Seattle Transit: 2017 and Beyond

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Abstract

Although a few American cities have older, heavy rail systems, many American cities have only recently began to develop a modern rail transit system. Consisting of light rail transit (LRT), modern streetcars, and commuter rail, these cities are leading a rail transit renaissance where density is often not high enough to justify heavy rail transit such as New York City's subway or the Chicago El. Seattle, one of these cities building out a modern rail system, is just coming off the success of Sound Transit 3, a ballot initiative that approved historic investments in its regional rail system. This paper will conduct a thorough review of Seattle's rail transit system, including its political climate and fiscal conditions, analyzing ridership data, comparing Seattle's rail system to peer cities, and performing a SWOT analysis. Finally, policy recommendations will be made based upon this review.

Introduction

Seattle is poised to lead the next generation of urban mobility. While it may not be one of the legacy-rail cities whose transit systems shaped the core of the urban form, Seattle is building on years of success in their bus transit network and making strategic investments in rail. Among its peers, Seattle displays a relatively low utilization of rail as part of its transit network, even though the network as a whole has high ridership. However, the newly opened Sound Transit Link Light Rail service's success and growing ridership demonstrates the readiness within the greater Seattle region for high-capacity modern rail service. Necessitated by rapid growth in both population and job markets, increasing demand for transit in Seattle provides an unparalleled opportunity to steer future growth toward non-motor-based urban form. With dedicated funding secured for both major transit service providers and downtown commute transit mode share on the rise, Seattle has the potential to become a truly car-light modern city.

Political Climates and Fiscal Conditions

The greater Seattle region has multiple transit agencies. The two most important agencies are Sound Transit, which is the regional transit agency operating light rail, commuter rail, and express bus services, and King County Metro, which operates local, rapid, and express bus

routes within King County. The City of Seattle also operates two modern streetcar routes within central Seattle.

The two transit agencies also contrast with respect to their governance structures. Sound Transit is a regional transit agency serving King, Pierce, and Snohomish counties and is independent from other jurisdictions. It is governed by an 18-member Board of Directors made up of elected officials, including 10 elected officials from King County, three elected officials from Snohomish County, and 4 elected officials from Pierce County, as well as the State Secretary of Transportation (Sound Transit 2017a). King County Metro, being a department of King County, is governed by the King County Council (King County 2017c).

Funding for transit agencies in Washington has shifted over the past 20 years. The State of Washington used to have a Motor Vehicle Excise Tax (MVET) to help fund transit, and agencies such as King County Metro relied on the source for nearly a third of their revenue (King County 2017b). However, voters in Washington approved ballot initiative 695 in 1999, eliminating the statewide MVET. Although the initiative was ruled unconstitutional in court, the State Legislature passed SB 6865 having the producing the same effect (State of Washington 2017). Since Washington state has no income tax, many cities and counties are able to levy their own local sales taxes, and a significant portion of transit funding has shifted to this source since the repeal of the MVET.

Voters in King County approved local sales tax increases in 2000, 2006, and 2014, bringing it to the maximum allowable rate of 0.9%, providing funding for the Seattle Transit Benefit District (STBD) programming plan and approximately 50-60% of King County Metro's operating revenue (King County 2017b). King County Metro also receives funding from the City of Seattle, as well as other miscellaneous sources (King County 2017a).

Sound Transit was created in 1996 when voters in King, Snohomish, and Pierce Counties approved Sound Move, a ballot initiative for funding of high-capacity transit system for the Puget Sound region (Sound Transit 2017c). Sound Move established a 0.04% local sales tax and a 0.03% local MVET, and set the first set of regional transit projects. Examples include light rail service between Sea-Tac Airport and the University of Washington, peak period commuter rail from Lakewood and Everett to Seattle, express bus routes linking various populate and employment centers, and capital investments in transit facilities (Sound Transit 2017c, 2017d). In 2008, voters approved Sound Transit 2 (ST2), raising the local sales tax an additional 0.05%

and allowing for an expansion of the Link light rail system to 55 miles (Sound Transit 2008, 2017c). The most recent ballot initiative, is known as Sound Transit 3 (ST3). The 25-year program will build 62 new miles of light rail for the Link system, bringing the total system to 116 miles, and highway bus rapid transit with service every 10 minutes, and an expansion of the Sounder commuter rail service (Sound Transit 2017c). ST3 established an additional local sales tax of 0.05%, an additional local MVET of 0.08%, and a property tax of $0.25 per every $1000 of assessed value. In addition to the new tax revenues, the plan will also utilize surpluses from Sound Move and ST2, federal grants, bonding, fares, and interest earnings (Sound Transit 2016).

Local sales taxes has given Sound Transit the ability to adopt ambitious, long term expansion plans. However, as a funding source, sales taxes are volatile and extremely reactive to economic conditions. King County Metro was a victim of this volatility twice in the 2000's, after the "dot-com" recession and Great Recession. This resulted in a budget shortfall of approximately $1.2 billion from 2009-2015 which led to cost reductions and fare increases, and even service cuts for 2014 and 2015 (King County 2017b). Although the economic recovery has stabilized sales tax revenues, another recession could once again lead to service reductions and put Sound Transit's expansion plan in jeopardy.

Ridership Data

In order to develop the best policy recommendations for Seattle area transit, it is helpful to look at the current characteristics of the transit system and the ridership for the express buses, regional rail, streetcar, and light rail routes in the metropolitan area. The questions used to guide this data analysis are:

·   How does Seattle's transit system ridership compare to other cities?

·   How much of Seattle's ridership uses the Link LRT?

·   Who does Seattle's transit currently serve?

·   What are the trends for the different transit modes?

·   Is the Link LRT ridership projected to grow?

Each of these questions is answered below, using either online mapping applications, original GIS analysis, or the quarterly ridership reports provided by Sound Transit, which is the agency which runs the Seattle Link LRT, Tacoma Link LRT, the express buses, and regional rail. King County, one county of three in the greater metropolitan region and county in which Seattle proper is located, operates buses as well. While these buses account for the majority of the transit ridership in the region, this data analysis focuses only on the rail systems and express buses operated by Sound Transit, since the focus of this report is rail transit. Express bus routes share more characteristics with rail routes than normal bus routes, and can directly compete with rail, so they are included in this analysis.

The first tool used to characterize Seattle's transit system is the US National Transit Map, which uses data from the National Transit Database (http://gti.umn.edu/data/usmap/index.html). This tool maps the number of unlinked passenger trips, either as a whole or by specific transit mode, and can be normalized by population or by total unlinked passenger trips. It can also map the number of vehicle revenue miles (the number of miles the vehicles travel while in service), as a whole or by transit mode, and be normalized by population or total number of vehicle revenue miles as well.

