U.S. Department of Transportation
Federal Highway Administration

Congestion Pricing

A PRIMER: OVERVIEW

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The Primer Series and the Purpose of This Volume

About This Primer Series

The Congestion Pricing Primer Series is part of FHWA's outreach efforts to introduce the various aspects of congestion pricing to decision-makers and transportation professionals in the United States. The primers are intended to lay out the underlying rationale for congestion pricing and some of the technical issues associated with its implementation in a manner that is accessible to non-specialists in the field. Titles in this series include:

- Congestion Pricing Overview.
- Non-Toll Pricing.
- Technologies That Enable Congestion Pricing.
- Technologies That Complement Congestion Pricing.
- Transit and Congestion Pricing.
- Economics: Pricing, Demand, and Economic Efficiency.
- Income-Based Equity Impacts of Congestion Pricing.

States and local jurisdictions are increasingly discussing congestion pricing as a strategy for improving transportation system performance. In fact, many transportation economists and national transportation experts believe that congestion pricing offers promising opportunities to cost-effectively reduce traffic congestion, improve the reliability of highway system performance, and improve the quality of life for residents, many of whom are experiencing intolerable traffic congestion in regions across the country.

Because congestion pricing is still a relatively new concept in the United States, the Federal Highway Administration (FHWA) is embarking on an outreach effort to introduce the various aspects of congestion pricing to decision-makers and transportation professionals. One element of FHWA's congestion-pricing outreach program is this Congestion Pricing Primer Series. The aim of the primer series is not to promote congestion pricing or to provide an exhaustive discussion of the various technical and institutional issues one might encounter when implementing a particular project; rather, the intent is to provide an overview of the key elements of congestion pricing, to illustrate the multidisciplinary aspects and skill sets required to analyze and implement congestion pricing, and to provide an entry point for practitioners and others interested in engaging in the congestion-pricing dialogue.

The concept of tolling and congestion pricing is based on charging for access and use of our roadway network. It places responsibility for travel choices squarely in the hands of the individual traveler, where it can best be decided and managed. The car is often the most convenient means of transportation; however, with a little encouragement, people may find it attractive to change their travel habits, whether through consolidation of trips, car-sharing, by using public transportation, or by simply traveling at less-congested times. The use of proven and practical demand-management pricing, which we freely use and apply to every other utility, is needed for transportation. Through usage and access fees, on local, regional, and national levels, we can build a fund that supports a sustainable transportation system, while decreasing congestion and improving the environment.

The application of tolling and road pricing to solve local transportation and sustainability problems provides the opportunity to solve transportation problems without federal or state funding. The size of the revenue stream that could be apportioned to where the revenue was generated would mean that a city or region could address its road and public transportation projects with confidence and determination. It could also mean that further gas tax, sales tax, or motor-vehicle registration fee increases are not necessary now or in the future. The idea of congestion pricing is a conceptual first step, not a complete plan of action. It has to be coordinated with other policy measures and environmental measures for sustainability.

Against this background, this Overview primer was produced to explain the concept of congestion pricing and its benefits, to present examples of congestion-pricing approaches implemented in the United States and abroad, and to briefly discuss federal-aid policy and programs related to tolling and pricing.

The Congestion Problem

COSTS OF TRAFFIC CONGESTION

Growing congestion in the U.S. transportation network poses a substantial threat to the U.S. economy and to the quality of life of millions of Americans.

Each year, Americans are paying billions of dollars in terms of lost time and productivity, air pollution, and wasted energy. The Texas Transportation Institute's (TTI's) latest survey of mobility in America's 437 urban areas shows that in 2005, traffic congestion resulted in 2.9 billion gallons of wasted fuel and 4.2 billion hours of lost time stuck in traffic. The cost of this delay and wasted fuel totaled $78 billion in 2005, more than quadruple the comparable cost figure in 1982. TTI's *Urban Mobility Report* also notes that congestion causes the average peak period traveler to spend an extra 38 hours of travel time and consume an additional 26 gallons of fuel, amounting to a cost of $710 per traveler.[1]

These estimates do not even include the environmental degradation and economic productivity losses caused by traffic congestion and were prepared at a time when fuel prices were considerably lower than they are today.

National Costs of Congestion [(1)]

The Texas Transportation Institute estimates the National costs of congestion to be $78 billion. The lost time and wasted fuel due to congestion equate to 105 million weeks of vacation and 58 fully loaded supertankers, respectively.

ALARMING TRENDS

Traffic congestion levels have increased in every area since 1982. Congestion occurs on more roads more frequently and for longer periods throughout the day, resulting in greater amounts of required travel time than before. Congestion levels have risen in all urban-area size categories, indicating that even small areas are unable to keep pace with rising demand.

For example, on the basis of current trends, a medium-sized city should expect its congestion in 10 years to be as bad, or worse than, what is currently experienced by a large city. The rate of congestion growth has been greater in rural areas than in urban areas, portending increased congestion in communities of all sizes.

CAUSES OF CONGESTION

At its most fundamental level, highway congestion is caused by the lack of a mechanism to efficiently manage use of capacity. When searching for a solution to the congestion problem, most people immediately think of adding a new lane to an overburdened highway. Construction costs for adding lanes in urban areas average $10–$15 million per lane mile.[2] In general, the funding for this type of construction comes from taxes that drivers pay when buying gas for their vehicles. Overall, funds generated from gas taxes on an added lane during rush hours amount to only $60,000 a year (based on 10,000 vehicles per day during rush hours, paying fuel taxes amounting to about 2 cents per mile). This amount is grossly insufficient to pay for the lane addition.

The bargain price paid by motorists for use of an expensive new capacity encourages more drivers to use the expanded highway. Introducing congestion pricing on highway facilities discourages overuse during rush hours by motivating people to travel by other modes, such as carpools or transit, or by traveling at other times of the day.

What Is Congestion Pricing?

Congestion pricing—sometimes called *value pricing*—is a way of harnessing the power of the market to reduce the waste associated with traffic congestion. Congestion pricing works by shifting some less critical or more discretionary rush-hour highway travel to other transportation modes or to off-peak periods, taking advantage of the fact that the majority of rush-hour drivers on a typical urban highway are not commuters. By removing a fraction (even as small as 5%) of the vehicles from a congested roadway, pricing enables the system to flow much more efficiently, allowing more cars to move through the same physical space. Similar variable charges have been successfully utilized in other industries, for example, airline tickets, cell phone rates, and electricity rates. There is a consensus among economists that congestion pricing represents the single most viable and sustainable approach to reducing traffic congestion.

