CAMBRIDGE SYSTEMATICS

Tolling Impacts and Mitigation Strategies for Environmental Justice Communities

research report

Prepared for

Oregon Department of Transportation

Prepared by

Cambridge Systematics, Inc.

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Table of Contents

List of Tables

List of Figures

1.0 Introduction

Variable pricing on roadways can reduce congestion, generate revenue, or both. This report describes the potential impacts, both adverse and beneficial, on environmental justice (EJ) communities and households, and describes corresponding mitigation strategies to reduce or eliminate adverse impacts and/or capitalize on beneficial impacts. EJ, as defined by the Federal Highway Administration (FHWA), means identifying and addressing disproportionately high and adverse effects of the agency's programs, policies, and activities on minority populations and low-income populations to achieve an equitable distribution of benefits and burdens.

In this report, we present potential impacts for variable pricing strategies on all types of roadways: e.g., separated managed lanes that could function as express lanes (i.e., all vehicles pay tolls regardless of occupancy), high-occupancy toll (HOT) lanes, all lanes tolled on a limited access highway, open-road tolling on all roads within a major corridor, bridge and tunnels, cordon pricing around an urban center or CBD. The severity of EJ impacts from tolled corridors, roads, lanes, bridges, tunnels, or CBD are proportional to their proximity to and the size of EJ communities and the number of drivers from EJ households travelling on the tolled facility.

1.1 Summary

Based on extensive research, we have identified five overarching categories of potential impacts to EJ communities: 1) cost and travel time impacts; 2) displacement impacts; 3) neighborhood traffic impacts; 4) environmental impacts; and 5) economic impacts. The following sections provides more detailed and findings on what each impact entails, potential mitigation strategies to minimize the impacts or strategies to amplify their affects, and example mitigation strategies, if applicable. Table 1.1 provides a summary of findings.

Table 1.1 Tolling Impacts and Mitigation Strategies Summary

Impact Type	Impact Type	Impact Description	Mitigation Possibility	Mitigation Strategy
Toll Price	Modestly to severely adverse	• The higher cost burden for EJ households may be offset by travel time savings. • Toll costs may increase household expenditures. •	Medium to High	• Fund alternative modes of transportation (e.g., shared mobility strategies such as peer-to-peer carpool transit). . • Provide subsidies for households meeting certain criteria.
Travel Time Savings	Modestly to significantly beneficial	• An EJ transit rider would receive free travel time benefits if transit service operates in a faster tolled lane. • Variable pricing may improve travel times on both tolled and non-tolled lanes within the same corridor.[1]	Medium to High	• Improve/subsidize access for higher occupancy modes in the corridor such as first-mile/last-mile park-n-ride lots (if tolled road involves HOT lanes) and transit stations/stops, providing the travel time benefits without paying tolls. • Provide SOV subsidies for households meeting certain criteria.
Tolling Payment Methods	Modestly to severely adverse	• Credit card or automatic-debit payment methods may not be readily available for unbanked households. • Additional purchase of a transponder may be required.	High	• Offer prepaid cash payment options at multiple locations accessible to EJ communities. • Allow multiple payment methods, including cash, money order, and checks. • Provide free or discounted transponders. • Reduce the minimum required balance.
Displacement of Homes & Businesses	Modestly to severely adverse & beneficial	• Unique to area under analysis. • Depending on design of new toll road/lane, none or many homes/businesses may be displaced.	Low to Medium	• Alter design of facility. • Provide relocation assistance to affected properties.