Key Numbers for Seattle Transit[1]

- Total Population: 3,059,393 (14th)

- Population Density: 3,028.2 persons per square mile (63rd)

- Vehicles Operated in Maximum Service: 4,333 (5th)

- Fare Revenues Earned: $342,324,992 (8th)

- Vehicle Revenue Miles: 103,149,936 (7th)

    - 2.6% Light Rail

- Unlinked Passenger Trips: 201,432,608 (8th)

    - 4.8% Light Rail

- Transit Way Mileage: 4,744 (7th)

[1] http://maps.umn.edu/USTransit/performanceMaps/upt.html, also source for Figures 1-4

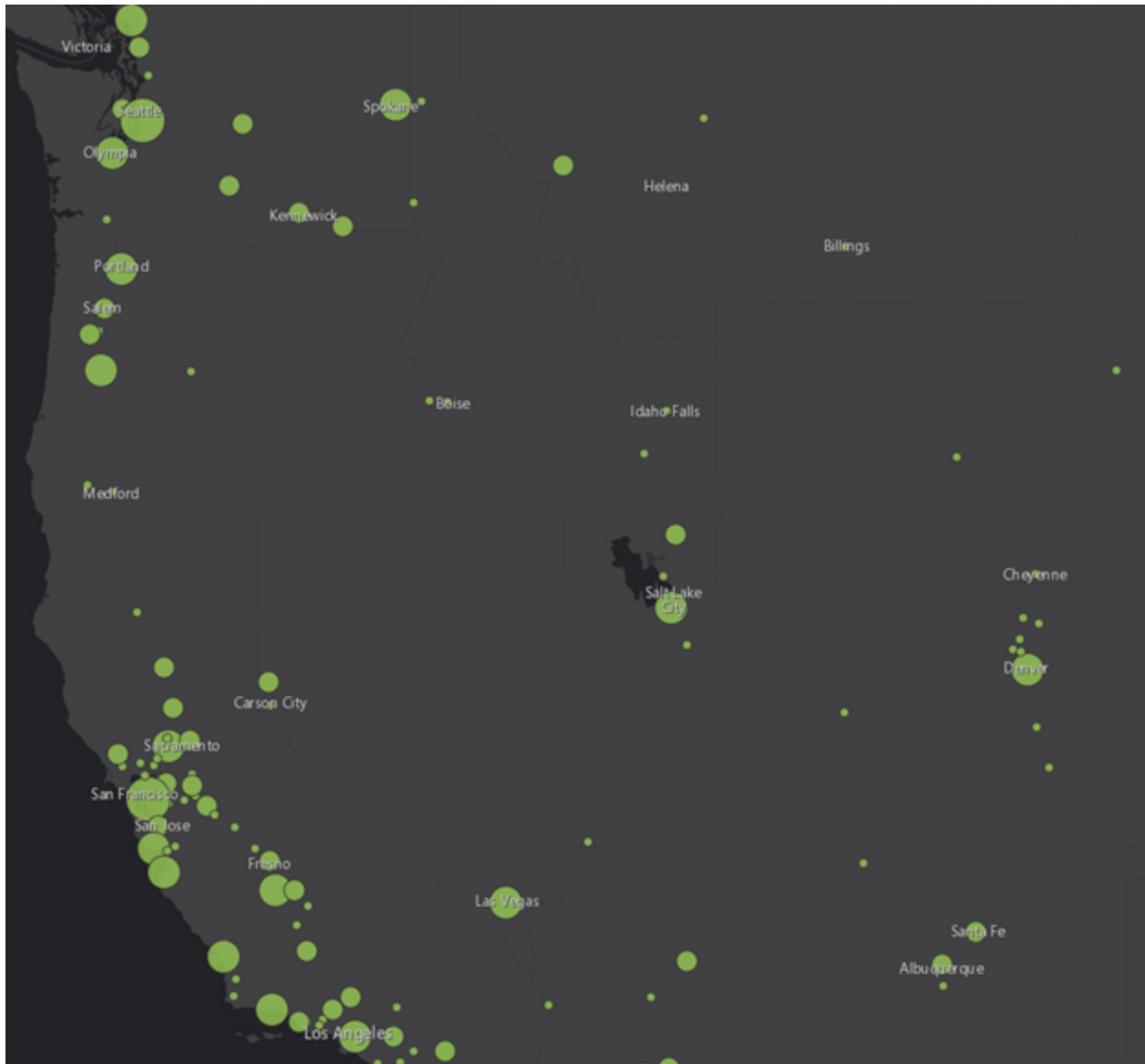Figure 1: Total Unlinked Passenger Trips Normalized by Population

Figure 1 shows a map of the western United States displaying the total number of unlinked passenger trips, normalized by population. It is worth noting that the comparison cities of Denver, San Francisco, and Portland are displayed on this map, in addition to Seattle. In the next section of this report, these cities, along with Minneapolis, will be considered the peer cities of Seattle. For this section, they are included to show how Seattle's transit system compares to and differs from its peer cities. Figure 1 shows that Seattle has transit usage per capita, with ridership similar to San Francisco and higher than Denver, Portland, and non-peer cities such as Los Angeles. Denver is well known for its regional rail system, and Portland is known for its light

rail system. Seeing that Seattle has higher transit ridership per capita than each of these cities is a sign that there is high demand for transit in Seattle, and that its current system is performing well. Seattle is the 14th most populous city in the United States, yet ranks 8th in total unlinked passenger trips, showing that it is performing better than many of its peers.

Figure 2: LRT Unlinked Trips – Normalized by Total Unlinked Trips
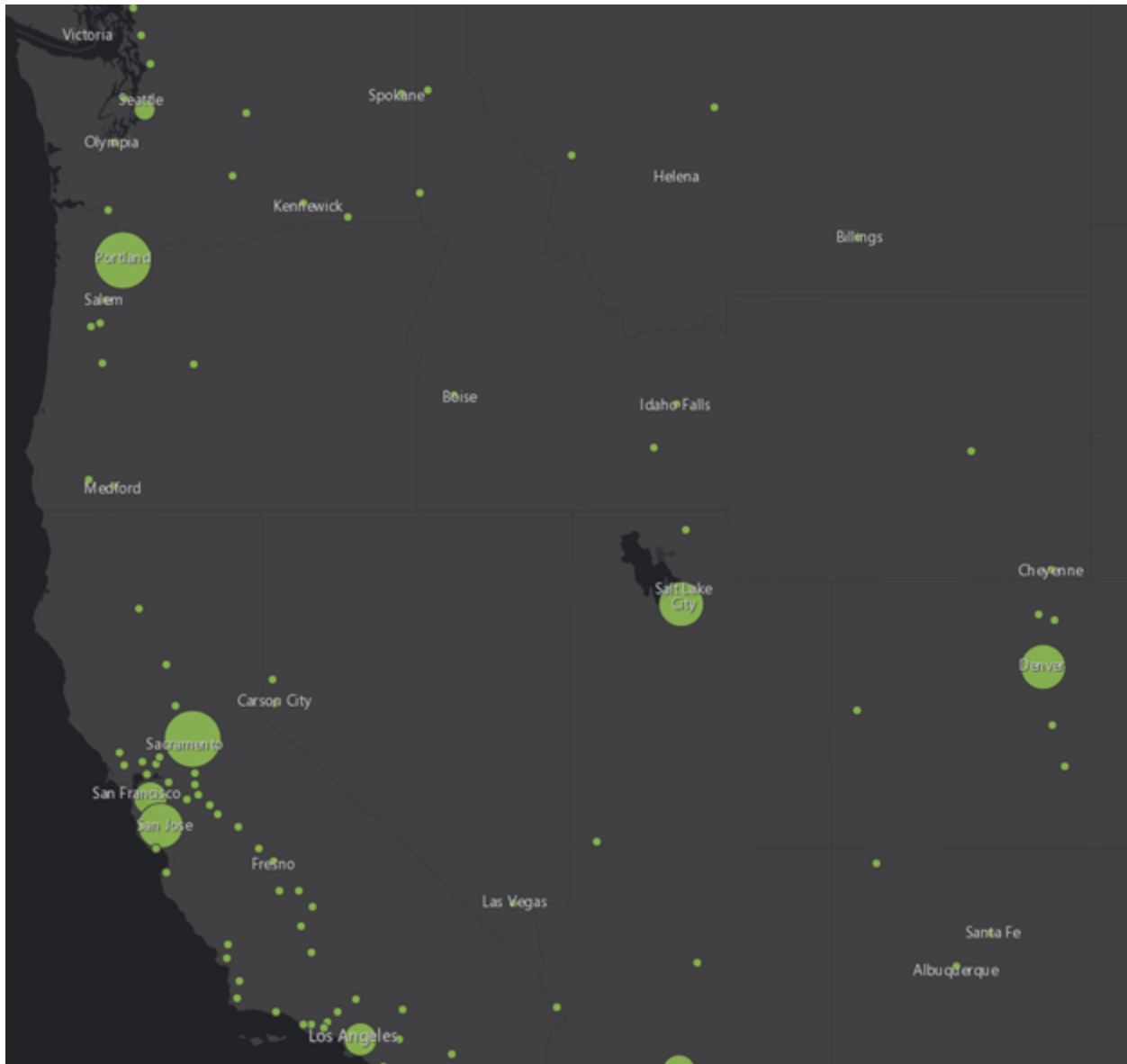
Displaying the number of unlinked light rail trips, normalized by total unlinked trips, paints Seattle in a much different light, however. Seattle has had commuter rail since 2000, but has only had the Link LRT since 2009, making it a relatively young system. The mode share of light

