Value Pricing Pilot Program: Lessons Learned

Final Report

August 2008

prepared for
U.S. Department of Transportation,
Federal Highway Administration

prepared by
K.T. Analytics, Inc.
6304 Haviland Drive
Bethesda, Maryland 20817

Cambridge Systematics, Inc.
100 Cambridge Park Drive, Suite 400
Cambridge, Massachusetts 02140

(Blank Page)

Value Pricing Pilot Program: Lessons Learned

Final Report

August 2008

Prepared by

K.T. Analytics, Inc.
Cambridge Systematics, Inc.

Kiran Bhatt
Thomas Higgins
John T. Berg
Lead Authors

Jeffrey Buxbaum
Evan Enarson-Hering
Contributing Authors

Prepared for

Federal Highway Administration

U.S. Department of Transportation

Value Pricing Pilot Program: Lessons Learned

Expert Panel

Kenneth Buckeye, *MNDOT, St. Paul, MN*
Mark Burris, *Texas A & M University, College Station, TX*
David Forte, *WSDOT, Seattle, WA*
Randall Guensler, *Georgia Institute of Technology, Atlanta, GA*
Greg Hulsizer, *South Bay Expressway, San Diego, CA*
Todd Litman, Victoria Transportation Policy Institute, Victoria, BC, Canada
MATTHEW MACGregor, *TXDOT, Dallas, TX*
Lee W. Munnich, Jr., *Humphrey Institute of Public Affairs, UMN, Minneapolis, MN*
Robert Poole, *Reason Foundation, Plantation, FL*
Mark F. Muriello, *The Port Authority of New York and New Jersey, New York, NY*
Michael Replogle, *Environmental Defense fund, Washington DC*
Edward Regan, *Wilbur Smith Associates, New Haven, CT*
William T. Roach, *Seattle, WA*
WM R. Stockton, *Texas Transportation Institute, College Station, TX*
Chris R. Swenson, *CRSPE, Inc., Cape Coral, FL*
Derek Toups, *San Diego Association of Governments, San Diego, CA*
David Ungemah, *Texas Transportation Institute, Austin, TX*

Foreword

Notice

This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The U.S. Government assumes no liability for the use of the information contained in this document. This report does not constitute a standard, specification, or regulation.

The U.S. Government does not endorse products or manufacturers. Trademarks or manufacturers' names may appear in this report only because they are considered essential to the objective of the document.

Quality Assurance Statement

The Federal Highway Administration (FHWA) provides high-quality information to serve Government, industry, and the public in a manner that promotes public understanding. Standards and policies are used to ensure and maximize the quality, objectivity, utility, and integrity of its information. FHWA periodically reviews quality issues and adjusts its programs and processes to ensure continuous quality improvement.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-HOP-08-023		

4. Title and Subtitle	5. Report Date
Value Pricing Pilot Program: Lessons Learned	**August 2008**
	6. Performing Organization Code
7. Author(s) **Kiran Bhatt, T. Higgins and J. Berg (With J. Buxbaum & E. Enarson-Hering)**	8. Performing Organization Report No.
9. Performing Organization Name and Address **K.T. Analytics, Inc. and Cambridge Systematics, Inc.** **6304 Haviland Drive 100 Cambridge Park Drive, Suite 400** **Bethesda, Maryland 20817 Cambridge, Massachusetts 02140**	10. Work Unit No. (TRAIS)
	11. Contract or Grant No.
12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This "Lessons Learned Report" provides a summary of projects sponsored by FHWA's Congestion and Value Pricing Pilot Programs from 1991 through 2006 and draws lessons from a sample of projects with the richest and most relevant experience across selected project categories.

Since the inception of the Congestion Pricing Pilot Program in 1991, over 50 pricing projects have been funded by FHWA. More than a dozen operational projects are providing important findings regarding traffic and congestion impacts, transportation funding issues, public acceptability, administrative matters and future prospects for addressing congestion using various pricing strategies. In addition, useful information and valuable lessons have been provided by project feasibility studies and by pricing projects that did not progress to implementation or exhibited unexpected outcomes.

This report aims to synthesize the experience from the projects in the federal pricing programs regarding effectiveness at meeting their objectives and the political and technical aspects related to implementation. In an epilogue, the authors look forward to possible future roles for pricing strategies in addressing emerging congestion, capacity and funding problems.

17. Key Words	18. Distribution Statement
Value Pricing Pilot Program, Value Pricing, Congestion Pricing, Road Pricing, Variable Pricing, Priced Express Lanes, Variable Driving Costs, HOT Lanes, Car Sharing, Parking Cash Out, Impacts of Pricing, Equity of Pricing, Acceptability of Pricing, Costs and Revenues of Pricing, Pricing Technology	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
		177	

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

TABLE OF CONTENTS

Acknowledgments

The research reported herein was performed by K.T. Analytics, Inc. under a subcontract with Cambridge Systematics, Inc.

Dr. William Perez of Cambridge Systematics, Inc. was the project manager. Dr. Kiran Bhatt, K.T. Analytics, Inc., served as the principal investigator. Other key staff involved included: Thomas Higgins (K.T. Analytics, Inc.), John T. Berg (Consultant), and Jeffrey Buxbaum and Evan Enarson-Hering (Cambridge Systematics, Inc.).

The authors are grateful to members of the "Expert Panel", set up by the Federal Highway Administration, for invaluable comments and suggestions they provided for the interim and final reports. Thanks also go to the tolling and pricing and congestion pricing special projects team members at the Office of Operations in the Federal Highway Administration (USDOT) who provided overall guidance, made available Value Pricing Pilot Program (VPPP) documents and related data at short notice, and reviewed and commented on numerous drafts of the report.

Needless to say, the authors alone are responsible for the accuracy of information presented and opinions expressed in the report.

EXECUTIVE SUMMARY

Overview

The purpose of this "Lessons Learned Report" is to summarize projects sponsored by FHWA's Congestion and Value Pricing Pilot Programs from 1991 through 2006, synthesizing project experience, drawing implications for federal and project level roles and looking forward to future roles for pricing strategies.

The 24 projects selected for review have been grouped into the following six categories of pricing strategies:

- HOT lane conversions with pricing
- Variable pricing of new express lanes
- Variable pricing on existing toll facilities
- Regionwide variable pricing initiatives
- Making driver costs variable
- Other pricing projects

Background

The Value Pricing Pilot Program (VPPP) has been a key component of the Department of Transportation's (DOT's) coordinated program to assist state and local governments in their efforts to stem the tide of escalating congestion costs. Since its inception in 1991, Federal pricing pilot programs have sponsored over 50 pricing projects and studies in 14 states. Projects and evaluations span a diverse group represented by the six broad concept categories described earlier. Of these, over twenty projects became operational. These projects and studies have generated invaluable lessons pertaining to the design, assessment, acceptability, implementation, administration and evaluation of pricing concepts.

More than a dozen pricing projects implemented in the U.S. during the past 15 years have demonstrated that pricing can be politically and publicly acceptable. Most of the projects have met their objectives without any significant controversy. By influencing travel behavior, pricing projects have prevented congestion from occurring on priced lanes, reduced congestion on toll facilities, and improved utilization of highway capacity. Yet, issues remain with regard to public attitudes toward pricing; equity concerns; and acceptance. Technical problems have also stalled or delayed several projects. This report summarizes the promises and challenges of value pricing, and describes how these challenges are being addressed.

Findings

For each project category, this section describes:

- Impacts (congestion reduction and performance, cost/revenues, energy and environment, equity)

- Implementation and operation details (planning and policy, outreach and stakeholder involvement, acceptability and politics, institutional issues, administration and enforcement); and evaluation

- Lessons and implications for planners and managers

Travel and Traffic Impacts

With few exceptions, variable pricing strategies across categories have met their principal travel and traffic objectives. Pricing programs have demonstrated that pricing can have a number of effects on driver behavior and traffic volumes, including: changes in times trips are made, routes, or modes of travel; willingness to pay for faster travel times by traveling on toll lanes; reductions in peak-period traffic volumes and more efficient use of highway capacity. In particular:

- HOT Lane conversions have gained better use of underutilized HOV lanes, kept lanes congestion free and not slowed or dissuaded HOV users. Also, there is some, albeit non-conclusive, evidence HOT lane conversions have brought relief to adjoining mixed flow lanes by attracting some traffic away from these lanes.

- New variably priced express lanes render much higher throughput at significantly higher speeds than adjoining general purpose lanes, and reduce congestion on the overall facility. New variable tolls on existing toll facilities have led to more efficient facility use, postponed the need for capacity improvements and generally preserved or increased revenues.

- Regionwide pricing initiatives are mostly in the pre-implementation stage, but planning studies suggest they will mirror the positive experiences of HOT lane conversions and new priced express lanes, and may be more effective than the sum of individual projects. Projects making fixed driving costs variable, while tested only in experimental conditions, have reduced weekday peak period and/or weekend travel by encouraging shifts in travel times and mode. Lastly, while the limited experience with carsharing and cash out cases showed mixed or inconclusive results, cash out and carsharing show sufficient promise in other referenced assessments to deserve further implementation and evaluation.

Costs/Revenues

The revenues generated by pricing have been an important source of benefits in most of the projects reviewed. Project revenues have been used to cover operating and enforcement costs, finance additional highway infrastructure, and improve transit alternatives.

- For HOT lane conversions, revenues generally support operations and, sometimes, additional transit service, though one smaller program did not raise sufficient revenue to cover all operations and a long standing program is starting new fees to cope with declining use and revenues caused by the opening of a new nearby facility. It appears that the initial capital cost burden may be difficult to cover from toll revenues - especially where conversion requires expensive capital outlays, or where a relatively large number of vehicles are allowed to travel free.

- The one well-evaluated new express lane project shows a privately owned and operated tollway can be financially viable and bring savings to the public sector. Financial information on new variable pricing on existing toll facilities suggests revenues can meet targets and may delay costly capital improvement expenditures. Introduction of pricing on existing toll facilities has been relatively low cost since infrastructure and operations typically already are in place. Consequently, revenues have exceeded the costs of these projects.

- Regionwide pricing initiatives are too new to draw confident financial conclusions, though one study suggests financial feasibility is highly dependent on capital costs of new facilities. Experiments with variable driver costs are also too limited for confident conclusions, though observed user responses in experimental demonstrations suggest these strategies might be able to more than cover costs.

- One carsharing case reviewed indicates economic viability of both profit and non-profit operations. Also, related studies suggest if carshare takes root with significant coverage and participation, it can operate successfully without the need for public funds

Equity

Since the inception of the VPPP, equity has been a key program interest, with particular attention given to mitigating possible adverse effects of projects on low-income drivers. However, project experience has shown, particularly with the most common projects funded under the early phases of the program, that the perception of unfairness may be overdone.

- Equity issues do arise in planning and implementation across several pricing categories, but they have rarely led to project termination. Equity evaluations,

though limited in scope, have found some differences in incomes of facility users, but these are not dramatic.

- HOT Lane conversions have encountered concerns in planning about catering to the rich, but usually not sufficient to halt projects. Such concerns tend to diminish among users and the public as operations get underway. User surveys reveal higher income travelers using facilities somewhat more than other income groups, but general use across a wide range of incomes.

- New expressways with variable pricing are limited in number but do reveal some differences in use based on income, though little difference in reactions to projects. In one case, use increased over time for all modes across all incomes. A planned expansion project found strong support with few differences about fairness based on ethnicity or income.

- For pricing on existing tollways, equity concerns about income have not blocked programs, but issues have been raised about fairness to those with inflexible work schedules and businesses that can not respond in the short run. User surveys for this project category have been limited, but one case suggests higher income travelers were more likely transponder owners both before and after price changes.

- The region wide pricing category again shows the variation in definitions and evaluation approaches for equity. One project accounted for impacts across ethnic and income groups by estimating jobs within a travel time perimeter compared to the general population.

- Field tests of making driver costs variable, carsharing and cash out have not delved into equity issues to any significant degree.

Environment

- Environmental evaluations are scarce across categories of pricing projects. A few findings suggest possible positive impacts, but more evaluation is needed to clarify the picture.

- One HOT lane conversion found emissions growth but a comparison corridor showed even more growth. Another project evaluated CO and noise and found no significant changes compared to pre-project.

- One case of pricing on tollways attempted a detailed air quality assessment, but found that existing forecasting models were inadequate. Regionwide pricing initiatives will entail some VMT and air quality assessments, but results are via models and still very preliminary.

- Field tests of making driver costs variable found mileage and congestion charges can reduce travel in priced vehicles. However, air quality effects depend on mode shift and degree of shift to un-priced household vehicles, a complexity requiring further study.

- Carsharing impacts on VMT across household vehicles and associated air quality implication requires further testing and evaluation.

Policy/Institutional

- New public policy and institutional arrangements depend on the specific project category. HOT conversions typically require new policies, legislation, organization and operational arrangements.

- New expressway development commonly has called for modifications to existing policies and required new agreements, especially in the case of private for-profit development.

- New variable pricing on tollways required governing authority approval but not new legislation.

- Regionwide pricing initiatives are likely to follow HOT conversions in the extent of policy and institutional development.

- Field tests of making driver costs variable did not require extensive policy initiatives, but clearly replacing gas taxes with mileage-based pricing or instituting pay-as-you-drive insurance products will entail significant policy initiatives.

- Voluntary cash out and carshare programs are initiated without significant policy changes though agreements are required for carshare arrangements with cities, employers or developers. Voluntary cash out can be supported by an agreement between a public agency promoting the concept and employers and/or developers; it also can be supported and encouraged by state legislation, as referenced literature suggests.

Outreach/Acceptance

- Public opinion is perhaps the most critical determinant of the prospect for successful pricing project implementation. For this reason, efforts to implement variable road pricing projects have given much attention to measuring and understanding public opinion about value pricing and to shaping informational programs to address concerns expressed in public opinion surveys, focus group meetings and stakeholder interviews.

- Outreach efforts as part of initial feasibility studies often find neutral or skeptical opinions, or outright resistance, but this is often followed by acceptance as projects get underway. Thus, early and continuing outreach efforts are expected to be most effective. The support of a key stakeholder who was able to influence public opinion also was crucial for the successful implementation of several projects.

- HOT lane conversions demonstrate extensive outreach often leading to revised or dropped plans, though early resistance can turn to acceptance with responsive service. Support from elected officials, advocacy groups and community leaders appears vital, and may take many months if not years of effort.

- New variably priced highway facilities suggest a similar lesson. While public support is generally favorable, the public may not understand what expenditure items pricing revenues support, and support can deteriorate if private sector operations are seen as monopolistic and inflexible.

- Variable pricing on existing toll facilities again is accompanied by considerable outreach, leading to a successful implementation in one case but not another. In the former, the positions of opponents and supporters remained the same before and after implementation showing the importance of continuous effort to maintain an acceptance threshold.

- Outreach is part of all ongoing region wide pricing initiatives, but with results yet to be documented.

- Results from variable cost field tests, as with HOT lane conversions, suggest initial concerns about security and technology can turn to a favorable response after sufficient time and experience.

- The cash out program met with stiff resistance which could not be overcome, underscoring how this category of pricing is highly dependent on the transportation, parking and economic environment in which it is attempted. The carsharing case demonstrated traditional marketing techniques can be successful in gaining participation and sustaining market share.

Technology

- HOT lane conversions have demonstrated sufficient advances in technologies to make fully dynamic pricing feasible, along with enforcement against transponder violations by stationary and mobile enforcement. However, automated occupancy enforcement has yet to be demonstrated. The lack of a proven technology for occupancy detection also has limited the possibility of multiple price schedules based on occupancy. The category of pricing new express lanes suggests the same conclusion.

- Congestion pricing on tollways again demonstrates the feasibility and reliability of transponders and the growth of open road tolling to ease payment. One project also is demonstrating truck axle counting equipment.

- The category of making driver costs variable suggests some sensitive technology issues. Reliability of vehicle and fueling station technology was a concern in one program, requiring further tests and assessments.

- The right to privacy is expected to continue to be an issue in future variable mileage fee applications. There is an important tradeoff between complete privacy or anonymity and the business need to prove that certain mileage was recorded for billing purposes
  .
- Findings indicate privacy was a significant concern among participants, but such concerns were alleviated once participants learned more about the technology and were confident in data security.

- The carsharing case has demonstrated reliable payment and vehicle check out technology.

Evaluation

- Project evaluations have adequately covered traffic impacts, project operations, public and customer reaction, but paid less attention to equity and environmental impacts.

- Attempts to isolate the effects of projects from outside influences such as gas price or economic swings have been modest at best.

- Most HOT lane conversions have focused on traffic impacts and public/user reactions, one giving attention to business and land use impacts, but less attention has been given to equity and environmental effects. In the most extensive evaluation case, a comparison corridor (though not strictly equivalent) provided some guard against spurious conclusions about project effects.

- The category of pricing new express lanes shows broad-ranging evaluations across traffic, travel time, accidents, user profiles (in part for equity assessments), user opinions and, in one case, opinions of corridor residents. Two projects compared results to non-tolled sections of the highway or nearby freeways to improve confidence of findings.

- In one case air quality impact models were not able to adequately account for accelerations and decelerations.

- New congestion pricing on toll facilities commonly use only before/after data without comparisons to trends on other facilities.

- Regionwide pricing initiatives are not far enough along to demonstrate evaluation methods.

- Field tests of making driver costs variable gather extensive baseline information to compare with travel during the pricing program and supplement vehicle instrument data with travel diaries. However, comparisons to controls without pricing are not always made.

Conclusions and Implications

Since the inception of Federal pricing pilot programs, interest in value pricing has increased significantly. Over the past decade and a half, Federal pricing pilot programs have fostered a variety of pricing applications around the country. 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 help diminish congestion and support alternatives to solo driving. State, regional and local authorities are showing increasing interest in variable pricing approaches to address traffic congestion, funding shortfalls and related problems. Pricing has come to be viewed as an innovative way of coping with recurring congestion problems and as an effective complement to existing transportation improvement programs.

Effects of Pricing

- Pricing does reduce congestion and can increase throughput.

- Pricing can be an important source of revenue for transportation.

- Equity issues are ever-present and likely to persist, but project impact studies show no great disparity in use across income groups and equity impacts have not been an impediment to implementation.

- Pricing can have positive environmental and energy benefits.

Feasibility and Implementation of Pricing

- The nature of policy and institutional issues that arise during implementation and operation of pricing projects depends on the category of pricing projects involved.

- Public opinion is perhaps the most critical determinant of the prospect for successful pricing project implementation and much attention is required to measuring and understanding public opinion and to shaping informational programs to address concerns identified via opinion surveys, focus groups and stakeholder interviews.

- The technology for pricing and enforcement generally is proving reliable and effective even with complex pricing policies, though some aspects like privacy safeguards and occupancy detection require further testing and development.

- Evaluation programs have dealt well with traffic impacts, project operations, public and customer reaction, but have paid less attention to equity and environmental impacts.

Federal Role

Federal Pricing Program managers have many opportunities to foster continued progress in the Pricing program. Key roles include continued demonstration support of pricing concepts emerging from lessons learned to date as deserving of further implementation; and corresponding support of well structured evaluations of effects and outcomes also emerging from lessons learned as important. In particular:

- While HOT lanes have matured and demonstrated useful findings, there is room for evaluation of the operational issues of occupancy checks, multiple access/egress locations, HOT lane effects on mixed flow lanes and continued monitoring and dissemination of mode shift and speed effects. Improved automatic occupancy detection would enhance further operational policies.

- New networks of HOT lanes deserve encouragement and good evaluation. A very critical question is whether new HOT lane networks rather than conversions can be financially feasible in a network where they require sizeable capital outlays. Private sector involvement in such networks also deserves attention as the one private case showed promising financial results but potential problems of public and political acceptability.

- Variable driver cost programs aimed at replacing gas taxes and standard insurance and vehicle lease programs also deserve continued attention. Operational and privacy issues remain to be examined fully and next steps in technologies for broader application deserve attention.

- New variable tolls on existing tollways deserve further encouragement and evaluation. There still is room to test, evaluate and document the peak-off peak differential needed to bring significant and long standing shifts in traffic, mode use and reduced peak congestion.

- Carsharing and parking cash out present challenges deserving focused work. Carsharing evaluation is very complex with multiple possible effects needing careful tracing. Experimental designs could be improved to render clear and confident conclusions.

- Cash out, while demonstrated effective in the literature, has implementation challenges identified in case study. Attention is needed to best markets and simplification of the concept especially at employers with multiple trip reduction programs.

- Equity evaluations would be helped by attention to more than income of users, including benefits to users across incomes and inclusion of several equity measures. Important are spatial equity within and outside priced zones, and who pays and benefits not only in terms of reduced travel time but improvements funded by pricing.

- Environmental evaluations need best possible models to account for VMT, speeds, speed variation and vehicle type. Testing various methods of direct measurement also deserve attention. The full range of emissions should be included, including CO and CO2 emissions.

- Federally supported evaluations in conjunction with all pilot programs are important. Emphasis on multiple measures should be maintained, across transportation, acceptability, policy and institutional formation, as well as equity, environment, costs, revenues and operations. Opportunities for improvement include attention to controls and statistical tests to insure valid results and to rule out effects of outside influences. Tracking long term effects also is important.

- Support for the development and distribution of best practice documents and technical assistance and guidance to local project partners are all appropriate and needed federal roles.

Local, Regional and State Roles

Local, regional and state governments can benefit from the various findings and lessons coming from experience to date with the Value Pricing programs. This report provides a resource to encourage more informed implementation of pricing concepts by category. As well, there are specific implications emerging from lessons learned for governments planning and implementing pricing projects:

- An important lesson for project planning is paying heed to the extensive outreach activities associated with all project categories. It seems evident wide effort involving not just the general public and travelers but stakeholders and champions is vital.

- Ongoing attention to customers, the public and a willingness to make changes as necessary are also evident in implemented programs. Patience and persistence also are important in planning stages since initial opposition often diminishes over time.

- HOT lanes present the most documentation on planning, impacts, operations, policy development and outreach. Well-designed programs can be expected to increase throughput without diminishing carpooling and perhaps generate sufficient revenues to support transit expansion. One caution is on the financial side: projects involving large capital costs, such as new facilities or networks, in contrast to conversions of existing lanes, may not be fully self-financing.

- Local, regional and state governments interested in general reductions in VMT as well as congestion reduction will benefit from attention to the category of projects turning fixed costs into variable costs. Results suggest potential effectiveness and acceptability for sensitive to types of employers, existing TDM programs and parking conditions.

- Project planning should pay careful attention to the assessment of latest technology innovations: For HOT lanes and new priced express lanes, important issues include pricing by transponders versus license plates; enforcement systems for transponder violations; latest developments in vehicle occupancy replacing gas taxes with VMT fees, and, perhaps, replacing standard insurance and vehicle lease programs. Planners interested in these approaches may wish to take the next steps in experiments to date. Solid experimental designs employing controls are also important to documenting impacts and paving a credible path to gas tax replacement.

- Based on findings to date, localities interested in carshare and cash out programs should be prepared to target and fashion programs carefully. Cash out is sensitive to types of employer, existing TDM programs and availability and nature of parking and its usage patterns. Carsharing planners need to be sensitive to possible multiple effects on travel based on prior mode and travel patterns of its users.

- Planning should pay careful attention to the assessment of technology innovations: For HOT lanes and new priced express lanes, important issues include pricing by transponders versus license plates; enforcement systems for transponder violations; latest developments in vehicle occupancy verification; open road tolling systems; and, depending on pricing options, truck axle counting automation. Findings suggest technology upgrades packaged with new pricing strategies may enhance prospects for acceptance.

(Blank Page)

1. Introduction

Background

Value pricing when used in the context of highways refers to using the price of a direct user charge to influence travel behavior, usually for the purpose of alleviating congestion. It is sometimes referred to as "congestion pricing", or sometimes just "pricing". It differs from "tolling" in that the purpose of the price is more about transportation system effectiveness than raising revenue to pay for an infrastructure improvement (although using revenue from a pricing project to pay for infrastructure improvements is certainly a potential outcome).

The Value Pricing Pilot Program (VPPP) has been a component of the Department of Transportation's (DOT's) coordinated program to assist state and local governments in their efforts to stem the tide of escalating congestion costs. The Department recognizes that congestion on the Nation's transportation system, whether it is highway, air, water or transit congestion, is one of the greatest threats to the nation's economic well being and way of life. The multi-modal Congestion Initiative, announced by the Department in May 2006, is designed to address congestion problems, with particular emphasis on establishing partnerships with major urban areas to make significant reductions in roadway congestion. Both the Congestion Initiative and its Urban Partnership Agreement (UPA) program, which in 2006 made federal funds available to metropolitan areas to pursue aggressive strategies to reducing traffic congestion using a combination of tolling, transit, telecommunicating and technology, draw heavily on the experience provided by the VPPP.

The VPPP remains a crucial underpinning for congestion reduction programs, serving as an incubator of innovative pricing solutions to highway congestion and related adverse impacts on environment, energy use and economic productivity. The program assists state and local governments in analyzing alternative pricing strategies, designing related public participation programs, identifying appropriate administrative, technological, and project design concepts, and implementing and evaluating pilot projects. The program provides funding support and technical assistance to state and local project partners.

The U.S. Congress established this pricing program as the Congestion Pricing Pilot Program in 1991 under ISTEA. It was subsequently renamed the VPPP under Section 1216 (a) of the Transportation Equity Act for the 21st Century (TEA-21) in 1998, and continued through the 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). Fifteen states are eligible to have projects under the VPPP.

During the initial years of federal support for value pricing (or congestion pricing), state and local government interest in the concepts promoted under the VPPP was limited, and the prospects for implementing pilot tests of these concepts seemed even more limited.

Yet, after 17 years of studies, discussions, public outreach efforts, feasibility investigations, and pilot testing, value pricing projects have become operational in many states and interest in further explorations of pricing is evident in several parts of the country. Participants in the VPPP have used a wide variety of approaches to bringing market pricing principles to transportation decision-making.

Since its inception in 1991, Federal pricing pilot programs have sponsored over 50 pricing projects and studies in 14 states covering a wide variety of approaches. Of these, sixteen projects have become operational.

Rationale For Pricing

The reason for growing interest in value pricing can be seen in nearly every urban area in the United States — traffic congestion is choking off valuable movement of people and goods in day-to-day economic and social activities. Each year, Americans are paying billions of dollars in terms of lost time and productivity, air pollution and wasted energy. The Texas Transportation Institute's latest survey of mobility in America's 437 urban areas shows that, in 2005, traffic congestion resulted in 2.9 billion gallons of wasted fuel and 4.2 billion hours of lost time stuck in traffic. The cost of this delay and wasted fuel totaled $78 billion in 2005, more than quadruple the comparable cost figure in 1982. These estimates do not even include the environmental degradation and economic productivity losses caused by traffic congestion, and were prepared at a time when fuel prices were considerably lower than they are in mid 2008.

Given the magnitude of these costs, it is little wonder that local, state and federal agencies have been seeking better ways of dealing with congestion problems. In some cases, capacity additions can be made to better serve peak-period travel, but capacity additions are not always possible and are often prohibitively expensive. In addition, added capacity is often overwhelmed by increases in travel demand. The use of technological and operational approaches to improving system performance also shows great promise for reducing congestion, as do strategies that promote telecommuting and the use of more flexible work schedules. Strategies that promote more efficient and responsive public transit systems that tailor services to meeting rush-hour demand also have an important role to play. Yet, none of these strategies, taken alone, is likely to be sufficient unless a way is found to link the decision to travel on a congested road with the full costs associated with that travel. Value pricing has the opportunity to provide such a link.

Value pricing relies on the power of the market to reduce waste associated with traffic congestion. It involves road use fees that vary with the level of congestion. Fees are normally assessed electronically to eliminate delay associated with manual toll collection. It is similar to the pricing approach used in other sectors of the economy where demand varies by time of day, or season, or location (e.g., airlines, telephones, hotels, electric or gas utilities).

Value pricing recognizes that trips have different values at different times and places and for different individuals. Faced with premium charges during periods of peak demand, road users are encouraged to eliminate lower-valued trips or take them at a different time, or to choose alternative routes or transport modes. In cases where value pricing is applied to specific traffic lanes rather than to an entire highway facility, users have the option of choosing to pay to use high-speed priced lanes or to continue to travel on general purpose lanes without paying a toll.