[1] Results on the performance of the SR 167 HOT lanes, derived from an independent analysis of the Washington State Transportation Center (TRAC), indicate travel times in the general purpose lanes are more reliable than before the HOT lanes opened and all peak-period traffic is moving more efficiently. On average, daily general purpose lane volumes have decreased 4 to 5 percent, while speeds have increased 8 percent, and daily HOT lane volumes have increased 15 percent, while speeds have remained around the posted 60 mph speed limit. (FHWA. 2010. SR 167 HOT Lanes Pilot Project SR 167, Seattle WA HOT Lanes Project. https://ops.fhwa.dot.gov/freewaymgmt/publications/documents/nrpc0610/workshop_materials/case_studies/seattle.pdf)

Impact Type	Impact Type	Impact Description	Mitigation Possibility	Mitigation Strategy
Property value of adjacent but non-displaced homes & businesses	Modestly adverse & beneficial	• Unique to area under analysis. • If facility design improves access to businesses/homes, property values may increase. • Property adjacent to non-tolled, parallel routes that experience higher traffic volumes because of diversion	Medium	• Dependent on local policies and programs. • Diminished property values may be offset by payment of “severance.” • Traffic calming along impacted to discourage diversion
Neighborhood Traffic Impacts	Modestly to severely adverse & beneficial	• Unique to area under analysis. • Depending on diversion to or from non-priced alternative routes, neighborhood traffic may increase or decrease.	High	• Ban heavy vehicles from neighborhood streets. • Implement traffic calming measures on local streets used for by-passing tolls. • Implement time-of-day or directional restrictions on local streets used for by-passing tolls... • Value-pricing of a new bypass can improve central business district (CBD) circulation. • Provide additional transit service • Improve bicycle/pedestrian network, especially separate facilities
Noise and Air Quality	Modestly adverse	• Unique to area under analysis. • Diversion could increase neighborhood traffic, which could increase noise & pollution. • Reduced congestion and improved throughput on tolled facility could reduce pollution on tolled facility and could reduce diversion through neighborhoods.	High	• Mitigation strategies for ‘Neighborhood Traffic Impacts’. • Prohibit compression/engine braking. • Support soundproofing buildings. • Structural design improvements, such as noise barrier or quieter pavements.

Impact Type	Impact Type	Impact Description	Mitigation Possibility	Mitigation Strategy
Safety and Collisions	Modestly adverse & beneficial	• Unique to area under analysis. • Diversion could increase neighborhood traffic, which would increase automobile, bicycle, and/or pedestrian conflicts. • Reduced congestion and improved throughput on tolled facility could reduce diversion through neighborhoods, reducing crashes on tolled highways & neighborhood streets.	High	• Mitigation strategies for 'Neighborhood Traffic Impacts', especially traffic calming strategies. • Provide infrastructure improvements for non-motorized vehicles (e.g., sidewalks, crosswalks). • Deploy Integrated Corridor Management (ICM) strategies, including variable message signs (accident warnings), parallel arterial signal synchronization, dynamic ramp metering, etc.
Access to Employment	Modestly beneficial	• Primarily positive impact • Improved travel time and reliability increases the number of jobs accessible within the commute shed	Medium	• Increase opportunities to alternative modes of transportation (e.g., carpool, transit), especially if they can utilize the toll facility
Goods Movement	Modestly adverse & beneficial	• Unique to pricing strategy deployed. • Reduced congestion across all lanes would improve travel time & reliability. • Diversion of auto traffic out of peak periods to avoid tolls could congest off-peak period, slowing truck travel times, reducing reliability, & increasing accidents.	Low to Medium	• Variable pricing strategies could be structured to convert tolled lanes from peak period auto-only to truck only during off-peak.

2.0 Cost and Travel Time Impacts

The adverse financial burdens and travel time benefits to EJ households that come with variable pricing are distinct impacts, but they are also flip sides of the same coin. While we separate these two impacts in two subsections below, we summarize research findings which evaluate how low-income drivers trade-off these reciprocal impacts. These findings indicate that in some highly congested tolled corridors a significant minority of users are lower income drivers who will pay tolls to travel faster or arrive at their destination on-time (i.e., travel time reliability).

