene median income. Her current means of transportation is her white 2007 Acura MDX with the fair market value of \$9,270. As an online instructor, she does not have to commute to work, which puts her monthly cost to own a car and commute to be \$488.33 (See Appendix for details). She also owns a bicycle that she does not use.

Her regular destinations are weekly grocery shopping at Market of Choice on Willamette Street, and daily workout at YMCA. Her irregular destinations are bimonthly veterinarian visits at Amazon Park Animal Clinic (725 E 25th Ave) and monthly doctor visit at Oregon Medical Group (600 Country Club Rd). In summer, she occasionally goes to the Saturday Farmer Market in Downtown Eugene. With a private car, Kim gets her freedom to travel around Eugene at her convenience and as often as she would like. It provides her an efficient time utilization since she does not have to be limited to fixed routes and timetables.

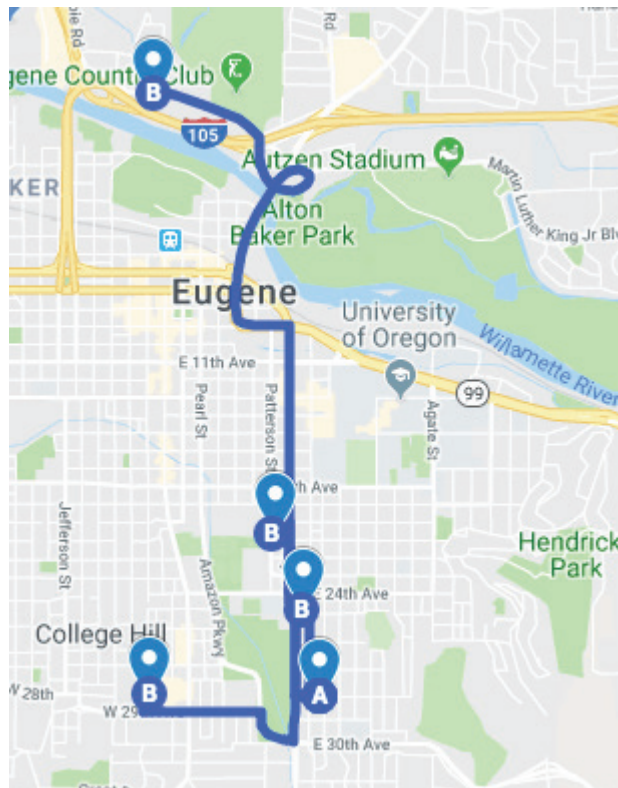


Figure 1. A: Kim's House, B: Doctor office, Gym, Vet office, and Market of Choice (From top to bottom)

Prim Phatthanaphong & Giao Ta MGMT 641

By looking at Kim's neighborhood Walk Score (Figure 2), the private car is overall a convenient mode of transportation for Kim to meet her needs. It provides flexibility and time efficiency. However, urban mobilities are emerging and opening opportunities and solutions to traffic and sustainable transportation. Below, we provided Kim with three possibilities to participate in urban mobility, be on trend, and cut transportation costs.

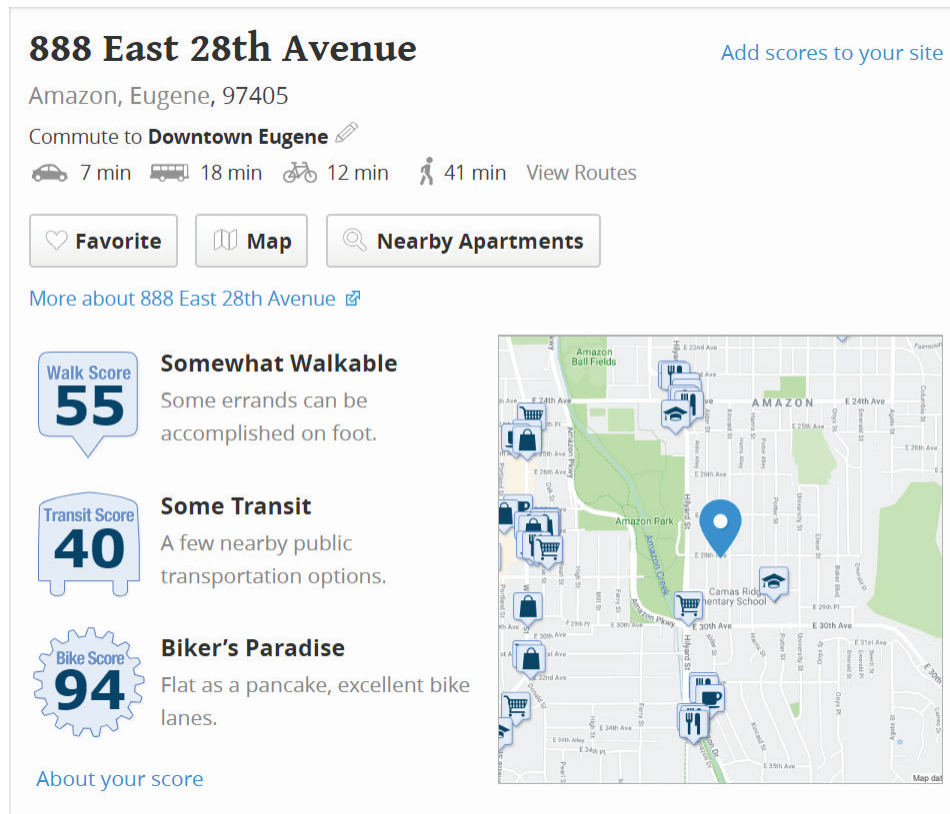


Figure 2. Walk Score

Alternative 1: Keep the car, and take more public transportation

Kim's modes of transportation in this option will be a car and Lane Transit District (LTD) buses. The reason we chose the LTD bus system is that it provides a coverage in Lane County, and her house is only two blocks from a bus stop. Kim also has a senior citizen perk, which is a free bus pass. For her regular trips like grocery shopping, she will continue to use her car because there is no public transit from her house to Market of Choice. Even though the distance from her house to the grocery store is only 0.8 miles, she buys soda and food cans, which are too heavy for her to carry.

However, her irregular activities can be accomplished by taking the buses because doctor and veterinarian appointments are during regular business hours on weekdays when the buses run

Prim Phatthanaphong & Giao Ta
MGMT 641

every thirty minutes. This provides some flexibilities in scheduling for her. In summer, she can directly reach to the farmer market by bus and be stress-less looking for a parking. Her workout routine may be impacted the most by the change because it is a daily activity. Nevertheless, she can get a good warm-up from a six-minute walk, from and to the bus stops.

As a result of Alternative 1, she would decrease her transportation cost by \$20. Even though she drives less and reduces half of the gas expense, her monthly insurance, and the ownership costs are fixed. The increase of the public transportation usage benefits Kim and her community financially and sustainably since it promotes fuel efficiency, safety, pollution, and traffic reduction. At the same time, Kim gets to interact with real people after teaching her online class. Without having to drive, she can use her free-up time on the bus to work on her class or do other things.

Nevertheless, there are some trade-offs in terms of convenience, flexibility, and time utilization. For the veterinarian visits, she will have to carry the cat carrier to/from bus stops and hold it throughout the bus ride. Also, she may have no flexibility to go from destination A to B with the fastest route, a pre-trip planning is needed. Buses can cause a loss of time in travels; even though the bus system runs on a specific schedule, the buses can run behind the schedules. Therefore, Kim will have to take an earlier bus to avoid being late. While Kim has free-up time during the ride, she will have to trade off her privacy.

Besides that, Kim will have to walk more, which is in a total of 390 mins/month. This promotes a healthy habit for many people, but it may be irrelevant to Kim because she works out every day already. Also, being in public space exposes her to germs and contagious illnesses from other passengers. Granted that there will always benefits and trade-offs for every alternative, this option may not be as challenging as the others, but it provides a smoother transition for Kim to integrate other modes of transportation in her daily life.

Transportation mode	Purpose of visit	No. Of Hours	Costs per month
Car	Many	-	\$468.33 (See appendix)
Bus	Grocery shopping	8	\$0
	Doctor visit	4	
Total			\$468.33

Alternative 2: Get rid of the car, take more public transportation, and use senior transportation services

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MGMT 641

The Rethink X report predicts that in the foreseeable future, the ICE vehicles will be more and more stranded, which means these vehicles unexpectedly lost value during their originally planned useful life, which is a result of shifting fundamentals. To avoid losing her car value, Kim should sell it and use the proceeds to cover the costs of other transportation modes. In addition to taking more public transportation, as discussed in Alternative 1, we recommend Kim to start using senior transportation services to get to her regular and irregular destinations. To be more specific, there are two types of senior transportation services that she should use: a door-to-door service by the local Area Agency on Aging (AAA), and private transportation service by Care.com.

To use the former service, Kim just needs to call Lane County AAA for senior transport services information. They'll help Kim meet her transportation needs at low costs, usually \$2.50 to \$5 per ride. AAA service vehicles stop at seniors' homes and take them to the grocery store, shopping center, or medical facilities. For the latter service, Kim can hire an individual as her private driver, which would cost her approximately \$12.75/hour. Care.com provides basic and extended background checks on driver's profiles listed on its website, which can assure Kim's safety.

Based on our estimates, the total costs of this alternative are \$153/month. Please see the cost breakdown below.

Transportation mode	Purpose of visit	No. Of Hours	Costs per month
Bus	Many	-	Free
Senior transportation services	Grocery shopping	8	\$12.75 max. x 12 hrs = \$153
	Doctor visit	4	
Total			\$153

Alternative 3: Get rid of the car, take more public transportation, ride her bicycle more often, and use ride-hailing services

Similar to Alternative 2, we recommend Kim to sell her car and take more public transportation. In addition to that, we also think she should ride her bike more often in the summer to nearby destinations, such as grocery store, gym and veterinarian office. Since Kim doesn't like to get wet, we expect her to ride her bike only in the spring or summer.

Another transportation mode that we recommend is ride-hailing services, such as Lyft and Uber, especially when Kim finds public transportation and biking unsatisfactory. Kim can have a car arrives in front of her house within a few minutes. Lyft and Uber apps are straightforward, hence

Prim Phatthanaphong & Giao Ta
MGMT 641

easy to use. Even if Kim is not comfortable using them, she can use GoGoGrandparent, which is a concierge service that connects her with Lyft and Uber. She would have to pay the regular price for the ride plus an additional 27 cents/mile for the concierge service.

Based on our estimates, the total costs of this alternative are \$131/month. Please see the cost breakdown below. (For simplicity, we ignore the concierge fees of GoGoGrandparent.)

Transportation mode	Purpose of visit	Frequency	Costs per month
Bus	Many	High	Free
Bike	Many	High (spring & summer)	\$23 (see appendix)
Lyft/Uber	Grocery shopping	Weekly	\$7/ride x 8 = \$56
	Doctor visit	Monthly	\$12/ride x 2 = \$24
	Veterinary visit	Bimonthly	\$7/ride x 4 = \$28
Total			\$131

Benefits and Tradeoffs of Alternative 2 & 3

Giving up her car means Kim wouldn't need to pay any car-related costs (including car ownership cost, gas, insurance, and maintenance), and has no parking hassles. She would also help the community reduce greenhouse gases and traffic congestion. Getting rid of her car would practically force her to spend more time walking or biking, which promotes her health.

On the other hand, going car-free means she wouldn't be as flexible as she used to be, and it could be more time-consuming. The tradeoffs for Alternative 2 and 3 would be similar to Alternative 1 in terms of convenience, flexibility, and time utilization. For example, the AAA service vans have a planned route based on set stops, so they are often slow and inflexible. However, this service offers seniors like Kim a way to get out and an opportunity to socialize with others in the van. Chatting with others is a pleasant way to pass time than sitting alone behind the wheel.

Conclusion

\$ per month	Alternative 1	Alternative 2	Alternative 3
Total Cost	468.33	153.00	131.00

We found that every option has benefits and tradeoffs. However, we would like to suggest Kim sell her car because it would save her money on the annual car ownership cost of \$3,000. In addition, with the prediction by RethinkX that vehicles are unexpectedly to lose most of its values in the foreseeable future, selling her car would be a prevention and solution to value lost and sustainable transportation.

Since time is not a major factor for Kim as she is retired and has a flexible online class schedule, she can save up for her summer trip to Paris while meeting her transportation needs with Alternative 2 or 3. The proceeds from the car sale can also be contributed to her vacation or savings while covering her transportation costs. Walking provides health benefit; Kim can have extra physical activities during the day and/or have an option to skip her gym class. Between Alternative 2 and 3, Kim can choose the best alternative that fits her needs and lifestyle, since the costs of these two alternatives are affordable and the costs difference is not significant.

