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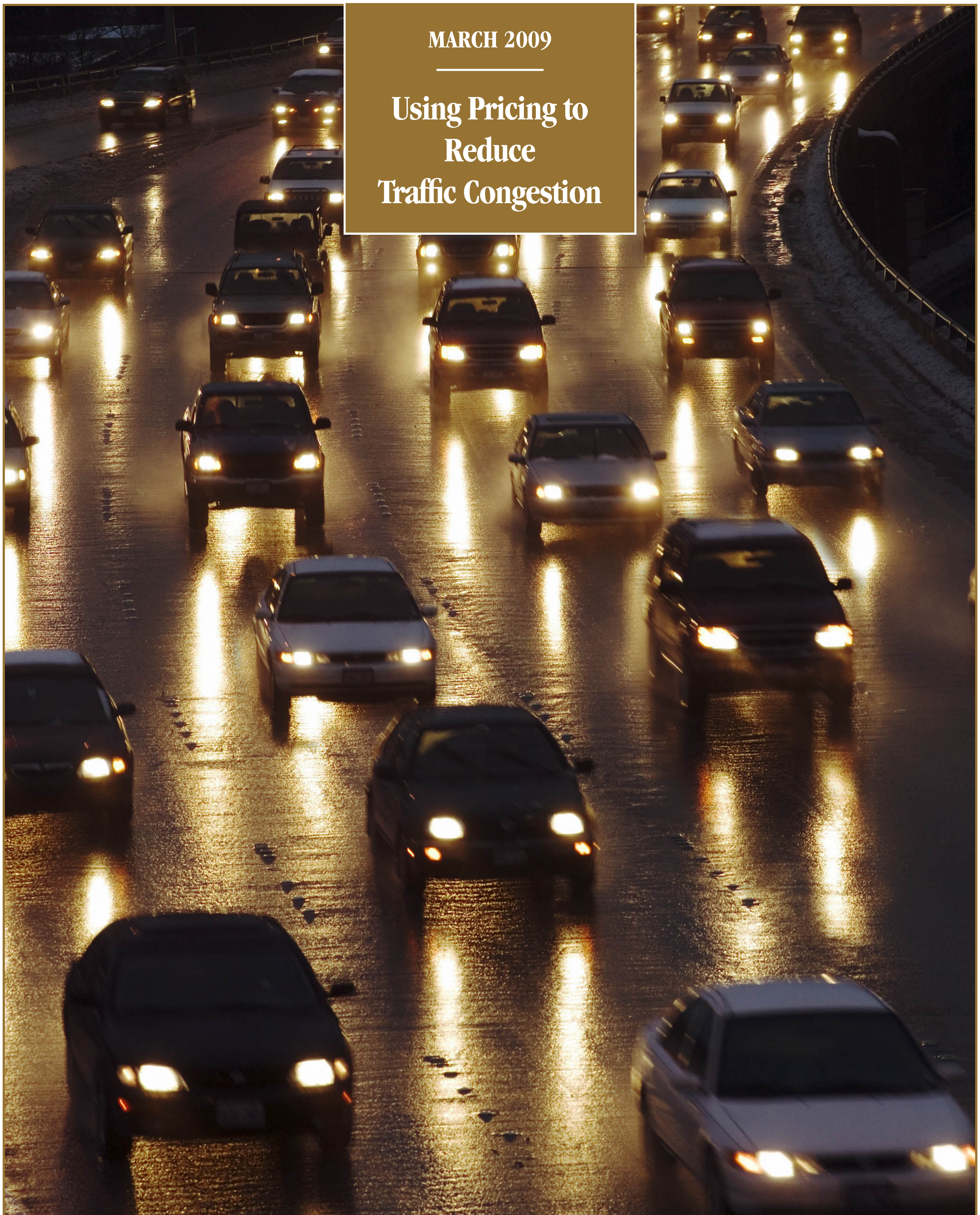
# Using Pricing to Reduce Traffic Congestion



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CBO

STUDY

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The Congress of the United States ■ Congressional Budget Office

# Preface

Congestion costs highway users billions of dollars every year. Although policymakers have adopted a variety of strategies for reducing or mitigating congestion, relatively little attention has been paid to policies to promote more efficient use of the highway system. One such policy is congestion pricing, under which drivers are charged a higher price for use of a highway at times or places with heavy traffic and a lower price in the opposite circumstances.

This study—prepared at the request of the Chairman of the House Committee on the Budget—explains how congestion pricing works, reviews the best available evidence on projects that make use of such pricing in order to assess the benefits and challenges of the approach, and discusses federal policy options for encouraging congestion pricing. In keeping with the Congressional Budget Office's (CBO's) mandate to provide objective, impartial analysis, this study makes no recommendations.

Scott Dennis of CBO's Microeconomic Studies Division wrote the study, with research assistance from Jacob Kuipers and under the supervision of Joseph Kile and David Moore. Kenneth Buckeye of the Minnesota Department of Transportation; Ross Crichton of the Department of Transportation's Federal Highway Administration; Patrick DeCorla-Souza of the Federal Highway Administration; David Lewis of HDR/HLB Decision Economics, a consulting firm with expertise in transportation; Mark Muriello of the Port Authority of New York and New Jersey; Bruce Schaller of the New York City Department of Transportation; Kenneth Small of the University of California at Irvine; Michael Sprung of the Federal Highway Administration; Derek Toups of the San Diego Association of Governments; Stefan Trinder of Transport for London; Jack Wells of the Department of Transportation; and Clifford Winston of the Brookings Institution provided valuable comments—as did Robert Dennis, Sarah Puro, and Thomas Woodward, all of CBO. (The assistance of external reviewers implies no responsibility for the final product, which rests solely with CBO.)

John Skeen edited the study, and Christine Bogusz proofread it. Maureen Costantino designed the cover and prepared the report for publication. Linda Schimmel coordinated the print distribution, and Simone Thomas prepared the electronic version for CBO's Web site (www.cbo.gov).

Douglas W. Elmendorf

Douglas W. Elmendorf
Director

March 2009

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# Summary

Highway congestion occurs when a vehicle causes delay to other vehicles on the road, resulting in longer and less reliable travel times, the use of additional fuel, and other costs to the economy. According to one widely cited study, in 2005 highway congestion resulted in 4.2 billion hours of delay and 2.9 billion gallons of additional fuel used, at a cost of $78 billion to highway users.[1] The costs are borne not just by highway users themselves, but by households and firms throughout the nation as well. Moreover, highway congestion has been increasing and is expected to worsen in the coming years.

Policymakers have adopted a variety of strategies for reducing congestion, including building more roads, supporting public transit, and improving the efficiency with which highway capacity is used. One fundamental way of improving efficiency is through congestion pricing.

Congestion pricing reduces the number of vehicles on a highway at peak periods by charging drivers for using the highway during those periods. When successfully applied, congestion pricing makes better use of highways' capacity by allocating it more efficiently. Other strategies that are designed to allocate the existing capacity more efficiently in specific circumstances include timed traffic signals, signs that warn drivers of congestion ahead, and improved responses to accidents. Such strategies have attracted more attention as building or expanding highways has become increasingly expensive and less feasible.

Congestion pricing also can be linked to strategies to improve mobility by making alternatives to the private automobile, such as subways, buses, or commuter rail service, more attractive during peak periods. The revenues generated by such pricing have sometimes been used to pay for improvements in public transportation systems.

## How Congestion Pricing Works

Congestion-pricing programs use variable pricing; that is, they charge highway users a higher price for use of a highway at times or places with heavy traffic, and a lower price at times or places with light traffic. In principle, the price would reflect the cost of delay that each driver imposes on all other drivers on the highway. In practice, determining the best price may be a complicated process requiring periodic adjustment. By providing a financial incentive for drivers to switch to times, routes, or modes of transportation that are less congested, such pricing encourages drivers to use the existing highways more efficiently. The resulting revenues both inform future investment decisions—by providing data about the value of expanding highway capacity at the places and times where the funds are collected—and can provide the funds to pay for doing so. At present, a few highways, bridges, and tunnels throughout the United States and in other countries use congestion pricing, and congestion-pricing projects are under construction at, or under study for, a number of additional locations.

The approach can be divided into cordon charges and corridor charges. A cordon charge applies to all highways, bridges, or tunnels serving a congested area, such as the center of a city. For example, in London, England, drivers are charged a fee to enter the center of the city during the business day. A corridor charge applies to part or all of one congested highway, bridge, or tunnel. For example, in order to use selected lanes on State Route 91 in Orange County, California, drivers are charged a fee that depends on the traffic conditions. Corridor charges can be further divided into variably priced facilities, in which all lanes of a highway, bridge, or tunnel are subject to a congestion charge; variably priced lanes, in which some lanes of a

1. Texas A&M University, Texas Transportation Institute, *Urban Mobility Report* (2007), p. 1, available at http://mobility.tamu.edu/ums.

highway, bridge, or tunnel are subject to a congestion charge; and high-occupancy toll (HOT) lanes, for which a fee applies to vehicles with, for instance, just a driver and no passengers.

Congestion pricing may be contrasted both with tolls and with other highway user fees such as the taxes some states apply to heavy trucks on the basis of their weight and the distance they travel. Although congestion charges are collected as tolls and are a form of highway user fees, not all tolls are congestion charges, nor are all highway user fees. The unique identifying characteristic of congestion charges is that they vary with the amount of traffic. (The impact of tolls or highway user fees as a way to raise revenues or pay for transportation infrastructure was outside the scope of this report.)

## The Benefits and Challenges of Congestion Pricing

The benefits from congestion pricing include reduced traffic congestion and shorter and more reliable travel times. With reduced congestion comes decreased fuel use, less pollution, and, ultimately, improved land use. In addition, congestion pricing results in more efficient use of highway capacity. For example, a recent study by the Department of Transportation's Federal Highway Administration estimated that widespread implementation of congestion pricing could reduce the amount of investment needed to maintain the highway system at its current physical condition and operational performance by more than 25 percent.[2]

Congestion-pricing projects have generated benefits to society that exceed their costs. For example, according to a recent study of the congestion-pricing program in Central London, the cordon-pricing system generated net social benefits of about £67 million per year ($122 million at then-current exchange rates).[3] Congestion pricing on the express lanes of California State Route 91, which were constructed in the median strip, is estimated to generate net social benefits of at least $12 million per year, compared with a scenario in which the lanes had been built but not priced. Nationwide studies suggest that widespread implementation of congestion pricing could provide net social benefits of $19 billion to $45 billion per year (in 2005 dollars), which would reduce the cost of congestion by one-quarter to more than one-half.[4]

But a number of challenges may reduce the benefits of congestion pricing, make it more difficult to put into practice, or require putting in place complementary policies. A common concern is the impact on low-income highway users. That concern has resulted in the rejection of congestion-pricing projects with benefits that appeared to exceed the costs for society as a whole. The possibility of increased congestion on alternative routes, the cost of building and operating congestion-pricing systems, and technical issues in implementation are other challenges that need to be addressed.

Despite those challenges, studies have found broad support for congestion pricing across all income groups in areas in which it has been applied.[5] Research has indicated that congestion pricing is more likely to be accepted if potential users are accustomed to paying tolls; have the option of not paying tolls on unpriced lanes, alternative routes, or alternative modes; know that the funds raised are devoted to expanding the roads used; or view congestion pricing as an incremental change, as in the conversion of high-occupancy vehicle (HOV) lanes to HOT lanes. In addition, surveys have shown a preference by the public for tolls instead of tax increases when funding new roads.[6]

2. Department of Transportation, Federal Highway Administration, *2006 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance* (March 2007), p. 10-4.
3. Jonathan Leape, "The London Congestion Charge," *Journal of Economic Perspectives*, vol. 20, no. 4 (Fall 2006), p. 172.
4. See David Lewis, *America's Traffic Congestion Problem: Toward a Framework for National Reform,* Discussion Paper 2008-06 (Washington, D.C.: Brookings Institution, The Hamilton Project, July 2008), p. 11; and Ashley Langer and Clifford Winston, "Toward a Comprehensive Assessment of Road Pricing Accounting for Land Use," *Brookings–Wharton Papers on Urban Affairs* (2008).
5. See Edward Regan, "I-15 Managed Lanes Expansion Program: Public Opinion Research" (presentation to a meeting of the Pricing Subcommittee, 81st Annual Transportation Research Board Meeting, Washington, D.C., 2002); and Edward Sullivan, *Continuation Study to Evaluate the Impacts of the SR 91 Value-Priced Express Lanes: Final Report* (prepared for the State of California, Department of Transportation, December 2000), pp. 123–134.
6. Johanna Zmud, "The Public Supports Pricing if . . . A Synthesis of Public Opinion Studies on Tolling and Road Pricing," *Tollways* (Winter 2008), pp. 29–39; and "New Tolls, Not Taxes, Favored for Area Roads," *Washington Post*, February 16, 2005, p. A1.

## Benefits

Congestion pricing offers a variety of benefits, including reduced congestion, shorter travel times, more reliable travel times, and more efficient investment.

As intended, congestion pricing has reduced congestion. For example, traffic within the Central London charging zone declined by 15 percent, and congestion there (as measured by the difference between actual travel times and the times that would occur if traffic flowed freely) declined by 30 percent.[7] Similarly, after congestion pricing was put in place for the bridges and tunnels between New Jersey and New York City, traffic in the peak morning period declined by 7 percent compared with what it was the previous year, and traffic in the peak afternoon period declined by 4 percent, even though the volume of traffic overall was unchanged.[8] According to a 2006 study of California State Route 91, congestion charges that were large enough to increase the cost of a trip by 10 percent would reduce traffic by an estimated 3.6 percent compared with a scenario in which the lanes had been built but not priced.[9] Converting HOV lanes to HOT lanes could also reduce congestion. About 5 percent of total peak traffic on I-15 in San Diego pays to use such converted lanes.[10] However, that effect could be attributed either to congestion pricing or to increased use of the previously underutilized HOV lanes.

Reduced congestion results in shorter and more reliable travel times. For example, according to the 2006 study of State Route 91, congestion pricing cuts travel time on a 10-mile trip by more than 8 minutes, again compared with the scenario in which the additional lanes were built but not priced. In London, the speed for trips within the congestion zone increased by 10 percent to 15 percent, while the times for trips that involve entering or exiting the zone declined by 14 percent.[11] Shorter and more reliable travel times are, of course, valued by drivers, and they benefit freight shippers as well. The more rapidly and reliably a freight shipment reaches its destination, the lower the costs that shippers incur for the value of goods in transit and for inventories that are held in case a shipment is delayed. Indirect benefits such as reduced fuel consumption and reduced pollution are much smaller.