All in all, congestion pricing promises a number of possible benefits including:

- Travel time savings
- More reliable travel times
- Improved traffic conditions and increased traffic throughput
- Reduced frustration and delay
- Reduction in emissions and improved air quality
- Improved safety
- Decrease in energy use
- Increased travel choices
- More efficient modal choices
- Revenue generation
- Greater personal mobility
- Economic productivity
- Fairer automobile trip cost recovery

Purpose and Overview

This "Lessons Learned Report" provides a summary of projects sponsored by FHWA's Congestion and Value Pricing Pilot Programs from 1991 through 2006 and draws lessons from a sample of projects with the richest and most relevant experience across selected project categories.

Since the inception of the Congestion Pricing Pilot Program in 1991, over 50 pricing projects have been funded by FHWA. More than a dozen operational projects are providing important findings regarding traffic and congestion impacts, transportation funding issues, public acceptability, administrative matters and future prospects for addressing congestion using various pricing strategies. In addition, useful information and valuable lessons have been provided by project feasibility studies and by pricing projects that did not progress to implementation or exhibited unexpected outcomes.

This report aims to synthesize the experience from the projects in the federal pricing programs regarding effectiveness at meeting their objectives and the political and technical aspects related to implementation. In an epilogue, the authors look forward to

possible future roles for pricing strategies in addressing emerging congestion, capacity and funding problems.

Following this introduction, Section 2 provides a summary of 24 selected projects grouped under six broad pricing concept categories:

- HOT lane conversions with pricing
- Variable pricing of new express lanes
- Variable pricing on existing toll facilities
- Regionwide variable pricing initiatives
- Making driver costs variable
- Other pricing projects.

The projects cover the full range of federally funded pricing initiatives:

- Fully implemented and evaluated programs
- Well documented feasibility or pre-implementation studies
- Experimental pricing trial demonstrations

The 24 projects were chosen to provide diversity in project type, project outcome (e.g., successes, failures), and public reaction and implementation experience. More detailed tabular summaries of each of the 24 projects are provided in Appendix B.

General conclusions and lessons learned across all project categories are provided in Section 3, along with implications for federal, state and local planners and managers. In addition to lessons learned related to driver behavior under pricing and the impacts on traffic throughput and delay reduction, Section 3 also provides lessons related to availability of funds for transportation programs; equity among different user groups; public acceptance; and environmental benefits and impacts.

Section 4 explains how the pricing program has evolved and explores implications for the future development of value pricing.

Key references and resources are listed in Appendix A, while Appendix B contains detailed summaries of the selected 24 pricing projects in tabular format.

2. Summary Of Vppp Projects And Findings

The purpose of this section is to synthesize key findings extracted from the detailed summaries of selected VPPP project case studies included in the Appendix. These key findings are provided across six categories of projects and form the basis for overall conclusions and implications presented in Section 3. The project categories are:

1. HOT Lane Conversions With Pricing
2. Variable Pricing of New Express Lanes
3. Variable Pricing on Existing Toll Facilities
4. Regionwide Variable Pricing Initiatives
5. Making Driver Costs Variable
6. Other Pricing Projects

The 24 VPPP Project case studies summarized in Appendix B cover pricing project categories encompassing the range of project types categorized in the FHWA Value Pricing Pilot Project Quarterly Reports. Some of the projects are feasibility or pre-implementation studies; others entail fully implemented and evaluated programs; others are experimental pricing trials. The summaries presented in Appendix-B are a selection from all the pricing projects that have been funded or granted authority to toll through the program. These case studies were selected for a variety of reasons, including: variety of project type; depth and breadth of available evaluation material; range of relevant project experiences and outcomes; range of success or failure along key implementation and outcome variables; and variation in location across the U.S. The case studies include: road pricing projects (pricing on new capacity, HOT lane conversions and on existing free roads) and controlled field tests (variablization of fixed costs, pay-as-you-drive insurance, time and location based automobile charges); non-road pricing projects (carshare, parking pricing/cash out); and cover both implemented projects and studies not culminating in projects.

Pricing Project Category 1: HOT Lane Conversions With Pricing

HOT Lane (High Occupancy Toll Lane) Conversions are HOV lanes allowing vehicles not meeting normal occupancy requirements to “buy-in” to the lane by paying a toll varying by time of day or level of congestion. HOT lanes allow drivers to use high-speed, uncongested HOV lanes either by meeting minimum occupancy requirements, or by paying a toll.

Like variable pricing on New Tolled Express Lanes and Existing Toll Facility Pricing, described later in Section 2, the HOT Lanes generally use variable pricing to control traffic demand, reduce peak period congestion and to ensure that HOT lanes provide

premium traffic service conditions to all users, both existing HOV users and new paying customers. HOT lane projects are intended to make better use of existing capacity on HOV lanes and create a new traffic option in the corridor being served. A side benefit may be that a shift of traffic to the HOT lane may reduce congestion on the general-purpose lanes.

Projects

The HOT Lane conversion projects summarized here include: I-15 in San Diego; I –10 & US 290 in Houston; I-394 in Minneapolis; I-25/US 36 in Denver; and SR 167 in Seattle. All were started with similar goals, with some variation in emphasis.

The earliest HOT conversion was the I-15 "FasTrak" Project in **San Diego** implemented in mid-1990s. The project grew out of concerns about growing traffic on the freeway, significant under-utilization of the existing HOV lanes (only 600 vehicles per hour per lane at peak - well below half the high-speed capacity, while the mixed traffic lanes were operating at heavily congested levels) and the desire to fund expanded transit service in the corridor. Another important formative goal was to maintain the level of service in the HOT lane without slowing down or inconveniencing HOV travelers.

Tolls vary with the level of congestion in order to maintain free-flow traffic conditions. Fees can vary in 25-cent increments as often as every six minutes. Motorists are informed of the toll changes through variable message signs located before the entrance to the FasTrak Lanes, allowing motorist choice between Express lanes or free lanes. The normal toll varies between $0.50 and $4, but during very congested periods it can be as high as $8. The average price paid per trip typically has been under $3 and seldom goes above $4. All transactions are electronic. Pricing is based on maintaining a Level of Service "C" 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.

The **Houston** "QuickRide" HOT Lane projects on I-10 (Katy Freeway) and US-290 (Northwest Freeway) were created because of concerns about congestion, but in this case heavy congestion in HOV lanes. The I-10 HOV lane initially started allowing only buses and vanpools, then opened to carpools with 2 or more occupants, but grew congested over time. Subsequent restriction to 3+ carpools (peak period) led to excess capacity and the eventual policy of pricing 2-person carpools in 1998. A similar approach was introduced on the US-290 HOV Lane in 2000.

Operations and pricing show some unique characteristics. The HOV lanes are reversible and free access is restricted to vehicles with three or more people during peak periods. Two person carpools can use the lanes by paying a toll between 6:45 – 8:00 a.m. inbound on both the Katy Freeway and US 290 and outbound 5:00 – 6:00 p.m. on the Katy Freeway. Single-occupant vehicles are prohibited. Two person carpools pay a $2 per trip. As in San Diego, the QuickRide project is completely automated and no cash transactions are handled on the facility.

The HOT Lane project on I-25/US-36 in **Denver** started in 2006 with preset pricing by time of day. Its goals were similar to those of San Diego's I-15 project, but with the added interest in generating revenues for general corridor improvements. For the I-394 **Minneapolis** HOT Lanes, begun in 2005, the main objectives included increased corridor capacity and throughput, reduced congestion, creation of a new travel option for solo drivers willing to pay a toll, and improvement of highway facilities and transit service in the corridor. The goals were achieved with the use of "dynamic pricing" (varying with congestion levels as often as every three minutes) while maintaining good speeds for transit and carpools (by policy, speeds in the MnPASS Lanes must remain above 55 miles per hour, 95 percent of the time). Finally, the SR 167 project grew out of an interest in testing the HOT concept in the **Puget Sound** region. Study and planning led to SR 167 as the best test case for results applicable to the region. The project has just become operational in May 2008.

The public sector is lead operator of HOT lane projects, though one involved the private sector in development and some contract with the private sector for operations and administration functions. Minnesota Department of Transportation operates the I-394 HOT lanes, but the project developed through a design-build arrangement between the state of Minnesota and a private firm. SANDAG, the regional metropolitan planning authority, operates the I-15 HOT lanes and contracts with a private firm for operations. I-10 & US-290 are operated by the Metropolitan Transit Authority of Harris County (Houston Metro), which administers all HOV lanes in the region. The I-25 project is operated by a nonprofit business center within the Colorado Department of Transportation. Washington State DOT operates the SR-167 HOT lanes.

Volumes of use and size of facilities summarized in the following Table 1 indicate the scale of the HOT lane conversions. Projects are less than 15 miles in length with use and transponder sales as shown in the table. Major expansions and/or ties to regional HOT networks are planned for several systems. The San Diego I-15 lanes are being extended to 20 miles in the median. The Houston I-10 will be expanded and plans call for a network of managed lanes. (See Project Category 2: Pricing of New Express Lanes for details).

Table 1: HOT Lane Conversion Projects

Project	Size	Use
San Diego I-15	8 mile, two reversible lanes in the freeway median	11,091 transponders in use by end of 1999; 18,000 by 2004
Denver I-25/US36	7.0 mile, two-lane barrier-separated reversible facility in freeway	95,091 total vehicles paid to travel in September of 2007 (10 months since opening)
Minneapolis I-394	11 miles, including two reversible lanes barrier separated 3 miles) and a one lane each direction (8 miles) with double-	Over 10,000 transponders have been leased by users since opening, May 2005

	white separation	
Houston -10 and US290	13-miles, reversible barrier separated lane in median of I-10 and 15-mile reversible lane on US-290	2200 registered users by 2004, for access on both the I-10 (Katy Freeway) and U.S. 290.
Puget Sound SR 167	9 miles of non-barrier separated express lanes in both directions	Prediction of 6,500 to 7,000 vehicles a day on the lanes

The earliest projects began with simple technologies and pricing schemes; later, these and other newer projects have used more advanced technology and pricing. For example, I-15 began with a paper permit test system (ExpressPass), then went on to electronic tolls in 1997. Initially, operations relied on limiting monthly permits to 500 ($50). Then, in 1998, a per-trip fee was instituted, using transponders compatible with all California toll facilities, and adjusted dynamically based on time of day and traffic levels. The early I-10 also began by limiting the number of priced vehicles to a target of no more than 600 vehicles per peak hour. The project also charged a simple flat fee per rush hour trip, though transponders were used from the outset. As a relatively new project, the I-394 not only employs transponders and dynamic pricing, but special transponders in police vehicles track cars entering the HOT lanes. A tone tells enforcers if the traveler has a valid transponder. The more recent I-25 started with variable pricing preset by time of day and a transponder system compatible with an existing toll facility (E-470) in the region that also services transactions.

Findings

The **Travel and Traffic** effects of HOT lane conversions are well documented and favorable. The most extensive evaluation was carried out on I-15 in San Diego. Before conversion in 1988, the I-15 HOV lanes were very underutilized with only 600 vehicles per hour per lane (representing less than half available capacity at high speeds) at peak while the mixed flow lanes were heavily congested. Average daily traffic was around 9,200. With the HOT conversion, average daily volume on Express HOT Lanes increased by approximately 125 vehicles per month. Evaluators concluded, “By the end of 1999, the Express Lanes were much better utilized than before the start of the project.” There was a large increase in carpooling from the beginning. By 2004, total daily traffic on HOT lanes had gone up to more than 21,000. The impact on mixed flow lanes was hard to sort out. Peak volumes slightly decreased compared to pre-project in 1996, while the peak volumes were increasing on a comparison corridor, I-8. The difference with I-8 trends is significant, but I-8 has no HOV lanes and travelers with different demographics, so comparison with the I-15 general-purpose lanes is not definitive. Pricing maintained LOS C in the HOT lanes, as required by policy. Also, there was significant reduction in SOV violators in the HOT lanes, probably due to more enforcement and some previous violators buying into the lanes. While HOV volumes moved up and down during the course of the evaluations, volumes still were greater than before project. Also, the majority of carpoolers interviewed during evaluations did not feel adversely affected by the HOT Lane program. HOT lane users reported savings up to 20 minutes compared to main lane travel. Transit ridership in the I-15 corridor increased about nine percent during

the evaluation, probably due in part to new bus service. However, outside influences may have been at work too since ridership increased 23 percent over the region at the same time.

Travel and Traffic evaluations of other HOT lane projects are also positive. On I-10 in Houston, the addition of the HOT caused HOV2 volume to increase 40 percent, while the HOV3 volume changed very little. Also on I-10, the total volume on the HOV lane increased by 21 percent during the AM peak. Average speed on general-purpose lanes was 25mph, while average speed on the HOT was 59 mph (over 17-minute time saving for 13 mile trip). On U.S. 290, relative travel time savings were 11 minutes for a 15-mile trip. Surveys indicate that most HOT users formerly traveled in single-occupant vehicles on the general purpose lanes, suggesting positive impacts on traffic there. Not unexpectedly, there also was a significant shift of 2-person carpools from the general purpose lanes to the HOT lane. Diversion of bus, vanpool and 3+ occupant carpoolers to the HOT was between 5 and 8 percent of the HOT lane trips. On the I-394 HOT lanes in Minneapolis, peak hour volumes increased from 9 to 33 percent of the corridor volume after HOT conversion, and despite increased volume, travel speeds in the lanes have not decreased. Speeds in the general-purpose lanes increased up to 15 percent during peak rush hours, with 600-1000 fewer vehicles at peak due to the shift to HOT lanes. On I-25/US 36 in Denver, preliminary estimates indicate between 10-15 percent of all daily person trips occur in the HOT lanes at full highway speeds, while the adjacent general-purpose lanes experience stop and go traffic during the peak periods. For SR 167, projections estimate throughput will increase, with about 13 percent more vehicles traveling the corridor daily. Estimates are 38 percent more vehicles will use the HOV/HOT lanes, while preserving high-speed express trip conditions for buses, vanpools and carpools.

A technical issue pertaining to HOT lanes has required particular attention: quick and safe access and egress to/from HOT lanes; and lane separation from general-purpose lanes. Unlike early HOT lanes projects, access to and egress from multiple entry/exit HOT lanes are requiring careful attention and planning. 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.

Findings pertaining to **Revenues and Financial Feasibility** suggest revenues can cover operating costs, typically are devoted to operations and corridor improvements and, in some cases, have been used to support transit and rideshare services. However, the toll revenues in some of these projects probably fail to cover all of the initial capital outlays associated with pricing project implementation (typically these have been covered by federal VPPP grant monies) and one case suggests revenues can be sensitive to a competing facility. By 2004, The FasTrak lanes were carrying over 5,000 toll-paying vehicles daily. The rest, approximately 17,000 vehicles, were buses and HOVs with two or more occupants. During the 2004 fiscal year I-15 collected $2.4 million in toll revenues. Approximately $1 million of the revenues 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, to maintain the electronic toll collection (ETC) system, and for the operation of the Customer Service Center. Revenues have covered operation costs of about $100,000 per month (about $5.00 per account), including toll operations, replacement of transponders and pricing equipment as well as enforcement and administration. More recently, I-15 has added an account maintenance fee and transponder fee to cope with declining accounts and revenues apparently due to the opening of an alternate route (SR 56). With the new route came less SOV/FasTrak usage of the I-15 lanes and corresponding reduced program revenues.

For the much smaller Houston HOV-2 buy-in projects on I –10 & US 290, toll revenues from a few hundred daily vehicles cover only costs of servicing accounts (approximately $100,000/year), with revenues generated by the program between 1998 and 2003 totaling $417,734. Capital, marketing and start-up costs associated with the pricing project were covered by federal value pricing demonstration funds and enforcement and enrollment services already in place at Metro. On I-394 in Minnesota, revenues average $4,400 a day in toll and fee revenue, sufficient to meet operating expenses. Again, transit support is part of the program. The first 50 percent of net revenue is devoted to transit improvements, the remainder is used for operations and corridor improvement. On I-25/US 36 in Denver, first year toll revenues are between $1.25 million and $1.5 million and revenues from violation fees and fines approach $600,000. In 2007, total monthly revenues, including tolls, fees, and fines were $222,762. As with I-15, revenues are designated for transportation improvements in the corridor, including transit, vanpool, and carpool services. For SR 167 in Seattle, opening year toll revenue is estimated to be $1.5 million, increasing to $2 million in 2014. Preliminary capital costs of HOT conversion are estimated to be recovered by net annual toll revenue within 11 to 12 years.

The conversion of existing HOV lanes to HOT lanes might appear to be financially attractive, 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 may not 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, requiring plastic pylons (as on SR-91) or paint striping to separate HOT traffic from regular lanes (as on I-394), options which may raise safety and convenience issues in some areas among motorists, lane operators and enforcers.

Regarding **Public Attitudes and Involvement**, projects typically are initiated after considerable public outreach and stakeholder involvement, with changes being made along the way in response to public reaction. The I-394 project in Minneapolis involved perhaps the most long-running outreach process. The project took more than a decade of attempts in the region, beginning with a failed proposal for I-394 in the mid-1990s. Finally, a task force of local elected officials, citizens and community leaders combined with public surveys, meetings and focus groups led to the project. I-394 also provides an example of making changes in response to public reaction. When the lanes opened initially, there was an increase in general purpose lane congestion in the non-peak direction since before the project all vehicles could use the HOV lane in the reverse-peak

direction. Public outcry prompted MnDOT to change the operating policy. I-15 provides another example of change along the way. The tolls were reduced in peak shoulders in 1998 due to operator and public concerns about excessive traffic at peak periods and an attempt to shift some peak users to the off-peak shoulders.

Outreach efforts as part of initial feasibility studies often find neutral or skeptical reactions, or outright resistance, but these are later followed by acceptance as projects get underway. Planners for **San Diego I-15** held public workshops and did postcard mailings preceding start up, but these did not gain much attention. Focus groups were helpful in setting project parameters, but again didn't elicit much reaction. Evaluators found business, users and stakeholder concerns about the potential elitist character of the project in the first year, but rarely in the second. With time, users expressed satisfaction with reductions in travel time, more on-time arrival and improved safety, while carpoolers were not negative. Businesses were either not aware of the project or had no opinion about business impact. An 800-person telephone survey carried out in 2001 found that support for value pricing is strongest 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 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 has grown to understand the value of priced lanes, and believe 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.

In **Denver**, a feasibility study before project start up found little interest or support for HOT lanes. But after an extensive outreach and informational campaign with businesses, employers and commuters, acceptance was sufficient to begin. Latest assessments show interest and support is strong, probably due to the perceived decline in current and foreseeable transportation funding. Once the **Minneapolis** project started after many failed attempts, reactions turned favorable: a January 2002 survey found that 57 percent of Minnesota drivers support the HOT concept. The same transition from resistance to acceptance was found in **Houston**. Reactions at public meetings and focus groups were mixed, with some fearing shifts of bus riders to carpooling, unclear commitment of revenues and agency inability to operate and enforce the project adequately. Focus groups recommended against the project, but planning continued taking heed of public reaction and decision makers finally authorized a pilot. A survey reported by Burris in 2004 suggests that 70 percent of current users and 67 percent of former users were supportive of allowing single occupant vehicles to travel on the HOT lane at a higher toll. The acceptance level is sufficient to support an expansion plan. See New Priced Express Lanes in this Section.

Several projects underscore the role of stakeholders. Evaluators of the I-15 concluded that a local mayor was vital to successful start up, as were policies directing revenues in part to transit expansion. Focus groups, surveys and public meetings for I-394 did not gain requisite consensus until a task force of elected officials, community leaders and

other stakeholders was formed. For SR 167, continuous stakeholder involvement accompanied public assessments to bring about an acceptable project. Stakeholders made up of affected jurisdictions, advocacy groups and corridor users met over two years while community meetings and varied outreach events were held. Findings did not uncover anticipated concerns about impacts on low-income people, and businesses perceived the value of trip reliability, as did all constituents. At this time, there are no foreseeable obstacles to start up.

Equity and Environmental Issues have not been a barrier to start up or continuation, and impact studies on both issues are generally positive. On I-15, as mentioned above, user and stakeholder concerns about the potential elitist character of the project arose in the first year, but diminished with time as users across all income groups used the facility. By the final evaluation, such concerns were minimal. A telephone survey of I-15 corridor users conducted in the Summer/Fall of 2001 found that corridor users did not consider equity to be a major issue or obstacle to implementing pricing on an expansion of the original project called "managed lanes." The majority of those interviewed in the telephone survey (71 per cent) felt that pricing the lanes is "fair" for travelers on the main lanes. Furthermore, 66 per cent approved of the currently operating HOT lanes, and 71 per cent believed that tolls are an effective way to manage demand. Both users and non-users of the dynamically priced I-15 HOT lanes supported the use of pricing. Support was high across all income groups, with the lowest income group expressing as much support as the highest income group (about 80 per cent). Evaluators also found while emissions grew for I-15 with increased use, they grew 3-5 times more for the control corridor. For I-25/US 36, public outreach leading to implementation did not uncover critical concerns regarding equity or other social impacts, nor have they arisen since. On I-394, the first attempt at HOT lanes (1997) met resistance in large part because of public belief only the rich would benefit. A second attempt about ten years later succeeded in part because advocates contended (pointing to evidence from San Diego and elsewhere) that all income groups value time savings and reliability for certain trips (worsening congestion and a shortage of transportation funds also were important to success, evaluators contend). Surveys of corridor users find a relatively small difference in income between those who do and don't own transponders: 75% of owners had incomes over $50K/year, compared to 68% of non-owners. Concerns and complaints about equity have not been significant since start up. Air quality monitoring reveals no adverse CO emissions impacts or corridor noise levels. On I–10 & US-290, focus groups held during project planning did not find concerns about social equity among either corridor users or the public at large. The general reaction was that all would benefit if congestion were reduced. Nor have equity concerns been raised during operations. For SR-167, outreach efforts found low-income drivers as or more supportive of the HOT lane as other drivers.

HOT Lane conversions have involved **Policy and Institutional** interaction among multiple agencies. All the HOT lane conversions began with specific policies authorizing initiation and, sometimes, specific directives on cost and revenue matters. On I-15, the regional government responsible for initiation adopted a policy allowing solo drivers to use the HOT lane at variable rates with some revenues going to fund transit in the corridor. New state legislation requires free-flow of HOVs (Level-of-Service C) at all

times. Federal environmental justice policy required initial outreach, public involvement across income groups. For I-25/US 36, enabling state legislation allowed project development, with revenues designated for transportation improvements in the corridor. The state assembly also created a new nonprofit business entity within the DOT to finance and operate the facility. The MN legislature created I-394 through legislation allowing a design-build arrangement with the private sector. For I-10/US 290, TXDOT, Houston Metro, the Federal Highway Administration and Federal Transit Administration formed a cooperative agreement to start the project. For SR-167, Washington State legislation authorizes the HOT lane and specifies revenues will go to a dedicated multi-modal account.

With respect to **Monitoring and Evaluation**, considerable assessment effort has been devoted to HOT lane conversions, attending to not only traffic impacts, but to issues of revenue, equity and acceptance. Some evaluations go beyond traveler assessments to analyze business and general public responses. For example, the evaluation of I-15 included not only traffic studies but an attitudinal panel and studies of possible changes in air quality, cost of delay, business impacts, bus ridership, land use, park-and-ride lot occupancy, public acceptance, media response, marketing and institutional issues. The evaluation also compared changes in the HOT lane to a control corridor, the I-8 in an attempt to account for outside influences such as changing gas prices. For I-25/US 36, ongoing evaluation focuses on traffic, user reactions, corridor employment and residential impacts. I-394 is evaluating attitudinal, income, traffic, air quality and other effects in a before/after comparison. Detailed user studies are included, as is the case for I-25/US 36 where both current and former users are tracked. SR-167 plans annual studies of traffic, system performance, socio-economics impacts and acceptance.

Summary

- Generally, HOT Lane conversions have achieved their goals of gaining better use of underutilized HOV lanes and maintaining congestion free travel for toll paying users without subjecting HOV and transit users to lower service levels.

- While projects to date have been relatively small in scale (under 15 miles in length), there are a few cases suggesting larger networks of HOT lanes may be forthcoming in the future.

- Pricing and enforcement technologies for HOT lane conversions are steadily advancing making introduction and administration of dynamic pricing fully feasible and effective. Advances in automated enforcement technologies are progressing to the point where transponder violations can be minimized by stationary and mobile enforcement. Occupancy verification technology requires further development.

- The effects of HOT lanes on traffic in general purpose lanes are mixed. Evidence from two projects suggests possible reductions in traffic on mixed flow lanes, but the finding is not clearly evident on other projects.

- HOT lane conversions generally produce sufficient revenues to support operations and, in some cases, additional transit service. While only one smaller program examined did not raise sufficient revenue to cover all operations, a long standing program had to impose new fees to cope with declining use and revenues caused by development of a new nearby facility . Furthermore, initial capital costs may not be covered from toll revenues, especially where conversion requires expensive capital outlays, or where a relatively large number of vehicles are allowed to travel free.

- Extensive outreach and flexibility in response to users and the public appear important to start up and continuation of HOT lane conversions. In some instances, protracted efforts to gain acceptance are evident, as early plans are dropped or revised. However, early skepticism and resistance or inattention often turn to support once operations are underway. Still, managers of HOT lane conversions appear to keep open the dialogue with users and the public, and make program changes accordingly to maintain acceptability.

- Beyond public outreach, stakeholder support appears as an important ingredient to initiating HOT conversions. Several projects suggest the essential role of buy-in from a critical mass of elected officials, advocacy groups and community leaders.

- Equity issues have not been a barrier to start up or continuation of HOT lane conversions. Impact studies on income equity issues, while not extensive, are generally positive. In planning stages, equity sometimes is raised as an issue of HOT lane conversions catering to the rich. However, the concerns rarely halt plans and, as projects develop, these concerns among users and the public typically diminish. User surveys generally reveal some, but not dramatic differences in incomes of facility users.

- Environmental evaluations of HOT lane conversions are not extensive or conclusive. One project compared emissions to a non-equivalent control corridor, finding emissions growth for the HOT conversion but even more so for the comparison corridor. Another has evaluated CO and noise impacts and found no significant changes compared to pre-project.

- All HOT lane conversions are initiated with specific policies often involving state legislation, much attention to the organizational and operating entity and specification of revenue allocation. Cooperative agreements with the Federal government have been necessary to allow pricing on federally funded HOV facilities.

- Evaluations of HOT lanes focus primarily on traffic impacts and public/user reactions, with less attention to equity and environment.

Pricing Project Category 2: Variable Pricing of New Express Lanes

New Expressways share characteristics with two other categories of projects in Section 2. Like HOT Lane Conversions (Category 1) and Pricing on Toll Facilities (Category 3), they use variable pricing to control traffic and reduce peak period congestion and generate new revenues. Also, projects described here may give some preference to HOV travelers. The distinguishing feature of these projects is that instead of applying pricing to existing facilities, congestion pricing is introduced with new road capacity. The overall goal is to increase capacity (thereby reducing congestion) and throughput in the corridor while managing traffic demand through pricing (thereby creating a new high quality travel option for the users).

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 variable 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 the SR-91 added lanes are allowed to vary by time-of-day and congestion and 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.

Projects

Orange County, CA. SR-91 Express Lanes opened in December 1995 as a four-lane, 10-mile toll facility in the median of SR-91 – one of the most heavily congested highways in the U.S. and connecting major employment centers of Orange County and southern L.A. County with residential communities of Riverside and San Bernardino Counties. The project added two new lanes in each direction to an existing highway. Toll lanes are separated from the general-purpose lanes by a painted buffer and plastic pylons with no intermediate exits or entrances. Tolls differ by direction and vary by day of the week and time of the day according to a pre-set schedule. Unlike many of the HOT Lane conversions, the toll schedule on SR-91 is not dynamically set to reflect real time congestion, but is set to maintain free flow. The set schedule is updated periodically to reflect trends in traffic condition and maintain free-flowing traffic condition on all toll lanes. As of 2007, the peak toll on the busiest half hour is $9.50, or 95 cents per mile. A "FasTrakTM" transponder is required of all vehicles. Tolls are deducted at full highway speeds from pre-paid accounts via on-board transponders. HOV3+ paid 50% of the regular toll during 2007 peak periods (now free). Initial capital cost was $134 million. Initial operations were under a private developer, California Private Transportation Company (CPTC); in January 2003, the Orange County Transportation Authority (OCTA) purchased the private project for $207.5 million, beginning public operations. The California Highway Patrol (CHP) provides police services at the facility owner's expense. Maintenance and operational costs also are the responsibility of the owner.