References

1. “GoGoGrandparent.” *gogograndparent.com*.
2. RethinkX, *Rethinking Transportation 2020-2030*, May 2017.
3. “Senior Transportation in Eugene.” *Care.com*, www.care.com/senior-transportation/eugene-or.

Appendix

Prim Phatthanaphong & Giao Ta
MGMT 641

Cost of having a car	Current		Alternative 1	
Estimated value lost in the first five years	\$ (15,000.00)		\$ (15,000.00)	
Mileage usage	350.00	per month	225.00	per month
Mileage usage	4,200.00	per year	2,700.00	per year
Mileage usage	21,000.00	per 5 years	13,500.00	per 5 years
Total useful life	5 years		5 years	
Total cost of cars	\$ 39,995.00		\$ 39,995.00	
Cost per miles	\$ (0.71)		\$ (1.11)	
Cost of ownership	\$ (3,000.00) per year		\$ (3,000.00) per year	
Cost of ownership	\$ (250.00) per month		\$ (250.00) per month	
Gas	(40.00) per month		(20.00) per month	
Maintenance	(98.33) per month		(98.33) per month	
Insurance	(100.00) per month		(100.00) per month	
Total cost of having a car	\$ (488.33) per month		\$ (468.33) per month	

Cost of having a bicycle					
Item	Price	Parts	Average life	Annual cost	
Bicycle	120	Chain	20	2	10
Helmet	30	Cassette	40	3	13.33
Fenders	100	Brake pads	20	1	20
Lock	50	Tubes	12	1	12
Lights	50	Tires	40	2	20
		Seat	30	5	6
		Bottom bracket	100	5	20
		Bike wash	16	1	16
		Cables	40	4	10
TOTAL	350	Bar tape/gel	30	4	7.5
		Wheels	150	5	30
Annual maintenance					
Tuneup	75	TOTAL			165
Parts	165				
TOTAL	240				
Theft rate	6%				
Stolen every	11.2 years				
Monthly TCO	\$23				
Annual TCO	\$271				

Appendix K

WHERE'S WALDO? – AN URBAN MOBILITY CASE

Introduction

Based on a real family in Eugene, we looked at a household living on the outskirts of town. More specifically, a household that fell into the average American demographics with a common non-urban geographic. The reason we chose this household is because studies in big cities are commonplace and fail to capture nearly half of the nation's population. TaaS will affect people's lives outside of the metropolitan areas, so it is important to examine them as well. The objective of this case analysis is to layout the everyday lives of our subject family and to estimate the impacts of their daily transportation. Then, we want to integrate TaaS, when reasonable, into their daily schedule to estimate the changes in impacts of their routine. We are focused on the savings in cost, overall time, and driving time – as well as the change in their carbon footprint from integrating TaaS into their daily routine.

Regular Destinations (See Table 1)

4 members in the Johnson family – Waldo, Wanda, Wyoming, and Wilma – live on a two-acre plot on Marcola Road about six miles out of town. Waldo is the husband who drives a 2002 Toyota Camry to Lane Transit District (LTD) for work. Wanda is the wife who drives a 2016 Subaru Outback to Lane Community College (LCC) for work. Wyoming and Wilma are their children, and both attend Yolanda Elementary School.

Table 1

Name	Age	Occupation	Salary
Waldo	42	Bus Driver	\$40,000
Wanda	35	Development Director	\$80,000
Wyoming	11	Elementary student	N/A
Wilma	5	Elementary student	N/A

Irregular Destinations

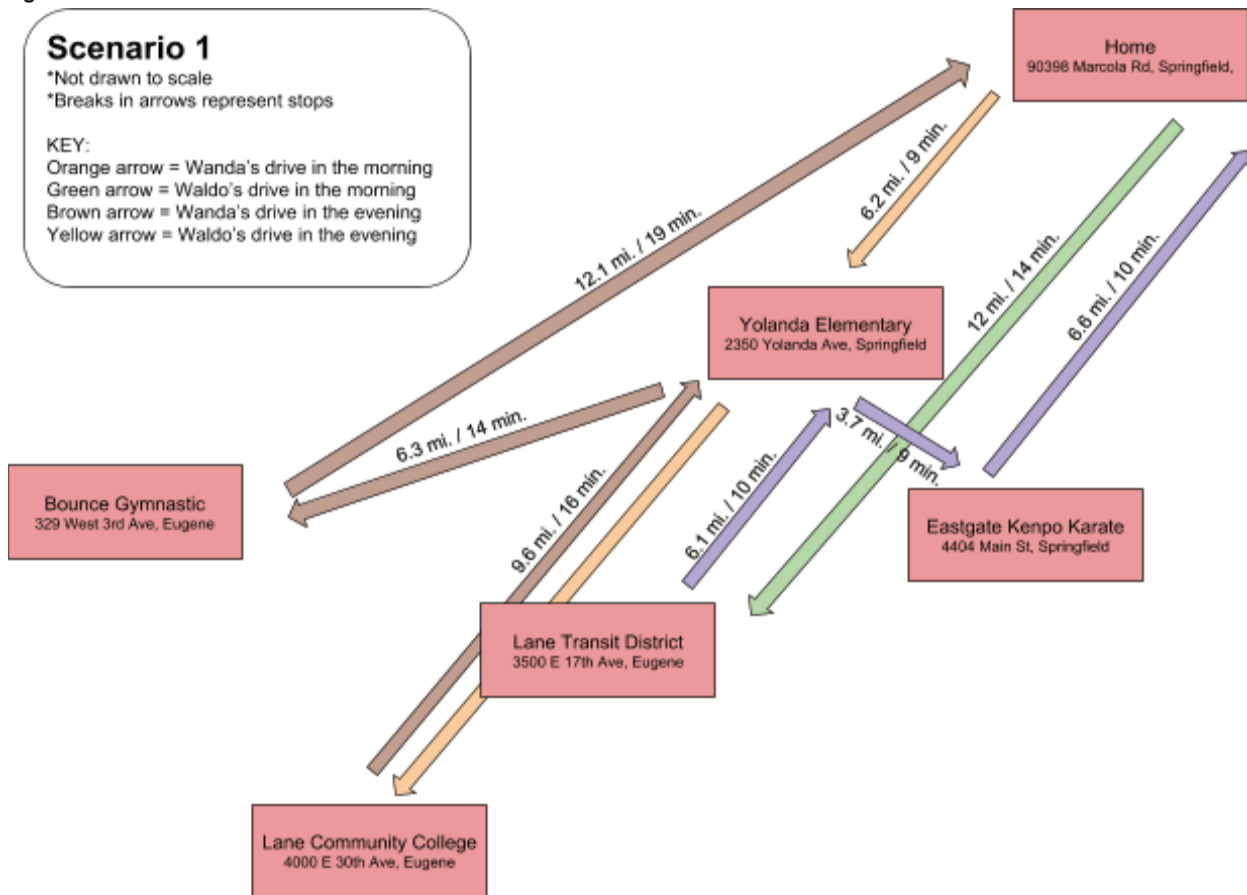
The family goes on three camping trips a year. We won't need to analyze these semi-annual trips, as TaaS is not reasonable to integrate for these applications due to the distance of the trip.

Wanda also has a weekly shopping trip. On the weekends, she takes the kids with her to go buy groceries. TaaS is not available for this trip, because we're assuming that TaaS does not operate near their home (based off the fact that Lyft and ZipCar aren't in their boundary). Most weekend driving occurs in the Subaru, not the Camry, as the Camry is primarily a commuter for Waldo. For these reasons, we will not analyze the changes of these irregular trips with TaaS integration.

Scenario 1 (see Figure 1 below)

Every morning, Wanda takes the kids to school on her way to work while Waldo heads straight to work from home. After work every evening, Wanda picks up Wilma and takes her to gymnastic practice while Waldo picks up Wyoming and takes him to karate practice. Once both practices are done, each parent and kid heads home. This scenario is representative of the current state the family lives in.

Figure 1



Cost Analysis

We estimated that the family spends \$2,300 per year in total on gas alone for this routine (Reference A). We assume that they will spend \$1,200 per year for insurance, \$400 per year for maintenance, and \$0 on parking — as their jobs provide parking and they have ample space to park at home. This totals to \$3,900 spent on their daily routine per year.

We estimated that the adults spend 117 minutes combined driving and the children spend 70 minutes combined riding in the car each day. The whole family spends a combined 187 minutes, or an average of 46.75 minutes per person (Reference B). The adults spend 67% more time in the car than the children. The adults' time is more valuable. The amount of time adults spend commuting in this routine is entirely restricted to driving, so their time is completely wasted.

We will use a two-pronged approach to energy efficiency. First, we will consider that any reduction in gas use is a fossil fuel reduction, assuming that the electricity is not sourced from fossil fuels for simplification purposes. Second, we will consider the total economic cost change in energy costs. Any use in electricity in kilowatt hours, will be considered at the dollar per kilowatt hours in order to value it against gas in dollars per gallon.

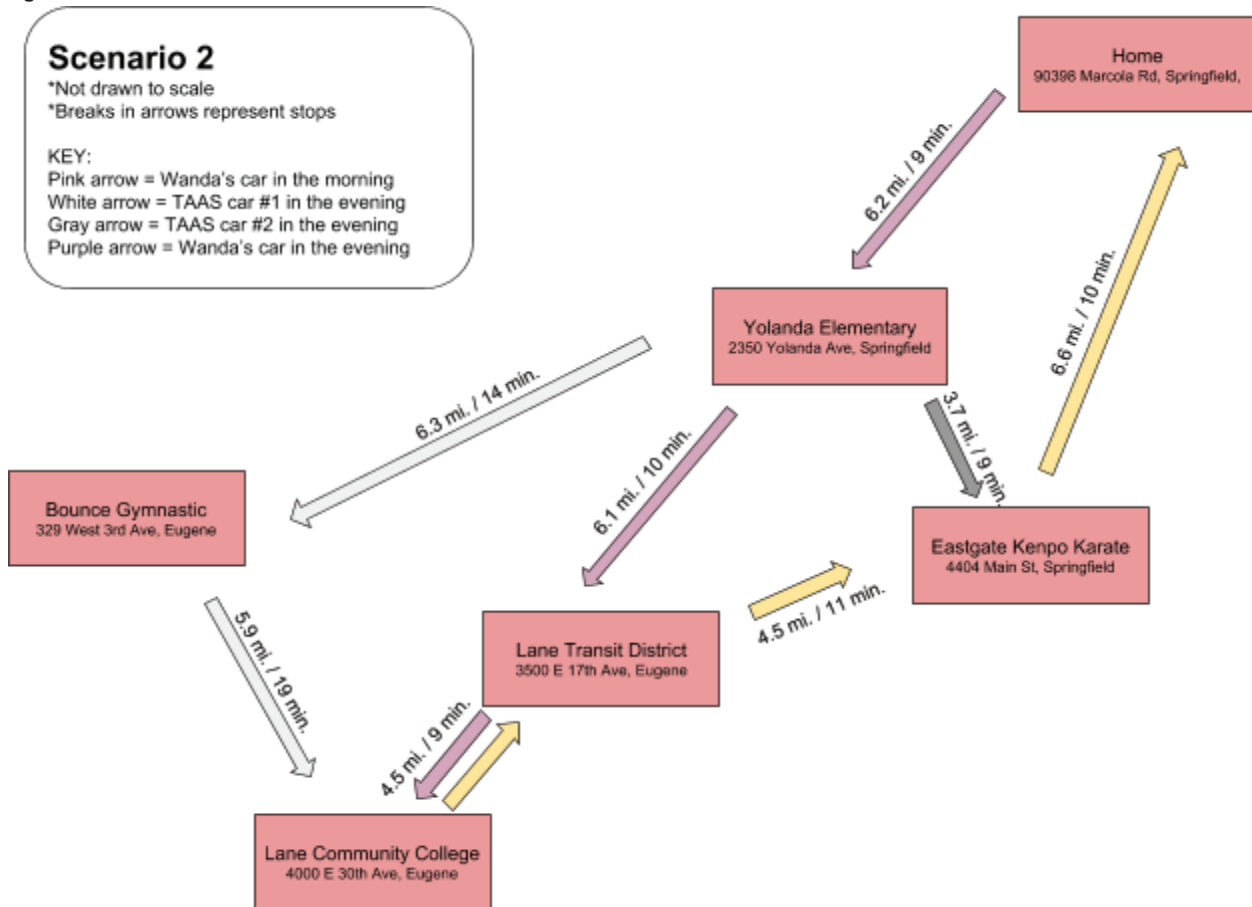
Ideally, what we would like to see is a reduction in cost to the family, time spent in vehicles, time spent driving, and amount of energy consumed.