Although drivers unfamiliar with the concept initially have questions and concerns, surveys show that drivers more experienced with congestion pricing support it because it offers them a reliable trip time, which is very valuable, especially when they have to be somewhere on time. Transit and ridesharing advocates appreciate the ability of congestion pricing to generate both funding and incentives to make transit and ridesharing more attractive.

There are four main types of pricing strategies, each of which is discussed in more detail later in this section:

1. *Variably priced lanes:* Variable tolls on separated lanes within a highway, such as express toll lanes or high-occupancy toll (HOT) lanes.
2. *Variable tolls on entire roadways:* Both on toll roads and bridges, as well as on existing toll-free facilities during rush hours.
3. *Zone-based or cordon charges:* Either variable or fixed charges to drive within or into a congested area within a city.
4. *Area-wide or system-wide charges:* Per-mile charges on all roads within an area or on a roadway network that may vary by level of congestion.

TECHNOLOGY FOR CONGESTION PRICING

With congestion pricing, tolls typically vary by time of day and are collected at highway speeds by using electronic toll-collection technology. Traffic flows freely, and there are no tollbooths. Vehicles are equipped with electronic devices called transponders or "tags," which are read by overhead antennas. Toll rates for different time periods may be set in advance, or they may be set "dynamically," that is, they may be increased or decreased every few minutes to ensure that the lanes are fully utilized without a breakdown in traffic flow.

Tags range from simple to highly sophisticated devices. Simple tags are "read-only," meaning that they can provide an identification number to overhead readers by using power from incoming radio frequency energy. More sophisticated tags are battery-powered and have processing power and memory. Tags are now the normal way tolls are collected from regular users—70 to 80 percent of tolls are now collected this way on most urban commuter toll roads during peak hours. Simple "sticker" tags may be obtained for less than $10.

Global positioning systems (GPS) are used to collect truck tolls in Germany on the autobahns. In tests of such systems in the United States, an in-vehicle device records charges incurred based on its location as identified by the GPS unit in the vehicle. All location and payment information remains in the vehicle, and the vehicle owner periodically uploads the summary of charges to a processing center along with payments. The costs of such systems are currently high—as much as $500 per vehicle in Germany. These high costs can be justified by the additional services provided by the systems, such as in-vehicle navigation and commercial fleet management. The need for roadside equipment for toll collection is reduced.

Cameras are an essential complement to tags and GPS units to gain a record of the identity of vehicles that do not have a working tag or GPS unit. Cameras can be used to deter toll violators. This is known as *video enforcement*. In cases in which a tag is required for use of a facility, camera images allow for a follow-up of violators and an imposition of a penalty.

Use of a toll facility may be permitted without a tag or GPS unit. In this case, a camera-based system is used to collect what is termed a *video toll*. This toll includes the additional costs for administration. Cameras are being improved steadily in their capabilities, and some believe that toll operators soon could rely entirely on video tolling.

VARIABLY PRICED LANES

Variably priced lanes include express toll lanes and HOT lanes. On HOT lanes, low-occupancy vehicles are charged a toll, whereas high-occupancy vehicles (HOVs), public transit buses, and emergency vehicles are allowed to use the lanes free of charge or at reduced rates. HOT lanes create an additional category of eligibility to use HOV lanes. People can meet the minimum vehicle passenger requirement, or they can choose to pay a toll to gain access to the HOV lane.

With citizens growing more frustrated with under-used HOV lanes, HOT lanes increasingly are being viewed as a solution that can reduce public

Transponders are read by overhead antennas, allowing tolls to be paid without stopping.

opposition to HOV lanes. Surveys show that low-income commuters express a high level of support for having a priced express-lane option. This is valuable when they absolutely must get somewhere on time. In places like San Diego, support from low-income travelers is over 70 percent. Low-income commuters also benefit from toll-financed transit improvements.

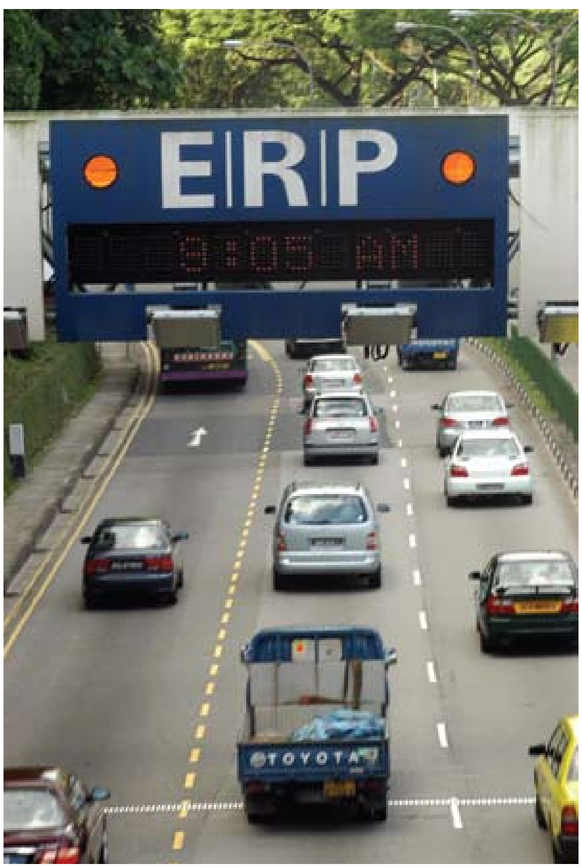
Express toll lanes are similar to HOT lanes. The difference is that all vehicles are required to pay a toll— HOVs do not get free service. This makes enforcement of toll cheaters much easier; however, many travelers still have an incentive to carpool. By sharing the ride, each person in a two-person carpool pays only half the price, whereas each commuter in a four-person carpool pays only one-fourth.

VARIABLE TOLLS ON ROADWAYS

With this type of pricing, flat toll rates on existing toll roads are changed to a variable toll schedule so that the toll is higher during peak travel hours and lower during off-peak or shoulder hours. This encourages motorists to use the roadway during less-congested periods and allows traffic to flow more freely during peak times. Peak toll rates may be high enough to guarantee that traffic flow will not break down, thus offering motorists a reliable and congestion-free trip in exchange for the higher peak toll.