Three other new express lane projects under development include San Diego I-15 Managed Lanes, Houston I-10 (Katy) reconstruction and Dallas I-30. The new I-30 serves as a major east/west corridor between Fort Worth and Dallas. The I-30 West Freeway will open an interim HOV lane and transition to tolled express lanes in later phases allowing single-occupant vehicles for a fee and a fee for HOVs up to 50% of the SOV rate. The project will feature two reversible lanes operating during the peak periods. In July 2007, the first six miles of the new HOV lanes opened between Dallas and Fort Worth on I-30. The tollway will utilize existing electronic transponder technology. In San Diego, new "managed lanes" are arising as an extension of I-15 HOT lanes started in 1991. The HOT lanes are being extended to 20 miles in the median of Interstate 15 (I-15). Plans call for four-lanes in the median, moveable barrier, multiple access points, direct access ramps for buses and eventual bus rapid transit (BRT). Pricing will be dynamic, based on level of congestion and distance traveled. On the I-10 "Katy" in Houston, new HOT lanes are under construction (to open in late 2008), with two new lanes in each direction. HOV-3+ users will be provided free access in each peak period, with HOV-2 and SOV travelers charged a variable fee. In addition to the new construction, Houston will add tolling to the other four HOV lanes in the region. Long-range plans call for a network of HOT managed lanes in Houston.

Findings

The effects of new, priced expressways on **Traffic and Travel** are best documented for SR-91. As of 2004, the use of Express Lanes averaged about 35,000 vehicles per day. The lanes carry well over 40 percent of the total SR-91 traffic during peak periods, with one-third of the total freeway capacity. Initially, the new capacity dramatically reduced traffic and congestion on the general-purpose lanes. Over the years, the traffic has increased on the general purpose lanes and congestion has returned, but the priced Express Lanes continue to be free-flowing even as the daily usage has gone up. Specifically, traffic on priced lanes moves at free-flowing speed of over 60 MPH in contrast to stop and go traffic in general purpose lanes averaging no more than 15 or 20 MPH in peak. Evaluation found a 40% increase in HOV3+ probably due to the free use policy in the first two years. Significantly, charging HOV3+ 50% beginning in 1998 did not change overall HOV use in the corridor. Overall, more SR 91 commuters shifted from single occupant vehicles to high occupancy vehicles than vice versa. There was no significant effect on transit use (1%) in the corridor. Accidents were down after the toll lanes opened, probably due to decreased congestion (accidents on a comparison section of 91 increased). There was no evidence of diversion to/from regional freeways. Use of parallel streets greatly decreased shortly after the 91X lanes opened, but increased in 1998, when freeway congestion returned. Demand on the 91 Express Lanes continues 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.

SR-91 shows the **Financial and Economic Viability** of a privately owned and operated tollway under certain conditions and consequent savings to the public sector and favorable cost/benefit of the project. The four-lane, 10-mile long, toll facility was

constructed for approximately $134M with private funds and toll revenues covered construction and operating costs. However, these costs did not involve new right of way, interchange modifications or intermediate access/egress points resulting in a cost of about $3.0 million per lane mile versus $10 million or more per lane mile for typical major urban freeway construction. CPTC corporate reports indicate "acceptable financial performance" when operated as private facility. Income (revenue less expenses) was 733K in 1996 rising to 13.7M in 2001, according to CPTC audits. The State of California saved construction and operating/enforcement costs and Orange County gained property taxes from CPTC of$6.8 million in first 6 years. Another favorable economic finding from SR-91 is the positive benefit/cost picture for the expressway compared to carpool lanes as an alternative. Benefit cost analysis comparing express to duel carpool lanes shows higher net present value for express (490M vs. 303M) largely due to higher travel time savings in spite of higher operating costs.

Evaluations of **Public and Stakeholder Acceptance** of the new expressway cases generally find support, though support is sensitive to private sector involvement. As part of developing a 20-mile "managed lanes" extension of the original I-15 HOT lane project, an assessment of stakeholders and commuters found strong support for the original program and planned expansion. The above referenced telephone survey of facility users found a majority of the respondents expressed approval of the FasTrak program, 92 percent liked a time saving option on I-15 and 84 percent of the respondents favored the managed lanes extension. However, as part of assessing public opinion about expanding the I-15 HOT lanes, researchers found very few knew that some FasTrak revenues supported transit. While SR-91 also found initial public and political support, it diminished with the rise of issues around private operation of the facility. Specifically, controversy arose around a "non-compete clause" in the CPTC-Caltrans agreement preventing adding lanes or building mass transit along the nearby Riverside Freeway to ensure profit for the express lanes. Under the non-compete provision, CPTC sued Caltrans over its widening at the interchange with the Eastern Transportation Corridor. The suits were dismissed only upon OCTA purchase of the facility. Two unsuccessful state bills (AB 1091, AB 1346) sought to void the non-compete clause and have the public sector acquire the lanes by condemnation. Media coverage portrayed CPTC as a "monopoly" with a 35-year operations contract. As the controversy continued, commuter group approval of private companies operating toll roads decreased to 30-45% between 1996 and 1999, compared to 50-75% approval in 1996. However in spite of this finding, commuters approved (in the 45-75% range) of HOT lanes in concept, if lanes don't become congested.

The SR-91, Dallas I-30 and the San Diego I-15 extension projects paid attention to potential issues of **Equity**, with generally favorable results where specific assessments were made. In the case of I-30, equity analysis and surveys will be included in all future environmental documents for the entire network of priced facilities. The initial findings and results have not indicated any adverse impacts, but will be regularly monitored and updated. In the case of I-30, a detailed equity analysis will be performed as part of the environmental assessment. In the case of SR-91, evaluation found a "moderate" income effect, with the percent of trips on the express lanes for the lowest and highest incomes

(20% and 50%) staying the same over the survey period. Evaluation also found use of the express lanes increasing over time for all modes across all incomes. In the case of the planned expansion of I-15 into longer and improved "managed lanes," a telephone survey of facility users found 71% consider the extension fair to regular lane users (71%) and managed lane users (75%). There were very few differences in attitudes about the fairness of the lanes based on ethnicity or income. However, half of respondents said tolling of SOV drivers was unfair double taxation (FasTrak customers less so than other corridor users).

SR-91, Dallas I-30 and Houston's planned HOT lane network suggest the importance of detailed **Public Policy** and agreements in support of new expressways development. SR-91 was set up as a private for-profit investment, one of four private-public partnership authorized by the California Legislature under the AB 680 legislation enacted in 1989. AB 680 provides up to a 35-year lease of right-of-way and airspace, which then reverts to the State. Law requires the facility must be built to State standards, meet applicable laws and environmental standards, and any State services must be fully compensated. Importantly, the initial franchise agreement with Caltrans included "non-compete" provision to limit nearby corridor improvements. And because several toll facilities were anticipated or developing at the time, state law (Title 21) required transponders to be useable on all state toll facilities. In the case of I-30, project development was supported by state and regional policy requiring that any planned new highway capacity must be evaluated for potential toll/managed lane applications, including value pricing. For the Houston planned HOT network, TXDOT, Houston Metro, the Federal Highway Administration, the Federal Transit Administration and Harris County Toll Road Authority will negotiate specific cooperative agreements to implement the network.

Both SR-91 and Houston I-10 "managed lanes" reconstruction project emphasize thorough ongoing **Evaluation**, and SR-91 shows the importance of multiple approaches and control corridor information for robust results. I-10 has established baseline data on traffic, accidents, travel time and other indicators to monitor performance into the future as pricing gets underway. As evaluators of SR-91, Cal-Poly State University carried out two phases of evaluations including direct observations, surveys of corridor users, and impact modeling. Telephone surveys included present and former commuters; residents from surrounding areas in proportion to the geographic distribution of SR 91 commuters; a panel of travelers surveyed over time; drivers identified by license plate observations and transponder use; and commuters participating in U.C. Irvine research. These multiple evaluation data sources indicating similar findings added confidence to conclusions. While there was no formal control corridor, evaluators did reference a non-tolled comparison section of SR-91, adjoining general-purpose lanes and nearby freeway corridors (SR 60 and SR 57) to help rule out effects of gas prices and other outside influences. Another evaluation finding of note is, at the time, EMFAC emission modeling could not account for the local effects of accelerations and decelerations, using factors derived from average free flow speeds. The result was an inaccurate prediction of the more congested periods showing lowest emissions.

Summary

- Implementation of a variably priced new highway facility in the SR-91 corridor has had a significant impact on congestion and throughput in the corridor. The priced expressway has resulted in considerably higher vehicle throughput at much higher speeds on the priced facility compared to the adjoining general-purpose lanes, and much less congestion on the overall facility compared to before implementation of the pricing project. Also, carpooling in the corridor increased due to pricing incentives and more commuters shifted from solo driving to carpooling than vice versa. Accidents were down after the toll lanes opened and there was no evidence of diversion to/from regional freeways.

- Findings from the same well-documented case indicate the financial and economic viability of a privately owned and operated tollway can be achieved with savings to the public sector and favorable cost/benefit ratios result, though these results may hinge on settings with lower than average construction costs.

- Public support and understanding of priced new expressways is generally favorable. Two well-documented projects show majority approval among facility users and stakeholders, though one suggested a lack of knowledge about the use of toll revenues to support transit. Also, public support is very sensitive to private sector operations. Initial public support for one major project diminished because of agreement terms preventing the public sector from implementing freeway improvements in the vicinity of a private sector project ("non-compete" provision).

- Equity assessments, although limited, indicate some differences in facility use based on income but little difference in reactions to projects. In one case, evaluation found about twice as many high-income users on express lanes as compared to the low income users, but increasing use over time for all modes across all incomes. In the case of a planned expansion of an existing express facility, a survey of facility users found strong support, with few differences about the fairness of the lanes based on ethnicity or income.

- New expressway development is commonly supported by detailed policy and agreements. In the case of private for profit development, state legislation enabled the project and specified right of way lease terms, building standards, environmental requirements, uniform and compatible technology specifications and reimbursement to the State for services. Multiple agency agreements underlie projects.

- Evaluations were carried out for most projects, though air quality assessments were lacking. Evaluations have focused on traffic, travel time, accidents, user profiles (in part for equity assessments), user opinions and, in one case, opinions of corridor residents. Both of the most well documented projects compared results to non-tolled sections of the highway or nearby freeways to account for possible

outside influences. Only one case attempted a detailed air quality assessment and found models unable to cope well with effects of acceleration and decelerations.

Pricing Project Category 3: Variable Pricing on Existing Toll Facilities

This category of pricing introduces variable tolls on highway facilities with fixed tolls. As with other pricing strategies highlighted in this section, the purpose is to introduce prices varying by day-of-the-week and time-of-day to reduce congestion. The variable prices are intended to encourage some travelers to use the roadway facility during less congested periods, to shift to another mode of transportation, or to change route. Toll agencies have also used the availability of off-peak toll discounts to encourage the use of electronic tolling.

Projects

Toll Authorities introduced variable tolls to reduce peak period congestion and to gain more efficient use of facilities, to delay capacity enhancements or to raise revenues for facility improvements (often by using off-peak toll discounts to make an overall toll increase program more acceptable). For the Cape Coral Bridge and Midpoint Memorial Bridge in Lee County, Florida, the explicit intent of the program was to spread traffic from peak to shoulder times and thereby postpone expensive bridge enhancements to accommodate growing peak traffic. In Illinois, the Tollway had not increased tolls since 1983 and wanted revenues for widening, rehabilitation and extension. The Tollway also was interested in boosting electronic toll payment for possible cost savings and revenue gains. In New Jersey, the variable pricing was intended primarily to gain better use of capacity rather than revenue increases, though preserving specific revenue levels was an important consideration. In the case of the Port Authority of New York and New Jersey (PANYNJ), the toll changes on Hudson River Bridges/Tunnels were aimed at better use of the facility by spreading peak congestion, but also were planned to meet specific revenue needs underlying the capital investment program. On the Pennsylvania Turnpike, the alternatives examined in the feasibility study were designed to improve use by spreading peak traffic, gain potential benefits of electronic toll collection and meet forecast revenue needs.

In August 1998, Lee County, Florida implemented value pricing on two toll bridges between the cities of Ft. Myers and Cape Coral, the Cape Coral Bridge and Midpoint Memorial Bridge. These bridges experience heavy use by commuters, with average daily traffic varying between 60,000 and 65,000 vehicles at the time of program initiation. The initial Lee County pricing strategy provided bridge users with a 50 percent toll discount during selected “shoulder-of-the-peak” periods before and after the peak-of-the-peak. To be eligible for the toll discounts users must pay tolls electronically. The shoulder period toll discount was extended to vehicles with 3-or-more axles in 2003. In November 2007, the toll structure was changed to a one-way toll (for a one-year trial period), with tolls for

two-axle vehicles doubled but collected only in the westbound direction. The future of toll levels and the discount program is currently being discussed in Lee County.

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 Authority introduced time-of-day tolls in 2000. Weekday peak-period users were charged a higher toll while the rate for off-peak users remained the same as it had been since 1991. To be eligible for the off-peak toll discount, users had to pay electronically with E-ZPass. The toll discount was a 7 percent reduction for E-ZPass users, and a 16 percent reduction for switching from paying cash tolls in the peak to using E-ZPass and traveling in the off-peak hours (reductions based on traveling the entire length of the Turnpike). In 2003, the general toll level was increased again, with time-of-day toll discounts maintained. The off-peak discount was 11 percent for E-ZPass users, while the difference between the cash toll and the off-peak discounted toll was 25 percent. In 2006, toll discounts for peak EZ-Pass users were eliminated, but the off-peak toll discounts were continued, creating a 25 percent discount for all users shifting travel to the off-peak period.

In 2001, the Port Authority of New York and New Jersey (PANYNJ) Board of Commissioners approved a variable toll program at the two tunnels and four bridges connecting New York and New Jersey. These crossings were very heavily used, with average daily eastbound traffic totaling over 127 million vehicles in 2006. Off-peak tolls were raised less than peak tolls (passenger cars using E-ZPass receive a $1 discount from the peak fee -17 percent). Passenger cars switching from cash to E-ZPass and traveling in the off-peak received a $2 (33 percent) discount from the peak fee. Trucks receive a $1 discount per axle (17 percent) for traveling in the off-peak hours, or a $2.50 discount (42 percent) for traveling during weekday overnight hours. (The latest tolls doubled the dollar discount to $2 between peak and off-peak hours by eliminating E-ZPass peak period discounts. Now, cash and E-Zpass pay $8 peak rate, but E-ZPass holders pay $6 off-peak).

The Illinois Tollway, which operates 274 miles of toll roads in northern Illinois, implemented a new toll structure in 2005. Tolls were raised for cars and trucks, with tolls for cash-paying cars doubling (from $0.40 to $0.80 on a typical toll plaza), while tolls for cars using electronic payment were not increased. Congestion pricing was implemented for small, medium and large trucks. Peak-period toll rates for cash-paying small, medium and large trucks were increased substantially (from $0.50 to $1.50 for 2-axle trucks, from a range of $0.75-$1.00 to $2.25 for 3&4 axle trucks, and from a range of $1.25-$1.50 to $4.00 for trucks with 5+ axles). Trucks using electronic payment (I-Pass) were offered discounts of $0.50 (small and medium trucks) and $1.00 (large trucks) for traveling during the daytime off-peak hours. These discounted rates also apply 10pm-6am.

In a study commencing in 2002, the Pennsylvania Turnpike Commission examined several congestion pricing scenarios for urban interchanges in the Philadelphia and Pittsburgh metro areas, but did not implement variable pricing. The study examined combinations of off-peak discounts (by time-of-day and areas covered), discount methods (fixed or variable), vehicle covered and toll differentials for cash and electronic payment

users. The alternatives were designed to shift traffic out of congested periods, encourage use of electronic tolling, promote safe and efficient traffic movement, and enhance revenue growth. At the same time the study was undertaken, electronic tolling (E-ZPass) was implemented for travel between ticket interchanges on the Turnpike mainline.

Findings

A range of **travel behavior changes and congestion reductions** resulted from introducing variable tolling on existing toll facilities. Simultaneous introduction of electronic tolling and time-of-day pricing sometimes made it difficult to isolate the effects of variable pricing, however, some programs interviewed users to supplement traffic data as a way to sort out the cause of behavior changes. Overall, it seems variable pricing has had the desired Traffic Impacts.

In Lee County, Florida, roughly 38 percent of drivers eligible for toll discounts (using transponders to pay tolls) indicated in interviews that variable pricing caused them to alter travel behavior. A survey taken the year after the toll discount program went into effect showed that 71 per cent of eligible drivers shifted their time of travel at least once a week to take advantage of the $0.25 off-peak toll discount available to customers paying an annual fee. Overall, evaluators concluded the program succeeded in making better use of existing capacity, thereby postponing the need for additions to capacity.

On the New Jersey Turnpike, off-peak traffic increased at a faster rate than peak traffic after implementation of time-of-day tolling, although congestion reductions were limited by rapid growth in overall traffic in all time periods. A survey of users taken after the first toll change in 2000 showed 7 percent of users altering their travel behavior in response to the toll differential. After the second toll change in 2003, again increasing the price differential, off-peak traffic increased at a faster rate than peak-period traffic. Analysts surmise that slower speeds in the off-peak due to growth in overall traffic made it less attractive to shift off-peak travel, as did a relatively small difference between peak and off-peak tolls.

The PANYNJ variable toll program also showed significant peak to off-peak traffic shifts for both autos and trucks, with resulting travel time savings and an earlier end to the morning peak by as much as 20 minutes at certain crossings. As with the New Jersey Turnpike, all of this change cannot be attributed solely to variable tolling, since some of the change resulted from reductions in waiting times at toll plazas due to increased E-ZPass adoption.

Surveys of auto users and truck dispatchers indicate that 7.4 percent of passenger trips and 20.2 percent of truck trips were changed in response to time-of-day pricing. Early data suggested that 20 percent of auto users who changed behavior switched to public transportation. Others switched to carpools, decreased the number of trips they made, or shifted out of peak. Analysis of 2003 traffic data (a period of sluggish economic activity in New York City) shows some shift of traffic back to the now less-congested peak period by former off-peak motorists. It seems level of congestion is key to motorists

decision about when to travel and peak/off-peak toll differentials may need to be adjusted to account for changing time-of-day driving decisions.

On the Illinois Tollway in 2005, a 200 percent increase in tolls in conjunction with off-peak discounts for trucks resulted in a 7.7 percent reduction in peak period truck traffic. The impact on passenger car traffic appears to be small probably because tolls did not go up for cars paying with I-Pass, which constitute a very large proportion of car traffic. Interviews with truckers using the Illinois Tollway suggest that potential for shifting commercial vehicle traffic out of the peak may be limited. Inflexibility of delivery times and ability to pass costs on to customers were cited as reasons by larger truckers. Analysts believe that the decrease in peak period truck traffic that did occur at some toll plazas likely came from smaller independent truckers who did not have the ability to pass costs along. Tollway authorities felt that any shift out of the peak, even if small, was a positive outcome, as was introducing the concept of time-of-day toll differentials.

Several study scenarios tested for the Pennsylvania Turnpike study showed some reduction in peak-period traffic. Non-commuters were more likely to respond positively, but many focus group participants indicated they were already exercising travel time flexibility to the maximum extent possible. Trucker surveys indicated that peak/off-peak toll differentials would have to be large to lead to altered travel times. Between 15 and 35 percent of trucking companies indicated they would shift traffic to take advantage of off-peak discounts. Based on these results, the Turnpike Authority decided not to adopt variable tolling.

Outreach campaigns, stakeholder involvement and media relations were all important to initiating and sustaining acceptable programs, or deciding not to proceed. Lee County established three citizen advisory committees consisting of local bridge users and businesses. Citizen focus groups objected to automated debiting of checking or credit card accounts. Increased peak tolls were seen as penalizing those with inflexible schedules, but off-peak discounts proved acceptable. Once the off-peak discount was underway planners were attentive to concerns, marketing included radio and print media advertisements, advertising billboards, point-of-sale displays, newsletters, press releases and media kits, presentations to community groups and employers. In Illinois, planners carried out twenty three interviews with trucking operators and found mixed reactions to variable pricing, but favorable reaction to electronic tolling. Tollway planners also met with civic groups and editorial boards to convey that congestion relief would be forthcoming if enough drivers switched to electronic payment. In the case of the New Jersey Turnpike Authority, the Executive Director served as a strong and active advocate of the pricing program. Strong support of several environmental and transit advocate groups served to counterbalance initial opposition from truckers and the Automobile Club. In the case of PANYNJ, building internal advocates for the pricing plan was an important first step, aided by analysis showing necessary revenue targets could be hit with variable pricing. PANYNJ initiated campaigns focused in part on large employers and encouraged flextime as a way to adjust to the tolls. Opposition still arose at public hearings, though more around the general toll increase than peak pricing. While sufficient support allowed the program to go forth, stakeholder surveys after the program started

revealed opposition and proponents largely held to the same views as before the program started, underscoring the continuous nature of gaining and holding the balance of acceptance. In the case of Pennsylvania, stakeholders included those with PADOT, the Turnpike Commissioners, Transportation Management Association, and the City of New York. The results of these interviews suggested considerable opposition, especially among those most knowledgeable about the proposal. Consequently, the decision was made not to proceed.

Equity issues generally were not critical to devising acceptable and ongoing programs, except in one case; and, equity evaluations show mixed or scanty results. In Florida, peak toll proposals were rejected largely due to a promise by the County Commission that tolls would not be raised again after a 1994 toll increase, leading instead to a program of reduced off-peak tolls. However, income equity was not an issue in planning or evaluation focus groups and surveys. In Illinois, a study of changes in I-Pass ownership concluded there was a "boost in I-PASS ownership rates across all income groups." However, in terms of absolute proportions of I-Pass users, income is a major determinant. The study indicated, "… high income ZIP Codes (median income among working households above $80,000) have more than twice as high a share of likely Tollway drivers as low-income ZIP Codes (less than $60,000)." Again, however, income equity did not derail program continuation. In New Jersey, breakdowns of users by income were not reliable because of small samples. PANYNJ did not uncover major equity issues in planning or evaluate equity effects after program implementation. Data from evaluation studies suggested that 58% of those traveling into Manhattan during peak periods who faced price increases had relatively high annual household incomes above $75,000. No equity analysis was conducted for the Pennsylvania study.

Environmental impacts were rarely evaluated in depth, though some positive and a few negative impacts were found. In Florida, variable pricing program had no significant impact on vehicle speeds, queue lengths at toll plazas, average vehicle occupancy, transit ridership, or accidents. Thus, evaluators conclude there was no significant environmental impact. Likewise, the heavy vehicle program was estimated to have no significant effect on environmental quality, since vehicles with 3 or more axles represent less than one percent of total bridge traffic at each toll facility. In Illinois, no environmental assessments were made. In New Jersey, after the introduction of variable pricing and E-ZPass, vehicle emissions at toll plazas declined. Evaluators conclude probably electronic payment was more responsible than pricing for the result. An important cautionary finding is emissions rose again after the initial decline as overall traffic levels increased. Neither PANYNJ nor Pennsylvania assessed air quality impacts.

Barring one example of toll discount without any peak-period toll increases (Florida), the **cost/revenue** picture has been quite favorable. Because these facilities already have much of the pricing infrastructure already in place, revenues have exceeded costs. Furthermore, pricing has also delayed the need for costly capital improvements. In Florida, the off-peak discount program did not generate positive cash flow, but probably did succeed in postponing by years the need for expensive bridge capacity enhancements. In Illinois, revenue impacts are not documented, though models predicted a 50% revenue

increase from electronic payment, varying toll schedules and the doubling of tolls for cash paying passenger cars (electronic payment unchanged). In New Jersey, the combination of higher peak tolls and off-peak toll discounts met revenue targets. For PANYNJ, variable pricing was set with revenue targets firmly in mind, and the targets are likely to have been met. No cost-revenue findings are available in the Pennsylvania study.

Evaluation methods usually involved before/after comparisons of traffic and user data, usually not with control facilities. In Florida, before/after data were tested for statistical differences. Variables included traffic volume counts, speed measurements, toll plaza queue lengths, travel times, bridge user surveys and random telephone surveys of bridge users. Focus groups also were employed. In Illinois, evaluators used before/after transaction data from the first 6 months of 2005 compared to the same six months in 2004 before toll change. The last six months of 2005 data was not used because construction and substantial gas price changes would cloud findings. Surveys were carried out with trucking companies assessing changes in tolls paid and reactions to toll increase. In New Jersey, assessment included traffic and emissions (using a microscopic traffic simulation model of the Turnpike), travel behavior, economic value of travel time savings, demand elasticity, and media/decision maker reactions. Evaluators cautioned simultaneous introduction of variable pricing and E-ZPass toll technology made it difficult to sort out their respective influences. Small numbers of passenger survey responses made it difficult to draw solid conclusions about demographics or behavioral choices. For PANYNJ, evaluation focused on before/after behavior, traffic and transit volumes, and public reactions. Focus groups with auto drivers and truckers were included. To avoid using traffic data affected by the impacts of 9/11/2001 and various operational restrictions placed at PANYNJ facilities after 9/11, the analyses focused on the time from April-August 2001 for the period after the new toll schedule went into effect. For the Pennsylvania study, a logit model was developed based on stated preference surveys used to determine the shift potential from variable pricing.

Technology changes often were linked to the introduction of variable pricing, making pricing transactions as easy as possible. In Florida, Lee County switched from the use of optical scanning labels to a transponder (LeeWay) system with prepaid toll accounts. As of February 2005, heavy vehicles (vehicles with 3-or-more axles) were required to use the attended lanes on all bridges to check the number of axles when the toll transaction was processed. However, axle counting and vehicle separation equipment is being installed at the Midpoint Bridge that would allow these vehicles to use electronic tolling lanes. The Cape Coral Bridge also is scheduled for new axle counting and vehicle separation equipment. In Illinois, pricing is via vehicle-mounted transponder with the toll deducted from a pre-paid account; some windshields and cars with GPS require an exterior transponder. In Illinois, the goal is to convert all facilities from a traditional barrier system to an end-to-end open road automated tolling system allowing payments at highway speeds. In New Jersey, the E-Z Pass toll technology enabled implementation of the variable pricing program. The PANYNJ and the NJ Turnpike charge tolls for commercial vehicles via electronic toll collection both via treadle equipment in

traditional toll lanes and in highway-speed open-road tolling through road loops and advanced vehicle classification software.

Summary

- Toll Authorities generally have met their goals in introducing variable tolls to shift traffic out of peak periods, gain more efficient use of facilities, delay capacity enhancements and to enhance revenues.

- Driver surveys suggest off-peak discounts do encourage shifts from peak to off-peak travel. However, lasting effect may depend on periodic toll adjustments as motorists change their peak/off-peak travel in response to varying congestion levels and travel times as well as price. In two cases of toll differentials, the initial shift of travelers to off-peak was not maintained.

- Evidence indicates both passenger cars and trucks will shift travel times in response to time-of-day pricing; however, interviews with truckers in one project carrying out trucker assessment suggest possibly more shifting by smaller independent truckers versus larger truckers.

- Outreach campaigns, stakeholder involvement and media relations were all important to initiating and sustaining acceptable programs, or deciding not to proceed. Focus groups, advisory committees, public hearings and interviews characterized planning. In one case, outreach assessment led to termination of plans. In another successful implementation, the positions of opponents and supporters did not change after start-up, suggesting keeping the balance of acceptance may require ongoing attention.

- Equity issues may involve more than income considerations, but have not blocked programs; equity evaluations are few and show mixed results. In one case, equity concern centered on fairness to those on inflexible work schedules rather than income, but did not derail program plans. In another project, equity concerns did not arise during planning. In two cases where traveler surveys were conducted, one was clouded by small samples; another concluded there was an increase in transponder ownership across all incomes after variable pricing, but higher income travelers were more likely transponder owners both before and after price changes.

