SEATTLE CONGESTION PRICING STUDY PHASE 1

Impacts and Benefits White Paper

May 2019

NELSON
NYGAARD

Lead author:

NELSON NYGAARD

In cooperation with:

Sam Schwartz Transportation Consultants

TransForm
Our communities. Our transportation. Our future.

enviroissues

SILICON Transportation Consultants

Daniel Firth

Table of Contents

Table of Figures

INTRODUCTION

The City of Seattle is exploring congestion pricing as a way to address traffic congestion, reduce greenhouse gas emissions, and create a more equitable transportation system.

Congestion pricing is based on the idea that traffic congestion comes with high costs to society and to individuals in the form of air and climate pollution, traffic collisions, and slower commutes for everyone. When tolls are charged—especially when based on demand so that the more congested a road becomes, the higher the fee to use it—some people make changes to some of their trips. To avoid tolls, they may choose to drive during off-peak times, shift to carpools or transit, or combine trips.

The purpose of this white paper is to provide a high-level description of what is currently understood about the potential impacts and benefits of implementing a congestion pricing program in Seattle. It begins with baseline conditions data, describing local and regional travel patterns that could be affected by congestion pricing. It discusses some of the programs already in place to reduce travel demand in congested areas and during congested times. The paper then reviews lessons learned from evaluating mobility pricing efforts in Seattle and around the world.

The remainder of the paper is dedicated to the high-level evaluation of select mobility pricing tools, focusing primarily on area pricing, as the evaluation of select impacts and benefits can be accomplished with readily available data. The paper also describes data still needed and proposed methods for further evaluation of additional pricing tools.

BASELINE CONDITIONS

Both within the City of Seattle and the central Puget Sound region, travel patterns are heavily oriented to Seattle's center city area. Each weekday, approximately 250,000 people travel to or through central Seattle, approaching from the north (91,000), east (64,000), south (70,000), and west (24,000).[1] Commute patterns within Seattle are also heavily oriented to the center city. Figure 1 shows commute flows between Puget Sound Regional Council (PSRC) forecast analysis zones (FAZs) using 2015 Longitudinal Employer Household Dynamics (LEHD) Origin-Destination Employment Statistics (LODES) data. Figure 2 shows these same commute flows at a regional level, illustrating the significance of Seattle's center city as a region-wide employment center.

While commute trips into center city originate from all parts of Seattle, the residential density of center city workers is greatest in census blocks in or near the downtown core (see Figure 3).

The concentration of employment in Seattle's center city leads to traffic congestion and low travel speeds on local and regional roadways, as shown in Figure 4 and Figure 5.

[1] City of Seattle traffic data from 2016 and 2014 for arterials and WSDOT 2017 data for state roads and freeways