2.1 Tolling Cost

Variable pricing that significantly reduces peak period congestion indicates that peak period toll rates are forcing low-income households to divert to a less desirable alternative time of day, route, or mode. The cost of paying a high toll during peak-period travel will likely impose a net financial burden or inconvenience on some significant portion of the lowest-income households because they are the most price sensitive. Nevertheless, effective strategies may be deployed to reduce the financial burden on EJ households of paying a toll or the inconvenience of diverting to a travel time outside the tolled period or to a slower or longer alternative route, including the following:

- **Reducing the cost of tolls.** Subsides for qualified EJ households can level or remove the burden across income levels. While the process of applying for means-tested subsidies creates a burden in itself, some phone companies, electrical utilities, schools, or county social service agencies have "lifeline" programs that screen and enroll qualified households for subsidized pricing of other services (e.g., telephone, school lunch, home power utilities, health care, etc.). Once an EJ household is qualified, its subsidy can be administered through automatic toll transaction credits on eligible transponder accounts for each transaction or can be provided as rebates at the end of the billing cycle.

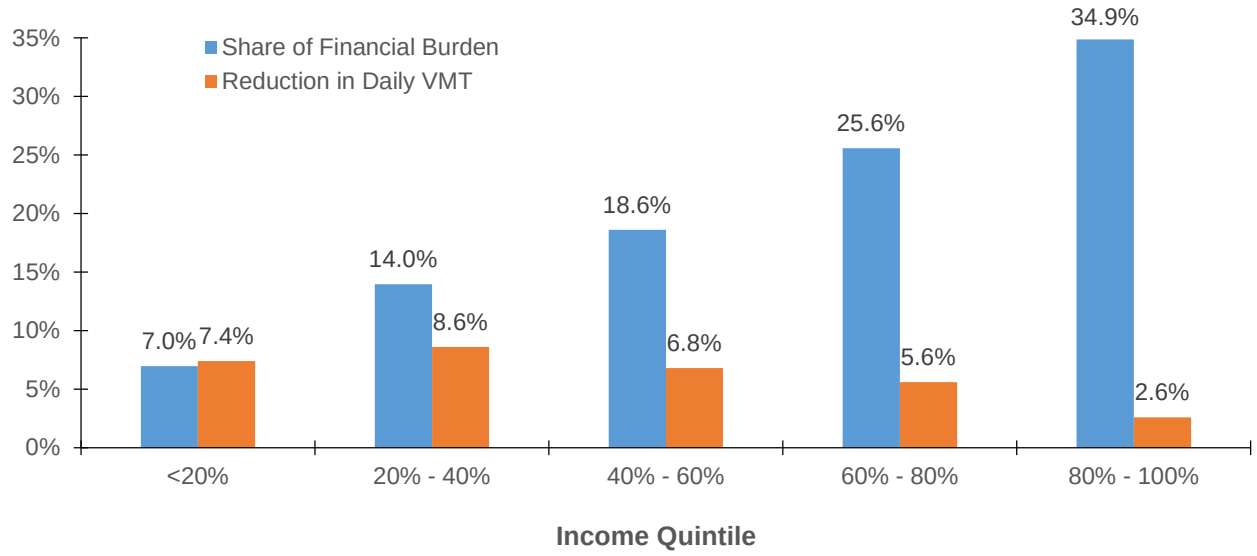
- **Providing unpriced alternative modes.** If the objective of variable pricing is to divert drive-alone autos out of peak period on congested routes, subsidized tolls are counterproductive. Providing improved access to higher occupancy modes, such as carpools, vanpools, and bus and rail transit, can reduce their inconvenience and relieve some EJ drivers of paying a toll. Nevertheless, for some portion of EJ drivers even these improved alternative modes will be less desirable, imposing longer travel time and/or less flexibility, comfort, and/or convenience. While the Oregon State Constitution prohibits spending toll revenue on public transportation, Oregon Department of Transportation (ODOT) could fund park-and-ride lots and other auto-based shared mobility infrastructure and services to improve peer-to-peer carpooling. Furthermore, other sources of funding may be spent to improve public transit in a priced corridor.