rail transit is only 4.8% (which is higher than other rail modes), a small share compared to cities such as Denver, San Francisco, Portland, and even Los Angeles. However, as will be shown later, the demand for light rail options is growing, and ridership has increased steadily since its introduction.

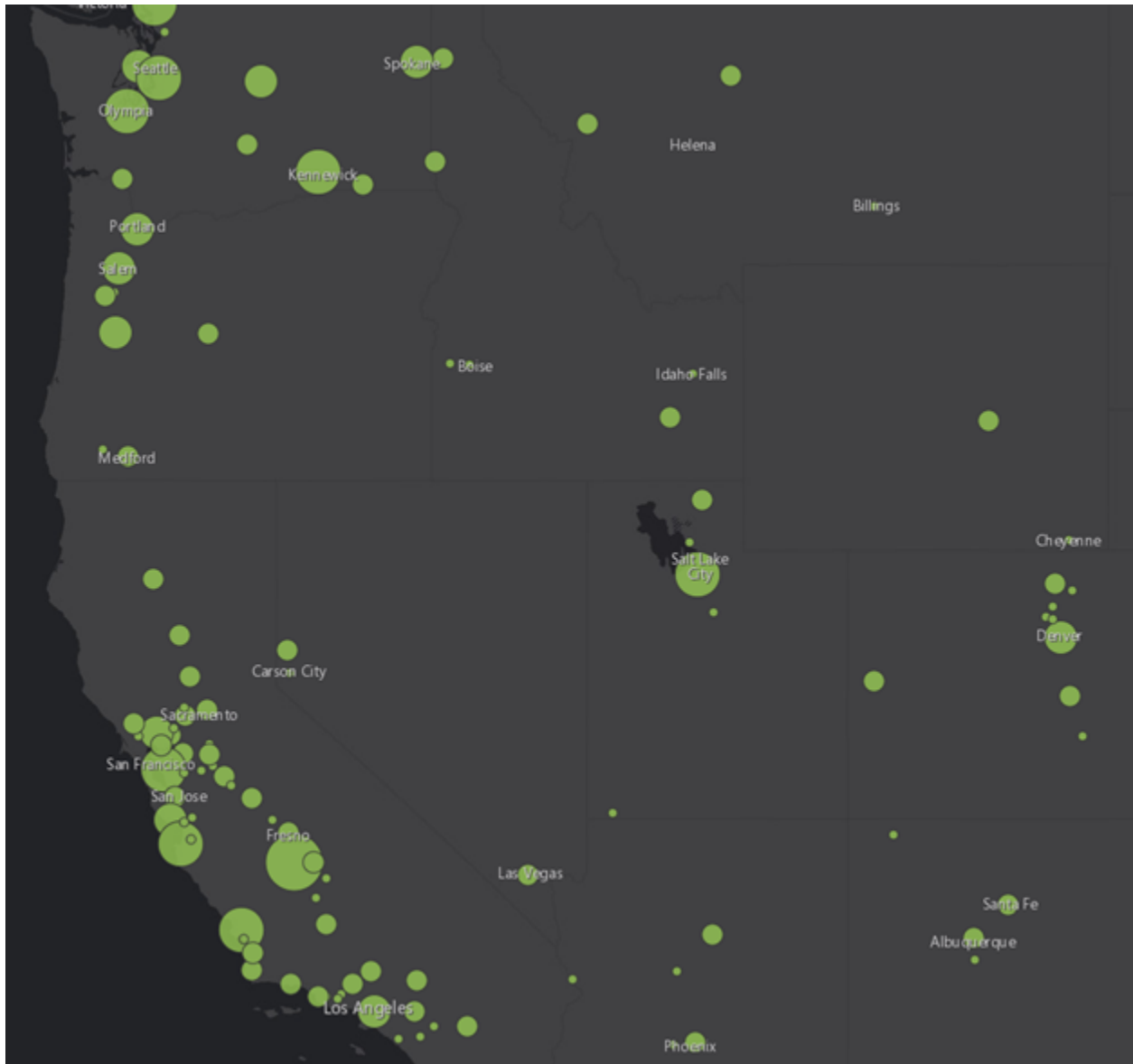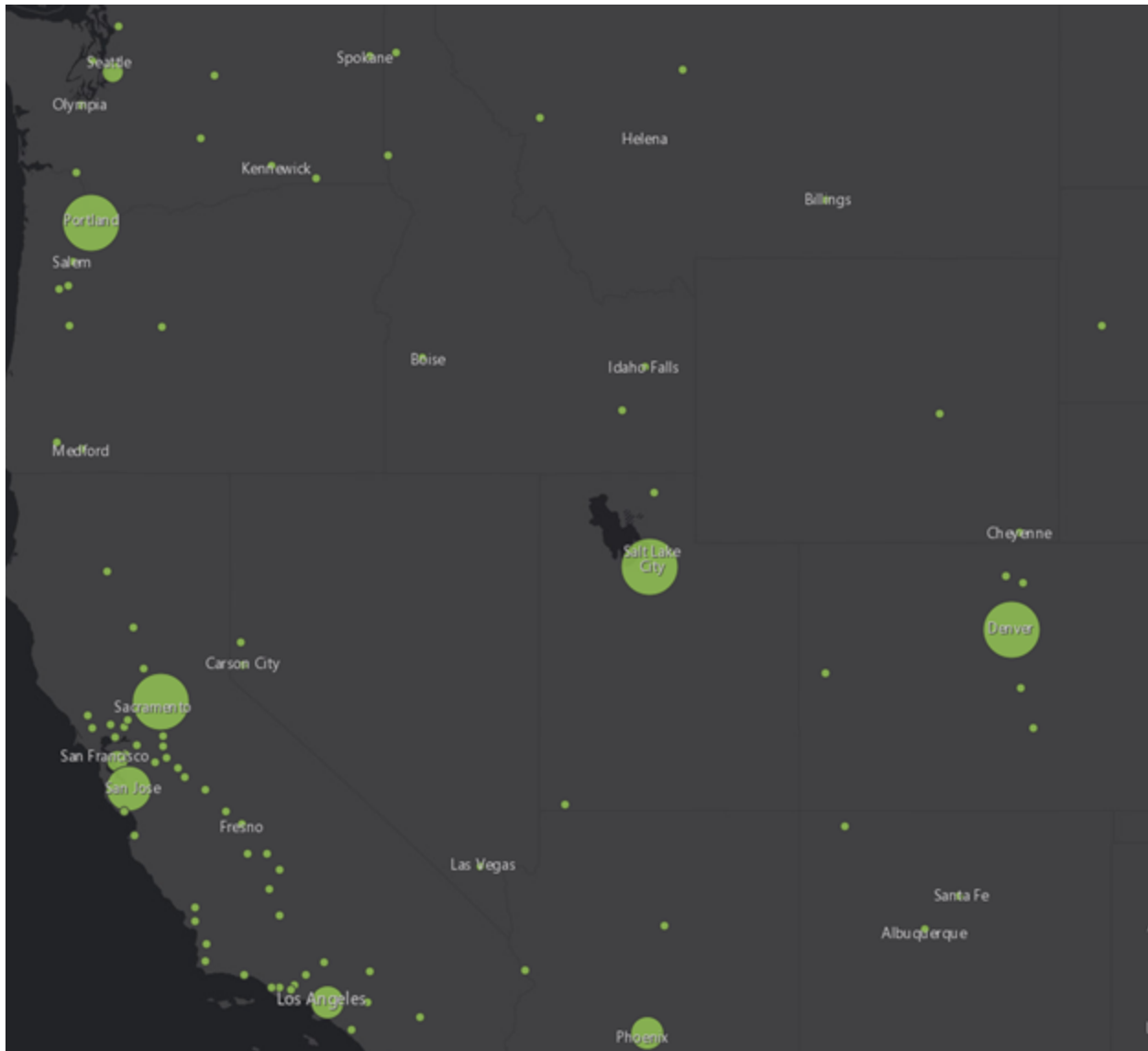Figure 3: Vehicle Revenue Miles – Normalized by Population