Figure 1 Commute Flows within the City of Seattle

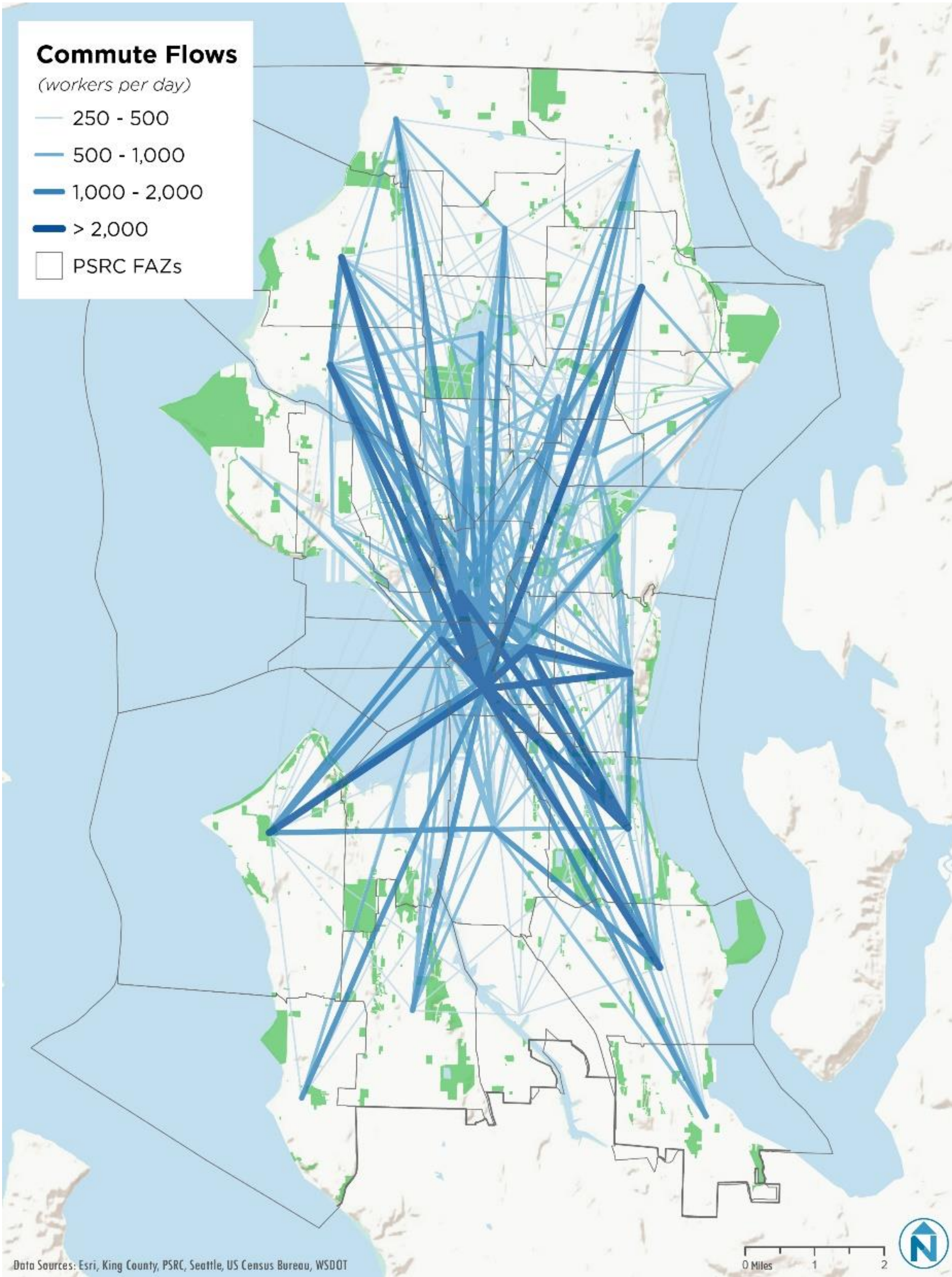


Figure 2 Commute Flows in the PSRC Region

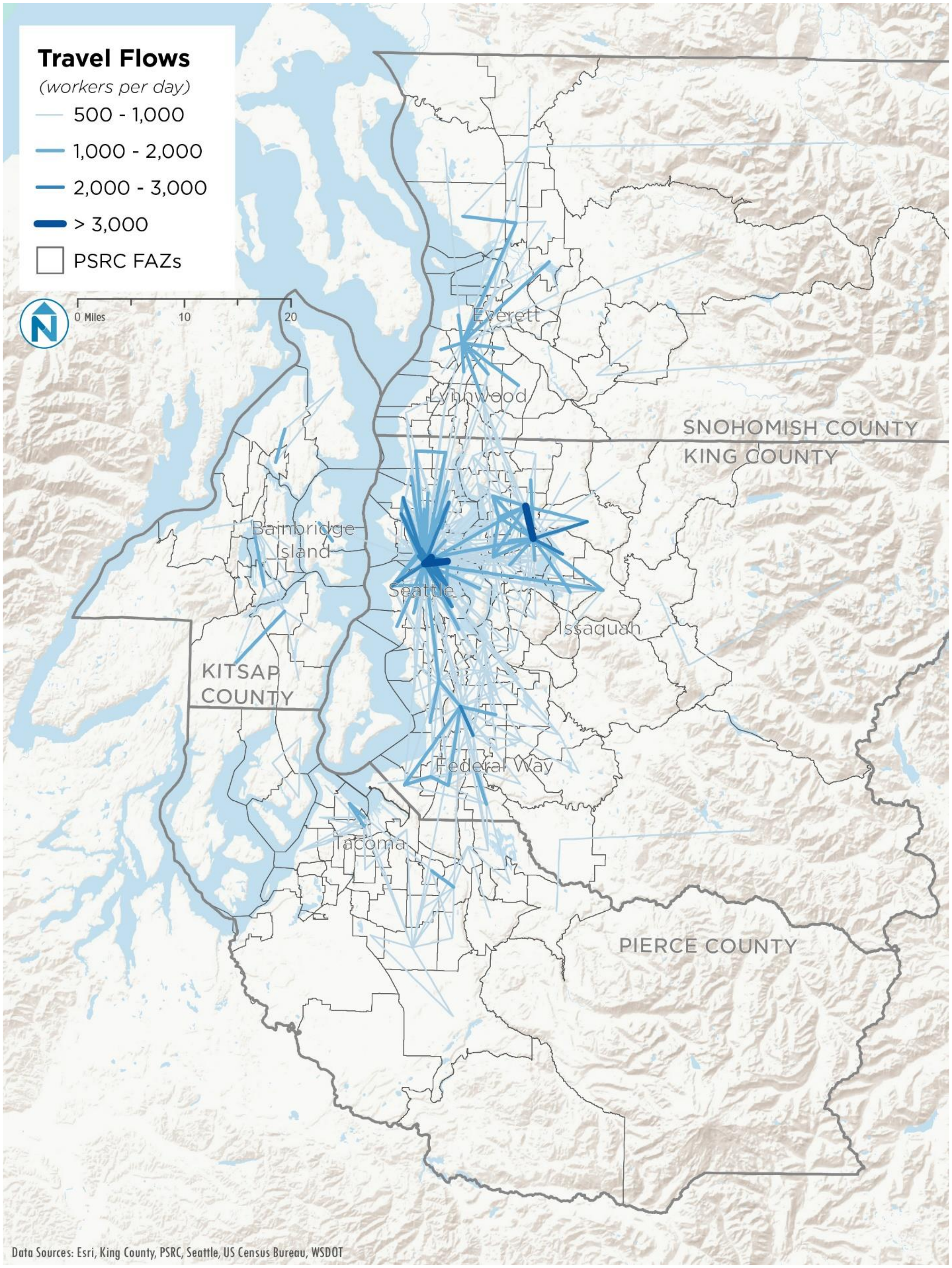


Figure 3 Residence Areas of Workers Employed in Center City

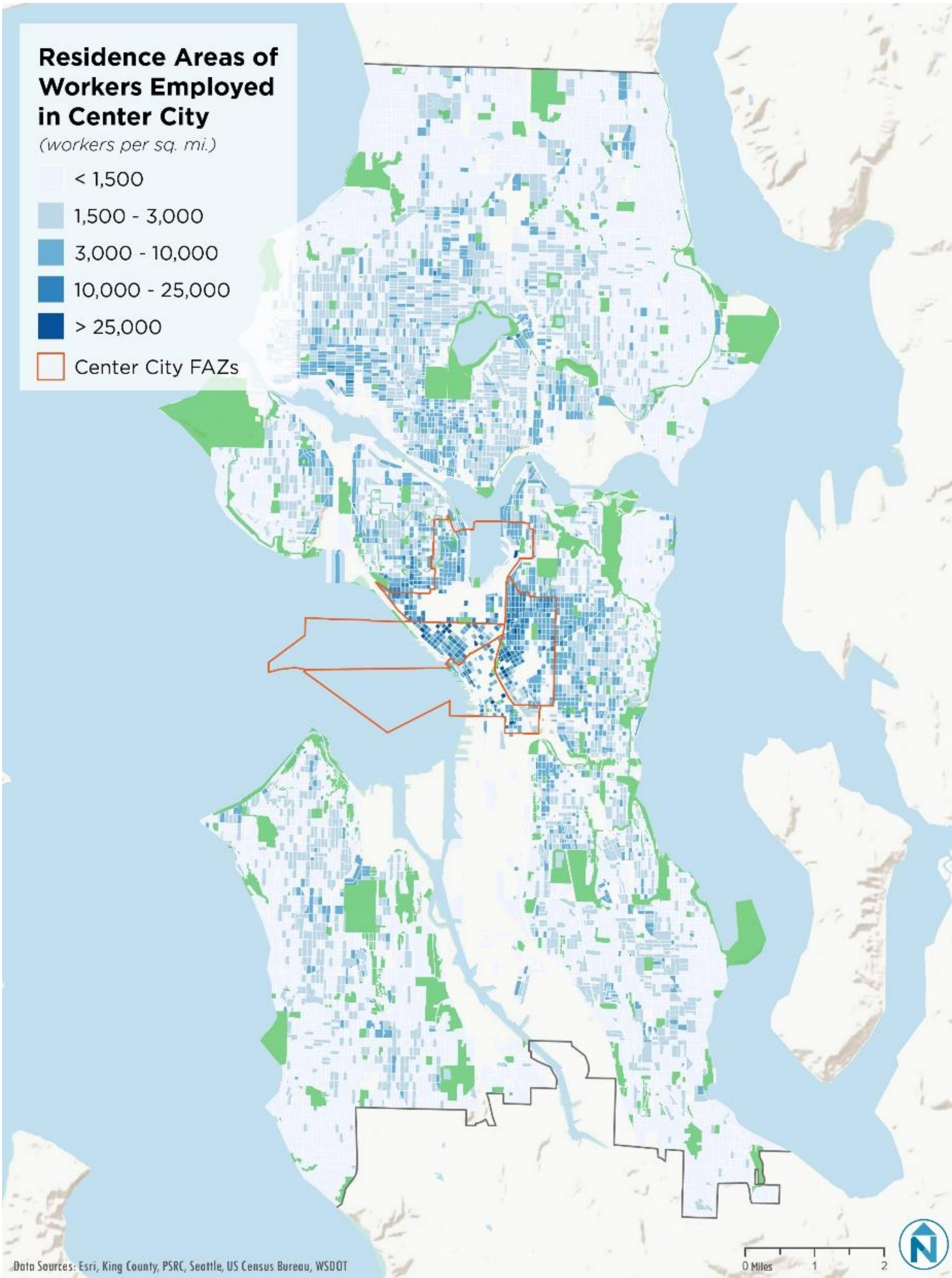


Figure 4 Average Annual Weekday Traffic on Seattle and Area Roadways

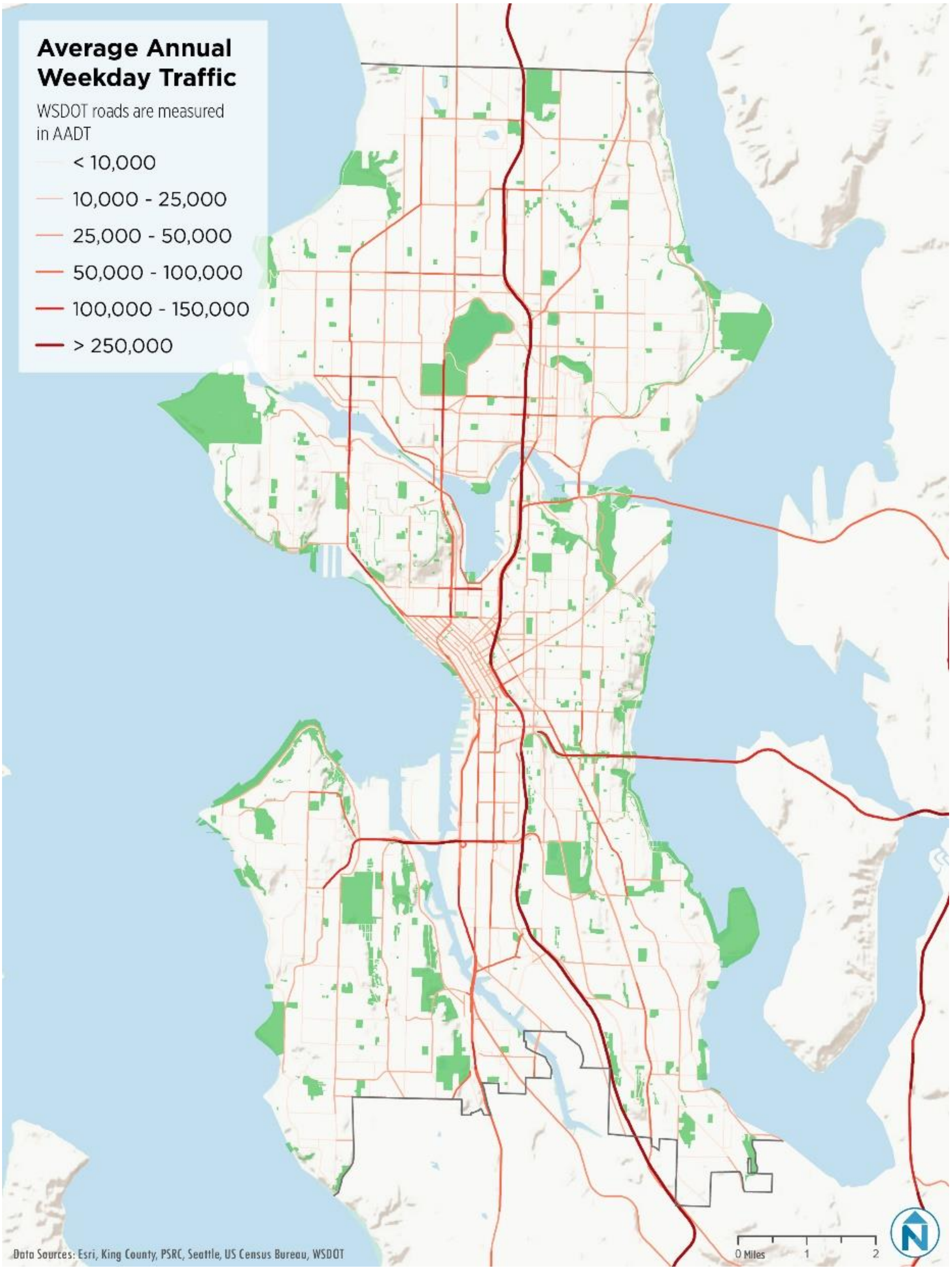
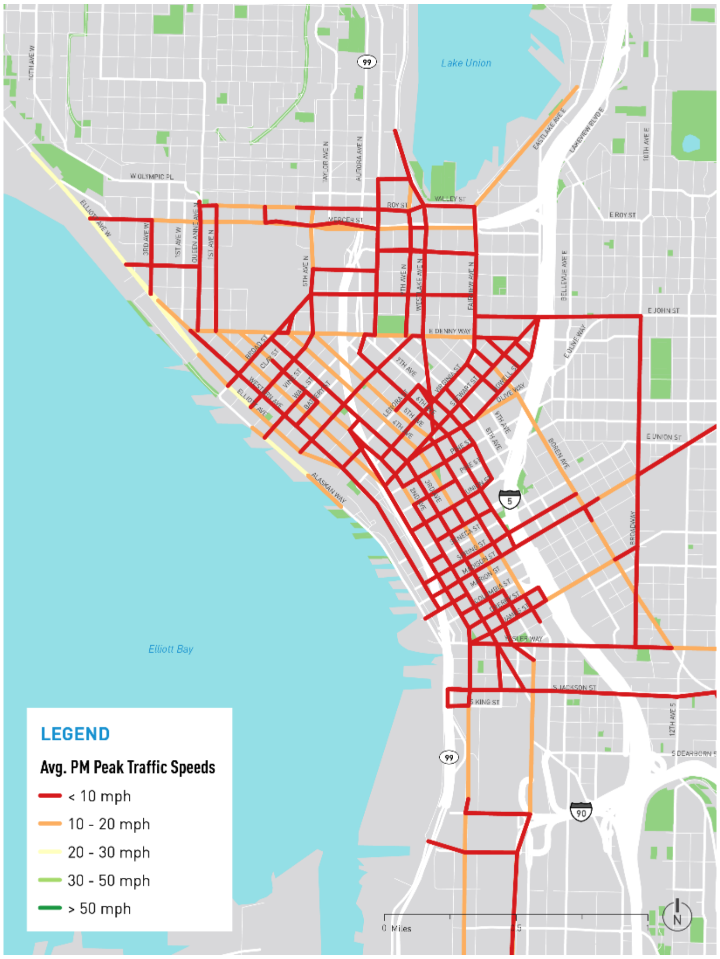


Figure 5 Average PM Peak Travel Speeds



Source: Acyclica. These data collected for the first week of each month in 2018. 4:00 PM to 7:00 PM period only. Available data for straightline segments corresponding with existing street network are shown.

Public Transportation Access

While the region's public transportation network is also heavily oriented toward Seattle's center city, with significant amounts of weekday peak-period commuter service from throughout the region into (or out of) downtown, there are areas of opportunity for better connections to center city employment and activities, especially in terms of creating a more equitable system.

Figure 6 shows low-income household density in Seattle, overlaid with the existing and future frequent transit network. Most areas with a higher density of low-income households have access to frequent transit service, though some gaps remain. An interesting comparison is provided by Figure 7, which shows density of zero-vehicle households in Seattle (again with the frequent transit network overlay). This figure suggests that low-income households are not a proxy for zero-vehicle households, with many higher density areas of low-income households having lower zero-vehicle rates. Zero-vehicle households appear to be more closely associated with proximity to the center city and the University of Washington, areas that have both priced and/or limited parking options and abundant transit service. This is relevant to the evaluation of congestion pricing impacts and benefits because it suggests that low-income residents to the north and south of downtown Seattle may own vehicles out of necessity and therefore may experience greater negative impacts due to the pricing of roadways or vehicle use.