Congestion pricing results in more efficient use of highway capacity. By decreasing the number of vehicles at times or places with heavy traffic, and increasing the number at times or places with light traffic, congestion pricing allows existing highway capacity to carry more traffic at the same or a better level of performance—thereby reducing the need for future investment in infrastructure. In addition, the revenues from congestion pricing provide signals to decisionmakers about where to make future investments in highways. The revenues represent the value to highway users of expanding capacity at the times and places where the funds are collected. By identifying investment opportunities with the greatest value, policymakers and transportation planners can minimize the overall level of investment needed to maintain any given level of performance.

## Challenges

Although more widespread use of congestion pricing would provide benefits to highway users, several concerns have been raised, including ones about the distribution of benefits, potential increases in congestion on other roads, the cost of building and operating congestion-pricing systems, and other implementation difficulties.

The benefits of congestion pricing are not distributed equally. Drivers who remain on the highway, pay the congestion fee, and benefit from a faster trip are better off. Drivers who switch to an alternative time, route, or mode or who do not travel at all are worse off. Higher-income drivers are more likely to be among the former; and lower-income drivers, the latter. Some observers have concluded that such distributional effects are the most important factor inhibiting the adoption of congestion pricing, and, in fact, such concerns have caused some

7. Transport for London, *Central London Congestion Charging: Impacts Monitoring,* Second Annual Report (2004), pp. 11 and 23.

8. Mark F. Muriello, *Pricing on Toll Facilities—NJ/NY: Variable Tolls on Port Authority Interstate Vehicle Crossings,* (September 30, 2003), available at www.knowledge.fhwa.dot.gov/cops/hcx.nsf/384aefcefc48229e85256a71004b24e0/f28934ff571ff3c685256db10063e81b?OpenDocument.

9. Kenneth A. Small, Clifford Winston, and Jia Yan, "Differentiated Road Pricing, Express Lanes, and Car Pools: Exploiting Heterogeneous Preferences in Policy Design," *Brookings–Wharton Papers on Urban Affairs* (2006), Table 5.

10. John E. (Jay) Evans, IV, Kiran U. Bhatt, and Katherine F. Turnbull, "Road Value Pricing: Traveler Response to Transportation System Changes," Chapter 14 in *Transportation Cooperative Research Report 95* (Washington, D.C.: Transportation Research Board, 2003), p. 14-56.

11. Ibid., p. 14-13; and Transport for London, *Central London Congestion Charging,* p. 11.

projects to be rejected. For example, projects in the San Francisco area; on I-35W in Minneapolis, Minnesota; and New York City—all with large projected net social benefits—have been rejected even though they included some allowances to make them more equitable.

Still, the use of priced lanes by both high- and low-income users appears to be selective. Studies indicate that roughly half of the drivers using such lanes do so once a week or less, so the decision is not solely based on income.[12] More important, revenues from congestion pricing can be used to address concerns about a disproportionate effect on lower-income users. In London, for example, revenues from congestion pricing have been used in part to improve bus service in the area, enhancing transportation services to low-income people and others who use them.

Congestion on alternative routes and highway lanes can reduce the benefits of congestion pricing. For example, on State Route 91 in California, charging a price for using the express lanes results in an increase in traffic in the unpriced lanes that reduces the net social benefits of the congestion pricing by about 30 percent compared with a scenario in which the pricing would apply to all lanes.[13] However, the magnitude of such an effect depends greatly on the availability and capacity of alternative routes. In addition, the persistence of congestion in spite of appropriate congestion charges provides an important signal to decisionmakers about where to make future investments.

The costs of building and operating a congestion-pricing system can also reduce the benefits of the policy. Those expenses include both the cost of collecting the charges and the cost of highway users' time waiting to pay the charges. Although congestion pricing has always been implemented with electronic toll collection—which has about the same collection costs as other systems but processes transactions much more quickly, thereby reducing waiting time—electronic systems require a large initial investment.[14] For example, an extension to the London congestion-pricing zone was estimated to cost approximately £140 million ($258 million at then-current exchange rates) to implement over three years, and the Ohio Turnpike Commission estimates that implementing E-ZPass on the Ohio Turnpike will cost between $45 million and $50 million by the time the project is completed late this year.

Implementation difficulties can also reduce the benefits of congestion pricing. For instance, complicated traffic patterns have made it more difficult to determine the appropriate congestion charge in some circumstances. Discounts for people living within the recent expansion of the Central London zone appear to reduce the social benefits of that expansion to the point that they are less than the costs. Concerns about ineffectiveness in reducing congestion (attributable in part to those discounts) and concerns about the effect on local businesses have prompted the newly elected mayor of London to decide to rescind the recent expansion of the zone.

In addition, congestion charges may not fully reflect the cost of congestion. For instance, significant congestion remains at the bridges and tunnels between New Jersey and New York City, as most users are apparently willing to pay the toll rather than switch to alternative times, routes, or modes. That persistence of congestion probably reflects the inadequacy of the charge rather than a failure of congestion pricing itself. Finally, concerns about the confidentiality of data collected by electronic tolling systems pose another potential barrier.

## Policy Options

The Safe, Accountable, Flexible, Efficient Transportation Equity Act—A Legacy for Users (SAFETEA-LU, 23 U.S.C. 101-166) is set to expire on September 30, 2009, providing the Congress with an opportunity to address highway congestion. Because the federal government owns or operates very few highways itself, federal policy must rely on encouraging state and local governments to expand the use of congestion pricing. There are various options to expand congestion pricing in reauthorizing surface transportation programs if the Congress determines that it would like to do so. Those presented here reflect a range of possibilities, rather than a ranking or a comprehensive list. They are not mutually exclusive, and any option could be used in combination with any other.

12. Evans, Bhatt, and Turnbull, "Road Value Pricing," pp. 14-55 and 14-60.

13. Small, Winston, and Yan, "Differentiated Road Pricing," Table 7.

14. See Washington State Department of Transportation, *Comparative Analysis of Toll Facility Operational Costs*, February 22, 2007, available at www.thenewspaper.com/rlc/docs/2008/07-wsdotoll.pdf.

The Congress could reduce federal barriers to the implementation of congestion pricing. For example, in order to increase the potential applicability of congestion pricing, the Congress could remove or reduce restrictions on the number of Interstate highway facilities charging tolls. It could also eliminate or ease the limit on the number of states allowed to participate in the Federal Highway Administration's Value Pricing Pilot Program, which provides tolling authority and federal funding for studies of demonstration projects involving congestion pricing. Increasing the number of states and localities permitted to participate in that program, and the associated funding, would both extend tolling authority and boost the funding available for planning.

The Congress could also change highway funding mechanisms. For example, it could create a program that would encourage the conversion of underutilized HOV lanes to HOT lanes. Because of the prevalence of HOV lanes throughout the United States, that approach represents a substantial opportunity to reduce congestion. The Congress could make federal transportation funding contingent on the adoption of congestion pricing (or other strategies to relieve congestion)—as the Department of Transportation's Urban Partnerships Program already does for large urban areas. The Congress could also increase the level of federal "matching" of state funds for highway projects that use congestion pricing, as it has done for HOV lanes on Interstate highways.

There are several ways in which the Congress could address concerns about equity that are posed by congestion pricing. It could, for instance, require that revenues from congestion pricing be spent on alternative transportation modes or routes. To keep traffic congestion from shifting undesirably to alternative routes, it could require that those routes meet minimum performance standards, such as maintaining minimum traffic speeds. To keep congestion pricing from disproportionately affecting low-income users, the Congress could provide them with tax credits or exemptions. Or it could reimburse affected low-income drivers or offset general taxes that fund transportation improvements.

Finally, the Congress could help reduce the transaction costs associated with congestion pricing by requiring interoperable electronic tolling for congestion-pricing projects, which would reduce the amount of time highway users spend waiting to pay tolls. Electronic toll collection is already required in the Federal Highway Administration's Express Lanes Demonstration Program, and electronic tolling mechanisms are required to be interoperable in various programs related to congestion pricing.

CHAPTER

# 1

# Highway Congestion and Federal Policy

According to one widely cited study, highway congestion caused 4.2 billion hours of delay and the use of 2.9 billion gallons of additional fuel in 2005, at a cost of $78 billion to highway users.[1] Other similar studies have found that highway users faced significant delays and costs because of congestion at major urban intersections, on major transportation corridors between cities, and at locations with large amounts of truck traffic.[2] Moreover, the costs of highway congestion extend beyond the highway users themselves. One recent study estimated that highway congestion cost businesses in one major metropolitan area up to $1 billion per year in increased production and distribution costs, over and above the costs borne by highway users themselves.[3] Congestion is estimated to represent half of all the "external costs" that an automobile user imposes on other members of society. (Other external costs include costs imposed by pollution generally, greenhouse gases, and accidents.)[4]

Highway congestion is defined as the delay a vehicle causes to other vehicles on the highway. Delays frequently occur when the number of vehicles approaches the highway's theoretical capacity. Those bottleneck delays are the single largest cause of delays nationwide (see Figure 1-1). But highways that were completely uncongested all the time would not necessarily be desirable from a social point of view; the cost of such a system would greatly exceed the benefits of any time saved.

Highway congestion has been increasing and is expected to be even more prevalent in the coming years. According to estimates by the Department of Transportation's Federal Highway Administration (FHWA), 11 percent of the major highways in the United States experienced peak-period congestion in 2002, but by 2035, that figure is expected to rise to 40 percent (see Figure 1-2).

Until recently, federal highway policy was not designed to reduce congestion.[5] The Federal-Aid Highway Act of 1956 acknowledged traffic congestion in urban areas, but

1. Texas A&M University, Texas Transportation Institute, *Urban Mobility Report* (2007), p. 1, available at http://mobility.tamu.edu/ums. The Texas Transportation Institute (TTI) provides the most widely cited estimates, but exact measures of congestion would be very difficult to develop. TTI's estimates do not include congestion on roads in smaller towns or rural areas and therefore may underestimate the amount of congestion nationwide. However, some observers note that TTI measures congestion relative to free flows of traffic and uses theoretical relationships rather than actual operational data. Those factors would cause TTI to overestimate traffic congestion in urban areas. In addition, the organization's figure on the amount of fuel wasted may be an overestimate because it relies on dated information on fuel consumption.

2. For a discussion of delays at major urban intersections, see American Highway Users Alliance, *Unclogging America's Arteries: Effective Relief for Highway Bottlenecks, 1999–2004* (Washington, D.C., February 2004), available at www.highways.org/pdfs/bottleneck2004.pdf; transportation corridors between cities, see Department of Transportation, Federal Highway Administration, Office of Freight Management and Operation, *Measuring Travel Time in Freight Significant Corridors* (April 2005), available at http://ops.fhwa.dot.gov/freight/documents/travel_time_flyer.pdf; locations with large amounts of truck traffic, see Cambridge Systematics, *An Initial Assessment of Freight Bottlenecks on Highways* (prepared for the Department of Transportation, Federal Highway Administration, October 2005), available at www.fhwa.dot.gov/policy/otps/bottlenecks/bottlenecks.pdf.

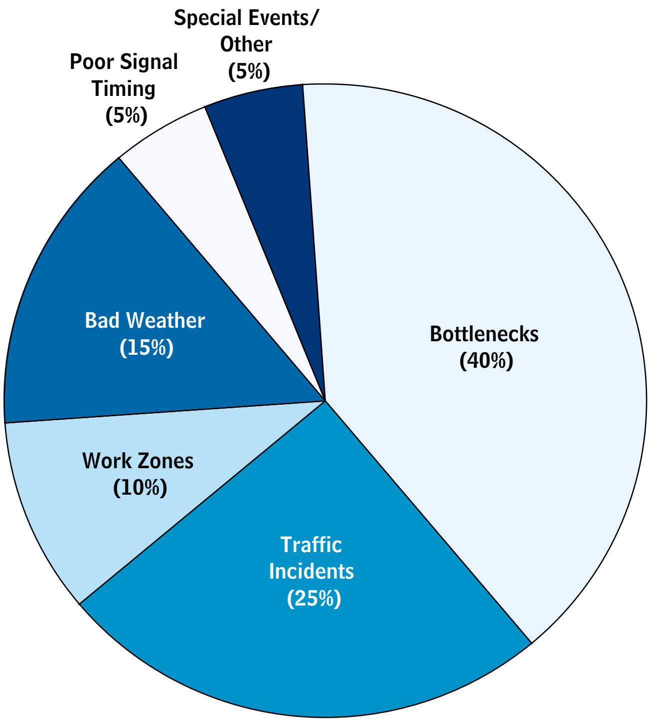
3. Transportation Research Board, National Cooperative Highway Research Program, *Economic Implications of Congestion*, Report 463 (Washington, D.C., 2001), available at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_463-a.pdf.

4. Ian W. H. Parry, Margaret Walls, and Winston Harrington, "Automobile Externalities and Policies," *Journal of Economic Literature*, vol. 45, no. 2 (June 2007), p. 384.

5. For a more extensive discussion of related legislative issues, see William J. Mallett, *Surface Transportation and Congestion: Policy and Issues* (Congressional Research Service, May 2007), available at www.wsdot.wa.gov/NR/rdonlyres/3E559F5A- 9958-4F05-816C-1EC02069BAE3/0/SurfaceTransportationCongestionPolicyandIssuesCRS.pdf.

**Figure 1-1.**

## Sources of Highway Congestion




Source: Cambridge Systematics, *Traffic Congestion and Reliability: Trends and Advanced Strategies for Congestion Mitigation* (prepared for the Department of Transportation, Federal Highway Administration, September 1, 2005), p. 3.

the primary purpose of the legislation was to authorize construction of the Interstate Highway System. The Highway Revenue Act of 1956 authorized creation of the Highway Trust Fund to finance the construction and expansion of the federal-aid highway system. Revenues paid to the trust fund come almost entirely from the federal tax on gasoline and other transportation-related excise taxes. Consequently, drivers pay about the same amount to use highways regardless of the number of vehicles on them at a given time or place.

Through the 1960s, the federal-aid highway program focused primarily on completing the Interstate Highway System. By the 1970s, with most of that system built, attention turned to energy efficiency, emissions, and highway safety. Since the 1980s, the number of highway lane miles has been essentially unchanged, while the number of vehicle miles traveled has nearly doubled (see Figure 1-3). The result was increased congestion that has brought the problem to the attention of policymakers.