Scenario 2 (see Figure 2 below)

In a TaaS based family transport plan, Waldo no longer needs his own car as the extra stops necessitated by the children’s extracurricular activities can be taken over by TaaS. Since Wanda works the furthest away, she needs her car. As usual, she drops her kids off at school on her way to work every morning. However, in this scenario, Waldo tags along. After her kids, she drops her husband off at his job before heading to her workplace.

In the evening, TaaS car #1 picks up Wilma from school to take her to her gymnastics practice while TaaS car #2 picks up Wyoming from school to take him to his karate practice. Once her practice is done, TaaS #3 drops Wilma off at LLC to rendezvous with her mother. They then drive home, picking up Waldo and then Wyoming on the way.

Figure 2



Cost Analysis

We estimated that the family spends about \$1,050 per year on gas for this routine alone (Reference C). We assumed that they will spend \$600 per year for insurance, \$200 per year for maintenance, and \$0 on parking. They will now pay for TaaS, which we estimated would cost roughly \$450. We calculated this considering TaaS vehicle’s depreciation, resale value,

insurance cost, maintenance cost, and monetization revenue. This totals to \$2,300 spent on their daily routine per year.

The cost savings to the family are approximately \$1600 for their daily routine. We recognized that the loss of one car will result in increased usage of services like Uber, as we assumed that their house is outside the TaaS service area. According to Uber's website, the estimated trip from their house to the nearest urgent care and shopping centers costs \$18. The trip from their home to Eugene would cost roughly \$24. Assuming they would need to use at least one of these monthly, this would decrease the Scenario 2 savings by \$252 to a rough estimate of \$1350.

Family Cost Savings	
Gas	\$1,269.98
Insurance	\$600.00
Maintainance	\$200.00
TaaS	-\$437.91
Total savings per year	\$1,632.07

The time the parents save is a combined daily total of 19 minutes (Reference D). The time the children lost is a combined daily total of 30 minutes. This may be a net loss in time to the family, but as mentioned before, time loss to children is less detrimental than it is for adults. The ratio of adult to child time in transit is reduced by 69%, making them nearly even. The adults' combined driving time is reduced by 30 minutes, which allows for benefits of multitasking while riding.

Adult to Child Ratio	
Scenario 1	1.671429
Scenario 2	0.98
Difference	-0.69143

The change in carbon footprint, in terms of

Energy Reduction (\$)	Scenario 1	Scenario 2	Reduction
Total cost of trips/year (\$)	2303.84	1130.31	1173.53

dollars' worth of energy, is a reduction of about \$1,200 per year. This takes into consideration the reduction of gas usage and increase in electric power usage. This measure acknowledges that the electricity may be sourced from some fossil fuel sources.

In terms of reduction of direct fossil fuel consumption, the family uses 470 less gallons of gasoline per year.

Fossil Fuel Reduction (gal)	Scenario 1	Scenario 2	Reduction
Total gas/year	853.27	382.91	470.36

Conclusion

In evaluating the benefits of adopting a mixed mobility routine, it is important to acknowledge that each person's preferences are different. Certain people weigh the value of convenience and money differently. In this case, we analyzed a family who were interested in saving money, but not with disregard to their comfort. It is clear that the one car drop-off routine is reasonably

doable, but not necessarily as comfortable. It is possible to also consider the use of TaaS for the children but keeping their second car for the convenience of less carpooling. All things considered, the case we have analyzed seems like a great opportunity, and completely feasible. Waldo and Wanda were able to take advantage of an automatic vehicle and saved time for themselves. Not only did integrating TaaS save the Johnson family a total of \$1,632.07 per year, but also reduced fossil fuel consumption by 470.36 gallons of gas.

It is important to recognize that our TaaS pricing is based entirely on estimates and the costs to the family could vary widely. The motivation for this exercise was to examine possibilities to integrate mixed mobility lifestyles into a semi-rural household. The amount of gas saved is absolute, as is the amount of time saved. However, the pricing could prove to be unaffordable if the estimates were too far off. We considered RethinkX's vision to be far too optimistic and approached this case with a non-urban and less efficient society in mind. TaaS's costs could triple, while maintaining a 20% profit margin, and the household would still save over \$100. This may not be worth the inconvenience of one car, but it is worth considering since our TaaS estimates were very conservative. It is also important to note that the household still has a car. Removing that car would not be feasible because of their non-urban location.

References

A

Scenario 1	Subaru	Camry	Total
Mi/gal	22	22	-
Price/gal	2.70	2.70	-
Trips/week (min)	219	142	361
Cost of trips/week (\$)	26.88	17.43	44.30
Cost of trips/year (\$)	1397.62	906.22	2303.8364

B

Scenario 1	Waldo	Wanda	Wyoming	Wilma	Total
Total car trip (min)	43	74	28	42	187

C

Scenario 2	Subaru	TaaS	Total
Mi/kWh	22	3	-
Price/kWh	2.70	0.07	-
Trips/week (min)	162.00	79.50	242
Cost of trips/week (\$)	19.88	1.86	21.74
Cost of trips/year (\$)	1033.85	96.46	1130.31

D

Family Time Savings (min)	
Adults (min)	19
Children (min)	-30
Total for family (min)	-11
Not driving (min)	59

F

<https://www.rethinkx.com/>

We used this site as a basis for our knowledge and understanding of TaaS in general

G

<https://www.fueleconomy.gov/feg/Find.do?action=sbs&id=38640>

- We used Tesla's specifications for TaaS because TaaS is an electric vehicle and Tesla's is the most advanced electric vehicle on the market. Therefore, we assume that it would be representative of early TaaS.

H

<http://www.pennapowers.com/how-much-do-ads-on-youtube-cost/>

- We used this site to determine the monetization value for TaaS ads

I

<http://www.oregongasprices.com/>.

- We used this site to price gas in Springfield

K

<http://www.subutil.com/electric/rates-and-billing/>

- We used this site to price kWh in Springfield

	Subaru	Camry	TAAS	Total
MPG/MPK	22	22	3	
\$PG/\$PK	\$ 2.70	\$ 2.70	\$ 0.07	
Old Trip	43.8	28.4		
Days	5	5	5	
Old \$Energy	\$ 26.88	\$ 17.43	\$ -	\$ 44.30
New Trip	32.4	0	15.9	
New \$Energy	\$ 19.88	\$ -	\$ 1.76	\$ 21.64

Scenario 1	Subaru	Camry	Total
Mi/gal	22	22	-
Price/gal	2.70	2.70	-
Trips/week (min)	219	142	361
Cost of trips/week (\$)	26.88	17.43	44.30
Cost of trips/year (\$)	1397.62	906.22	2303.83636

Scenario 2	Subaru	TaaS	Total
Mi/kWh	22	3	-
Price/kWh	2.70	0.07	-
Trips/week (min)	162.00	79.50	242
Cost of trips/week (\$)	19.88	1.86	21.74
Cost of trips/year (\$)	1033.85	96.46	1130.31

Energy Reduction (\$)	Scenario 1	Scenario 2	Reduction
Total cost of trips/year (\$)	2303.84	1130.31	1173.53
Fossil Fuel Reduction (gal)	Scenario 1	Scenario 2	Reduction
Total gas/year	853.27	382.91	470.36

Costs to TaaS	Per Year
Depreciation	\$10,000.00
Insurance	\$600.00
Maintenance	\$200.00
Cost	\$10,800.00

Costs to TaaS	Per Week
Depreciation	\$192.31
Insurance	\$11.54
Maintenance	\$3.85
Cost	\$207.69

This is the costs to family and p	
TAAS Costs:	
Energy	\$ 1.76
Time	210
Margin Time	45
Total Time	255
TAAS Week	5040
% of TaaS Car	0.050595238
TaaS Car Cost	10.50824176
TaaS Total Cos	\$ 12.27
less	\$ 6.30
Cost to Family	\$ 8.42
TaaS Profit	\$ 2.45

Waldo

Old Car Trip 43

New Car Trip 40

TAAS Trip 0

New Total Tr 40

Adult time Sa 3

Child Time Savings

Change in Ti 43

Total Family Time Savings

Yearly Gas Savings

\$ 1,269.98

Yearly Energy Savings by \$

\$ 1,178.48

Scenario 1	Waldo	Wanda	Wyoming
Total car trip (min)	43	74	28

Scenario 2	Waldo	Wanda	Wyoming
Total car trip (min)	40	58	19
TaaS trip (min)	0	0	9
Total (min)	40	58	28

Time Saved	Waldo	Wanda	Wyoming
Adults (min)	3	16	-
Children (min)	-	-	0
Total for family (min)			
Not driving (min)	43	16	-

Family Time Savings (min)	
Adults (min)	19
Children (min)	-30
Total for family (min)	-11
Not driving (min)	59

Adult to Child Ratio	

Scenario 1	1.6714286
Scenario 2	0.98
Difference	-0.691429

Family Cost Savings	
Gas	\$1,269.98
Insurance	\$600.00
Maintainance	\$200.00
TaaS	-\$437.91
Total savings per year	\$1,632.07

This is the estimated time before TaaS car picks somebody else up, so the customer should be billed

Revenue from 30 second ads that can be viewed in car valued at \$0.015 per view (15% the minimum revenue fc

Assuming 20% margin on cost before ad revenue

Assumptions:		
Car - cost per mile		\$0.34
Personal bike - cost per mile		\$0.07
Bike share - cost per mile		\$0.10
Bus - cost per trip		\$1.75
Avg. scooter speed (mph)		7.5
Scooter - cost per mile		0.48
Walk speed (mph)		3.1
Car2Go - cost per min	\$	0.45
Car2Go - cost per day	\$	110.00
TaaS - cost per mile	\$	0.25
TaaS additional time vs car		2%
Ride-hail additional time vs car		3%

Work	Cost	
Distance (mi)	3	
Time (min) - car	10.0	\$1.03
Time (min) - bike personal	18.0	\$0.21
Time (min) - bus	40.0	\$1.75
Time (min) - walk	57.0	\$0.00
Time (min) - ride-hail	10.3	\$13.00
Time (min) - scooter	24.0	\$1.44
Time (min) - bike share	19.0	\$1.30
Time (min) - Car2Go	12.0	\$4.50
TaaS	10.2	\$0.75

Downtown Bars (SizzlePie)	Cost	
Distance (mi)	2.4	
Time (min) - car	8	\$0.82
Time (min) - bike personal	14	\$0.17
Time (min) - bus	26	\$1.75
Time (min) - walk	41	\$0.00
Time (min) - ride-hail	8.2	\$14.50
Time (min) - scooter	19.2	\$1.15
Time (min) - bike share	15	\$1.24
Time (min) - Car2Go	10	\$3.60
TaaS	8.2	\$0.60

Albertsons	Cost	
Distance (mi)	0.7	
Time (min) - car	4	\$0.24
Time (min) - bike personal	4	\$0.05
Time (min) - bus	12	\$1.75
Time (min) - walk	13	\$0.00
Time (min) - ride-hail	4.1	\$7.00
Time (min) - scooter	5.6	\$0.34

Salary
\$40,000
\$80,000
N/A
N/A

Appendix L

Matt Harvey and Nicholas Vanzwol

Matt Harvey
Nicholas Vanzwol

Urban Mobility

Resident name: Michael

Home address: 260 W 6th Ave, Eugene Oregon 97401

Number of people and age: One male adult, age 25

Income: \$26,000 (just over minimum wage). Michael's income is very low when compared to other single occupants in the Eugene area. Due to Michael's low income, he is price sensitive when considering alternative modes of transportation.

Situation Overview

In our research, we looked at the various transportation options for Michael -- a single male in his mid-20s that lives in downtown Eugene. We designated dependability and flexibility as his two most important variables when selecting a mode of transportation, with cost also being an important contributor as he makes just over minimum wage. We concluded these factors to be most important because of his need for punctuality getting to work, and the unpredictability of his social life.

To understand the costs and viability of two different transportation lifestyles, we studied 2 different scenarios so that can be summarized as the following:

1. Resident owns and depends heavily on a car, while occasionally using other modes for convenience.
2. Resident doesn't own a car and depends solely on alternative modes. One of these modes (car2go) is not currently utilized in the Eugene area, but likely will be in the near future.