- **Avoiding tolls.** EJ households can avoid paying a toll by diverting to a non-tolled parallel route or to off-peak travel times. Strategies that mitigate the downsides of route diversion along parallel arterials include signal synchronization, grade separation at busy intersections and at-grade rail crossings, and lane widenings at bottlenecks. Policies that promote employers allowing flex-time and extended hours for daycare and after-school care provide an effective mitigation strategies to allow travel off-peak (i.e., temporal diversion) commute travel.

The Federal Highway Administration (FHWA) investigated the equity impacts of congestion pricing, including the perception of whether higher income drivers receive more benefits from tolled facilities, and found that while higher income households are more likely to use variable-priced facilities, all income groups use them

(FHWA, 2008, Income-Based Equity Impacts of Congestion Pricing. See References at end of report). Unfortunately, the FHWA research does not report the income bracket distribution between peak and off-peak. Nevertheless, the case study of SR-91 Express Toll Lanes in California reports that the income distribution during the peak period showed that 19 percent of the peak-period HOT lane users made less than $40,000 and 42 percent made less than $60,000. One study indicated an individual's flexibility of time and availability of alternative routes may be stronger predictors of their use of a tolled facility than income (Weinstein and Sciara, 2004). Another study analyzed a hypothetical toll in Los Angeles and found that higher income travelers would actually have the highest financial burden share, but the lowest reduction in daily vehicle miles traveled (VMT) (see Figure 2.1).

Figure 2.1 Equity Implications of Hypothetical Los Angeles 5-Cent VMT Fee



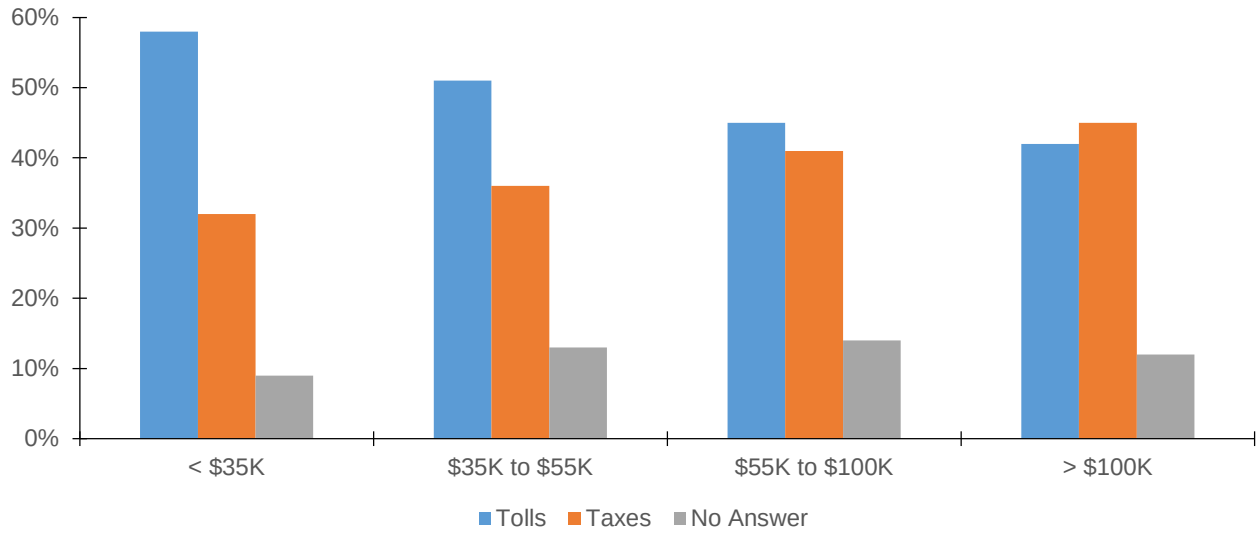
Source: FHWA, 2008.