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA, 23 U.S.C. 1001 et seq.) recognized that traffic congestion in urban areas was becoming a growing problem.[6] Increasing air pollution from greater highway use and the growing amount of resources needed to maintain the mature highway system made it difficult to solve the problem by expanding capacity. Instead, ISTEA sought to improve the efficiency with which the existing highway system was used. States and localities were encouraged to use the money they received from the Highway Trust Fund to develop their own solutions to local congestion problems.

Two factors have made it difficult for the federal government to direct money where it is most needed to reduce congestion nationwide. First, funding has been limited by the formula to allocate funds among states, which has tended to equalize the resources among states. Second, identifying where to invest has been problematic because the costs of congestion have sometimes been borne by people far removed from where the congestion occurs. In an effort to address those problems, ISTEA provided funding for five demonstration projects in the Congestion Pricing Pilot Program; provided funding for technology-based approaches, termed intelligent transportation systems; and made it easier to use federal-aid funds to build and maintain toll roads.[7]

In 1998, the Congress enacted the Transportation Equity Act for the 21st Century (TEA-21, Public Law 105-178), essentially continuing the congestion-mitigation policies begun in ISTEA.[8] The Congestion Pricing Pilot Program was renamed the Value Pricing Pilot Program, and funding for it and intelligent transportation systems was increased.

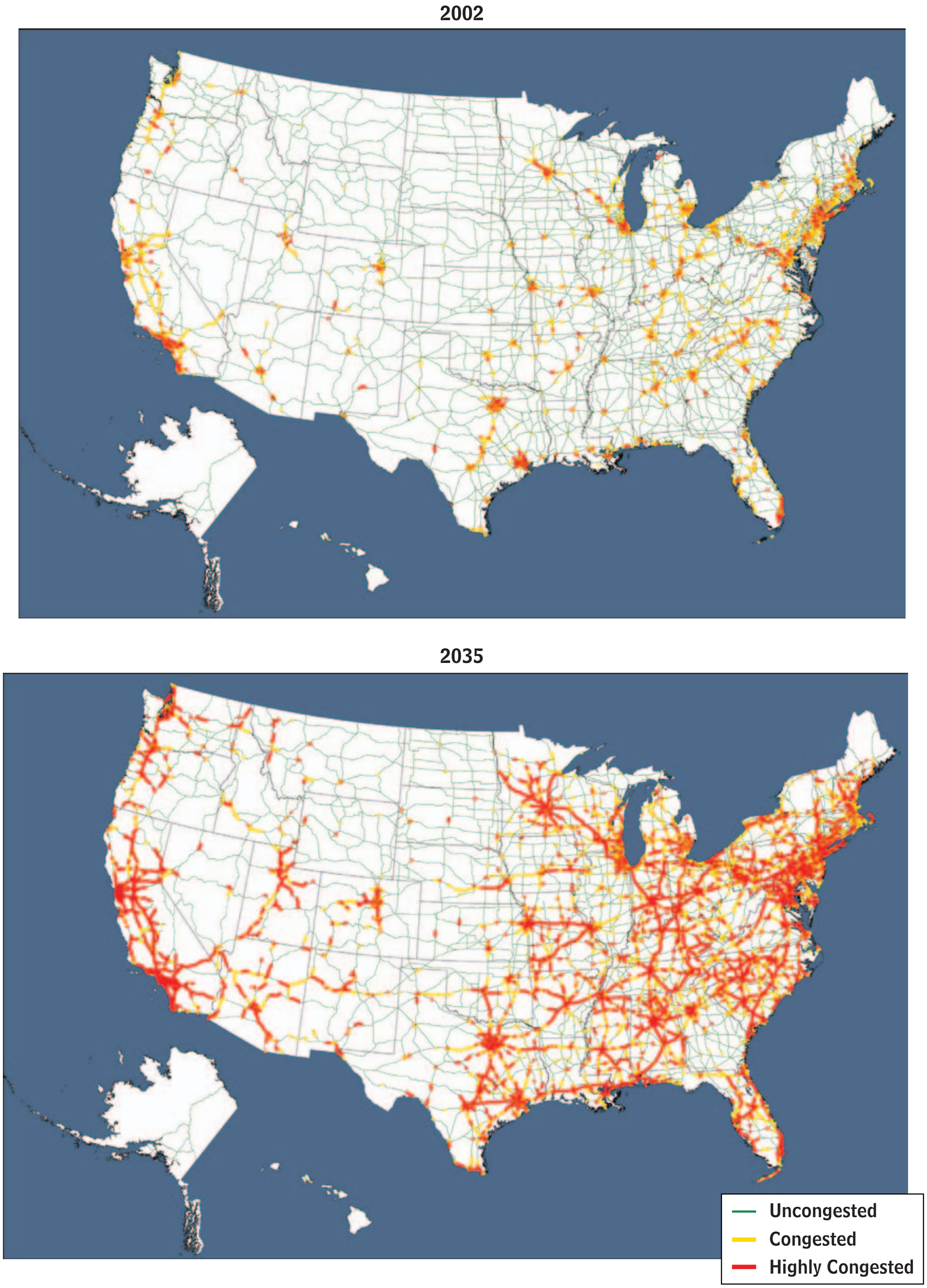
6. See Senate Committee on Environment and Public Works, *The Surface Transportation Efficiency Act of 1991*, S. Rept. 102-71 (June 4, 1991); and House Committee on Public Works and Transportation, *Intermodal Surface Transportation Infrastructure Act of 1991*, H. Rept. 102-171(I) (July 26, 1991).

7. Intelligent transportation systems use a variety of computer, communication, and sensor technologies to improve highways and mass transit. See Congressional Budget Office, *High-Tech Highways: Intelligent Transportation Systems and Policy* (October 1995).

8. For information on major provisions, see Federal Highway Administration, *Transportation Equity Act for the 21st Century, A Summary* (July 14, 1998), available at www.fhwa.dot.gov/tea21/sumcov.htm.

**Figure 1-2.**

## Peak-Period Congestion in the National Highway System, 2002 and 2035

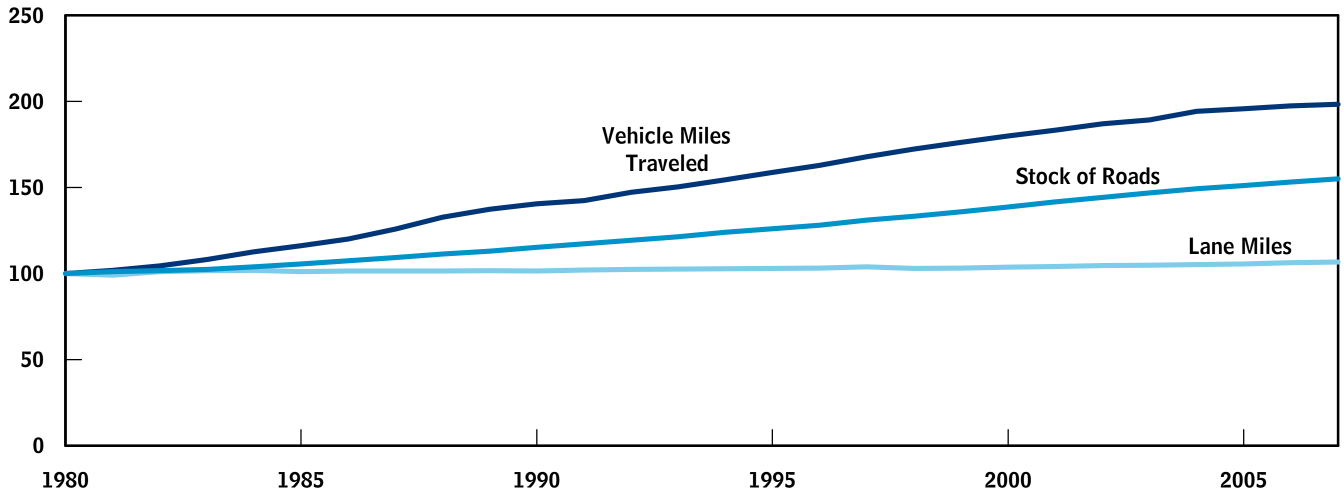



Source: Federal Highway Administration.

**Figure 1-3.**

## The Amount of Traffic Compared with the Stock of Roads

(Index, 1980 = 100)




Source: Congressional Budget Office based on data as follows: for vehicle miles traveled, Department of Transportation, Federal Highway Administration, *Highway Statistics Summary to 1995*, Table VM201, "Annual Vehicle Distance Traveled by Vehicle Type and Highway Category," and *Highway Statistics*, Table VM-1, "Annual Vehicle Distance Traveled"; for lane miles, Department of Transportation, Federal Highway Administration, *Highway Statistics Summary to 1995*, Table HM260, "Estimated Lane Length," and *Highway Statistics*, Table HM-60, "Functional System Lane Length"; for stock of roads, Department of Commerce, Bureau of Economic Analysis, Fixed Asset Table 7.2B, "Chain-Type Quantity Indexes for Net Stock of Government Fixed Assets," Line 14, available at www.bea.gov/national/FA2004/TableView.asp?SelectedTable=31&FirstYear=2002&LastYear=2007&Freq=Year, accessed on January 16, 2009.

Note: "Vehicle Miles Traveled" conveys the increase since 1980 in the total amount of traffic. The "Stock of Roads" expresses the increase over the same period in the value of roads, bridges, signs, and other such capital—representing a rough measure of the condition of the highway system. "Lane Miles" is a physical measure of the stock of roads.

In 2005, the Safe, Accountable, Flexible, Efficient Transportation Equity Act—A Legacy for Users (SAFETEA-LU, 23 U.S.C. 101-166) was enacted.[9] That law again continued the policies begun by ISTEA. It increased the funding of the Value Pricing Pilot Program (from $51 million to $59 million over five years), again increased funding for intelligent transportation systems, and changed rules to make it easier for state and local governments to use federal-aid funds to build and maintain toll roads. However, the formula to allocate funds among states again tended to equalize resources, making it more difficult to direct money to where it was most needed to reduce congestion. SAFETEA-LU also provided legal authority, but not federal funding, to convert high-occupancy vehicle (HOV) lanes to high-occupancy toll (HOT) lanes (23 U.S.C. section 1121).

9. See John W. Fischer, *Safe, Accountable, Flexible, Efficient Transportation Equity Act—A Legacy for Users (SAFETEA-LU or SAFETEA): Selected Major Provisions (*Congressional Research Service, October 18, 2005), available at www.congress.gov/erp/rl/html/RL33119.html, for a summary of major provisions of SAFETEA-LU.

CHAPTER

# 2

# Evaluating Congestion Pricing

Drivers will decide to use a busy highway at rush hour if the benefit *for them* is greater than the cost *to them.* The cost to them would include their vehicle operating costs and the value of their travel time. However, as more drivers use the highway, increasing congestion forces everyone to slow down, increasing the travel time for everyone and, hence, the cost of the trip. An individual driver is not likely to consider the congestion costs that he or she imposes on other drivers because each driver is just one of thousands on the highway at that hour. But the highway is overused because the costs that drivers making the least-valued trips impose on all of the others is greater than the benefits they receive individually from making the trips.

Congestion pricing charges drivers for the costs they impose on other highway users by driving at peak hours. The fee converts the cost of delay imposed on other drivers into an explicit monetary cost for each driver using the road. In principle, the congestion fee equals the cost of delay that each driver imposes on all other drivers already on the highway. The costs incurred by drivers would then include operating costs, the opportunity cost of travel time, *and* the cost of delay that they impose on others. Faced with paying the fee, fewer drivers use the highway at that time, so congestion is reduced, and trip times become shorter and more reliable.

For people making highly valued trips (such as people who place a high value on time or who do not have alternative times, routes, or modes readily available), the value of the time savings usually exceeds the cost of the congestion charge, so they are likely to remain on that route at that time. Others are likely to switch to an alternative time, route, or mode or possibly not make the trip at all. Because the users taking the more highly valued trips are likely to remain on the road, and the users taking the less valued trips are likely to find another alternative, the benefits to the users who remain on the road are greater than the losses to the users who leave. Some of the revenue brought in by congestion charges can then be put to improving transportation options for other times, routes, or modes—enough that even drivers making less valued trips are better off.

## Types of Congestion Pricing

Congestion pricing can be of two types: cordon charges, which apply to all highways, bridges, or tunnels serving a congested area, such as the center of a city, and corridor charges, which apply to part or all of one congested highway, bridge, or tunnel. Corridor charges can apply to variably priced facilities, where all lanes of a highway, bridge, or tunnel are subject to a congestion charge; variably priced lanes, where some lanes are subject to a congestion charge; and high-occupancy toll lanes, where vehicles with one or two occupants are subject to a fee for using high-occupancy vehicle lanes.

According to a recent estimate, congestion pricing has been applied to less than 1 percent of the congested highways in the United States.[1] But a number of additional projects are under construction or under study—motivated in large part by the potential to reduce congestion more effectively than trying to reduce demand through strategies that do not involve pricing, and at a much lower cost than expanding highway capacity or improving alternative modes. (Table 2-1 provides a list of congestion-pricing projects that are in operation or under consideration in the United States. A more detailed description of a project of each type is presented in the appendix.)

1. See David Lewis, *America's Traffic Congestion Problem: Toward a Framework for Nationwide Reform*, Discussion Paper 2008-06 (Washington, D.C.: Brookings Institution, The Hamilton Project, July 2008), p. 11, available at www.brookings.edu/papers/2008/07_congestion_pricing_lewis.aspx.