Figure 6 Low-Income Households and Frequent Transit Network in Seattle

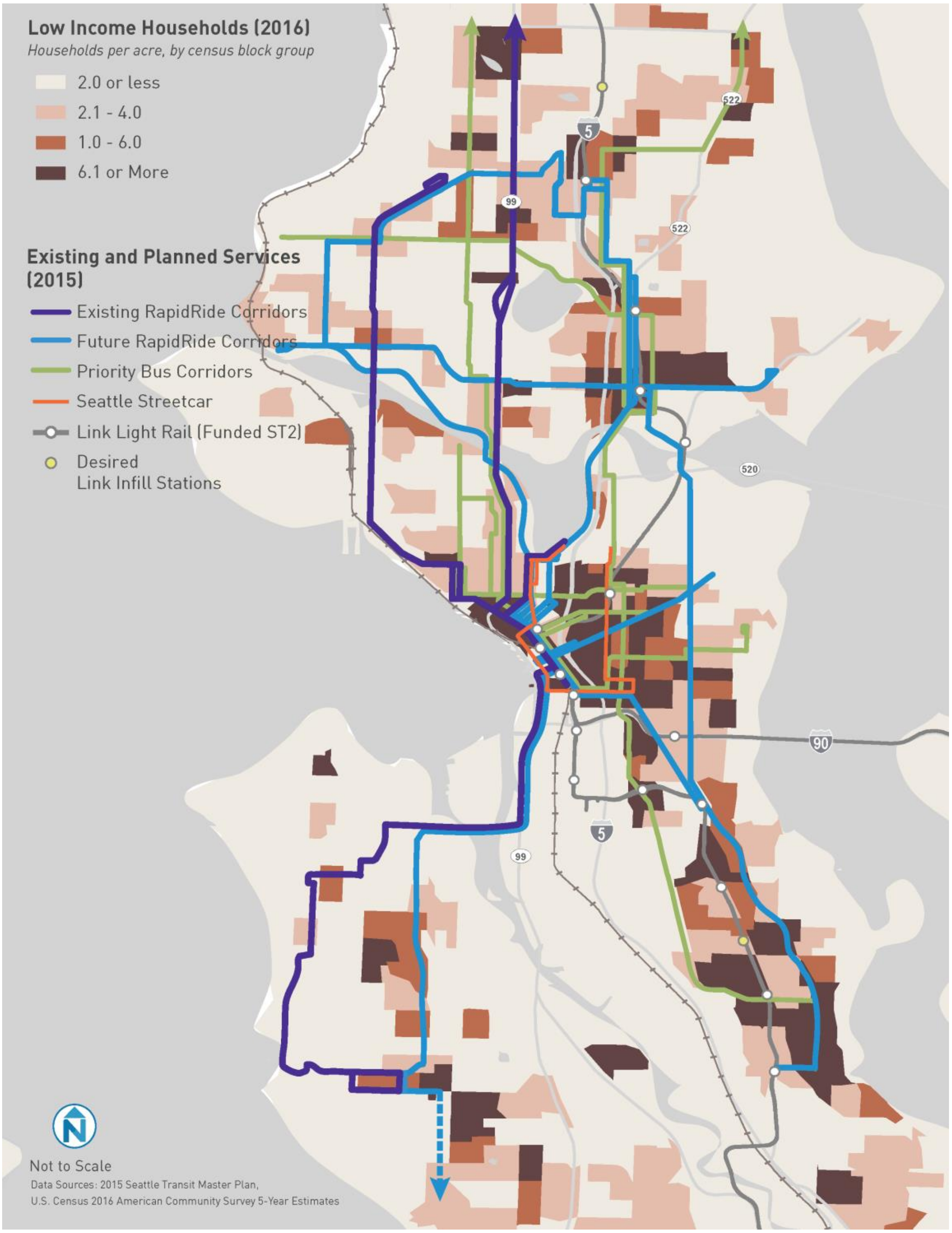
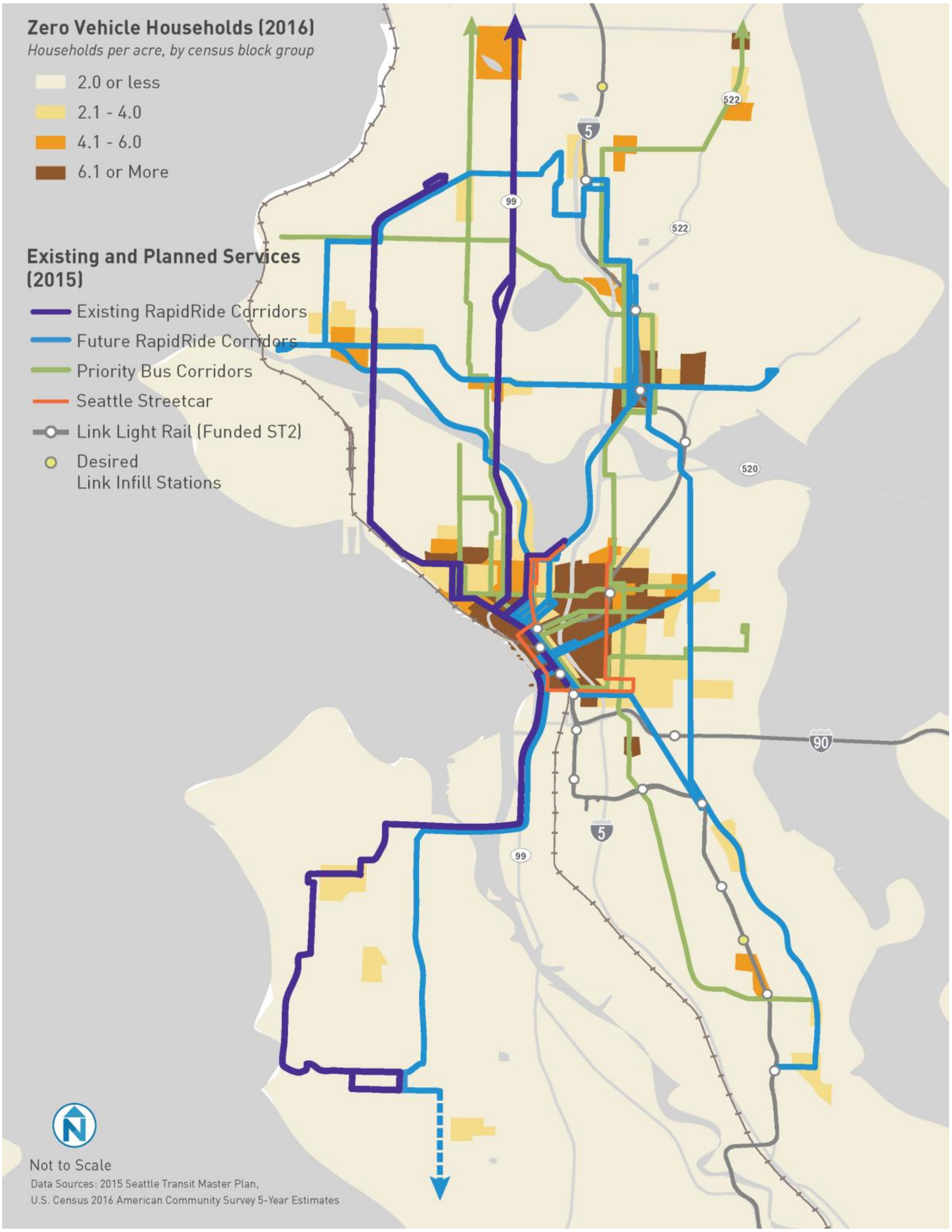


Figure 7 Zero-Vehicle Households and Frequent Transit Network in Seattle



TRANSPORTATION EQUITY AND TRANSPORTATION COSTS

As discussed in the Pricing and Equity White Paper, historical transportation policies and investments have helped to create and uphold racial and social inequalities by favoring those with the resources to own and operate private vehicles. The City of Seattle is considering congestion pricing as a tool to help address climate change, and also as a tool that can help to make the transportation system more equitable by using new revenues to provide people with additional options other than driving alone (such as improved transit service). This study comes in the wake of successful efforts by the City and region to improve transit access, including:

- **Seattle Transportation Benefit District:** In 2014, Seattle voters chose to fund additional transit service and other transit programs in Seattle, contributing to increased transit service and higher transit ridership throughout the city.
- **ORCA LIFT and ORCA Opportunity Programs:** In 2015, King County Metro, Sound Transit, and other regional transit providers implemented a low-income fare rate available on the regional fare card, One Regional Card for All (ORCA), called ORCA LIFT. The program offers reduced fares for people whose household income is less than double the federal poverty level. Seattle also implemented the ORCA Opportunity program (formerly Youth ORCA program) to provide free ORCA passes to high school students at Seattle Public Schools.

In addition, Seattle is a leader in using parking pricing to internalize some of the private costs of transportation. Seattle's employer commute trip reduction efforts have led to a 10% decrease in drive-alone mode share and corresponding increases in transit and active commute modes to center city jobs between 2010 and 2017.[2] The citywide drive alone rate has decreased by 5% over the same period.

The evaluation of congestion pricing tools continues Seattle's efforts to create a more equitable transportation system. The Pricing and Equity White Paper recommends approaches that can be taken to ensure that community voices are included in the discussion, with a goal that any recommended congestion pricing program improve rather than exacerbate inequalities in the transportation system.

LESSONS FROM LOCAL AND INTERNATIONAL MOBILITY PRICING EFFORTS

This white paper does not provide a full evaluation of lessons learned from other cities' mobility pricing studies and programs; rather, it identifies high-level evaluation methodologies used elsewhere to inform SDOT's understanding of potential impacts and benefits of various pricing programs. A key finding of this best practices scan indicates that when cities and regions have evaluated potential congestion pricing impacts and benefits, they have conducted and documented their evaluation using resource-intensive modeling of well-defined pricing programs. Other findings relevant to this phase of Seattle's evaluation are presented below.

The Washington State Department of Transportation (WSDOT) will collect a toll on vehicles traveling through the SR 99 tunnel in downtown Seattle beginning in summer 2019. WSDOT conducted a tolling study to determine toll rates and impacts of the newly-tolled facility, which is useful for this Congestion Pricing Study analysis. The WSDOT tolling analysis focused on achieving two goals: 1) minimize diversion and 2) meet the minimum revenue target. Income was considered in the diversion rate, which assumed that lower-income drivers would be more price-sensitive and likely to change behaviors to avoid a toll. A

[2] 2017 Center City Commuter Mode Split Survey Results

pricing program on downtown roads could mean that low-income drivers would have few or no alternative to priced routes.

Vancouver, BC conducted a high-level screening of pricing tools that reflected the goals and objectives that the region determined should be achieved by a mobility pricing program. The high-level screening approach discussed in the next section is based on Vancouver's example.

For additional lessons learned from mobility pricing efforts in other areas of the country and world, refer to the Pricing Tools, Equity and Pricing, and Communications Best Practices White Papers.

PRICING TOOLS SCREENING APPROACH AND OUTCOME

The project team identified 11 potential pricing strategies for Seattle to consider as part of a congestion pricing program. These were screened through a simple process designed to prioritize the most promising congestion pricing strategies for further study and refinement. The screening was informed by a set of focus areas and preliminary desired outcomes, the six key steps to pricing referenced in the companion Pricing and Equity White Paper, and implementation considerations.

Through the screening process, four pricing tools were recommended for further analysis. These tools are:

- **Cordon pricing:** Charge vehicles crossing the boundary into a designated zone
- **Area pricing:** Charge vehicles both crossing the boundary and driving within a designated zone
- **Fleet pricing:** Apply targeted pricing to specific vehicle types, such as ride-hailing fleets or commercial vehicles; this can be applied within a designated zone or citywide
- **Road user charge (RUC):** Charge all vehicles for use of the roadway OR restrict access to a zone to vehicle enrolled in a RUC program

The Pricing Tools: Review and Preliminary Screening White Paper describes the tools and screening process in greater detail.

HIGH-LEVEL IMPACTS AND BENEFITS ANALYSIS

This high-level impacts and benefits analysis uses readily available data to evaluate the potential impacts any of these four tools might have on different groups currently using the system. It also informs an understanding of the additional data needed to complete further analysis. Area pricing is the congestion pricing tool used for this analysis. In the absence of well-defined pricing strategies (including specific geography, time, and fee schedule), area pricing serves as a proxy for both cordon pricing and a road user charge; both likely would include a charge for vehicles using a zone similar to the one assumed for area pricing in the following analyses.

Area Pricing: Impacts to Vehicle Trip-Makers

This section describes the findings from a preliminary evaluation of impacts of an area-based congestion pricing program on those making vehicle trips that would be affected by the pricing program. The analysis uses two publicly-available datasets and two similar pricing structure assumptions to estimate the impacts of such a program on people of color and low-income populations in Seattle, the Puget Sound region (defined as the four counties that are members of the Puget Sound Regional Council: King, Pierce, Snohomish, and Kitsap), and Washington state.

To reflect our focus on equity and concern for priority populations, the analysis uses existing data on workers who drive in the region to estimate the percent of drivers that might be affected by a potential downtown area pricing program in two categories: income and race. Because the details of a potential pricing program are not yet defined—meaning both a pricing structure and exemptions—it is not yet possible to estimate the magnitude of the impact that a particular driver or group of drivers might face. Rather, this initial analysis indicates only the relative numbers of people in different categories who might experience the pricing program.

The primary findings of the analysis are:

- Auto trip-makers who are people of color may be disproportionately affected by a congestion pricing program.
- Lower-earning auto trip-makers are likely to be disproportionately affected by a congestion pricing program.

The results of these analyses suggest that a zone-based congestion pricing program could have some inequitable impacts to people of color and lower-income people, but the magnitude of the impacts is not yet known.

Methods

This equity analysis uses two primary sources of data:

- 2016 Five-Year American Community Survey (ACS)
- 2015 Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics (LODES)

LODES and ACS data are used to estimate quantities and qualities of workers living or working in a potentially priced zone, which proxies as a measure of commute trips. The PSRC Household Travel Survey was not used for this analysis due to small sample sizes. The potentially priced zone used in this analysis focuses on the general downtown Seattle area. This area was selected to increase sample sizes and produce conservative analyses that err on the side of over-estimating priced trips.

The analysis used 2015 LODES data (which consist of home-workplace pairs for jobs at the Census block level) to estimate commute travel affected by a potential congestion pricing program. These data include a far greater sample size (nearly all jobs[3]) than the PSRC travel survey data, but the analysis relies on the assumption that workers travel from their home to their workplace as a commute. Other assumptions inherent to a LODES-based analysis include:

- Workplaces in the data represent the physical location of the workers' employment activities (workers may, for example, have an office in Seattle but work in Bellevue)
- Current spatial patterns of employment are similar to those reported in 2015
- Workers live at their reported address (workers may, for example, have their permanent residence in Ellensburg but stay with family in Seattle during the work week)[4]
- Workers commute during times of the day that a pricing program would be active

To determine which workers would be affected by an area-based congestion pricing program, those with workplaces or residences located within the potential pricing zone were first flagged as potentially priced. ACS data was then used to find the percentage of commuters traveling to work in a car, truck, or van (variable B08006_002) in each Census tract. Each block was then assigned this percentage to produce a number of workers that would be affected by pricing.

---

[3] LODES data include all unemployment insurance-covered jobs and many federal government jobs. Job types that are not included are FBI, DEA, ATF, Secret Service, USPS, CIA, and others. For a more complete list of job types that are not included, see <https://lehd.ces.census.gov/doc/help/onthemap/FederalEmploymentInOnTheMap.pdf>

[4] This analysis does not include workers that live outside the state of Washington.

Jobs in LODES data are included in one of three distinct monthly earning categories: less than $1,250, $1,250 to $3,333, and greater than $3,333. This categorization was used to estimate the difference in impacts on various worker income groups. ACS data for drive-alone commute rates by race/ethnicity in each census tract[5] (variable B08105A_002) were then applied to the priced trips from each block to determine the difference in impacts on various groups. All racial/ethnic groups other than "white alone" were considered people of color for this analysis.