- Environmental impacts were rarely evaluated in depth, though some positive and a few negative impacts were found. In one case, no change in speeds, toll plaza queues or vehicle occupancy suggested no air quality impacts. In another project, emissions at toll plazas declined, though probably due more to electronic payment than pricing. Where traffic increased over time in one project, emissions increased.

- Some evidence indicates reductions in peak period congestion would enable capital costs of expansion to be postponed. One project (Lee County) appears to have successfully put off major improvements through its program. In others, revenue targets were met. The increased revenues from peak period toll increases probably more than offset the relatively low additional implementation and operations costs on these facilities where the tolling infrastructure and administration already was in place.

- Evaluation methods usually involved before/after comparisons of traffic and user data without reference to control facilities to sort out outside influences such as gas price changes. Instead, projects sought comparable before project periods for after comparisons. Focus groups and surveys of users commonly assess reactions to programs. In the study included in this category, stated preference and modeling predicted possible traveler responses.

- The introduction or improvement of transponders or open road tolling accompanies most variable pricing, easing payment transactions. Some projects are introducing or have introduced advanced axle counting equipment to facilitate pricing by axle for trucks.

Pricing Project Category 4: Regionwide Pricing Initiatives

This project category encompasses pricing at several potential locations within a region, including new or existing lanes or other facilities and, in some cases, including region wide initiatives to promote carpooling or improve transit services. All are feasibility studies potentially leading to implementation. The purpose of the studies is to determine the most effective and feasible location for pricing or the feasibility and effectiveness of several pricing programs implemented at once or in sequence. The overall purpose is to add highway capacity to a region while managing new traffic levels and generating revenues through pricing. The lane management is aimed at creating new high quality travel options for the users where the toll revenues can cover all or a significant proportion of the associated costs.

Projects

An 18-month study of region wide pricing applications was initiated by the Maryland Department of Transportation in 1999. The study objective was to determine the feasibility of a broad range of variable pricing strategies in Maryland and to develop recommendations for possible implementation. The initial study examined potential pilot projects in several locations and was followed in 2002 and 2004 by HOT lane options for I-270, I-495, I-695, and I-95 north of Baltimore. In 2005, an agreement was signed for new express toll lanes on I-95/JFK Expressway in Baltimore (expected to be complete by 2011). Study is underway to possibly extend these express lanes another 10 miles. In 2007, a study examined managed lanes on I-270 and I-495, possibly connecting a

planned new Inter-County Connector (ICC) in Prince Georges/Montgomery Counties with planned I-495 HOT lanes in Virginia. The ICC project, already under construction, will be an 18-mile, controlled access tolled highway built to link existing and proposed activity centers in the I-270 and I-95/US 1 corridors.

In early 2008, Minnesota is launching a feasibility study to explore the potential for implementing a "FAST Miles" program in the Twin Cities area. Participating motorists would receive credits each month to pay tolls on priced lanes. Once credits are exhausted, the motorist would pay the full toll. If credits are not used for tolls, they can count against vehicle registration fees, property taxes and possibly other fees and costs. The purpose is to encourage saving credits by carpooling or using public transportation, thus reducing highway congestion.

The National Capital Region Transportation Planning Board road pricing study was launched in 2005 to examine the feasibility of a region wide network of value priced lanes. Scenarios examined include combinations of: (1) adding two new toll lanes in each direction on every freeway in the region, with one new toll lane in each direction to major arterials outside the Capital Beltway; (2) tolling all DC river crossings and tolling all freeway lanes in the District; (3) tolling parkways in the region. Other scenarios remove priced lanes based on lack of demand and enhanced transit. Analysis includes demand, revenue, costs, viability of transit operations, land use impacts, equity impacts and other elements. The scope includes HOT lanes along 15 miles of the Capital Beltway in Virginia, six new priced lanes along the new Inter-County Connector in Maryland, and HOV lanes converted to HOT lanes on the I-95/395 corridor in Northern Virginia.

Findings

In Maryland, the project team has examined travel demand forecasts, pricing strategies, toll collection technologies, enforcement options, equity concerns, legal issues, infrastructure requirements, and lane separation options. Public outreach has included project brochures, websites, public meetings, hearings, open house workshops and local advisory groups. Public reaction to early studies of HOT lanes was negative and important to revising work scopes in subsequent studies. Equity concerns have been a major point of emphasis. Preliminary engineering work, cost estimating, and preliminary assessment of environmental impacts is underway. No cost or projected impact information is yet available. Regarding technology, the HOT lane projects on I-270 in Montgomery County and HOV lanes along US 50 in Prince Georges County may use monthly "hang tags" as passes for entry into existing HOV lanes, similar to the early version of I-15 in San Diego. The State Highway Administration expects to receive and review the draft feasibility report in early 2008. The first segment of the ICC project is expected to be under construction in early 2008, with all segments projected to be open to traffic by 2012.

In Minnesota, proposals will be solicited in early 2008 from private sector and academic partners to begin the outreach and implementation of the FAST miles project. Tasks will include establishing a panel of pricing experts and local officials to examine expected

benefits and potential barriers to project implementation. A Task Force of national, state and local officials (including Vehicle Infrastructure Integration program representatives) will also be assembled to help guide the project. At this stage, there are no available findings on equity, costs/revenues, traffic or environmental impacts or planned evaluation and monitoring.

In the National Capital Region, an important preliminary finding suggests the cost revenue picture of variable priced lanes very much depends on the specific combination of new and existing facilities. A comparison of the forecasted revenues versus costs for each of the study scenarios found the high costs of building new interchanges and lanes were critical. Applying variable pricing to existing HOV or general purpose lanes generated revenues significantly in excess of costs. However, where new lanes are built, all depends on level of demand and size of capital costs. For some segments, revenues will not offset capital and operating costs.

Impact projections are generally favorable. Initial analysis of HOT lanes on the Beltway and I-95/395 show an increase in transit use, some decrease in HOV, slight increase in VMT and some increase in speeds on mixed use lanes. One key finding is a network of variable priced lanes will have more effect than the simple sum of individual projects.

Equity and environmental effects are still being assessed. One metric used to account for impacts across ethnic and income groups is the proportion of jobs within 45 minutes by auto compared to the general population. Planners are calculating this metric under various pricing scenarios relative to not implementing pricing.

The extensive regional analysis and multiple scenarios demands considerable modeling effort: The model incorporating region wide jobs and households has over 2000 zones and includes tens of thousands of highway and transit links. Each model run takes approximately 16 hours of computer processor time. The TPB project team has also begun evaluation of enhanced transit service on the priced network and is assessing potential land use effects. A project phasing plan has been developed, including value-priced networks for 2010 and 2020

Summary

- To date, region wide pricing initiatives consist of studies not implementation, though some have start-up segments. Most focus on HOT and/or managed lanes. One unique approach studied is limited credits against tolls to encourage transit or HOV use.

- One study finds potential increased transit use and corridor speeds with a network of variable priced lanes more effective than the simple sum of impacts from individual projects.

- Equity concerns are attended to in all the studies, with some variation in approach. One project is accounting for impacts across ethnic and income groups

by estimating the proportion of jobs within 45 minutes by auto compared to the general population.

- Outreach is part of all projects, including some combination of public meetings, websites, hearings, workshops, advisory expert and stakeholder panels.

Pricing Project Category 5: Making Driver Costs Variable

The projects in this category convert some of the fixed costs of owing and operating a car to variable costs or introducing greater variability to existing variable charges. As with other pricing approaches in this section, the purpose is to set travel prices in a way to reduce driving especially at congested times and places. Such variable charges are also seen as revenue generating mechanisms that could fully or partially replace existing road user taxes in the future. Projects included here demonstrate consumer responses to:

- VMT fees as gas tax replacement.
- Introduction of per trip prices varying by congestion (varying by time-of-day, place, and distance).
- Implementation of per trip variable pricing strategy that converts certain fixed costs of auto ownership to mileage-based equivalents.
- Pay-as-you-drive insurance products.

The projects have evaluated driver responses in experimental groups rather than developed ongoing, fully operational programs. The four projects described here examine the effects particular variable road use pricing strategies on travel behavior and seek insights into some of the institutional and technological challenges facing large scale implementation of these concepts.

Projects

The Oregon Department of Transportation introduced the *Road User Fee Program* pilot to assess the technical feasibility of replacing the state gas tax with mileage fees, as well as the potential of using variable fees in congested areas at peak travel times to influence traffic levels. The Puget Sound Regional Council's *Traffic Choice Study* tested the practicality and travel implications of charging tolls based on distance, time of day, and road location. . The Minnesota Department of Transportation's Mileage-based User Fee (*Pay-as-You-Drive)* demonstration project evaluated impact on travel of charging auto lease costs or insurance premiums by the mile. The Atlanta program is initially testing the user response to mileage based insurance charges across test households, and later will evaluate varying the fee further by congested times and places.

The projects share certain goals, though emphasis varies. The Oregon program, while interested in driver behavior, also emphasized the potential of user fees to generate revenues and possibly replace the gas tax as the principal source of highway funding. The state also was interested in varying the fee to reduce congestion. The Puget Sound program emphasized the test of area wide congestion pricing for congestion relief focusing on the travel behavioral impacts of prices varying by time, place and distance. The Minnesota project aimed at better understanding the sensitivity of drivers to alterations in vehicle ownership/lease costs, and how results varied by income, location, and annual mileage driven. Planners also wanted to gauge the potential of user-based fees to reduce travel, acceptance of user-based fees, and ways to develop new user fee policies and requisite institutional arrangements for eventual wide scale implementation. The Atlanta program initially focused on the travel effects of a mileage based insurance fee, but the purpose grew to influencing not only total daily trips and mode choice, but shifting travel out of congested periods.

There were similarities among the organizational and experimental aspects of the projects. All established mileage budgets based on baseline driving records. Mileage-based charges were debited from these budgets and any balance was paid to study participants, though participants were not at risk of losing their own money if they exceeded their budget. All studies involved relatively small sample sizes and were conducted in metropolitan areas. Cooperating gas stations in the area and participant vehicles were equipped with hardware needed to charge fees based on mileage. In the case of Atlanta, baseline information and some preliminary pricing response data has been collected, with plans underway to implement congestion pricing in similar fashion to the above three projects. Households shifting travel out of congested periods will retain a significant portion of their budget accounts.

Oregon 5-month experimental field test included 299 motorists and two service stations in the Portland area. Three experimental groups participated in the pilot: (1) a "control" group in which technology was tested but no charge made; (2) a fixed-fee group of 95 vehicles subject to a flat mileage fee, and; (3) a variable-fee "rush-hour" group of 102 vehicles that paid mileage fees based on place and time of travel. On-board equipment kept track of miles driven inside and outside of zones and the calculated mileage fee was reported at the gas pump. The Oregon study sized the mileage fees to simulate a direct replacement for the motor fuel tax – $0.012 per mile. It also discounted fees to $0.0043 during non-peak hours in certain zones and adjusted upwards to $0.10 for peak travel in congested zones and times.

The Puget Sound experimental field test ran for eight months, involved 257 households and over 400 participants. Drivers were made aware of pricing levels on certain roads both though system maps and with real-time displays on an in-vehicle meter. Mileage fees varied based on freeway versus non-freeway use and time of travel on all major roads in the region. Weekday toll rates for freeways were $0.40 in morning peak periods, $0.50 in evening peak and between $0.10 and $0.15 in between. Weekday toll rates for non-freeways were $0.20 in morning peak periods and $0.25 in evening peak periods, and ranged between $0.05 and $0.075 in between. Weekend travel was priced differently.

The Minnesota experiment included 130 participants whose travel behavior was measured under priced and non-priced conditions in a longitudinal study. Minnesota's pricing replicated the mileage component of vehicle leases or insurance policies, and ranged from $0.05 to $0.25 per mile. Some of the experimental groups had peak versus off-peak pricing, but pricing was not dependent on location.

For Atlanta, research is monitoring one year of baseline travel for 285 participating households. Approximately 500 vehicles are equipped with instruments to track vehicle speed and position for every trip. Travel diaries and employer commute options surveys are being collected from participants and their employers, and the same for controls. Participating drivers have an LCD panel displaying the price of each trip made. So far, about 100 households have begun to participate with initial analysis focusing on responses to changing gas prices and cent-per-mile incentives. A 20 cents per mile congestion surcharge will be assessed to commute trips undertaken under congested freeway conditions (speeds < 40 mph).

Findings

All evaluated programs found evidence that drivers respond to mileage-based and congestion pricing by reducing travel. Oregon VMT fee project found the fixed-fee group increased average peak miles per day by 11 percent and reduced average off-peak miles per day by 12 percent. The rush hour group decreased average peak mileage by 16 percent and reduced average off-peak mileage by 14 percent. In contrast, the control group increased peak period mileage by 17 percent and reduced off-peak mileage by 6 percent. The Puget Sound congestion pricing project compared travel patterns among participants before and after the program, not to patterns of a control group as in Oregon. Findings indicated an approximately 10 percent (4% AM, 11% PM) reduction in vehicle use during peak travel times, with considerably greater traffic reduction on specific roadways. Minnesota compared participant travel before and after the program. The evaluation found an 8.1 percent decline in weekend average daily mileage per vehicle for participants between un-priced and priced travel. Average daily mileage fell 6.6 percent during weekday peak-periods. In all other comparison cases, the average mileage during priced periods was lower than for un-priced periods. Drivers already with leased vehicles and vehicles not subject to the variable pricing were more likely to change behavior than those not under these circumstances. While the overall averages in daily mileage followed the noted trends, breakdowns by price levels showed some inconsistencies. Some of those facing the highest prices increased daily mileage, though the result may be attributable to small sample sizes.

Some of the evaluations addressed mode changes and changes to unpriced vehicles. In Oregon, 14 percent of households in the rush-hour group reported that a household member began using public transit to save money. Twelve percent of households in the flat-fee group reported mode changes to transit. Measurable impacts of Puget Sound study indicated nearly 80 percent of households drove less and/or shifted travel modes.

Minnesota found that if one or more unpriced vehicles are available within a household, some driving may shift to the unpriced vehicle(s).

Reliability of technology became an issue in one program, and several gave strong attention to privacy matters. In Oregon, there were technological problems reported with communication between the fueling stations and the on-vehicle device transmitting mileage to the service station computers. Service station owners reported integrating with existing computer systems and equipment installation were a burden, but reported no change in business costs or fueling operations. The Puget Sound study applied simpler technology and reported no significant issues. Both studies concluded that the technology to implement large-scale mileage pricing programs was available and could be readily employed by states. The Minnesota study was not intended to test GPS or area-based technology, and instead used the most readily available off-the-shelf equipment that met the study needs.

To satisfy privacy concerns, in Oregon project, no vehicle location or trip data was stored. The only centrally stored data were vehicle identification numbers, zone mileage totals for each vehicle, and the amount of fuel purchased. In Puget Sound, privacy was addressed by balancing the specificity of data remaining with the vehicle (for auditing and in disputes) against data transmitted to gas station or program computers. The GPS system deployed collected detailed information on not only miles driven, but exact vehicle location. Minnesota also addressed privacy by consideration of where key information resides. The program used a removable data recorder plugged into the vehicle's OBD II port that recorded trip data, mileage, and time of travel and could be retrieved by researchers.

Participant reactions to the pilot programs demonstrate favorable reactions are possible with experience and also point to key determinants of driver opinions. Oregon found participant concerns at the outset included possible damage to vehicles from equipment installation, lack of knowledge about the mileage fee system, mistrust of the technology, and doubts about its utility and security. However, after the pilot, 91 percent of participants said they would be willing to keep the on-vehicle equipment and pay the mileage fee rather than the gas tax if the system were extended statewide. In Minnesota, participants in the experiment group were more likely than the control group to consider pay-as-you-drive insurance and leasing with variable mileage pricing by time of day and yearly audits, again pointing to the role of experience in forming opinion. Minnesota findings also suggest the importance of flexibility: the majority of the participants said that they were more likely to choose pay-as-you-drive insurance if they could switch to traditional insurance without penalty. Finally, Minnesota results suggest drivers may prefer variable insurance to variable leasing. A survey of 410 drivers in the Minneapolis St. Paul area found 25 percent of respondents probably or definitely interested in mileage-based insurance compared to 16 percent of respondents expressing the same interest level in mileage-based leasing.

Summary

- Projects included experimental tests of mileage-based pricing, pay-as-you-drive insurance products, gas tax replacement, and other value pricing initiatives. Purposes include gauging user responses to variable pricing (with some variation by congested periods or locations), acceptance and revenue potential with an eye possibly to replacing gas taxes. All established mileage budgets were based on baseline driving records. Then, these budgets were debited as the variable charges were incurred, and any balance was paid to the study participants.

- All evaluated programs found drivers respond to mileage and congestion pricing by reducing travel. One project found reductions in peak period travel up to 10%, another even greater reduction compared to controls. Another found about an 8% reduction in weekend travel comparing priced and unpriced periods. Responses also include shifts to transit or unpriced vehicles within the household.

- Reliability of vehicle and fueling station technology was an issue in one program, though evaluators believe the test technologies can be improved for wider applications.

- Three projects addressed concerns about the privacy of travel data in various ways. A key consideration is the specificity of data remaining with the vehicle (for audits and disputes) versus data transmitted to central computers.

- Results from two programs suggest participants have initial concerns about possible vehicle damage, mistrust of the technology and doubts about security. However, after program surveys indicate diminished concerns and favorable response to variable pricing compared to traditional gas tax, insurance or leasing payment systems.

- Experimental designs generally are set to gain valid results. All projects collect baseline travel information to compare with travel during the pricing program. To add confidence, most projects gather data from both vehicle instruments and travel diaries. However, not all projects contrast before/after results with control groups without pricing.

Pricing Project Category 6: Other Selected Pricing Projects

Two additional pricing projects are selected for inclusions in this Section. As with projects described under Project Category 5: Making Driver Costs Variable, the two projects described here make explicit certain auto use costs normally obscured from motorists with the goal of reducing auto use. Car sharing charges an hourly rate for short-term car rental. Parking cash out enables employees to know the cost of parking often hidden in employer leases with building owners, and provides the employee the option of

taking cash instead of parking. The goal is to encourage automobile users to reduce their travel by: making them more fully aware of the actual cost of riving and/or parking; and enabling them to reduce the number of vehicles owned. The first large car sharing programs in the U.S. began in1998. Programs now exist in at least 15 metropolitan areas. Impacts and operations of these programs have been examined in the literature, including a comprehensive Transportation Cooperative Research Program publication.[1] Likewise, parking cash out has been implemented at several employer sites in the U.S. beginning in 1997. Impacts were assessed early on by Donald Shoup. An updated description of the concept and listing of relevant studies can be found at the TDM Encyclopedia website sponsored by the Victoria Transport Policy Institute.[2] The reader is encouraged to examine these resources to complement the findings and conclusions provided here.

Projects

Car Sharing:

This strategy involves hourly neighborhood car rentals. By sharing a neighborhood car, individuals can eliminate fixed expenses of ownership and insurance costs, and instead incur a variable payment based on usage. This results in an increase in the perceived costs of driving. This type of pricing provides an incentive for auto users to reduce vehicle miles in order to realize cost savings. People who drive very little and/or live in very dense urban areas may lower costs by not owning a vehicle by allowing 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 car, reducing the costs associated with vehicle ownership. Launched in 2001, non-profit City Car Share in San Francisco operates a car share program reaching 4,000 drivers with reported revenues of about $2 million in 2003. Under the authority of San Francisco County Transportation Authority (SFCTA) and formed in cooperation with Berkeley and Oakland and with support from public interest trusts and coalitions, it offered 90 short term rental vehicles available in more than 40 locations in San Francisco and east bay. It makes agreements with transit, businesses and building owners, insuring car/driver and managing reservations. The attraction of car share is it is cheaper than taxis or rental cars for most trips, with membership dues that were set at the start of the program at: $10/month; then $5/hour and 40¢/mile for most cars (application fee was $30 with a refundable security deposit of $300). The program operates in the same service area as two for profit companies.

Parking Cash Out:

Parking Cash Out strategy works by allowing employees to give up their free or subsidized parking in exchange for an equivalent monthly cash amount that they can use for any purpose they choose. The rationale behind this strategy is that those who were receiving subsidized or free parking now face market rates for parking and have the

[1] Car Sharing: Where and How It Succeeds, TCRP Report 108, Transportation Research Board, Washington, D.C., 2005.
[2] http://www.vtpi.org/tdm/tdm8.htm

option of avoiding paying for parking if they choose to shift to other commuting options. Those who shift eliminate SOV trips and reduce traffic and related problems. Evidence from past studies of cash out suggests employees accepting cash instead of parking may well opt for more use of auto alternatives while pocketing some of the cash allowance. Ideally, employers then can negotiate with parking/building managers to pay for fewer monthly parking spaces.

King County Metro in 2001 began promotion of parking cash-out to downtown Seattle employers. King County offered employers both a financial incentive and technical support in administering cash out: $125 a month per employee receiving free parking prior to program implementation; after 9 months, the offer was an additional $125 per employee relinquishing free parking space. No public policy changes were needed to implement the program, though a trip reduction law in the project area allowed for good access to employers. County staff marketed to these employers, presented at meetings in downtown Seattle, distributed brochures at transportation fairs and worked through the Downtown Seattle Association.

Findings

The assessment of the San Francisco car share program showed mixed results and the need for continued, well structured evaluation. After two years of operation of the San Francisco program, a third of participants reduced their car ownership by at least one car, and two-thirds reported that they had opted not to purchase another car because of the program. In a matched pair comparison with non-members, it was estimated that members drove 6.46 miles less per day than non-members. While this program also enabled some prior transit users to make new automobile trips, the overall net impact seemed to have been to reduce vehicle miles of travel among the members. Further, the observed trend of reduction in auto ownership among members appeared to promise future reduction in vehicle miles.

The latest evaluation report (2006) shows a large proportion of car share trips are made off-peak, possibly moderating congestion. There is evidence of some curtailing of adding vehicles to households (carshare compared to control group), but reductions in vehicles already owned show no consistent result (again, carshare compared to controls). Overall VMT declines were cited by evaluators, but were not statistically significant without certain assumptions and adjustments for mode and occupancy. A complication in evaluation was the difficulty of creating comparable controls, as these were made up of applicants who initially registered but did not join, meaning they may not have been fully comparable to joiners. Overall, the SF carshare experience suggests possible reductions in congestion, car ownership and overall VMT. Clearly, continued and careful evaluation is vital.

Results of the Seattle parking cash out promotions are unclear due to minimal participation. For example, while the downtown businesses association made 744 sales calls, only three employers agreed to a presentation, and none elected to participate in the program. Eventually, all efforts resulted in three businesses and 18 employees

participating. Minimal acceptance probably was due to parking subsidies already eliminated for most employees; an extensive bus pass program already operating; a decrease in King County and downtown employment reducing employer interest in "something new"; the difficulty of reaching smaller employers without transportation coordinators; and a core of employees believing they must have a car for work. Another key finding is building and parking management wanted to keep tenants and maintain revenues with office vacancies on the rise and parking prices appearing to decrease. Building owners were reluctant to renegotiate tenant leases to change monthly parking spaces, suggesting cash out may be viable only where demand outstrips supply, and spaces can be sold daily. Finally, employer transportation coordinators said cash out added size and complexity to a significant existing package of employer TDM measures. Clearly, cash out requires a particular market fit to work.

Summary

- Two projects in this category make explicit certain auto use costs normally obscured from motorists with the goal of reducing auto use. Car sharing charges an hourly rate for short term car rental based on total auto use costs. Parking cash out enables employees to know the cost of parking often hidden in employer leases with building owners, and provides the employee the option of taking cash instead of parking.

- Evidence from the San Francisco car share program showed some positive results. A large proportion of car share trips are made off-peak, possibly moderating congestion. Yet, because many prior trips were via walk, bike or transit, a large proportion (68%) are new vehicle trips. There is evidence of some reduced vehicle ownership across households (carshare compared to control group), but reductions in vehicles already owned show no consistent result. Overall VMT declines were cited by evaluators, but were not statistically significant without certain assumptions and adjustments for mode and occupancy. Continued evaluation is necessary to sort out effects more fully.

- Cash out experience documented in the literature suggests employees accepting cash instead of parking may reduce auto use. The Seattle project addressed here found cash out promotions were not very effective, in spite of offering employers both a financial incentive and technical support. Only three business and 18 employees participated. Follow up examination concluded minimal acceptance was probably due to parking subsidies already eliminated for most employees; an extensive bus pass program operating; employer reluctance possibly due to an economic downturn; difficulty reaching smaller employers; program complexity cited by transportation coordinators; and a core of employees insisting on a car for work. Also, building owners were reluctant to renegotiate tenant leases to change monthly parking spaces, suggesting cash out may be viable only where demand outstrips supply, and spaces can be sold daily. Overall, success of cash out appears to be highly dependent on the transportation, parking and economic environment in which it is attempted.

- Neither carshare nor cash out done on a voluntary basis required new public policy, though agreements between localities and car share organizations supported the evaluated program. Referenced literature indicates state law also can encourage cash out.

- The one cash out program did not take hold sufficiently to judge the cost/revenue picture, though revenues consist of fees and government startup grants. However, the carshare case operated successfully for several years as a non-profit alongside two for profit companies serving the same area suggesting carshare can be economically viable under both for profit and non-profit operations..

- Related studies referenced here suggest if carshare takes root with significant coverage and participation, it can operate successfully without the need for public funds.

- Carshare evaluation presented the difficulty of creating comparable controls. The selected approach used applicants who initially registered but did not join. This group may not have been comparable to joiners.

3. Conclusions And Implications

More than a decade and a half of value pricing demonstration programs and studies has provided a rich body of knowledge about how travelers respond to price, the technology associated with implementing these concepts, the determinants of public acceptance, and other policy considerations. Some of the work done under the program resulted in actual implementation. Others involved studies that did not result in implementation, but often provided valuable insights into potential user responses and policy issues needing attention. This section ties together the lessons learned from these programs.

This section presents general conclusions and lessons across all the project categories, drawing on the range and diversity of findings in Section 2. The discussion of lessons learned includes the effects of value pricing on: travel and traffic, costs and revenues, equity and the environment. In addition, lessons are drawn relating to the successful adoption of value pricing including: policy and institutional issues; outreach and public acceptance requirements; and issues relating to the adequacy of technology for the administration and enforcement of pricing programs. Lessons pertaining to project monitoring and evaluation are covered next, followed by a review of implications of the lessons learned for federal, state and local planners.

Effects of Pricing

Travel and Traffic Impacts

- *Pricing Does Reduce Congestion and Can Increase Vehicle Throughput*

With few exceptions, variable pricing strategies that have been implemented across categories have met their principal objectives of reducing congestion and increasing traffic throughput. Pricing has been shown to cause travelers to change their behavior by changing times, routes, trip frequency, or modes of travel. Travelers have also shown a willingness to pay for faster travel times when an option such as toll lanes is made available. These responses have led to reductions in peak-period traffic congestion, increased vehicle and person throughput in some cases, and more efficient use of highway capacity. The nature and magnitude of impacts on travelers and traffic has been found to depend on many factors including: the pricing concept involved, price levels and schedules, coverage, pricing periods, the existing traffic levels and demographic characteristics.

The HOV to HOT lane conversions in San Diego, Houston, Minneapolis, and Denver have all been successful at making better use of previously underutilized HOV lanes, and providing drivers with a congestion-free alternative. 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. Also, there is some, albeit non-conclusive, evidence HOT lane

conversions have brought relief to adjoining mixed flow lanes by attracting some traffic away from these lanes. HOT lanes have provided a new high-speed travel option to the public without reduced HOV use. Many users also view HOT lanes as providing safety due to reduced congestion.

The new variably priced express lane project (SR-91 Express Lanes in Orange County, California) has been successful at allowing much higher throughput at significantly higher speeds than adjoining general purpose lanes, and reduced congestion on the overall facility. The priced express lanes with only one-third of the total capacity carry well over 40 percent of the total SR-91 traffic during peak periods, congestion free, at more than 60 MPH, while the general purpose free lanes are heavily congested and moving at very low speeds.