**Table 2-1.**

## Congestion-Pricing Projects in the United States

| State | Location | Route or Facility | Type of Project | Status |
|---|---|---|---|---|
| California | Orange County | State Route 91 | Priced Lanes | Operating, December 1995 |
| California | San Diego | I-15 | Conversion of HOV to HOT Lanes | Operating, December 1996 |
| Texas | Houston | I-10 | Conversion of HOV to HOT Lanes | Operating, January 1998 |
| Florida | Lee County | Fort Myers Bridges | Priced Facility | Operating, August 1998 |
| New Jersey | Statewide | New Jersey Turnpike | Priced Facility | Operating, Fall 2000 |
| Texas | Houston | U.S. 290 | Conversion of HOV to HOT Lanes | Operating, November 2000 |
| New Jersey | Hudson River | Crossings | Priced Facility | Operating, March 2001 |
| California | Orange County | State Route 73 | Priced Facility | Operating, February 2002 |
| California | Orange County | State Routes 241 and 261 | Priced Facility | Operating, February 2002 |
| Illinois | Northern | Illinois Tollway | Priced Facility | Operating, January 2005 |
| Minnesota | Minneapolis | I-394 | Conversion of HOV to HOT Lanes | Operating, May 2005 |
| Utah | Salt Lake City | I-15 | Conversion of HOV to HOT Lanes | Operating, September 2006 |
| Colorado | Denver | I-25 and U.S. 36 | Conversion of HOV to HOT Lanes | Operating, June 2006 |
| Washington | Seattle | State Route 167 | Conversion of HOV to HOT Lanes | Operating, May 2008 |
| California | San Diego | I-15 | Priced Lanes | Operating, September 2008 |
| Florida | Miami | I-95 | Conversion of HOV to HOT Lanes | Operating, December 2008 |
| Texas | Houston | I-10 | Priced Lanes | Opening, March 2009 |
| Texas | Dallas | I-30 | Conversion of HOV to HOT Lanes | Opening, Spring 2010 |
| Maryland | Baltimore | I-95 | Priced Lanes | Began Construction, 2005 |
| Maryland | Montgomery County | Intercounty Connector | Priced Facility | Began Construction, 2008 |
| Virginia | Northern Virginia | I-495 | Priced Lanes | Began Construction, July 2008 |
| California | Alameda County | I-680 | Conversion of HOV to HOT Lanes | Began Construction, Fall 2008 |
| Colorado | Denver | State Route 470 | Priced Lanes | Under Study |
| Florida | Broward County | State Route 869 | Priced Facility | Under Study |
| Florida | Broward County | I-595 | Priced Lanes | Under Study |
| Florida | Lee County | Sanibel Island Bridge | Priced Facility | Under Study |
| Florida | Southern | Florida Turnpike | Priced Facility | Under Study |
| Georgia | Atlanta | I-75 | Priced Lanes | Under Study |
| Georgia | Atlanta | State Route 400 | Priced Facility | Under Study |
| New Jersey | Weehawken | Lincoln Tunnel Bus Lane | Priced Facility | Under Study |
| North Carolina | Research Triangle | I-40 | Priced Lanes | Under Study |
| Oregon | Portland | State Route 217 | Priced Lanes | Under Study |
| Texas | Austin | Loop 1 | Priced Lanes | Under Study |
| Texas | Austin | State Route 130 | Priced Facility | Under Study |
| Texas | Dallas | I-635 | Priced Lanes | Under Study |
| Texas | San Antonio | I-10 | Priced Lanes | Under Study |
| Texas | San Antonio | I-35 | Priced Lanes | Under Study |
| Virginia | Northern Virginia | I-395 | Priced Lanes | Under Study |

Sources: Department of Transportation, Federal Highway Administration, *Value Pricing Quarterly Report* (October-December 2007); David Lewis, *America's Traffic Congestion Problem: Toward a Framework for Nationwide Reform,* Discussion Paper 2008-06 (Washington, D.C.: Brookings Institution, The Hamilton Project, July 2008), Table 7; and Congressional Budget Office, interviews with officials of the Federal Highway Administration, September 2008.

Note: HOV = high-occupancy vehicle; HOT = high-occupancy toll.

## Benefits

The Congressional Budget Office (CBO) reviewed the best available evidence on congestion-pricing projects to assess the benefits and challenges. Although the basic mechanism by which congestion pricing works is the same regardless of the method used, the benefits and challenges may differ depending on the particular circumstances.

CBO's review indicates that congestion-pricing projects have reduced congestion and generated benefits to society in excess of their costs. For example, according to the best available estimate, a cordon charge that applies to the most congested area of London has generated net social benefits of about £67 million annually ($122 million at then-current exchange rates).[2] Similarly, priced lanes on State Route 91 in Orange County, California, generate net social benefits of at least $12 million per year, compared with a scenario in which the lanes had been built but drivers did not pay to use them.[3]

Some studies have estimated the impact of widespread implementation of congestion pricing. They rely on very aggregated estimates of highway traffic, the responsiveness of highway traffic to changes in price, and other factors. They employ different methodologies, simulate congestion pricing on different sets of highways, consider different types of benefits and costs, and cover different time periods. Those studies suggest that widespread implementation of congestion pricing could provide net social benefits of $19 billion to $45 billion per year (in 2005 dollars), which would reduce the estimated cost of congestion by one-quarter to more than one-half.[4]

Congestion pricing offers a number of benefits, including reduced congestion, shorter travel times, more reliable travel times, and more efficient investment in infrastructure. Indirect benefits, such as reduced fuel consumption and reduced pollution, are much smaller. For example, the Texas Transportation Institute (TTI) estimates congestion resulted in an additional 2.9 billion gallons of fuel used in 2005. At an average price of $2.31 per gallon that year, the additional fuel represents just under 10 percent of TTI's estimated $78 billion in congestion costs. The external costs of local pollution and greenhouse gases from automobile use have been estimated at 48 cents per gallon. With that cost applied, the additional 2.9 billion gallons of fuel used because of congestion results in costs for global warming and local pollution of $1.4 billion per year, roughly 2 percent of TTI's overall estimate. The indirect benefit of improved land use applies over the long term—and may be much larger.[5]

### Reduced Congestion

Evidence from various projects indicates that congestion pricing reduces congestion. Most estimates indicate that a 10 percent increase in the fee reduces traffic by up to

2. Jonathan Leape, "The London Congestion Charge," *Journal of Economic Perspectives*, vol. 20, no. 4 (Fall 2006), p. 172.

3. CBO's estimate is based on information from Kenneth A. Small, Clifford Winston, and Jia Yan, "Differentiated Road Pricing, Express Lanes, and Car Pools: Exploiting Heterogeneous Preferences in Policy Design," *Brookings–Wharton Papers on Urban Affairs* (2006); and Edward Sullivan, *Continuation Study to Evaluate the Impacts of the SR 91 Value-Priced Express Lanes: Final Report* (prepared for the State of California, Department of Transportation, December 2000).

4. Lewis, *America's Traffic Congestion Problem*, Table 5, estimates the long-term net social benefits of a nationwide system of congestion pricing at roughly $17 billion per year (in 2000 dollars). Ashley Langer and Clifford Winston, "Toward a Comprehensive Assessment of Road Pricing Accounting for Land Use," *Brookings–Wharton Papers on Urban Affairs* (2008), Table 5, estimates a net social benefit of $40 billion per year (in 2000 dollars) once the long-term effects of land use are taken into account. After an adjustment for inflation, the benefits reported in those studies represent one-quarter to more than one-half of the $78 billion in congestion costs (in 2005 dollars) reported by the Texas Transportation Institute.

5. Those calculations represent rough estimates of the costs. TTI's estimate of congestion costs includes travel time but not travel time reliability. Including reduced travel time reliability as part of the costs would reduce the percentage of benefits attributable to indirect factors. Local pollution reductions due to congestion pricing are likely to take place in large cities, where the cost of pollution is higher than average. Taking account of local pollution costs would increase the share of benefits attributable to pollution reduction. For estimates of the external costs of automobile use, see Ian W. H. Parry, Margaret Walls, and Winston Harrington, "Automobile Externalities and Policies," *Journal of Economic Literature*, vol. 45, no. 2 (June 2007); for average fuel prices in 2005, see Department of Energy, Energy Information Administration, Weekly Retail Gasoline and Diesel Prices, available at http://tonto.eia.doe.gov/dnav/pet/pet_pri_gnd_dcus_nus_w.htm, accessed on February 10, 2009; for a discussion of the effect of congestion pricing on fuel use and pollution, see John E. (Jay) Evans, IV, Kiran U. Bhatt, and Katherine F. Turnbull, "Road Value Pricing," Chapter 14 in *Transportation Cooperative Research Report 95, Traveler Response to Transportation System Changes* (Washington, D.C.: Transportation Research Board, 2003), pp. 14-48–14-50; for a discussion of the effect on land use, see Langer and Winston, "Toward a Comprehensive Assessment of Road Pricing Accounting for Land Use."

5 percent and shifts traffic away from the periods with the highest charges.[6] The program in Central London provides an example of how cordon charges can reduce congestion. In February 2003, Transport for London imposed a daily cordon charge of £5 per vehicle (about $8.20 at then-current exchange rates) to drive or park on a street within an 8-square-mile zone in the city center.[7] As a result, traffic within the zone declined by 15 percent, and congestion within the zone (as measured by the difference between actual travel times and travel times when traffic is flowing freely) declined by 30 percent.[8] However, the most recent data indicate that although the number of vehicles has declined since the charge was implemented, traffic congestion has returned to the levels that existed before the charge was implemented—for two reasons: Some street capacity was allocated to bicycle and pedestrian lanes, and utility companies and local governments took advantage of reduced congestion to conduct repairs.[9] One study suggested that a similar plan might reduce congestion in New York City, but such a plan was considered in 2008 and rejected (see Box 2-1).[10]

The bridges and tunnels of the Port Authority of New York and New Jersey (PANYNJ) provide an example of how variably priced facilities can reduce congestion. In March 2001, PANYNJ implemented a congestion-pricing system on its six bridges and tunnels, which carry about 350,000 vehicles in each direction each day. Tolls are collected only in the eastbound direction into New York City, with no tolls in the other direction. Under that system, users who paid cash were charged $6.00 at all hours, while users of the E-ZPass electronic toll collection system paid $5.00 at peak hours and $4.00 at off-peak hours. As a result of the program, traffic in the peak morning period declined by 7 percent compared with that in the previous year, traffic in the peak evening period declined by 4 percent, and overall traffic remained the same.[11] Among trucking carriers, 6 percent shifted their operations to off-peak hours as a result of the change in tolls.[12] On March 2, 2008, the tolls increased, so the cash charge is now $8.00, and E-ZPass rates are $8.00 during peak hours and $6.00 during off-peak hours. Those changes eliminated the discount for E-ZPass users at peak hours, but offered a larger percentage discount for E-ZPass users during off-peak hours. The effect of those recent changes has not yet been analyzed.

Although the charges have reduced congestion at the Port Authority's bridges and tunnels, many users still value travel at peak hours, and congestion on those bridges and tunnels remains. For instance, although 6 percent of trucking carriers shifted their operations to off-peak hours as a result of the change in tolls, in a survey two-thirds of the carriers that did not do so cited the inability of recipients to accept off-peak deliveries as the reason for not switching.[13] Presumably, in those trucking companies' estimation, the cost of lost business would exceed the cost of the congestion charge. The cost of the congestion charges paid by trucking companies will ultimately be paid in whole or in part by the businesses that take the deliveries, and other highway users will experience somewhat less congestion than they did previously.

6. See Evans, Bhatt, and Turnbull, "Road Value Pricing," p. 14-5.

7. Transport for London, *Central London Congestion Charging: Impacts Monitoring,* First Annual Report (2003), p. 228. In February 2007, the charging zone was approximately doubled to its current size by including an area west of the original zone.

8. Transport for London, *Central London Congestion Charging: Impacts Monitoring,* Second Annual Report (2004), pp. 11 and 23.

9. Transport for London, *Central London Congestion Charging: Impacts Monitoring,* Sixth Annual Report (2008), pp. 3 and 53–55.

10. See Jeffrey A. Zupan and Alexis F. Perrotta, "An Exploration of Motor Vehicle Congestion Pricing in New York" (presentation given at the Eno Transportation Foundation's conference on congestion pricing, New York City, November 3–4, 2003), available at www.rpa.org/pdf/RPA_Congestion_Pricing_NY.pdf.

11. Mark F. Muriello, *Pricing on Toll Facilities—NJ/NY: Variable Tolls on Port Authority Interstate Vehicle Crossings,* September 30, 2003, available at http://knowledge.fhwa.dot.gov/cops/hcx.nsf/384aefcefc48229e85256a71004b24e0/f28934ff571ff3c685256db10063e81b?OpenDocument. A separate analysis indicated that among E-ZPass users who were aware of the off-peak pricing, 16 percent had changed their travel schedules to take advantage of the discount. See Department of Transportation, Federal Highway Administration, *Value Pricing Project Quarterly Reports*, October–December 2007, p. 43, available at www.ops.fhwa.dot.gov/tolling_pricing/value_pricing/pubs_reports/quarterlyreport/qtr4rpt07/index.htm.

12. José Holguín-Veras, Kaan Ozbay, and Allison de Cerreño, *Evaluation Study of Port Authority of New York and New Jersey's Time of Day Pricing Initiative, Final Report* (prepared for the New Jersey Department of Transportation and the Federal Highway Administration, March 2005), p. 7, available at www.knowledge.fhwa.dot.gov/cops/hcx.nsf/All+Documents/F28934FF571FF3C685256DB10063E81B/$FILE/PANYNJ%20Final%20Report.pdf.

13. Ibid.

**Box 2-1.**

## New York City's Congestion-Pricing Plan

In December 2006, the Department of Transportation solicited proposals from a number of cities to develop a variety of complementary strategies to relieve urban congestion. New York City applied for a $500 million grant to implement a three-year pilot project on congestion pricing as part of a more comprehensive program known as PlaNYC 2030.[1] Under the plan, automobiles would have been charged $8.00 per day and trucks $21.00 per day to enter Manhattan below 86th Street between 6 a.m. and 6 p.m. on weekdays. Drivers of automobiles that operated solely within that area would have received a 50 percent discount; emergency vehicles, vehicles with disability license plates, and taxis would have been exempt from the charge, and drivers who had already paid tolls to enter the city would have received credits. Charges were to be collected using E-ZPass and photographic recording of license plates, and all revenues were to be used for transportation improvements.

Proponents of the plan envisioned substantial benefits, including reduced congestion, improved transit service (funded by an estimated $400 million each year in net revenues from the congestion fees), and improved air quality. Opponents of the plan raised a variety of objections.[2] Chief among them were concerns about the impact that the plan would have on drivers in the outer reaches of New York City and the surrounding suburbs and on low- and moderate-income drivers. (Subsequent modifications to the plan included tax credits for low-income drivers who paid the congestion charge.) Other objections were based on concerns about who would control the plan (the mayor or the state legislature), whether the revenues from the plan should be used to improve the transit system or to reduce fares, whether sufficient transit improvements would be in place before the plan went into effect, whether residential parking permits would be available, and whether tolling data would remain confidential.

State legislation was needed in order for the city to impose a congestion fee and have the right to fine violators. The governor and state senate supported the necessary legislation, but the state assembly did not.[3] As a result, New York City was not able to develop a congestion-pricing plan within the time specified by the Department of Transportation and was therefore unable to obtain the grant offered by the department. At this point, New York City is considering congestion-pricing options that would not involve federal funds.

1. City of New York, *PlaNYC 2030: A Greener, Greater New York* (April 22, 2007), pp. 72–97, available at www.nyc.gov/html/planyc2030/html/home/home.shtml.