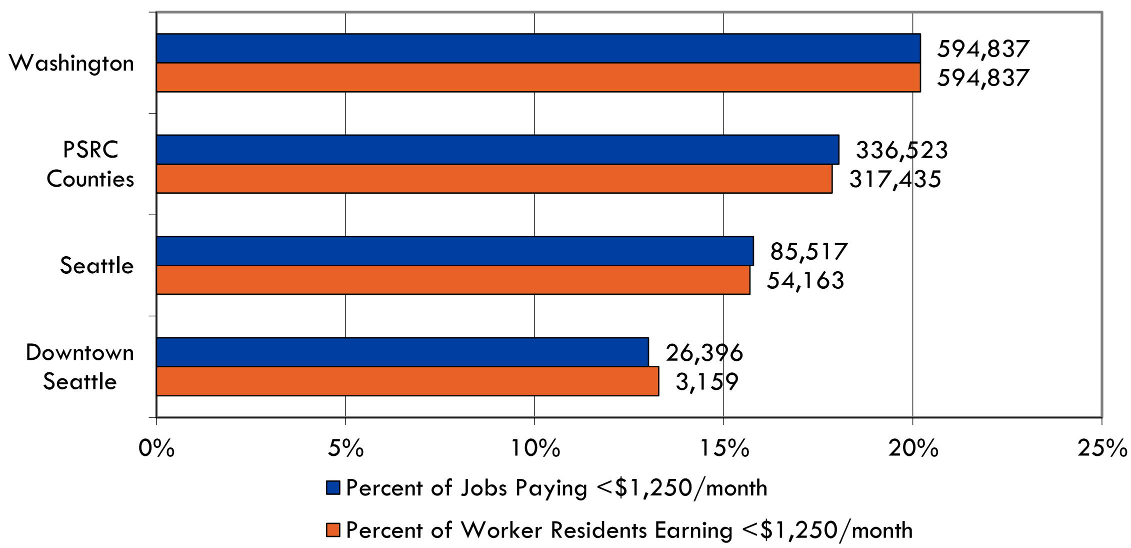
LODES data were also used to produce simple estimates of the types of jobs in the potential pricing zone relative to other geographies.

Results

This section presents the results of the analysis described above. As context, Figure 8 and Figure 9 show relevant percentages of lower- and higher-earning employment by geography. These percentages, which are based on LODES data, show that as the geography narrows to the potentially priced zone (labeled "Downtown Seattle" on charts), the percentage of higher-earning jobs and worker-residents increases, while the percentage of lower-earning jobs and worker-residents decreases. This suggests that, at a very broad level, an area-based pricing program focused on downtown Seattle would capture a larger number of trips made by higher-earning workers.

In both figures, the *n*= data labels indicate the number of jobs or worker-residents.

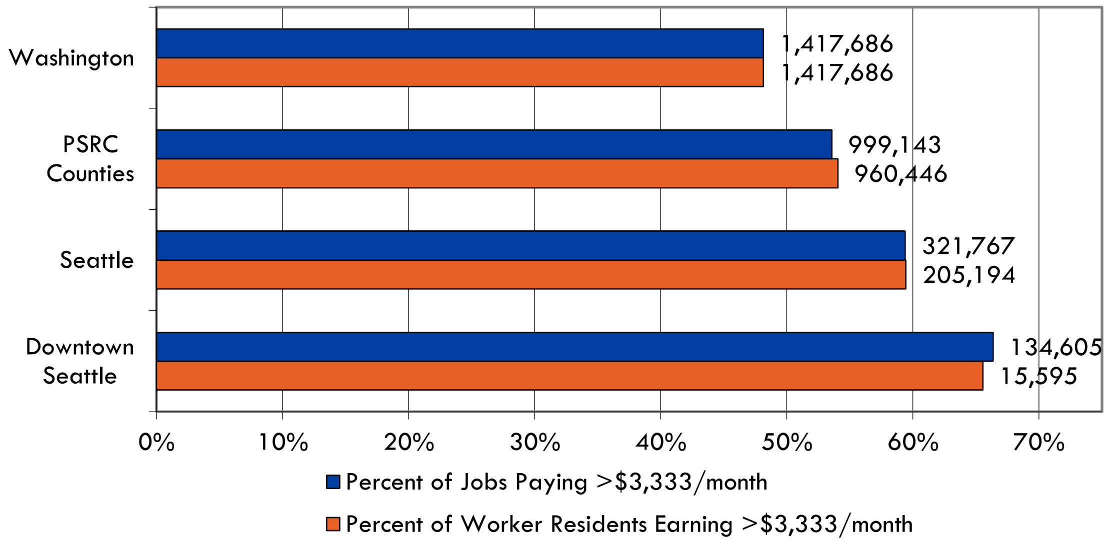
Figure 8 Lower-Earning Employment by Geography[6]



[5] ACS data were collected at the tract level and assumed to be spatially consistent across all internal blocks because ACS data at the block group level have far larger margins of errors.

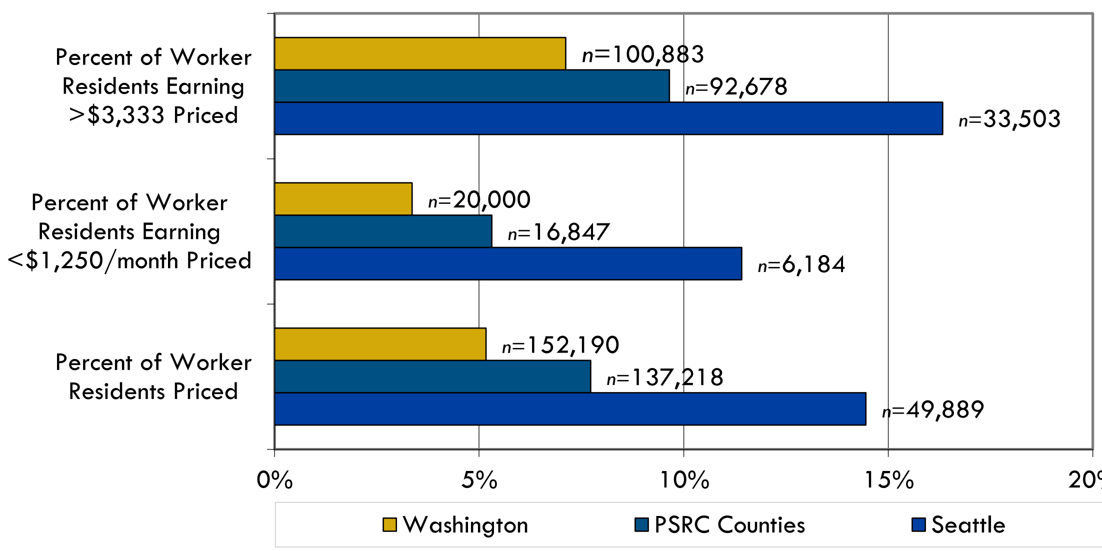
[6] PSRC counties are King, Kitsap, Pierce, and Snohomish counties.

Figure 9 Higher-Earning Employment by Geography



The results presented in Figure 10 show that, across all tested geographies, higher-earning worker residents are more likely to be impacted by a congestion pricing system.

Figure 10 Percentages of Priced Worker Resident Earning Types by Geography

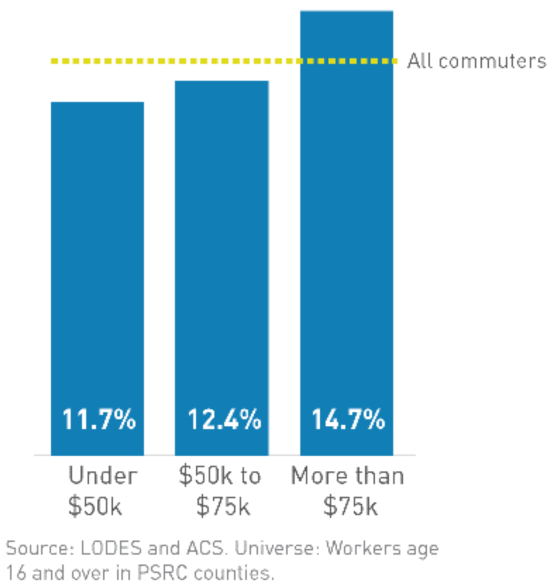


Across the PSRC region, we looked at drivers and people who carpool to work (over 16 years of age). Assuming a downtown Seattle area pricing program, we identified the people who work or live within that boundary, as well as those who both live and work within that boundary. That group of people is approximately 13% of the regional drivers/carpoolers to work.

Figure 11 shows that—of the 13% of drivers who would be impacted by a potential downtown area pricing program—people earning above $75,000 per year are more likely to be affected than people making less than $50,000 per year.

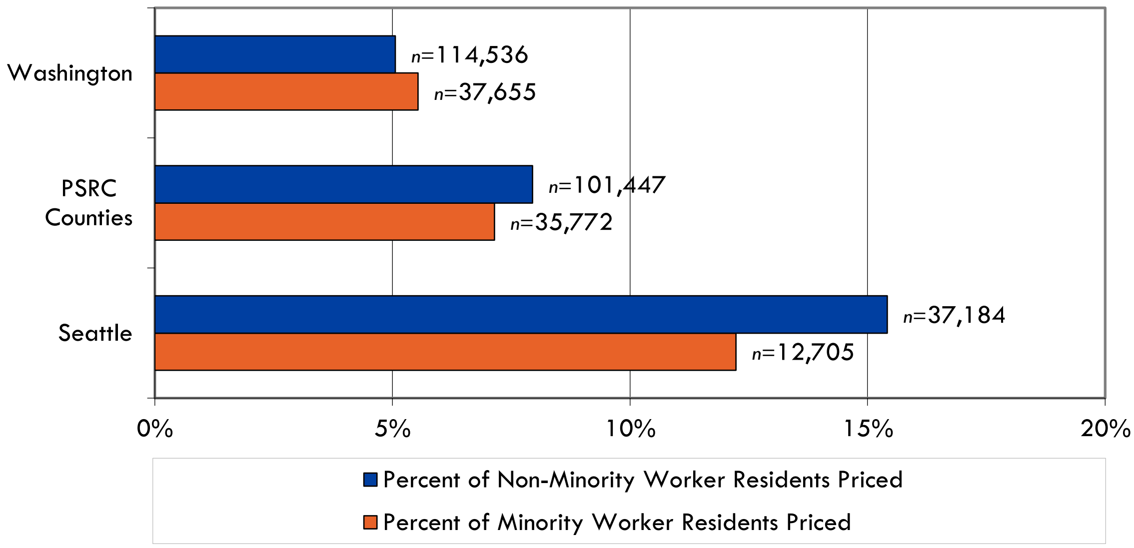
This does not, however, reflect the magnitude of impact; it indicates only the percentage impacted within each group. These results reflect the fact that this initial analysis includes only jobs within downtown Seattle and only people who drive to those jobs. It does not include people who may drive through downtown to get to a job elsewhere in the region. The added cost of parking downtown may deter some lower-income workers who drive, and affect transportation costs for those who do. A pricing program designed with a focus on equity could include discounts or other program features to ensure that there is not a disproportionate impact on lower-income populations.

Figure 11 Percent of Drivers (Commute Trips Only) Impacted by Pricing, by Income



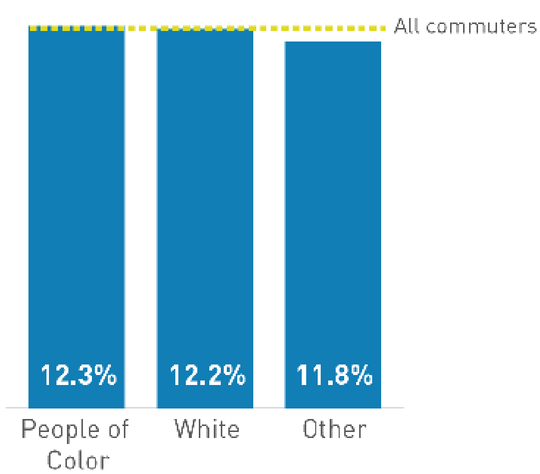
The results presented in Figure 12 indicate that white workers living in Seattle and PSRC counties are more likely to be charged by a congestion pricing system than non-white worker residents. At the state level, people of color worker residents are more likely than white worker residents to be charged.

Figure 12 Percentages of Priced Worker Resident Race/Ethnicity Types by Geography



Within the 13% of regional drivers who would be impacted by a potential downtown pricing program, we then looked at the percentage of people in various demographic groups. Although these 13% of commuters include many fewer people of color than white people, we normalized the data by total regional demographic population to most accurately reflect the likely impact on each group. The analysis shows that approximately the same percentage of people of color and white people would be impacted by a potential downtown area pricing program. The percentages for both groups are similar to the overall percent of the population that would be impacted. A pricing program must be designed to address potential disparate impacts and advance equity.