Figures 3 and 4 lead to similar conclusions as the prior two figures. Seattle operates the 7th most vehicle revenue miles of any city in the country, with 103,149,936. Only 2.6% of these miles, however, are light rail vehicle revenue miles, which is lower than the percentages seen in peer cities Portland, San Francisco, and Denver. However, it is worth noting that despite the relatively low amount of rail service, and the limited geographic extent of the Central Link LRT (which is currently only one route covering 20.35 miles), the light rail ridership is doing well. Even though LRT service accounts for only 2.6% of the vehicle revenue miles, it accounts for 4.8% of the total unlinked passenger trips, meaning that the ridership per vehicle revenue mile for LRT is significant.

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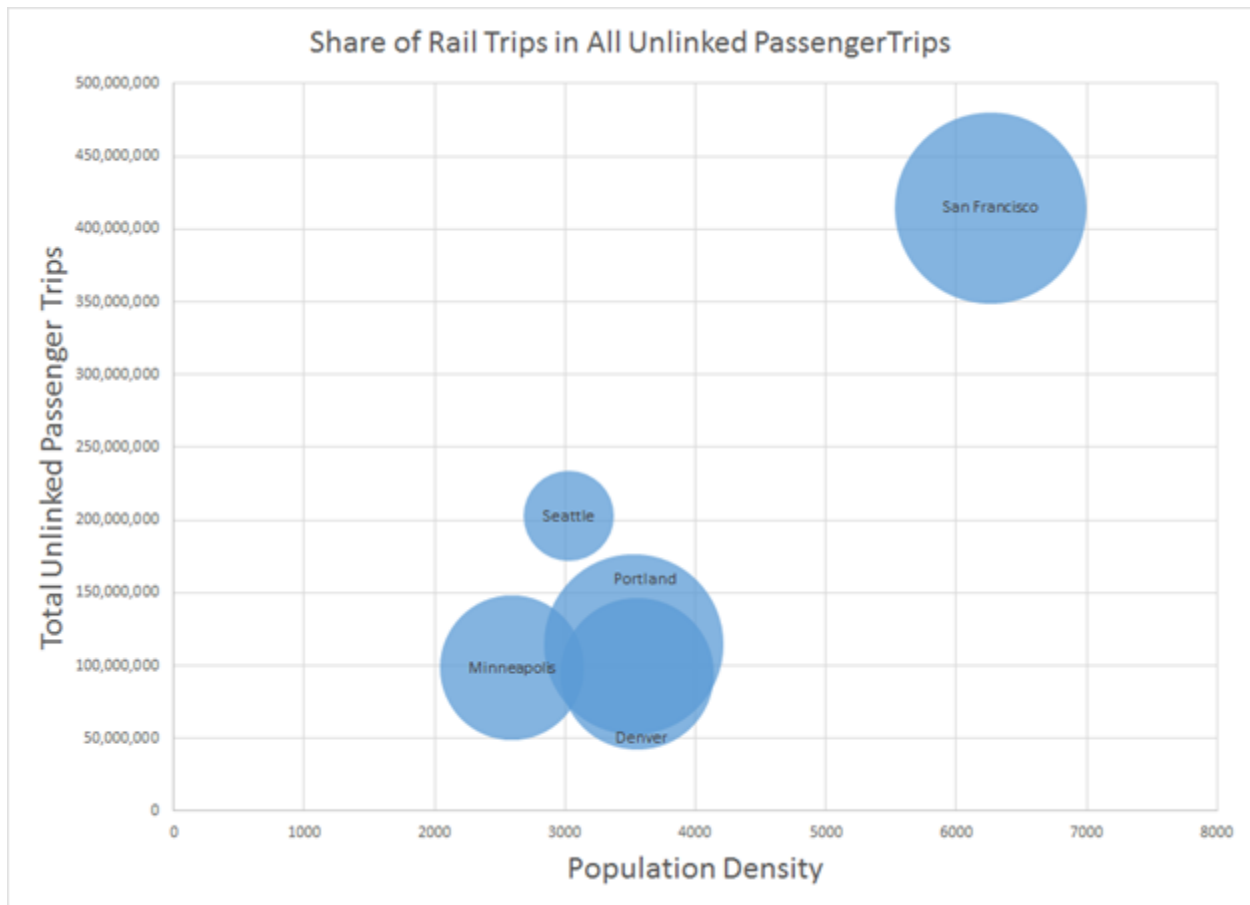Share of Rail Trips in All Unlinked PassengerTrips

Figure 5 shows the correlation between population density and transit ridership. San Francisco, which is the densest of the five cities graphed, clearly has the highest transit usage. Seattle, on the other hand, has the second lowest population density, ahead only of Minneapolis. However, Seattle has a higher number of unlinked passenger trips than Minneapolis, Portland, and Denver. This could mean several different things. Seattle may be doing a better job than the other cities of making transit affordable, reliable, and convenient, or it may just have a higher demand for transit due to its geography, weather, or other factors. It is difficult to say exactly why Seattle's ridership is so high, but it is an encouraging sign for future transit projects. This graph also shows, by the size of the bubble for each city, the mode share occupied by rail transit, including commuter rail, light rail, streetcars, and other rail. Again, Seattle lags behind

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[2] Data from Federal Transit Administration's National Transit Database, www.transit.dot.gov/ntd/ntd-data

the other cities in the amount of rail trips, but this is an opportunity, not a barrier, as will be discussed later in this paper.