Variable tolls also can be introduced on existing toll-free facilities to manage traffic flow. Again, tolls vary by time of day and are charged *only on congested highway segments* to manage traffic flow and recover the highway's capacity to carry the number of vehicles it was designed for. The most efficient way to operate our freeways is to prevent congestion and keep traffic moving freely. When traffic flow collapses under congested conditions, capacity is lost. By preventing congestion, pricing recovers this daily waste of public investment that occurs on congested highways.

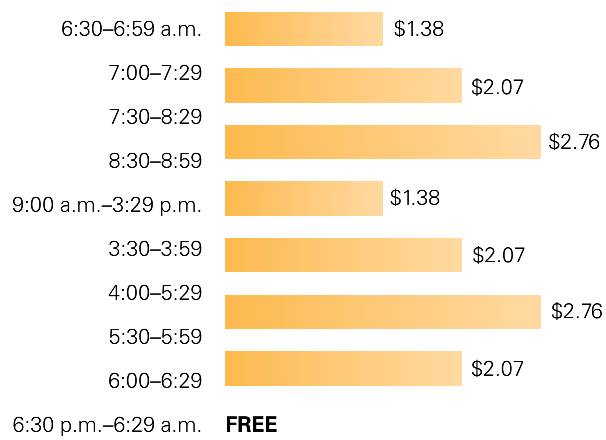
Real-life examples show the effects of pricing. In Ft. Myers, Florida, a 50-percent discount on the toll is offered on the Midpoint and Cape Coral bridges for a short period of time before and after the rush hours. Survey data revealed that, among those eligible for the discount, there was an increase in traffic of as much as 20 percent during the discount period before the morning rush hours, with corresponding drops in the rush hour itself.



Traffic passes under an electronic road pricing (ERP) gantry in Singapore.

ZONE-BASED OR CORDON PRICING

Cordon pricing involves charging a fee to enter or drive within a congested area, usually a city center. Singapore introduced the first such pricing scheme in 1975 by using low-tech daily charges. In 1998, the city shifted to a fully automated electronic charging system. In 2003, a zone-based pricing scheme was introduced in central London. A cordon-pricing scheme functioned in central Stockholm on a trial basis in 2006 from January through July, and was made permanent in August 2007. (See section on *Examples From Abroad*).



Fees for travel within Stockholm vary according to time of day, with higher fees during rush hours (dollar rates converted from Swedish krona at current rates).
Source: Stockholm Trial Expert Group

AREA-WIDE OR SYSTEM-WIDE PRICING

The State of Oregon has tested a pricing scheme involving per-mile charges, which it will consider using as a replacement for fuel taxes in the future. A congestion-pricing component was tested, with higher charges during congested periods on high-traffic road segments. The Puget Sound Regional Council tested the travel behavior impacts of a similar charging system in the Seattle metropolitan area during 2005–2006. Charges were based on the type of facility being used and its level of congestion.

USE OF REVENUES FROM PRICING

Congestion pricing can generate substantial revenues from tolls. A portion of the revenues generated will be needed to operate the toll-collection and traffic-management systems. Net revenues after payment of operating costs can be used to pay for expansion of roadway facilities or to support alternatives to driving alone, such as public transit; to address impacts on low-income individuals by providing toll discounts or credits; or to reduce other taxes that motorists pay for highways such as fuel taxes, vehicle registration fees, or sales taxes.

Flat Tolls, "Stepped" Variable Tolls, and "Dynamic" Tolls

The first roads in the United States and in many other countries were toll roads. In these cases, toll rates were fixed at a flat rate, because their purpose was to raise revenue, not to manage demand. If tolls are to be used to manage demand, they must vary by the level of demand. They may be set in advance by time of day and based on traffic volumes observed during the past week, month, or quarter. In each case, the toll schedule may appear as a "stepped" form, as shown below.

Tolls to manage demand may also be set "dynamically." Under this approach, a maximum toll rate may be specified in advance for selected time periods (*see Schedule for I-15 HOT lanes* shown below), but actual tolls typically vary below the maximum based on real-time traffic observed on the facility. Although a driver knows the maximum rate that can be charged, actual rates, which are generally lower, are known to him or her only a few minutes in advance of approaching the priced facility. The driver can then choose to use the priced facility or continue to use toll-free facilities.

Maximum Toll Rates	Evening Period (Northbound)							
	3:00–3:30	3:30–4:00	4:00–4:30	4:30–5:00	5:00–5:30	5:30–6:00	6:00–6:30	6:30–7:00
$4.00				X	X			
$3.00								
$2.50								
$2.00		X	X			X		
$1.50								
$1.00							X	
$0.75	X							X
$0.50								

Maximum toll schedule for I-15 HOT lanes, San Diego, California.

Benefits of Congestion Pricing

Congestion pricing benefits drivers and businesses by reducing delays and stress, by increasing the predictability of trip times, and by allowing for more deliveries per hour for businesses. It benefits mass transit by improving transit speeds and the reliability of transit service, increasing transit ridership, and lowering costs for transit providers. It benefits State and local governments by improving the quality of transportation services without tax increases or large capital expenditures, by providing additional revenues for funding transportation, by retaining businesses and expanding the tax base, and by shortening incident response times for emergency personnel, thus saving lives. By preventing the loss of vehicle throughput that results from a breakdown of traffic flow, pricing maximizes return on the public's investment in highway facilities. It benefits society as a whole by reducing fuel consumption and vehicle emissions, by fostering more efficient land-use decisions, by reducing housing market distortions, and by expanding opportunities for civic participation.

Variable tolls create incentives for more efficient use of existing capacity, and they also provide improved indicators of the potential need for future capacity expansion. When high toll rates are needed to balance demand with supply of road space, this is a signal that additional transportation capacity may be needed. At the same time, the higher tolls generate revenues that can be used to pay for capacity expansion to further enhance urban mobility.

People have varying needs for mobility from day to day. For example, one day they may be in a hurry to get to an appointment and thus be willing to pay more to get there on time. With our current fuel tax-based system to pay for roads, commuters cannot pay for better mobility, even if they want to. Everyone is forced to be stuck in the same traffic jam. That said, with electricity, which is also essential for life today, people pay for what they use in a direct fashion. Revenues generated ensure that power systems are designed to meet demand, and people are able to use as much as they need, when they need it, and are not forced to cope with inadequate heating or cooling in their homes. Pricing of highways will likewise generate sufficient revenue to design and run our road system efficiently and not force people to suffer inadequate mobility. With priced highways, those who are willing to pay more for better mobility will have the option to do so.