After our analysis, we concluded that **scenario 1 is too cost intensive** given Michael's current income and social habits. However, it does offer a greater benefit for both time and flexibility, especially leaving work when his time is highly valued. The cost tradeoffs don't justify independent vehicle ownership when compared to the costs of scenario 2.

We have acknowledged the emergence of bulk-purchasing options for ride-hailing services at a discounted rate (Appendix E). Although, even at this price-point, the upfront cost and cost per ride is still much higher than other modes to make it a viable option. Bulk-purchasing also forces Michael to ride-hail at least 30 times a month to avoid taking a loss on the packaged rate.

Transportation Needs:

The following table references notable destinations for Michael. By incorporating the frequency of visits, we identified that infrequent destinations are almost exclusively reached by car (assuming we're in scenario 1). This is based off the unfamiliarity with public transit routes to reach these destinations, and/or the distance from Michael's home. Additionally, a majority of the frequent and regular destinations are commonly reached via bike due to their proximity to our residence home, and the need for efficient travel accommodations because of their frequency of occurrence. Michael leverages his downtown location by walking and biking to destinations within a reasonable distance. However, when visiting an unfamiliar location, he prefers to drive to account for his potential margin of error when identifying the location, and the reduction of overall travel time.

	Frequent	Infrequent
Regular	<ul style="list-style-type: none">• Work at Best Buy in Gateway Mall 5 days a week from 1:30pm-10pm (close)• Safeway on 18th twice a week• Skinner's Butte 4-5 days a week for exercise purposes	<ul style="list-style-type: none">• Health care visits roughly twice a year• Portland once a month to see family located in SE Portland
Irregular	<ul style="list-style-type: none">• Downtown Eugene bars and Restaurants for leisure purposes once or twice a week• Target down west 11th 4 times a year for furnishing goods• Sizzle Pie on Broadway once a week for leisure purposes• Glennwood on 13th for breakfast	<ul style="list-style-type: none">• Spencer's Butte once or twice a year by car• Eugene Airport 1-2 times a year for friend pickup / dropoff

Additionally, Michael needs a flexible transportation method that can accommodate a closing shift at his place of work. This is particularly important for when Michael has

closing shifts, which have a major impact on his demand for convenient modes of transport. Closing shifts are often accompanied by work exhaustion, an urgency to attend social events, and lower levels of safety by the Gateway mall at night.

Methods of transportation that have an outdoor component to them (biking, walking and waiting for buses) are more appealing during the summer months because of the pleasant weather conditions. Alternatively, the harsher conditions of the winter months drive Michael to seek transportation that's more weather protective.

Due to Michael's independent living situation, it isn't necessary for him to have access to modes that transport multiple people. He will occasionally split ride-hailing services when needed, but can predominantly depend on modes not as suited for transporting more than one person.

Michael subscribes to PeaceHealth rides due to the unpredictability of where his social life takes him. He appreciates the aspect of being able to change the trajectory of his night, without the consequence of being stranded. The \$15 non-student price point (Appendix A) is acceptable because if he uses the service at least one time per month, it pays for itself in comparison to the price of a ride-hailing alternative.

Scenario 1: Resident owns and depends heavily depends on car

Michael appreciates this method because it is highly flexible and convenient, and allows him to quickly reach destinations, including a 9 minute commute to work and a 6 minute commute to the grocery store. (Appendix F)

Michael enjoys the comfort and independency of driving his own vehicle, listening to music and switching gears in his manual transmission, while leveraging his vehicle as a means of storage.

Michael will also use PeaceHealth's bike share service for close trips. Although he primarily uses PeaceHealth to get home from bars and irregular destinations outside of his typical bus route, he continues to subscribe because he values the flexibility.

However, despite these gains in adaptability, our resident feels the financial strain of gas and insurance each month, and is not happy with the unpredictableness of needing to search for parking. Variable costs associated with owning a vehicle fluctuate with the economy, and have a large impact on Michael's below average income. Luckily for Michael, there is no additional cost to park at his place of residence, and he can also park for free at Best Buy. Michael had the benefit of inheriting his car from his family, avoiding a monthly car payment. However, it is an older vehicle that experiences costs in the form of frequent oil changes and a

low-performing MPG, which we've assigned a value in the financial overview. Our resident does not know how to work on his vehicle so he is forced to take it to a mechanic when necessary.

The largest costs in this scenario are the financial responsibilities with owning a vehicle. There are unavoidable costs in the form of gas, maintenance, insurance, and other standard upkeep procedures (i.g. tag renewals and DEQ check-ins). There are also social and potential legal costs associated with owning a vehicle, especially in scenarios where our resident expects to drink. Upon driving to a social event, Michael has to deal with overnight parking and retrieving the vehicle the following day (often using an Uber/Lyft) or risk legal repercussions. Given Michael's income, the cost of owning a vehicle outweighs the opportunity costs highlighted in scenario 2.

Scenario 2: Resident doesn't own a car

Now, Michael does not have a vehicle and solely relies on biking and public transport. Most commonly for work, he walks 5 blocks to the bus stop, and takes the 12 the remaining (roughly) 4 miles to his place of work at Gateway Mall.

This combination of travel modes is suitable for Michael's needs because they allow him to get to work in a somewhat predictable and adaptable manner, barring any changes in service due to outside factors (such as traffic, weather, and other unforeseen circumstances). Further, Michael has a level of fitness that enable walking roughly 5 blocks each way while commuting to work. If anything, Michael prefers this component because it allows him to enjoy the nice attributes of being outside, while getting some mental clarity from the brief stint of exercise.

The biggest impact to our resident in this scenario is the opportunity cost associated with waiting for and traveling on the bus. This scenario is adaptable in the sense of time and destination, but driving an ICE or ride hailing typically requires significantly less time to reach the destination. Michael feels a greater burden when waiting for the bus because of the colder climate, the fatigue that is felt after working a full shift, and lower levels of safety around the bus-stop at night. It is fair to assume that a majority of our resident's ride-hailing will take place after his shifts at Best Buy when he faces potentially longer wait times (up to 41 minutes on weekends). (Appendix D)

Financials:

We have forecasted the following monthly expenses:

Scenario 1 - Car	
Travel Expenses	
Car Gas (3x per month)	\$150
Car Insurance	\$75
Oil Change (2 per year @ \$40)	\$80
BikeShare	\$15
Uber/Lyft (2 per month)	\$30
Total Expense Monthly	\$350
Total Expense Annual	\$4,200
Annual savings vs No Car	-\$2,388

Scenario 2 - No Car	
Travel Expenses	
3 month Bus Pass @ \$135	\$45
Uber/Lyft (4 per month)	\$60
Bike (\$300 upfront)	\$0
PeaceHealth Bike Share	\$15
Greyhound to PDX	\$12
car2go	\$19
Total Expenses Monthly	\$151
Total Expense Annual	\$1,812
Annual savings vs Car	\$2,388

We calculated these expenses using the following assumptions:

- Uber/Lyft rides are \$15 each
- Michael has any equipment and skills needed for bike maintenance.
- Michael's inherited vehicle has frequent use and a low MPG. We've allocated 3 fills at \$50 each.
- Michael will change his oil twice per year.

Appendices

Appendix A: PeachHelath BikeShare Pricing

Pricing

Choose the plan that works for you and be ready to ride when the system launches on April 19th!

Per Trip
\$1 for 15 mins
10 cents per minute after the first 15 minutes, prorated by the minute.
[Choose this plan](#)
*Prefill of \$2 is required to validate credit card and will be applied as ride credit to your account.

Monthly
\$15 a month
Includes 60 minutes of ride time per day. Additional time is billed at 10 cents per minute.
[Choose this plan](#)

Source: <https://www.peacehealthrides.com/>

Appendix B: Average Greyhound travel cost

DATE	BUS ROUTE	ONE WAY BUS FARE	
Tuesday 12/04/2018	Eugene to Portland	\$11.00 starting at*	BOOK NOW
DATE	BUS ROUTE	ONE WAY BUS FARE	
Wednesday 12/05/2018	Portland to Eugene	\$15.00 starting at*	BOOK NOW

Source:

<https://locations.greyhound.com/bus-routes/destination/eugene-or/portland-or>

Appendix C: car2go rates

car2go Packages

We know life can get unpredictable but your trip costs shouldn't be. With our new Trip Packages you'll have the option to select a package that best suits your needs. Each package differs in time and cost, so you know what you're getting before you go.

If your Trip Package runs out before you're done – don't sweat it! You'll be charged the minute rate until you're ready to complete your trip.

	Minute rate (150 mi.)	20 min. (150 mi.)	1 hour (150 mi.)	2 hours (150 mi.)	4 hours (150 mi.)	1 day (150 mi.)	2 days (300 mi.)
Mercedes-Benz	\$0.45**	\$6*	\$19*	\$29*	\$55*	\$79*	\$159*