Several existing toll facilities have instituted differential toll rates by time of day with the aim of spreading travel demand out of the most congested times. Variable pricing on Hudson River crossings in the New York City area and in Fort Myers/Cape Coral, Florida have demonstrated that drivers will change behavior even for relatively modest price changes. Variable tolls on existing toll facilities have reduced congestion and led to more efficient use of existing capacity, postponed the need for capacity expansion and generally preserved or increased toll revenues. While the magnitude and permanence of the effects depend on motorists adjusting to congestion levels, economic conditions and general travel costs, key pricing determinants are the magnitudes of tolls and the degree of difference in peak vs. off-peak tolls. Clearly, motorists on toll facilities have chosen to shift their time of travel to off-peak periods to take advantage of lower tolls.

Regionwide pricing initiatives are undergoing feasibility studies or are in the pre-implementation stage, so no definitive conclusions based on actual experience can be drawn. However, planning studies of region wide networks of priced express lanes in Maryland, Virginia and Minnesota suggest they will mirror the positive experiences of HOT lane conversions and new priced express lanes, and that the sum of individual projects may have a larger impact on travel behavior than individual projects. These studies are attending to not just the traffic throughput on priced facilities, but on the overall impact on the transportation system, including non-priced facilities and transit.

Field tests and experimental projects involving converting fixed driving costs to variable costs in Oregon, the Puget Sound Region, Minnesota and Atlanta have shown that such pricing strategies do reduce peak period and/or weekend travel by encouraging shifts in travel times and mode. These tests suggest that while shifts in travel patterns are possible even with moderate prices, some drivers and certain trip types are more likely to change behavior than others.

Carsharing and parking cash out also have been examined in field tests in San Francisco and Seattle, respectively. While the limited experience with carsharing and parking cash out showed mixed or inconclusive results, both show promise as ways of reducing automobile trips and, possibly, automobile ownership, and are deserving of further evaluation.

Cost and Revenue Impacts

- *Pricing Can be an Important Source of Revenue For Transportation*

Although the primary rationale for value pricing projects has been to improve mobility and efficiency, revenue from pricing clearly has been of major interest to decision makers. The revenues generated by pricing have been an important source of benefits in most of the projects reviewed in this report.. Project revenues have been used to cover operating and enforcement costs, fund additional highway infrastructure, and to improve transit alternatives.

The revenue picture for HOT lane conversions is generally favorable. In all but one of the HOT lane conversions, revenues have been sufficient to support operating expenses, although in the case of the I-394 HOT lanes in Minneapolis it took over a year until revenues exceeded operating expenses. One project, the I-15 HOT lanes in San Diego, is subsidizing transit service with toll revenue in addition to paying for HOT lane operating expenses (support for and emphasis on transit also is important at PANYNJ and will be integral to new managed lanes in Houston). One smaller program (Houston) did not raise sufficient revenue to cover all operations and a long-standing program (San Diego I-15) is starting new fees to cope with declining use and revenues due to the opening of a new nearby facility. Covering the initial capital cost of conversion from HOV to HOT lane operation is more difficult, especially where conversion requires expensive capital outlays, or where a relatively large number of vehicles are allowed to travel free.

The one well-evaluated new express lane project, SR-91 Express Lanes in Orange County, California, shows that a privately owned and operated tollway can be economically viable and can result in savings to the public sector. The success of this one project, however, does not necessarily translate to other projects. The SR 91 corridor was intensely congested, with no real alternative routes, and the right-of-way was donated by the state.

Projects where existing tolls are varied to modify travel behavior have a much easier time being financially viable, since they have not been used to finance new facilities, and tolling systems and personnel are already in place. The revenues from pricing reforms have exceeded costs. Studies have also shown that if variable pricing is successful at reducing congestion, then costly capital improvement can be delayed.

Regionwide pricing initiatives are too new and untested to draw confident financial conclusions, though one study suggests financial feasibility is highly dependent on capital costs of new facilities. With region wide and area wide pricing concepts there is a potential for a large amount of gross revenue.

Experiments with variable driver costs are also too limited for confident conclusions, though user responses suggest these strategies might be able to more than cover costs. Studies also suggest possible acceptance of replacing gas taxes with new variable VMT

fees. One carsharing case indicates profit and non-profit operations can be economically viable.

Equity Impacts

- *Equity issues have been less of an issue than many decision makers believe*

Equity issues are ever-present, but have been successfully dealt with through project experience. Any change, in the way charges are made for road use, will result in winners and losers. Some road users will value time savings and reliability more than the cost of the toll, others will not. Those who are "tolled off" the priced facility may shift to off-peak times or alternative routes, decide to carpool or switch to a different mode of travel, or simply make fewer trips. Changes in trip making behavior may also change patterns of commerce and affect businesses differently. Like other aspects of value pricing, how all this is resolved depends on a number of factors, including the type of pricing project involved, the level of congestion being addressed, and the policies or programs that go along with a value pricing program. In particular, the perception of fairness also depends on how the revenues are used and what alternative policies are considered as ways of dealing with congestion.

While the array of winners and losers from value pricing does not necessarily fall along income lines, the perception that value pricing is "unfair" to low income drivers has been a concern for many projects. Since the inception of the pricing pilot projects, equity has been a key program interest, with particular attention given to mitigating possible adverse effects of projects on low-income drivers. However, project experience has shown, particularly with the most common projects funded under the early phases of the federal program, that concerns sometimes raised about perceptions of severe inequities may be overdone.

Equity issues do arise in planning and implementation across several pricing categories, but have not often been sufficient to prevent a project from moving forward. Equity evaluations, though limited in scope, have found some differences in incomes of facility users, but these differences are not dramatic. HOT Lane conversions have encountered concerns in planning about catering to the rich, but usually these have not been sufficient to halt projects. Such concerns tend to diminish among users and the public as operations get underway. User surveys reveal some, but relatively small, differences in incomes of facility users.

New expressways with variable pricing are limited in number but do reveal some differences in use based on income, though little difference in reactions to projects. In one case, use increased over time for all modes across all incomes. A planned expansion case (San Diego I-15 Managed Lanes Project) found strong support with few differences about fairness based on ethnicity or income.

For pricing on existing tollways, equity issues around income have not blocked programs, but concerns about fairness to those with inflexible work schedules have been expressed.

User surveys for this category have been limited, but one case suggests higher income travelers were more likely transponder owners both before and after price changes.

In the region wide pricing category, one project is accounting for impacts across ethnic and income groups by estimating jobs within a travel time perimeter compared to the general population.

Field tests of converting fixed costs of driving to variable costs have not delved into equity issues to any significant degree; nor have the carshare and cash out projects in the final category.

Environmental Impacts

- *Pricing Can Have Positive Environmental and Energy Benefits*

Pricing can alter the operating speeds, number and timing of trips or even the mode on which trips are taken. These changes, in turn, may lead to reductions in fuel consumption and consequent reductions in vehicle emissions, resulting either from fewer vehicle trips being taken or smoother traffic flows under less congested conditions, but the results are highly dependent on the specific implementation.

Environmental evaluations of US pricing projects are scarce. A few findings suggest possible positive impacts, but more evaluation would clarify the picture. One HOT Lane conversion (I-15) found growth in emissions but even more growth was found in a comparison corridor. Another HOT Lane project evaluated CO and noise and found no significant changes compared to pre-project.

Only one case of using variable pricing on existing toll facilities attempted a detailed air quality assessment and found existing models to be inadequate for the task.

At this point, evaluation of energy and environmental implications of region wide pricing initiatives has to rely on travel and traffic forecasting models. The feasibility study findings are still very preliminary. Field tests with mileage and congestion charges shows reduced vehicle miles traveled, however, air quality effects depend on mode shift and degree of shift to household vehicles not priced, a complexity requiring further ongoing study. Likewise, carsharing impacts on VMT across household vehicles and associated air quality implication requires further testing and evaluation.

Feasibility and Implementation of Pricing

A number of factors influence the prospects for successful implementation of value pricing, including policy and institutional issues, public outreach and acceptance programs, and technological factors.

Public Policy and Institutional Issues

- *Pricing Projects Often Call For New Policy and Institutional Arrangements*

The nature of policy and institutional issues that arise during implementation and operation of pricing projects depends on the category of pricing project involved. HOT conversions typically require new policies, legislation, and organizational and operational arrangements. New expressway developments are likewise commonly supported by detailed policy and agreements, especially in the case of private for-profit development. New variable pricing on tollways requires governing authority approval but not new legislation. Regionwide pricing initiatives are likely to follow HOT conversions in the extent of policy and institutional development. Experiments with variable driver costs do not seem to require extensive policy initiatives, but clearly replacing gas taxes with mileage-based pricing or instituting pay-as-you-drive insurance products will entail significant policy initiatives. Voluntary cash out and carshare programs are initiated without significant policy changes, though agreements with cities, employers or developers are required for carshare arrangements. The voluntary cash out program reviewed did not require policy changes but was supported by an agreement between a public agency promoting the concept and employers and/or developers.

Outreach and Acceptance

- *Successful Projects Depend on Effective Outreach, Public Support and Flexible Management*

Public opinion is perhaps the most critical determinant of the prospect for successful pricing project implementation. All of the projects in the pricing programs have paid considerable attention to measuring public attitudes and reaching out to the public, stakeholders, and elected officials so that they understand the new concepts in transportation that pricing represent. As described in Section 2, projects typically are initiated after considerable public outreach and stakeholder involvement, and many have made changes in response to public reactions. Outreach efforts as part of initial feasibility studies often find neutral or skeptical opinions, or outright resistance, but this is often followed by acceptance as projects get underway. The outreach efforts, often using focus groups, surveys, and public forums, have resulted in a better understanding of public concerns that have been incorporated into project designs and public education materials. The support of a key stakeholder who was able to influence public opinion also was crucial for the successful implementation of several projects.

HOT lane conversions demonstrate extensive outreach leading to revised or dropped plans, though agency flexibility and responsiveness to public concerns has turned early resistance to acceptance and been important to maintaining acceptance by altering programs in response to user and public reactions. Support from elected officials, advocacy groups and community leaders appears to be vital, and may take many months if not years of effort. New variably priced highway facilities suggest a similar lesson. While public opinion is generally favorable, the public may not understand what

expenditure items are being funded from pricing revenues, and support can deteriorate if private sector operations are seen as monopolistic and inflexible. Variable pricing on existing toll facilities again is accompanied by considerable outreach, stakeholder involvement and media relations leading to a successful implementation in one case but not another. In the former, the positions of opponents and supporters remained the same before and after implementation, showing the importance of continuous efforts to maintain an acceptance threshold.

Outreach is part of all ongoing region wide pricing initiatives, although results are yet to be documented. Results from variable cost experiments, as with HOT lane conversions, suggest initial concern about security and technology can change to a favorable response after sufficient time and experience. On the other hand, the cash out program met with stiff resistance which could not be overcome, underscoring how this category of pricing is highly dependent on the transportation, parking and economic environment in which it is attempted. The carsharing case demonstrated traditional marketing techniques can be successful in gaining participation and sustaining market share.

Based on project experience and public opinion studies on value pricing, certain key factors emerge as important to public acceptance of pricing:

- Congestion must be seen as a major and endemic problem.
- Besides congestion, pricing should be shown as addressing other important local goals such as the environmental quality and transportation funding needs.
- Pricing should be portrayed as offering new travel choices to the users.
- Positive experience with pricing elsewhere needs to be presented to the public; and pricing proposed should be portrayed as a fair and equitable way of addressing the problem.
- Program management should be responsive to user and public reactions and be prepared to make changes accordingly..

Technology

- *Pricing and Enforcement Technologies are Working, but some Challenges Remain*

Technology is important the success of most pricing concepts, and the technology has been generally up to the task. The technologies for pricing and enforcement generally are proving reliable and effective, but a few cautions are in order. HOT lane conversions have demonstrated that tolling technology is sufficiently advanced to make fully dynamic pricing feasible, when combined with stationary and mobile enforcement against transponder violations. A remaining challenge in HOT lanes and any other systems with differential toll schedules based on occupancy is that automated methods of detecting

occupancy are not yet available, though they are under development. The same encouraging developments and challenge applies to the categories of pricing new express lanes (though limited to one well-evaluated case) and pricing on existing tollways. Two other developments also are progressing to ease pricing applications: open road tolling systems and advanced axle counting equipment to facilitate pricing by axle for trucks.

While the technology for open road tolling seems to have evolved to the fully operational level and is effectively enabling variable pricing on HOT lanes, new express lanes and on some of the existing toll facilities, the use of variable tolling on a wider scale may have to await further adoption of the latest tolling technologies by existing toll authorities.

The category of making driver costs variable suggests some sensitive technology issues. Reliability of vehicle and fueling station technology was a concern in one program, requiring further tests and assessments. Electronic tracking of vehicle movements is a new and developing technology, technology reliability was an issue in some of the programs.

Privacy of travel data also requires attention. As electronic tolling becomes more prevalent, the right to privacy is expected to continue to be an issue for future variable mileage fee applications. There is an important tradeoff between complete privacy or anonymity and the business need to prove that certain mileage was recorded for billing purposes. The results from the two longest operating programs (I-15 HOT lanes and SR-91 Express lanes) suggest initial mistrust of the technology and doubts about security can be managed. All studies indicated that privacy was a significant concern among participants, but such concerns were alleviated once participants learned more about the technology and were confident about data security.

Evaluation of Pricing Projects

Evaluation programs have dealt well with traffic impacts, project operations, and public and customer reaction, but have paid less attention to equity and environmental impacts. Attempts to distinguish the effects of pricing from outside influences such as gas price or economic swings have been modest at best. Most HOT lane conversions have focused on traffic impacts and public/user reactions, one even attending to business and land use impacts. Less attention has been given to equity and environmental effects. In the most extensive evaluation case, a non-equivalent corridor provided some guard against spurious conclusions about project effects. The category of pricing new express lanes shows broad ranging evaluations across traffic, travel time, accidents, user profiles (in part for equity assessments), user opinions and, in one case, opinions of corridor residents. Two projects compared results to non-tolled sections of the highway or nearby freeways to improve confidence of findings, certainly better than no controls. In one case, attempts to modeling air quality impacts were not able to adequately account for accelerations and decelerations. New congestion pricing projects on toll facilities commonly use only before/after data without comparisons to trends on other facilities.

Regionwide pricing initiatives are not far enough along to allow assessment of evaluation methods. Projects in the category of experimental variable pricing have gathered extensive baseline information to compare with travel during the period of the pricing program and will supplement vehicle instrument data with travel diaries. However, comparisons to controls without pricing are not always made.

Implications For Federal, State and Local Planners

Federal Role

Federal Pricing Program managers have many opportunities to foster continued progress in the Pricing program. Key roles include demonstration support of pricing concepts emerging from lessons learned to date as deserving of further implementation; and corresponding support of well structured evaluations of effects and outcomes also emerging from lessons learned as important. Suggested implications by pricing categories follow.

While HOT lane projects have matured and demonstrated many useful findings, there is room for further testing and evaluation, giving Federal pricing program managers opportunities to foster continued progress in value pricing. In particular, operational issues of access/egress, lane separation and occupancy checks, as well as the issue of HOT lane effects on mixed flow lanes, deserve demonstration and further assessment. New HOT lane networks deserve encouragement and careful evaluation of traffic, equity, environmental and cost/revenue results. Clearly, HOT networks may offer more substantial and complex impacts than individual HOT lanes. A very critical question is whether new HOT lane networks rather than individual conversions can be financially feasible in a network sometimes demanding sizeable capital outlays. Private sector involvement in such projects also deserves attention as the one private development case evaluated here showed very promising financial results but potential problems of public and political acceptability.

Variable driver cost programs aimed at replacing gas taxes and standard insurance and vehicle lease programs also deserve continued attention and demonstration. To date, these have been small scale experimental tests showing promise for reducing both peak and area wide travel in forms acceptable to participants, but operational and privacy issues remain to be examined fully. Continued testing, with a focus on replacing or reducing gas taxes, while continuing to generate transportation revenues, can address problems associated with greenhouse emissions and potentially provide new revenue sources for transportation. Technological developments for broader application also deserve attention as the technologies employed in the test programs were not as sophisticated or reliable as possible.

New variable tolls on existing tollways deserve further encouragement and evaluation. Demonstrations have shown more efficient use, postponed capacity improvements and

preserved revenues. In addition, some ingredients for increased acceptability have emerged and can be replicated. However, there still is room to test, evaluate and document the peak-off peak differential needed to bring significant and long standing shifts in traffic and reduced peak congestion. There is a need to address the apparent reluctance on the part of toll operators to adopt variable pricing on a wider scale.

Carsharing and parking cash out programs present challenges and deserve focused work. Carsharing evaluation is very complex with multiple possible effects needing careful tracing. So far, experimental designs have not been adequate to render clear and confident conclusions. Cash out has been demonstrated as being effective in the referenced literature, but can face implementation challenges identified in the case study evaluated here. Attention needs to be given to finding the best markets for cash out and simplifying the concept for implementation especially for employers with multiple trip reduction programs.

All categories of pricing concepts deserve continued equity and environmental evaluations. Equity evaluations would be helped by attention to more than income of users, including benefits to users across incomes and inclusion of several equity measures. As the cases suggest, perceptions of fairness also pivot around travelers on fixed versus variable work hours, as well as geographic distribution of costs and benefits. Environmental evaluations require the best possible models to account for VMT, speeds, speed variation and vehicle type. Testing various methods of direct measurement also deserves attention, especially where pricing increases throughput and speeds and reduces stop-go travel and idling, either corridor-wide or at specific points (e.g., toll plazas). The full range of emissions should be included, including CO2 emissions in line with interest in global warming.

Federally supported evaluations in conjunction with all pilot programs are important as a means for encouraging comprehensive and well-structured assessments with implications for future directions of pricing. Emphasis on multiple measures should be maintained, across transportation, acceptability, policy and institutional formation, equity, environment, costs, revenues and operations. Opportunities for improvement include attention to controls and statistical tests to insure valid results and to rule out influences of ongoing swings in gasoline prices and economic conditions. Support for preparation and distribution of best practice documents, and technical assistance and guidance to local project partners are all appropriate and needed roles of federal support programs.

Local, Regional and State Roles

Local, regional and state governments can benefit from the various findings and lessons arising from experience to date with value pricing programs. This report provides a resource to encourage implementation of pricing concepts in the most feasible and effective way. It provides planners and managers of new projects a summary of the most extensive and confident results for HOT lanes, new express lanes, and variable tolls on existing tollways. Because there is less experience with other project types, less confidence surrounds region wide pricing, changing fixed into variable travel costs, car

sharing and cash out. Specific implications emerging from lessons learned for governments planning and implementing pricing projects follows.

An important lesson for planning and initiating new projects is that careful attention needs to be paid to the extensive outreach activities associated with all project categories. It seems evident that substantial effort involving not just the general public and travelers but other stakeholders and champions is a common ingredient of implemented programs. Ongoing attention to customers and the general public and willingness to make changes as necessary are also evident in implemented programs. Patience and persistence also are important in planning stages since initial opposition often diminishes over time.

HOT lane projects provide the most extensive documentation on planning, impacts, operations, policy development and outreach. Well-designed programs can be expected to increase throughput without diminishing carpooling and perhaps can generate sufficient revenues to support transit expansion. They also provide good models for developing necessary policy, institutional, operational, enforcement and technology arrangements. One caution on the financial side is that projects involving large capital costs, such as new facilities or networks versus conversions of existing lanes, may not be fully self-financing. Flexibility in pricing and fee policies is important not only to maintain congestion reduction but financial viability in the long term. Another caution is in granting private sector operators certain protections against development of new, nearby facilities.

Local, regional and state governments interested in general reductions in VMT as well as congestion reduction will benefit from attention to the category of projects turning fixed into variable travel costs. With global warming high on the agenda of many governments, this category offers promise for affecting a wide range of travel. While this category has developed only to the experimental stage, the results suggest potential effectiveness and acceptability for replacing gas taxes with VMT fees, and, perhaps, replacing standard insurance and vehicle lease programs with variable fees more sensitive to the extent, time and location of travel. Planners interested in these approaches may wish to take the next steps in experiments to date, paying particular attention to the latest and best technologies; ways to best manage privacy concerns (the cases here reveal useful first approaches); the financial implications of gas tax replacement; and the requisite policy, institutional and legislative steps necessary for broad implementation. Solid experimental designs employing controls are also important to documenting impacts and paving a credible path to gas tax replacement.

Based on findings to date, localities interested in parking cash out programs should be prepared to target and fashion parking cash out carefully. They should evaluate carshare impacts for its multiple effects on travel. The cases evaluated here reveal more and less promising applications of cash out based on types of employers, existing TDM programs and parking conditions. Carshare requires impact assessment not only for replaced and new trips associated with carshare vehicles, but impacts on all household vehicle travel. Good controls also are important for specifying results with confidence. Finally, local planners are encouraged to stay abreast of referenced literature on carshare and cash out to complement findings of cases in this study.

Another important general lesson for planning and developing projects across categories is the need to carefully assess the latest technological innovations. For HOT lanes, important issues include pricing using transponders versus license plates, enforcement systems against transponder violations and the latest developments in vehicle occupancy verification. HOT lanes, new express lanes and variable pricing on existing tollways all will benefit from attention to open road tolling systems and, depending on pricing options, truck axle counting automation. Technology is not only important in and of itself. As experience with pricing existing tollways shows, technology upgrades packaged with new pricing strategies may enhance prospects for acceptance. With fast changing technology innovations, localities need to determine which technologies are sufficiently tried to allow for wide scale application versus those requiring further testing and evaluation. Again, several projects documented here provide important starting points for planning considerations.

4. Looking Forward

Potential of Value Pricing

- *Interest in Value Pricing is Increasing*

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 to traffic congestion problems. The implemented projects have shown that travelers are willing to pay for improvements in transportation service and that pricing can lead to more efficient use of existing highway facilities. Theorists have predicted this for decades, but the demonstration projects have confirmed that people respond to price signals when making transportation decisions, just as they do in other aspects of their economic lives, and those responses can help diminish congestion and support alternatives to solo driving. The demonstrations have also been a test-bed for the technologies that enable pricing to be used, as well as a discussion forum for important issues related to equity and public perceptions.

Whereas pricing was once something talked about by a small corner of academia, pricing is now front-page news, and is openly discussed by transportation professionals, interest groups, and elected officials. Pricing has come to be viewed as an innovative way of coping with recurring congestion problems and as an effective complement to existing transportation improvement programs.

- *Revenue-generating Effects of Pricing Provide Important Stimulus*

Although the primary rationale for value pricing is that it improves mobility, the revenue-generating effects of pricing have also been a major reason for interest in this approach to reducing congestion. While the past projects in U.S. have focused on single facilities and generated moderate revenues as compared to what can be expected from broader applications, some of these programs have been self-financing and a few have generated revenues in excess of operating and capital costs. Overall, value pricing shows considerable promise in a time where transportation agencies are struggling to find new and robust approaches for financing transportation programs. Moreover, it has been shown that pricing can be a fair and equitable part of a road user charge program.

- *A Variety of Project Types Will Continue To Emerge*

Half a dozen HOT Lane Conversions have been implemented and several others are being designed across the United States. These projects have now been “main streamed” in the Federal Aid Highway Program. A pricing concept once only theoretical has been thoroughly tested, well evaluated and adopted in several congested urban areas. As pricing technologies progress more advances can be anticipated, whether in the open road systems, refinements based on GPS or other innovations. There also will be need to

address access to and egress from multiple entry/exit HOT lanes especially in network applications. The challenge will be balancing the cost and safety of safer flyover ramps versus lower cost means of minimizing and managing weaving to/from slip ramps.

Many metropolitan areas and states are planning for variably priced new express lanes and toll authorities are considering introduction of variable tolls on existing facilities. Of course, challenges remain. Some authorities are apprehensive about adopting variable tolls due to a policy catering to cash-paying customers; administrative and cost considerations; reluctance of the bonding and financing industry to move away from long-standing and familiar flat tolling practice; apprehension about limits of available pricing technologies; and concerns about public and political backlash. Yet, the pilot programs examined here suggest concerns to date are not insurmountable and progress is possible. Further carefully evaluated efforts likely will encourage more adoptions.

As more has been learned about small-scale pricing applications, interest has expanded to more comprehensive region wide and network pricing programs as well as downtown area wide cordon pricing programs. The Federal Value Pricing Pilot Program focus is also evolving in this direction as the recently launched Federal Urban Partnership Agreement Program under the FHWA's Congestion Initiative launched in 2006 has promoted comprehensive programs with wide area and network coverage. The comprehensive programs promise to address area or region-wide congestion, generate large revenues and provide more substantial environmental benefits. Further expansion to cross state programs and continued attention to pricing in the larger role of national highway finance are potential future directions.

Programs aimed at making fixed costs of driving variable are generating interest and variable VMT fees are beginning to be debated as a possible future replacement of per-gallon fuel taxes for financing transportation funding needs. The experimental pilot projects demonstrate the possibility of employing mileage-based pricing and fee structures at a region wide or statewide level. Rich lessons from the pilots to date will aid long-term planning and policy making in areas considering implementing such systems, however much depends on viable technological and business models, new public policy as well as public acceptance and knowledge of concepts. Importantly, these programs show that the mileage fee could be paid at the pump, with minimal difference in process or administration for motorists, compared to how they pay the gas tax. Planners and policy makers at the local, state and national level can look forward to continued progress in developing these new alternatives.

- *Much Remains to be Learned*

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. Long-run impacts on land use, auto ownership, business and productivity need to be monitored over time. Continued progress in implementing acceptable, effective and ultimately informative pricing programs 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. Several models for effective and workable ways to proceed are shown in this report.

The Federal Congestion and Value Pricing Pilot Programs have played an important supportive role in the evolution of interest in pricing solutions to traffic congestion problems. The framework provided by the Federal Pricing Programs has helped to bring together state and local interests and the research community of universities, think tanks and consulting firms to move pricing forward and ensure programs are properly evaluated. It is now easier for State and local leaders to introduce these relatively new approaches for dealing with congestion and related problems. The Pricing Programs have also played a valuable supporting role by facilitating information exchange and sharing of experience among interested parties, providing direct technical assistance on many aspects of project design, implementation and evaluation.

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. Yet, despite this potential, the concept of value pricing remains controversial in many potential applications. It involves a new approach to dealing with congestion problems and charging for road use. However, public reactions to all pilot programs demonstrate favorable outcomes are possible with careful and inclusive planning and outreach. The future federal pricing programs have an important role to play in assisting state and local governments in testing, adopting and evaluating the latest pricing concepts, technologies and operational programs.

Planning For The Future

The experience over the past 17 years provides a valuable guide to planners in exploring the feasibility of future pricing applications and identifying projects for implementation.

A particularly important consideration in assessing pricing options and their equity implications is the use of revenues generated by value pricing tolls. Toll revenues can be used to compensate those who might otherwise consider themselves “losers” as a result of value pricing. Compensation can come in a variety of forms, including financing of highway improvements (particularly in the corridor where the tolls are levied), improvements in transit service, or, in cases where effects on low-income drivers are felt to be particularly severe, toll rebates to eligible drivers. Each of these approaches have been used or considered for use in pricing programs. Operating pricing programs can also help increase public awareness of the often overlooked fairness aspect of pricing placing the greatest cost burden on those who make the most use of priced facility.

Planners also need to put in more effort to highlight the potential environmental and energy benefits of pricing. While the air quality and energy conservation benefits of small-scale pricing projects implemented to date might be expected to have more modest effects on overall regional environmental quality, such projects could still have

substantial health benefits by reducing localized concentrations of carbon monoxide. Further, any traffic smoothing effects of reduced congestion or positive effects on carpooling and transit use are clearly moves in the direction of improving air quality and reducing energy consumption. For instance, in HOT lane and other facility pricing projects, smoothing of traffic flows could reduce fuel consumption and emissions on priced lanes and perhaps on adjacent general lanes if congestion is reduced because space is freed up by diversion of traffic to the priced lanes. Other environmental influences could result from land use changes associated with priced lanes, but little is known to date about the extent of such influences.

