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LESSONS LEARNED FROM THE VALUE PRICING PILOT PROGRAM

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ABSTRACT

Value pricing projects implemented in the U.S. during the past decade have demonstrated that pricing can be politically and publicly acceptable – so far, four priced lane projects and four variably priced toll facility projects are operating without any significant public or political controversy. On operating projects, pricing keeps congestion from occurring on priced lanes, reduces congestion on toll facilities, changes travel behavior, and improves utilization of existing highway capacity. Revenues from tolls have been used to provide funding for transportation improvements. Yet, issues remain with regard to public attitudes toward projects involving tolls; equity concerns; and political acceptance. Technical issues have also stalled several projects, including high construction costs that limit self-financing capability; access to and egress from priced lanes within freeways; and difficulties with regard to enforcement of toll exemption restrictions for high-occupancy vehicles (HOVs) on priced lanes. Private sector involvement in investment and operation of priced lanes has also encountered problems. This paper summarizes the promises and challenges of value pricing, and how the challenges are being addressed in the various projects implemented or under development under the Value Pricing Pilot Program.

INTRODUCTION

In the United States, market-based approaches to reduce congestion are now widely referred to as "value pricing", a term often used synonymously with the more traditional "congestion pricing" or "road pricing." The term "value pricing" was proposed by the U.S. Department of Transportation during the development of federal legislation to promote use of a broad range of pricing strategies, in order to emphasize the positive benefits (or *value*) gained by using pricing to reduce congestion.

The U.S. established the Value Pricing Pilot Program in 1998. This Federal grant program, authorized under the Transportation Equity Act for the 21st Century (TEA-21), provides states, local governments, or other public entities with 80 per cent Federal matching funds to establish, maintain and monitor a wide variety of pricing projects. Since Program authorizations first became available in the fiscal year 1999, about $35 million have been obligated under the Program to support almost 50 projects in 15 states. This amount is in addition to about $30 million expended under the predecessor Congestion Pricing Pilot Program authorized in 1991 under the Intermodal Surface Transportation Efficiency Act (ISTEA). While many of the projects are in early stages of development, many more are under study, and several have already been implemented and have proven to be successful. This paper focuses on the successfully implemented operational projects and lessons learned from these projects.

Four types of value pricing strategies have been implemented in the U.S. to manage congestion (see Table 1):

1. New variable tolls on existing toll-free facilities, including tolls for vehicles not meeting normal occupancy requirements for use of High Occupancy Vehicle (HOV) lanes;

2. Variable tolls on lanes added to existing highways, including tolls on newly-constructed lanes with tolls for vehicles not meeting occupancy requirements;
3. Variable tolls on existing toll roads, bridges, and tunnels. The difference between this strategy and the preceding two is that strategies 1 and 2 impose *new* tolls on existing *toll-free* facilities, while with strategy 3, flat tolls on existing or new *toll* facilities are changed to variable tolls.
4. Usage-based vehicle charges, including mileage-based vehicle taxation, mileage-based charges for insurance, and car sharing.

Table 1. Operating Value Pricing Projects

State	Locality/ Year Implemented	Project
A. Pricing on Existing Roads		
California	San Diego/ 1996 (low tech) 1998 (electronic tolls)	HOT lanes on I-15: Toll varies dynamically from 50 cents to $4 depending on traffic demand.
Texas	Houston/ 1998	HOT lanes on Katy Freeway (I-10): $2 toll charged to two-person carpools in the peak hour of the peak period; 3-person and larger carpools are free
Texas	Houston/ 2000	HOT lanes on US 290: Toll policy same as for I-10, but applies only to morning peak period
B. Pricing on New Lanes		
California	Orange County/ 1995	Express Lanes on SR91: Toll varies from $1 to $6.25 depending on traffic demand
C. Pricing on Toll Roads		
California	Orange County/ 2002	Peak pricing on the San Joaquin Hills and Foothill Toll Roads: Toll surcharge ranging from 25 cents to $1.00 during peak period at selected toll plazas
Florida	Lee County/ 1998	Variable pricing of two bridges: 50 percent toll discount (amounting to 25 cents) offered in shoulders of the peak periods. In 2003, the program was expanded to allow heavy vehicles (three plus axle trucks) to participate during off peak hours.
New York	New York metropolitan area/ 2001	Variable tolls on interstate crossings: Off-peak tolls discounted by 20% relative to peak period tolls, i.e., $4 vs. $5
New Jersey	Statewide/ 2000	Variable tolls on New Jersey Turnpike: Peak period toll exceeds off-peak toll by 12.4%; for the entire 238 km (148 mile) length, off-peak toll is $4.85 vs. peak toll of $5.45
D. Usage-Based Vehicle Charges		
California	San Francisco/ 2001*	Car sharing: Charges are $4 per hour (10 AM –10 PM) and $2 per hour (other times); plus 44 cents per mile

* Car sharing programs are also operational in other locations in the U.S.

There are other types of pricing strategies that are being explored, but have not yet been implemented. The Value Pricing Pilot Program supports project pre-implementation studies, project implementation, and post-implementation monitoring and evaluation studies. In addition, the Program supports region-wide studies within metropolitan areas attempting to identify candidates for implementation of pilot pricing projects. The projects listed in Table 1 are now operational, and are discussed briefly in the next section. A comprehensive listing of all projects, with brief project descriptions and current status, is provided in the Program's Quarterly Progress Report available on the Federal Highway Administration web site at: http://www.fhwa.dot.gov/policy/otps/valuepricing.htm

PILOT PROJECTS

Projects on Existing Toll-free Facilities

"HOT" is the acronym for "High Occupancy/Toll". On HOT lanes, low occupancy vehicles are charged a toll, while High-Occupancy Vehicles (HOVs) are allowed to use the lanes for free or at a discounted toll rate. HOT lanes create an additional category of eligibility for travelers wanting to use HOV lanes, since drivers can be eligible to use the facility either by meeting its minimum passenger requirement, or by choosing to pay a toll to gain access to the HOV lane. HOT lanes currently operate in Houston, Texas and San Diego, California. The difference between HOT lanes and other pricing systems is that with HOT lanes drivers can choose between meeting the vehicle occupancy requirement or paying the toll in order to use the HOV lane. Tolls are set high enough to ensure that vehicle demand for use of the lane is within certain thresholds, in order to ensure free-flowing traffic conditions.