Figure 13 Percent of Drivers (Commute Trips Only) Impacted by Pricing, by Race



Source: LODES and ACS. Universe: Workers age 16 and over in PSRC counties.

Area Pricing: Impacts to Transit Riders and Service

This section summarizes the results of a high-level analysis of the potential impacts and benefits of area pricing on transit riders and service. The primary findings of the analysis are:

- Both transit riders and operators could see significant benefits from an area pricing program in Seattle.
- Savings in transit travel time could fund additional transit service and accommodate some of the additional demand generated with implementation of a congestion pricing program.

Methods

This analysis estimated cumulative travel time savings for transit riders and transit operators in the presence of an area pricing program. To calculate the time savings for transit riders, the following equation was used:

Cumulative time saved (person minutes)	=	Transit vehicle trips	x	Travel time savings (minutes/trip)	x	Average vehicle load (people/vehicle)

The assumptions for each element of the equation are as follows:

- **Transit Vehicle Trips:** Transit vehicle trips include fixed-route bus service that travels through or within the potentially priced area. The analysis uses the number of trips operated by King County Metro (Metro), Sound Transit, and Community Transit in October 2018 during the weekday afternoon peak hour (4:30-5:30 PM). Three potential peak hours of service were evaluated; this hour was selected because it includes the greatest volume of transit trips starting or ending in the potentially priced area, compared to 4:00-5:00 PM and 5:00-6:00 PM.
- **Travel Time Savings:** Transit trips take an average of 37 minutes[7] to traverse the assumed pricing zone from north to south during the weekday PM peak hour. Based on travel time savings observed in cities with congestion pricing programs in place, an estimate of 15% travel time savings, or six minutes, was assumed for transit trips included in the analysis.
- **Average Vehicle Load:** To calculate average vehicle load, the project team used an assumed mix of current fleet types and capacities:

Vehicle type	50% of standing + seated capacity	Assumed proportion of fleet
40’ standard coach	38.0	45%
60’ articulated coach	56.5	45%
Double–decker coach	48.5	10%
Average vehicle load	48.0	

The average vehicle load is a composite of the fleet makeup and an assumption that vehicles are carrying half of their standing plus seated capacity while in the priced zone. The load value is based on the assumption that most vehicles start empty when they begin their trip in or near the edge of the potentially priced area. By the time they leave the area, most vehicles are at or near capacity during the PM peak hour. It is assumed that passenger boardings are distributed evenly through the priced zone and reach their maximum loads just prior to departing the zone. Thus,

[7] Google Maps Navigation estimates 26-48 minutes (average: 37 minutes) for a transit vehicle to cross Seattle's Center City by transit, north to south, when departing on a weekday (Monday, 10/8/2018) during transit's PM peak hour (4:45 PM). This trip time reflects both a base time for a bus to cross the Center City, and additional time due to daily traffic delay.

the average load during the trip through the zone is half of the average vehicle's (standing plus seated) capacity, or about 48 people.

Transit vehicle time savings is calculated using a similar equation, leaving out vehicle loads.

Cumulative time saved (vehicle minutes)	=	Transit vehicle trips	x	Travel time savings (minutes/trip)

Results

Using these equations and converting minutes to hours, the daily (weekday) travel time savings for transit riders and transit vehicles during the PM peak hour are shown in Figure 14. The daily person-hour savings are equivalent to about 1.25 full-time employees' hours for a year. The transit vehicle hours saved could equate to a significant upgrade in service to one or more transit routes. For example (and depending on vehicle and operator availability), the potential savings is equivalent to 55 one-way trips that take one hour to complete. This could be five new PM peak trips on 11 routes, or enough capacity to carry more than 5,200 additional riders during the PM peak hour.

Figure 14 Estimated Weekday Hours of Transit Travel Time Saved with PM Peak Hour Area Pricing

Units	Daily hours saved
Person hours	2,592
Transit vehicle hours	55

Demographic and other characteristics of Metro riders, who represent the majority of riders in this analysis, are presented in Figure 15. Overall, these riders are fairly representative of King County residents. Notable differences include age, region of residence, and vehicle ownership. A greater percentage of Metro riders are likely in the 55+ age category than the county population; however, the Metro rider survey only includes respondents 16 years of age or older, so the age group proportions cannot be directly compared.

Metro riders tend to be more concentrated in Seattle and North King County (64% of Metro riders compared with 34% of King County residents), with fewer living in East and South King County compared to the county population as a whole. Metro riders are also more likely to live in households without a vehicle than King County residents overall. Metro riders are fairly representative of the King County population in terms of race and household income.

Figure 15 King County Metro Rider[8] and King County Resident[9] Demographic Characteristics

Characteristic	Attribute	KCM Riders	King County
Gender	Male	48%	50%
	Female	52%	50%
Age	0-16	NA	21%
	16-17	3%	
	18-34	25%	26%
	35-54	34%	29%
	55+	38%	25%
Region of Residence	Seattle / North King County	64%	34%
	South King County	19%	38%
	East King County	17%	28%
Race/Ethnicity	White	69%	67%
	Black or African-American	5%	6%
	American Indian or Alaskan Native	1%	1%
	Asian or Pacific Islander	17%	17%
	Multi-race	1%	6%
	Hispanic	5%	9%
	Other	0%	NA
Vehicle/Driver Information	Valid driver license	84%	NA
	Household owns a vehicle	76%	90%
	Vehicle for personal use	93%	NA
Annual Household Income	<$35,000	25%	22%
	$35,000 - $100,000	34%	39%
	>$100,000	32%	39%
Disability	Yes	14%	10%
	No	86%	90%

Because certain demographic groups are overrepresented among Metro's ridership, travel time transit time savings will likely accrue to these groups. Because the sources of data for Metro's ridership and King County's population are samples, it cannot be said with a high degree of confidence that difference of a few percentage points between populations represents a real-world difference. For gaps that are more than a few percentage points, it may be more likely that these groups will receive benefits from transit travel time savings.

[8] King County Metro 2016 Rider Survey Report

[9] U.S. Census Bureau, 2016 American Community Survey Five-Year Estimates

It is likely that, among King County residents, older people will disproportionately benefit from transit travel time savings, along with those living in Seattle and North King County. King County residents who do not own a car will also likely disproportionately benefit from transit travel time savings. Residents with a disability will likely disproportionately benefit.

Demographic groups living in King County that will disproportionately not receive benefit are likely to be Hispanic/Latino people, people identifying as multi-racial, and high-earning households.

Comparing Transit and Auto Travel Time

To assess existing transit service to Seattle's Center City area, a comparison of transit- and auto-based travel was conducted for each census block group in all four PSRC counties. This analysis was conducted using the Google Directions API, which was called to return a travel time between the centroid[10] of each block group and five destinations in the center city area. These five destinations were selected to balance geographic distribution of destinations with major activity centers:

- Occidental Square
- Columbia Tower
- Washington State Convention Center
- Space Needle
- Westlake Avenue N at Harrison Street

Both transit and auto mode API calls were given parameters instructing their trips to arrive as close to 8:45 AM as possible on a Wednesday. (This arrival time was selected because morning peak travel times are generally more "peaked" than afternoon peak times.) The five travel times (one for each destination) by auto and transit to each of the Center City destinations were then averaged to produce a mean transit travel time and mean auto travel time to Center City Seattle from each census block group. These mean transit and auto travel times were then used to produce total travel time difference in minutes and percent difference in travel time per census block group.

The significant shortcoming of this analysis is the lack of trips that are chained using non-walking and transit modes. Although the Google Directions API does incorporate walking into transit trips up to a certain distance, it does not incorporate parking or walking from a parked car into the drive-time analysis. Google Directions API also does not allow for theoretical trip-takers to drive or walk—say, to a park-and-ride—to transit. This means that park-and-ride drivesheds, amongst other multimodal trips, are not included in the transit trips modeled for this analysis. For all block groups where transit trips were not possible, no travel time comparison was calculated.

Figure 16 shows the absolute difference in travel time (in minutes) for AM peak hour trips to the center city made via transit and auto. Figure 17 shows the same difference, symbolized as a percent.

---

[10] The US Census Bureau's standard INTPTLAT and INTPTLON fields were used in lieu of centroids; they are similar and are generally located outside of GIS water polygons.

Figure 16 Transit Time vs. Driving Time to Center City During AM Peak Hour - Total Difference

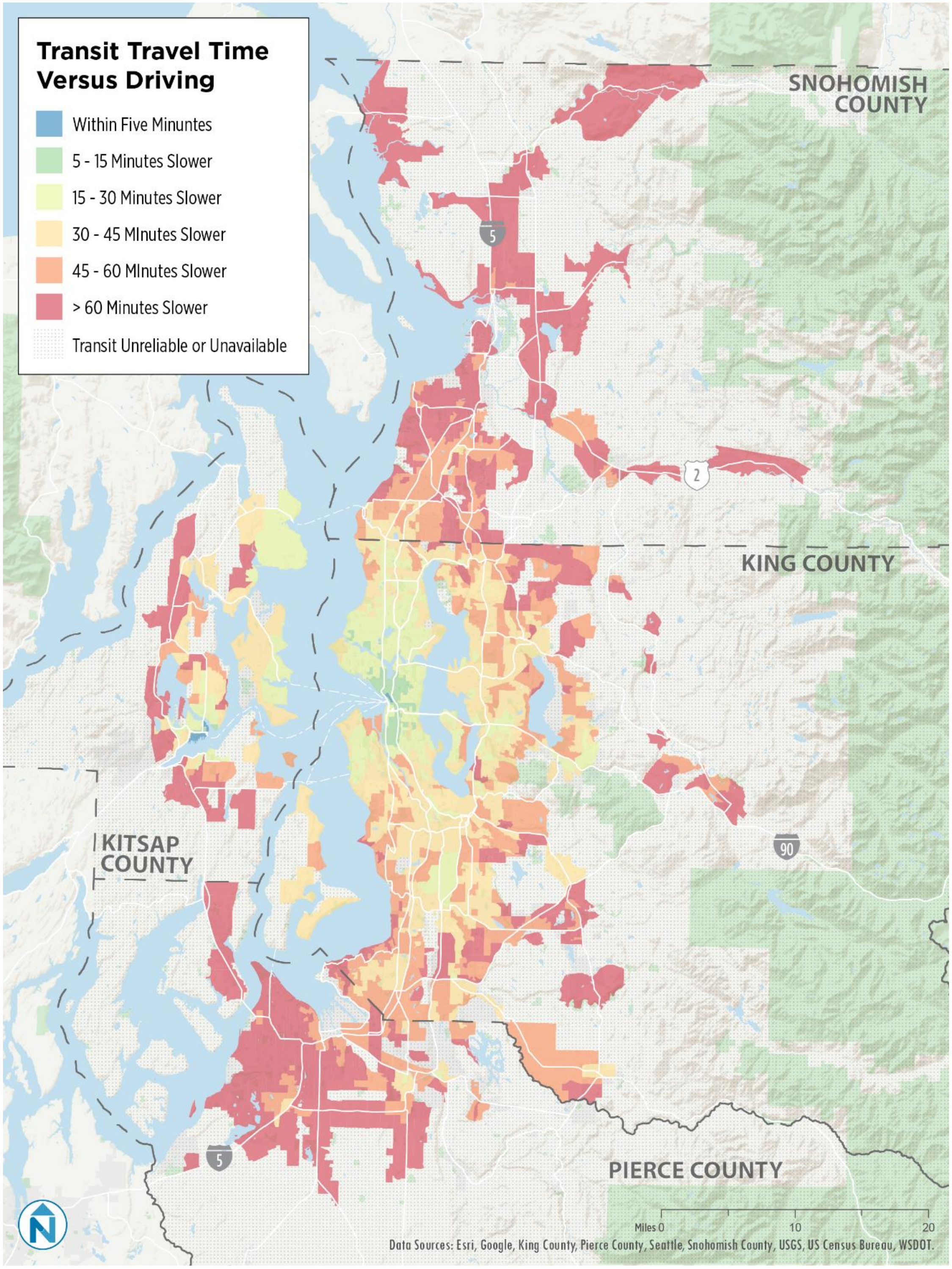
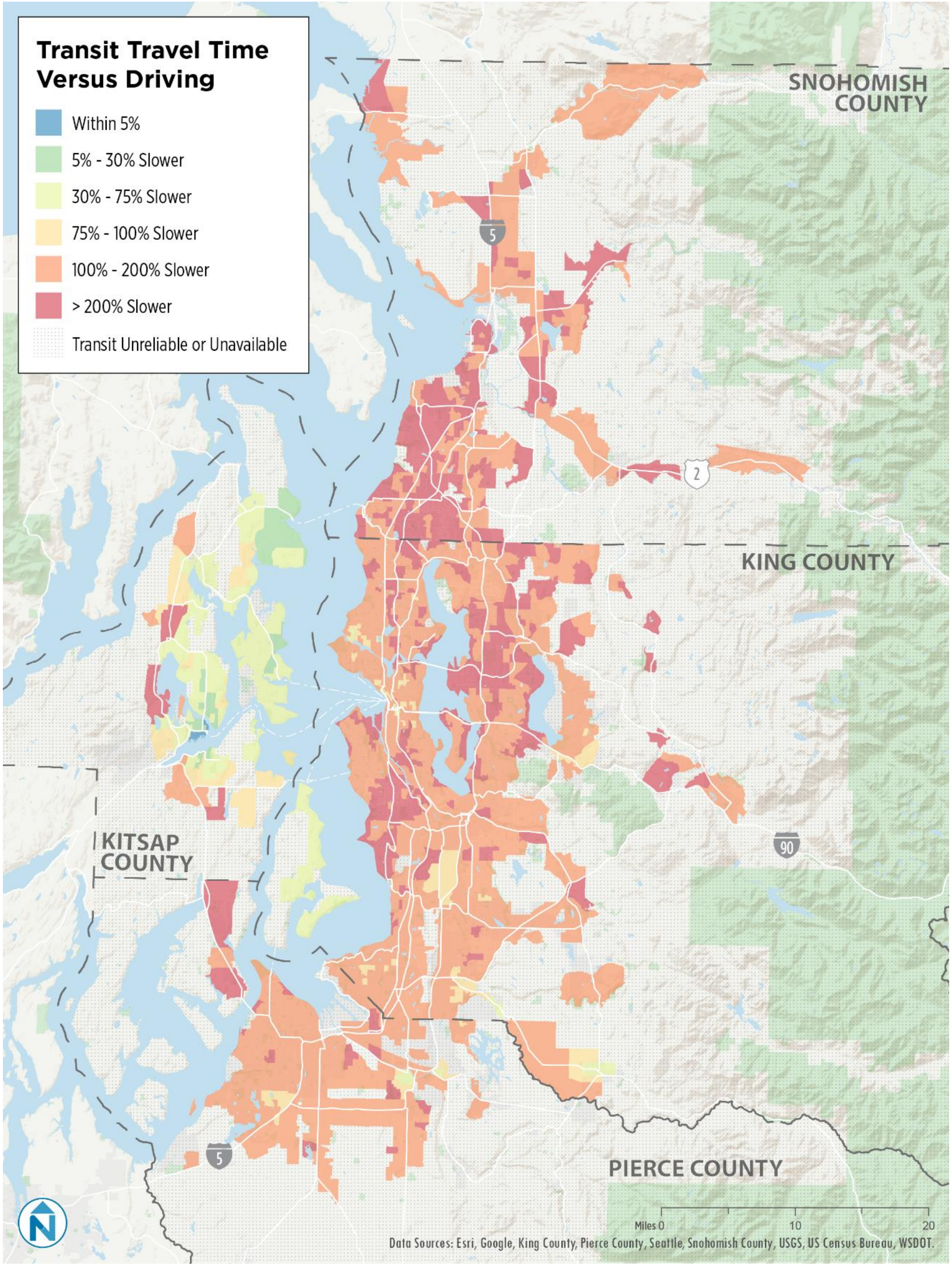