Steps to successful pricing projects

The pricing program has taught the transportation community a few lessons about how to conceptualize, plan, discuss, and carry out a successful pricing project:

Define the problem - Proposals for pricing solutions need to focus on the costs of severe congestion, including traffic delay, air quality problems, accidents, lost productivity, or other locally perceived problems. Proposals need to show how pricing will address these problems, and how pricing compares to alternative potential solutions. The revenue raising aspects of pricing programs are also important considerations and these need to be compared (in terms of revenue productivity, equity, etc.) to more traditional transportation financing approaches.

Take time to include all interests - Pricing is a significant departure from existing practices, and it may have far reaching impacts and necessitate realignment of existing institutional relationships. Several public and private interests and agencies are likely to have a stake in the workings and outcomes of pricing proposals. All these stakeholders and interests need to be involved in project development. This takes time but will make for a much more successful outcome.

Consider a full range of alternatives - Pricing should be viewed in the context of a range of strategies for addressing congestion and related problems. Alternative applications of pricing should be considered and an incremental strategy with continuous evaluation and potential broader applications should be contemplated.

Carefully attend to the estimation of impacts - The estimation of a variety of potential impacts of pricing is both difficult and essential. Impact estimation difficulties stem from the lack of experience with road pricing and limitations of forecasting tools. Fortunately, as findings summarized here indicate, impacts of pricing strategies are documented and can aid planners and local decision makers in estimating potential ranges of impacts.

Introduce pricing as a part of a package - Alternative travel mode enhancements and travel demand management programs should be considered along with pricing. Alternative uses of pricing revenues should be proposed and assessed.

Focus on customer relations - Public outreach and education have been a critical determinant of acceptance of pricing programs by public and decision makers. Focus groups, public opinion surveys and media campaigns have all contributed to project successes and should be attended to all through planning, implementation and evaluation of future pricing programs.

(Blank Page)

5. Appendix A: References And Resources

VPPP Project References

Information sources for the selected VPPP case study projects included in this report are listed under each project summary table in Appendix B.

Other Selected Documents

Berg, J. T., Kawada, K., Burris, M., Swenson, C., Smith, L. and Sullivan, E. (1999), Value Pricing Pilot Program. TR News 204, 3-10.

Berg, J.T. (2003) "Listening to the Public: Assessing Public Opinion about Value Pricing,", State and Local Policy Program, Humphrey Institute of Public Affairs, University of Minnesota, Minneapolis, MN.

Bhatt, Kiran (2006), "Road Pricing Experience and Lessons", Proceedings of the Fifth ICTTS Conference, X'ian, China, 2006.

Bhatt, Kiran (2008). "Road User Pricing in the United States: Experience and Lessons", A Report Prepared for the Institute for Transportation Studies, University of Leeds & The CURAĆAO Project, February 2008.

Burris, M. W., Pendyala, R. M., and Swenson, C (2002), Discrete Choice Models of Traveler Participation in Differential Time of Day Pricing Programs. Transportation Research Board 81st Annual Meeting, Preprint Paper No. 02-2088. Washington, D.C.

Burris, M, Swenson, C. and Crawford, G. (2002). Lee County's Variable Pricing Project. ITE Journal 72, 36-41.

Burris, M, and Appiah, J. (2004), An Examination of Houston's QuickRide Participants by Frequency of QuickRide Usage, Texas Department of Transportation.

Cervero, R. and Tsai, Y. (2003). San Francisco City CarShare: Second Year Travel Demand and Car Ownership Impacts, http://knowledge.fhwa.dot.gov/cops/

Deakin, E (1994), "Urban Transportation Congestion Pricing: Effects On Urban Form." Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion. Special Report 242, Vol. 2. Transportation Research Board, Washington, D.C.

Deakin, E. and Harvey, G. et al (1996). "Transportation Pricing Strategies for California: An Assessment of Congestion, Emissions, Energy and Equity Impacts," California Air Resources Board, Nov. 1996.

DeCorla-Souza, P. (2000), FAIR Lanes: A New Approach to Managing Traffic Congestion. ITS Quarterly 8, 5-13.

DeCorla-Souza, P. (2004), A New Public-Private Partnership Model for Road Pricing Implementation. To be presented at the Annual Meeting of the Transportation Research Forum in March 2005.

DeCorla-Souza, P. (2004), FAIR Highway Networks: A New Approach to Eliminate Congestion on Metropolitan Freeways. Public Works Management and Policy. Scheduled for publication in the January 2005 issue.

DeCorla-Souza, P., Lee, S., Jacobs, A., and Bhatt, K. (2005), "Lessons Learned From The Value Pricing Pilot Program", 75th Annual Meeting of the Institute of Transportation Engineers, Melbourne, Australia, August 2005.

Evans, J., Bhatt, K., and Turnbull, K. (2003), Traveler Response to Transportation System Changes, Chapter 14 – Road Value Pricing, TCRP Report 95, TRB, Washington D.C.

Federal Highway Administration (1998), Report to Congress: Reducing Traffic Congestion Using Market Prices to Enhance Mobility, U. S. Department of Transportation, Washington, D.C.

Federal Highway Administration (2006), Value Pricing Pilot Program Project Reports, http://www.fhwa.dot.gov/policy/otps/valuepricing.htm.

Federal Highway Administration (Quarterly), Value Pricing Pilot Program Projects Quarterly Reports, U. S. Department of Transportation, Washington, D.C.

Giuliano, G (1994), "Equity and Fairness Considerations of Congestion Pricing." Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion. Special Report 242, Vol. 2. Transportation Research Board, Washington, D.C.

Guensler, R, Dunning, A, Amekudzi, J. Ogle, and J. Swanson (2004), Privacy Issues in Instrumented Vehicle Research, Submitted for consideration for publication in Transportation Policy.

Guensler, R., and Sperling, D (1994), "Congestion Pricing and Motor Vehicle Emissions: An Initial Review." Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion. Special Report 242, Vol. 2. Transportation Research Board, Washington, D.C.

Higgins, T. J. (1997) "Congestion Pricing: the Public Polling Perspective," Washington, D.C., Transportation Research Board.

Holguín-Veras, J, and Ozbay, K. (2004), Evaluation Study of the Port Authority of New York and New Jersey's Value Pricing Initiative. Draft Final Report, November 5, 2004.

Illinois State Toll Highway Authority (2005), Press Release 03-Jan-05 and 10-Feb-05, http://www.illinoistollway.com.

Ison Stephen (2004). Road User Charging: Issues and Policies, Ashgate Publishing Company, Burlington, Vermont.

Jacobs Angela (2005), "International Perspectives on Road Pricing", International Symposium on Road Pricing (2003) Conference Proceedings 34, Transportation Research Board, Washington, D.C.

K.T. Analytics, Inc. (1996). "Congestion Pricing: Guidelines for Project Development, Revised Interim Report," For Federal Highway Administration, U.S. Department of Transportation, Washington, D.C.

Litman, T. (1997), Distance-Based Vehicle Insurance as a TDM Strategy, Transportation Quarterly 51, 119-138.

Metropolitan Washington Council of Governments (2003), "Qualitative Analysis of the Potential Regional Air Quality Impacts of HOT Lanes on the Capital Beltway in Virginia", MWCOG, Washington D.C.

Munnich L. W., Jr., and K. R. Buckeye (2007), "I-394 MnPASS High-Occupancy Toll Lanes: Planning and Operational Issues and Outcomes (Lessons Learned in Year 1)". In Transportation Research Record No. 1996, Transportation Research Board, National research Council, Washington, D.C., 2007.

Muriello, M. and Jiji, D. (2003). The Value Pricing Toll Program at the Port Authority of New York & New Jersey: Revenue for Transportation Investment and Incentives for Traffic Management, Paper No.04-3116, presented at the 83rd Annual Meeting of the Transportation Research Board, Washington DC, January 11-15 2004, available on the CD-ROM of the Annual Meeting.

New Jersey Turnpike Authority (2003), First Consolidated Toll Road Annual Report 2003, http://www.state.nj.us/turnpike/03arfull.pdf.

Parsons Brinckerhoff, K.T. Analytics, Howard/Stein –Hudson Associates and Sarah J. Siwek & Associates 2002. "A General Framework for Evaluating the Potential of Value Pricing and its Impacts in New Jersey: Final report", Prepared for New Jersey Department of Transportation.

Poole, Robert W. and C. Kenneth Orski (2003). HOT Networks: A New Plan for Congestion Relief and Better Transit. Reason Public Policy Institute, Policy Study No.305.

Regan, E (2002), I-15 Managed Lanes Expansion Program: Public Opinion Research, Presentation to the Pricing Subcommittee meeting, 81st Annual Transportation Research Board Meeting, Washington, D.C.

Replogle, Michael and David Reinke (1998). "Estimating the Effects of Transportation Pricing Policies on Travel behavior: Current Techniques and Future Directions", Presented to the Pricing Committee, Transportation Research Board 77th Annual Meeting, Washington D.C.

Resource Systems Group (2003), Illinois Tollway Value Pricing Focus Group Summary Report. November 2003.

Schade, J. and Schlag B., editors (2004), Acceptability of Transportation Pricing Strategies, Elsevier Science, Inc., usbkinfo@elsevier.com.

Small, Kenneth A (2005), "Road Pricing and Public Transit: Unnoticed Lessons from London," Access, No. 26, Spring 2005.

State & Local policy program (1996), Buying Time: Final report, Institutional and Political Issues of Congestion Pricing. Hubert Humphrey Institute of Public Affairs, University of Minnesota: Section 5.

Sullivan, Edward. (2000). Continuation Study to Evaluate the Impacts of the SR 91 Value-Priced Express Lanes. Final Report. December 2000. Cal Poly State University, San Luis Obispo, CA 93407.

Sullivan, E. C (2002), Updated Observations from the State Route 91 Value Priced Express Lanes, 81st Annual Transportation Research Board Meeting, Preprint Paper No. 02-2554. Washington, DC (2002).

Transportation Research Board (1994), "Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion. Special Report 242, Vol. 1 and 2. Transportation Research Board, Washington, D.C.

Transport for London (2007), "Central London Congestion Charging: Impacts Monitoring," Fifth Annual Report, July 2007.

Wilbur Smith Associates (2002). I-15 Managed Lanes Value Pricing Project Planning Study: Volume 2 Public Outreach, San Diego Association of Governments. January 21, 2002. http://argo.sandag.org/fastrak/pdfs/concept_plan_vol2.pdf

University of Leeds (2007), "State of the Art Report", Draft Report Prepared By University of Leeds, U.K. for the EC CURAĆAO Project: Coordination of Urban Road User Charging and Organisational (sic.) Issues.

U.S. Department of Transportation (2003), A guide for HOT Lane Development, Parsons Brinckerhoff, Texas Transportation Institute and Federal Highway Administration, Washington D.C.

U.S. Department of Transportation (2006), Congestion Pricing: A Primer, Office of Transportation Management, Federal Highway Administration, Washington D.C.

U.S. Environmental Protection Agency (1998), "Technical Methods for Analyzing Pricing Measures to Reduce Transportation Emissions." Washington, D.C.

Wachs, M (1994), "Committee Report and Recommendations." Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion. Special Report 242, Vol. 2. Transportation Research Board, Washington, DC (1994).

Yan, J, Small, K. A, and Sullivan, E. C (2002), Choice Models of Route, Occupancy and Time-of-Day with Value Priced Tolls, Transportation Research Board 81st Annual Meeting, Preprint Paper No. 02-2617. Washington, D.C.

Zmud, Johanna (2007) "The Public Supports Pricing If...: A Synthesis of Public Opinion Studies on Tolling and Road Pricing," NuStats, Austin, Texas.

Additional Bibliographic Resources

Transportation Research Board (2001-2008), Compendium of Papers CD- and DVD-ROMs, Pre-prints of Peer-reviewed Papers Including Documents on Road Pricing, TRB 80th – 87th Annual Meetings, Washington D.C.

Transportation Research Board (2003-2008), Value Pricing Related Papers Published by the TRB, Transportation Research Records: 1839, 1864, 1932, 1960, 1996, 2003 and 2010, Washington D.C.

Other Web Resources

FHWA, Office of Operations, Value Pricing Program Information: http://ops.fhwa.dot.gov/tolling_pricing/value_pricing/index.htm

FHWA, Highway Community Exchange Knowledge Sharing: http://knowledge.fhwa.dot.gov/ (Click “Highway Community Exchange” link and then “Value Pricing” link)

U.S. Department of Transportation, Congestion Initiative and Urban Partnership Agreement (UPA) Program Information: www.fightgridlocknow.gov

Humphrey Institute (University of Minnesota) Value Pricing Program Information Site: www.valuepricing.org

Transportation Research Board, Congestion Pricing Committee Site: www.trb-pricing.org

(Blank Page)

6. Appendix B: Vppp Case Study Project Summaries

- Appendix-B (Vppp Project Summary Tables) Is Bound Separately
- A Short Introduction And Project Summary Matrix Template Are Included Below

Introduction

The U.S. Department of Transportation (USDOT) has commissioned a Lessons Learned Report summarizing findings to date from Federal Highway Administration's (FHWA) Value Pricing Pilot Program projects. The report is intended to assist program managers within the USDOT in continuing support and oversight of value pricing projects within the United States. The report is also designed to assist state and local decision-makers, value pricing practitioners, and transportation planners in developing pricing programs to reduce congestion on the nation's roadways. Finally, the report will provide the basis for a biennial report to the United States Senate and House of Representatives on the status of the Value Pricing Pilot Program. "Lessons" are defined as conclusions and implications supported by a synthesis of evidence in available, published evaluation reports associated with selected projects. While a single project may provide unique insights, only a confluence of findings across projects is likely to serve as the basis of robust lessons and conclusions.

Project Summary Tables

The Appendix includes summaries and key findings from selected congestion and value pricing pilot projects sponsored under the federal pricing pilot programs over the past 17 years. Twenty-four summaries are presented covering the primary project categories and encompassing the range of project types categorized in the FHWA Value Pricing Pilot Project Quarterly Reports. Some of the projects are feasibility or pre-implementation studies; others entail fully implemented and evaluated programs; others are experimental pricing trials. The Twenty-four summaries presented are a selection from all the pricing projects that have been funded or granted authority to toll through the program. These case studies were selected for a variety of reasons, including: variety of project type; depth and breadth of available evaluation material; range of relevant project experiences and outcomes; range of success or failure along key implementation and outcome variables, and; variation in location across the U.S. The twenty-four case studies presented here are organized under the appropriate FHWA project categories and do not appear in any particular order.

Each project summary is presented according to the matrix described below:

Pricing Project Category	**Name and location of project**

Operations	**Details of program or study, including:** • Description of participating agencies, pricing mechanisms, enforcement, operational details, project management, advisory committee presence. • Phasing of project or operational changes, e.g. development into managed lane, revised fees, variable introductions, and technology.
Cost, Finance, and Revenue	**Reports any financial details included in projects, including:** • VPPP grant monies awarded to project. • Cost and revenue information, and when available, breakdown by operations, equipment, enforcement, etc. • Relevant legislation pertaining to surplus revenue distribution, designated support of alternative modes, earmarks, etc.
Policy and Institutional	**Indicates key institutional and legislative aspects of projects, including:** • Enabling policies and legislation with key provisions, e.g. free flow in HOT lane. • Operational requirements for public involvement, transparency, profit distribution, environmental justice, reporting, sunset, etc.
Outreach and Acceptance	**Outlines the extent of public engagement efforts and reports results, including**: • Formation of public processes, e.g. key actor or champion roles, workshops, surveys, hearings, focus groups, etc. • Ongoing efforts, e.g. newsletters, hot line media or customer relations. • Public opinion or media reactions, e.g. hearings, customer service tracking, and any program changes resulting.
Technology	**Introduces types of, and experiences with, technology in projects, including:** • Pricing system, e.g. transponders, readers, driver signs, dynamic vs. other. • Operational performance, accuracy, failures, functioning MOEs.
Equity and Environmental	**Examines impacts, costs, and benefits of study or project, including:** • Emissions impacts from traffic or user surveys. • Low-income group impacts from surveys, benefit-cost or economic studies. • Business, land use, or other interest group impacts, per evaluation.
Impacts	**Reports quantitative and qualitative findings of study or project, including:** • Traffic (volumes, VMT, delay, LOS, speed, general purpose lanes, surface streets, diversion, etc.) • Mode share (HOV, transit, PAR impacts.) • Violations (SOV, HOV citations, observation results.) • Users perceptions (travel time, on time arrival, safety) and affected party perceptions (e.g. business, low income.)
Evaluation	**Methodology, limitations and strengths of evaluation completed.** • Evaluation framework, e.g. traffic studies, user panels, business, land use, air quality, equity assessments, acceptance, or phases over time. • Evaluation manager, i.e. agency, independent contractor, or other. • Evaluation particulars including use of controls, survey sample sizes, response rates, means of evaluating difficult impacts, e.g. businesses.

The project summaries are organized under six broad pricing concept categories:

- HOT Lane Conversions With Pricing
- Variable Pricing of New Express Lanes
- Variable Pricing on Existing Toll Facilities
- Regionwide Variable Pricing Initiatives
- Making Driver Costs Variable
- Other Pricing Projects

(Blank Page)

final report

Value Pricing Pilot Program: Lessons Learned

Appendix B: VPPP Project Summaries

August 2008

prepared for

U.S. Department of Transportation,
Federal Highway Administration

prepared by

K.T. Analytics, Inc.
6304 Haviland Drive
Bethesda, Maryland 20817

Cambridge Systematics, Inc.
100 Cambridge Park Drive, Suite 400
Cambridge, Massachusetts 02140

Table of Contents

List of Tables

Executive Summary

LESSONS LEARNED REPORT

The "Lessons Learned Report" provides a summary of projects sponsored by FHWA's Congestion and Value Pricing Pilot Programs from 1991 through 2006 and draws lessons from a sample of projects with the richest and most relevant experience across selected project categories.

Since inception of Pricing Pilot Program in 1991, over 75 pricing projects have been funded by FHWA. More than a dozen operational projects are providing important findings regarding traffic and congestion impacts, transportation funding issues, public acceptability, administrative matters and future prospects for addressing congestion using various pricing strategies. In addition, useful information and valuable lessons have been provided by project feasibility studies and by pricing projects that did not progress to implementation or exhibited unexpected outcomes.

This report aims to synthesize the experience from the projects in the federal pricing programs regarding effectiveness at meeting their objectives and the political and technical aspects related to implementation.

VPPP CASE STUDY PROJECT SUMMARIES

The following set of Case Studies summarizes key findings from past congestion and value pricing pilot projects. Twenty-four summaries are presented covering the primary project categories and encompassing the range of project types categorized in the FHWA Value Pricing Pilot Project Quarterly Reports. Some of the projects are feasibility or pre-implementation studies; others entail fully implemented and evaluated programs; others are experimental pricing trials. The 24 summaries presented are a selection from all the pricing projects that have been funded or granted authority to toll through the program. These case studies were selected for a variety of reasons, including: variety of project type; depth and breadth of available evaluation material; range of relevant project experiences and outcomes; range of success or failure along key implementation and outcome variables, and; variation in location across the United States. The 24 case studies presented here are organized under the appropriate FHWA project categories and do not appear in any particular order.

Each case study is summarized according to the matrix described below in Table ES.1:

Table ES.1 Name and Location of Project

Pricing Project Category	Name and Location of Project
Operations	• Details of program or study, including: – Description of participating agencies, pricing mechanisms, enforcement, operational details, project management, advisory committee presence. – Phasing of project or operational changes, e.g., development into managed lane, revised fees, variable introductions, technology.
Cost, Finance, and Revenue	• Reports any financial details included in projects, including: – VPPP grant monies awarded to project. – Cost and revenue information, and when available, breakdown by operations, equipment, enforcement, etc. – Relevant legislation pertaining to surplus revenue distribution, designated support of alternative modes, earmarks, etc.
Policy and Institutional	• Indicates key institutional and legislative aspects of projects, including: – Enabling policies and legislation with key provisions, e.g., free flow in HOT lane. – Operational requirements for public involvement, transparency, profit distribution, environmental justice, reporting, sunset, etc.
Outreach and Acceptance	• Outlines the extent of public engagement efforts and reports results, including: – Formation of public processes, e.g., key actor or champion roles, workshops, surveys, hearings, focus groups, etc. – Ongoing efforts, e.g., newsletters, hot line media or customer relations. – Public opinion or media reactions, e.g., hearings, customer service tracking, and any program changes resulting.
Technology	• Introduces types of, and experiences with, technology in projects, including: – Pricing system, e.g., transponders, readers, driver signs, dynamic versus other. – Operational performance, accuracy, failures, functioning MOEs.
Equity and Environmental	• Examines impacts, costs, and benefits of study or project, including: – Emissions impacts from traffic or user surveys. – Low-income group impacts from surveys, benefit/cost or economic studies. – Business, land use, or other interest group impacts, per evaluation.
Impacts	• Reports quantitative and qualitative findings of study or project, including: – Traffic (volumes, VMT, delay, LOS, speed, general purpose lanes, surface streets, diversion, etc.). – Mode share (HOV, transit, P&R impacts). – Violations (SOV, HOV citations, observation results). – Users perceptions (travel time, on time arrival, safety) and affected party perceptions (e.g., business, low-income).
Evaluation	• Methodology, limitations and strengths of evaluation completed: – Evaluation framework, e.g., traffic studies, user panels, business, land use, air quality, equity assessments, acceptance, or phases over time. – Evaluation manager, i.e., agency, independent contractor, or other. – Evaluation particulars of interest, e.g., use of controls, survey sample sizes, response rates, means of evaluating difficult impacts, e.g., businesses.

1.0 HOT Lane Conversions with Pricing

Table 1.1 HOT Lanes on I-15 in San Diego

HOT Lane Conversions	HOT Lanes on I-15 in San Diego
Operations	• Located on 8-mile (13-kilometer) two reversible lanes in the freeway median between the junction of I-15/State Route (SR) 163 south end and I-15/SR 56 junction north end. The project converted underutilized HOV lanes to HOT lanes; allowing solo drivers to "buy in" to the HOV lanes. The project currently is being expanded to 28-mile managed lane system with moveable barriers and reversible lanes a.m. to p.m. peaks. • Phase I started in 1996 using paper windshield permit test system (ExpressPass); go to electronic toll in 1997; limited to 500 monthly permits ($50) at start, then 1,000 monthly permits ($70). • Phase II began in March 1998, with per-trip fee adjusted dynamically based on time of day and traffic levels ($0.50 to $4 per trip, up to $8 maximum). • At beginning of Phase II, there were 1,497 FasTrak™ transponder accounts, by end of 1999, there were 11,091 transponder accounts. The number has now crossed 20,000. This was the first use of dynamic pricing in the World. • SANDAG MPO is lead agency; CHP enforces; Metropolitan Transit Development Board (MTDB) provides transit; private consultants for planning, technical assistance, provision/management of electronic tolls, violation enforcement system, and customer services. • Project Management Team (PMT): SANDAG, Caltrans, FHWA, FTA, CHP, MTDB, Mayor's representative, City of Poway, AAA; advises project. • The SOV/FasTrak-only lane at the toll zone was removed in July 1999 due to customer complaints about difficult merge conditions in/out of third lane. • Tolls were lowered in the peak shoulders on August 31, 1998, to encourage more off-peak and less peak use. • The expansion of an alternate route (SR 56) reduced I-15 corridor demand, resulting in less SOV/FasTrak usage of the I-15 lanes and corresponding reduced program revenues. As a result and in response to low overall tolls-per-transponder usage, in March 2007, SANDAG Board assessed new account management fee of $3.50 and $1 per transponder fee, less tolls. The fees are waived if the customer uses the toll lanes during the month on a dollar for dollar basis, so accounts spending >$4.50/mo with 1 tag pay only the toll and no fees. • The facility was initially open only during peaks on weekdays. Eventually, due to public demand, hours were extended and weekends added. • I-15 HOT lanes are being extended to 20 miles in the median of Interstate 15 (I-15) between SR 163 and SR 78; plans call for four-lanes in the median, moveable barrier, multiple access points, direct access ramps for buses and eventual bus rapid transit (BRT); pricing to be dynamic based on congestion and distance traveled; new system to open in stages: first, an 8-mile, 4-lane extension of managed lanes between SR 56/Ted Williams Parkway and Center City Parkway in the City of Escondido; later, 4-mile extension north of Center City Parkway to SR 78; and the widening to four lanes of the existing two-lane reversible lanes between SR 163 and SR 56; BRT through five stations; new tolling system at 41 locations.

HOT Lane Conversions	HOT Lanes on I-15 in San Diego
Cost/Finance/Revenue	• Enabling state legislation requires toll revenues remaining after operational and enforcement costs go to "transit and HOV services"; also limits SANDAG to 3 percent of total revenues for planning and administration. • Phases I and II revenue: daily revenues from 5K to 8K from 1999-2001. • Operation and management of the I-15 FasTrak program currently costs SANDAG approximately $100,000 per month; about $64,000 per month goes to the toll operator; remaining $36,000 per month for life-cycle costs for minor equipment, transponder replacements, enforcement, other directs. • $100,000 per month program costs on more than 19,000 accounts implies costs of about $5 per account per month. • Since 1997, the FasTrak program has provided more than $7 million in funding for transit service in the I-15 corridor; with recent revenue decline, service could be jeopardized. More recently, I-15 has added an account maintenance fee and transponder fee to cope with declining accounts and revenues apparently due to the opening of an alternate route (SR 56).
Policy/Institutional	• SANDAG Board policy adopted (No. 91-65) test of allowing solo drivers to use facility at variable rates with revenues to increase transit in the corridor. • State legislation (Assembly Bill 713), authored and sponsored by concept champion Jan Goldsmith, made law in 1994 to permit SOV use of HOV, requiring free-flow of HOVs (LOS C) at all times. • Environmental Justice requirements (Executive Order 12898) required initial outreach, public involvement across income groups.
Outreach/Acceptance	• Formed in good part because of champion for concept Mayor (and then Assemblyman) Jan Goldsmith. • Phase I (1999): public workshops and postcard mailing did not gain much attention, but no controversy; focus groups helped form project; media coverage generally confined to information versus opinion. • Phase II (2001): both print and electronic media coverage "informative, balanced, timely, and accurate" throughout project. • Continuous information from management (25 marketing events, customer newsletter, hot line) and responsiveness characterize program: negative comments about the merging into the FasTrak-only lane led to change; CHP increased enforcement after violation complaints; extended hours of operation in response to suggestion. • As part of developing a 20-mile "managed lanes" extension of the original HOT lane project, as assessment of stakeholders and commuters found strong support for the original program and planned expansion; e.g., a telephone survey of 600 main lane users and 200 transponder-owners found a majority of the respondents expressed approval of the FasTrak program, 92 percent like a time saving option on I-15 and 84 percent of the respondents said they favored the managed lanes extension. • Same telephone survey found just 2 percent knew that FasTrak tolls fund transit and most preferred revenues go to maintaining/improving regular or express lanes on I-15 or all San Diego freeways.

