U.S. Department of Transportation

Electronic Payment and Pricing

ITS Benefits, Costs, and Lessons Learned: 2017 Update Report

Electronic Payment and Pricing

Toll Collection
Transit Fare Payment
Parking Fee Payment
Multi-Use Payment
Pricing

Highlights

- Congestion pricing benefits drivers by reducing delays and stress, businesses by improving delivery and arrival times, transit agencies by improving transit speeds, and state local governments by improving the quality of transportation services without tax increases or large capital expenditures, and by providing additional revenues for funding transportation improvements.
- Congestion pricing projects can be costly to implement and operate, but the costs are offset by toll revenues, resulting in a positive benefit-to-cost ratio.
- A 500-participant mileage-based user fee study in Wright County, Minnesota that used an after-market device generated nearly $38,000 in simulated revenue over six months.

Introduction

This factsheet is based on past evaluation data contained in the ITS Knowledge Resources database at: www.itskrs.its.dot.gov. The database is maintained by the U.S. DOT's ITS JPO Evaluation Program to support informed decision making regarding ITS investments by tracking the effectiveness of deployed ITS. The factsheet presents benefits, costs and lessons learned from past evaluations of ITS projects.

Congestion pricing, also known as road pricing or value pricing, uses ITS technology to charge motorists a fee that varies with the level of congestion. Value pricing reflects the idea that road pricing directly benefits motorists through reduced congestion and improved roadways. To eliminate additional congestion, most pricing schemes are set up electronically to offer a more reliable trip time without creating additional delay. Congestion pricing is different from tolling in that pricing strategies are used primarily to manage congestion or demand for highway travel, while also generating revenue to repay a bond or debt.

The U.S. DOT Congestion Pricing Primer describes four main types of congestion pricing strategies [1]:

- Variable priced lanes including express toll lanes and high-occupancy toll (HOT) lanes.
- Variable tolls on entire roadways or roadway segments (i.e., changing flat toll rates on existing toll roads to variable rates based on congestion levels).
- Cordon charge (i.e., charging a fee to enter or drive in a congested area).
- Area-wide charge including distance-based charging or mileage fees.

The electronic payment and pricing applications profiled in this chapter, particularly variable tolling and congestion pricing are key elements of the U.S. DOT Tolling and Pricing Program. For more information please visit FHWA's Congestion Pricing site: http://www.ops.fhwa.dot.gov/congestionpricing/index.htm.

Benefits

Electronic toll collection is a proven technology that has greatly reduced toll plaza delays, with corresponding improvements in capacity, agency cost savings, and fuel consumption reductions.

Electronic tolling can also produce safety benefits. Underused HOV lanes may irritate solo drivers on general purpose lanes, and hence motivate them to “cheat" and make a sudden entry. HOT lanes can help reduce violations and thus sudden entries by giving solo drivers a choice to opt in. For example. an analysis revealed that violation rates on I-394 decreased following the implementation of MnPASS’ transponder-based electronic tolling. This was particularly evident in the diamond lane sections of the corridor where violation rates fell from 20 percent to nine percent (2015-01019).

Congestion pricing builds on the success of electronic tolling and “benefits drivers by reducing delays and stress, businesses by improving delivery and arrival times, transit agencies by improving transit speeds, and state and local governments by improving the quality of transportation services without tax increases or large capital expenditures, and by providing additional revenues for funding transportation.”[2] Recent congestion pricing initiatives have produced positive benefit-cost ratios, ranging from 6:1 to 25:1, as shown in Table 1.

Table 1: Benefit-to-Cost Ratios of Congestion Pricing Strategies.

Benefit-Cost Ratio	Description	Application
7:1 to 25:1	Integrated Corridor Management (ICM) strategies that promote integration among freeways, arterials, and transit systems can help balance traffic flow and enhance corridor performance; simulation models indicate benefit-cost ratios for combined strategies range from 7:1 to 25:1. (2009-00614)	Integrated Corridor Management
6:1	In the Seattle metropolitan area the net benefits of a network wide variable tolling system could exceed $28 billion over a 30-year period resulting in a benefit-cost ratio of 6:1. (2011-00694)	Network wide – freeways and arterials
6:1	The Minnesota UPA projects along the I-35W corridor in the Minneapolis-St. Paul metropolitan area included high-occupancy toll (HOT) lanes and a priced dynamic shoulder lane (PDSL), for a total benefit-cost ratio of 6:1 (2014-00910).	Variable Priced Lanes; Freeway shoulder lanes

Figure 1 shows ranges of benefits for select entries in the ITS Knowledge Resource database at: http://www.itsknowledgeresources.its.dot.gov/. Benefits can be seen with many different measures across multiple goal areas including mobility, safety, and the environment. In this case, congestion pricing benefits include travel speed increases, traffic reduction, crash reduction, carbon dioxide emissions reduction, and transit ridership increases.