***San Diego's FasTrak Lanes*:** San Diego's HOT Lanes were originally approved as part of the FHWA's Congestion Pricing Pilot Program in ISTEA. The first implementation effort consisted of collecting tolls via monthly permits in the window in 1996; subsequently, the FasTrak™ pricing program was implemented in April 1998. Under this program, customers in single-occupant vehicles pay a toll each time they use the Interstate-15 (I-15) HOV lanes. The unique feature of this pilot project is that tolls vary dynamically with the level of demand for use of the HOV lanes. Fees can vary in 25-cent increments as often as every six minutes. Motorists are informed of the toll rate changes through variable message signs located in advance of the entrance to the FasTrak Lanes, so that they can elect to enter the Express Lanes or remain on the free lanes. The normal toll varies between $0.50 and $4, but during very congested periods it can be as high as $8. All transactions are electronic. Pricing is based on maintaining a Level of Service "D" for the carpoolers. Overhead antennas read a transponder affixed to the inside of a vehicle's windshield and deduct the toll electronically from the driver's pre-paid account.

***"QuickRide" Lanes in Houston, Texas*:** The "QuickRide" pricing program was initially implemented on an existing reversible HOV lane on Interstate-10 (I-10, also known as the Katy Freeway) in Houston in January 1998. A similar project was subsequently implemented on Houston's US 290 highway in November 2000. The HOV lanes are reversible and restricted to vehicles with three or more people during the core hours of the peak periods. The pricing program allows a limited number of two-person carpools to pay a toll to access the HOV lanes during these hours. Single-occupant vehicles are not allowed to use the HOV lanes. Participating two-person carpool vehicles pay a $2 per trip toll, while vehicles with higher occupancies continue to travel for free. As in San Diego, the QuickRide project is completely automated and no cash transactions are handled on the facility.

***Projects under Development*:** Under the Value Pricing Pilot Program, pricing of existing HOV lanes is being studied for implementation in Minneapolis, Minnesota on I-394; in Denver, Colorado on Interstate-25 (I-25)/US 36; in the San Francisco, California Bay Area on I-680 in Alameda County; and in the Seattle, Washington metropolitan area on State Route 167. In addition, the potential conversion of

existing HOV lanes to HOT lanes is under study for route I-95 in Miami-Dade County, Florida; I-30 in Dallas, Texas; I-75 in Atlanta, Georgia; and I-95/I-395 in the Northern Virginia portion of the Washington, DC metropolitan area. Houston, Texas, is examining the feasibility of pricing a network of interconnected HOV lanes.

Introducing new tolls on existing toll-free facilities without continuing to allow some opportunity for free travel on the same facility (as HOT lanes allow) has generally been considered to be unacceptable to the public in the U.S. However, two such projects are under consideration. In one Western city, the City government is currently exploring a cordon toll scheme for its downtown area. In New York, a proposal by the Regional Plan Association (RPA) to introduce cordon tolls in Manhattan is under consideration. The proposal includes tolling existing toll-free bridges over the East River, which connect Manhattan with the Burroughs of Queens and Brooklyn.

Another concept involving tolling of existing toll-free facilities that is being explored is FAIR lanes, or "Fast and Intertwined Regular" lanes. This strategy (DeCorla-Souza, 2000) would involve separating multiple freeway lanes, typically using plastic pylons and striping, into two sections: "fast" lanes and "regular" lanes. The fast lanes would be electronically tolled express lanes, where tolls could change dynamically to manage demand. In the remaining unpriced lanes, drivers whose vehicles were equipped with transponders would be compensated with credits that could be used as toll payments on days when they choose to use the fast lanes, or as payment for transit fares, paratransit fees, or parking at commuter park-and-ride lots in the corridor. Feasibility studies involving FAIR lanes have been funded on I-680 and I-580 in Alameda County, California in the San Francisco Bay area, and at freeway entrance ramps on Highway 217 in Portland, Oregon. A FAIR lanes simulation study was also funded in Atlanta, Georgia, on Route 400.

Projects Involving Pricing of New Lanes

State and local budget cuts and unsuccessful attempts to fund transportation improvements through taxation have increased the interest of states in financing lane additions to existing highways using toll revenues. Newly constructed express lanes with tolls have been implemented to date in only one location, on State Route 91 in Orange County, California, but similar strategies are under development in many states. Tolls on added lanes could be allowed to vary by time-of-day and be collected without slowing highway speeds using electronic toll collection technology. Tolls could also be set "dynamically", i.e., they could be increased or decreased every few minutes in response to fluctuating demand so as to ensure that the lanes are fully utilized, yet remain uncongested.

***Express Lanes on State Route 91 in Orange County, California*:** The State Route 91 (SR 91) express lanes in Orange County, California opened in December 1995 as a four-lane toll facility in the median of a 16 km (10 mile) section of one of the most heavily congested highways in the U.S. The toll lanes are separated from the general purpose lanes by a painted buffer and plastic pylons. Toll revenues have been adequate to pay for construction and operating costs. In fact, the California Private Transportation Company (CPTC), the private company that built the facility at a cost of $135 million, sold the 91 Express Lanes to the Orange County Transportation Authority (OCTA) for $207.5 million, including $72.5 million in cash and the assumption of $135 million in taxable bonds.

In November 2004, tolls on the express lanes vary between $1 and $6.25. Tolls differ by direction, and are set by day of the week and time of the day to achieve several policy goals including, maintaining free-flowing traffic conditions on the toll lanes. Drivers can observe message signs before entering the SR 91 Express Lanes to obtain the current toll schedule, which is subject to change without notice in order to optimize traffic flows (Orange County Transportation Authority, 2003).

SR 91 Express Lanes customers pay tolls by having them electronically deducted from pre-paid accounts. All vehicles traveling on the express lanes must be equipped with a FasTrak™ transponder mounted on the inside of the windshield. In 2003, OCTA implemented a "Three-Ride-Free" policy allowing that vehicles with three or more occupants are not charged except when traveling eastbound from 4 PM to 6 PM on weekdays, the peak period in the heavy traffic direction. During that time, they receive a 50 percent discount from the posted toll. The policy has increased HOV use.