Source: <https://www.car2go.com/US/en/portland/how/>

Appendix D: Bus 12 Schedule

To: Gateway Station					To: Eugene Station			From: Eugene Station To: Gateway Station					From: Gateway Station To: Eugene Station		
LEAVE Eugene Station Bay S	Coburg at Oakmont	Gateway Station Bay A	VA Clinic	ARRIVE Gateway Station Bay B	LEAVE Gateway Station Bay B	Oakway Center on Coburg	ARRIVE Eugene Station	LEAVE Eugene Station Bay S	Coburg at Oakmont	Gateway Station Bay A	VA Clinic	ARRIVE Gateway Station Bay B	LEAVE Gateway Station Bay B	Oakway Center on Coburg	ARRIVE Eugene Station
1	2	3	4	3	3	2		1	2	3	4	3	3	2	
MONDAY-FRIDAY / LUNES A VIERNES															
AM	--	--	--	--	5:57	6:03	6:10	6:00	6:05	6:12	6:18	6:26	6:26	6:33	6:40
	6:30	6:35	6:42	6:48	6:57	7:05	7:15	6:30	6:35	6:42	6:48	6:57	6:57	7:05	7:15
	7:00	7:05	7:12	7:19	7:28	7:37	7:50	7:00	7:05	7:12	7:19	7:28	7:28	7:37	7:50
	7:30	7:36	7:44	7:51	8:01	8:11	8:25	7:30	7:36	7:44	7:51	8:01	8:01	8:11	8:25
	8:00	8:06	8:15	8:22	8:32	8:42	8:55	8:00	8:06	8:15	8:22	8:32	8:32	8:42	8:55
	8:30	8:36	8:45	8:52	9:02	9:12	9:25	8:30	8:36	8:45	8:52	9:02	9:02	9:12	9:25
	9:00	9:06	9:15	9:22	9:32	9:42	9:55	9:00	9:06	9:15	9:22	9:32	9:32	9:42	9:55
	9:30	9:36	9:45	9:52	10:02	10:12	10:25	9:30	9:36	9:45	9:52	10:02	10:02	10:12	10:25
	10:00	10:06	10:15	10:22	10:32	10:42	10:55	10:00	10:06	10:15	10:22	10:32	10:32	10:42	10:55
	10:30	10:36	10:45	10:52	11:02	11:12	11:25	10:30	10:36	10:45	10:52	11:02	11:02	11:12	11:25
	11:00	11:06	11:15	11:22	11:32	11:42	11:55	11:00	11:06	11:15	11:22	11:32	11:32	11:42	11:55
	11:30	11:36	11:45	11:52	12:02	12:12	12:25	11:30	11:36	11:45	11:52	12:02	12:02	12:12	12:25
PM	12:00	12:07	12:16	12:23	12:33	12:43	12:55	12:00	12:07	12:16	12:23	12:33	12:33	12:43	12:55
	12:30	12:37	12:46	12:53	1:03	1:13	1:25	12:30	12:37	12:46	12:53	1:03	1:03	1:13	1:25
	1:00	1:07	1:16	1:23	1:33	1:43	1:55	1:00	1:07	1:16	1:23	1:33	1:33	1:43	1:55
	1:30	1:37	1:46	1:54	2:04	2:14	2:25	1:30	1:37	1:46	1:54	2:04	2:04	2:14	2:25
	2:00	2:07	2:17	2:24	2:34	2:44	2:55	2:00	2:07	2:17	2:24	2:34	2:34	2:44	2:55
	2:30	2:37	2:46	2:53	3:03	3:13	3:25	2:30	2:37	2:46	2:53	3:03	3:03	3:13	3:25
	3:00	3:07	3:16	3:23	3:33	3:43	3:55	3:00	3:07	3:16	3:23	3:33	3:33	3:43	3:55
	3:30	3:37	3:46	3:53	4:03	4:13	4:25	3:30	3:37	3:46	3:53	4:03	4:03	4:13	4:25
	4:00	4:07	4:16	4:23	4:33	4:43	4:55	4:00	4:07	4:16	4:23	4:33	4:33	4:43	4:55
	4:30	4:37	4:46	4:53	5:03	5:13	5:25	4:30	4:37	4:46	4:53	5:03	5:03	5:13	5:25
	5:00	5:07	5:17	5:24	5:34	5:44	5:55	5:00	5:07	5:17	5:24	5:34	5:34	5:44	5:55
	5:30	5:36	5:45	5:52	6:01	6:11	6:20	5:30	5:36	5:45	5:52	6:01	6:01	6:11	6:20
	6:00	6:06	6:15	6:22	6:31	6:41	6:50	6:00	6:06	6:15	6:22	6:31	6:31	6:41	6:50
	6:30	6:36	6:45	6:52	7:01	7:11	7:20	6:30	6:36	6:45	6:52	7:01	7:01	7:11	7:20
	7:00	7:06	7:15	7:22	7:31	7:41	7:48	7:00	7:06	7:15	7:22	7:31	7:31	7:41	7:48
	7:45	7:51	7:59	8:05	8:13	8:21	8:30	7:45	7:51	7:59	8:05	8:13	8:13	8:21	8:30
	8:45	8:51	8:59	9:05	9:13	9:21	9:30	8:45	8:51	8:59	9:05	9:13	9:13	9:21	9:30
	9:45	9:51	9:59	10:05	10:13	10:21	10:30	9:45	9:51	9:59	10:05	10:13	10:13	10:21	10:30
	10:45	10:51	10:59	11:05	11:13	11:21	11:30	10:45	10:51	10:59	11:05	11:13	11:13	11:21	11:30
	11:45	11:51	11:58	12:03	--	--	--	11:45	11:51	11:58	12:03	--	--	--	--
SATURDAY / SÁBADO															
AM	--	--	--	--	--	--	--	7:30	7:36	7:44	7:50	7:59	7:08	7:15	7:25
	8:00	8:06	8:15	8:22	8:32	8:42	8:55	8:00	8:06	8:15	8:22	8:32	8:08	8:15	8:25
	8:30	8:36	8:45	8:52	9:02	9:12	9:25	8:30	8:36	8:45	8:52	9:02	9:08	9:15	9:25
	9:00	9:06	9:15	9:22	9:32	9:42	9:55	9:00	9:06	9:15	9:22	9:32	10:03	10:11	10:25
	9:30	9:36	9:45	9:52	10:02	10:12	10:25	10:00	10:06	10:15	10:21	10:30	10:33	10:41	10:55
	10:00	10:06	10:15	10:22	10:32	10:42	10:55	10:30	10:36	10:46	10:52	11:01	11:04	11:12	11:25
	11:00	11:06	11:15	11:22	11:32	11:42	11:55	11:00	11:06	11:16	11:22	11:31	11:34	11:42	11:55
	11:30	11:36	11:45	11:52	12:02	12:12	12:25	11:30	11:36	11:47	11:54	12:03	12:04	12:12	12:25
PM	12:00	12:06	12:17	12:23	12:32	12:42	12:55	12:00	12:06	12:17	12:23	12:32	12:32	12:40	12:55
	12:30	12:36	12:47	12:53	1:02	1:12	1:25	12:30	12:36	12:47	12:53	1:02	1:02	1:10	1:25
	1:00	1:06	1:17	1:23	1:32	1:42	1:55	1:00	1:06	1:17	1:23	1:32	1:33	1:42	1:55
	1:30	1:36	1:47	1:53	2:02	2:12	2:25	1:30	1:36	1:47	1:53	2:02	2:03	2:12	2:25
	2:00	2:06	2:18	2:24	2:34	2:44	2:55	2:00	2:06	2:18	2:24	2:34	2:34	2:44	2:55
	2:30	2:36	2:48	2:54	3:04	3:14	3:25	2:30	2:36	2:48	2:54	3:04	3:04	3:14	3:25
	3:00	3:06	3:18	3:24	3:34	3:44	3:55	3:00	3:06	3:18	3:24	3:34	3:34	3:44	3:55
	3:30	3:36	3:48	3:54	4:05	4:15	4:25	3:30	3:36	3:48	3:54	4:05	4:05	4:14	4:25
	4:00	4:06	4:18	4:24	4:34	4:44	4:55	4:00	4:06	4:18	4:24	4:34	4:34	4:44	4:55
	4:30	4:36	4:48	4:54	5:04	5:14	5:25	4:30	4:36	4:48	4:54	5:04	5:04	5:14	5:25
	5:00	5:06	5:18	5:24	5:34	5:44	5:55	5:00	5:06	5:18	5:24	5:34	5:34	5:44	5:55
	5:30	5:36	5:48	5:54	6:04	6:14	6:25	5:30	5:36	5:48	5:54	6:04	6:04	6:14	6:25
	6:00	6:06	6:16	6:22	6:31	6:41	6:50	6:00	6:06	6:16	6:22	6:31	6:37	6:45	6:55
	6:30	6:36	6:47	6:53	7:02	7:12	7:20	6:30	6:36	6:47	6:53	7:02	7:02	7:10	7:20
	7:00	7:06	7:15	7:21	7:30	7:40	7:48	7:00	7:06	7:15	7:21	7:30	7:33	7:40	7:50
	7:45	7:51	7:59	8:05	8:13	8:21	8:30	7:45	7:51	7:59	8:05	8:14	8:23	8:30	8:40
	8:45	8:51	9:00	9:06	9:15	9:25	9:30	8:45	8:51	9:00	9:06	9:15	9:23	9:30	9:40
	9:45	9:51	10:00	10:06	10:15	10:25	10:30	9:45	9:51	10:00	10:06	10:15	10:23	10:30	10:40
	10:45	10:51	10:59	11:05	11:14	11:24	11:30	10:45	10:51	10:59	11:05	11:14	11:14	11:21	11:28

Source: https://www.ltd.org/mobile/route_details.php?id=12#tab-4

Appendix E: Lyft Monthly Subscription

How it works

Subscribe for \$299 every 30 days to get these benefits:

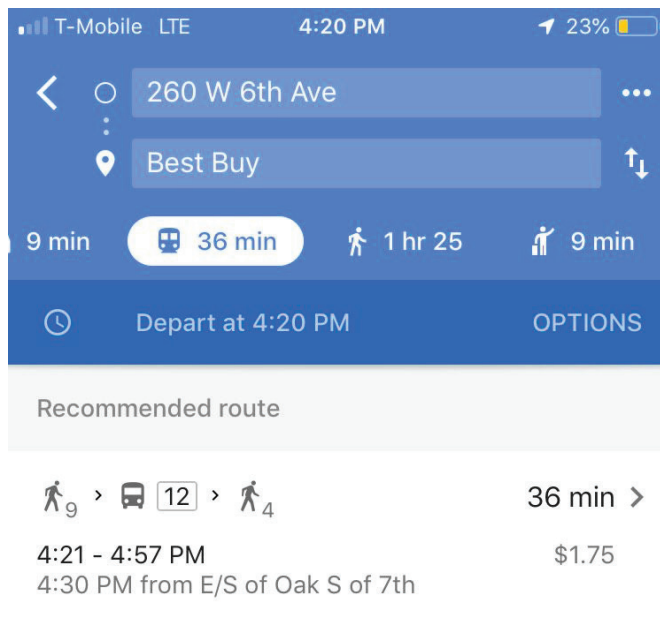
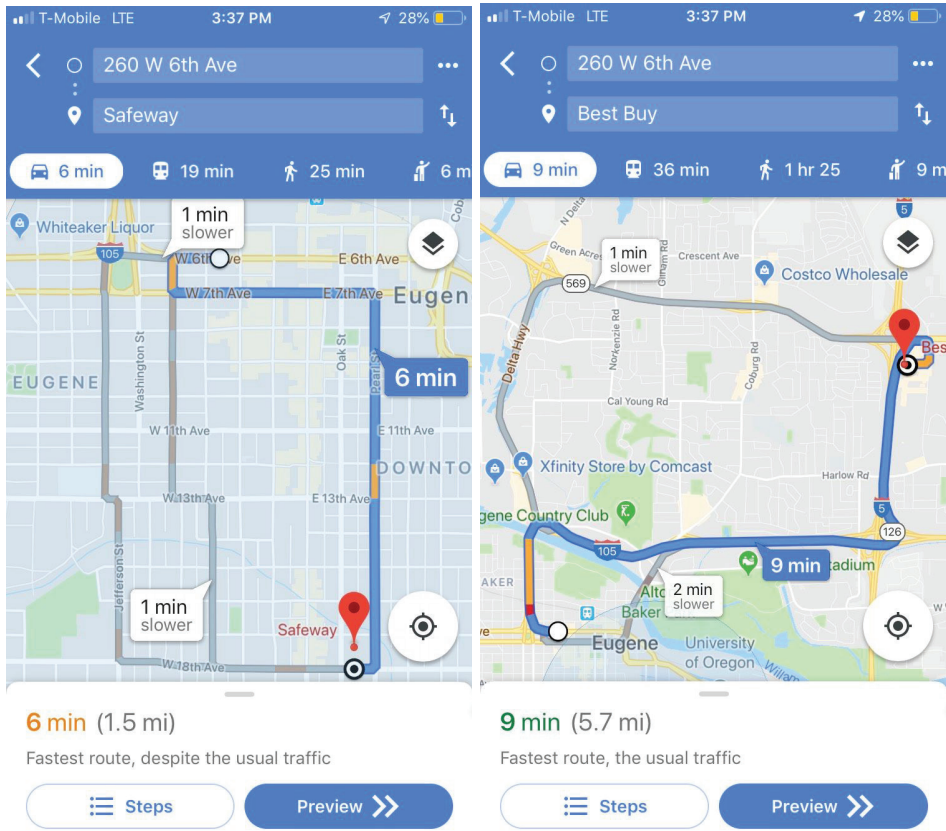
- 30 rides
- \$0 per ride (up to \$15 each)
- 5% off additional rides

Note: Plan applies to all ride types, but rides do not roll over to the following period. If a ride goes over \$15, you just pay the difference.

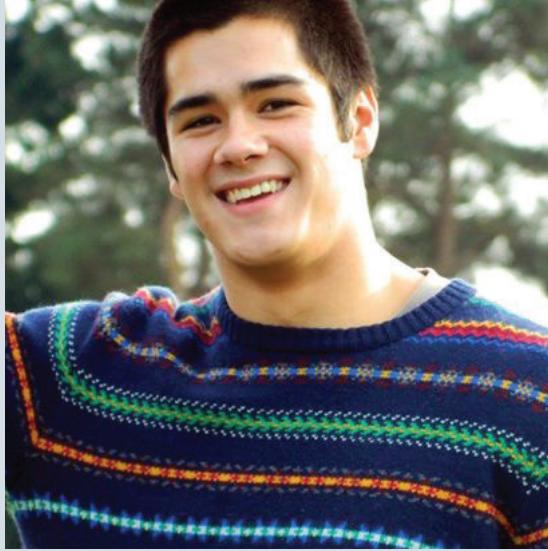
** Actual costs vary by city, and personal expenses may vary. Cost of car ownership sourced from AAA's report "Your Driving Costs" which calculates the true cost of vehicle ownership.*

Source: <https://blog.lyft.com/posts/subscribe-and-save-with-the-all-access-plan>

Appendix F - Travel Times



Appendix G - Resident Profile



Name: Michael Ellen

Age: 25

Born: Portland, Oregon

Likes: Working hard, and enjoying leisure time when he gets it. Michael enjoys being social and looks for opportunities to participate in group settings.

Dislikes: Michael experiences anxiety when running late, and does everything he can to be where he needs to be on time.

Biography: Michael moved to Eugene from Portland to be with his friends that are attending the university. Although he is not a student himself, he does enjoy engaging in social gatherings alongside his long-time friends. He doesn't know how long he will live in Eugene for, but is happy here for the time being.

Travel needs: Michael has a vibrant social life, that keeps him out of the house all hours of night. Being in his young twenties, he enjoys the social component of joining friends at the bar after closing down Best Buy for the night. Normally he works Monday through Friday. Michael experience punctual time requirements that are tied to financial compensation.