Figure 17 Transit Time vs. Driving Time to Center City During AM Peak Hour - Percent Difference



In both representations of travel time difference, the only areas where transit is currently time-competitive with driving to the Center City are the Center City itself and Bremerton, which is served by both the Kitsap Fast Ferry and the Washington State Ferry. Areas where transit travel is nearly time-competitive with auto travel are eastern portions of the Kitsap Peninsula, the City of Seattle, Issaquah Highlands, Kent, Puyallup, Sumner, and Lakewood. Elsewhere, driving to Center City Seattle in the AM peak is considerably faster than transit. A potential congestion pricing program could decrease transit travel times and increase the competitiveness of this option for people throughout the region.

Fleet Pricing

The impacts and benefits of a congestion-reducing fleet pricing program would be highly dependent on the times, locations, and levels of pricing. The largely proprietary nature of data on fleet vehicle behavior makes it difficult to tailor these parameters to potential pricing program goals. This portion of the white paper explains data needs, discusses potential parameter definitions, and outlines a theoretical understanding of likely impacts and benefits.

To produce a thorough impacts and benefits analysis of a fleet pricing program—which would follow sequentially—the following variables must be addressed:

- Data availability for fleet vehicles in Seattle
- Definition of fleet vehicles for congestion pricing purposes
- Identification of applicable pricing tactics
- Assessing pricing-relevant technologies of fleet vehicles
- Planning data collection for iterative implementation

Baseline Fleet Data

The foundation for successful fleet pricing is data that provide an accurate understanding of baseline fleet conditions. At a minimum, it is imperative to have a rough understanding of how many vehicles of each type are operating within a potential pricing zone. At present, SDOT has access to at least two datasets that could be used to assess baseline fleet conditions: Teralytics mobile phone data and aggregated TNC origin-destination data. These data will be available for modeling and analysis in a future phase of work.

Defining Fleet Vehicles

Perhaps the most essential parameter a fleet pricing program must define is what constitutes a “fleet vehicle.” Potential categories/definitions of fleet vehicle are:

- Ride-hailing vehicles (e-hailing and/or street-hailing type)
- First-mile/last-mile delivery vehicles (trucks, vans, and/or personal vehicles)
- Tour vans and buses
- Heavy trucks (and/or other high-emissions vehicles)
- Vehicles operated by entities with more than *x number* of registered vehicles
- Vehicles owned by a incorporated entity, as opposed to an individual

Beyond these definitions, vehicles can be targeted according to their relative emissions, size, or congestion production. Without a rough understanding of current vehicle type shares and volumes in Seattle, it is difficult to align congestion pricing goals with proposed fleet pricing parameter definitions.

However, there has been robust enough evaluation of existing congestion pricing programs to support a discussion of the generalized theoretical understanding of fleet pricing impacts.

- **Ride-hailing vehicles** (and particularly e-hailing vehicles) have been widely implicated as a major contributor to increased congestion in a number of U.S. cities.[11,12,13,14,15] Pricing e-hailing vehicles, which typically operate as a *de facto* fleet, could reduce their overall vehicle miles traveled (VMT).

  An analysis conducted on taxi use in New York City found that for-hire passengers are less sensitive to price increases than other road users, suggesting that only a significant charge would be effective in reducing ride-hail VMT. One examination of pricing ride-hailing vehicles in New York City concluded that a per-hour charge would be most effective,[16] while the New York City Council recently capped the number of e-hailing vehicles allowed to operate in the city.[17] New York City implemented a charge on for-hire vehicles in early 2019.

  Pricing e-hailing vehicles may be a sound tactic, as Uber has publicly supported a congestion pricing program in Seattle.[18] Uber CEO Dara Khosrowshahi recently wrote: "One policy we plan to put our energy behind is congestion pricing, which is viewed by urban planners, transit advocates, and academics as the single best way to ease the road congestion that is choking many cities across the globe. We're ready to do our part to help cities that want to put in place smart policies to tackle congestion—even if that means paying money out of our own pocket to pass a tax on our core business."[19]

- **First-mile/last-mile delivery vehicles,** such as those used by Amazon, FedEx and UPS, wholesale distributors, and other goods deliverers, likely cause congestion disproportionate to their VMT because of typical delivery behaviors (including reversing to loading docks, double-parking, cruising for load zones, and slow travel). In New York City, it was recommended that these vehicles be priced at 2.2 times the rate of personal vehicles due to their outsized impact on congestion.[20]

  Delivery vehicles, which can be personal autos, vans, or light or heavy trucks, are an important component of a high-functioning urban economy and would need to be priced in a way that avoids disproportionate charges to certain industries. An analysis of Stockholm business revenues before and after congestion pricing implementation found that the pricing program had no

---

11 San Francisco County Transportation Authority. October 2018. "TNCs & Congestion". <https://www.sfcta.org/sites/default/files/content/Planning/TNCs/TNCs_Congestion_Report_181015_Final.pdf>

12 Schaller Consulting. July 25, 2018. "The New Automobility: Lyft, Uber and the Future of American Cities". <http://www.schallerconsult.com/rideservices/automobility.pdf>

13 Metropolitan Area Planning Council. February 2018. "Fare Choices: A Survey of Ride-Hailing Passengers in Metro Boston". <http://www.mapc.org/wp-content/uploads/2018/02/Fare-Choices-MAPC.pdf>

14 Gutman, David. November 5, 2018. *Seattle Times*. "How popular are Uber and Lyft in Seattle? Ridership numbers kept secret until recently give us a clue". <https://www.seattletimes.com/seattle-news/transportation/how-popular-are-uber-and-lyft-in-seattle-ridership-numbers-kept-secret-until-recently-give-us-a-clue/>

15 UC Davis Institute of Transportation Studies. October 2018. "Disruptive Transportation: The Adoption, Utilization, and Impacts of Ride-Hailing in the United States". <https://itspubs.ucdavis.edu/wp-content/themes/ucdavis/pubs/download_pdf.php?id=2752>

16 Schaller Consulting. July 25, 2018. "The New Automobility: Lyft, Uber and the Future of American Cities". <http://www.schallerconsult.com/rideservices/automobility.pdf> p. 9.

17 Local Law No. 147 (2018) of City of New York. Int 0144-2018. <https://legistar.council.nyc.gov/View.ashx?M=F&ID=6467078&GUID=F5AFBAEE-1A39-4540-B4F1-D386701C52B9>

18 Beekman, Daniel. October 8, 2018. *Seattle Times*. "Uber gets political, will spend $10M pushing for 'congestion pricing' tolls in Seattle, elsewhere". <https://www.seattletimes.com/seattle-news/politics/ride-hail-companies-to-lobby-for-congestion-pricing-in-seattle-as-city-considers-tolling-downtown-streets/>

19 Khosrowshahi, Data. September 26, 2018. "The Campaign for Sustainable Mobility". <https://www.uber.com/newsroom/campaign-sustainable-mobility/>. Emphasis by Nelson\Nygaard.

20 Fix NYC Advisory Panel. January 2018. "Fix NYC Advisory Panel Report". <http://www.hntb.com/HNTB/media/HNTBMediaLibrary/Home/Fix-NYC-Panel-Report.pdf>. p. 21.

negative impacts; on the contrary, center city retail and wholesale sectors showed positive changes in revenue versus the county at large.[21] Because delivery vehicles infrequently make discretionary trips, their elasticity rates are likely lower than personal autos, meaning that some portion of priced trips will likely pass a congestion charge on to consumers.

- **Tour vehicles,** such as terrestrial and amphibious tour buses, operate throughout Seattle, with higher trip volumes during summer and the peak tourist season. These vehicles are largely diesel-powered, which makes them significant contributors to air and noise pollution. A fleet charge on tour vehicles would likely be passed on to consumers, which could reduce ticket sales and revenues for the tour companies.
- Pricing **heavy trucks** (or other high-emissions vehicles) would charge vehicles producing the greatest relative rates of harmful emissions and damage to roadways. These vehicles typically also cause more congestion than personal autos when driven in urban environments because of their slow movement, delivery behaviors (e.g., backing up to loading docks, double-parking), and poor maneuverability.

  Semi-trailers are not typically operated in the center city of Seattle because of its land use and street network, so pricing these vehicles may only affect a small proportion of total VMT. Rather, it may be prudent to consider a ban on trucks over a certain size in the center city (except with a special permit) as a component of a fleet pricing initiative. As with pricing first-mile/last-mile delivery vehicles, any fleet charge would likely be passed on to consumers. Most semi-trailer container trips to and from the Port of Seattle would likely not be priced, as they do not typically pass through Seattle's center city.
- "Fleet vehicles" could also be defined by counting the number of vehicles operated by an individual entity, regardless of type or purpose. This could take the form of a fleet charge for a vehicle that **is owned by an entity that operates *x number* of other vehicles**, or for any vehicle **owned by an incorporated entity and not a person.** In London, a vehicle receives a £1 discount on the congestion zone charge if it is part of a fleet, which is defined as six or more vehicles.[22] Rigorous enforcement for both of these classification approaches would be both necessary and challenging.