Projects Under Development: Projects involving pricing of new lanes are under construction in Houston, Texas on the Katy Freeway (I-10) as an extension of the existing HOT lane; and in San Diego, California as an extension of the existing I-15 HOT lanes. Pricing of new lanes is being studied for implementation on I-680 in Alameda County, California in the San Francisco Bay Area; on C-470 in Denver, Colorado; in Orlando, Florida on I-4; in Lee County, Florida on Queue-bypass lanes at two intersections; on Interstate-40 (I-40) in the Raleigh-Durham and Piedmont areas in North Carolina; on Highway 217 in Portland, Oregon; on the Capital Beltway (I-495) in the Northern Virginia portion of the Washington, DC metropolitan area; and on LBJ Freeway (I-635) in Dallas, Texas. In addition, a study in Sonoma County, California in the San Francisco Bay Area has recommended new HOT lanes on Highway 101, and a study has recently begun to plan for new HOT lanes on I-35 in San Antonio, Texas.

Variable Pricing on Existing Toll Facilities

Facilities that are already tolled - but on which tolls do not vary by time of day or traffic conditions - can introduce variable rates in order to reduce traffic during peak times. Thus, existing tolls on congested facilities may be varied by day of the week or time of the day with the intention of encouraging some travelers to use the roadway during less congested periods, to shift to another mode of transportation, or to change route. If congestion at peak times is reduced, the remaining peak period travelers will experience decreased delays. Projects have been implemented in four states in the U.S.: Florida, New York, New Jersey, and California.

***Bridge Pricing in Lee County, Florida*:** In August 1998, Lee County implemented a value pricing strategy on two toll bridges between the cities of Ft. Myers and Cape Coral. The project created a peak/off-peak pricing structure offering bridge users a discount from the prevailing toll during times immediately before and after the peak periods. Under the time varying toll schedule, a 50 per cent toll discount (from a base toll of $0.50 normally charged to vehicles with electronic transponders) is provided for trips made during the half-hour period before the morning peak of 7-9AM, as well as during the two-hour period following it. In the evening, the discount periods are the two-hour period before the evening peak of 4-6:30 PM, and the half-hour period following it. In December 2003, the existing program was expanded to allow three plus axle vehicles to participate in the program encouraging heavy vehicles to travel during off-peak times.

***Variable Tolls on Hudson River Crossings in New York*:** The Port Authority of New York and New Jersey adopted a variable toll strategy for users of the electronic toll collection system (E-ZPass) in March 2001. The Port Authority provides a 20 per cent discount from normal tolls for off-peak use of its bridges and tunnels crossing between New York and New Jersey. Peak periods are weekdays 6-9 AM and 4-7 PM, and Saturdays and Sundays 12 noon to 8 PM. An estimated 121.4 million vehicles and approximately 65 million interstate transit system riders use the interstate crossings annually.

***Variable Tolls on the New Jersey Turnpike*:** The 148-mile New Jersey Turnpike is one of the most heavily traveled roadways in the country with average daily trips exceeding 500,000 vehicles. The Turnpike's variable pricing program began in the fall of 2000, for users of the electronic toll collection system. A second toll increase was implemented on January 1, 2003. The price differential for EZ-Pass users between the peak and off peak tolls increased to 14% The peak traffic

hours are 7-9 AM and 4:30-6:30 PM, Monday through Friday. When the value pricing program initially started, the price differential was 7.6 per cent. The differential between peak and off-peak tolls is scheduled to increase in a phased manner over several years.

***Variable Tolls on the San Joaquin Hills Toll Road and Foothill Toll Road*:** In October 2003, a peak period premium of $1.00 (50 cents for those paying electronically) was implemented at one mainline toll plaza. This premium is in addition to the normal toll of $2.50. Tolls at two other plazas increased by $.25 for FasTrak"TM and $ 0.50 for cash customers.

Projects Under Development: The Illinois State Toll Highway authority will institute off-peak discounts for trucks under a new toll schedule to be implemented in January 2005. Similar proposals are being explored by Turnpike Authorities in Ohio and Pennsylvania. The Chicago Skyway will implement variable tolls after a private company purchases it on a 99-year lease. Several variable pricing schemes are under consideration for implementation on toll facilities in Florida, on the Florida Turnpike, the Sawgrass Expressway, and on toll expressways operated by the Miami-Dade County Toll Authority.

Usage-Based Vehicle Pricing

Pay-As-You-Drive (PAYD) Automotive Insurance: By converting automotive insurance from a fixed to a per mile cost, insurance companies may more accurately bill their customers based on driver behaviors that evaluate crash risk and provide them a financial incentive to drive less. This may in turn reduce accidents, public infrastructure costs, and congestion and environmental externalities. The Progressive Insurance Company completed a pilot test of this strategy in Texas. In August 2004, the Progressive Insurance Company began offering this type of insurance to 5,000 drivers in Minnesota. (Note: The federal Value Pricing Pilot Proagrm did not sponsor these projects).

***Mileage-Based Vehicle Taxation*:** About 80 per cent of the costs of owning and operating a vehicle are fixed (Litman 1997). Once a person has chosen to acquire a vehicle, the incremental costs of operating it are comparatively low. Converting some fixed vehicle costs, such as vehicle registration fees and vehicle property taxes, to a pay-as-you-drive (PAYD) fee schedule financially rewards consumers for reducing their driving and related congestion and vehicle emissions. Pilot simulation tests of various types of mileage-based pricing strategies are underway in the Twin Cities, Minnesota, the State of Oregon, Atlanta, Georgia, and the Puget Sound (Seattle) region of Washington State. Global Positioning System (GPS) based pricing is being tested in the Atlanta, Georgia and Puget Sound Region of Washington State. In these pilots, meters will be placed in the vehicles of voluntary participants so that different charges can be imposed depending on the location and time of travel, which will be determined by an integrated GPS antenna/receiver. Oregon DOT is moving forward with a test of a vehicle miles traveled fee collected at the fuel pump, with data generated by a combination GPS device and odometer sensor with automated vehicle identification technology to reduce the ability for device tampering.