BENEFITS TO TRANSIT RIDERS AND CARPOOLERS

Pricing, in combination with transit services, provides bus riders with travel-time savings equivalent to those for drivers and reduces waiting time for express bus riders due to more frequent service. Introduction of pricing in central London and Stockholm has resulted in significant shifts of commuters to transit, particularly buses. Bus delays in central London dropped by 50 percent after the pricing scheme was introduced. There was a 7 percent increase in bus riders. In Stockholm, 200 new buses were put into service in August 2005, several months in advance of the pricing trial, which began in January 2006. After the pricing scheme was implemented, daily public transportation use, compared with the same month in 2005, was up by 40,000 riders daily. Ridership on inner-city bus routes rose 9 percent compared with a year earlier. (See section on *Examples From Abroad*).

Within 3 months of the opening of the priced express lanes on California's SR-91, a 40 percent jump occurred in the number of vehicles with three or more passengers. Ridership on buses and a nearby rail line have remained steady. On San Diego's I-15 HOT lanes, revenues generated by toll payers financed transit improvements that contributed to a 25-percent increase in bus ridership. (See section on *Examples in the United States*).

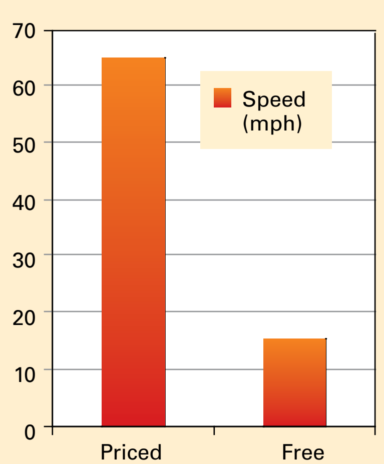
After the HOV lanes were converted into HOT lanes on I-15 in San Diego, carpooling increased significantly, even though there was no change in incentives to carpool—carpoolers continued to use the lanes free of charge, as they did before the lanes were converted. Similar effects were observed when the HOV lanes on I-25 in Denver were converted to HOT lanes in June 2006. It's not clear why carpooling increases—it could be a result of the extra publicity by the media.

BENEFITS TO DRIVERS

On the State-Route-91–priced lanes in Orange County, California, traffic during rush hours moves at over 60 mph, whereas the traffic in adjacent lanes crawls at average speeds of 15 mph or less. Commuters on the priced express lanes thus save as much as half an hour each way on the 10-mile trip, or as much as an hour a day.

If we could use pricing to restore free-flowing traffic conditions on other metropolitan freeways during rush hours, similar results could be achieved. An average commuter using a 5-mile freeway segment twice each day (i.e., once in each direction) would save about half an hour each day, or 120 hours annually—equal to 3 weeks of work or leisure time!

The day-to-day variation in travel times is now understood as a separate component of the public's and business sector's frustration with congestion. An important benefit of pricing is that it guarantees toll-paying vehicles a reliable trip speed and travel time.



Traffic speeds on SR 91 during rush hours.

BENEFITS TO BUSINESSES

Growing congestion and unreliability threatens truck transportation productivity and ultimately the ability of sellers to deliver products to market. In addition, when deliveries cannot be relied on to arrive on time, businesses must keep extra "buffer stock" inventory on hand. This can be expensive. Pricing of the nation's major thoroughfares to guarantee free flow of traffic will ensure that reliability is restored to the transportation system, keeping business and transportation costs low. Lower costs will increase the competitiveness of U.S. businesses in international markets and boost the U.S. economy.

Evidence From Recent Research on Freeway Delay

When traffic flow collapses under high-traffic densities, highway capacity is lost. If only a fraction of vehicles are removed from a congested highway at critical times during the rush hours, traffic would flow much more efficiently throughout the peak period, allowing about 10 percent more cars to move through the same physical space than would be possible under congested flow. By preventing congestion from taking hold, pricing recovers the daily waste of time that occurs on congested highways when traffic flow breaks down.

Data show that maximum vehicle throughput occurs at speeds of about 45–55 mph.[1] When severe congestion sets in, the number of vehicles that get through a bottleneck location per hour may drop by as much as 10 percent. Traffic flow is kept in this condition of "collapse" with lower throughput and speeds for several hours after the rush of commuters has stopped. This causes further delay for motorists who arrive later in the day when demand might have easily been accommodated by available capacity, had traffic flow not broken down earlier.

With congestion pricing of highways, a variable toll dissuades some motorists from using limited access highways (generally freeways) at critical locations such as bottlenecks where traffic demand exceeds capacity in the peak hours. It prevents surges in demand that may push highway traffic volume over the threshold at which traffic flow collapses. Pricing prevents a breakdown of traffic flow in the first instance, maintaining a high level of vehicle speed and throughput throughout the rush hours. Collapse of traffic flow from overcrowding is avoided. Not only are more motorists able to get through bottlenecks during each hour, but also they get through faster.

1. Chen, C., & Varaiya, P. (2002, Spring). The freeway–congestion paradox. Access, (No. 20), 40–41.

Examples in the United States

Plastic pylons separate priced lanes from free lanes on State Route 91.

The sign shows “shoulder” time periods when discount tolls are in effect on two bridges in Ft. Myers.

HOT LANES ON I-15 IN SAN DIEGO, CALIFORNIA

Since 1998, single-occupant vehicles pay a per-trip fee each time they use the I-15 HOT lanes.[3] Tolls vary “dynamically” with the level of traffic demand on the lanes. Fees vary in 25-cent increments as often as every 6 minutes to help maintain free-flow traffic conditions on the HOT lanes. The project generates $2 million in revenue annually, about one-half of which is used to support transit service in the corridor.

SR 91 EXPRESS LANES IN ORANGE COUNTY, CALIFORNIA

The four variably priced express lanes in the median of the State Route 91 Freeway opened in December 1995.[4] The toll schedule is adjusted every 3 months based on traffic observed over the 3-month period. Speeds are 60–65 mph on the express lanes, whereas congestion on the free lanes has reduced average peak hour speeds to no more than 15–20 mph. During the peak hour, which occurs on Friday afternoon (5:00–6:00 p.m.) in the eastbound direction, the two “managed” express lanes each carry almost twice as many vehicles per lane than do the free lanes because of the effect of severe congestion on vehicle throughput in the free lanes. Toll revenues have been adequate to pay for construction and operating costs. In fact, in 2003 the private company that had the franchise to build and operate the facility sold the franchise to the Orange County Transportation Authority for a profit.