Fleet pricing should be informed by the general understanding that—to the extent fleet vehicles provide goods and services—any charge will likely be passed on to consumers. Additionally, goods movement trips are rarely discretionary; evidence from Sweden's congestion pricing program showed that only 5% of "professional traffic" was eliminated by implementing a congestion charge, suggesting a low level of price sensitivity.[23]

Define Pricing Parameters

A successful fleet pricing program depends on well-defined pricing parameters. To best achieve potential congestion pricing goals, Seattle would need more robust datasets with which to set fleet pricing zones, times, charge amounts, and vehicle classifications. Ideal data would give analysts a clearer picture of when, where, and what types of vehicles are used in Seattle.

---

[21] City of Stockholm Traffic Administration. September 21, 2009. "Analysis of traffic in Stockholm". <http://www.stockholm.se/PageFiles/70349/Sammanfattning%20eng%20090918_.pdf>

[22] The threshold was lowered from ten to six vehicles: <http://www.politics.co.uk/reference/congestion-charge>

[23] Eliasson, Jonas. July 2014. "The Stockholm congestion charges: an overview". <http://www.transportportal.se/swopec/cts2014-7.pdf>. p. 14.

Considerations when defining fleet pricing parameters rest largely on estimated elasticity rates of various fleet vehicle and trip types. Although these rates are unique to a metro area, there are some precedent estimations available. Swedish researchers have used 10 years of congestion pricing experience to estimate elasticities for private vehicles, trucks, and all vehicles, in both peak and off-peak travel periods.[24] Elasticity estimates could be produced from other congestion pricing data abroad and from U.S. tolling data. These sources likely would need to be combined to inform parameter definition for fleet pricing in Seattle.

Definitions of fleet pricing parameters should be closely tied to theoretical understandings of likely outcomes. For example, consider the following potential outcomes:

- Pricing peak hour and daytime first-mile/last-mile delivery trips could incentivize delivery services to operate at night.
- Imposing hefty charges on larger delivery vehicles may shift fleet owners to smaller vehicle types or to non-auto delivery modes, such as UPS' current e-trike small pod delivery pilot in downtown Seattle.[25]
- Pricing all incorporated entity vehicles may reduce traffic caused by people with access to "company cars," shifting their trips to public transport.
- Pricing e-hailing fleet vehicles could make public transit and active transportation more attractive travel options.

In general, fleet pricing should reduce discretionary professional VMT.

Fleet Pricing Technologies

Pricing fleet vehicles could be simpler logistically than pricing personal use vehicles, as market penetration of vehicle tracking and communication technology is more consistent in fleet vehicles. E-hailing vehicles, for example, are tracked across both space and time by their parent companies, making potential price assessment and billing processes simple. Other data collected by e-hailing companies include deadhead time, passenger count, and vehicle type—all of which could be incorporated into a fleet pricing program.

Recently-implemented federal electronic logging device rules have accelerated the trucking industry's transition toward advanced onboard technology. Operators of large fleets are adopting GPS tracking of vehicles, and truck manufacturers have begun incorporating GPS into new vehicles, representing an opportunity to introduce and streamline fleet pricing for these vehicle types.

Fleet Pricing as a Data Collection Opportunity

Fleet pricing is an opportunity to fill aforementioned data gaps and to use these new data to operate an iterative fleet pricing program. A timetable could be set, for example, to analyze historic charging data, re-evaluate a fleet pricing program's progress towards stated goals, and adjust pricing parameters accordingly. These changes could be made on a fully-dynamic, minute-by-minute schedule, or at a fixed interval (e.g., every month or every quarter).

---

[24] Centre for Transport Studies Stockholm. February 2017. "The Swedish Congestion Charges: Ten Years On". <http://www.transportportal.se/swopec/cts2017-2.pdf>

[25] UPS. October 25, 2018. "UPS To Launch First-Of-Its-Kind U.S. Urban Delivery Solution In Seattle." <https://www.pressroom.ups.com/pressroom/ContentDetailsViewer.page?ConceptType=PressReleases&id=1540482965617-103>

Because a successful fleet pricing program depends on accurate data, it is important to plan, from the outset, what data must be collected and how it will be iteratively incorporated into program optimization.

CONGESTION PRICING BENEFITS

Lessons from Peer Cities

Congestion pricing tools that other cities have implemented include low-emissions zones (LEZ), congestion charges (CC), electronic road pricing (ERP), and GPS-based road pricing (GPS ERP). In every case, congestion pricing has reduced vehicle trips (by 10% to 44%), reduced CO_2 emissions (by 2.5% to 22%), and lowered travel times (by 10% to 33%). Revenues generated are almost exclusively reinvested into transit or other mobility options. Figure 18 summarizes five implemented congestion pricing programs and their results.

Figure 18 Major Cities with Congestion Pricing Programs

	Stockholm	London	Singapore	Milan	Gothenburg
Mechanism	LEZ – 1996 CC – 2007	CC – 2003 LEZ – 2008	ALS – 1975 ERP – 1998 GPS ERP – 2017	LEZ – 2008 CC – 2012	CC – 2013
Motor Vehicle Trip Reduction	22%	16% all 30% charged	15% with new technology 44% in 1975	34%	10%
GHG Reduction	14% CO2	17% CO2	15% CO2	22% CO2	2.5% CO2
Travel Time	33% reduction in delays	30% reduction in delays	Managed through pricing	30% reduction in delays	10% to 20% faster travel time in corridors
Net Annual Revenue	$150M	$230M	$100M	$20M	$90M

In most cities that have implemented congestion pricing, the reduction in motor vehicle trips is paired with an increase in transit and cycling trips, both in total and as a percentage of all peak period trips. Figure 19 shows how mode split changed over time in London in concert with select congestion pricing milestones. Between 2000 and 2014, private auto trips declined approximately 10 percentage points while public transport trips increased by slightly more than 10 percentage points. The rates of walking and biking trips remained relatively constant. Figure 20 shows changes in travel behavior in Stockholm—including a reduction in drive-alone trips—as a result of congestion pricing implementation. Unlike trips in London, much of the reduction in drive-alone trips resulted from people foregoing a trip or making it at another time rather than switching to transit or another mode.

Figure 19 Milestones for London Congestion Charging and Mode Split (2000-2014)

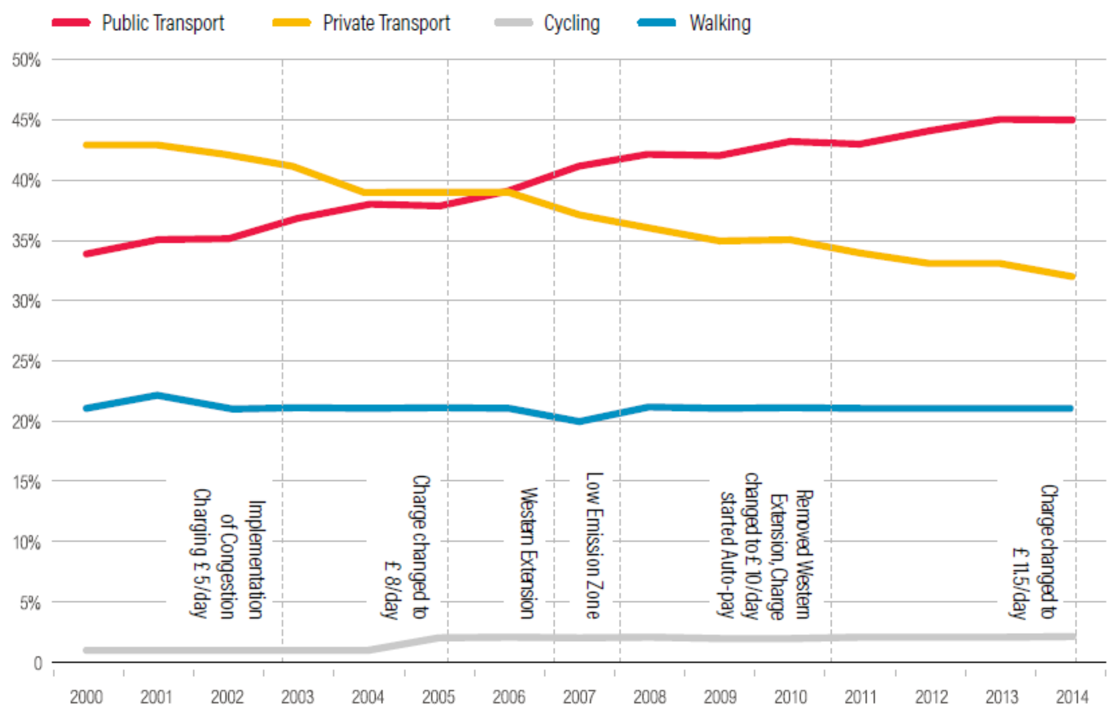
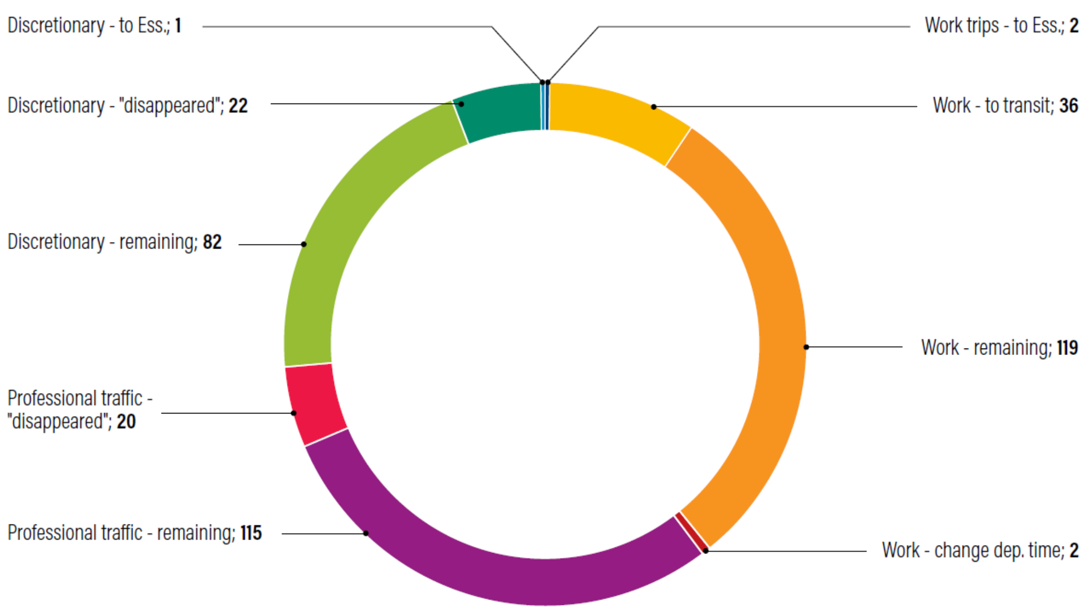


Figure 20 Estimated Changes in Stockholm Car Trips Across the Charging Boundary (in 1,000 trips)



Potential Vehicle Miles Traveled (VMT) and Greenhouse Gas (GHG) Reductions

VMT and GHG reduction impacts were estimated based on potential trip reductions rather than on modeling. Modeling was outside of the scope of the Phase 1 analysis but will be part of a future phase.

The analysis relied on high-level assumptions, including the following:

- Range in VMT impacts for cordon pricing based upon traffic (trip) reduction impacts in London and Stockholm
- VMT impacts for limited access pricing based upon traffic (trip) reduction impacts in Singapore (analysis for San Francisco)
- Assumed weekday implementation only, as in London, Stockholm, and Singapore

The analysis used a trip-length multiplier as well as a local emissions factor to develop the estimates. Figure 21 shows a potential reduction in VMT that ranges from 14-23% from the baseline (where we are today) to 22-30% in 2035 (against a 2035 control scenario). GHG reduction estimates for those same scenarios are approximately 6-10% from the baseline and 10-13% in 2035.