Car Sharing: This strategy involves automated hourly neighborhood car rentals that substitute for car ownership. By sharing a neighborhood car, individuals eliminate their fixed monthly car expenses such as car loan and insurance costs, and instead incur a variable car payment based on usage. This results in an increase in the perceived costs of driving, without a real increase. In effect, this type of value pricing provides an incentive for auto users to reduce vehicle miles in order to realize cost savings. At the same time, the locality benefits from a reduction in vehicle miles and congestion. Similarly, people who drive very little and/or live in very dense urban areas may actually substantially lower their costs by not owning a vehicle. This is particularly true in an area where parking alone may cost several hundred dollars a

month. The availability of a car sharing program allows these individuals the option of selling their vehicle (in some cases an older, inefficient, polluting vehicle) and participating in the car share program instead. Customers may use the program in place of a second car, reducing the costs associated with vehicle ownership. Several municipal governments in the San Francisco Bay area have eliminated their own fleets and substituted using the car share program. Similarly the program has other corporate accounts. In the U.S., there are active and growing car sharing programs in Seattle, Boston, San Francisco, Portland (Oregon), Chicago, New York, and Washington, DC. Under the Value Pricing Pilot Program, an evaluation of the impacts of car sharing on driving and congestion has been completed in San Francisco.

IMPACTS OF PRICING ON TRAVEL

Table 2 summarizes key travel demand and traffic impacts for the various types of value pricing projects implemented in the U.S. under the Value Pricing Pilot Program during the past decade. In the Houston, San Diego and Los Angeles metropolitan areas, pricing has kept congestion from occurring on priced lanes, and has improved utilization of existing highway capacity. In San Diego, traffic volumes have increased on the HOT lanes by as much as 140 percent (without loss of speed) to make use of spare capacity on these lanes. This project took traffic off the regular lanes and thereby reduced the congestion levels that they would have otherwise experienced.

Pricing has changed travel behavior and reduced congestion on toll facilities, as exhibited by shifts in traffic on variably priced toll facilities in New York, New Jersey and Florida. Motorists on toll facilities have chosen to shift their time of travel to off-peak periods to take advantage of lower tolls. While many of these impacts are what theory has predicted for decades, the contribution of the pilot projects is that they provide valuable real world, on-the-ground evidence that has been very useful to U.S. transportation professionals in their efforts to convince elected officials and the public about the potential impacts and benefits of pricing strategies.

Lane Pricing

Houston's QuickRide: Results from surveys conducted on I-10 indicate that the primary source of QuickRide participants is persons who formerly traveled in single-occupant vehicles on the regular lanes (Berg *et al*, 1999). Several hundred two-occupant vehicles elect to pay the $2 toll each day.

On the Katy Freeway, during the AM peak, average speed is 25 mph on the general-purpose (GP) lanes and 59 mph on the HOT lane. That difference represents an average travel time savings of 17.3 minutes on the HOT lane. During the PM peak, the average speeds are 27 mph on the GP lanes and 58 mph in the HOT lane, representing an average 15-minute time savings on the HOT lane. On US 290, during the AM peak, average speeds are 29 mph on the GP lanes and 58 mph on the HOT lane, representing an average time savings of 11 minutes on the HOT lane.

Table 2. Comparison of Key Aspects of Operational Pricing Strategies

	Priced lanes on otherwise free facilities, including conversions of HOV lanes and new priced lanes	**Variable tolls on toll facilities**	**Mileage-based user charges for insurance, taxes and leasing fees and car sharing**
How does it reduce congestion?	Keeps traffic free flowing on the priced lanes, maintains high vehicle throughput, accommodates some traffic previously using regular lanes	Shifts peak period travelers to other modes, routes and times	Reduces use of driving for all trips, both peak and off-peak
What economic incentive is offered to change travel behavior?	Prices change in the priced lanes to influence traveler choice and keep demand within pre-determined limits	Off-peak toll discounts, or higher peak tolls	Travelers save money by reducing driving
What are the key observed travel impacts?	In the peak hour, Express Lanes on SR 91 carry twice as many vehicles as the regular lanes, and speed is 3 to 4 times higher.	4% to 7% reduction in peak period traffic observed in New York; 71% of participants shifted time of travel to get discount at least once a week in Florida	San Francisco, California's car sharing members drove 6.46 miles less per day than non-members

A recent study (Burris 2004) of 3,500 QuickRide users revealed that males, those with a college education, those with annual household income below $50,000, those on commute trips, those carpooling with a child or an adult family member and those between the ages of 25 and 54 are likely to make more QuickRide trips. Sharing the toll does not significantly affect the level of participation. Those who perceive higher travel time savings, travel on the corridor more frequently, and/or take longer trips are likely to use QuickRide more often.

Perceived time savings averages 29.77 minutes, which is double the actual savings. Based on the $2 toll and time saved, value of time for QuickRide users was estimated at $5.63 per hour. Most carpool with a co-worker, adult family member, or child. Things limiting use are convenience, not cost, with 73.4 percent reporting that the toll had little or no significant impact on the decision to use QuickRide. Average time spent picking up and/or dropping off carpool partners was significantly higher among former participants (i.e., those who left the program), with current participants spending on average 4.3 minutes and former participants spending 12.2 minutes. Development of a carpool is a deterrent to use of QuickRide.

San Diego's I-15 FasTrak Lanes: During the period of July-September 2004, the I-15 Express Lanes average daily traffic (ADT) was 21,191 on weekdays, including both vehicles meeting the occupancy requirement for free use and those paying the toll. This represents an increase of 130 percent from the 9,200 daily vehicles prior to the initiation of the program. On average, 75 percent of the daily traffic is from high occupancy vehicles, and 25 percent is from toll-paying customers. There was a large increase in carpooling after initiation of the program, possibly due to the increased flexibility that the program offered, e.g., a driver who usually carpools with another commuter could continue to drive on the Lanes even if his or her passenger was not available to carpool on any particular day, by using a FasTrak transponder to pay for use.

Orange County, CA's SR 91 Express Lanes: Experience with the variably priced Express Lanes on SR 91 in Orange County, CA has clearly demonstrated the ability of pricing to maximize freeway efficiency. The Lanes became operational in December 1995. Initially, due to the addition of four lanes in the median, there was little congestion on the regular lanes, since total capacity had increased by 50 percent, i.e. two lanes were added per direction to the existing four lanes per direction. However, by 1997, congestion had increased on the free lanes as demand increased due to development growth in Riverside County, from which most commuters on SR 91 come. As congestion increased, vehicle throughput decreased on the free lanes, consistent with freeway traffic flow theory (Transportation Research Board 2000).