Appendix M

Tianna Zhou and Iris Zhang

New Mobility Group Case

MGMT 641

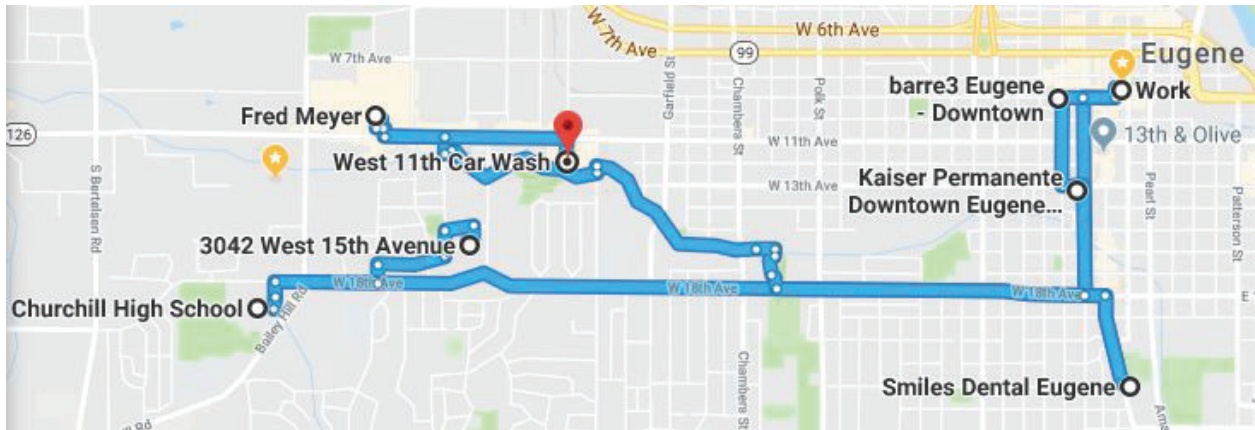
Tianni Zhou, Iris Zhang

38-year-old single mom Mary and her two high school kids live in Eugene, Oregon following a divorce with her ex-husband last year. She works at the Wells Fargo bank in downtown Eugene as a service manager with an annual income of \$40,000. She lives at Devonshire Hills Apartments, located at 3042 15th ave, 97402, which is a 15-minute drive to her work without traffic. She bought her car five years ago and it's completely paid off. Mary's two kids named Emily and John are 15 and 16 years old. They both go to Churchill High School where is located at 1850 Bailey Hill Road, Eugene, OR 97405. Their high school is a mile away from home, so Mary drives them to school before going to work.

Mary pays \$895 per month in rent for their three-bedroom apartment. In her free time, Mary loves doing yoga and has been doing it since she was 20. Mary usually goes to yoga classes on Saturdays after work at Barre3 Eugene downtown. The classes cost her \$580 a year. After Mary divorced with her husband, she has started to realize it costs a lot to raise her kids as a single mom with an annual income of only \$40,000. She has tried to get child support from her ex husband, but she was unable to locate him. The school meal plan costs her \$1,865.6 per year. She also gives her kids an allowance of \$50 per month for their own spending. Mary's regular costs include groceries, clothes, travel, insurance, doctor, dentist, etc. The biggest challenge Mary is facing now is the cost of transportation because she won't have extra money after those expenses to support her and her children's daily transport needs.

Our project objective is to try to help Mary and her family reduce the expenses on daily transportation, therefore improving their living standard. Base on Mary's daily activities shown on the map below, we will provide two scenarios for Mary, then compare them and give her suggestions based on her habits and needs. The first scenario is baseline transportation which means Mary can drive her car to fit all her transportation needs. The second scenario is

multimodal transportation which means Mary has more opportunities to get to the destination at a cheaper cost.



The first scenario is that Mary uses her car almost everyday. On weekdays, Mary usually drives her kids to school at 8:00 am and then drives to work since she has to be there at 8:30 and there is typically traffic in the morning. Emily and John usually get off at 3:30 and they have to either walk home or take the bus because Mary doesn't get off work until 6:15. During the weekend, Mary drives to Fred Meyer or Walmart to get groceries for the whole week. Mary also uses her car to eat out, for dentist visits, and for doctor visits. On the Saturdays Mary has worked, she drives to work in the morning and drives back home after work around 2:15 pm. Mary drives back to downtown for the yoga class at 4:30 pm. For vacation, she occasionally drives to Portland or drives to the forest for camping with her kids. Here we listed an estimated cost of Mary's car ownership for one year.

Option 1-car cost	\$/Year
Insurance	1440
Average Maintainance cost	360
Variable repair cost	420
Parking	240
Fuel	4000
Traffic Tickets	200
Car wash	120
Depreciation per year	753
Total cost	7533

Another scenario for Mary is that she bikes from home to work instead of driving. In the morning, instead of driving Emily and John to school, Mary has them walk or take the bus. It takes only about 20 minutes to walk to school. Since Emily and John both go to Churchill High School and they are old enough, it is pretty safe for them to walk to school together. At the same time, Emily and John can leave for school at 8:10 instead of 8 o'clock. They can also get their exercise done with the 20-minute walk, which is good for their health. Not only is this a better alternative for Emily and John, but it also saves time and money for Mary. Mary can leave at 8:10 instead of 8 o'clock. Mary usually works at 8:30, and it takes her about 20 minutes to bike to work, which is the similar time as if she drives since there's traffic during that time. At around 8:10 in the morning, Mary takes the Fern Ridge Trail to work, which is a very nice biking trail with no cars. By doing so, Mary can enjoy the beautiful views and avoid the traffic during rush hours. It is also safer for Mary to ride her bike than driving and Mary doesn't risk getting speeding tickets. Mary is a sloppy and impatient person, so the traffic sometimes makes her rush, and she tends to drive faster to get to work on time, and has received multiple tickets throughout the year. Emily and John walk back home together after school at 3:30. Mary bikes home using the same route after work at 6:15 and she usually gets home at 6:35.

Mary usually works every other Saturday. Mary bikes to work and goes to her Yoga class after work at 4:30 pm. Since Barre3 Eugene is in downtown as well, Mary stays in a coffee shop nearby and reads after she gets off at 2:15. Instead of driving back and forth, Mary gets to enjoy her own time for a couple of hours and do things she likes. Mary's Yoga class ends at 5:30 and she gets home at around 5:50. Mary and the kids usually eat at restaurants around their house like Shari's and Hawaii Time on Saturdays. Since almost all of them are less than a mile away, they walk over and walk back. Even though Fred Meyer is pretty close by, Mary drives her car to do grocery shopping during the weekend since it will be inconvenient to carry groceries and catch the bus or walk. Mary also drives to her dentist and doctor since it's only a few times out of a year and it's more convenient especially if she has to take her kids as well.

There are situations that this alternative might not work completely. When it's raining heavily or snowing, it is unrealistic to ride her bike. Mary then takes the EMX to work which takes her about half an hour. When there's an emergency that Mary needs to leave work and go somewhere, Mary uses Uber or Lyft. To eliminate the wait time of ordering Uber or Lyft, Mary may also use Zipcar sometimes instead. It is also a lot more convenient when Mary needs to go to multiple places.

The first scenario helps Mary save a lot of time since she can drive to wherever at anytime immediately. It is also very comfortable to drive to the office in the morning during winter or rainy days. She can drive her kids to school, so they don't have to wait for the bus or walk there. However, driving could be inconvenient sometimes. A lot of times, it's hard for Mary to find parking spaces especially when she's in downtown. From the cost table of owning a vehicle, Mary spends a lot of money on transportation due to other comprehensive costs.

Transportation	From	To	Mileage	Gas Cost	Time in minute	Frequency/year	Total cost	Total Mileage	Total time
Car	Home	School	1.1	0.583	6	160	93.28	176	960
Car	School	Work	3.7	1.961	20	160	313.76	592	3200
Car	Work	Home	2.7	1.431	15	240	343.44	648	3600
Car	Home	Work	2.7	1.431	15	80	114.48	216	1200
Car	Work	School	3.7	1.961	12	5	9.805	18.5	60
							874.765		9020

Transportation	From	To	Time in minute	Frequency	Total cost	Total time
Walk	Home	School		19	160	0
Bike	Home	Work		17	200	12
Bike	Work	Home		17	200	12
Bus	Home	Work		24	40	0
Bus	Work	Home		24	40	0
Uber/Lyft	Work	School		20	3	45
Zipcar	Wok	School		12	2	18
						87
						11844

According to our financial analysis shown above, Mary can save about \$790 (875-87) per year on gas and 1,651 miles on her car if she does the second option. Now if we look at the cost of owning her car, Mary can save around \$2,680 (7,533-4,853) just for not driving her car as often. By driving much less than the first option, Mary has less risk of getting a speeding ticket as well.

Another benefit of this option is that both Mary and her kids are forced to exercise every day, which will keep them healthy. There is also less carbon emission when Mary drives 10% out of her daily activities versus 100% before. However, a few disadvantages are that the weather could be too cold or too hot for Mary to bike everywhere; her bike could be stolen easily at any point; it takes her longer to bike to places than driving sometimes; it's an inconvenience when she needs to deal with emergencies.

Option 2-car cost	\$/Year
Insurance	1200
Average Maintainance cost	360
Variable repair cost	100
Parking	60
Fuel	2512
Traffic Tickets	50
Car wash	100
Depreciation per year	470.625
Total cost	4852.625

We suggest Mary switches to the second transport option because she can save more money in her account and have a healthier life. We estimated some irregular activities that Mary will do during a year. For example, she will go to Portland with her kids every three months, go to see the dentist, go to the hospital, buy clothes, or visit other family members out of state. If Mary can save money on transportation, she can allocate her saved fund elsewhere. With everything considered, making these changes will cause a positive impact on the lives of Mary and her children.

Appendix

<https://www.4j.lane.edu/nutrition/payment/>

<https://www.fueleconomy.gov/feg/Find.do?action=sbs&id=37971>

<https://www.zipcar.com/pricing>

<https://www.autogravity.com/blog/money/whats-average-miles-driven-per-year-car-lease-guide>

<https://www.ifebp.org/news/regulatoryupdates/Pages/2018-irs-mileage-rates.aspx>

<https://barre3.com/studio-locations/eugene>

<https://chs.4j.lane.edu/>

<https://www.apartments.com/devonshire-hills-apartments-eugene-or/39zbdkg/>

Price paid	11000			
Mileage when bought	10000			
Max Mileage	200000	190000		
Year used	5			Depreciation per year
average mileage /year	13000	65000	0.06842105263	752.6315789
mileage left		125000	0.6578947368	
Current Sell Price	7236.842105			

Transportation	From	To	Mileage	Gas Cost	Time in minute	Frequency/year	Total cost	Total Mileage	Total time	
Car	Home	School		1.1	0.583	6	160	93.28	176	960
Car	School	Work		3.7	1.961	20	160	313.76	592	3200
Car	Work	Home		2.7	1.431	15	240	343.44	648	3600
Car	Home	Work		2.7	1.431	15	80	114.48	216	1200
Car	Work	School		3.7	1.961	12	5	9.805	18.5	60
								874.765	1650.5	9020
Car	Home	Dentist		2.8	1.484	12	6	8.904	16.8	72
Car	Home	Hospital		2.6	1.378	12	3	4.134	7.8	36
Car	Home	Portland		113	59.89	115	4	1762.568	452	460
Car	Home	FredMeyer		0.9	1.7649	5	48	84.7152	43.2	240
Car	Home	Portland		113	59.89		4	239.56		
	Portland	Home		113	59.89		4	239.56		
Car	Home	Willamette National fore		28.1	14.893		5	74.465		
	Willamette Natl	Home		28.1	14.893		5	74.465		
								3363.1362		

Appendix N

Brenna Leech and Ness Zolan

Resident Information

Name: Angel and Charlie Bosley	Annual Salary for Charlie: \$33,605 ¹
Location: 1830 Friendly Street, Eugene, OR 97405	Supplemental Security Income for Angel: \$12,576 ²
Household Size: 2 Adults, No children, 1 Service Dog (Seedy)	Total Annual Household Income: \$46,181; AMI: 90%
Unique Needs: Angel is a fully disabled paraplegic, currently is not working, but has the potential to work in the future.	

Situation Overview

Angel and Charlie Bosley are two mid-30s Eugene residents who live in the Friendly Neighborhood with Angel's service dog, Seedy. Due to Angel's disability, they do not have children and have no immediate plans to raise any. Fully disabled, Angel receives benefits under the Supplemental Security Income (SSI) program, equivalent to \$12,576 for a couple. Under Oregon Law, Angel has the opportunity to earn up to \$34,591 and retain this \$12,576 benefit, but his duties around the home, his regular attendance at physical therapy, and his recovery have not allowed him to work.³ His income, therefore, is capped at \$12,576.