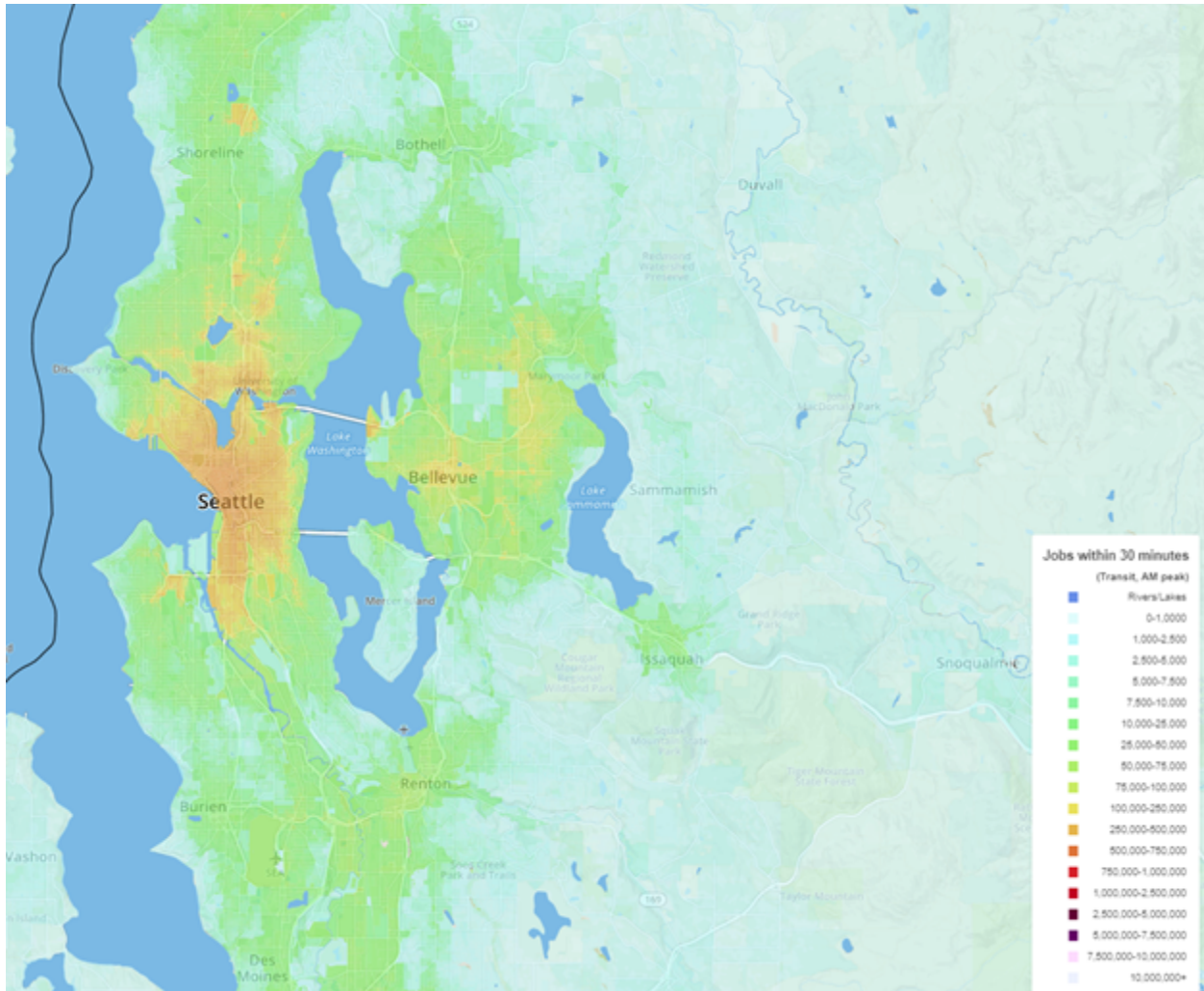Figure 6: Job Accessibility by Transit[3]

Figure 6 is a map showing the number of jobs accessible by a 30 minute or less commute using existing transit in Seattle. Access Across America ranks Seattle 8th in the United States for job accessibility. One of the guiding questions for the data analysis was "who does Seattle's transit currently serve?" It is encouraging to see that Seattle has so far excelled at connecting people

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[3] Data from Access Across America, Accessibility Observatory at the University of Minnesota, ao.umn.edu/research/america

to jobs via transit, and this characteristic of the system might be one factor explaining its high ridership when compared to other cities.

It is also important to consider equity concerns that may arise in future rail developments. Rail transit should serve both the transit dependent riders who would benefit the most and the choice riders necessary to financially support the project. The Central Link LRT currently only has one corridor, running from the University of Washington, through downtown Seattle, and then south to the airport. It is difficult to critique this path for its location, it is a very reasonable corridor for the first line. It serves high trafficked areas and areas with many jobs, such as downtown. Seattle is also oddly shaped, like an hourglass, and so transit corridors through the center of the city are also limited by geography. Because there is, excluding the Tacoma Link LRT which is more a streetcar with only two stops, only one light rail corridor in the Seattle metro area, a more intensive GIS analysis of the income, ethnicity, and race of the communities along the corridor is not included in this report. There was little to be gained from this analysis, but these are factors that should be taken into account when expanding the system in the future.

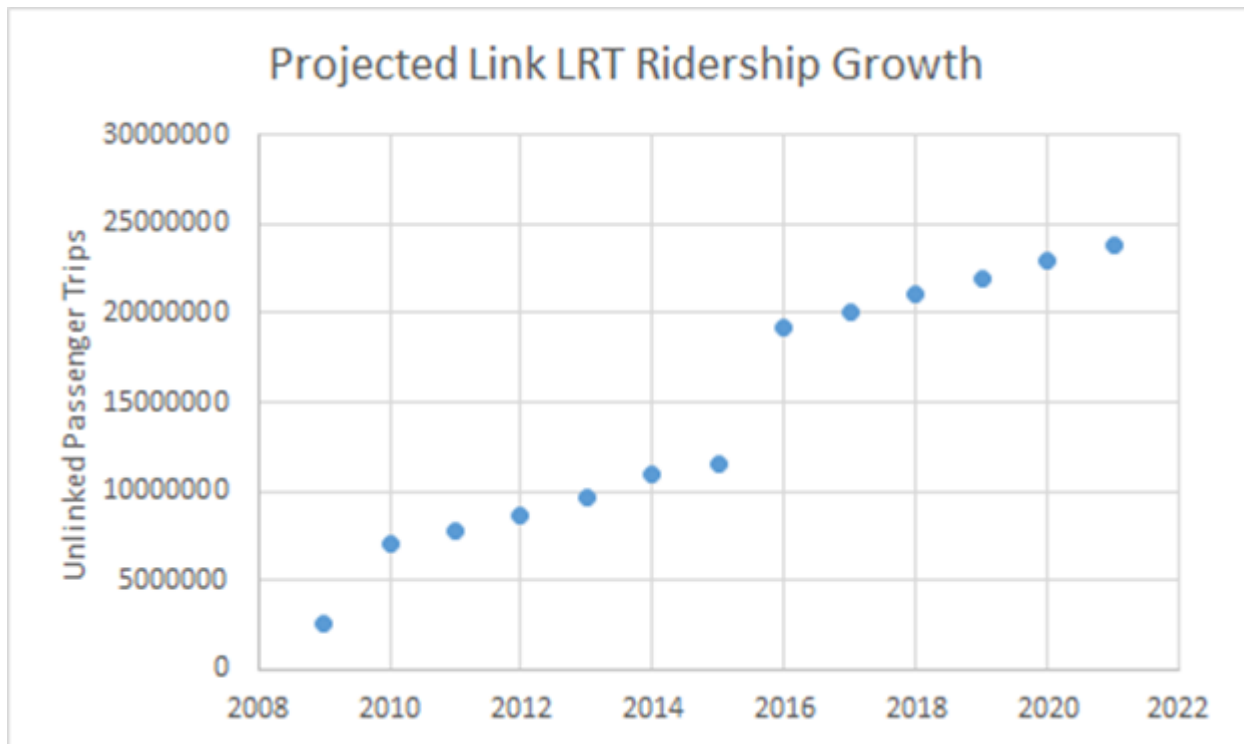Figure 7: Sound Transit Annual Ridership by Mode:[4]