HOT Lane Conversions	HOT Lanes on I-15 in San Diego
Technology	• Phase I began with colored permits to solo drivers (ExpressPass). • Phase II used windshield-mounted transponders (FasTrak) and began with a third FasTrak-only lane, (AVI) system, including overhead antennae, readers, and vehicle detectors imbedded in the Express Lanes, giving traffic levels in 6-minute increments, level of service and program user information. • In Phase 1 (1999), start up loop detector equipment failed to operate for 10 percent of the time, AVI equipment not functioning 12 percent of time. • Managed lanes plans for future will rely on existing transponder and reader radio communications; (HOVs – 2+) to travel free with no transponder required. • The program has not had automated enforcement capability. This probably has hindered enforcement and possibly resulted in violations/uncollected revenue.
Equity/Environment	• Phase I (1999) air quality: not improved; "increased vehicle speeds resulted in subsequent increases in most pollutants." • Phases I and II (2001): emissions up for both I-15 and control corridor; 3-5 times more for control (a.m. to p.m. peak, respectively); speculation about possible diversion of some traffic from mixed flow to pay lane as the cause of lower increase on I-15, but not compelling conclusion as changes in speeds and vehicle types compound picture. • Phases I and II (2001): equity issue of possible elitism, effects on the poor and new paying for road use appeared only during the first year of the project and rarely during the second year. • Phases I and II (2001) I-15 residents significantly more likely than I-8 control to say ExpressPass/FasTrak are factors in recent housing decision, but other factors (e.g., school and work proximity) far more important; conclusions less strong due to different demographics between corridors. • As part of developing a 20-mile "managed lanes" extension of the original HOT lane project, a telephone survey of facility users found 71 percent consider the extension fair to regular lane users (71 percent) and Managed Lane users (75 percent); very few differences in attitudes about the fairness of the lanes found based on ethnicity or income; however, half of respondents said tolling of SOV drivers was unfair double taxation (FasTrak customers less so than other corridor users).
Impacts Phase I – Paper Permit, Monthly Unlimited Use Fee	• Baseline situation: HOV lane beginning in 1988 underutilized: only 600 vehicles per hour per lane at peak while mixed flow lanes heavily congested. • Traffic: significant increase in HOVs; gradual increase in ExpressPass vehicles; better utilization of the facility; LOS C maintained in express lanes; no significant reduction in main lanes (fall 1996 to fall 1997). • Violations: significant reduction in SOV violators in ExpressLanes, maybe due to more enforcement and some violators buying passes. • P&R: lot utilization steady, but declining on I-8 corridor (no HOV lane). • Perceptions of users: users satisfied with reduction in travel time, more on time arrival, improved safety, while HOVs not negative; survey of businesses perceptions shows most not aware or no opinion about business impact, but those most dependent on corridor more likely say positive impact; stakeholder interviews show positive opinions.

HOT Lane Conversions	HOT Lanes on I-15 in San Diego
Impacts Phases I and II Combined – From Permit to AVI, Dynamic Per Use Fee	• Use: across both phases, average daily volume on Express Lanes increased by approximately 125 vehicles per month; "by the end of 1999, the Express Lanes were much better utilized than before the start of the project." • Carpools: HOVs increased during the ExpressPass phase by about 81 vehicles per month, then declined during the FasTrak phase by about 27 vehicles per month; but volumes during FasTrak still were greater than before project (1996); overall, while SOV increased a.m. peak from 1996 to 1999, HOV volume fell; pricing may be responsible, as there was a rise in HOV volume along I-8 from 1997 to 1999, though differences in demographics and growth between the corridors clouds picture; importantly, Panel Study interviews with HOVs shows an increase in carpooling from spring 1998 to spring 1999, and no change in carpooling between the last panel waves 1998 and 1999; no supporting for lots of FasTrak customers drawn from former carpoolers; and, the majority of carpoolers did not feel adversely impacted by the FasTrak program. • Impact on mixed flow lanes: peak volumes "slightly" decreased comparing 1999 to pre-project, 1996, while increased on I-8 main lanes (no HOV lanes); difference with I-8 trend is significant, but given noncomparable corridors, not definitive. • Violations: "violations higher during the FasTrak phase than during the ExpressPass phase, yet smaller than in pre-project period." • Level of service: (LOS) C was sustained at virtually all times in price lanes. • Travel time: from 1997 to 1999, average travel times increased more along I-15 than along I-8, perhaps because of stronger commercial and residential development along I-15; uncertain result. • Ramp and overall delay: FasTrak users save about 16 minutes during most congest times avoiding the on-ramp to the main lanes; combining savings at ramps and main lane at worst times, save up to 20 minutes. • Park-and-Ride: control corridor (I-8) has no HOV lane, so comparison not meaningful; but, no significant decline in PAR lot use along I-15. • Transit: bus ridership in the I-15 corridor increased about nine percent from fall 1996 to fall 1999, compared to 23 percent increase over region, so some overall growth at work; new Inland Breeze main part of increase in corridor, though most riders used another bus prior to the Inland Breeze. • Perceptions of users, business, stakeholders: potential elitist character of the project and price concerns appeared only during the first year of the project and rarely during the second year; businesses have slight preference for monthly ExpressPass system allowing unlimited use versus per use FasTrak.
Evaluation	• Traffic study evaluated volumes, modes, speeds, travel times, violations. • Attitudinal Panel Study surveyed 1,500 individuals every six months from three different commuter groups. • SDSU was evaluation contractor; collected five waves of data in fall 1997, spring, fall 1998, and spring, fall 1999; pre project data included vehicle class, occupancy, violation data gathered by Wilbur Smith Associates (October 1996); traffic and incident data from Caltrans for 1988-1996. • Evaluation also assessed possible changes in air quality, cost of delay, business impacts, bus ridership, land use, park-and-ride lot occupancy, public acceptance, media response, marketing and institutional issues. • I-8 corridor used as control gives added but not definitive confidence to conclusions; I-8 has no carpool lanes, carries less traffic than I-15, has better traffic conditions; commuters are lower socioeconomic and more balanced gender makeup; development patterns also are different. • Business impacts measured by telephone (I-15, I-8, downtown compared) subject to small sample and low response rate; no attempt to examine tax revenues.

Sources:

From SANDAG web site: http://fastrak.sandag.org/pdfs/i-15.pdf.

Phase 1 Overview:

I-15 CONGESTION PRICING PROJECT, MONITORING AND EVALUATION SERVICES

PHASE I: OVERALL REPORT By Janusz Supernak, San Diego State University; Jacqueline Golob

Jacqueline Golob Associates; Tom Golob. University of California, Irvine; Christine Kaschade

San Diego State University; Eric N. Schreffler, ESTC; Camilla Kazimi, San Diego State University; March 17, 1999.

From SANDAG web site, Phase II Overview:

http://fastrak.sandag.org/pdfs/yr3_overall.pdf.

I-15 CONGESTION PRICING PROJECT, MONITORING AND EVALUATION SERVICES, TASK 13

PHASE II YEAR THREE OVERALL REPORT By Janusz Supernak, San Diego State University; Jacqueline Golob, Jacqueline Golob Associates; Thomas F. Golob, University of California, Irvine; Christine Kaschade, San Diego State University, Camilla Kazimi, San Diego State University; Eric Schreffler, Eric N. Schreffler, Transportation Consultant; Duane Steffey, San Diego State University, September 24, 2001.

Business, Phase II: http://fastrak.sandag.org/pdfs/yr3_business.pdf.

For revenues, see: I-15 Managed Lane Value Pricing Study, volume 1, for SANDAG, by Wilbur Smith Associates, FPL and Associates; Judith Norman Transportation Consultant; Fairfax Research San Diego; Frank Wilson Associates; ESTC, ALESC, February 2002. See http://fastrak.sandag.org/pdfs/concept_plan_vol1_part1.pdf.

PAR Phase II: http://fastrak.sandag.org/pdfs/yr3_parkride.pdf.

Bus Study Phase II: http://fastrak.sandag.org/pdfs/yr3_bus.pdf.

Attitudinal, Perceptions, Phase II: http://fastrak.sandag.org/pdfs/yr3_att_pan.pdf.

Land use, Phase II: http://fastrak.sandag.org/pdfs/yr3_landuse.pdf.

Public outreach, Phase II: http://fastrak.sandag.org/pdfs/concept_plan_vol2.pdf.

Relevant State legislation: Senate Bill No. 313, Chapter 275, An act to amend Section 149.1 of the Streets and Highways Code See: http://fastrak.sandag.org/pdfs/yr3_senatebill.pdf.

Latest cost/revenue issues, possible revised fee structure: http://www.sandag.org/uploads/meetingid/meetingid_1617_6609.pdf.

Relevant excerpt: BOARD OF DIRECTORS AGENDA ITEM NO. 07-03-10

MARCH 23, 2007 ACTION REQUESTED – APPROVE

PROPOSED CHANGES TO OPERATIONS OF

FasTrak PROGRAM File Numbers 6000200/6000201

See Item 10, approximately page 178

For Managed Lanes update, especially regarding enforcement: http://www.sandag.org/programs/transportation/services/2006_i15_ML.pdf.

General Managed Lanes update:

www.sandag.org/uploads/rfpid/RFP_5000680_I_15.pdf.

For Managed Lanes outreach and public acceptance research, see:

I-15 Managed Lanes Value Pricing

Project Planning Study

Community Outreach Program

Wilbur Smith Associates

For SAN DIEGO ASSOCIATION OF GOVERNMENTS

January 21, 2002

Table 1.2 HOT Lanes on I-25/U.S. 36 in Denver, Colorado

<table>
<tr><th>HOT Lane Conversions</th><th>HOT Lanes on I-25/U.S. 36 in Denver, Colorado</th></tr>
<tr><td>Operations</td><td>

A regional study of the feasibility of HOT lanes in Denver concluded that the I-25/ U.S. 36 corridor was the most feasible location for a pilot demonstration of HOT lanes.
The section of interstate south of U.S. 36 to Downtown Denver currently serves nearly 240,000 vehicles a day under heavily congested conditions.
Opened in June 2006, the Downtown Express HOT lanes, consists of a two-lane barrier-separated reversible facility in the median of I-25 between downtown Denver and 70th Avenue (a distance of 6.6 miles), and extends further on U.S. 36 to Pecos Street for a total distance of 7.0 miles.
Lanes are open to southbound traffic from 5:00 a.m. to 10:00 a.m., and by northbound traffic from 12 noon to 3:00 a.m.
The HOT lanes are controlled access and electronic tolling is administered at a single toll collection zone in the 7-mile stretch. At this point HOV and SOV vehicles must separate into marked lanes to declare their eligibility. Buses may use either lane.
Planning, implementation and construction 2001-2005, Operation, study and evaluation period 2006-2010.

</td></tr>
<tr><td>Cost, Finance, and Revenue</td><td>

Total project cost was estimated at $9.0 million. VPPP funding for FY 2002 ($1,721,526) and FY 2003 ($1,078,474) was awarded for implementation of the project.
Toll rates are not dynamically set but are pre-scheduled and vary by time of day and are posted on “static” signs in advance of the entrance to the lanes.
<table>
<tr><th colspan="4">I-25 Time-of-Day HOT Fee Structure</th></tr>
<tr><td>5:00 a.m. to 6:00 a.m.</td><td>$0.50</td><td>12:00 p.m. to 3:00 p.m.</td><td>$0.50</td></tr>
<tr><td>6:00 a.m. to 6:45 a.m.</td><td>$1.75</td><td>3:00 p.m. to 3:30 p.m.</td><td>$1.50</td></tr>
<tr><td>6:45 a.m. to 7:15 a.m.</td><td>$2.75</td><td>3:30 p.m. to 4:30 p.m.</td><td>$2.00</td></tr>
<tr><td>7:15 a.m. to 8:15 a.m.</td><td>$3.25</td><td>4:30 p.m. to 6:00 p.m.</td><td>$3.25</td></tr>
<tr><td>8:15 a.m. to 8:45 a.m.</td><td>$2.75</td><td>6:00 p.m. to 7:00 p.m.</td><td>$1.50</td></tr>
<tr><td>8:45 a.m. to 10:00 a.m.</td><td>$1.25</td><td>7:00 p.m. to 3:00 a.m.</td><td>$0.50</td></tr>
<tr><td>10:00 a.m. to 12:00 p.m.</td><td>Closed</td><td>3:00 a.m. to 5:00 a.m.</td><td>Closed</td></tr>
</table>

Vehicles with four or more axles must pay a flat fee of $18 in addition to the base toll rate.
September 2007 revenues increased with revenue from tolls totaling $188,982 and revenue from fees and fines collected equaling $33,779. Total monthly revenues, including tolls, fees, and fines were $222,762.
The first six months of operations in 2006 yielded approximately $650,000 in toll revenues and $330,000 in revenues from fees and fines. Revenue exceeded expectations and revised estimates of first year toll revenues are between $1.25 million and $1.5 million and revenues from violation fees and fines will approach $600,000.

</td></tr>
</table>

HOT Lane Conversions	HOT Lanes on I-25/U.S. 36 in Denver, Colorado
Policy/Institutional	• Colorado State Statute 42-4-1012, adopted in the 1999 Legislative session, required the Colorado Department of Transportation to convert an existing HOV lane to a HOT lane. • HOT lane excess revenues are permitted, under state law, to be designated to transportation improvements in the corridor, including transit, vanpool, and carpool services. • In 2002, the Colorado General Assembly passed legislation creating the Colorado Tolling Enterprise (CTE), a government-owned, nonprofit business operating within, and as a division of CDOT. The Transportation Commission serves as the Tolling Enterprise Board. The purpose of the CTE is to finance, construct, operate, regulate and maintain a system of toll highways in Colorado.
Outreach/Acceptance	• CDOT's project team completed an extensive outreach and informational campaign to increase public knowledge about HOT lanes on I-25. Among other activities they, conducted interviews with business owners, employers, and commuters in the Denver-area; completed two-meeting panels with 5 focus groups; conducted public meetings with north and northwest Denver area residents; held conversations with the public in open houses; conducted high-visibility intercept open houses in public areas; and completed a stated-preference telephone survey of 350 area residents. • Public opinion research found that: – Support for HOT lanes is greater in 2004 than it was in 2000. In the CDOT Value Express Lanes Feasibility Study conducted from June 1999 through April 2001, there was very little interest or support for HOT Lanes. In 2004, both interest and support was strong due to the perceived decline in regional transportation funding and the possibility of limited funding in the future. – Issues related to income and equity were not as pronounced as anticipated, Out of 21 interviews with opinion setters, only one was completely opposed to the implementation of HOT Lanes. Other respondents had reservations or concerns but were not opposed to them. – Public opinion can be favorably affected when individuals are informed on means of avoiding tolls by carpooling or riding the bus. – HOT lanes were generally viewed as an interim solution that is only one component of a regional multimodal transportation system. Respondents saw the I-25 HOT Lanes project as a demonstrable opportunity to develop clear guidelines for how HOV lanes are to be evaluated and revised over time. It was important to respondents to never lose sight that the purpose of HOV lanes is to promote carpool, vanpool, and transit use.
Technology	• System utilizes EXpressToll transponder that is compatible with existing tolling facilities on E-470 and the Northwest Parkway. Before opening of the I-25 HOT lanes Colorado had over 381,500 EXpressToll transponders in use. • An overhead array interacts with a transponder that is placed on the windshield of the car; the backend technology then uses this information to assess the toll to the user's account. • Vehicles without a transponder are identified with license plate photographs and mailed a fine of $70.
Equity/Environmental	• Public outreach and statistical analysis conducted during the Value Express Lanes Study did not reveal any particular concerns regarding equity or other social impacts. • The pilot program for I-25 is expected to continue to investigate the social and economic effects of value pricing upon the corridor's employment and residential communities as the program evolves over time.

HOT Lane Conversions	HOT Lanes on I-25/U.S. 36 in Denver, Colorado
Impacts	• Approximately one-third of the vehicles traveling in the Express Lanes are toll-paying customers. • By September of 2007 (10 months from opening), approximately 95,000 total vehicles per month were paying to travel in the I-25 Express Lanes. • Preliminary estimates indicate that between 10 to 15 percent of all daily person trips in the 7-mile section occur in the Express Lanes, at full highway speeds, while the adjacent general-purpose lanes experience stop-and-go congestion during the peak periods. • Express bus service utilizing the HOT lanes was on-time 97 percent of the time in September 2007, alleviating concerns that tolled vehicles would degrade transit level of service. • HOT lane toll and HOV violations have increased since implementation, with increases in enforcement activities and stops by Colorado State Highway Patrol.
Evaluation	• Comprehensive evaluation is focusing on traffic and travel impacts, costs and revenue yields and operational issues. • Evaluation is also assessing possible changes in air quality, cost of delay, business impacts, bus ridership, land use, park-and-ride lot occupancy, public acceptance, media response, marketing and institutional issues.

Sources:

Colorado Department of Transportation, *Interstate 25 Value Pricing Implementation Pilot Program Plan*. Proposal to Federal Highway Administration, Value Pricing Pilot Program. October 2001.

http://knowledge.fhwa.dot.gov/cops/hcx.nsf/All+Documents/000ED394C695FE9C85256DC5006A85AD/$FILE/I-25_Proposal_final.pdf.

Ungemah, David; Swisher, Myron; Tighe, Daniel, Transportation Research Board of the National Academies, *Discussing High-Occupancy Toll Lanes with the Denver, Colorado, Public*. Transportation Research Record, Volume 1932, 2005.

Colorado Department of Transportation, *I-25 HOV/Express Lanes: Monthly Progress Report*. Colorado Tolling Enterprise, September 2007.

http://www.dot.state.co.us/cte/expresslanes/SeptemberReport2007.pdf.

Colorado Department of Transportation, I-25 HOV/Tolled Express Lanes Web Site.

http://www.dot.state.co.us/cte/expresslanes/tollmain.cfm.

Table 1.3 HOT Lanes on I-394 in Minnesota

HOT Lane Conversions	HOT Lanes on I-394 in Minnesota
Operations	• Minnesota's High-Occupancy Toll (HOT) lanes were created on I-394 through conversion of existing High-Occupancy Vehicle (HOV) lanes. The HOT lanes are dynamically priced and remain free to buses, HOVs and motorcyclists during peak hours, and are free to all users during off-peak periods. • The MnPASS project goals are to improve the free flow speeds for transit and carpools in the HOT lanes, to improve highway facilities and transit service in corridor, to employ electronic toll collection using transponders and readers, and to pilot new concepts such as dynamic pricing and in-vehicle electronic enforcement. • Beginning in May 2005, HOV lanes from Highway 101 to I-94 in the Minneapolis area were converted to dynamically priced HOT lanes. • There are two sections: the 3-mile east section, closest to downtown, has two reversible lanes that are barrier separated from the general purpose traffic; the 8-mile west section has one lane each direction with double-white stripes separating the HOT lane from the general purpose lane. This was the first case of nonbarrier-separated, "stripe only" HOT lanes in the World. Also, this is the first time dynamic pricing has been introduced on HOT lanes with multiple access/egress points and with a single lane HOT lane section. • By policy, speeds in the MnPASS Lanes must remain above 55 miles per hour, 95 percent of the time. • The HOT lanes operate from 6:00 a.m. to 10:00 a.m. heading into Minneapolis (eastbound) and from 2:00 p.m. to 7:00 p.m. heading out of Minneapolis to the suburbs (westbound). This is consistent with the previous HOV lane operating hours. • Phase I planning, implementation and construction occurred from 2002-2005; operations and evaluation period was from 2005-present. The lanes are still operating.

HOT Lane Conversions	HOT Lanes on I-394 in Minnesota
Cost, Finance, and Revenue	• Total cost of the project was estimated to be $12,982,800. VPPP grant was received in FY 2004 and covered planning, outreach, and education and totaled $925,000. • Minimum toll is set at $0.25 per section and maximum is $8. Typical peak-hour tolls range from $1 to $4. Average toll paid per trip is $1.16. • MnPASS is statewide electronic toll system. Monthly fee for transponder lease is $1.50. • Initial annual gross revenues were estimated at $2 to $2.5 million per year. At maturity, annual revenues of $3 to $3.5 million were expected based on 24-hour operation in both directions. Actual revenue is about half the original estimate due in part to reduced minimum fares and a necessary policy change which allows tolling only in the peak direction. • The original plan was for the HOT lanes to operate all day, however when the lanes opened initially, there was an increase in general purpose lane congestion in the nonpeak direction. This increase in congestion was due to a reduction in general purpose lane capacity since the pre-HOT implementation configuration allowed all vehicles to use the HOV lane in the reverse-peak direction. The public outcry prompted the legislature to force Mn/DOT to change the operating policy. As a result, revenue from the HOT lane operation is considerably less than originally forecast. • A modified toll rate structure was implemented in January 2006 that adjusted the toll rate scale that was applied for different congestion levels. Although the range of possible tolls remained unchanged, this modification typically resulted in higher average tolls ($0.55 to $1.10 average toll) as increases in toll levels were triggered by higher congestion levels. • In September of 2006, the MnPASS lanes were averaging $4,400 a day in toll and fee revenue, which allowed the Express Lanes to meet operating expenses. • First 50 percent of net revenue after capital and operating costs are covered is mandated for transit improvements in corridor, remaining revenue generated can be allocated for corridor improvement.
Policy/Institutional	• February 22, 2001 the Minnesota State Legislature posted Bill H.F. 1054 (Minnesota Session Laws 2001, 1st Special Session, Chapter 8, Article 1, Section, Subdivision 7(c)) mandating that Mn/DOT conduct a study of how opening the High-Occupancy Vehicle (HOV) lanes on I-394 to general-purpose traffic would impact traffic flow and safety. • The project was developed and completed through a public/private partnership involving the State of Minnesota and Wilbur Smith Associates. The contract was a design/build arrangement with the private firm funded 25 percent of the project's cost through in-kind contributions. The private firm did not take any revenue risk.

HOT Lane Conversions	HOT Lanes on I-394 in Minnesota
Outreach/Acceptance	• The I-394 HOT lane was the culmination of more than a decade of attempts to create tolling and pricing projects in the Minneapolis-St. Paul region. An earlier attempt to implement I-394 HOT lanes in the mid 1990s did not move forward. • To advance this project, a I-394 Community Task Force was created of representatives of local elected officials, citizens and community leaders. A comprehensive evaluation plan has been developed and is being implemented to thoroughly understand conditions and public attitudes before and during project operations. • Three focus groups were held before implementation with solo drivers who travel into downtown Minneapolis during peak commuting hours. A fourth focus group was held with carpoolers and the fifth focus group consisted of bus commuters. The participants in the focus groups represented a general cross section of the population from the Twin Cities (mix of age, income, employment, and gender) who commute into or beyond downtown Minneapolis, during peak commuting hours and travel I-394 or an adjacent highway, such as Highway 55 or Highway 7. • A January 2002 survey found that 57 percent of Minnesota drivers supported "having an option of paying a fee to use an uncongested freeway when in a hurry." • A January 2004 Star Tribune survey found that: "…69 percent of Minnesota adults like the idea of paying for new highway lanes with tolls collected from drivers who choose to use them."
Technology	• Tolls vary up to 20 times an hour depending on traffic levels ("density" in the HOT lanes), which are determined with in roadway sensors. • MnPASS drivers need to open a prepaid account with a credit card and then install a transponder to the inside of their vehicle's windshield. • A first in HOT lane enforcement, special transponders in police vehicles are used to track vehicles entering HOT lanes with audible tone indicating that a tolling transponder is valid. Enforcement beacons mounted above roadways also will signal if a transponder is present. Violation fine is assessed at $142. Mobile enforcement readers can validate that transponders were engaged at the previous antenna location. • As of November 2006 findings, enforcement stops totaled 3,300 on the I-394 corridor, 50 percent of stops involved HOV or double white line crossing violations. Violation rates on I-394 are lower than rates on I-35W.
Equity/Environmental	• An evaluation of transit service characteristics in the corridor was completed. • Monitoring conducted by Mn/DOT revealed no adverse CO emissions impacts from implementation of the project. Additional monitoring revealed no significant increases in corridor noise levels. • While higher-income motorists are more likely to have MnPASS transponders and use the lane, drivers of all income levels use the lanes, and the level of support for the option of using the lane for a fee is high among all income levels. Sixty-four percent of I-394 and I-35W corridor residents with incomes below $50,000 support and 21 percent oppose allowing single drivers to use the carpool lanes by paying a fee.

HOT Lane Conversions	HOT Lanes on I-394 in Minnesota
Impacts	• I-394 MnPASS lanes peak-hour volumes increased from 9 to 33 percent between June and December 2005, after implementation of MnPASS. • Despite increases in volume, travel speeds in HOT lanes have not decreased. At the same time, speeds in the general purpose lanes increased from 2 percent to 15 percent during peak rush hours. • Preliminary performance data for I-394 MnPASS for the first six months of operation indicates the following: – Toll trips per week (average): 17,625; – Revenue per week (average): $20,377; and – Toll per trip (average): $1.16. • A technical evaluation of the project released in November 2006 included the following key findings: • Over 10,000 transponders have been leased by users and the average user chooses to pay the MnPASS lane toll about twice a week. • Before and after vehicle volumes through the corridor increased during the peak hour by up to 5 percent. This increase occurred while regional volumes in other non-MnPASS corridors observed a decrease. • Total hours of delay in the corridor have declined appreciably since the implementation of MnPASS. • Travel speeds increased in the general purpose lanes, as well as the MnPASS lane, providing a reduction in travel times through the corridor. • Key findings from a November 2006 Attitudinal Study of the I-394 project include: – Dynamic Pricing Works – Average speeds of 50 mph are maintained 95 percent of the time. Survey results indicate that 85 percent of users are satisfied with the speed of the traffic flow in the MnPASS lane. – Technology Works – More than 95 percent of current customers are satisfied with the all-electronic system; 93 percent are satisfied with the credit card-based system of funding accounts; 92 percent are satisfied with the ease of installing the transponder, and; 87 percent reported no problems merging into the MnPASS lane. – Broad Support – Approval was consistent across all income groups – 71 percent higher-income, 61 percent middle-income, and 64 percent lower-income indicated "strong" or "somewhat" approval of tolling. Support remained strong among carpoolers (60 percent "good idea") and stable among transit users (49 percent "good idea"). – HOV Use Has Not Changed – The current mode share of I-394 panelists is comparable to that captured in the first round surveys, pre-operation: 81 percent drive alone and 19 percent carpool.

HOT Lane Conversions	HOT Lanes on I-394 in Minnesota
Evaluation	• Two different teams were subsequently contracted by Mn/DOT to evaluate different aspects of the I-394 MnPASS deployment. The Attitudinal Evaluation Team, headed by the University of Minnesota's Humphrey Institute State and Local Policy Program supported by NuStats, Inc., was charged with collecting and analyzing the public's perceptions regarding the MnPASS system. • The Technical Evaluation Team was managed by Cambridge Systematics, Inc., and supported by Short-Elliott-Hendrickson and LJR, Inc. This team was tasked with collecting and analyzing data regarding the ability of the MnPASS system to achieve the stated project goals, and to evaluate other performance impacts observed in the corridor. • In order to isolate the impact of the MnPASS deployment, the evaluation approach was designed to analyze data collected over broad time periods both before and after the implementation to provide a wide sampling of travel conditions under a variety of influencing factors. This provides the opportunity to group and compare conditions on similar travel days both before and after the implementation, and minimizes the erroneous identification of MnPASS impacts based on averages from a limited sampling on diverse travel days. This also provides the opportunity to assess how the impacts of the MnPASS system vary based on different conditions (e.g., good weather days versus bad weather days, Tuesdays versus Fridays, etc.) in order to provide Mn/DOT with valuable feedback on when and under which conditions the system is more or less effective.

Sources:

Value Pricing Program Quarterly Report: 3rd Quarter 2007. Federal Highway Administration, Office of Operations. (September 2007: Washington, D.C.).

http://www.ops.fhwa.dot.gov/tolling_pricing/value_pricing/quarterlyreport/qtr3rpt07/pdf/qtr3rpt07.pdf.

Minnesota Department of Transportation, *Report on MnPASS I-394 HOT Lane Project "Get in and Go."* Presented to the Washington State Transportation Commission by Charlie Howard, Director, Strategic Planning and Programming Division. January 19, 2005.

http://www.wstc.wa.gov/AgendasMinutes/agendas/2005/Jan18/Item16_MinnTripPPT.pdf.

Minnesota Department of Transportation, *MiMnPASS System Study*. Prepared by Cambridge Systematics with URS Corp. April 7, 2005.

http://knowledge.fhwa.dot.gov/cops/hcx.nsf/All+Documents/7B8A9B46944C50DE85256DE4005845B1/$FILE/FR1_MnDOT_MnPass%20System%20Study_FINAL_execsummary1.pdf.

MnPASS Issues Resolution. Presented by Ferrol O. Robinson, Executive Vice President, SRF Consulting Group, Inc. to TRB Midyear Meeting of Joint Subcommittee on Road Pricing. Minneapolis, Minnesota. July 2004.

http://knowledge.fhwa.dot.gov/cops/hcx.nsf/All+Documents/7B8A9B46944C50DE85256DE4005845B1/$FILE/MN-Pass%20Presentation%207-04.pdf.

University of Minnesota, Humphrey Institute of Public Affairs, *MnPASS Evaluation, Attitudinal Panel Survey: Wave 3*. Final Report. Prepared by NuStats. August 2006.

http://www.mnpass.org/pdfs/MnPassFinalReport%2027NOV06.pdf.