Charlie works as a Front Desk Coordinator at the Accessible Education Center on the UO campus, salaried at \$33,605. She receives benefits and works a normal 40-hour work week, 8 AM - 5 PM, Monday through Friday. Outside of normal household costs, the Bosley Family has costs associated with Angel's medical bills, maintenance of their home (built in 1953 on highly erodible soil), and care of Seedy.⁴



¹ Research, UO Office of Institutional, "UNIVERSITY OF OREGON CLASSIFIED PERSONNEL LIST: Employees on Record November 1, 2018," Eugene, OR, 2018. Pg 249. Comparable to Martínez, Daisy L, who is currently employed in this same position at the UO AEC office.

² Disability Benefits Center, "Federal Benefit Rates," 2018. <https://www.disabilitybenefitscenter.org/glossary/federal-benefit-rate>;

³ Network, Work Incentives, "Minimum Wage and Supplemental Security Income," Salem, OR, 2017.

⁴ For the purposes of this project, we focused only on financials surrounding transportation, but would like to highlight the significant additional costs that might affect individuals with disabilities (medical and support animal costs) or in the elderly Friendly neighborhood (housing maintenance). Tax Lot information can be found in Appendix 5. Sourced from: Services, Eugene Planning & Development Building and Permit. "Property Information Tax Lot 18-03-06-22-03800," Eugene, OR, 2018.

The Bosley Family own a single mobility equipped vehicle (see Appendix 3) that can be driven by both family members (but not external parties). This used, hand-driven 2014 Dodge Grand Caravan SXT cost the family \$39,999 to purchase, excluding maintenance and gas. Charlie typically buses to and from home and work. Angel also owns a hand-powered cycle, but when feasible, he rides the bus or takes Ride Source for longer distances. Strolling around town is a common transportation method for both parties. (See Scenario 1 section for a full breakout of mobility options depending on activity, needs, and availability.)

They almost never drive outside of Eugene/Springfield city limits, as their needs are all accommodated within this geographic area. The farthest they drive is to the Eugene Airport for occasional trips. Even though their finances are stretched, Charlie and Angel are extremely reluctant to give up their car as it is the most reliable mode of transportation in case of an emergency due to Angel's limitations. They also find the car much more adaptable to Angel's situation for non-routine travel (such as to a friend's house).

As mid-30s professionals, much of Charlie and Angels' schedules fall within normal waking hours, defined as 0600 - 2200 for our purposes. Charlie and Angel rarely travel outside these times, excepting occasional nights out with friends or at the theatre.

An average transportation day for the Bosleys would look similar to the chart on the right.

Average Workday	Mode	Time
Walk Seedy	WALK	06:00
Charlie > Work	BUS	07:30
Angel > PT	RIDESOURCE	09:00
Angel > Moss Crossing	BUS	11:30
Angel > Home	BUS	12:00
Walk Seedy	WALK	03:00
Charlie > Home	BUS	05:00
Both > Friends' Home (Dinner)	OWNED CAR	18:30
Both > Home	OWNED CAR	21:30

Scenario 1: Current Situation in 2018

The Bosley Family's current situation regarding transportation needs is limited to reasonable and modern mobility options on hand for classified frequent and infrequent visits. Frequent visits include trips to the grocery store, the University of Oregon for Charlie's work, physical therapy for Angel, the drug store, parks and paths, friends' houses, the local cannabis dispensary Moss Crossing, and temple. Infrequent visits include the travelling to the dentist, hardware store, city hall, Hult Center for the Performing Arts, airport, and doctor's office. The available options on their regular routes include taking the bus, ride-hail services such as Lyft and Uber, personal bikes, PeaceHealth bike-share, EMX, Ride Source, owned car, walking or strolling, and car-share options such as ZipCar. The following matrix identifies which modes of transportation can be used by Charlie and/or Angel for each of the various visited locales.

Modes of Transportation	x - Charlie (♀)													
	y - Angel (♂)													ZipCar (car-share)
	Frequently Visited Locales							Infrequently Visited Locales						
Bus	xy	x	y	xy	xy	xy	xy	xy	xy	xy	xy	xy	xy	xy
Ride-Hail	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Bikes	xy	xy	xy	xy	xy	xy	xy	xy	xy	xy	xy	xy	xy	xy
PeaceHealth														
EMX		x												
Ride Source			x											x
Owned Car	xy	xy	xy	xy	xy	xy	xy	xy	xy	xy	xy	xy	xy	xy
Walking	xy		xy	xy	xy	xy	xy	xy	xy	xy	xy	xy	xy	xy
ZipCar (car-share)		x												

Although nine transportation modes have been identified as viable options, the unique factors of the Bosley Family remove PeaceHealth rides as a viable option for either member of the family, barring extenuating circumstances.

Due to a lack of accessible ride hailing services, in combination with the limited operating hours of Ride Source, which is the accessibility transit option provided by the city, Angel is limited within the bounds of only four transportation options, including the bus, riding his hand-powered cycle, driving in the custom vehicle, or strolling to a nearby location in his wheelchair. Residents without accessibility needs have upwards of nine options for transportation. Angel's disability poses major accessibility issues for his and the family's transportation needs. It also is significant drain to their finances: requiring ownership of a specialty vehicle which accounts for 79% of their current transportation at a conservative estimate of \$5,624.47 (Appendix 2).

Scenario 2: Future Situation

Unlike many households, the crux of the Bosley family's transportation issues relies not on the time value of money, but rather on the availability and equity of transportation modes to allow Angel to travel both independently and with Charlie. The element of their transportation needs that allows them to overcome this availability and equity issue is their hand-driven vehicle, which improves Angel's quality of life and freedom of movement.

To overcome this, we've designed a future scenario which incorporates disability-friendly ride-hailing options into the Eugene transit system. A portion of the Lyft, Uber, and other ride-hailing fleets must be wheelchair enabled and be accurately distributed across times to allow for Angel and others like him to have access at the key times they need. It will be on the city and ride-hailing

companies to design their contract with this need in mind to prevent gaps in coverage. These vehicles would operate in the same geographical boundaries as current Lyft and Uber systems, including travel to the airport.

The mobility and area serviced by ride-hailing matches the capabilities of their Grand Caravan. As the Bosleys rarely travel outside Eugene/Springfield, the current scope of geographic coverage would meet their needs. Additionally, even with initial coverage gaps for ride-hail availability as the new mode begins operation, the travel time requirements for Angel and Charlie would fall within normal waking hours, and therefore not place undue stress on the family.

With this new coverage option, the Bosleys can eliminate the need for their specialty vehicle. Assuming no change to their trip count, this results in a total cost savings for transportation of \$1,856.47. More importantly, this equates to a 4% savings from overall Bosley budget, which can be applied to relief for the additional financial challenges. While not an overwhelming amount, this nearly \$2,000 worth of savings is accompanied by significantly fewer responsibilities for both Angel and Charlie: chiefly, time and hassle associated with maintenance, permitting, and operational training for a specialty vehicle.

Total Cost Savings	\$ 1,856.47
% Savings	25.9%
% Income (Current)	15.5%
% Income (Future)	11.5%
Total % of Income Saved	4.0%

Solutions

With several adjustments and additions to transportation options currently available for people with disabilities, the city can provide cost effective, efficient, and egalitarian transport modes for all of its residents. Uber and Lyft have developed wheelchair accessible van options in major metropolitan hubs in Arizona, California, Connecticut, and Illinois currently.⁵ Due legal pressure to provide better accessibility service in all markets, these options will likely be brought to Eugene in the near future.⁶ TaaS will play an increasingly important role in the future needs of the Bosley Family, as long as they operate almost exclusively in Eugene and do not often travel along the I-5 corridor. These new services will be especially for trips that cannot be planned, such as emergency visits to the hospital. By increasing the availability of disability ride-hailing services and on-demand TaaS, the Bosleys may be able to function seamlessly without the need to own their expensive and customized internal combustion engine vehicle, which would provide increased financial stability.

5 Lyft. "Accessible Vehicle Dispatch – Lyft Help," 2018. <https://help.lyft.com/hc/en-us/articles/15013081668-Accessible-vehicle-dispatch>.

6 Andrew J. Hawkins. "Uber and Lyft Are Terrible at Providing Wheelchair-Accessible Service, and Here's the Proof - The Verge," The Verge, May 23, 2018. <https://www.theverge.com/2018/5/23/17384600/uber-lyft-wheelchair-accessible-fair-ny-report>

Appendices

Please note, all financial calculations and supporting sources are available in the supplementary Excel Document, titled Mobility Project Financials, Scenarios, and Matrix.

Appendix 1: Additional Photos of the Bosley Family



ze1000388 www.fotosearch.com



Appendix 2: Financial Estimates for Transportation-related Expenses

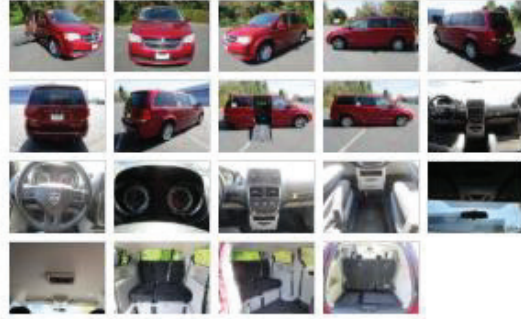
Current Scenario (2018): Yearly	# of Uses or Mileage	Cost Per Use	Total Cost	Limiting Factors Hours	Range	Additional Notes	
Modes of Transportation							
Bus (Household)	Charlie	1.13 \$	540.00	Daily	0600 - 1230 City Limited	Main: LTD ROUTE 78, with 3 month Pass. Used primarily for work. Not available on weekends. Main: LTD ROUTE 78, ROUTE 36, with 3 month Pass at Half-Fare. Used primarily for household errands. Not available on weekends.	
	Angel	0.47 \$	270.00	Daily	0715 - 1930 -		
	Total		810.00				
	Owned Car			Daily	24 Hr Unlimited		Used, Hand-Driven Specialty Car
	Purchase Cost	2,660.00 \$	2,660.00				\$39,999 purchase cost/15 years of use, sans depreciation (due to expectation for vehicle lifetime use)
Gas Cost (Mileage)	3200	0.19 \$	600.47	-	-	Assuming 10 mi average per trip, with 60wk or 312/yr trips	
Maintenance, Insurance	1	2,364.00 \$	2,364.00	-	-	Maintenance (new car) ~ \$99/mo or \$1,188/Yr. Insurance (new car) ~\$98/mo or \$1176/Yr. Used as a conservative estimate (Used Specialty cars likely more)	
Total	312		5,624.47			Significantly less than the average cost at 15,000 miles, \$9,446/yr for Mirafians, according to AAA.com	
Bikes							
Fixed Cost	1	599.80 \$	599.80	Daily	24 Hr Neighborhood Limited	Fixed Cost	
Variable Cost				-	-	Mid-Range Handcycle (Top End Excelsior XLT Hand Cycle ~\$2,499) + Mid-Range Bicycle (\$500) / 5 years of use, sans depreciation (due to expectation of cycle lifetime use)	
Total			599.80				
Ride-Hail	12	10.00 \$	120.00	Daily	24 Hr City Limited	Rarely used, with Charlie using independently if she stays very late at work. Once per month estimate. Based on fares average from Bernina's Lyft driving experience	
Ride Source	2			Daily	0800 - 1700 City Limited	Free for Angel, with prior scheduling. Available Monday - Friday, 8am to 5pm, Saturday - Sunday, 11am to 5pm, 24 hr notice required	
Walking	14			Daily	24 Hr Neighborhood Limited	Free, used recreationally	
			Total Transportation Cost (Yr) \$			7,154.27	
Future Scenario: Yearly							
		# of Uses	Cost Per Use	Limiting Factors		Additional Notes	
				Availability	Hours	Range	
Bus (Household)							
Charlie	480	1.13 \$	540.00	Daily	0600 - 1230 City Limited	Main: LTD ROUTE 78, with 3 month Pass. Used primarily for work	
Angel	576	0.47 \$	270.00	Daily	0715 - 1930 -	Main: LTD ROUTE 78, ROUTE 36, with 3 month Pass at Half-Fare. Used primarily for household errands	
Total	1056		810.00				
Bikes							
Fixed Cost	1	599.80 \$	599.80	Daily	24 Hr Neighborhood Limited	Fixed Cost	
Variable Cost				-	-	Mid-Range Handcycle (Approx \$2,500) + Mid-Range Bicycle (\$500) / 5 years of use, sans depreciation (due to expectation of cycle lifetime use)	
Total			599.80				
Ride-Hail	324	12.00 \$	3,888.00	Daily	24 Hr City Limited	Assumes all trips formerly accomplished by personal vehicle, assuming no change in trip count, including former ride hails. Trip price increases by 20% for increased cost.	
Ride Source	2			Daily	0800 - 1700 City Limited	Free for Angel, with prior scheduling. Available Monday - Friday, 8am to 5pm, Saturday - Sunday, 11am to 5pm, 24 hr notice required	
Walking	14			Daily	24 Hr Neighborhood Limited	Free, used recreationally	
			Total Transportation Cost (Yr) \$			5,297.80	