In 2004, speeds are 60 to 65 mph on the Express Lanes while congestion on the free lanes has reduced average peak hour speeds to no more than 15 to 20 mph. Express Lane users actually perceive that they save 40 minutes on their commute time, somewhat higher than the actual time savings. Similar to Houston's QuickRide, users overestimate their time savings by 5-30 minutes and use is correlated to perceived time savings. The value of time for toll lane users on SR 91 is estimated at $13-16 per hour, much higher than that estimated for QuickRide users.

As shown in Table 3, the share of vehicles carried in the peak hour of the peak day on the Express Lanes has increased to 49 percent. (The peak hour occurs on Friday afternoon from 5 to 6pm in the eastbound direction.) This means that the two express lanes each carry almost 25 percent of the vehicles. This also means that the remaining four free lanes are carrying 51 percent of the vehicles, or slightly more than 12.5 percent of the vehicles per lane. The Express Lanes are thus carrying almost twice as many vehicles per lane than are the free lanes. This demonstrates clearly the benefits of pricing on freeway lanes. Pricing allows twice as many vehicles to be served on a lane in the peak hour than the same lane without pricing. Also, it does so at three to four times the speed on the

unpriced lane. Table 3 provides recent 2004 data on traffic carried on the Express Lanes and the regular lanes.

Table 3. Traffic in the Peak Hours on SR 91 Eastbound on Friday in 2004

	9-Jan	15-Jan	29-Jan	19-Feb	4-Mar	11-Mar	25-Mar	Avg.	Share of Total	Volume Per lane
General Purpose Lanes										
4 - 5 pm	3527	3578	3295	4218	3624	4163	3881	3755	54%	939
5 - 6 pm	3066	3098	2992	3823	3199	3633	3682	3356	51%	839
Express Lanes										
4 - 5 pm	3192	3129	3242	3149	3257	3182	3342	3213	46%	1607
5 - 6 pm	3068	3200	3246	3110	3288	3184	3416	3216	49%	1608
Total										
4 - 5 pm	6719	6707	6537	7367	6881	7345	7223	6968		
5 - 6 pm	6134	6298	6238	6933	6487	6817	7098	6572		

As a result of the change in policy to encourage HOV use, the HOV share of the vehicle trips increased from 15% to 20% in one year. The HOV3+ share in particular increased by 42%. Average vehicle occupancy increased from 1.38 in February 2003 to 1.51 in November 2004 (Orange County Transportation Authority 2004).

Data indicate that Express Lane users are more likely to be using HOVs than SOVs – with 46% of HOV3+ and 26% of HOV2 commuters indicating they share the commuting costs (Sullivan 2000). The researchers concluded that the ability to split the toll may be a factor – unlike the Houston QuickRide program.

The presence of employer rideshare and transit incentive programs was found to be associated with more frequent toll lane use, due to those companies having more HOV commuters, who use the lanes more than SOV commuters. Similarly, the ability to telecommute decreased the usage of the toll facilities. But the ability to have work schedule flexibility was found to be unrelated to the level of use – surprising, because it was expected that schedule flexibility would result in time-of-day shifts to avoid congestion and high tolls. Users of the Lanes generally have a longer commute than others in the region.

Variable Tolls Introduced on Toll Facilities

Lee County Bridges: The pricing program in Ft. Myers, Florida has been successful in inducing significant shifts in traffic out of the peak times. Surveys indicate that over 71 per cent of eligible motorists (i.e., those with vehicle transponders) shifted their time of travel at least once a week to obtain a toll discount amounting to just 25 cents (Burris *et al*, 2002).

New York Bridges and Tunnels: Survey results (Holguin-Veras and Ozbay 2004) indicate that 7% of users changed their travel behavior due to the toll change. Those who changed their travel

behavior traveled less by car and more by public transportation. Approximately 60% of those surveyed were aware that discounts were available for E-ZPass users on the PANYNJ facilities. However, 45% of E-ZPass users were aware of the off-peak discount program as opposed to only 18% of cash users.

Studies estimate that total annual savings in delay on weekdays were about 143,000 hours during peak periods, valued at $2.85 million, and 97,000 hours during off-peak periods, valued at $1.92 million (Holguin-Veras and Ozbay 2004). As a result of implementing variable pricing, total delay at toll plazas has been reduced on average by 31% with a corresponding 25% increase in EZ-Pass demand (Ozmen-Ertekin and Ozbay 2004). Morning peak period traffic in May 2001 was reduced by 7 per cent compared to the same month in 2000. Evening peak period traffic dropped by 4 per cent; and overall traffic remained stable (Port Authority of New York and New Jersey, 2001). Muriello and Jiji (2003) provide evidence that a significant share of morning traffic has shifted to the 5-6 AM hour when off-peak rates are in effect. Weekday 5-6 AM traffic increased from 10.6 per cent of total 5-10 AM traffic in 2000 (before the value pricing program began) to 12.9 per cent of total 5-10 AM traffic in 2002.

New Jersey Turnpike: A survey of 513 respondents (Ozmen-Ertekin and Ozbay 2004) found that 15% of those who were aware of the toll increase changed their travel behavior due to implementation of the variable priced toll structure. Almost 60% of respondents currently had an E-ZPass tag. Travel time savings was the main reason an overwhelming majority of respondents (65%) use E-ZPass and 60% of respondents acquired their transponder within the previous three years.

Preliminary data from the value pricing program on the New Jersey Turnpike show that value pricing is working to shift traffic out of the peak period. Most of the recent growth in traffic on the Turnpike has been in the off-peak hours, with total traffic up by around 7 per cent, but morning peak traffic up by only 6 per cent and afternoon peak traffic up by only 4 per cent. The proportion of daily Turnpike traffic accounted for by the morning peak dropped from 14 per cent to 13.8 per cent, and the afternoon peak's share of traffic decreased from 14.7 per cent to 14.3 per cent.

***Variable Tolls on the San Joaquin Hills Toll Road and Foothill Toll Road*:** A summary of AM and PM data representing the "peak" for one of the plazas subjected to value pricing (comparing 2002 to 2003) shows that there was a 1.5% increase in transactions and 18.9% increase in revenue for FasTrak customers. Cash customers recorded a 7% reduction in transactions and a 5.6% increase in revenue.