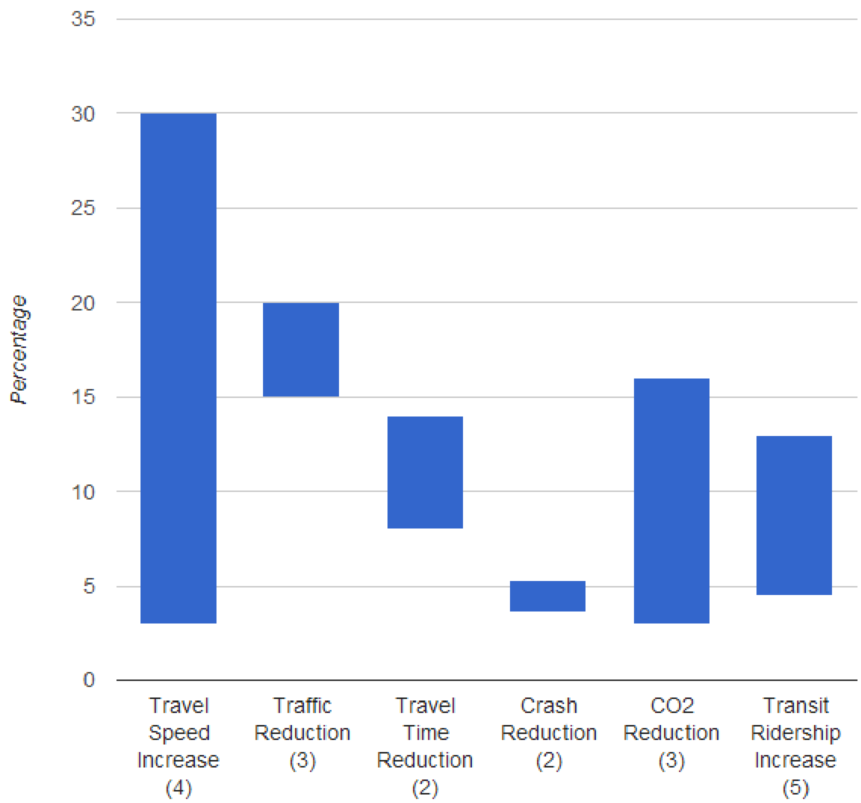

Figure 1: Range of Benefits for Congestion Pricing (Source: ITS Knowledge Resources).

The online versions of the factsheets feature interactive graphs that contain all the data points included in the ranges. Here, each metric has a number after the text, representing the number of data points used to create the range; no number means only there was only one data point.

Costs

Congestion pricing is becoming more popular as a viable and sustainable solution to traffic congestion. Increasingly, highly congested areas in the U.S. are looking at HOT lanes as an alternative to under-used HOV lanes.

Typically, the highest costs for congestion pricing stem from converting existing toll lanes to HOT lanes or building new ones. Operations and Maintenance, including enforcement, and maintaining toll readers, dynamic message signs and surveillance equipment is also a significant expense. In many cases these costs are borne or shared by a private entity that builds and manages the high occupancy toll lanes in exchange for some or all of the revenue generated by them.

Table 2: Congestion Pricing Capital Costs.