Figure 7 shows how the ridership of the Tacoma Link, Central Link, Express Buses, and Sounder Commuter Rail, all operated by Sound Transit, have changed since 2009, when the Central Link was opened. The Tacoma Link, which is a streetcar with only 2 stops, has had a slight decline in ridership but has had largely static ridership. Sounder Commuter rail has had modest growth since 2009. The real standout, however, among the rail service is the Central Link LRT, which has seen an increase in ridership each year since its opening. Sound Transit's quarterly reports show that the Central Link LRT (often shortened to just Link LRT) often surpasses its ridership targets, and the total number of boardings (their term for unlinked passenger trips) passed the number of boardings budgeted for each year since its opening. Ridership increased even more in 2016, which Sound Transit attributes to the expansion of the route to 3 new stations at the University of Washington, Capitol Hill, and Angle Lake. The Express Buses saw a slight decrease in ridership this same year, which can be attributed to the expanded service of the Link LRT.

Figure 8 shows the projected ridership for Link LRT for the next 5 years. This projection uses a linear regression model based on the ridership from 2010 to 2015. 2016 was excluded from the regression, since the increase in ridership was larger than expected due to new station

openings, and 2009 was excluded because the Link LRT was not open at the beginning of the year. The model shows ridership growing by 944,643 unlinked passenger trips per year in the absence of new station openings. However, 2017 has so far seen an increase even greater than projected, as ridership for Q3 of 2017 is up 13.5% from Q3 of 2016, showing the the demand for rail transit is still growing.

Peer Region Comparison

When measuring transit performance, it is important to make a distinction between effectiveness and efficiency, whereas effectiveness measures the extent to which an objective has been achieved and efficiency measures the degree to which resources were utilized to achieve said objective. One way to put it is that "effectiveness is 'doing the right thing' and efficiency is 'doing things right,'" (Gleason and Barnum 1982). However, when it comes to measuring effectiveness and efficiency, there is disagreement on which methods to use. Although a large number of agencies use a set of different ratios to measure effectiveness and efficiency, such as total passengers per revenue mile or passengers served per capita as measures of effectiveness and operating cost per revenue mile as a measure of efficiency, others argue the need to have single measure for effectiveness and a single measure for efficiency, along with different methods for how to calculate them (Khasnabis et. al. 2002, Chu and Fielding 1992). However, because of the goal to compare performance of rail systems for peer cities, and for simplicity, several measures of effectiveness will be compared, specifically rail unlinked passenger trips as a percentage of all unlinked passenger trips and rail unlinked passenger trips per rail revenue mile. These effectiveness measures will also be compared within the context of each cities existing and planned rail systems.

The peer cities that were chosen are Portland (PDX), Denver (DEN), Minneapolis/Saint Paul (MSP), and San Francisco (SFO). Portland, Denver, and Minneapolis/Saint Paul were chosen because each are similar in size, with Portland, Denver, and Minneapolis/Saint Paul being the 25th, 19th, and 16th largest metropolitan statistical areas, compared to Seattle being the 15th largest, and also because each has its own light rail system. San Francisco was chosen because it has similar geography to Seattle.

Figure 9: Peer City Comparison[5]

	SEA	PDX	DEN	MSP	SFO
Existing Rail System	2 LRT lines, 2 modern streetcar lines, 2 commuter rail lines	5 LRT lines, 2 modern streetcar lines, 1 commuter rail line	7 LRT lines, 2 commuter rail lines	2 LRT lines, 1 commuter rail line	5 heavy rail lines, 7 LRT lines, 2 heritage streetcar lines, 3 cable car lines, 1 commuter rail line
Planned Rail System	8 LRT extensions, 2 commuter rail extensions	1 LRT line	3 LRT extensions, 3 commuter rail extensions	2 LRT extensions, 3 modern streetcar lines	1 LRT line
LRT % of UPT	4.8%	33%	27.01%	23.33%	11.84%
All Rail % of UPT	9.5%	37.46%	27.01%	24.07%	42.27%
LRT UPT/LRT Revenue Mile	3.61	5.09	2.33	4.41	8.6
All Rail UPT/ All Rail Revenue Mile	3.56	5.3	2.33	3.85	2.6

Amongst all the cities, Seattle is the weakest performer when it comes to number of rail unlinked passenger trips as a percentage of all unlinked passenger trips (both LRT and all rail). This means that Seattle's rail transit system is the least established amongst it's peer cities. However, Seattle's system is the newest amongst all peer cities. However, when it comes to rail unlinked passenger trips per rail revenue mile, Denver is actually the worst performer, meaning they carry the least amount of passengers for the level of service provided. San Francisco performs the best in all categories except for LRT unlinked passenger trips as a percentage of all unlinked passenger trips (San Francisco also has a heavy rail system which would compete with LRT in this category), as well as all rail unlinked passenger trips per all rail revenue miles. Besides similar geography, San Francisco might be the weakest peer city comparison.

Although Seattle performs poorly compared to all peer cities, it has the largest and most ambitious expansion plan, which may allow Seattle to catch up and even surpass its peer cities in the next several decades.

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[5] Data from http://maps.umn.edu/USTransit/performanceMaps/upt.html

Several areas where there is not data readily available which would be useful to compare peer cities with is bus-rail integration and rail-land use integration. For rail specific systems, both would be excellent effectiveness measures. First, although there is disagreement on whether transit's role should be to connect suburban residents to jobs in the CBD, or whether it should be more interconnected and serve more complex travel patterns, for the latter, being able to measure bus-rail integration is very important (Brown and Thompson 2008). Since most rail systems in the United States are heavily dependent on feeder service from busses, having a specified method for measuring how well bus routes are designed to complement rail transit would be very useful. Second, since every transportation decision has land use impacts and vice versa, and since higher density land use is integral to generate the mass ridership needed to make mass transit successful, having a specified method for measuring how well land use complements transit use would also be very helpful (Fan 2016a, 2016b, 2017).

SWOT Analysis

Seattle has in the past decade begun to stand out as a particularly strong regional transit system, as most US transit agencies struggle to maintain ridership. However, Sound Transit and King County Metro have also distinct challenges that demand vision and dedication to overcome.