2. See Richard L. Brodsky, Chairman, Committee on Corporations, Authorities, and Commissions, New York State Assembly, *An Inquiry into Congestion Pricing as Proposed in PlaNYC 2030 and S. 6068: Interim Report* (July 9, 2007).

3. "$8 Traffic Fee for Manhattan Fails in Albany," *New York Times*, April 8, 2008, p. A1.

State Route 91 in Orange County, California, provides an example of how variably priced lanes can reduce congestion. Opened in 1995, the variably priced lanes are located in a 10-mile section of the median strip of the highway. Current tolls range from $1.25 to $9.55 depending on the time of day and day of week and are adjusted every three months to maintain a free flow of traffic in the priced lanes.[14] According to the best available estimate, congestion charges sufficient to increase the total cost of a trip by 10 percent decrease traffic by 3.6 percent compared with a scenario in which the lanes had been built but not priced.[15]

14. See www.91expresslanes.com/tollschedules.asp, accessed on February 3, 2009. See also Department of Transportation, Federal Highway Administration, *Congestion Pricing, A Primer* (December 2006), p. 6; and Sullivan, *Continuation Study*, p. 2.

15. Small, Winston, and Yan, "Differentiated Road Pricing," Table 5. The total cost of a trip includes operating costs, the value of travel time, and the value of travel time reliability.

Evidence on the effect of congestion charges in HOT lanes is sparse. CBO knows of no studies demonstrating how such a charge *itself* reduced congestion.[16] San Diego's I-15 Express Lanes, which were converted from HOV to HOT lanes and opened in December 1996, provide some indirect evidence of the effect. Pricing on that eight-mile segment is adjusted to maintain a constant travel time in the HOT lanes. The congestion charge for those lanes normally varies between $0.50 and $4.00 but can be as high as $8.00 in very congested periods. By October 1999, the number of vehicles with single occupants who were paying to use the HOT lanes had grown to 3,600 per day, or about 5 percent of the total during peak periods.[17] In addition, a commuter bus line funded in part through toll revenues from the HOT lanes carried approximately an additional 1,000 passengers per day. A subsequent reduction in off-peak tolls shifted some of the single-occupancy vehicles to off-peak times. That shift might provide some evidence of the efficacy of the charge in reducing congestion, but the effect could also be attributed to increased use of the previously underutilized HOV lanes.[18]

The prevalence of HOV lanes throughout the United States represents a substantial opportunity to reduce congestion by converting some of them to HOT lanes, regardless of whether the reduction is attributed to congestion pricing itself or simply to increased utilization of those lanes. Of the more than 120 existing HOV projects in the United States, only 7 make use of HOT lanes.[19] Although some HOV lanes have become congested in recent years, converting underutilized HOV lanes to HOT lanes could substantially reduce congestion by, in effect, expanding highway capacity. Converting overutilized HOV lanes to HOT lanes could reduce congestion by diminishing peak demand.[20]

## Shorter Travel Times

Reduced congestion results in shorter travel times—which, of course, people value. Time savings are an important factor for highway users in determining their choice of route. In London, travel speeds for trips within the congestion zone increased by 10 percent to 15 percent, while travel times for trips entering or exiting the zone declined by 14 percent.[21] According to a recent study of State Route 91 in Orange County, California, which estimated the effect of congestion pricing compared with a scenario in which additional lanes had been built but not priced, congestion pricing reduces travel time on the priced lanes by more than eight minutes for a 10-mile trip.[22] Travel time on the unpriced lanes increases by two to three minutes. Because users of the priced lanes implicitly tend to value their travel time more than users of the unpriced lanes, as evidenced by their willingness to pay the charge in return for a faster trip, a net benefit results.[23] Pricing the lanes, the study concluded, reduces congestion enough to generate a net savings of more than $2 per trip.[24] On the basis of the number of trips analyzed in that simulation, the priced

16. Such a study would, ideally, compare congestion where HOT lanes existed with a case in which there was no charge but all lanes were open to all users. In a simulation of HOT lanes on State Route 91, Small, Winston, and Yan find that the net social benefits of such lanes are slightly larger than those of variably priced lanes—because the HOT lanes provide an additional incentive for carpooling, which slightly reduces congestion relative to what it would be with variably priced lanes.

17. The experience of San Diego's I-15 Express Lanes is discussed in Evans, Bhatt, and Turnbull, "Road Value Pricing," p. 14-56.

18. For example, estimates have indicated that opening HOV lanes on I-394 in Minneapolis, Minnesota, to other traffic would increase the use of the highway. See Katherine F. Turnbull, Herbert S. Levinson, and Richard H. Pratt, "HOV Facilities," Chapter 2 in *Transportation Cooperative Research Report 95, Traveler Response to Transportation System Changes* (Washington, D.C.: Transportation Research Board, 2006), p. 2-17.

19. Transportation Research Board, *List of Existing HOV Facilities* (2005), available at www.hovworld.com/inventory.htm; and Department of Transportation, Federal Highway Administration, *Report on the Value Pricing Pilot Program Through June 2008* (August 25, 2008), Appendix 4.

20. Congestion has become a problem primarily in cases in which vehicles with two occupants or hybrid vehicles are allowed to use the HOV lanes. See Turnbull, Levinson, and Pratt, "HOV Facilities," pp. 2-33–2-44.

21. Evans, Bhatt, and Turnbull, "Road Value Pricing," p. 14-13; and Transport for London, *Central London Congestion Charging,* Second Annual Report, p. 11.

22. Small, Winston, and Yan, "Differentiated Road Pricing," Table 7.

23. Users of the priced lanes implicitly valued their time at $25.51 per hour, while users of the unpriced lanes valued their time at $18.63 per hour. Ibid., Table 4. The benefits accrue primarily to those who remain in the priced lanes.

24. Ibid., Table 7. Another study found a smaller effect using earlier data. See Louie Nan Liu and John F. MacDonald, "Efficient Congestion Tolls in the Presence of Unpriced Congestion: A Peak and Off-Peak Simulation Model," *Journal of Urban Economics*, vol. 44, no. 3 (November 1998), pp. 352–366.

lanes on that highway are estimated to generate net social benefits of at least $12 million per year.[25] Those savings reflect a combination of both shorter and more reliable travel times.

Similar savings apply to freight transportation on highways. The more rapidly a freight shipment reaches its destination, the less inventory costs shippers incur for the value of goods in transit.

### More Reliable Travel Times

In addition to shorter travel times, more reliable travel times also benefit highway users. Surveys of London highway users indicated that the variability of trip times into and out of the charging zone declined by roughly 30 percent after the implementation of congestion pricing.[26] Data taken from a survey of users of the priced lanes on State Route 91 in Orange County, California, indicate that highway users valued an improvement in the reliability of their travel time as much as they valued a decrease of similar magnitude in travel time itself.[27] Other data, taken from surveys capturing stated preferences, indicate that travelers valued the increased reliability more than twice as much as reductions in travel time itself.[28]

Similar benefits apply for freight transportation on highways. As transit times become more reliable, shippers need to hold fewer inventories in case of delays. One study estimated that freight transportation incurs more than 25 percent of all congestion costs, reflecting both longer and less reliable travel times.[29]

Interestingly, though, the importance that highway users accord to improved travel time and reliability of travel time may, in fact, limit their willingness to shift to alternative times, routes, or modes in response to congestion charges.

### More Efficient Investment

Congestion pricing also results in more efficient use of current highway capacity. By decreasing the number of vehicles at times or places with heavy traffic and increasing the number of vehicles at times or places with light traffic, congestion pricing allows the existing stock of highway capacity to carry more traffic at the same or a better level of operational performance, thus reducing the need for highway investment. Because highway infrastructure is expensive, more efficient use of that investment could save substantial amounts of money. In a recent study, the Department of Transportation's Federal Highway Administration estimated that widespread implementation of congestion pricing could reduce the amount of investment needed to maintain the highway system at its current physical condition and operational performance by more than 25 percent.[30]

In addition, congestion pricing allows future investment in highway infrastructure to be made more efficiently. In principle, congestion fees equal the cost of the delay that each highway user imposes on other users on the highway. The total of all congestion fees paid on a particular highway equals the value of the delays that could be avoided if capacity were greater. Viewed that way, congestion fees represent the return on an investment in increasing that highway's capacity. By thus helping to identify the need for new capacity at the right place and at the right time, congestion pricing can promote more efficient future investment, and it can help pay for its construction. For example, revenues from congestion pricing

25. Small, Winston, and Yan analyze a case involving approximately 24,700 rush hour trips. Multiplying that number by $2.00 per trip and then by 250, roughly the number of working days per year, results in estimated net social benefits of approximately $12 million per year. The current number of trips during rush hour is substantially more than 24,700.

26. Transport for London, *Central London Congestion Charging,* Second Annual Report, p. 11.

27. Users of the priced lanes implicitly valued reliability at $23.78 per hour, while users of the unpriced lanes valued it at $19.50 per hour. See Small, Winston, and Yan, "Differentiated Road Pricing," Table 4.

28. Kenneth Small and others, *Valuation of Travel-Time Savings and Predictability in Congested Conditions for Highway User-Cost Estimation,* National Cooperative Highway Research Report 431 (Transportation Research Board, 1999), p. 3.

29. See Clifford Winston and Ashley Langer, "The Effect of Government Highway Spending on Road Users' Congestion Costs," *Journal of Urban Economics,* vol. 60, no. 3 (November 2006), p. 478.

30. Department of Transportation, Federal Highway Administration, *2006 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance* (March 2007), p. 10-4. Based on computer models of highway infrastructure, the estimates were derived using an analysis that calculated the annual investment required to maintain highways at their current level of performance given the expected growth in traffic and no change in current public policies other than the adoption of congestion pricing.

more than cover capital and operating expenses for the priced lanes on California State Route 91.[31]

## Challenges

A number of challenges may either reduce the benefits of congestion pricing or make it more difficult to put into practice. Those challenges include distributional effects, congestion on alternative routes, transaction costs, and implementation difficulties.

### Distributional Effects

The most common objection to congestion pricing is concern about the distribution of benefits between high- and low-income highway users. Facing congestion fees, high-income drivers are more likely to remain on the highway, pay the charge, and enjoy a faster trip, whereas low-income drivers are more likely to choose other times, routes, or modes that are less expensive and be worse off. Any given congestion fee represents a larger percentage of income for a low-income person than it does for a high-income person. Consequently, congestion fees (like all other forms of highway user fees) are regressive, and congestion-pricing projects are sometimes criticized as "Lexus lanes." State and local governments may be hesitant to adopt congestion pricing because they are uncertain that the resulting benefits can be distributed in a way to make all highway users better off—even though successful projects are operating in the United States. Some observers have concluded that distributional considerations are the most important factor inhibiting the adoption of congestion pricing.[32]

Research has consistently shown that high-income highway users are more likely to use congestion-priced facilities than low-income users are. For example, a study of California State Route 91 found that high-income drivers were more than twice as likely to use the priced lanes as low-income drivers were.[33] In addition, other research has suggested that congestion pricing on that route may have made low-income drivers worse off than if the new lanes had been built but not priced.[34]

However, the use of congestion-priced lanes appears to be selective, so the decision to use them is not based solely on income. Half of the users of the priced State Route 91 lanes do so once a week or less, and similar usage occurs for the HOT lanes of I-15 in San Diego.[35] According to one survey, low-income drivers on State Route 91 used the priced lanes for 20 percent of their trips.[36] Some observers have suggested that such trips represent occasions on which low-income drivers are placing a high value on their time, when they are late for work or day care pickup, for instance.[37]

More important, some of the revenues from congestion pricing can be used to make low-income highway users better off. Lower-income commuters who used buses were some of the greatest beneficiaries of the Central London project, because revenues from congestion pricing were used to improve bus service into the cordon. As a result, the number of buses entering the congestion zone increased by 23 percent during the peak morning

31. Orange County Transportation Authority, *91 Express Lanes Annual Report* (2006), p. 16. The cost of building the priced lanes was much lower than that for similar projects because the site was within the existing median strip, eliminating the need to acquire land and to grade extensively. However, even in instances in which the cost of a project exceeds the revenues, the project may still be economically beneficial because the additional capacity of the priced lanes provides an additional benefit by reducing the traffic using competing unpriced lanes. See Transportation Research Board, *The Fuel Tax and Alternatives for Transportation Funding,* Special Report 285 (2006), pp. 5-6.

32. See, for example, Lewis, *America's Traffic Congestion Problem,* pp. 11–13.

33. Sullivan, *Continuation Study,* p. 85.

34. Small, Winston, and Yan, "Differentiated Road Pricing," Table 7.

35. Evans, Bhatt, and Turnbull, "Road Value Pricing," pp. 14-55 and 14-60.

36. Sullivan, *Continuation Study,* p. 85.

37. *Economic Report of the President* (2007), p. 145. One study presents data indicating that priced lanes are mostly used by middle-aged women, which suggests that family responsibilities are an important factor in the use of the lanes. See Jin Yan, Kenneth A. Small, and Edward C. Sullivan, "Choice Models of Route, Occupancy, and Time of Day" (presentation at the 81st Annual Transportation Research Board Meeting, Washington, D.C., 2002), p. 5. Another study also found that women were more likely to use the toll lanes. See Small, Winston, and Yan, "Differentiated Road Pricing," p. 67.

period, and bus ridership increased by 38 percent.[38]

Studies have found broad levels of support for congestion pricing across all income groups in areas in which it has been applied.[39] Other studies, although not explicitly comparing attitudes among different income groups, indicate that congestion pricing is more likely to be accepted if potential users have the option of not paying tolls on unpriced lanes, alternative routes, or alternative modes; know that congestion pricing is used to fund new capacity rather than being applied to existing capacity; view congestion pricing as an incremental change, as in the conversion of HOV lanes to HOT lanes; or are accustomed to paying tolls.[40] For example, one such study of HOT lanes on I-15 near San Diego found that over 70 percent of highway users thought that congestion pricing was fair to users of both the priced and unpriced lanes.[41] In addition, surveys have shown the public's preference for tolls instead of tax increases when funding new roads, and several recent congestion-pricing projects have gained public acceptance.[42]

In spite of those findings, congestion-pricing projects still face perceptions of unfairness. Proposals for projects in the San Francisco area; on I-35W in Minneapolis, Minnesota; and New York City (see Box 2-1 on page 9)—all of which promised large net social benefits and made allowances to address concerns about inequity—have been rejected.[43]

### Congestion on Alternative Routes

Congestion pricing gives highway users a financial incentive to switch times, routes, or modes of transportation, but if those alternatives cannot absorb the increased traffic, the benefits of congestion pricing could be reduced or eliminated. The effect on alternative times, routes, and modes may differ greatly depending on the type of congestion pricing and the availability and capacity of alternatives.