A separate study investigated the public opinion of using tolls versus taxes to pay for transportation infrastructure (Taniguchi, 2008). The survey result found that approval ratings for the tolled facilities were high among all income groups, with the highest support among low-income households who also supported funding through tolls instead of taxes. Unfortunately, none of the recent survey research provides detailed findings of how many low income households use tolled facilities or the level of approval for tolling among non-users. FHWA concludes that all income groups appreciate the option of paying a toll for a reliable trip, especially when getting to a destination on time is of high importance, such as picking up a child from daycare before late fees occur.[2] Nevertheless, a 1998 survey of Portland metro area drivers found that approximately three percent of peak hour SOV commuters are low-income and 38 percent of the SOV commuters have relatively high incomes.[3] Among all low income Portland metro area drivers (households earning less than the poverty line), almost 59 percent were not employed, 17 percent drove in SOV during the peak period, and the remaining 24 percent drove off-peak or in other modes (transit and carpools).

[2] https://ops.fhwa.dot.gov/publications/fhwahop08040/fhwahop08040.pdf

[3] Svadlenak, J. and B. Jones (1998), "Congestion pricing and ability to pay: Income levels and poverty rates of peak-hour, single occupant vehicle commuters in Portland Oregon," Northwest Journal of Business and Economics, 1-14.

Figure 2.2 Support for Tolls versus Taxes by Income Level in King County, Washington



Source: FHWA, 2008.

2.2 Variable Pricing Travel Time Benefits

Effective variable pricing charges drivers a toll amount sufficient to deter enough drivers on a congested facility (i.e., roadway, bridge, tunnel, or urban area with the application of cordon pricing) to improve traffic flow on the tolled lane; and also increase overall throughput on the corridor during peak periods. The amount of congestion reduction can vary from achieving free-flow speeds with corresponding modest revenue generation to modest congestion reduction with corresponding higher revenue generation. As explained above, a significant reduction in congestion indicates adverse impacts for low-income households because these are the most price sensitive, but those that do pay are indicating the benefits of travel time savings exceed the financial burden.

Nevertheless, some lower-income drivers may pay the tolls because they value the beneficial travel time savings more than the adverse cost of the toll. Research on specific tolled corridors determined that a majority of HOT lanes users were from high income households, but a significant minority of frequent HOT lanes users were lower income workers who must reach their jobs on time (e.g., contractors commuting to job-sites at the start of their work day)[4]. WSDOT conducts an annual survey the SR 167 HOT Lane users. The 2016 survey showed 66 percent satisfaction among the lowest income quartile households (below $50,000) with the value of the HOT lanes, which was the same as for the other three higher income groups. Nevertheless, WSDOT did not report what share of the 8,200 users surveyed fell into this lowest income

[4] RAND Corporation. 2009. Equity and Congestion Pricing. http://www.rand.org/content/dam/rand/pubs/technical_reports/2009/RAND_TR680.pdf, Los Angeles Magazine, June 11, 2015 http://www.lamag.com/driver/oc-register-find-a-new-name-for-lexus-lanes/

quartile, nor did the survey report the satisfaction with HOT lanes among the non-users or the percentage of all travelers using HOT lanes.[5]

2.3 Tolling Payment Methods

Some EJ households are burdened by the need to enroll in electronic toll collection (ETC) programs to pay for tolls using a transponder or license plate recognition. Not all households have access to credit cards, bank accounts (unbanked), and on-line payment options; or are able to deposit large amount of funds, creating a barrier to using a tolled facility (FHWA, 2008). Since ETC methods decrease costs and delay significantly, ETC deployment has become the de facto technology for all variable pricing deployments.[6]

Direct mitigation for unbanked EJ households or those without convenient access to banks or the Internet involves supplementing the ETC systems with a variety of payment options, including cash, money orders, and checks that may be conducted at a wide variety of locations, such as convenience stores, gas stations, grocery stores, and other retail locations. These outlets allow drivers to purchase and reload transponders, inspect and settle account balances, obtain authorization for discounted of free transponders, toll subsidies, or rebates. Examples of these mitigations include:

- **The Louisville-Southern Indiana Ohio River Bridges Project.** This new bridge toll crosses the Ohio River, connecting Louisville, Kentucky with Indiana via I-65, and requires all vehicles to pay a toll. For a limited time, transponders were provided at no cost and are now available for purchase at readily available locations, including physical stores within or with easy access to low-income and minority communities on both sides of the river. The facility also accepts a wide range of payment methods, including credit/debit cards, checking accounts, and cash. Drivers also can pay the toll by registering their license plate, removing the need for a transponder (KTC & INDOT, 2015; RiverLink, 2017).

- **The Los Angeles County Metropolitan Transportation Authority (LA Metro) ExpressLanes in Los Angeles County, California.** LA Metro has a program specifically aimed at low-income residents. The Low-Income Assistance Plan provides a one-time $25 credit when an account is created, and the $1 monthly maintenance fee is waived. Residents must meet certain eligibility requirements in order to be approved for the program (LA Metro, 2017).

[5] https://www.nga.org/files/live/sites/NGA/files/pdf/0806TransportationTaniguchi.pdf

[6] Transponders automatically charge and collect the toll, removing queue delays, toll booths, and associated labor.

3.0 Displacement Impacts

3.1 Displacement of Homes & Businesses

Any variable pricing strategy that involves widening the physical footprint of the highway, interchanges, or access roads may adversely impact adjacent communities. Additional land is often needed for right-of-way to construct additional travel lanes, auxiliary lanes, shoulders, clear zones, toll collection equipment, signage, supportive infrastructure, and other associated facilities. These acquisitions can displace homes, businesses, or community and public facilities (e.g., schools, parks, churches, recreational areas, graveyards, etc.).

Mitigation strategies include temporarily or permanently relocating housing and business. The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Uniform Act) is one resource for the relocation process and requirements (U.S. Department of Transportation (DOT) et al., 2012). This act provides minimum standards for federally funded projects that displace homes, businesses, or farms, including provision of relocation assistance without discrimination and purchasing properties based on fair market value.

For example, the Colorado DOT's Environmental Impact Statement of U.S. 36 Express Lanes found that residential units and businesses would be displaced, depending on which design alternative was undertaken. Initial mitigation strategies included design modifications to decrease the number of displacements, such as reconfiguring interchanges, relocating storm water ponds, and realigning bikeways. When design modifications could not prevent property acquisition or relocation, Colorado DOT looked to the Uniform Act, including assigning each property owner a right-of-way specialist to assist them in an acquisition. Relocation instances also referenced the Uniform Act for assisting the owner with the relocation effort. The program covers both relocating structures within an acquisitioned parcel or away from the project (CDOT, 2009).

3.2 Property Value for Remaining Homes and Businesses

In some instances, taking right-of-way for a variable pricing project may not only displace homes and businesses in EJ communities, but may reduce the value of the remaining property if, for example, the decreased setbacks from the roadway leave the business or home with fewer parking spaces or mature trees, or diminished roadway or pedestrian access. Even if a landowner does not have to sell any of their property through eminent domain, their proximity to a wider or busier tolled roadway or ancillary facilities may reduce their property value due to increased traffic, noise, and pollution. These adverse effects trigger a complicated legal process called "severance" within in the body land use law known as "Takings."

Severance requires compensation or mitigation for the reduced value of the remaining private property. An explanation of when compensation is legally required for severance is beyond the scope of this report. There are legal precedents that support offsetting the cost of severance with the value of benefits conferred on property owners from a transportation investment, such as improved accessibility to workers, suppliers, customers, entertainment, recreation, etc. Furthermore, a value pricing project may reduce cut through traffic that clogs adjacent arterials or neighborhoods. Improved travel times and reliability on tolled corridors can be especially beneficial for industrial- and freight-related businesses. Tolling agencies may want to consider policies to mitigate the adverse impacts for reasons of social equity, such as relocation or monetary compensation. Agencies may need legal guidance on funding these mitigations with toll revenues. We describe in-lieu mitigations, such as sound walls and traffic calming, in Neighborhood Traffic Impacts below.