Strengths

While many regions flounder in building support for sustained transit project funding, one of the keystone strengths of this metro is its ability to secure voter-approved dedicated funding sources. Time and again, as discussed in the funding section, Seattle region voters have approved measures to give a firm mandate to maintain and expand service, most recently through the STDB funding from 2014-2020 and the Sound Transit 3 funding authorized in 2016. With this kind of predictable funding stream, both transit agencies have gone about implementing service plans that consistently make progress toward long-range goals (Schmitt 2017). Currently, Seattle is tracking ahead of its 2020 goal to give 55% of the city 10-minute frequency transit within a 10-minute walk, by already having reached 63% of the city by 2017 (Fesler 2017a) .

In addition to popular support among voters, who view the system as a worthwhile investment, the business community in Seattle also recognizes the value of transit improvement. According to the Commute Seattle report in 2017, "In turn, downtown employers invested over $100 million in infrastructure and transportation benefits in 2016" (Commute Seattle 2017). This is a critical

element in everything from route development, ridership encouragement, and with respect to funding security.

The Commute Seattle report also highlighted a major milestone for the Seattle metro: the share of people commuting downtown who drive alone sits at 30% while transit takes the lead with 47% (Commute Seattle 2017). Even more dramatic, this comes in an era where downtown Seattle added 45,000 new jobs, but only 2,255 single-occupancy car commutes - meaning 95% of the new commuters chose not to drive alone into downtown. The modal split of downtown commuters points toward a meaningful prominence of transit ridership for daily commuting, with trends only increasingly shifting away from drive-alone behavior (Fesler 2017a).

The ridership strength of the Seattle system also reveals several strengths of the agencies. The RapidRide system, one of the 2015-2016 investments from STBD funds, has been vital to building momentum for non-car commutes (Fesler 2017a). Since opening, these lines have experienced dramatic 13-40% ridership growth per line, leading to an additional 71,000 service hours and overall successful service (City of Seattle 2017). Link Light Rail Transit (LRT) extensions and added service on commuter train lines have also bolstered ridership in the rail system. Sound Transit has experienced system wide growth by 16% over 2016 ridership by end of 2018, with the expanded Link LRT service experiencing 66% growth over 2016. Another 62% jump in ridership is expected between now and 2023, driven by regional growth and planned improvements to reliability and transit system speed (City of Seattle 2017). Growth on this scale is both a strength that could propel the Seattle region toward justification and development of a world class transit system, or alternatively, could stress the system's ability to adapt.

Weaknesses

An assessment of weaknesses is a necessary part of any plan for service growth. In the Seattle region, a major weakness is the sheer number of involved agencies within the transportation sphere. Many agencies, making many plans, to serve various constituents, can sometimes add up to incoherent or even conflicting goals. Sound Transit, King County Metro, City of Seattle Department of Transportation and Puget Sound Regional Council all have a hand in setting the vision for how to improve transit for residents of the city. One resulting vulnerability created by this cross-sectional approach is services provided by King County are partially paid for by the Seattle DOT, whose funding is unsupported by the STBD that King County Metro receives

(Fesler 2017b). This is justified by the higher expectations for transit options in Seattle proper, but acts to decentralize decision making.

King County Metro's STBD funding stream expires in 2020, which will require the agency to put another proposition to voters to again initiate or restructure the taxation district. If no funding is put in place of the STBD, it could leave a hole millions of dollars large in the budget, leading to service cuts or a fare hike (City of Seattle 2017). Funding woes for Sound Transit could easily arise on some of the core lines of their service as well. The Tacoma Link and Sounder Lines have been underperforming in terms of subsidy per rider (Sound Transit 2017b). These deficiencies are yet heightened by the weak growth and even decline seen in the lines' ridership numbers in recent years.

While Sound Transit undergoes major expansion with the ST3 funds and King County Metro expands their recent RapidRide program, weaknesses in the built form are opened up. The central city area where transit service has been focused is pedestrian friendly, but as service reaches the outer areas with more frequency and coverage, the land use is less transit supportive (Fesler 2017b). Without more concentrated efforts from the agencies to coordinate supportive land use, there is high risk for the extended services' ridership to flounder. The ex-urban services have also exposed a weakness in King County Metro's outreach approach, in that they have seen comparatively lower participation rates in the reduced-fare rider program, called Orca Ride (City of Seattle 2017).

Opportunities

The promise of being able to shift policy to reflect these clear commuter preferences places Seattle in a position to become a truly car-light modern city, in the direction that Paris, Copenhagen and other legacy European cities have been moving. Likewise, our analysis showed that the newly opened light rail system still has a relatively low share of unlinked passenger trips when compared with peer city systems. As the system expands to its ST3 extents, there is great potential for rail to absorb much of the regional growth anticipated in the area. In the Seattle region, there is strong momentum toward orienting growth patterns toward transit, as demonstrated by the 86% of new housing units that have been added within the service area of the 10-minute frequency network (City of Seattle 2017).

If the agencies are working toward their rapid expansion reach of the network of 10-minute frequency transit service, they could also take advantage of several technology-based

platforms. Agencies across the nation are initiating partnerships with rideshare, bikeshare and other mobility-as-a-service providers to expand access to high-frequency transit. While this is no substitute for a planned system buildout, it can greatly improve accessibility, especially in low density areas even the most successful transit agencies struggle to meaningfully serve. Additionally, the King County Metro Orca Card program can continue expanding its highly successful youth transit-encouragement program to continue building the next generation of riders (City of Seattle 2017). This program could be expanded and offered on a mobile platform, providing further incentive for the younger generation and ease of scalability for the agency administration.

Regional integration and cross-agency coordination also opens up prospects for synergistic service benefits. This principle is already arising through planning efforts on the One Center City plan, a 20-year, 10-neighborhood collaborative vision for the fastest-growing part of the region. With the City of Seattle, King County Metro, Sound Transit and the Downtown Seattle Neighborhood Association at the table to shape the plan with neighborhood residents, it is an ambitious approach that could serve as a model for agency integration throughout the region (One Center City 2017). However the proof of this partnership will come in the implementation phase, when beyond agreeing on goals and outcomes, agencies will have to collaborate on an operational level, where shared responsibility can be a burden to efficiency.

Threats

Yet the kind of rapid expansion the region is experiencing, necessarily comes a distinct risk for overburdening and decline. Even with planned efforts to meet the demands of a burgeoning economy and population, keeping pace with regional growth projections will be a challenge for Seattle. Already, some lines struggle with overcrowding that diminishes on-time performance and rider comfort (City of Seattle 2017). Growth could also threaten service as busses and express busses get snarled in increasing regional congestion. The 2018 Service Implementation Plan and 2017 All Access report posts an on-time performance rate for the bus system run by King County Metro at 77% and for ST Express busses a rate fluctuating in the low 80's (City of Seattle 2017, Sound Transit 2017b). Together, overcrowding and unreliability could diminish ridership in a dramatic fashion. Increasing system-wide capacity through investment in light rail service and bus rapid transit will be critical to ensuring that the quality of service meets the expectations of riders who could turn to motorized alternatives.

Policy Recommendations

Few critical issues will require as undeniable of a resolution as the impending end of the 2014 STBD funding stream for the King County Metro Service. The All Access Report on the use of these funds displays how critical improvements made with these funds have been to maintaining the kind of vital bus service that can continue to grow ridership while other bus systems in the nation flounder (City of Seattle 2017). Similar to the format of the STBD, another county-wide tax should be reinstated through a vote by the King County metro residents. Having just passed the proposition for Sound Transit 3 funds, it can be assumed that there is fairly strong support for transit in the region. However, coming so close on the tails of a major transit investment, it will be necessary to make clear to voters how the two funds are different and why the bus service improvements are just as or perhaps more necessary after having just made major investment in rail. Longer term, Seattle should explore different, more reliable sources of funding than sales taxes. Sales tax volatility has proven to be detrimental to King County Metro's operating budget in the past. Different sources such as transit value capture should be explored.