Generally, drivers have been able to change their travel choices in response to congestion pricing without increasing congestion at alternative times or on alternative routes or modes. For example, according to survey estimates, about half of the people who no longer drove as a result of the congestion pricing in London shifted to public transportation, about one-quarter drove around the priced zone, about 10 percent changed to other forms of private transportation such as taxis and bicycles, around 10 percent changed their trips to different hours, and 5 percent stopped traveling.[44] There was no evidence of increased congestion in off-peak hours or on local roads outside the charging zone, the latter due in part to changes in traffic signals to allow a better flow of traffic around the zone.[45] While that example illustrates people's ability to change their travel choices to other good alternatives, it also illustrates the benefits of using the revenues from congestion pricing to improve the alternatives.

However, changing travel patterns may sometimes increase congestion on alternative routes, particularly under two scenarios. First, when congestion pricing is implemented, users' most common adjustment is to switch to unpriced lanes at the same time of day.[46] If the unpriced lanes were congested to begin with, then imposing congestion pricing on some lanes could make the unpriced lanes more congested—and thereby reduce or

38. Transport for London, *Central London Congestion Charging,* Second Annual Report (2004), p. 39. In addition, businesses inside the zone raised concerns about the potential loss of customers to businesses outside the zone—which could also be considered a distributional effect. However, the transit authority found no discernible long-term impacts on businesses inside the zone. See Transport for London, *Congestion Charging Impacts Monitoring*, Fifth Annual Report (2007), p. 87.

39. See Edward Regan, "I-15 Managed Lanes Expansion Program: Public Opinion Research" (presentation to the Pricing Subcommittee, 81st Annual Transportation Research Board Meeting, Washington, D.C., 2002); and Sullivan, *Continuation Study,* pp. 123–134.

40. Johanna Zmud, "The Public Supports Pricing if . . . A Synthesis of Public Opinion Studies on Tolling and Road Pricing," *Tollways* (Winter 2008), pp. 29–39.

41. Lee Hultgren and Kim Kawada, "San Diego's Interstate 15 High-Occupancy/Toll Lane Facility Using Value Pricing," *Institute of Transportation Engineers Journal*, vol. 69, no. 6 (June, 1999), p. 27.

42. Zmud, "The Public Supports Pricing if . . ." pp. 27–38; and "New Tolls, Not Taxes, Favored for Area Roads," *Washington Post*, February 16, 2005, p. A1.

43. See Evans, Bhatt, and Turnbull, "Road Value Pricing," p. 14-39.

44. Transport for London, *Congestion Charging Impacts Monitoring*, Third Annual Report (2005), pp. 54–56.

45. Transport for London, *Congestion Charging Impacts Monitoring*, Second Annual Report, pp. 23–37.

46. Evans, Bhatt, and Turnbull, "Road Value Pricing," p. 14-5.

eliminate the benefits of the pricing.[47] The magnitude of the effect depends greatly on the availability of alternative routes.

Second, the impact of congestion pricing on other routes also depends greatly on the capacity of those routes. For example, traffic leaving a heavily congested freeway will increase delays on narrow city streets much more than it will reduce delays on the freeway—again, reducing or eliminating the benefits of congestion pricing. Certainly, the specific circumstances matter. For instance, early feasibility studies indicated that applying congestion pricing to I-35W in Minneapolis was likely to divert traffic to local streets.[48] But congestion pricing on California State Route 91 reduced peak-period traffic on local streets, as drivers were attracted by the reduced travel times.[49]

### Transaction and Implementation Costs

Congestion pricing involves transaction costs: the cost of collecting the charges and the cost of highway users' time waiting to pay the charges. The charges can be collected in any of four ways. With manual toll collection, the driver pays a toll to an attendant, who can provide change. With automatic toll collection, the driver pays a toll to a machine, which automatically counts the money. With electronic toll collection, electronic sensors read a transponder in each vehicle as it moves slowly through the toll plaza. With open road toll collection, a specialized type of electronic toll collection, sensors read a transponder in each vehicle as it passes beneath an overhead gantry without having to slow down at all. In either of the last two cases, the amount of the congestion charge is deducted from a prepaid account.

Congestion pricing has always been implemented with electronic toll collection, which makes it easy to vary prices by time of day. In the Safe, Accountable, Flexible, Efficient Transportation Equity Act—A Legacy for Users, the Congress mandated automatic or electronic tolling for the various programs related to congestion pricing and sought to accelerate progress toward an interoperable national electronic toll collection system.[50] The Department of Transportation has issued a notice of proposed rulemaking indicating that the only practical way to meet the requirement for interoperability is to require electronic tolling.[51]

The cost of toll collection depends on the way in which the tolls are collected. Frequent collection of small tolls can impose large transaction costs. One study estimated that, with the collection methods in place in 2000, the cost of collection, drivers' time, fuel, and pollution engendered by tolls at a busy plaza on New Jersey's Garden State Parkway was as high as 37 percent of the revenues.[52] Another study of half a dozen toll facilities with larger and less frequent transactions found that the operating and maintenance costs of toll collection were about 20 percent regardless of the type or mix of collection methods used.[53] It might be expected that recent technological advances in electronic toll collection systems, such as E-ZPass (see Box 2-2), have substantially reduced the cost of collecting congestion charges. But that study found that the lower operating cost of electronic toll collection was offset by higher collection costs from a greater number of violations.

Electronic toll collection systems have, though, reduced the amount of time people spend waiting to pay tolls and, thus, reduced congestion at toll plazas. The systems can process 50 percent more vehicles per lane than an

47. Liu and MacDonald, in their November 1998 analysis, estimated that applying congestion pricing on some lanes of California State Route 91 would generate only 10 percent of the benefits gained by applying congestion pricing to all of the lanes. However, Small, Winston, and Yan, studying the same facility a few years later, estimated that a single-lane toll could generate 72 percent of the gains of the most efficient congestion pricing.

48. Evans, Bhatt, and Turnbull, "Road Value Pricing," p. 14-49.

49. Edward Sullivan, *Evaluating the Impacts of the SR91 Variable Toll Express Lane Facility: Final Report* (prepared for the State of California, Department of Transportation, May 1998), p. 22; and *Continuation Study,* pp. 37–40.

50. Sections 1604(b)(5) and 1604(b)(6)(B)(i).

51. Department of Transportation, Federal Highway Administration, "Interoperability Requirements, Standards, or Performance Specifications for Automated Toll Collection Systems," FHWA-2006-23597, *Federal Register*, vol. 72, no. 182 (September 20, 2007), pp. 53736–53742.

52. Jonathan R. Peters and Jonathan K. Kramer, "Inefficiency of Toll Collection as a Means of Taxation: Evidence from the Garden State Parkway," *Transportation Quarterly,* vol. 57, no. 3 (Summer 2003), pp. 17–31. To some degree, those costs reflect start-up problems with the E-ZPass system. See "E-ZPass Bugs Give Cheats a Free Ride," *New York Times,* December 19, 2002, p. B1.

53. Washington State Department of Transportation, *Comparative Analysis of Toll Facility Operational Costs,* February 22, 2007, available at www.thenewspaper.com/rlc/docs/2008/07-wsdotoll.pdf.

**Box 2-2.**

## How E-ZPass Works

E-ZPass is the most widely used electronic toll collection system in the United States. It can be used at toll facilities in 14 Northeastern and Midwestern states but is not compatible with other electronic toll collection systems outside that region. In 2007, E-ZPass processed almost 2.2 billion charges accruing to more than 17 million vehicles, amounting to almost $3.9 billion in toll revenues.[1]

E-ZPass users establish a prepaid account using a credit card, personal check, or cash. The use of a credit card automatically replenishes the account when the balance falls below a set threshold, usually $10. Users may also be required to pay a fee or deposit, usually about $25, for a transponder and in some cases an account maintenance fee, usually about $1 per month. They then receive a small electronic transponder about the size of a deck of cards, which they attach to the windshield of their vehicle just behind the rearview mirror. The transponder contains an electronic chip that identifies the vehicle and links it to the user's E-ZPass account. Each time the user drives through a toll facility where E-ZPass is accepted, an antenna in the toll lane reads the transponder information. The appropriate toll is deducted from the user's account as the vehicle passes through the lane. A record of the transaction is then included in a periodic statement sent to the user.

Toll facilities that accept E-ZPass usually have a mix of "E-ZPass Only," "Cash Only," and "E-ZPass or Cash" lanes. E-ZPass users must slow to 15 to 25 miles per hour when passing through a traditional toll plaza in order to allow the transponder to be read and to ensure traffic safety. Passing through the lane at a higher speed or with insufficient funds in the account results in a fine to the user. Larger toll facilities now use open road toll collection, by which electronic sensors read the transponder in each vehicle as it passes beneath an overhead gantry without having to slow down at all.

Despite some start-up problems, toll facilities accepting E-ZPass indicate that about 65 percent of their transactions are now conducted with that method, with some transportation agencies reporting shares as high as 75 percent.[2]

1. James Mwape, "Tags and Transactions Statistics" (presentation to the E-ZPass Interagency Group, Reciprocity Task Force Meeting, Woodbridge, N.J., July 24, 2008), available at www.e-zpassiag.com.

2. See "E-ZPass Bugs Give Cheats a Free Ride," *New York Times*, December 19, 2002, p. B1; Mwape, "Tags and Transactions Statistics"; and Metropolitan Transit Authority, State of New York, "Bridges and Tunnels E-ZPass Market Share" (2008), available at www.mta.info/mta/ind-perform/month/bt-ez.htm.

automatic system can and three times the number that a manual system can.[54] They therefore require less land than a corresponding manual or automatic system, which is an important consideration when adding new lanes to an existing right of way. They also allow congestion charges to be changed more frequently in response to changes in traffic conditions.

There are fixed costs associated with introducing an electronic toll collection system. Implementation costs for the first two years of the London plan were approximately £190 million ($348 million at then-current exchange rates), more than twice the amount expected.[55] And the recent extension of the congestion zone in London was estimated to cost approximately £140 million ($258 million at then-current exchange rates) to implement over

54. Peters and Kramer, "Inefficiency of Toll Collection as a Means of Taxation," Table 1.

55. Leape, "The London Congestion Charge," p. 170.

three years.[56] The Ohio Turnpike Commission estimates that it will take two years to implement E-ZPass on the turnpike and will cost $45 million to $50 million by the time the project is completed late this year.[57]

The enforcement component of collection costs includes the cost of detecting and billing drivers who either avoid paying tolls or, in some cases, misrepresent themselves as having a lower class of vehicle that would be eligible for a cheaper toll. Violation rates appear to vary from 2 percent to 5 percent for facilities equipped with photo enforcement and between 5 percent and 15 percent for HOT lanes, for which there are no means of automated enforcement.[58] One common enforcement mechanism, adopted for the Central London congestion zone, PANYNJ's facilities, and California State Route 91, uses photographs of a violator's license plate followed by a mailed fine. Cameras in the London system successfully identify license plate numbers 70 percent to 80 percent of the time for vehicles making a single pass by a camera; the overall detection rate is estimated to be 85 percent to 90 percent, because most vehicles pass multiple cameras in the charging zone.[59] In many cases, the fines, even on private toll roads, are ultimately enforceable by state and local police and the state motor vehicle administration.

Although only a small percentage of users evade tolls, collections from enforcement can account for a substantial percentage of a program's revenues. For the Central London zone, where drivers do not encounter toll booths, gantries, or barriers at any of the numerous entrances or exits, fines accounted for 27 percent of the total revenues in the fiscal year that ended in June 2008.[60] In contrast, payments for E-ZPass violations on the New Jersey Turnpike and the Garden State Parkway in 2004 accounted for about 1.5 percent of the program's revenues.[61] Those facilities have toll booths, gantries, or barriers at each entrance, which reduce the violation rate. However, the payments may not have covered the full collection costs.

### Implementation Difficulties

Improved technology has reduced the transaction costs of congestion pricing, but implementation difficulties remain. Those difficulties include determining the appropriate congestion charge, adopting charges that fully reflect the cost of congestion, and maintaining the confidentiality of data. Difficulties in determining an appropriate congestion charge, or charges that do not fully reflect the cost of congestion, do not mean that congestion charges are of no use. Any charge that exceeds the cost of collection but is less than the cost of delay to other drivers is likely to reduce congestion and make highway users better off. However, the greater the deviation from the appropriate charge, the smaller the benefit to highway users will be.

First, determining the appropriate congestion charge may be difficult. The appropriate charge is not simply the cost of delay to highway users at the time the charge is insti-

56. Transport for London, *Congestion Charging: Proposed Western Extension of the Central Charging Scheme*, 2005, p. 106. The implementation costs include setup costs, expenses to procure new service providers to operate the system, and the cost of new traffic management devices.

57. "Ohio Turnpike Doing Electronic Tolling," *Toll Road News,* December 18, 2006, available at www.tollroadsnews.com/node/1721, accessed on February 4, 2009. The Ohio Turnpike has 31 interchanges and 231 toll lanes over its 241-mile length.

58. Priced facilities such as the New Jersey Turnpike and PANYNJ bridges and tunnels report violation rates of about 2 percent using E-ZPass electronic tolling. See New Jersey Turnpike Authority, *E-ZPass Working for New Jersey*, July 12, 2004, p. 5; and Bob Williams, "The Violations Enforcement Program of the Port Authority of New York and New Jersey" (presentation to the Violations Enforcement Summit of the International Bridge, Tunnel, and Turnpike Association, Boston, Mass., July 29–31, 2007). CBO estimates violation rates for the London congestion-charging program at about 5 percent, on the basis of 110,000 transactions per workday and 30,000 penalty notices per work-week in 2005, as reported in Leape, "The London Congestion Charge," pp. 163–164. The HOT lanes on I-15 in San Diego, California, report a violation rate of between 5 percent and 15 percent. See San Diego Regional Planning Agency, "Interstate 15 FasTrak" (project description), May 2005, p. 2. Violation rates on HOV lanes vary widely by facility but tend to be reduced when they are converted to HOT lanes. See A. Scott Cothron, Douglas A. Skowronek, and Beverly T. Kuhn, *Enforcement Issues on Managed Lanes*, FHWA/TX-03/4160-11 (technical report, Texas Transportation Institute, September 2002, resubmitted January 2003), Table 2, available at http://tti.tamu.edu/documents/4160-11.pdf.