BRIDGE PRICING IN LEE COUNTY, FLORIDA

Variable pricing began August 3, 1998, on the Midpoint and Cape Coral toll bridges in Lee County, Florida.[5] Bridge travelers are offered a 50-percent discount on their toll if they travel during specific discount periods and pay their toll electronically. The discount periods are from 6:30 p.m. to 7:00 a.m., from 9:00 a.m. to 11:00 a.m., from 2:00 p.m. to 4:00 p.m., and from 6:30 p.m. to 7:00 p.m. This toll structure was developed to encourage drivers to shift from peak periods to discount periods.

OREGON’S MILEAGE-BASED PRICING TEST

The State of Oregon has studied an approach that would allow area-wide pricing with smaller expenditures on roadside infrastructure. The study focused on mileage-based fees and peak-period driving charges designed to reduce traffic during the most congested periods while at the same time raising revenue to replace existing fuel-based fees. GPS-based technology was also tested.[6]

Examples From Abroad

CENTRAL LONDON

On February 17, 2003, London implemented an ambitious plan for using pricing to combat congestion in central London.[7] The scheme involves a standard per-day charge for vehicles traveling within a zone bounded by an inner-ring road. The congestion charge, together with improvements in public transit financed through revenues from the charging system, led to a 15-percent reduction in traffic in central London, with no significant displacement to local roads outside the area. The majority of ex-car users have transferred to public transport. Travel delays were reduced by 30 percent. Excess waiting time on buses fell by around one-third.

Motorists are currently charged £8 a day to drive within the central city zone between 7:00 a.m. and 6:30 p.m. on Monday through Friday. Drivers are able to pay on a daily, weekly, monthly, or annual basis by telephone, regular mail, Internet, or at retail outlets. The registration numbers of their vehicles are entered into a database. A network of fixed and mobile cameras observes the license plates of vehicles entering or moving within the central zone. There are no tollbooths, gantries, or barriers. Drivers do not have to stop. Their license plate numbers are matched against vehicle registration numbers of those who have paid the charge. A number of exemptions from the charging plan are allowed, including a 90-percent discount for residents.

Sign alterting drivers to congestion-pricing area in central London.

STOCKHOLM CITY CENTER

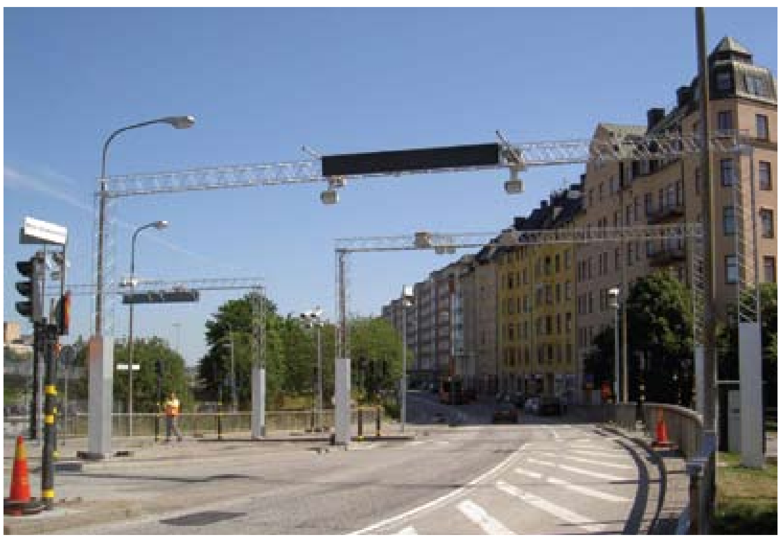
Stockholm is the most recent large international city to deploy cordon pricing. It was first introduced on a trial basis from January 2006 to July 2006.[8] The "trial" results were very favorable, with public acceptance climbing throughout the trial, from under 30 percent approval before the trial to over 52 percent toward the end. There was an immediate 22-percent drop in vehicle trips, a decrease in travel times, and a large shift to public transit—ridership on inner-city bus routes rose 9 percent. Buses, taxis, and distribution vehicles reported reductions in travel times. Traffic accidents involving injuries fell by 5 to 10 percent. Exhaust emissions decreased by 14 percent in the inner-city and by 2–3 percent in Stockholm County. Residents of the City of Stockholm voted for continuation of the system in a referendum on September 17, 2006. It was reinstated on a permanent basis in August 2007.

SINGAPORE

Traffic congestion was significantly reduced when peak-period pricing was introduced in downtown Singapore during the morning rush hours in 1975. In spring 1998, the city shifted to a fully automated electronic charging system. In-vehicle electronic devices allow payment by smart card, which is enforced by using cameras and license-plate–reading equipment.[9] Variable electronic charges were also introduced on the expressway system, with charges set by time of day to ensure free flow of traffic. The system, the first of its kind in the world, has reduced traffic by 13 percent and has increased vehicle speed by 22 percent.

NATIONWIDE TRUCK PRICING IN GERMANY

In January 2005, Germany implemented a new system to toll trucks on the autobahns. An average user charge of Euro 0.15 per kilometer (about $0.38 per mile) replaced the previous fee for a time-based permit called "Euro-Vignette." All trucks with a permissible gross weight of 12 or more tons are charged electronically by using GPS. The tolls are based on distance traveled, number of axles, and the vehicle's emissions class. Net toll revenues go toward funding for transportation infrastructure.



In Stockholm, electronic tag readers and cameras are installed overhead on gantries.

Federal Policy and Programs on Pricing

FEDERAL LEGISLATION

There are three programs or provisions within the Federal-Aid Highway Program that support congestion pricing:

- Value Pricing Pilot Program: This program, initially authorized in the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991 as the Congestion Pricing Pilot Program, encourages implementation and evaluation of projects encompassing a variety of strategies to manage congestion on highways, including both tolling of highway facilities and other pricing strategies not involving tolls. This is the only program that provides funding.
- High-Occupancy Vehicle (HOV) Facilities: This program allows states to charge tolls to vehicles that do not meet the established occupancy requirements to use an HOV lane if the state establishes a program that addresses the selection of vehicles allowed in such lanes and procedures for enforcing the restrictions.
- Express Lanes Demonstration Program: This program permits tolling on up to 15 selected demonstration projects to manage congestion, reduce emissions in a non-attainment area, or to finance new and improve existing lanes while reducing congestion.