Furthermore, the city must address mounting capacity needs that cannot be met by rail alone. The city's current subsidization of 30% King County Metro route hours served within the city, there is clear service deficit that will only grow as the central city job market continues to expand. Therefore, the Seattle DOT should funnel their cost participation into development of further Rapid Ride bus rapid transit service to upgrade key bus corridors. Since the investment would be coming from SDOT, the agency who controls right of way, these new lines could take advantage of dedicated lanes to provide rail-light service quality that would contribute toward maintaining strong transit mode share among commuters.

Finally, in order to better measure the performance of its rail system, and transit system in general, Seattle should develop methods to measure both bus-rail integration and rail-land use integration. Being able to measure both will ensure that ridership is maximized in the future, as well as transit access.

Conclusion

In the coming years, Seattle has the opportunity to maintain its momentum and expand its rail infrastructure to a point that rivals other cities. Seattle's rail transit is relatively new, and does not benefit from a legacy system like many other cities in the United States. However, the ridership on the Central Link LRT has grown every year since its opening, and the ridership shows no signs of slowing down anytime soon. Seattle's current transit system excels at connecting people to places of interest, including employment areas, operates the 7th most amount of vehicle revenue miles of any city in the country, and has the 8th highest ridership and earns the 8th highest fare revenue. There are many factors that could explain Seattle's high transit ridership, be it the climate and geography, high demand for transit, or the quality of service. Whatever the reason, the expansion of rail infrastructure will help Seattle maintain the quality of its transit network. Riders' preference for rail is clear, shown by success of the Central Link LRT, and Seattle is responding through its aggressive expansion with the Sound Transit 3 projects. For these projects to succeed, Seattle must consider the policy recommendations discussed in this report and other strategies to make sure that the projects will have the funding needed for construction and operations, and that the projects are being built along corridors where ridership will be guaranteed. Connecting a variety of destinations, and connecting stations to mixed land uses, will encourage riders to use rail not only during their commutes to work, but also to other destinations within the city. If these factors are addressed in future projects, Seattle has the potential to have a rail system on par with the rest of its transit network.

Works Cited

Brown, Jeffrey R. And Gregory L. Thompson. 2008. "Service Orientation, Bus-Rail Service
  Integration, and Transit Performance: Examination of 45 U.S. Metropolitan Areas."
  Journal of the Transportation Research Board, No. 242: 82-89. doi: 10.3141/2042-09.

Chu, Xuehao, Gordon J. Fielding and Bruce W. Lamar. 1992. "Measuring Transit Performance
  Using Data Envelopment Analysis." *Transportation Research Part A: Policy and Practice*,
  26(3), 223-330.

City of Seattle. 2017. "All Aboard: Seattle Transportation Benefit District Year 2 Performance
  Report." Last accessed December 2017. https://www.seattle.gov/Documents
  Departments/Transit/STBDYear2AnnualReport_FINAL.pdf

Commute Seattle. 2017. "How Do You Get There, Seattle?" Last accessed December 17.
  https://commuteseattle.com/modesplit/

Fan, Yingling. 2016a. "The Future of U.S. Transit is in Regional Place-Making (Part I)." The
  Global Transit Blog, May 2. https://globaltransitblog.wordpress.com/2016/05/02thefuture-
  of-u-s-transit-is-in-regional-place-making-part-i/

Fan, Yingling. 2016b. "THE FUTURE OF U.S. TRANSIT (PART II): Historical and Contemporary
  Development-Oriented Transit." The Global Transit Blog, June 8. https://
  globaltransitblog.wordpress.com/2016/06/08/the-future-of-u-s-transit-is-in-regionalplace-
  making-part-ii/

Fan, Yingling. 2017. "American Cities By Rail, Week 1, Introduction: US transit at crossroads."
  In-class Presentation, Humphrey School of Public Affairs, September 6.

Fesler, Stephen. 2017a. Looking Back on Two Years of Investment in Seattle Transit." *The
  Urbansit*, November 7. https://www.theurbanist.org/2017/11/07/looking-back-two-years
  investment-seattle-transit/

Fesler, Stephen. 2017b. "What's Next for Seattle's Transportation Benefit District?" *The
  Urbanist*, November 8. https://www.theurbanist.org/2017/11/08/whats-next-seattles
  transportation-benefit-district/

Gleason, John M., and Darold T. Barnum. 1982. "Toward valid measures of public sector
  productivity: performance measures in urban transit." *Management science* 28, no. 4:
  379-386.

Khasnabis, Snehamay, Emadeddin Alsaidi, Libo Liu, and Richard Darin Ellis. 2002.
  "Comparative study of two techniques of transit performance assessment: AHP and

GAT." *Journal of Transportation Engineering* 128, no. 6: 499-508. King County. 2017a.

"Budget." Last accessed December 17. http://kingcounty.gov/depts

transportation/metro/about/budget.aspx

King County. 2017b. "Financial stability & sustainability." Last accessed December 17. http:/

kingcounty.gov/depts/transportation/metro/about/financial-stability.aspx

King County. 2017c. "Meet your elected officials." Last accessed December 2017. http:/

www.kingcounty.gov/elected.aspx

One Center City. 2017. "One Region. One Plan. One Center City." Last accessed December 17.

https://onecentercity.blob.core.windows.net/media/Default/ResourceLibrary

2017_0323_OCC_fs_v7c_English.pdf

Schmitt, Angie. 2017. "How Seattle Avoided the Transit Death Spiral to Turn Around Its Bus

System." *Streetsblog USA*, November 8. https://usa.streetsblog.org/2017/11/08/how

seattle-avoided-the-transit-death-spiral-to-turn-around-its-bus-system/

Sound Transit. 2017a. "Board of Directors." Last accessed December 17. https:/

www.soundtransit.org/About-Sound-Transit/Board-of-Directors

Sound Transit. 2008. "Sound Transit 2." Last accessed December 17. https:/

www.soundtransit.org/sites/default/files/documents/pdf/st2/transitexapansion

st2_plan_web.pdf Sound Transit. 2017c. "History: what voters approved." Last accessed

December 17. https://www.soundtransit.org/Projects-and-Plans/Developing-Regional

Transit/History-what

voters-approved

Sound Transit. 2016. "Sound Transit 3: the Regional Transit System Plan for Central Puget

Sound." Last Accessed December 17. https://www.soundtransit.org/sites/default/files

project-documents/st3-system-plan-2016.pdf

Sound Transit. 2017b. "Draft 2018 Service implementation Plan." Last accessed December 17.

https://www.soundtransit.org/sites/default/files/2018-service-implementation-plan.pdf

Sound Transit. 2017d. "Paying for the system - RTA taxing and bonding." Last accessed

December 17. https://www.soundtransit.org/About-Sound-Transit/News-and-events

Reports/Sound-Move/Paying-for-the-system

State of Washington. 2017. "Recent Initiatives." Last accessed December 17. http://leg.wa.gov

JTC/trm/Documents/TRM_1315Update/5%20-%20Recent%20Initiatives.pdf