4.0 Neighborhood Traffic Impacts

Which neighborhoods experience the most severe diversion from a tolled highway depend on the capacity and performance of parallel routes and the density of trip origins and final destinations proximate to those neighborhoods, but there are not any reasons to assume that EJ communities will be more impacted by diversion than non-EJ communities. Robust simulation modeling can provide reliable forecasts of diversions and impacts on specific intersections, parallel arterials, transit mode share, and carpooling. Traffic patterns may shift when a toll is implemented. These shifts involve both drivers cutting through neighborhoods to avoid the tolled sections and other drivers using the tolled facility to take advantage of the more reliable and faster travel time. Other drives might take transit or other travel modes, shift their time of travel, or decide not to make their trip. The net impact these route diversions on neighborhood streets can differ significantly at different locations along the same corridor, by time of day, day of week, and stochastic events, such as accidents, extreme weather conditions, and special events. Increased traffic volumes drive more automobile collisions, where more vehicles on neighborhood streets create more conflict points between autos and bicycles and pedestrian.

Although temporary, construction of a tolled facility on an active highway can cause such significant delays on the main line that highway traffic will divert to parallel routes or avoid entering the freeway until they are past the construction. Mitigation strategies include limiting lane closures during certain days or hours, identifying alternative routes to divert traffic and reduce traffic volumes along certain roadways, or restricting heavy vehicles to off peak travel.

Mitigation strategies include bans of heavy trucks from neighborhood streets, non-synchronized signal timing, restrictive intersection turning movements, enforcing time-of-day or directional restrictions,[7] installing speed tables,[8] and other traffic calming measures, which reduce speeds and degrade travel time savings for nonlocal traffic. Other mitigation strategies include roundabouts and streetscape improvements. These improvements also can be implemented for non-motorized vehicles, such as crosswalks and sidewalks, to provide safe infrastructure for all roadway users. In addition, these mitigation strategies can help reduce noise and pollution.

[7] Physical barriers and traffic control measures prevent certain turning movements and/or funnel traffic in a certain direction (e.g., one-way streets, right-in-right-out driveways, medians preventing left turns), signs that prohibit no left turns during peak congestion (http://www.ite.org/uiig/treatments/09%20Prohibit%20Movements%20Using%20Signs.pdf?pass=67).

[8] Speed tables are midblock traffic calming devices that raise the entire wheelbase of a vehicle to reduce its traffic speed. Speed tables are longer than speed humps and flat-topped, City of Seattle, 2017, (https://nacto.org/publication/urban-street-design-guide/street-design-elements/vertical-speed-control-elements/speed-table/).

5.0 Environmental Impacts

Our focus here is on the environmental impacts from increased traffic volumes and speeds on a variable-priced corridor. If the project only applies variable pricing to existing lanes without adding new capacity, the environmental impacts may be neutral or adverse depending on the aggregate change in speeds and throughput for all (tolled and non-tolled) lanes. If a tolling project adds new lane capacity to a congested highway corridor, implementation of well-functioning variable-pricing should further increase vehicle throughput, thus, increasing vehicle speeds and volumes on the highway. These increases may generate a net increase in noise and air pollution in the corridor, adversely impacting adjacent EJ communities. Nevertheless, the improved performance of the tolled corridor may divert some of the existing traffic from neighborhood streets, where this slower, longer, stop-and-go trip can generate more accidents, noise, and pollution than a trip at free-flowing freeway speeds. An evaluation of noise and air quality impacts before and after the variable pricing project is completed may show that conditions would worsen across the entire corridor (including adjacent communities) under a "no build" option. This is because a "build" scenario would attract latent (i.e., induced) demand because of the increase in the tolled corridor's capacity. The net effects could be positive. In the short term, then trend toward neutral as latent demand congests the corridor.