In addition, there are three programs or provisions within the Federal-Aid Highway Program that support tolling for the purpose of highway financing:

- Interstate System Construction Toll Pilot Program: This program authorizes up to three new facilities on the Interstate System to be tolled for the purpose of financing their construction.
- Interstate System Reconstruction and Rehabilitation Pilot Program: This program allows up to three existing Interstate facilities (highway, bridge, or tunnel) to be tolled to fund needed reconstruction or rehabilitation on Interstate corridors that could not otherwise be adequately maintained or functionally improved without the collection of tolls.
- Title 23 United States Code Section 129 Tolling Agreements: Section 129 allows tolling of non-Interstate highways as well as Interstate bridges and tunnels. There is no limit to the number of agreements that may be executed.

U.S. DOT'S CONGESTION RELIEF INITIATIVE

The 2007 U.S. Department of Transportation's Congestion Initiative focused the above tolling programs toward the overall goal of relieving congestion. The Department has entered into Urban Partnership Agreements with selected cities, pursuant to which the cities and Department have committed to the following actions:

- Implementing a broad congestion pricing or variable toll demonstration;
- Creating or expanding express bus services, which will benefit from free-flow traffic conditions;
- Encouraging and supporting use of technology to improve the efficiency of operation of the highway system; and
- Committing discretionary resources and expertise to support the above actions to the maximum extent possible, including transit Small Starts funds, Intelligent Transportation System (ITS) funds, and Value Pricing Pilot Program funds.

Frequently Asked Questions

How does electronic tolling work?

Drivers typically put small electronic tags, called transponders, on the windshield inside their cars. In conjunction with using the transponder, they open an account with a toll operator. Tolls are then collected as the tag is read at normal highway speeds by electronic scanners suspended from gantries above the highway. Motorists ensure that adequate funding is available in their accounts by linking their accounts to their credit card accounts or through a quick call, a trip to a kiosk or office, or a visit to a Web site. Tags may emit a signal warning consumers when their account is running low, or they may be informed through messages beamed to them as they go by a toll collection point.

How does dynamic pricing work?

With dynamic pricing, tolls are continually adjusted according to traffic conditions to maintain a free-flowing level of traffic. Under this system, prices increase when the tolled lane(s) get relatively full and decrease when the tolled lane(s) get less full. The current price is displayed on electronic signs prior to the beginning of the tolled section. This system is more complex and less predictable than using a fixed-price table, but its flexibility helps to consistently maintain the optimal traffic flow. Motorists are usually guaranteed that they will not be charged more than a pre-set maximum price under any circumstances.

How do out-of-town motorists who don't have a transponder pay?

This is handled in several ways. Of course, clear signage is used to show drivers which lane(s) or route to use to avoid the toll. This prevents most of these kinds of problems. Some systems allow drivers to pay via credit card after the fact by calling a toll-free line. Some project sponsors simply let drivers use the tolled lane(s) at no charge the first few times. For instance, a letter may be sent to non-paying drivers identified based on matching a photo of license plates with State vehicle registration databases. The letter would explain that if the driver wants to continue to use the facility, he or she should get a tag or risk a fine, but that initial usage is being allowed at no cost. The operator of an all-electronic toll facility in Toronto, Canada, simply bills such motorists for the cost of the toll plus an administrative fee. Through these kinds of steps, the chances of tourists, occasional visitors, or inadvertent users being penalized are minimized.

Wouldn't electronic tolling invade a motorist's privacy?

All of the operating pricing projects in the United States and more than 250 other toll facilities across the country use electronic toll collection (ETC). Tolling agencies have devised a method to protect the public's privacy by linking the transponder and the driver's personal information with a generic, internal account number that does not reveal the driver's identity and that is not disclosed to other organizations. In addition, a motorist can open an anonymous pre-paid account if he or she so chooses.

The German *TollCollect* system fits each registered vehicle with a GPS unit that gathers data about its usage. The GPS unit can then be interrogated to generate a bill. Once the bill is paid, the usage data is erased from *TollCollect's* systems; thus, there is no central record of the vehicle's movements. The enforcement approach is similarly privacy friendly: roadside cameras check the vehicle's registration against the billing database as it passes, and so long as there are no overdue bills or police warrants, the data is erased before it even makes it to the central system.

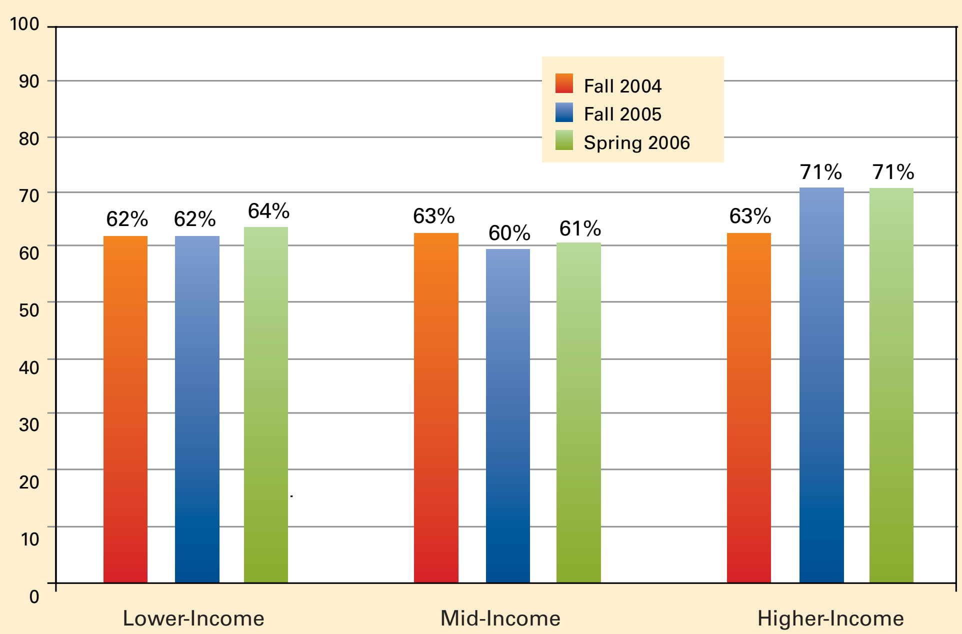
How much is the charge?