Description	Capital Cost	Type of Congestion Pricing	Location
Cost to convert HOV to HOT on a seven-mile section of I-25/US-36 in Denver. (2010-00201)	$9 million	Variable priced lanes	Colorado
Cost to convert HOV to HOT on an eleven-mile section of I-394 in Minneapolis. (2010-00201)	$13 million	Variable priced lanes	Minnesota
Cost to convert HOV to HOT on a nine-mile section of SR-167 in Puget Sound. (2010-00201)	$17 million	Variable priced lanes	Washington

Description	Capital Cost	Type of Congestion Pricing	Location
Cost to convert HOV to HOT on 16 miles of I-35W North and 14 miles of I-35W South; add a priced dynamic shoulder lane (PDSL) and construct two auxiliary lanes on I-35W South. (2014-00298)	$39.6 million	Variable priced lanes	Minnesota
Planning, design and construction costs for HOV to HOT conversion on 16 miles of the I-85 corridor under Atlanta's congestion reduction demonstration project.(2016-00364)	$52.7 million	Variable priced lanes	Georgia
Congestion pricing example in Italy. (2011-00213)	$72 million	Cordon charge	Rome
Congestion pricing example in the United Kingdom. (2011-00213)	$170 million	Cordon charge	London
Cost for the Orange County Transportation Authority (OCTA) to purchase a four-lane 10-mile-long limited access variable toll facility. (2010-00202)	$207.5 million	Variable priced lanes	California
Congestion pricing example in Sweden. (2011-00213)	$500 million	Cordon charge	Stockholm
Estimate to implement a network-wide variable tolling system in Seattle. (2011-00235)	$749 million	Variable toll – entire network	Washington
Estimate to implement a comprehensive VMT-based charging system for all road use in the Netherlands by 2016. (2011-00241)	$2.26 billion	Area charge based on Vehicle miles travelled	The Netherlands

Table 3: Congestion Pricing Operating Costs.

Description	Annual Operating Cost	Type of Congestion Pricing	Location
Operations and maintenance costs for HOV to HOT conversion on 16 miles of the I-85 corridor under Atlanta's congestion reduction demonstration project. (2016-00364)	$4 million	Variable priced lanes	Georgia
Congestion pricing example in Italy. (2011-00213)	$4 million	Cordon charge	Rome
Congestion pricing example in Sweden. (2011-00213)	$35 million	Cordon charge	Stockholm
Congestion pricing example in the United Kingdom. (2011-00213)	$161 million	Cordon charge	London
Rough estimate to operate a network-wide variable tolling system in Seattle. (2011-00235)	$288 million	Variable toll – entire networks	Washington

Description	Annual Operating Cost	Type of Congestion Pricing	Location
Rough estimate to operate a comprehensive VMT-based charging system for all road use in the Netherlands by 2016. (2011-00241)	$667.6 million	Area charge based on Vehicle miles travelled	The Netherlands

Congestion pricing projects can be costly to implement and operate, but the costs are offset by toll revenues, typically resulting in an overall positive benefit-cost ratio. Between 2003 and 2007, annual operating costs and revenues at 15 tolling agencies averaged $85.825 million and $265.753 million, respectively. In 2007, tolling agencies expended about 33.5 percent of revenues on toll collection operations, administration, and enforcement costs (2011-00240).

Lessons Learned

The Volpe National Transportation Systems Center conducted a demographic household traveler panel survey in Seattle as part of the evaluation of the Urban Partnership Agreement Program that focused on reducing congestion by employing strategies consisting of combinations of tolling, transit, telecommuting/travel demand management, and technology. The survey, targeted at corridor users, assessed changes in route and mode choice, trip timing, origin and destination patterns, and telework that resulted from implementing various pricing related strategies. The survey was also designed to explore changes in travel and tolling-related attitudes and equity impacts. Findings included the following lessons learned (2017-00760):

- **Pricing influences travel behavior, particularly with respect to route choice and the timing of trips.** Even modest toll levels can significantly shift traffic volumes, route and lane choice, modes used, and vehicle occupancies.
- **Travelers have a surprising amount of flexibility in their overall levels of travel.** Diary data from Seattle showed respondents reduced their use of the priced route, total trips fell 14 percent, VMT decreased 15 percent, and average daily time spent traveling decreased 12 percent.
- **Pricing affects the timing of trips in complex ways.** General demand by time-of-day did not change significantly; however, there were small but measureable increases in the *share* of vehicle trips that occurred during the peak period
- **Pricing does not appear to have a noticeable impact on telecommuting.** Tolling did not lead to any increase in telecommuting.
- **Travelers appreciate improved traffic conditions from variable tolling.** Improvements in travel times on the tolled facility are noticed and appreciated by travelers. It led to greater levels of subjective trip satisfaction among SR-520 users.
- **Attitudes toward tolling change with direct experience.** In Seattle, general attitudes toward tolling shifted in a positive direction after the project was implemented.
- **There are demographic differences in responses to tolling, mostly related to income.** Although respondents of all income groups used the tolled facilities, the heaviest users were disproportionately from upper-income households.