Usage-Based Vehicle Charges

San Francisco Car Sharing: After two years of operation of the San Francisco program, a third of those who signed up for the program (i.e., "members") have reduced their car ownership by at least one car, and two-thirds report that they have opted not to purchase another car because of their participation in the program. In a matched pair comparison with non-members, it has been estimated that members drove 6.46 miles less per day than non-members. While this program has also enabled some prior transit users to make new automobile trips, the overall net impact seems to have been to reduce vehicle miles of travel among the members. Further, the observed trend of reduction in auto ownership among members promises significant future reduction in vehicle miles.

IMPACTS ON LOW-INCOME MOTORISTS

Lane Pricing

San Diego's I-15: Surveys conducted on priced lanes in San Diego have found that motorists from all income groups do use the priced lanes. However, those with higher incomes *do* use the Express lanes more often.

SR 91 Express Lanes: Use of the Express Lanes increases with income, according to data collected on SR 91 in 1996 and 1999. In 1999, 45% of the highest-income quintile of users of SR 91 reported *frequent* use of the Express Lanes as a solo-driver paying the fee, vs. only 18% of users in the lowest-income quintile.

Houston, Texas QuickRide: In Houston, Texas on the QuickRide lanes, surveys suggest that use by those with lower incomes predominates (Burris 2004), probably because SOVs are not eligible for the QuickRide program, and one has to form a two-person carpool to be eligible.

Variable Tolls Introduced on Toll Facilities

New York Bridges and Tunnels: Data from studies underway (Holguin-Veras and Ozbay 2004) suggest that 58% of those traveling into Manhattan during peak periods had annual household incomes above $75,000. The cost to park in Manhattan (average parking fee of $17.29) is three times higher than the average toll paid ($5.32).

Usage-Based Vehicle Charges

As automobiles become more fuel-efficient or are designed to use to alternative fuels, the share of fuel taxes paid by motorists with newer vehicles will decline. Since wealthier motorists are more likely to afford these newer vehicles, middle- and low-income motorists with older vehicles will pay an increasing share of total fuel tax revenues collected. The additional revenues that come from usage-based vehicle taxation, such as mileage-based fees being tested in Georgia, Oregon, Washington and Minnesota, will allow State and local transportation agencies to reduce their reliance on fuel taxes and phase out tax-based funding of highways. In the longer term, moving away from tax-based funding of highways has the ability to increase equity towards highway users with older, less fuel-efficient vehicles.

IMPACTS ON REVENUE AND FINANCIAL FEASIBILITY

Lane Pricing

Houston's QuickRide: The Houston QuickRide projects, with only about 2,200 toll account holders, have an average of about 200 toll-paying vehicles per day. The rest are HOVs and buses. Toll-paying vehicles generate about $100,000 annually, sufficient to cover only costs for operation of program. (Texas Department of Transportation 2003). The HOT lanes in Houston did not involve new construction, since existing lanes were used, so the program is financially self-sufficient.

San Diego's HOT lanes: The FasTrak lanes carry over 5,000 toll-paying vehicles daily. The rest, approximately 17,000 vehicles, are buses and HOVs with two or more occupants. During the 2004 fiscal year (July 1-June 30) I-15 collected $2.4 in toll revenues. Approximately $1 million of the revenues are

used to fund the Inland Breeze express bus service that operates in the corridor. The remainder is used to fund enforcement on the HOV lanes by the California Highway Patrol, and for maintenance of the electronic toll collection (ETC) system and operation of the Customer Service Center. Currently, there are approximately 18,000 FasTrak accounts. Again, the HOT lanes did not involve new construction, since existing lanes were used, and the program is financially self-sufficient.

Orange County, CA's SR 91 Express Lanes: The only operational HOT lane project on new lanes was relatively inexpensive to implement. The SR 91 Express Lanes were constructed on existing right-of-way in the median of the facility. New rights-of-way did not need to be acquired. Also, construction of the Lanes did not involve major modifications of existing freeway interchanges. There are no intermediate access points and only a single entry and exit is provided in each direction. Consequently, cost of construction per lane mile averaged only about $3 million, vs. nationwide average costs of almost $10 million per lane mile for high-cost urban freeway construction (US DOT 2000).

On the other hand, the motoring public is willing to pay relatively high tolls for use of the Express Lanes, due to severe congestion in the corridor, and toll exemptions or discount tolls are provided only to HOVs with three or more occupants, motorcycles, zero emission vehicles and vehicles with disabled plates and disabled veterans. Single occupant and two-person carpools pay the full toll at all times. During 2003, the first year of operation under the ownership by OCTA, the facility served an average of 28,400 vehicles per day, and yielded revenues of over $26.5 million – up from 23,850 vehicles per day and $23.2 million in 2002 under private ownership. Demands on the 91 Express Lanes continue to grow – since opening, total annual vehicle trips have grown 67 percent from 5.7 million trips in 1996 to 9.5 million in 2002. Revenues are sufficient to provide funds not only for operation of the Express Lanes, but also to pay debt service charges on bonds amounting to approximately $135 million. The bonds were issued by the Orange County Transportation Authority (OCTA) to finance the purchase of the facility from the private company that constructed and operated the project through 2002. Through the purchase, OCTA also acquired the franchise rights allowing them to eliminate a non-compete provision, clearing the way for $700 million in enhancements in the corridor planned over the next ten years that will further improve traffic flow.

Projects Under Construction that involve New Priced Lanes: Unlike the currently operating SR 91 Express Lanes, the two new HOT lane projects that broke ground in 2003 (i.e., extensions of the I-15 HOT lanes and Katy Freeway HOT lanes) will not be self-financing. The expansion and extension of the HOT lanes on I-15 in San Diego is projected to yield between $7 and $9 million in annual toll revenues at full build-out. This amount would be sufficient to pay for operation of the value pricing element, toll enforcement, and subsidy of an enhanced bus rapid transit (BRT) system that will operate in the corridor. Toll revenues from the existing I-15 Express Lanes will fund a portion of the design and installation costs of an upgraded and expanded electronic toll collection and monitoring system for the 22-mile Managed Lanes. This cost is less than two percent of the total project costs of $750 million.