If needed, strategies to reduce noise and pollution associated with the tolled facility vary, including more transit service and carpooling, structural improvements such as installing noise barriers along highways or installing quieter pavements on neighborhood streets. Subsidies for sound proofing buildings immediately adjacent a tolled roadway mitigate the remaining impacts, especially for sensitive sites, such a schools, hospitals, and places of worship (WSDOT, 2008). In Colorado DOT's assessment of tolling the U.S. 36 Corridor, specific noise mitigation strategies were analyzed and implemented in identified impacted areas (CDOT, 2009), ranging from shifting highway alignment, depressing the highway, installing quiet pavement, installing earthen berms, reducing speeds, and installing sound walls. Some strategies, such as earthen berms, were not implemented due to site conditions.

A primary driver of congestion in these corridors involves the tradeoffs low-income families make between affordable housing and access to jobs. On average throughout Portland's metropolitan region, housing becomes more affordable the further from the central business district and other concentrated job centers. EJ households may settle for longer commutes in exchange for cheaper housing. Unfortunately, as commute times grow, both the number of jobs available for EJ households and the number of lower wage and lower skilled workers available to employers' declines. The benefits of variable pricing, especially when applied to highly congested regional corridors, such as I-5 and I-205, include improving travel time and reliability for all trips, including commute trips made by EJ households. We describe the underlying reasons for two major benefits EJ households below.

5.1 Access to Employment

All types of toll facilities with effective variable pricing shorten travel time and improve reliability of commute trips, which increases the distance a worker can travel to a job in the same amount of time (i.e., expands the catchment area or commute shed). These two benefits flow to workers, who have more jobs available to choose from, and businesses, who have more workers accessible within the commute shed. This benefit may be further improved if existing or new transit services use tolled lanes, increasing their speed and reliability. Expanding alternative modes of transportation, such as carpool and transit, will further capitalize on this increased access workers have to employment and businesses have to workers.

The ultimate benefits to EJ households comes from growth in employment and wages when the regional economy expands. This expansion occurs because improved access to labor expands the size and diversity of the labor pool in closer proximity to employers, which in turn increases the likelihood that employers can match their needs to worker skills and visa-a-versa (i.e., a skilled worker can better find a job that matches her skills).[9] Better matches lead to higher productivity because they are more efficient. Estimates of productivity gains from an expanded labor pool depend on the regional economy, but they are consistently positive and more significant if the region has labor shortages, or commutes have long, congested commutes.

5.2 Goods Movement

A more reliable and uncongested route also benefits goods movement, allowing freight to reach its destination faster, making shippers, receivers, and logistic hubs more competitive. Variable pricing also can increase the feasibility of trucks traveling through a downtown area at peak hours, which are traditionally avoided due to high congestion and low reliability. This increases the total productive hours available to truck drivers, which confer the following benefits on goods movement intensive businesses:

1. Expand accessibility to intermediate inputs from a wider number and diversity of suppliers;
2. Sell their outputs to a larger customer market;
3. Lower freight transport costs;
4. Lower inventory and increase just in time delivery; and
5. Improve a more efficient mix of transportation and warehousing.

These benefits result in higher regional output and employment growth overall and especially in the goods movement-intensive industries. For low income households within the Portland metro region, expansion of goods-movement employment is especially beneficial because these jobs on average have better wages than many service sector jobs which pay minimum wages.

[9] At a national (and possibly international) level, the benefits to the Portland derived from improving access to labor come at some expense of other regions, because the improved competitiveness of regional businesses lead them to capture market share from businesses outside the region. In other words, the global demand for the goods and services does not change, so an expanded market share in Portland costs businesses outside Portland to lose market share (e.g., Central Oregon, Washington State, southern states, China).

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