Appendix 3: Used 2014 Dodge Grand Caravan SXT



2014 Dodge Grand Caravan SXT (ER182174A)

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Recently Reduced

VEHICLE OVERVIEW

VEHICLE DETAILS

Type	Used
Year	2014
Make	Dodge
Model	Grand Caravan
Trim	SXT
Mileage	39330
Exterior Color	RED
Interior Color	Black
Engine Size	
MPG (City/Hwy)	17/25 ²
Stock	ER182174A
VIN	2C4RDGG55ER182174
Location	Chico CA 95973



ESTIMATE YOUR PAYMENTS

Price	\$39,900.00 ¹
Down Payment	<input type="text" value="0"/>
Interest Rate	% ▾
Length of Terms	Months ▾
Estimated Payment	\$
Calculate Payment Request Financing Approval	

CONVERSION DETAILS

Conversion Make	BraunAbility
Conversion Model	Braun Entervan
Entry Location	Side Entry
Entry Operation	Automatic
Entry Type	Fold Out

VEHICLE FEATURES

MOBILITY EQUIPMENT

Tie Downs
Removable Seat Base Driver
Rubberized Floor
Seat Belt Receiver
Rollaway Seat Base Passenger
Kneeling System

OPTIONAL EQUIPMENT

Power Adjustable Mirrors

78

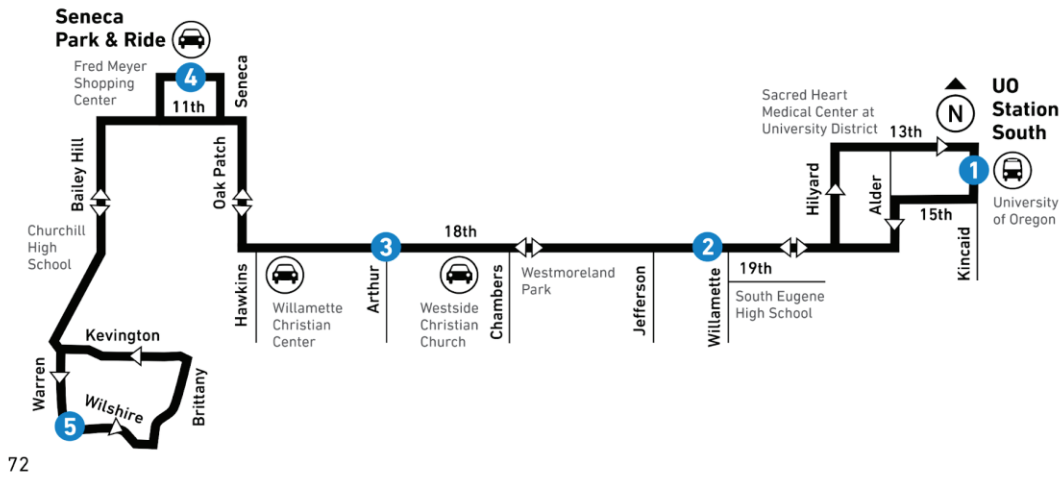
UO/SENECA/WARREN • MON-FRI



SNOW & ICE DETOURS
This route may be affected by winter weather conditions.

DESvíOS POR NIEVE & HIELO
Esta ruta puede ser afectada por las condiciones climáticas de invierno.

From: University of Oregon (UO) To: Seneca/Warren						From: Warren To: Seneca/UO				
LEAVE UO Station South	18th at Willamette	18th at Arthur	Seneca Park & Ride	Wilshire at Warren	ARRIVE UO Station	LEAVE Wilshire at Warren	Seneca Park & Ride	18th at Arthur	18th at Willamette	ARRIVE UO Station
1	2	3	4	5		5	4	3	2	
MONDAY-FRIDAY / LUNES A VIERNES										
AM	6:55	6:59	7:04	7:10	7:17	7:17	7:26	7:33	7:38	7:45
	7:20	7:24	7:29	7:35	7:42	7:42	7:51	7:59	8:04	8:12
	7:50	7:54	7:59	8:05	8:12	8:12	8:21	8:29	8:34	8:42
	8:20	8:24	8:28	8:34	8:41	8:41	8:51	8:59	9:04	9:12
	8:50	8:54	8:59	9:05	9:12	9:12	9:22	9:30	9:35	9:43
	9:50	9:54	9:58	10:04	10:11	10:11	10:21	10:29	10:34	10:42
	10:20	10:24	10:29	10:35	10:42	10:42	10:52	11:00	11:05	11:13
	10:50	10:54	10:58	11:04	11:11	11:11	11:21	11:29	11:34	11:42
PM	12:05	12:10	12:16	12:22	12:29	12:29	12:40	12:48	12:53	1:01
	1:05	1:10	1:16	1:22	1:29	1:29	1:40	1:48	1:53	2:01
	2:05	2:10	2:16	2:22	2:29	2:29	2:40	2:48	2:53	3:01
	2:35	2:40	2:46	2:52	2:59	2:59	3:10	3:18	3:23	3:31
	3:10	3:15	3:22	3:28	3:35	3:35	3:46	3:55	4:00	4:08
	3:40	3:45	3:52	3:58	4:05	4:05	4:16	4:25	4:30	4:38
	4:10	4:15	4:22	4:28	4:35	4:35	4:46	4:55	5:00	5:08
	4:40	4:46	4:54	5:00	5:07	5:07	5:18	5:27	5:32	5:41
	5:15	5:21	5:29	5:35	5:42	5:42	5:53	6:02	6:07	6:15
	6:10	6:15	6:21	6:27	6:34	6:34	6:44	6:52	6:57	7:05
SATURDAY-SUNDAY: NO SERVICE / SÁBADO-DOMINGO: NO HAY SERVICIO										



72

Appendix 5: Tax Lot information for 1830 Friendly St

Property Information

Tax lot 18-03-06-22-03800



Planning & Development
Building and Permit Services
Run Date: 11/29/2018

Property Owners

Owner 1	OREGON SUPPORTED LIVING PROGRAM 1250 CHARNELTON ST EUGENE, OR 97401 UNITED STATES
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Zoning Data

Zone	R-1	LOW-DENSITY RESIDENTIAL
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FEMA Flood Hazard Zone Data

Zone X	Areas determined to be outside of 500-year flood.
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Boundary Data

Incorporated City Limits	Eugene
Urban Growth Boundary	Eugene
Neighborhood Group	Friendly Area Neighbors
School District	EUGENE
Willamette Greenway	N

Land Use Land Use information has not been field verified

Landuse General Code	General Code Description	Landuse Code	Land Use Description
S	Single Family	1111	Single Family Housing

Building R01 Characteristics

Year Built	1953	Total Square Footage	1751
Bedrooms	3	Fireplaces	NO
Full Baths	1	Half Baths	1
Basement Garage Sq Ft	0	Attached Garage Sq Ft	475
Attached Carport Sq Ft	0	Detached Garage Sq Ft	0
Driveway Sq Ft	380	Paved Patio Sq Ft	180

Building R01 Floors

Floor	Heat	Base Area	Finished Area
1.0	None	1751	1751

Approximate Lot Square Footage

8712.00

Land Use Files

File	Application Name	Request
LA-17-49	Washburn	Property line adjustment

There are no enforcement actions.

Soils

Medium/High Shrink Potential	Y
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Erosion Data

Erodable Soil	Y
Lot Greater than 1 Acre	N
Slope Greater than 10 Percent	N
Directly Drained Lot	N

Current Scenario (2018): Yearly				Limiting Factors		
	# of Uses or Mileage	Cost Per Use	Total Cost	Availability	Hours	Range
<i>Bus (Household)</i>				Daily	0600 - 1230	City Limited
Charlie	480	\$ 1.13	\$ 540.00	Daily	0715 - 1930	-
Angel	576	\$ 0.47	\$ 270.00	Daily	0715 - 1930	-
<i>Total</i>	1056	\$	\$ 810.00			
<i>Owned Car</i>				Daily	24 Hr	Unlimited
Purchase Cost	1	\$ 2,660.00	\$ 2,660.00	-	-	-
Gas Cost (Mileage)	3200	\$ 0.19	\$ 600.47	-	-	-
Maintenance, Insurance	1	\$ 2,364.00	\$ 2,364.00	-	-	-
<i>Total</i>	312	\$	\$ 5,624.47			
<i>Bikes</i>				Daily	24 Hr	Neighborhood Limited
Fixed Cost	1	\$ 599.80	\$ 599.80	-	-	-
Variable Cost		\$ -	\$ -	-	-	-
<i>Total</i>		\$	\$ 599.80			
<i>Ride-Hail</i>				Daily	24 Hr	City Limited
Ride Source	2	\$ -	\$ -	Daily	0800 - 1700	City Limited
Walking	14	\$ -	\$ -	Daily	24 Hr	Neighborhood Limited
			Total Transportation Cost (Yr) \$			
			7,154.27			

Modes of Transportation

Future Scenario: Yearly				Limiting Factors		
	# of Uses	Cost Per Use	Total Cost	Availability	Hours	Range
<i>Bus (Household)</i>				Daily	0600 - 1230	City Limited
Charlie	480	\$ 1.13	\$ 540.00	Daily	0715 - 1930	-
Angel	576	\$ 0.47	\$ 270.00	Daily	0715 - 1930	-
<i>Total</i>	1056	\$	\$ 810.00			
<i>Bikes</i>				Daily	24 Hr	Neighborhood Limited
Fixed Cost	1	\$ 599.80	\$ 599.80	-	-	-
Variable Cost		\$ -	\$ -	-	-	-
<i>Total</i>		\$	\$ 599.80			
<i>Ride-Hail</i>				Daily	24 Hr	City Limited
Ride Source	2	\$ -	\$ -	Daily	0800 - 1700	City Limited
Walking	14	\$ -	\$ -	Daily	24 Hr	Neighborhood Limited
			Total Transportation Cost (Yr) \$			
			5,297.80			

Modes of Transportation

Total Cost Savings	\$	1,856.47
% Savings		25.9%
% Income (Current)		15.5%
% Income (Future)		11.5%
Total % of Income Saved		4.0%

Average Workday	Mode	Times
Walk Seedy	WALK	06:00
Charlie > Work	BUS	07:30
Angel > PT	RIDESOURCE	09:00
Angel > Moss Crossing	BUS	11:30
Angel > Home	BUS	12:00
Walk Seedy	WALK	03:00
Charlie > Home	BUS	05:00
Both > Friends' Home (Dinner)	OWNED CAR	18:30
Both > Home	OWNED CAR	21:30

HOUSEHOLD

\$ 46,181.00 Income

CHARLIE

\$135.00 3 Month Pass
 10.00 times per week 120 Rides per Pass
 4.00 weeks 480 Rides per Year
 3.00 months
 \$1.13 Price per ride <https://www.ltd.org/fare-pass-pricing/>

ANGEL

\$67.50 3 Month Pass @ Half-Fare Pricing
 12.00 times per week 144 Rides per Pass
 4.00 weeks 576 Ride per Year
 3.00 months
 \$0.47 Price per ride <https://www.ltd.org/fare-pass-pricing/>

CAR

\$2,660 Cost by Sale of Car/Yr (Assuming 15 yr use, use until complete depreciation without resale)
 312 Mile Per Year (6 rides per week)
 \$3.19 Cost of Gas (per gallon) <https://www.gasbuddy.com/GasPrices/Oregon>
 20 Gallons Per Tank
 17 MPG City
 25 MPG Highway <https://www.mobilityworks.com/wheelchair-vans-for-sale/2014-dodge-grand-caravan-braunability-2c4rdgcg5er182174/>
 340 Miles per Tank
 \$63.80 Cost per Tank
 \$0.19 Cost per Mile

LYFT (RIDESHARE OF CHOICE)

\$1.35 Average Price Per Mile
 125.00% Surge %
 \$1.69 Total Price per Mile
 2.25 Base Fair <https://www.engadget.com/2014/06/27/uber-lyft-explain>

SCI Directors and Staff

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Megan Banks	SCYP Manager, University of Oregon
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Katie Fields	SCYP Graduate Employee
Jonathan Yamakami	Graphic Designer