The Katy Freeway expansion project in Houston will include four HOT lanes and several new free lanes. Total costs, including costs for construction, right-of-way, engineering and project management will exceed $2.0 billion. However, the Harris County Toll Road Authority, the agency designated to operate the HOT lanes, expects that bonds backed by toll revenues will finance only $250 million of these costs.

Variable Tolls Introduced on Toll Facilities

New York Bridges and Tunnels: The Port Authority introduced the variable toll program in 2001 to generate incremental revenue to support its five year, $14 billion intermodal capital investment program. The Value Pricing Toll Program has been successful in accomplishing its revenue objective in support of the capital investment plan (Muriello and JiJi 2003).

New Jersey Turnpike: The NJ Turnpike 2003 annual report showed a 37% increase in toll revenues between 2001 and 2003 (New Jersey Turnpike 2003).

***Variable Tolls on the San Joaquin Hills Toll Road and Foothill Toll Road*:** As indicated earlier, a summary of AM and PM data representing the "peak" for one of the plazas subjected to value pricing (comparing 2002 to 2003) shows that there was a 1.5% increase in transactions and 18.9% increase in revenue for FasTrak customers. Cash customers recorded a 7% reduction in transactions and a 5.6% increase in revenue.

Potential of Mileage-Based Taxation.

As automobiles become more fuel-efficient or move to alternative fuels, the fuel taxes paid by motorists with newer vehicles will decline. Moving to mileage-based user fees will allow State and local transportation agencies to reduce their reliance on fuel taxes and phase out tax-based funding of highways. For example, Germany is expecting that a new mileage-based charging system, to be implemented in early 2005 for heavy goods vehicles will provide sufficient revenue to replace the existing time-based user fee called "Euro-Vignette."

PUBLIC ATTITUDES

Lane Pricing

***San Diego's HOT Lanes*:** Extensive outreach was conducted to measure public response to the HOT lanes concept in San Diego. The outreach included 25 stakeholder interviews, three focus groups, 100 intercept surveys at park and ride lots and transit centers, and a telephone survey of 800 I-15 corridor users conducted in the Summer/Fall of 2001. The surveys (Wilbur Smith Associates *et al*, 2002) found that corridor users did not consider equity to be a major issue or obstacle to implementing pricing on the managed lanes. The majority of those interviewed in the telephone survey (71 per cent) feel that pricing the lanes is "fair" for travelers on the main lanes. Furthermore, 66 per cent approve of the currently operating HOT lanes, and 71 per cent believe that tolls are an effective way to manage demand. Both users and non-users of the dynamically priced I-15 HOT lanes support the use of pricing. Support is high across all income groups, with the lowest income group expressing as much support as the highest income group (about 80 per cent).

The 800-person telephone survey found that support for value pricing is deep among the people who have the most extensive experience with value priced HOT lanes. This suggests that operational pilot projects can have a significant influence on public attitudes. Both HOT lane and non-HOT lane users of I-15 felt that the most effective way to reduce existing and future congestion on I-15 was to add priced lanes. This option was even preferred over adding regular lanes, by a wide margin (37% for priced lanes vs. 26% for regular lanes). It appears that a large share of the public in San Diego have grown to understand the value of priced lanes, and that simply providing new general purpose lanes, without fees or other restrictions, will not help much in relieving congestion due to continuing increases in traffic.

Orange County, CA's SR 91 Express Lanes: A study by Sullivan (2000) found that people are willing to pay tolls for travel time savings, comfort and perceived safety, but most do not do it for all trips. Being female is the factor most likely to influence *use.* Income, age, education and travel to work influence the decision to purchase a transponder.

Between 1996 and 1998 surveys, the proportion of commuters who used the 91 Express Lanes increased from 28.2% to 42%. Those using the Lanes for more than 20 toll lane trips per month have decreased. They currently represent only about 12% of transponder holders. The most cited reasons for use were driving comfort and the perception of greater safety with reliability of travel time cited a distant third. Those who report the Lanes as "safe" outnumber by 4:1 those who do not.

Houston's QuickRide Program: 69.5 percent of current users and 66.9 percent of former enrollees were supportive of allowing single occupant vehicles to travel on the HOT lane at a higher toll (Burris 2004).

Variable Tolls Introduced on Toll Facilities

New York Bridges and Tunnels: Survey results (Holguin-Veras et al. 2004) indicate that almost 80% of E-ZPass users felt that travel time savings were the most attractive feature of the E-ZPass program. However, only 45% of E-ZPass users were aware of the value pricing component of the program involving off-peak discounts to E-ZPass users.

New Jersey Turnpike: The NJ Turnpike Authority was the first toll authority in the country to introduce value pricing. The Turnpike wanted to make sure that the program would be introduced successfully. It adopted a set of strategies designed to buffer it from criticism. One was to present the E-ZPass off peak period pricing as a zero percent increase. The peak period price differential was big enough to show there was a difference, but not so large as to create opposition to the program. Value pricing was an option that allowed some drivers to choose the times they would drive on the NJ Turnpike (Ozmen-Ertekin and Ozbay 2004). There was comprehensive media coverage of the NJ Turnpike Authority's long term financing program, that focused on all the elements of the program—the toll increases, the financial plan, the introduction of EZ-Pass, and the value pricing initiative.

***Chicago*:** Focus groups conducted as part of the Illinois Tollway Value Pricing Study (Resource Systems Group 2003) found that both cash and I-PASS users felt I-PASS discounts would encourage I-PASS acquisition. However, participants voiced concerns that increasing tolls for cash users would be seen as "undemocratic" and unfair. About half of all respondents indicated that they would pay at least twice as much for a free-flowing commute. Adding new lanes on the Tollway with congestion management using HOT lanes was far more attractive to users versus implementing value pricing on existing lanes. Nearly all respondents felt that carpooling was a good idea and that carpools should be eligible for preferential pricing, but almost everyone indicated they would not carpool themselves.

Privacy Concerns with Mileage-Based Taxation

While privacy concerns are often raised with regard to electronic tolling, this has not been a major issue with existing operational projects. Even when anonymous transponder accounts have been offered, such as on the SR 91 Express Lanes, there have been few takers. However, with mileage-based fees, privacy concerns appear to dominate media reports. Privacy is therefore a major design consideration for mileage-based charging schemes. In addition to privacy with regard to others knowing where and when they travel, people are concerned that data on their travel speeds could be used by insurance companies to raise insurance rates, or could be used against them in court in case of an accident or other court proceedings (Guensler et al. 2004).