59. Leape, "The London Congestion Charge," p. 163.

60. Transport for London, *Congestion Charging Impacts Monitoring*, Sixth Annual Report, p. 220.

61. That estimate is based on data on toll revenues, the share of transactions using E-ZPass, and payments for violations. See Regional Plan Association of Connecticut, New Jersey, and New York, *Reform, Revenue, Results: How to Save New Jersey's Transportation System*, November 2005, Appendix D; and New Jersey Turnpike Authority, *E-ZPass Working for New Jersey.* pp. 2 and 16.

tuted, because imposing a congestion charge changes the traffic on the route and, hence, the appropriate value of the charge. In addition, if the charge causes a substantial increase in congestion on other unpriced routes, then the charge should be lowered to account for the additional congestion on those routes. Most adjustments of congestion prices have been focused on maintaining the proper price to ensure smooth-flowing traffic, not necessarily incorporating those other considerations. In order to reduce congestion for the highway system as a whole, congestion charges need to be high enough to prevent the priced lanes, roads, or areas from becoming congested but low enough so that revenues are not forgone or that the priced capacity is not underutilized.

In practice, the difficulties are often resolved using an iterative approach. For example, the congestion tolls on California State Route 91 are recalculated every three months.[62] The congestion tolls on the I-15 HOT lanes in San Diego are adjusted dynamically, changing by 25-cent increments as frequently as every 6 minutes, up to a maximum of $8.00.[63] Although frequent changes may help ensure that the appropriate fee is charged, drivers' uncertainty about the fee may reduce its impact. For example, a driver wary of mistakenly underestimating a frequently adjusted toll may choose to not use a HOT lane, when, in fact, the toll charged would have proved worth paying.

A second possible problem is that congestion charges may not fully reflect the cost of congestion. Congestion charges on PANYNJ's bridges and tunnels provide one example. Under the congestion-pricing system implemented in March 2001, automobile drivers who paid cash were charged $6.00 at all hours, while users of the E-ZPass system paid $5.00 at peak hours and $4.00 at off-peak hours. Despite those charges, the bridges and tunnels remain heavily congested at peak hours. The $1.00 extra charge for travel during peak times (which applies only to E-ZPass users) probably did not fully reflect the cost of congestion to other users.[64] The persistence of congestion in this case probably reflects the inadequacy of the charge rather than a failure of congestion pricing.

New York City's recently rejected PlaNYC 2030 (see Box 2-1 on page 9) provides another illustration of that problem. That plan would have provided discounts to residents within the cordon in order to make the plan more palatable to them. However, a car trip by a local resident probably causes the same amount of congestion as a car trip by someone living outside the cordon. Providing residents with a discount diminishes their incentive to switch to alternative times, routes, or modes or avoid some trips altogether as a way to reduce congestion.

The cumulative impact of residents' trips can substantially reduce the effectiveness of congestion pricing. In London's congestion zone, residents receive a 90 percent discount and account for 41 percent of the number of payments made each week.[65] At least one observer has suggested that the prevalence of the residents' discounts reduces the social benefits of the Western extension of the zone to the point that they are less than the costs.[66] Perceived ineffectiveness in reducing congestion (owing to those discounts, the reallocation of street capacity to bicycle and pedestrian lanes, and increased utility and street repair work) and concerns about the effect on local businesses have prompted the newly elected mayor of London to decide to rescind the recent expansion of the zone.[67]

Concern about the confidentiality of data collected by electronic tolling systems is a third potential barrier to implementation. To overcome that concern, data collected by most electronic tolling systems are protected from third-party inquiries and generally only released

62. Orange County Transportation Authority, "91 Express Lanes Toll Policy," available at www.91expresslanes.com/generalinfo/tollpolicy.asp. Tolls set to allow a free flow of traffic in the priced lanes of State Route 91 probably reduce congestion on those lanes more than is necessary to maximize net benefits.

63. Department of Transportation, Federal Highway Administration, *Value Pricing Quarterly Report* (October–December 2007), p. 4.

64. Tolls on the crossings increased on March 2, 2008. See www.panynj.gov/CommutingTravel/bridges/html/tolls.html. The cash charge is now $8.00. E-ZPass rates are $8.00 during peak hours and $6.00 during off-peak hours, which represents a larger percentage discount for users of E-ZPass during off-peak hours. The effect of those recent toll changes has not yet been analyzed.

65. Transport for London, *Congestion Charging Impacts Monitoring*, Sixth Annual Report, p. 209.

66. David Newbery, discussion of Georgiana Santos and Gordon Fraser, "Road Pricing: Lessons from London," *Economic Policy*, vol. 21, no. 46 (April 2006), pp. 305–306, at a panel meeting, London, October 2005.

67. Transport for London, *Non-Statutory Consultation on the Future of the Western Extension of the Congestion Charging Zone* (November 2008).

upon a subpoena from criminal or civil courts. Of the 14 Northeastern and Midwestern states that are part of the E-ZPass system, 7 provide electronic tolling data in response to court orders in criminal or civil cases, including divorces.[68] Four states provide electronic tolling data only in criminal cases, one state has no policy as of yet, and the policies of the remaining two states could not readily be determined. Some observers have noted that a highway user could avoid having data collected about his or her travel by avoiding electronic tolling and that interested parties may in some cases be able to obtain electronic tolling data from another source, such as a spouse.

Other observers have raised still other concerns about congestion pricing. Congestion fees have sometimes been viewed as "double taxation" for roads that have already been paid for through the fuel tax. But such fees are charges for the delay caused to other users, not charges for use of the road itself. Congestion fees have sometimes been viewed as an incentive for highway agencies to be inefficient, because greater congestion would generate greater revenues for them. But congestion fees can also lead to more efficient infrastructure investment.

68. "E-ZPass Also an Easy Path to Divorce Court," *Dallas Morning News,* August 15, 2007, available at www.dallasnews.com/sharedcontent/dws/news/longterm/stories/081607dnnatezpass.3a3cda53.html; and E-ZPass Interagency Group, www.e-zpassiag.com/IAG%20Map%202008-10-08.pdf.

CHAPTER

# 3

# Policy Options for Congestion Pricing

The Safe, Accountable, Flexible, Efficient Transportation Equity Act—A Legacy for Users is scheduled to expire on September 30, 2009, providing the Congress with an opportunity to address the issue of highway congestion. Because congestion pricing has been able to reduce congestion and generate benefits to society in excess of its costs, the Congress, in reauthorizing surface transportation programs, may wish to examine policy options that would increase its use. Because the federal government owns or operates very few highways itself, federal policy must rely on encouraging state and local governments to expand the use of congestion pricing.

The options considered here include reducing federal barriers to implementation, improving funding mechanisms, addressing equity issues, and reducing transaction costs. Those options, which are not mutually exclusive, are intended to reflect a range of possibilities rather than a ranking or a comprehensive list.

## Reduce Federal Barriers to Implementation

One way that the Congress could reduce federal barriers to implementation is to reduce restrictions on tolling on existing Interstate highways. States have limited legal authority to collect tolls, including congestion fees, on highways built or maintained using federal aid. Current law permits federal aid to be used to build or maintain toll roads, convert existing roads into toll roads, or add toll lanes to existing roads, provided that the roads are not part of the Interstate Highway System.[1] However, with some exceptions, federal aid cannot be used to build new Interstate highways that charge tolls, convert existing Interstate highways into toll highways, or add toll lanes to existing Interstate highways.[2] Those restrictions are due to concerns that widespread tolling may impede interstate commerce.[3] Because urban interstates account for one-quarter of vehicle miles traveled in urban areas, reducing or removing restrictions on tolling on Interstate highways would increase the potential applicability of congestion pricing.[4]

The Congress could also reduce federal barriers to implementation by easing or eliminating existing restrictions on congestion-pricing programs. Under SAFETEA-LU, the Value Pricing Pilot Program provides tolling authority for studies or implementation of new congestion-pricing

1. 23 U.S.C. 129.

2. Some existing toll roads, bridges, and tunnels were incorporated into the Interstate System with the proviso that federal-aid funds could not be spent on them. See Congressional Budget Office, *Toll Roads: A Review of Recent Experience* (February 1997), p. 5. Federal-aid funds may be used for tolling on Interstate highways in a few cases. Authorized by section 1604(c)(2) of SAFETEA-LU, the Interstate System Construction Toll Pilot Program allows tolling on up to three facilities in the Interstate Highway System for the purpose of financing the construction of new Interstate highways. See Department of Transportation, Federal Highway Administration, "Interstate System Construction Toll Pilot Program," available at http://ops.fhwa.dot.gov/tolling_pricing/interstate_constr.htm. The Interstate System Reconstruction and Rehabilitation Pilot Program, section 1216(b) of the Transportation Equity Act for the 21st Century, allows tolling on up to three existing Interstate facilities to fund needed reconstruction or rehabilitation that could not otherwise be undertaken without collecting tolls. See Department of Transportation, Federal Highway Administration, "Interstate System Reconstruction and Rehabilitation Pilot Program," available at http://ops.fhwa.dot.gov/tolling_pricing/interstate_rr.htm. Last, 23 U.S.C.129 allows tolling on Interstate bridges and tunnels for the purpose of financing their reconstruction.

3. Congestion may also impede interstate commerce. See Congressional Budget Office, *Toll Roads,* pp. 22–27, for a detailed discussion of federal policy toward tolling.

4. Department of Transportation, Federal Highway Administration, *Highway Statistics* (2006), Table VM-1.

demonstration projects in up to 15 states or localities.[5] That program usually has agreements with nearly the maximum number of states and localities allowed by law. So allowing more than 15 states and localities to participate in the program at any one time would increase tolling authority available for congestion-pricing projects.

The Express Lanes Demonstration Program (SAFETEA-LU, section 1604(b)) is another congestion-pricing program. That program provides tolling authority for up to 15 projects to add capacity to existing highways, bridges, or tunnels. Increasing the number of projects participating in that program would probably have little effect, because the program currently has only one active project and is considering an application for a second project. A third congestion-pricing program, HOT Lanes (SAFETEA-LU, section 1121), imposes no limit on the number of projects or the number of states that may participate, as long as a new high-occupancy toll lane is created or an existing high-occupancy vehicle lane is converted to an HOT lane.

## Change Funding Mechanisms

If it wants to promote congestion pricing, the Congress could make federal funding for transportation contingent on adoption of that strategy.

The Department of Transportation's Urban Partnerships Program provides an example. In December 2006, the Department of Transportation solicited proposals from a number of cities for the use of available federal discretionary funds to develop a variety of complementary strategies, including congestion pricing, to relieve urban congestion.[6] The program was made possible, in large part, by the availability of authorized highway and transit funds that are typically directed to specific programs by appropriation acts but that were not during fiscal year 2007. Those discretionary funds made up a significant amount of the funding available for the Urban Partnerships Program, with other funds coming primarily from older but unobligated money under the purview of the Federal Transit Administration. After receiving about two dozen applications, the Department of Transportation awarded $853 million in grants in August 2007 to five recipients (Miami, Minneapolis–St. Paul, New York City, San Francisco, and Seattle).[7] In November 2007, the Department of Transportation's Congestion Reduction Demonstration Program solicited a second round of grant proposals and then received about three dozen applications.[8] In April 2008, the department made a $213 million award to Los Angeles and a $153 million award to Chicago.[9] In November 2008, the department made a $110 million award to Atlanta.

Another way that the Congress could make federal transportation funding contingent on the adoption of congestion pricing is to increase the level of federal matching of state funds for highway projects using congestion pricing. Unless otherwise specified in the authorizing legislation, the federal government generally pays 80 percent of the total cost of highway construction. However, it pays 90 percent of such costs for HOV lanes on Interstate highways. In a similar way, the Congress could have the federal government pay for 90 percent of the total cost for projects using congestion pricing. Alternatively, the Congress could have the federal government pay only 70 percent of the total cost for projects that could reasonably use congestion pricing but do not.

5. See John W. Fischer, *Safe, Accountable, Flexible, Efficient Transportation Equity Act—A Legacy for Users (SAFETEA-LU or SAFETEA): Selected Major Provisions* (Congressional Research Service, October 18, 2005), available at www.congress.gov/erp/rl/html/RL33119.html.

6. Department of Transportation, Office of the Secretary of Transportation, "Applications for Urban Partnership Agreements as Part of Congestion Initiative," OST-2006-26266, *Federal Register,* vol. 71, no. 236 (December 8, 2006), pp. 71231–71236.

7. The grant to New York City was later withdrawn when the State of New York failed to approve the City's congestion plan. See Box 2-1 on page 9.

8. Department of Transportation, Office of the Secretary of Transportation, "Solicitation of Applications for Funding of Congestion-Reduction Demonstration Initiatives," OST-2007-0004, *Federal Register*, vol. 72, no. 218 (November 13, 2007), pp. 63951–63956.

9. Much of the funding for those awards was provided using money that New York City would have received. Before the Urban Partnerships Program, the House version of SAFETEA-LU (H.R. 3550) contained a Motor Vehicle Congestion Relief Program, which would have required states with urbanized areas of 200,000 people or more to set aside funds for projects that increased capacity and relieved congestion. See William J. Mallett, *Surface Transportation and Congestion: Policy and Issues* (Congressional Research Service, May 2007), pp. 24–25, available at www.wsdot.wa.gov/NR/rdonlyres/3E559F5A-9958-4F05-816C-1EC02069BAE3/0/SurfaceTransportationCongestionPolicyandIssuesCRS.pdf. That program was not included in the final version of SAFETEA-LU.

Because congestion pricing results in more efficient use of highway capacity and reduces the need for investment, increasing the federal matching funds would effectively allow the federal government and state governments to share in the savings from reduced requirements for investment. In addition, contingent federal funding would encourage state and local governments to implement congestion-pricing projects.

Increasing funding for existing congestion-pricing programs could be another means for promoting the approach. The Value Pricing Pilot Program has funding of $12 million per year for fiscal years 2006 through 2009. Of that amount, $3 million is set aside for congestion-pricing projects not involving tolling, such as parking management strategies. The Express Lanes Demonstration Program and HOT Lanes program provide tolling authority but are not currently being funded. Boosting the funding for those programs would probably encourage state and local governments to implement congestion-pricing projects.

Providing funds for the conversion of underutilized HOV lanes to HOT lanes, in which vehicles with only a driver are subject to a toll but vehicles with more occupants are not, is likely to be especially beneficial. Under section 1121 of SAFETEA-LU, states have legal authority but not federal funding to convert HOV lanes to HOT lanes. That authority extends to any highway with HOV lanes, including Interstate highways. The large number of highways in which HOV lanes are currently operating appears to provide widespread opportunities for conversion to congestion-priced lanes. In the United States, more than 120 HOV projects exist, but only 7 HOT projects.[10] Expanding funding of that conversion program probably offers an opportunity to increase highway capacity by increasing the use of underutilized HOV lanes and reducing congestion on overutilized HOV lanes.