Prices will vary from project to project because of supply and demand, as well as other regional factors. If all lanes on an existing toll-free facility are priced, charges will be much lower, because there will be more "supply" of premium free-flowing traffic lanes, thus lowering the market-based price that must be charged to fully utilize the available capacity. Some projects do use a pre-set schedule of tolls. This has the advantage of being predictable and simple. With dynamic pricing, the toll fee is adjusted in real time until optimal traffic flow is achieved. For example, the express lane fees for an 8-mile section in San Diego typically range from $1 to $4.

Isn't pricing inequitable toward low-income motorists?

Results from surveys conducted for projects in operation show that drivers of all income levels use priced express lanes. Although many low-income users don't choose to use the tolled facility every day, they support having the option. For instance, a low-income parent racing to avoid the financial penalty associated with being late for pick-up at a daycare facility or for work, is often pleased to have the option of paying a fee to bypass gridlock in the regular lanes. In fact, a high level of support for San Diego's HOT lanes comes from the lowest income users (70 percent support). Moreover, when pricing is coupled with transit investment, it helps rather than harms the poor, because low-income bus riders benefit significantly from toll-financed transit improvements.

A well-designed value-pricing plan can be less burdensome to low-income citizens than current systems that are based on regressive taxes, such as car registration fees, sales taxes, and the gas tax. A recent study by Lisa Schweitzer and Brian Taylor[10] found that using sales taxes to fund roadways shifts some of the costs of driving from drivers to consumers at large, and in the process disproportionately favors the more affluent at the expense of the poor.



Percentage of Minneapolis consumers surveyed who approve of allowing single-occupant drivers to use the carpool lane for a fee.

Finally, with congestion pricing, toll discounts or credits can be provided to low-income individuals. For example, a proposal for pricing the San Francisco–Oakland Bay Bridge included life-line discounts for low-income motorists, alleviating concerns about affordability. The bridge also currently provides free service for carpool vehicles during rush hours. In New York, a cordon-pricing scheme that was under consideration in 2008 included income supplements for low-income motorists.

Isn't congestion pricing "double taxation"?

Some argue that congestion tolls constitute a double tax because revenue from motor fuel taxes, other user fees, and general taxes have already paid for the costs of constructing roads. However, congestion tolls pay for a different set of costs, namely the economic costs of delay, pollution, and lost productivity due to congestion. The delays that vehicles impose on one another on congested highways temporarily balance demand and supply but only by deterring travelers (and shipments) whose time may be more valuable, while wasting large amounts of others' time. In addition, according to a 2005 study by the Ontario College of Family Physicians, congestion has significant health consequences. These include arthritis, asthma, back pain, high blood pressure, increased frequency of illness, headaches, stress, road rage, absenteeism, reduced job satisfaction, and overall life satisfaction.

Despite the magnitude of these costs imposed on others by rush-hour vehicle users, they are currently not charged for these costs. Thus, separate congestion charges are appropriate. Gas taxes paid by a motorist amount to just 2 cents per mile driven. To avoid the claim of "double taxation," gas taxes already paid can be tallied separately and reimbursed to the driver, as is already done for toll-road users in a few States.

Won't adjacent free roads get more congested due to diverted traffic?

It is true that when toll rates are raised on toll ways, some drivers do divert to alternative toll-free routes. However, introduction of congestion tolls during rush hours will be accompanied by expansion of transit capacity and improved availability of carpooling options; thus, some solo drivers will use transit or carpool rather than divert to free roadways. Others may divert to off-peak or peak shoulder hours to take advantage of toll-free service or lower toll rates.

Rush-hour toll revenues may be used to pay for freeway widening or active traffic management, including, for example, expansion of peak-period capacity by using shoulders as travel lanes during rush hours.[11] This will allow the expanded freeway to carry even more traffic, reducing traffic on parallel free arterials.

Do people have flexibility to change the time when they travel?

On average, over half of peak-period drivers in metropolitan areas are not commuting.[12] In other words, there is far more schedule flexibility than commonly understood. Moreover, the rise of the Internet, personal digital assistants and telecommuting are providing employees with unprecedented flexibility to work outside the four corners of their offices. Giving people the option and incentive to shift trip times even 30–45 minutes can significantly reduce congestion. It is expected that some employers would respond to congestion pricing by offering employees more work-schedule options.

Will the public accept congestion pricing?

Public opinion surveys taken *prior* to implementation of congestion pricing have found that populations are about 70% opposed to congestion pricing. However, *after* congestion pricing is implemented and operating, rejection slips to about 30%. A study of public opinion surveys undertaken throughout the United States over the past few years found that, if people are convinced that more funding is needed for transportation, they prefer tolls to taxes.[13] With tolls, they see a direct relationship between what they pay and the service they get and feel reassured that their dollars are not being siphoned off for purposes unrelated to their travel.

Will congestion pricing lead to privatization of highways?

By creating a revenue stream, congestion pricing may make public–private partnerships an option that states and local governments could consider. However, public agencies can and do operate many toll roads in the United States, and the London, Stockholm, and Singapore pricing projects are run by public agencies with contractual services provided by the private sector. Thus, public agencies could build, finance, and operate congestion-pricing projects. Privatization is not essential for successful pricing projects.