CHALLENGES

Gaining Public and Political Acceptance

There are two key strategies that need to be employed to get public and political acceptance of value pricing strategies: (1) conduct an effective public education and involvement campaign early in the process; and (2) implement an integrated package that benefits all income groups. These two strategies have been employed in many of the successful value pricing projects in the U.S.

If a proposed value pricing project is to be publicly acceptable, its benefits must be clearly identified to motorists. Motorists may benefit either directly in the form of reduced travel delay and enhanced travel options, and/or indirectly through appropriate use of toll revenues. To help address equity, pricing may need to be combined with some form of direct benefits to those who pay tolls or those who give up the right to use facilities that were formerly provided without charge. These can take a number of forms, including highway improvement or expansion, construction of new highways, provision of alternative modes of transport such as transit, or investment in other areas within the transport sector such as safety and environment. Other revenue allocations may include some kind of explicit compensation to low-income groups, such as toll credits similar to credits provided to low income public utility customers, tax credits to low-income commuters for tolls paid by them on value priced lanes, or toll credits provided to those who choose not to use value priced lanes, such as in the FAIR lanes concept.

Operational Issues with Priced Lanes

Access and egress: Access to and egress from HOT lanes are proving to be major issues with regard to implementation of HOT lanes on urban freeways. Unlike the SR 91 Express Lanes that have a single point of entry and a single point of exit, other HOT lane projects being developed require multiple entry and exit points. This poses problems. Weaving through several lanes of traffic to use slip ramp entrances may pose safety problems, and may exacerbate congestion on the regular lanes. On the other hand, if direct connector flyover ramps are provided to allow direct entry and exit without having to weave through the regular lanes, construction costs rise precipitously, affecting financial feasibility of the HOT lanes.

Lane separation: Conversion of existing HOV lanes to HOT lanes might appear to be more financially feasible, since construction costs for new lanes are avoided. However, experience with projects under development suggests that the I-15, US 290 and Katy Freeway HOT lane projects cannot be easily replicated. Unlike these HOT lanes, few existing HOV lanes are barrier-separated. In many cases, neither barriers nor buffers exist between regular lanes and HOV lanes, and use of plastic pylons to separate HOT traffic from regular lanes (as on SR 91) is not favored in regions of the country where snow removal must be undertaken.

Enforcement: Enforcing proper use of HOT lanes is generally more complicated than policing traditional toll facilities. Most HOV lanes do not have tollgates or electronic tolling. They rely on visual inspection (including camera monitoring) to count occupants – an approach that may require vigorous application to be effective. HOT lanes pose an additional challenge, in that vehicles not meeting occupancy requirements may still use the lanes if they pay a toll. This makes visual inspection insufficient, as both valid users and violators could be traveling on the lanes at the same occupancy levels. Relatively complex combinations of visual and electronic methods are thus needed to address enforcement in such situations. One approach to simplify priced lane enforcement is to charge all vehicles using the lane, as the State of Maryland has recently proposed. HOV vehicle occupants would still receive an effective discount, as the standard toll would be spread over multiple occupants of a single vehicle.

Institutional Issues

Restrictive Clauses in Private Sector Agreements: In Orange County, California, a "non-compete" clause in the agreement with the original private sector partner operating the Express Lanes on SR 91 prevented public agencies from making improvements in the adjacent free lanes. Eventually, this provision led to the acquisition of the Express Lanes by the Orange County Transportation Authority. Simply eliminating non-compete provisions is not a solution. Involvement of the private sector may be difficult without adequate protection against future competition. A companion paper at the 2005 Annual Meeting of the Transportation Research Forum (DeCorla-Souza 2004a) discusses one possible solution. There are other possible solutions as well, such as the arrangement being employed in Toronto, Canada on Highway 407, and the proposed public-private partnership arrangement for operation of HOT lanes in Tel Aviv.

CONCLUSIONS

Value pricing projects in the U.S. are breaking new ground and providing important lessons for those interested in exploring the use of market-based approaches in responding to traffic congestion problems. Observations from projects implemented to date reveal that travelers are willing to pay for improvements in transportation service and that pricing can lead to more efficient use of existing highway facilities. People respond to price signals when making transportation decisions, just as they do in other aspects of their economic lives, and those responses can serve as important guides for transportation planners and policy makers.

Much has been learned about the promise and potential of value pricing over the last several years, yet much more remains to be learned. Many aspects and types of pricing remain untested in the U.S. Although value pricing is being tested in a number of locations and contemplated in many more, value pricing is still a new and innovative concept, one that requires careful planning, coalition building, public education and participation, and sufficient time and resources for the development of well designed and locally acceptable project plans.

The Value Pricing Pilot Program has funded a large number of "localized" or facility-specific pricing proposals involving single highway facilities or travel lanes. However, further efforts are needed for more comprehensive region wide applications of road pricing such as toll rings or toll zones on the scale of projects in Norway, Singapore and London. According to one study (DeCorla-Souza 2004b), in a typical large metropolitan area such as Washington, DC, introduction of region wide pricing with added freeway capacity could generate $300 million to $600 million in toll revenues annually and $400 million to $1.1 billion in net annual economic benefits from reductions in travel delay, fuel consumption, accidents and other social costs. Yet, there are large technical and political risks involved in piloting such a major path-breaking effort. Large U.S. metropolitan areas are likely to continue to be reluctant to take the risks involved in piloting a region wide pricing project unless political risk-sharing and financial incentives are available.

Some transportation experts envision a long-term scenario involving radical changes in the current funding and institutional arrangements in highway transportation. Opportunities for value pricing projects may be enhanced as movements are made toward increased privatization of highway infrastructure. Value pricing could play an important role as part of a new financing mechanism for highways as existing funding sources become less effective with the advent of more fuel efficient vehicles and vehicles fuelled by alternative sources of energy.

In conclusion, value pricing holds the promise of reducing congestion, enhancing mobility and economic productivity, reducing environmental and energy costs, and providing new sources of funding for

transportation investments. Despite the promise and potential shown in early value pricing projects, the concept of value pricing is, by its very nature, controversial. It involves a very new approach to dealing with congestion problems and a very new way of charging for road use. The need for Federal encouragement of State and local government consideration of value pricing is likely to continue for a number of years.

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