10. Transportation Research Board, *List of Existing HOV Facilities*, 2005, available at www.hovworld.com/inventory.htm; and Department of Transportation, Federal Highway Administration, *Report on the Value Pricing Pilot Program Through June 2008* (August 25, 2008), Appendix 4.

## Address Equity Issues

In principle, revenues from congestion pricing can be redistributed in such a way that all (or nearly all) users are better off. There are two basic ways for the Congress to do so.[11] One approach would be to require that all revenues from congestion pricing on federally funded roads be spent on alternative transportation modes or routes. Although such a requirement would improve the options available for users who chose alternative routes or modes, it would not compensate people who chose not to travel at all and would not fully address concerns about the regressivity of congestion pricing.

A second approach would be to use the revenues from congestion pricing to reimburse low-income users, which could add significant complexities to the implementation process. Different policies have been proposed for such reimbursement. For example, one modification to New York City's plan would have provided a tax credit to low-income drivers for the difference between the congestion charge they paid and what they would have paid had they used mass transit. One proposal for the San Francisco–Oakland Bay Bridge would have exempted low-income drivers from the congestion charges.[12] Although both of those proposals addressed regressivity, the one for New York City posed significant difficulties in determining both eligibility for and the amount of the credit. Both proposals would have reduced the incentive to use alternative times, routes, and modes; neither proposal would have compensated people who chose not to travel at all.

To answer concerns about increased congestion on other routes, the Congress could, for example, require that alternative unpriced routes meet minimum performance

11. For discussions of the use of congestion-pricing revenues to address equity concerns, see Kenneth Small, "Using Revenues from Congestion Pricing," *Transportation,* vol. 19, no. 4 (1992), pp. 359–381; and P. B. Goodwin, "The Rule of Three: A Possible Solution to the Political Problem of Competing Objectives for Road Pricing," *Traffic Engineering and Control,* vol. 30, no. 10 (1989), pp. 495–497.

12. Lee W. Munnich, Jr., David Van Hattum, and Maria V. Zimmerman, "Buying Time: Institutional and Political Issues in Congestion Relief Tolls," *Transportation Research Record*, vol. 1576 (1997), p. 106.

standards, such as maintaining minimum traffic speeds, after the implementation of congestion pricing.[13]

## Reduce Transaction Costs

Although electronic tolling has about the same operating and maintenance costs as manual tolling, as discussed in Chapter 2 electronic tolling reduces delays and congestion at toll plazas. Such tolling is often essential in projects expanding capacity, because there may not be enough space to add manual or automatic toll booths. The Congress could require use of electronic tolling for congestion-pricing projects and already does so in the Express Lanes Demonstration Program.[14]

SAFETEA-LU seeks to accelerate progress toward a interoperable national electronic toll collection system, and the Department of Transportation has issued a notice of proposed rulemaking indicating that the only practical way to meet the requirement for interoperability is to mandate electronic tolling.[15] However, such a requirement would involve start-up costs.

13. David Lewis, *America's Traffic Congestion Problem: Toward a Framework for Nationwide Reform*, Discussion Paper 2008-06 (Washington, D.C.: Brookings Institution, The Hamilton Project, July 2008), p. 26. Such requirements would be similar to those in section 1121 of SAFETEA-LU, which provides that hybrid vehicles, motorcycles, or other exempt vehicles may not use HOV lanes if the speed of traffic in the lanes drops below 45 miles per hour.

14. SAFETEA-LU, section 1604(b)(5).

15. Section 1604(b)(6)(B)(1); and Department of Transportation, Federal Highway Administration, "Interoperability Requirements, Standards, or Performance Specifications for Automated Toll Collection Systems," FHWA-2006-23597, *Federal Register*, vol. 72, no. 182 (September 20, 2007), pp. 53736–53742.

APPENDIX

# A

# Case Studies

This appendix provides some details about the workings of four different types of congestion pricing: cordon pricing, priced facilities, priced lanes, and high-occupancy toll (HOT) lanes. The four case studies were selected primarily on the basis of the availability of extensive data on the results of congestion pricing:

- The Central London congestion-charging zone (cordon pricing);
- The Port Authority of New York and New Jersey's bridges and tunnels (priced facilities);
- State Route 91, Orange County, California (priced lanes); and
- I-394 in Minneapolis, Minnesota (HOT lanes).

## The Central London Congestion Charging Zone

The Central London congestion charging zone applies cordon pricing to an approximately 15-square-mile section of the city.[1] The zone first covered an 8-square-mile area in February 2003 and was approximately doubled to its current size in February 2007 by including an area west of the original zone. That western extension is now intended to be removed from operation, but no earlier than 2010. Although no similar system currently exists in the United States, a similar arrangement was proposed for use in New York City and recently rejected (see Box 2-1 on page 9).

Drivers pay a daily charge of £8 (about $11 at current exchange rates) to drive or park on a street within the zone; the charge was £5 when first implemented in 2005. The congestion charge applies on Monday through Friday, from 7:00 a.m. to 6:00 p.m. Motorbikes, mopeds, taxis, buses, emergency vehicles, and vehicles using alternative fuels are exempt, as are vehicles whose drivers are disabled, and residents of the zone receive a 90 percent discount. The congestion fee may be paid in advance on a daily, weekly, monthly, or annual basis by phone, mail, or Internet or at retail outlets. If paid on the following day, the charge is £10 (about $14 at current exchange rates).

Entry into the congestion zone is indicated by street signs or pavement markings. The license plates of vehicles moving into or within the zone are recorded by a network of fixed and mobile cameras. Drivers encounter no toll booths, gantries, or barriers on entering the zone, and traffic does not have to stop. License plate numbers are compared with those in a database of vehicles for which the fee has been paid, and a £120 fine (about $166 at current exchange rates) is assessed to the vehicle owner if the fee has not been paid. The fine is reduced to £60 (about $83) if paid within 14 days. Authorities may apply a "boot" to immobilize vehicles with multiple outstanding fines.

Implementation costs for the first two years of the project were £190 million ($348 million at then-current exchange rates), more than twice the amount expected.[2] Approximately £140 million in costs ($258 million at then-current exchange rates) were incurred in extending the zone to the west. Annual operating expenses for the entire tolling system are approximately £130 million ($246 million).[3] The system has covered its capital and operating expenses every year since its inception. In a typical day, the system handles 78,000 payments from non-

1. More information about the Central London Congestion Zone may be found at Transport for London's Web site: www.tfl.gov.uk/roadusers/congestioncharging.

2. Jonathan Leape, "The London Congestion Charge," *Journal of Economic Perspectives*, vol. 20, no. 4 (Fall 2006), p. 170.

3. Transport for London, *Central London Congestion Charging: Impacts Monitoring,* Sixth Annual Report (2008), p. 220.

residents, 60,000 from residents, and 20,000 from operators of fleets. All together, in the fiscal year ending in June 2008, the congestion fees totaled £268 million ($507 million). All proceeds from the program must be spent on improving transport within Greater London.

## The Port Authority of New York and New Jersey's Bridges and Tunnels

The Port Authority of New York and New Jersey operates six major bridges and tunnels, which cross from New Jersey into New York City. Those facilities include the George Washington Bridge, Lincoln Tunnel, Holland Tunnel, Goethals Bridge, Outerbridge Crossing, and Bayonne Bridge. Those bridges and tunnels are among the most heavily used in the country, carrying an estimated 127 million eastbound vehicles in 2007, including 8 million trucks and 3 million buses.[4]

The toll for automobiles is $8.00 at all hours for drivers paying cash. E-ZPass rates for automobiles are $8.00 during peak hours and $6.00 during off-peak hours. During weekdays, peak-hour tolls apply from 6:00 a.m. to 9:00 a.m. and 4:00 p.m. to 7:00 p.m., and on weekends, from noon to 8:00 p.m. Tolls for trucks are $8.00 per axle for cash at any hour. E-ZPass rates are $8.00 per axle during peak hours, $7.00 per axle in off-peak hours, and $5.50 per axle on weekdays between midnight and 6 a.m. For buses, at any hour, the charge is $6.00 if paid in cash or $4.00 if paid via E-ZPass. Tolls are collected only in the eastbound direction into New York City, with no tolls in the other direction. That practice reduces the cost of collecting tolls and allows for a more efficient flow of traffic.

The Port Authority has electronic toll lanes exclusively for E-ZPass users, as well as other lanes that can accommodate manual, automatic, or electronic tolling. The system relies on photo enforcement of toll violations. Fines for violations are mailed to the registered owner of the vehicle. For each violation, a $25 administrative fee is assessed, in addition to the amount of the toll. Highway users who drive through E-ZPass lanes too quickly either receive a warning letter or have their account suspended for a period of time. Violators who ignore the fines may be referred to a collection agency or pursued in civil courts.

4. Port Authority of New York and New Jersey, *Annual Report*, (2007), p. 93.

The Port Authority processes more than 127 million toll transactions per year, with about 73 percent of them conducted by E-ZPass.[5] The revenues that the authority collects from the tolls on its bridges and tunnels are used exclusively to build, operate, and maintain transportation facilities in the New York–New Jersey area.[6] Such revenues totaled almost $720 million in 2007, which more than covered the facilities' operating and capital expenses.[7]

## State Route 91, Orange County, California

The express lanes of California State Route 91 occupy a 10-mile section of the median of the freeway, which runs between Orange and Riverside Counties. Before the lanes' opening in 1995, that was one of the most heavily congested sections of highway in the state, with typical delays of 20 to 40 minutes during peak periods. There are two extra priced lanes in each direction, separated from the adjacent freeway lanes by a "soft" barrier of painted pylons, with no intermediate entrances or exits.

The congestion charges vary both by time of day and day of week, currently ranging from $1.25 to $9.55 for traffic in various one-hour time periods. The charges are adjusted on the basis of the traffic observed over a three-month period to maintain a free flow in the toll lanes. Published toll schedules are used, rather than dynamic pricing, because surveys showed that drivers would prefer predictable fees. Tolls are recorded by automatic vehicle identification, a technology that reads transponders as vehicles drive beneath overhead gantries without having to slow down at all. There are no toll booths, and only customers who have suitable transponders are permitted in the toll lanes.

5. Bob Williams, "The Violations Enforcement Program of the Port Authority of New York and New Jersey" (presentation to the Violations Enforcement Summit of the International Bridge, Tunnel, and Turnpike Association, Boston, Mass., July 29–31, 2007).

6. José Holguín-Veras, Kaan Ozbay, and Allison de Cerreño, *Evaluation Study of Port Authority of New York, and New Jersey's Time of Day Pricing Initiative, Final Report* (2005), p. 12, available at www.knowledge.fhwa.dot.gov/cops/hcx.nsf/All+Documents/F28934FF571FF3C685256DB10063E81B/$FILE/PANYNJ%20Final%20Report.pdf.

7. Port Authority of New York and New Jersey, *Annual Report*, p. 94.

The system relies on photo enforcement of toll violations. For each violation, a $20 processing fee is assessed, in addition to the amount of the toll. The fee is waived if the driver signs up for a toll account. If a driver fails to respond to the first notice of toll evasion, a second notice, with an additional $35 processing fee, is sent. If a driver fails to respond to those notices, the driver's vehicle registration renewal may be withheld until the fees are paid.

The project cost $134 million to build, which is much less than the cost of similar construction projects because the site was within the existing median and therefore did not require the acquisition of land or extensive grading.[8] Operating expenses for both the express lanes themselves and the tolling system were almost $24 million in 2006.[9] Revenues exceeded $44 million that year, which was more than sufficient to cover capital and operating expenses.

## Interstate 394, Minneapolis, Minnesota

The I-394 "MnPass" express lanes, which opened in 2005, are located on a 12-mile stretch of the highway west of Minneapolis, Minnesota. Drivers who are without passengers can use the high-occupancy-vehicle lanes by paying an electronic toll; for transit buses, carpools, and motorcycles, the use of those lanes remains free. The western section, which has multiple access points, provides one extra lane in each direction, separated from the adjacent general-purpose lanes by a "soft" barrier consisting of a painted buffer that is 2 feet wide. The eastern section, which has no intermediate entrances or exits, provides two reversible lanes separated from the adjacent freeway lanes by concrete dividers.

Tolls vary by time of day, day of week, and the level of congestion in the express lanes. The toll during peak periods is typically between $1.00 and $4.00 but can reach a maximum of $8.00. The minimum toll is $0.25. Like the tolls on California State Route 91, the ones on I-394 are recorded by automatic vehicle identification—so vehicles need not stop or slow down for the tolls to be collected, and only cars with suitable transponders, cars with two or more individuals, transit buses, and motorcycles are permitted to use the lanes.

Enforcement is accomplished through mobile readers that scan cars for the MnPASS transponders and verify when and where their last toll was paid. Enforcement regarding the number of occupants in vehicles is accomplished through visual inspection, as Minnesota law prohibits mechanisms employing photography.[10] The Minnesota Highway Patrol assesses a $142 fine for each violation, which, as a moving violation, is handled through the state court system and appears on the driver's record. If a violator does not pay the fine, a warrant is issued for the driver's arrest.

The State of Minnesota paid almost $13 million to build the 12-mile project.[11] The cost was far lower than it normally would have been because the lanes in the western segment had already been built and the lanes in the eastern section were within the existing median strip, which avoided the need to acquire land or grade extensively.[12] Operating expenses for both the express lanes themselves and the tolling system were just over $1 million in 2007. Revenues were sufficient to cover operating expenses that year, and MNPass expects revenues to continue to cover operating expenses in future years.[13]

8. Edward Sullivan, *Evaluating the Impacts of the SR91 Variable Toll Express Lane Facility: Final Report* (prepared for the State of California, Department of Transportation, May 1998), p. 2.

9. Orange County Transportation Authority, *91 Express Lanes Annual Report* (2006), p. 16, available at www.octa.net/default.aspx?id=22224&terms=2006+annual+report.

10. *State of Minnesota v. Kuhlman* (A06-568), 722 N.W.3d 1 (Minn. App. 2006), Aff'd. 729 NW.2d 577 (Minn. 2007).

11. Minnesota Department of Transportation, *Amendment No. 5 to Mn/DOT Contract No. 85492*, October 2004.

12. More information about the conversion of high-occupancy vehicle lanes to HOT lanes may be found at the Web site MnPass I-394 Background: www.mnpass.org/394/index.html.

13. Cambridge Systematics, Inc., *MnPass System Study: Executive Summary* (April 7, 2005), p. 11.