Figure 21 Estimated VMT and GHG Reduction with a Seattle Center City Area Pricing Program

Congestion Pricing Approach	Change in VMT		Change in Road GHG Emissions	
	From Baseline	From 2035 Control (Low – High)	From All Seattle 2014 Baseline	From All Seattle 2035 Control (Low – High)
Area Pricing: Center City	-14.3% – -23.1%	-22.0% – -30.0%	-6.1% – -9.9%	-9.8% – -13.3%

BEHAVIOR CHANGE AND PRICE SENSITIVITY

Behavior Change

Changes in travel behavior have been documented following the implementation of congestion pricing in cities such as London, Stockholm, and Singapore. These changes include decreased volumes of private vehicles in charged areas, increased public transit activity, and redistributions of traffic flows.[26,27] Additional behavior changes that are often made but are more difficult to document include the following:[28]

- Some trips may not be made at all

[26] International Council on Clean Transportation. April 2010. "Congestion Charging: Challenges and Opportunities". https://www.theicct.org/sites/default/files/publications/congestion_apr10.pdf

[27] World Resources Institute. January 2017. "Study on International Practices for Low Emission Zone and Congestion Charging," https://www.wri.org/sites/default/files/Study_on_International_Practices_for_Low_Emission_Zone_and_Congestion_Charging.pdf

[28] Transport for London. September 2008. "Demand Elasticities for Car Trips to Central London as revealed by the Central London Congestion Charge". http://content.tfl.gov.uk/demand-elasticities-for-car-trips-to-central-london.pdf

- Some trips may be made using an alternate travel mode
- Some trips may be deviated to alternate routes or destinations
- Some trips may be shifted to different times of day

Research into how congestion pricing can prompt behavior change shows trends in the relationship between price and travel behavior change:[29]

- Higher value trips (i.e., commute trips and business travel) tend to be less price sensitive than lower value trips (i.e., shopping and recreation trips)
- People with higher incomes tend to be less sensitive to pricing than people with lower incomes
- If better travel options are available, trips tend to be more price sensitive
- The impacts of fees can be affected by how they are promoted, structured, and collected
- People who drive are more likely to accept vehicle price increases if they are presented as part of a larger program that is considered fair and provides dispersed benefits
- The perception of fairness is a key factor in how people respond to pricing and their preferences for different price structures
- The perception of too much complexity in a cost structure can motivate people to "disengage" from a priced mode
- Travel behavior can be influenced by the method and timing of road pricing payments

Price Elasticity

A traveler's sensitivity to changes in price is called price elasticity. It is the foundation of models to estimate travel behavior changes in a congestion pricing scenario. This number can be estimated from observed elasticities on similar priced roads (such as the SR 520 bridge) or from experiments in other cities. A well-estimated elasticity makes it possible to forecast how travel behavior may change based on a proposed congestion pricing program.

Estimating Elasticities

A travel-price elasticity is generally a single number that represents the percentage change in consumption of travel (which can be defined as trip-taking, miles driven, mode used, etc.) that results from a 1% change in price. Elasticities of some sort have been estimated for most major road tolling studies, transit fare analyses, and other urban planning pricing studies. Because there are so many variables that interact with a traveler's trip-making decisions, elasticities are best estimated based on observed responses to price changes.

Figure 22 shows a sample of vehicle travel elasticities based on peak/off-peak road pricing and traveler income. Figure 23 provides equations for calculating price elasticity of a priced travel mode or path.[30]

[29] Victoria Transport Policy Institute. February 27, 2017. "Understanding Transport Demands and Elasticities: How Prices and Other Factors Affect Travel Behavior". http://www.vtpi.org/elasticities.pdf. pp. 41-43.

[30] Victoria Transport Policy Institute. February 27, 2017. "Understanding Transport Demands and Elasticities: How Prices and Other Factors Affect Travel Behavior". http://www.vtpi.org/elasticities.pdf

Figure 22 Consumer Demand Elasticities (2000)

	Price, Peak	Price, Off-Peak	Income
Vehicle travel - essential trips	-0.16	-0.43	0.70
Vehicle travel - optional trips	-0.43	-0.36	1.53
Bus, Tram, Metro passenger-kms	-0.19	-0.29	0.59
Rail passenger-kms	-0.37	-0.43	0.84

Note: Table reflects data collected in studies of travel in European cities.

Source: VTPI, 2017

Figure 23 Equations for Road Pricing Elasticity

Elasticity Equations

Arc Elasticity

$$\eta = \frac{\Delta \log Q}{\Delta \log P} \quad \text{or} \quad \eta = \frac{\log Q_2 - \log Q_1}{\log P_2 - \log P_1}$$

$$P_2 = P_1 \left(\frac{Q_2}{Q_1}\right)^{\frac{1}{\eta}} \quad \text{or} \quad Q_2 = Q_1 \left(\frac{P_2}{P_1}\right)^{\eta}$$

Mid-Point Arc Elasticity

$$\eta = \left[\frac{\Delta Q}{\frac{1}{2}(Q_1+Q_2)}\right] \div \left[\frac{\Delta P}{\frac{1}{2}(P_1+P_2)}\right] \quad \text{or} \quad \eta = \left[\frac{\Delta Q}{P_1+P_2}\right] \div \left[\frac{\Delta P}{Q_1+Q_2}\right] \quad \text{or} \quad \eta = \frac{(Q_2-Q_1)(P_1+P_2)}{(P_2-P_1)(Q_1+Q_2)}$$

$$P_2 = P_1 \times \left[\frac{Q_1(\eta-1)+Q_2(\eta+1)}{Q_2(\eta-1)+Q_1(\eta+1)}\right] \quad \text{or} \quad Q_2 = Q_1 \times \left[\frac{P_1(\eta-1)-P_2(\eta+1)}{P_2(\eta-1)-P_1(\eta+1)}\right]$$

where η is the elasticity value, Q_1 and Q_2 are before and after consumption, and P_1 and P_2 are before and after price or service.

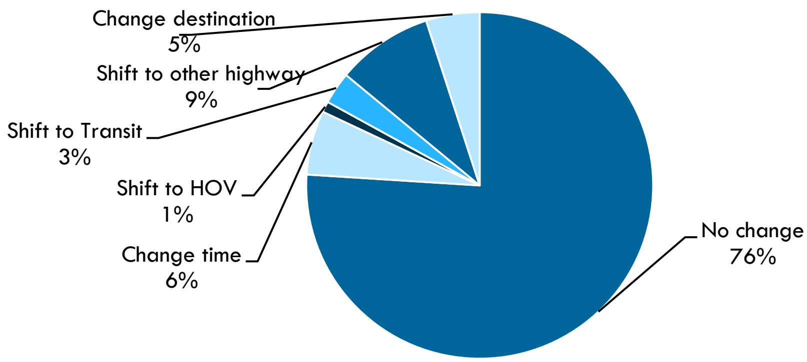
Source: VTPI, 2017

Because congestion pricing has not been implemented in any U.S. cities, elasticity estimates used to model mode shift, reductions in travel, or trip re-routing in a Seattle congestion pricing scenario will need to be carefully selected. A sampling of relevant elasticities includes:

- **Puget Sound Traffic Choices Study:** PSRC conducted a study of 275 households to develop elasticities for potential tolling systems in the Puget Sound region. This analysis is highly relevant to a Seattle congestion pricing effort. Its shortcomings include the dates in which it was conducted (early 2000s) and its geography (the Seattle metro area).
- **London Congestion Charge:** Elasticities based on observed traveler responses to the introduction and subsequent changes to London's central zone congestion charge are a helpful reference for Seattle. London's urbanized world market-based economy, similar demographic-employment dynamics, and travel landscape are a better reference point for congestion pricing in Seattle than—for example—Singapore, where the sociopolitical context differs more significantly.
- **New York Bridges & Tunnel Tolls:** Elasticities developed from observed travel changes in New York City may be relevant because some elements of Seattle's geography are similar to New York's, specifically waterways and water bodies that limit auto access.
- **SR 520 Bridge Tolls:** Analysis of the relationship between SR 520 bridge tolls and travel behavior would be valuable in informing congestion pricing elasticities in Seattle. Although much of the SR 520 work used PSRC's travel model to help set the current variable toll rates, defined elasticity rates have not been made available. Since the introduction of SR 520 bridge variable

tolling and accompanying improved transit service, it has been estimated that 76% of bridge users made no change in their travel and 11% of users made the same trip but at a different time or using a different mode (Figure 24). In the six months after tolling was instituted on the bridge, travel times were approximately seven minutes shorter during peak periods. Bus ridership increased by 25% and vanpool trips increased by 18%.

Figure 24 SR 520 Tolling Effects on Demand[31]



More difficult to measure are elasticities that estimate the relationship between road price increases and travelers shifting away from auto travel modes. Because there are so many variables that interact with a traveler's trip-making decisions, a simple price-traffic volumes elasticity is likely a more reliable predictor of congestion pricing impacts than a price-mode share elasticity, which would attempt to tease out the relationship between pricing, geography, travel options, time-of-day travel distribution, and demographics.

That being said, surveys and other tools (such as PSRC's travel models) can be used in conjunction with traffic volume elasticities to estimate the amount of trips that might shift to transit in a congestion pricing scenario. It is likely this shift would occur if road pricing were introduced to the Puget Sound region, given the availability of high-capacity transit, geographical constraints for accessing Seattle's center city, and high downtown core parking prices. An analysis of this type was performed as part of the Puget Sound Traffic Choices Study, finding that the elasticity of home-to-work travel was approximately four times greater for residents with access to high-quality transit.[32]

Applying Elasticities

After identifying and vetting relevant elasticities for a Seattle congestion pricing approach, a high-level travel model should be developed to estimate reductions in traffic, VMT, time-of-day travel, or mode shifts (depending on the type of elasticity application).

Estimates of travel reductions cannot be performed, however, without details on the types of facilities, vehicles, trips, times, and/or people to be priced. These inputs, along with information identified elsewhere in this report (e.g., sources of trips traveling to the priced area, the distance and time of those trips, and the demographics of the trip-takers) would also be integral to this high-level model.

Through a separate effort, SDOT has research underway to develop an understanding of the price elasticities associated with on-street parking. When that research is complete, the project team will review the findings for use in future phases of work.

[31] WSDOT, 2012. Managing Congestion with Tolls on the SR 520 Floating Bridge. <https://www.ibtta.org/sites/default/files/Stone_Craig.pdf>. p. 12

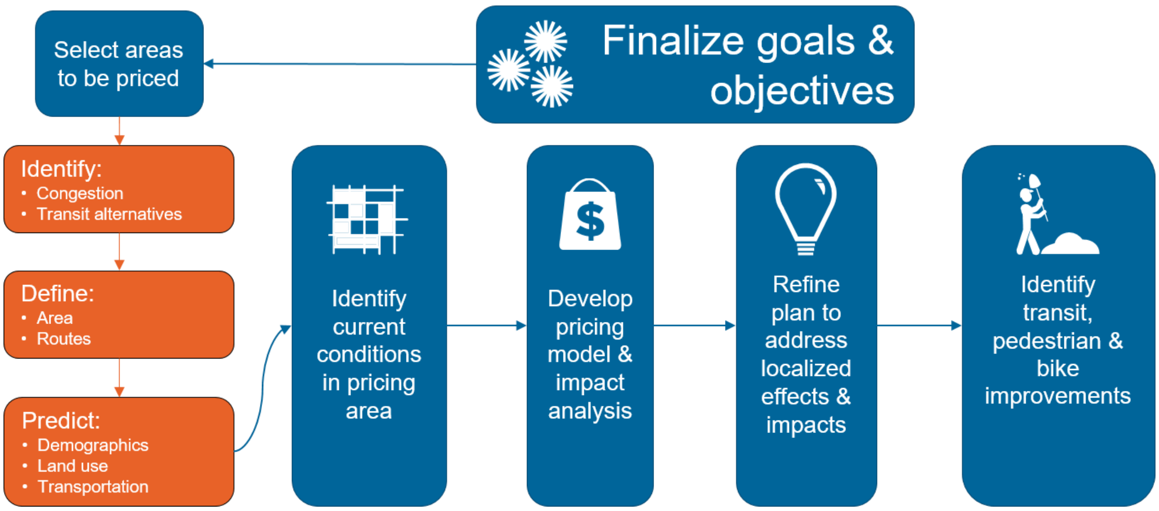
[32] p. 88

PHASE 2: DETAILED CONGESTION PRICING EVALUATION

This impacts and benefits analysis provides a high-level summary of how an area pricing program might distribute impacts and benefits to different groups of people who use Seattle's roadways.

To understand the full impacts of congestion pricing strategies on various communities—and to develop a potential congestion pricing program in a way that meets Seattle's goals—a more thorough analysis and evaluation is needed, supported by extensive community engagement. Figure 25 describes a potential process for moving forward with additional analysis.

Figure 25 Potential Analysis Approach for Future Study Phases



The first step in this proposed approach is to confirm and finalize the goals and objectives of congestion pricing in Seattle. This would be informed by deep and wide community and stakeholder involvement that would continue throughout the analysis and program development processes.

The next steps involve clearly defining pricing programs to be evaluated, documenting existing conditions, and assessing candidate technologies for administering the pricing program(s). The existing conditions would then be modeled to support comparison with a modeled pricing program. This would likely be an iterative process of refining and re-analyzing the impacts of various congestion pricing scenarios. Ultimately, the analysis would support the recommendation for a preferred program, supported by investments in related transportation infrastructure and service improvements.