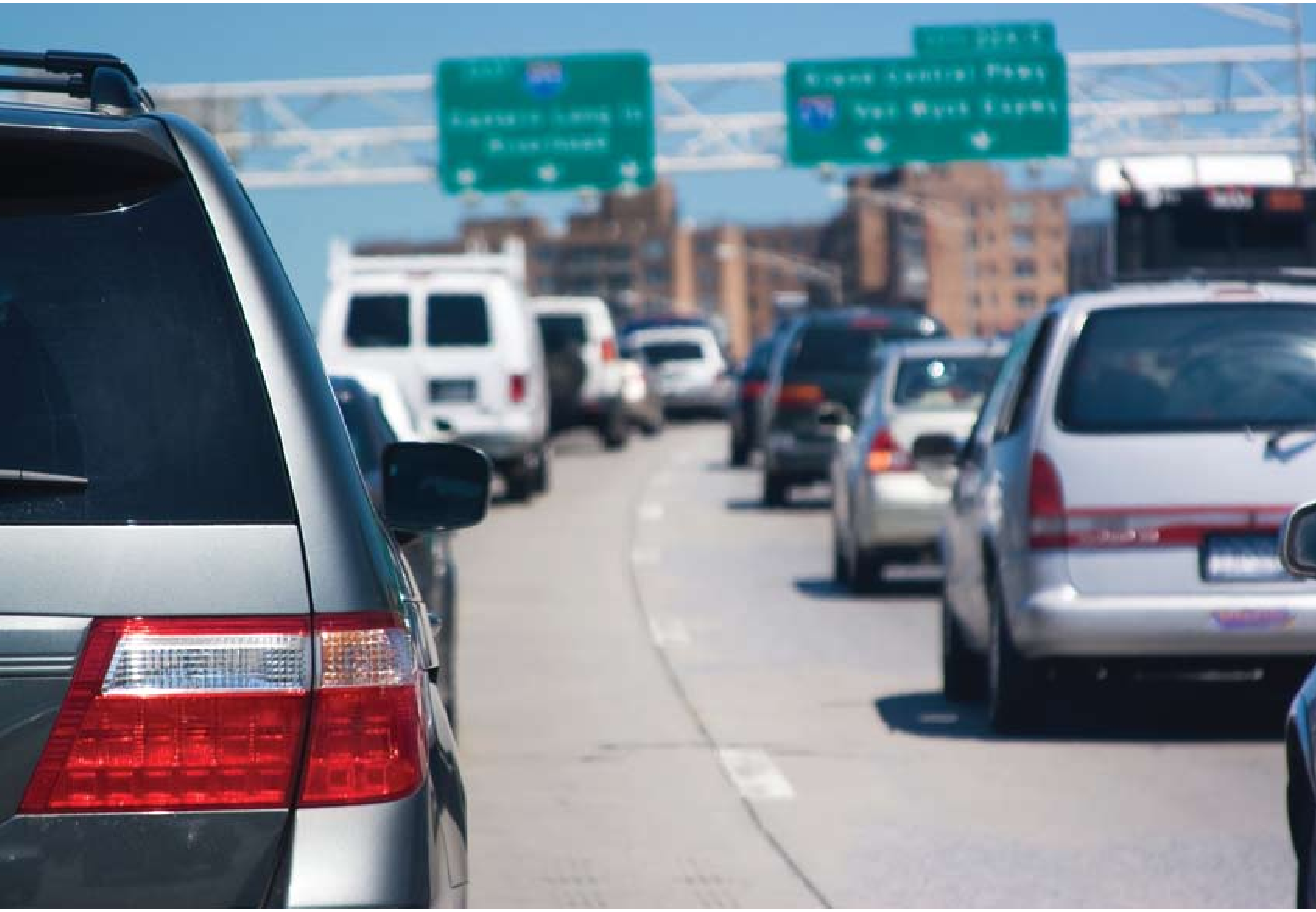
Won't congestion pricing involve high costs for implementation and operation?

Although costs for administration, collection of tolls, and enforcement are higher for congestion pricing relative to other ways of generating revenue, the costs of the technology and telecommunications have been dropping over the past 20 years and are expected to drop further in the future. More important, however, these costs must *not* be compared with costs for other means to generate the same amount of revenue. Because the primary purpose of congestion pricing is to reduce congestion and improve mobility, the more appropriate comparison is with other means of accomplishing the same level of mobility improvement. For example, adding a lane on a freeway to reduce congestion may cost as much as $15 million per lane mile in metropolitan areas. The same amount of congestion relief may be achieved at much lower cost with congestion pricing.

What effect will congestion pricing have on the quality of the environment?

Better environment has been one of the primary objectives of the Stockholm cordon congestion-pricing program. London took advantage of the reduced traffic volumes and reduced the amount of road space allocated for vehicles in order to increase pedestrian and bicycling amenities.

Stockholm, London, and Singapore all measured significant air quality improvements as a result of pricing. As noted by the Environmental Defense Fund, London reduced emissions of particulate matter and nitrogen oxides by 12 percent and fossil fuel consumption and carbon dioxide emissions by 20 percent in its central business district. Singapore's congestion pricing scheme prevents the emission of an estimated 175,000 lb of carbon dioxide each day, and Stockholm's congestion-pricing system has led to a 10–14 percent drop in carbon dioxide emissions in its central area. In addition, the indirect effect of public transportation expansion, made possible by the congestion charge revenues, has the potential to reduce all pollutants and sustain reductions over time.



References

1. Texas Transportation Institute. (2007). *2007 Urban mobility report*. College Station, TX: Texas A&M University.
2. Federal Highway Administration. (2000). *Highway economic requirements system (HERS) report* (Tech. Rep. Vol. 4). Washington, DC. (Updated based on construction cost index.)
3. Berg, J. T., Kawada, K., Burris, M., Swenson, C., Smith, L., & Sullivan, E. (1999). Value pricing pilot program. *TR News*, 204, 3–10.
4. Sullivan, E. (2000, December). *Continuation study to evaluate the impacts of the SR 91 value-priced express lanes: Final report*. Retrieved November 3, 2008 from http://ceenve3.civeng.calpoly.edu/sullivan/SR91/final_rpt/FinalRep2000.pdf
5. Burris, M., Swenson, C., & Crawford, G. (2002). Lee County's variable pricing project. *ITE Journal*, 72, 36–41.
6. Whitty, J. (2007, November). *Oregon's mileage fee concept and road user fee pilot program: Final report*. Salem, OR: Oregon Department of Transportation.
7. Transport for London. (2007, July). *Central London congestion charging: Impacts monitoring* (Fifth Annual Report). Retrieved November 20, 2008 from http://www.tfl.gov.uk./assets/downloads/fifth-annual-impacts-monitoring-report-2007-07-07.pdf
8. Beser Hugosson, M., Sjöberg, A., & Byström, C. (2006, December). *Facts and results from the Stockholm Trial*. Stockholm, Sweden.
9. Christainsen, G. B. (2006, Winter). Road pricing in Singapore after 30 years. *Cato Journal*, 26(1).
10. Schweitzer, L. A. C., & Taylor, B. (2008). Just pricing: The distributional effects of congestion pricing and sales taxes. *Transportation*, *35*(6), 797–812.
11. DeCorla-Souza, P. (in press). Congestion pricing with lane configurations to add highway capacity. *Public Roads*.
12. Federal Highway Administration. (2007, August). *National Household Travel Survey (NHTS) briefs*. Retrieved on November 3, 2008 from http://financecommission.dot.gov/Documents/NHTS%20Fact%20Sheet%20on%20Congestion%20and%20Peak%20Travelers.pdf
13. Zmud, J. & Arce, C. (2008). *Compilation of public opinion data on tolls and road pricing* (NCHRP Report No. 377). Washington, DC: Transportation Research Board.

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