Lessons learned lead to the following implications for deployment of congestion pricing strategies:

- **Near term shifts in mode or increases in carpool size require programmatic support.** Travelers are much more apt to make changes to their number of trips, the timing of those trips, and their choice of route (or lane), than they are to make more fundamental shifts in their mode of travel. For regions contemplating congestion pricing, this is an important consideration. The region may need to conduct additional community outreach and programmatic support to generate larger shifts in transit, carpooling, and telework.
- **Make requirements for using a priced facility as simple and convenient as possible.**
- **The more public communication, the better.** A robust outreach plan, with ongoing and constant public communication, can be a great tool to prepare the public for the new system.
- **Agencies should anticipate that pricing will have differential impacts on corridor users.** Road pricing creates a

set of “winners” and “losers” in the region.

- **Strong community and civic engagement supports a positive response to road pricing.**

Case Study – Mileage-Based User Fee (MBUF) Pilot Project

Revenue derived from fuel taxes is a crucial source of funding for state departments of transportation, however, these revenues have decreased in recent years as vehicles have become more efficient. As a result, states have expressed growing interest in exploring options for replacing or supplementing the fuel tax, including the possibility of implementing road user fees, such as mileage-based user fees (MBUF) in many cases.

In 2007, the Minnesota Legislature appropriated $5 million for a technology research project exploring MBUF. The Minnesota Department of Transportation (Mn/DOT) was tasked with leading the effort of executing a pilot project to demonstrate technologies that would allow for the eventual replacement of the gas tax with a cost-neutral mileage charge. The objective of the Minnesota Road Fee Test (MRFT) was to guide future public policy decisions regarding mileage-based user fees and connected vehicle applications. To accomplish this, Mn/DOT utilized a commercially available after-market device (a smartphone) to assess mileage-based user fees and convey safety alerts (visual and audible) to a test group of 500 drivers through in-vehicle signing.

Wright County, Minnesota was selected as the key study area for the MBUF. The fee structure used in the test included a rate of $0.03 per mile for travel that was both during peak hours and in the predefined Minneapolis “Metro Zone” and $0.01 per mile for all other travel. Participants were not charged for device-compliant travel that occurred outside of the state of Minnesota. The overall fee structure for the MBUF is summarized in the following table:

Table 4: Fee Structure for the Mileage-based User Fee

Current Driving Location		Peak Times (Monday-Friday 7AM-9AM and 4PM-6PM)	Off Peak Times
Outside of Minnesota		$0.00	$0.00
Inside Minnesota	Outside the Twin Cities Metro Zone	$0.01	$0.01
	Inside the Twin Cities Metro Zone	$0.03	$0.01
All Miles Driven without Device/Non-Technology Miles/"opt-out" miles		$0.03	$0.03

The MBUF system was capable of assigning variable mileage fees determined by user location or time of day, as well as presenting in-vehicle safety notifications which had measurable effects on participants' driving habits, successfully meeting its primary objectives.

The MBUF field test generated $38,000 in simulated revenue. Monthly statements for each individual participant averaged $20 (about 66 cents per day). Eighty-three (83) percent of participants reported that rates were about equal or lower than what they expected. Additionally, 37 percent of the test group indicated a preference for the MBUFs as a replacement for the fuel tax. The pricing elements of the test also appeared to have made participants more conscious of their total mileage driven during peak hours in the Twin Cities. Compared to the baseline period, which did not show drivers a rate per mile, mileage and fees per day in the Metro Area dropped by 15.6 percent during the test period (2016-01094).

References

[1] What is Congestion Pricing?” *Congestion Pricing, A Primer*, U.S DOT Federal Highway Administration website, http://ops.fhwa.dot.gov/Publications/congestionpricing/sec2.htm, last accessed 2/6/2017.
[2] Benefits of Congestion Pricing,” *Congestion Pricing, A Primer*, U.S DOT Federal Highway Administration website, http://ops.fhwa.dot.gov/Publications/congestionpricing/sec3.htm, last accessed 2/6/2017.
All other data referenced is available through the ITS Knowledge Resources Database, which can be found at http://www.itsknowledgeresources.its.dot.gov/.