Minnesota Department of Transportation *I-394 MnPASS Technical Evaluation, Final Report*. Prepared by Cambridge Systematics. November 2006.

http://www.mnpass.org/pdfs/394mnpass_tech_eval.pdf.

Buckeye, K. R., and L. W. Munnich, Jr., *Value Pricing Education and Outreach Model: I-394 MnPASS Community Task Force*. In Transportation Research Record No. 1960, Transportation Research Board, National research Council, Washington, D.C., 2006.

Munnich L. W., Jr., and K. R. Buckeye, *I-394 MnPASS High-Occupancy Toll Lanes: Planning and Operational Issues and Outcomes (Lessons Learned in Year 1)*. In Transportation Research Record No. 1996, Transportation Research Board, National research Council, Washington, D.C., 2007.

Table 1.4 HOT Lanes on I-10 (Katy Freeway) and U.S. 290 in Houston, Texas

HOT Lane Conversions	HOT Lanes on I-10 (Katy Freeway) and U.S. 290 in Houston, Texas
Operations	• The "QuickRide" pricing program implemented in 1998 on an existing reversible HOV lane in the median of I-10. A similar program was implemented on U.S. 290 (the Northwest Freeway) in year 2000. In both cases, carpools with 2 occupants were allowed to "buy-in" to the HOV lane usually reserved for carpools with 3 or more occupants. Thus these lanes are HOT (high-occupancy toll) lanes where buy-in is available to 2-person carpools while the single occupant vehicles are excluded from the HOT Lanes. • Thirteen-mile I-10 HOV lane was initially open to buses and registered vanpools and later allowed carpools with 2 or more occupants. As the lane became congested 1990s, occupancy requirement were changed to allow only carpools with 3 or more occupants during peak hours. This led to excess capacity and a significant reduction in number of persons typically moved during peak hours. • Allowing a limited number of 2-person carpools into the lane through the use of electronic tolling equipment allowed state/local agencies to make better use of available capacity without reintroducing congested conditions. • Under QuickRide, two-person carpools were allowed to use the HOV lane for a $2 per trip fee during rush hours (6:45-8:00 a.m. and 5:00-6:00 p.m.; morning only on U.S. 290). Three-person carpools still free. Prior to 1990, the morning rush hour was defined as 6:45 a.m. to 8:15 a.m. • An initial QuickRide balance of $40 is required. Fee deducted for each use. When balance reaches $10, credit card charged to bring balance back to $40. • Monthly statement were issued reflecting all trip costs and credit card charges. • A one time $15 Trip Tag deposit and a $2.50 monthly service fee are required. • To maintain free-flow traffic conditions, the target number of QuickRide vehicles was initially set at 600 during each peak hour. • Enforcement handled by METRO police already stationed at HOV lane exit locations. • In a little more than a year, 650 transponders had been issued and between 100 to 200 tolled trips daily were made on the I-10 QuickRide lane during the two peak periods combined. As of April 2002, over 1,500 transponders had been issued for QuickRide access on both the Katy Freeway and U.S. 290. By 2004, there were 2,200 registered QuickRide users. • Study is underway (expected completion date August 2009) to develop an implementation plan for a network of managed lanes in Houston that would include expansion of current HOT programs on the Katy and Northwest Freeways and add tolling to the other four HOV lanes to develop an integrated network of HOT lanes. Current activities are focusing on enforcement options. • The Katy Freeway is undergoing a massive multi-year reconstruction to increase the number of general purpose lanes to eight (four in each direction) and expand the HOV lane to four managed lanes, two in each direction, with three lanes operated as HOT lanes where HOV-2 and solo drivers will pay tolls. Some sections have been completed with the final section scheduled for completion in late 2008. Tolling operations are expected to begin in the fall of 2008.

HOT Lane Conversions	HOT Lanes on I-10 (Katy Freeway) and U.S. 290 in Houston, Texas
Cost, Finance, and Revenue	• VPPP grant of $460,000 was awarded. • Toll revenues from several hundred vehicles each day pay for costs of maintaining and servicing accounts (approximately $100,000 per year). This excludes the costs of capital, marketing and start-up costs paid with Federal pricing grant funds as well as costs of enforcement and enrollment services already in place as part of other METRO programs (TRB News, September-October 1999). • Revenues generated by the program between 1998 and 2003 totaled $417,734.
Policy/Institutional	• The Texas Department of Transportation owns and operates the freeways, but the QuickRide lanes are operated by the Metropolitan Transit Authority of Harris County (Houston Metro), which operates all HOV lanes in the region. • TxDOT, Houston Metro, the Federal Highway Administration, and the Federal Transit Administration, as well as the Harris County Toll Road Authority, all have a stake in the projects completed and planned in the Houston area, necessitating the negotiation of cooperative agreements to implement any pricing project on the region's HOV lanes. • The planned expansion to managed lanes represent not only the expansion in scope of the HOT lane concept, but also unique partnership developed between TxDOT, HCTRA, and METRO.
Outreach/Acceptance	• QuickRide marketing campaign began on January 5, 1998, with advertisements in the Houston Chronicle (both general circulation and neighborhood editions) and radio spots played during rush-hour traffic reports. • Advertisements were coordinated with issuance of QuickRide application packets so potential users could view the packets at the same time the ads were run. • Nearly 1,400 individuals participated in 14 public meetings and two focus groups to measure public opinion on the QuickRide project before it was implemented. One focus group consisted entirely of Katy Freeway users, while the second consisted of members of the general public. The users group included SOV drivers, carpoolers and transit riders, while the general public group did not contain any regular Katy Freeway users, but did include a cross-section of population representing a variety of socioeconomic backgrounds. (Collier and Goodin, 2002). • Members of the Katy users group felt that QuickRide would be a good way of using excess capacity, yet the majority did not anticipate using the service every day. Some bus riders felt the project would result in more carpools and fewer bus riders. • Focus group members felt that if the project were to be acceptable, use of project revenues should be clearly defined and the public must feel confident in the ability of agencies involved to operate and enforce the pricing project. • The Katy user's focus group ultimately recommended against the project, recommending improvements in bus service and the HOV lane. The general public group also felt that project would not be worth the effort and would not encourage the use of carpools and transit.
Technology	• Approved applicants receive an Auto ID (rearview mirror hang tag) and a METRO Trip Tag (small, credit card-sized transponder to attach to inside of windshield). The Transponder is an "active" tag and "reads" each time an equipped vehicle uses Katy or 290 HOT lanes. • Accepts Harris County Toll Road EZ tags and is interoperable with TxTAG (TxDOT) and TOLLTAG (NTTA).

HOT Lane Conversions	HOT Lanes on I-10 (Katy Freeway) and U.S. 290 in Houston, Texas
Equity/Environmental	• Social equity was not an issue for the Katy users focus group. Most felt that pricing was an economic solution where one pays for premium service. • The general public focus group did not indicate a bias toward low-income users. They felt that if the program were successful in alleviating congestion, everyone would benefit (with the exception of 3-person carpools since the HOV lane would have more users). • Some members of the general public focus group expressed the opinion that it was unfair to pay for roads initially financed and constructed with tax money. They felt that the project should be used to generate revenue to support transit improvements and/or improvements on the main lanes of all freeways, rather than just the HOV lanes.
Impacts	• Surveys indicate that most QuickRide participants are persons who formerly traveled in single-occupant vehicles on the regular lanes (a quarter to a third of QuickRide trips). (FHWA/ops/quarterly report) There was, however, a significant movement of 2-person carpools from the general purpose lanes to the QuickRide lane. • Diversion of bus, vanpool and 3+ occupant carpoolers to QuickRide appeared to be limited to roughly 5 to 8 percent of the QuickRide trips. (Shin and Hickman, 1999a and b; LKC Consulting Services, Inc. and Texas Transportation Institute, 1998 in *Road Value Pricing*, 2003.) • Most participants only use the facility occasionally, with about 25 percent of QuickRide users using their tag on any given day and only about 6.5 percent of enrolled tags producing five or more commute trips a week (out of 10 possible trips). • After six months of program initiation, only about 25 percent of registered QuickRide tags had been used. Of those, about 40 percent were second tags owned by single household. It appears that many participants value having an electronic tag as insurance to meet occasional needs. • On I-10, during AM peak, average speed on general purpose lanes was 25 mph, while average speed on the QuickRide lane was 59 mph (over 17-minute time saving for 13-mile trip). During the PM peak, average general purpose lane speed was 27 mph, while average QuickRide lane speed was 58 mph (a 15-minute time savings). [Burris and Stockton]. • On U.S. 290, the QuickRide time savings (relative to travel on the mixed use lanes) were 11 minutes for a 15-mile trip. The addition of QuickRide program caused the HOV2 volume to increase 40.3 percent between 2000 and 2001, while the HOV3 volume changed very little (-2.7 percent). The total volume on the HOV lane increased by 21.1 percent. • The Katy/290 HOT lanes receive considerably lower patronage than HOT lane projects in California have experienced. The fact that the Texas HOT lanes are buy-ins by 2-person carpools rather than single occupant vehicles likely explains much of this difference, with survey results showing that the effort/disutility of forming a carpool was a major deterrent to QuickRide participation. The $2 toll was not found to be a significant deterrent to participation in the QuickRide program. (Burris and Appiah.)

HOT Lane Conversions	HOT Lanes on I-10 (Katy Freeway) and U.S. 290 in Houston, Texas
Evaluation	• The QuickRide program has been intensively examined in a number of academic studies, many by the Texas Transportation Institute under sponsorship by the Texas Department of Transportation, Houston Metro, and the Federal Highway Administration. • Studies have examined QuickRide usage by time, occupancy, vehicle type and various user characteristics. Data used have included billing records for QuickRide trips and surveys of current and former QuickRide enrollees. For instance, a study of frequency of usage relied on a mail survey of 1,459 QuickRide enrollees. The survey included 36 questions regarding QuickRide and non-QuickRide trips, typical use of QuickRide, opinions on alternate pricing schemes, and user socioeconomic characteristics.

Sources:

Burris, Mark W. and Appiah, Justice, *Examination of Houston's QuickRide Participants by Frequency of QuickRide Usage*, Transportation Research Record No. 1864 (2004).

Burris, Mark W. and Stockton, Bill R., *Hot Lanes in Houston – Six Years of Experience*, Journal of Public Transportation, Volume 7, Number 3 (2004).

http://www.quickride.org/about_quickride.stm.

http://houstonvaluepricing.tamu.edu/reports/documents/us_290.pdf.

http://houstonvaluepricing.tamu.edu/reports/documents/HVP_pilot_brochure.pdf (July 2003).

Office of Operations, Federal Highway Administration, *Value Pricing Project Quarterly Report*, July-September 2007.

Road Value Pricing, Chapter 14 in Transportation Research Board, TCRP Report 95, 2003.

U.S. Department of Transportation, Federal Highway Administration, *Current HOT Lane Experience*, Chapter 7 in A Guide for HOT Lane Development (March 2003).

Table 1.5 HOT Lanes on SR 167 in the Puget Sound Region, Washington

HOT Lane Conversions	HOT Lanes on SR 167 in the Puget Sound Region, Washington
Operations	• The Washington State Department of Transportation's (WSDOT) SR 167 Hot Lane pilot project evaluated the High-Occupancy and Toll (HOT) lane concept to manage congestion, generate revenue and test transponder technology. The conversion of the existing HOV to HOT lanes has been completed and opened to traffic May 3rd, 2008. • The SR 167 High-Occupancy Toll (HOT) Lanes Pilot Project will convert the existing HOV lanes from Southwest 15th Street in Auburn to I-405 in Renton, without expansion of the existing freeway. There is one lane in each direction. • Average daily traffic on Highway 167 is about 110,000 vehicles. WSDOT predicts 5,000 drivers a day will utilize HOT lanes. • Non-HOV drivers will pay an electronic toll for access to nonbarrier-separated express lanes in both directions along 9 miles of SR 167. Rates will fluctuate based on traffic levels in the express HOT lanes. HOV 2+ vehicles will travel for free. • Planning, implementation and construction 2004-2008; study and evaluation period 2008-2012.
Cost, Finance, and Revenue	• Total project cost estimated at $17.9 million; the VPPP grant total for FY 2004 and 2005 equaled $2,060,000. Preliminary engineering and construction are expected to account for the majority of the cost. • Toll rates will vary based on congestion in the HOT lane, so that that HOT lane remains free flowing. Toll rates are estimated to average between $1.50 and $2 per trip when the HOT Lane begins operation in 2008. Toll rates could be considerably higher depending on traffic conditions. Earlier estimates of 2010 maximum and minimum rates were between $0.60 and $6 for the 9-mile trip. • Opening year toll revenue is estimated to be about $1.0 million increasing to approximately $3 million in 2012. • Preliminary capital costs of conversion of these existing HOV lanes are estimated to be recovered by net annual toll revenue within 11 to 12 years.
Policy/Institutional	• WSDOT obtained legislative approval for this four-year trial. A study was completed to identify which highway in the Puget Sound region could best test the HOT lane concept. • A Corridor Working Group was formed and composed of representatives from cities along the SR 167 corridor, Pierce and King Counties, the Washington State Patrol, regional agencies, and WSDOT. • Authorizing legislation created a special multimodal account specifying that HOT lane revenue, "may be used for… debt service, planning, administration, construction, maintenance, operation, repair, rebuilding, enforcement, and expansion of high-occupancy toll lanes and to increase transit, vanpool and carpool, and trip reduction services in the corridor." The legislation also directs that, "a reasonable proportion of the moneys…be dedicated to increase transit, vanpool, carpool, and trip reduction services in the corridor" (ESHB 2808, 2004). • There are no statutory requirements to repay debt or pay for operations and maintenance costs. There also is no requirement for a citizen's advisory committee. • The Washington State Transportation Commission holds statutory toll rate setting authority over the proposed HOT lanes and has set the toll rates to be a minimum of $0.50 and maximum of $9.00.

HOT Lane Conversions	HOT Lanes on SR 167 in the Puget Sound Region, Washington
Outreach/Acceptance	• A Stakeholder Advisory Committee, comprised of affected jurisdictions, advocacy groups, corridor users, and other affected stakeholders, was consulted at key decision points during the implementation of the pilot study. • Over two years, a series of community meetings and varied outreach events were held to gauge public understanding and educate drivers of the legality of using HOT lanes. • Focus groups included 3 low-income-specific groups, 2 typical commuter groups, and 1 small/service businesses group. Findings from these outreach efforts included: 1) Low-income drivers generally as supportive, if not more supportive, of the HOT lane concept than typical drivers; 2) Business leaders and service business leaders see and value the benefit of trip reliability; and; 3) Trip reliability and time savings are important to all constituents. • Updated project materials, including the HOT Lanes folio and web site with explanatory video. Continued public comments tracking and responses. • From a peer-review of SR 167 activities by representatives from other state HOT projects the following key findings from public activities were presented: – Public communication should emphasize that this project is only in a demonstration period to fine-tune the system but also to illustrate that HOT lanes are here to stay and that more are on the way. – SR-167 project's focus on the customer, including community meetings, focus groups, workshops, surveys and stakeholder involvement is very good. – Messaging must continually emphasize that transit and carpool service will not be degraded and what revenue will be used for. • Have communications plan in place for opening day, included readily available data and anticipate questions by meeting with media and editorial boards throughout process.
Technology	• Transponder-equipped vehicles may enter HOT lanes at certain access points. Toll rates will vary dynamically with the level of congestion in the HOT lanes to ensure that tolled traffic flows at least 45 mph 90 percent of the time during the peak. • Drivers pay the single rate at which they enter the HOT lane for the entire distance of their trip, regardless if tolls are updated en route. • The existing HOV lane was modified from an enter-at-will configuration and re-striped to defined HOT lanes with double white stripe buffers, and defined access points. • Tolls are debited from existing pre-paid accounts using the State's existing windshield-mounted sticker transponders (branded "Good to Go" in Washington State). Customers must pay $12 to purchase a transponder and can set up accounts with credit cards, bank accounts or cash to establish pre-paid account. • Transponder-equipped vehicles participating in carpools are able to temporarily disable the transponder and travel for free. Customers must pay $3.50 to purchase a disabling devise for the purpose. • WSDOT funds additional Washington State Patrol troopers to monitor HOT lane traffic. When single drivers with a valid e-sticker enter the HOT lanes, a light will flash on the overhead sensor. If the light does not flash and there is a single passenger in the vehicle, a state trooper will stop the vehicle and issue a citation of $124.

HOT Lane Conversions	HOT Lanes on SR 167 in the Puget Sound Region, Washington
Equity/Environmental	• Focus groups were held in south King County with lower-income commuters that frequently use SR 167. Members of these groups expressed interest in paying a toll to use the HOT lane. • WSDOT plans to survey users of the HOT lanes after the lanes are open to determine if there are any impacts. • Bus and carpool travel times are not expected to decrease as a result of the project. • Transit advocacy groups suggested that toll rates must not offer an incentive for solo commuters to transfer trips from transit or carpool options in the corridor.
Impacts	• Any actual impacts are unknown, since the project has not opened yet. • Studies estimate that 13 percent more vehicles will travel the SR 167 corridor daily, and 38 percent more vehicles will use the HOV/HOT lanes, while preserving express trips for buses, vanpools and carpools. • Estimates indicate room for an additional 450 more vehicles per hour in the HOV/HOT lane before the 1,500 vehicles per hour threshold is reached.
Evaluation	• During the four-year study period, the program's performance, socioeconomic impacts, and public interest and acceptance of the facility will be assessed on an annual basis.

Sources:

Engrossed Substitute House Bill 2808, State of Washington, 2004.

Washington State Department of Transportation, Projects, SR-167 – H OT Lanes Pilot Project. Accessed November 2007. http://www.wsdot.wa.gov/Projects/SR167/HOTLanes/.

WSDOT, *HOT Lanes Pilot Project Analysis, Working Draft*. November 2003.

http://www.wsdot.wa.gov/NR/rdonlyres/794FDB83-056F-4B4A-A3C6-D16B8AD8E1A4/0/HOTlanes_Rep2_11_13_03.pdf.

Washington State Department of Transportation *State Route 167 High-Occupancy Toll (HOT) Lanes Pilot Pre-implementation Project, Proposed Scope of Work*. Prepared for Federal Highway Administration, March 2005. http://knowledge.fhwa.dot.gov/cops/hcx.nsf/All+Documents/F80D0BCC0630974E8525701A0065ED3C/$FILE/FINALVPPPWSDOTSR167ScopeofWorkRev.pdf.

2.0 Variable Pricing of New Express Lanes

Table 2.1 Express Lanes on State Route 91 in Orange County, California

Pricing of New Lanes	Express Lanes on State Route 91 in Orange County, California
Operations	• Opened in December 1995 as a four-lane toll facility, adding two new lanes in each direction. First fully automated (ETC/transponder only) facility in the world. • Located on median of a 10-mile section of Riverside/State 91 freeway; the toll lanes are separated from the general purpose lanes by a painted buffer and plastic pylons; no intermediate exits or entrances; heavy vehicles prohibited. • Express lanes connect major employment centers of Orange County and southern L.A. County with residential communities of Riverside and San Bernardino Counties. • Tolls started as same toll for each four-hour peak (and the six-hour p.m. peak on Friday); changed in September 1997 to varying hour-by-hour in peak (pre-set schedule to maintain free flow, but not dynamic tied to real-time congestion); as of August 2005, tolls on the express lanes varied between $1.10 and $7.75; Since April 1, 2007, the toll on the busiest hour on the tollway, 4:00 p.m. to 5:00 p.m. eastbound of Fridays, is $9.50, or 95 cents per mile. Tolls now adjusted by formula established by OCTA (current owner) to keep lanes congestion-free. • FasTrak transponder required of all vehicles; HOV3+ were free prior to January 1998, thereafter free except eastbound, Monday through Friday 4:00 p.m. to 6:00 p.m., paying 50 percent of the regular toll; same policy for motorcycle; other toll discounts apply to disabled veteran and zero-emission vehicles. HOV-3+ vehicles use a "3+ verification lane" in the toll zone. • As of 2004, averaging about 35,000 vehicles per day; 172,000 transponders in circulation as of 2005; lanes carry over 40 percent of the total SR-91 traffic during peak periods, with one-third of the total freeway capacity. • Initial operations under private developer, California Private Transportation Company (CPTC); in January 2003, the Orange County Transportation Authority (OCTA) purchased the private project for $207.5 million, beginning public operations. • The CHP provides police services at facility owner's expense; maintenance and operational costs also the responsibility of owner.

Pricing of New Lanes	Express Lanes on State Route 91 in Orange County, California
Cost, Finance, and Revenue	• The four-lane, 10-mile-long toll facility was constructed for approximately $134M with private funds. • In 2005, a FHWA VPPP grant of $588,000 was awarded for evaluation. • Toll revenues covers construction and operating costs. • CPTC corporate reports indicate "acceptable financial performance" when operated as private facility. • State saved construction and operating, enforcement costs; Orange County gained property taxes from CPTC ($6.8 million in first 6 years) when under private ownership. • Benefit/cost analysis comparing express to dual carpool lanes showed higher net present value for express (490M versus 303M) largely due to higher travel time savings and in spite of higher operating costs. • Net income (revenue – expenses) 733,000 in 1996 rising to 13.7 million in 2001, according to CPTC audits.
Policy/Institutional	• Set up as private for-profit investment, one of four private-public partnership authorized by the California Legislature under the AB 680 legislation enacted in 1989. • AB 680 provides up to 35-year lease of right-of-way and airspace, which then reverts to the State (may remain a toll road); must be built to state standards; meet applicable laws, environmental standards; any state services fully compensated. • CPTC transferred ownership of the facility to the State of California prior to opening, Caltrans then leased the toll road back to CPTC for a 35-year operating period. • Initial franchise agreement with Caltrans included "noncompete" provision to limit nearby corridor improvements, except safety-related improvements, which could be built. • AB 1010, Chapter 688 (2002) allowed OCTA to purchase the Toll Road from CPTC (for over $200 million); eliminates noncompete clause; OCTA prohibited from transferring its franchise without state approval; all projects become nontoll when franchises expire; no more new franchises after January 1, 2003; creates an SR 91 advisory committee with strong local political control. • New legislation has been introduced to allow OCTA and Riverside County Transportation Commission (RCTC) to extend lanes into Riverside County and extend franchise period.
Outreach/Acceptance	• Private Sector Operations – Controversy arose around "noncompete clause" in CPTC-Caltrans agreement preventing widening the nontolled lanes for nonsafety purposes along 30 miles of the Riverside Freeway; CPTC sued Caltrans over proposed widening at interchange with Eastern Transportation Corridor extending east to the Riverside County Line, Caltrans withdrew project as a result of CPTC litigation and CPTC ultimately dismissed with OCTA purchase; while under CPTC ownership, two unsuccessful bills (AB 1091, AB 1346) sought to void the noncompete clause, have public acquire lanes by condemnation. • Public Opinion – Project consistently received high marks from customers. As part of controversy on noncompete issue, commuter group approval of private companies operating toll roads decreased to 30-45 percent between 1996 and 1999, compared to 50-75 percent approval in 1996; in spite of this, commuters approve (in the 45-75 percent range) priced or HOT lane concepts if lanes do not become congested. • Media – Media coverage grew negative around noncompete issue, noting CPTC has a "monopoly" over the SR 91 freeway through the 35-year contract.

Pricing of New Lanes	Express Lanes on State Route 91 in Orange County, California
Technology	• AVI required of all vehicles, including free pass carpools. • Transponders compatible with California "Title 21" standard and usable on all state toll facilities. • Express separated from the general purpose lanes by a painted buffer and plastic pylons. • Credit card account to maintain positive cash balance in the driver's toll account required, but no deposit on its AVI transponders. • Upstream changeable message signs provide traveler information on closures. • Violation enforcement by video and CHP.
Equity/Environmental	• Emissions – Modeling indicated emissions with the priced 91X project would have been about the same as with dual HOV lanes or dual general use lanes constructed instead; however, much would depend on uncertain level of "induced travel" and emission model has structural weakness (see evaluation section of table). • User Incomes – "Moderate" income effect (percent of trips on 91X for the lowest and highest incomes – 20 percent and 50 percent – stayed same over survey period); use of 91X increased over time for all modes across all incomes. • Gender – Generally, proportion of commuters using 91X lanes over the free lanes has been higher for females than for males (only in the HOV3+ category is the proportion higher for males than females).
Impacts	• Traffic, Overall – Express lanes accommodate 1,400 to 1,600 vehicles/hour/lane, throughput 33 percent higher than general-purpose lanes because of free flow express conditions; overall facility less congested than previous facility. In PM peak Express Lanes carry 40 to 50 percent of total vehicles on only 33 percent of capacity. • Carpools – 40 percent increase in HOV3+ opening probably due to free use policy in first two years; charging HOV3+ 50 percent beginning 1998 did not change overall HOV use in corridor; overall, more SR 91 commuters shifted from single occupant vehicles (SOV) to high-occupancy vehicles (HOV) than vice versa. • Transit – No significant effect on transit use (1 percent) in corridor. • Accidents – Accident down after the toll lanes opened, probably due to decreased congestion; accidents on comparison section of 91 increased. • Employer/Family/Other Pay of Tolls – About 18 percent do not pay own tolls. • Comfort/Safety – Some users use lanes for comfort or safety even if time savings not great; four times as many say 91X lanes are safer than the freeway lanes as say lanes are less safe. • Time Savings – Users reported saving 20-40 minutes per trip; overestimated time savings by 5-30 minutes. • Elasticities – About 0.7 to 0.8 during the six-hour period of heaviest use (morning westbound or afternoon eastbound); 0.9 and 1.0 during one-hour "peak of the peak." • Mode, Time-of-Day Changes – "Very small" shifts to different vehicle occupancies or times of day in response to toll, possibility because of available parallel unpriced lanes. • Diversion – No evidence of diversion to/from regional freeways; use of parallel streets decreased substantially shortly after the 91X lanes opened, then increased 1 in 1998, when freeway congestion increased.

Pricing of New Lanes	Express Lanes on State Route 91 in Orange County, California
Evaluation	• CalPoly State University evaluator in two phases covering operations and impacts from June 1997 to late 1999 (initial report May 1998, final report December 2000); evaluation included direct observations, surveys of corridor users, and impact modeling • No formal control corridor, but occasional reference to a nontolled comparison section of 91, adjoining general purpose lanes and nearby freeway corridors (SR 60 and SR 57). • Telephone surveys (1,788 completed interviews) included present and former commuters; residents from surrounding areas in proportion to the geographic distribution of SR 91 commuters; a panel of travelers surveyed over time; drivers identified by license plate observations and transponder use; commuters participating in U.C. Irvine researchers. • Multiple evaluation data sources added confidence to conclusions when converging. • EMFAC emission modeling did not account for the local effects of accelerations and decelerations, using factors derived from average free flow speeds and thereby indicating more congested periods have lower emissions.

Sources:

http://ceenve3.civeng.calpoly.edu/sullivan/sr91/sr91.htm.

http://pwm.sagepub.com/cgi/content/abstract/5/4/259.

http://www.uctc.net/scripts/access.pl?25/Access%2025%20-%2005%20-%20Lessons%20From%20SR%2091.pdf.

http://www.corridorwatch.org/ttc_2007/CW00000091.htm.

http://www.trb.org/Conferences/RoadPricing/Presentations/Sullivan.ppt.

Table 2.2 Texas: Express Toll Lanes on I-30/Tom Landry in Dallas

Pricing of New Lanes	Texas: Express Toll Lanes on I-30/Tom Landry in Dallas
Operations	• The I-30 West (Tom Landry) Freeway managed HOV lanes will be a phased implementation. The project will open as an interim HOV lane and transition to tolled express lanes in later phases. • I.H. 30/Tom Landry Freeway serves as a major east/west corridor between Fort Worth and Dallas, Texas. The 15-mile corridor identified in the value pricing plan extends from Arlington to the Dallas Central Business District. • In 2004, the Dallas-Fort Worth Regional Value Pricing Corridor Evaluation and Feasibility Study, a cooperative study between FHWA's VPPP and local stakeholders, determined that the I.H. 30/Tom Landry Freeway corridor was a viable demonstration project corridor for implementation of value pricing concepts. • I-30 currently is undergoing a staged reconstruction process. Currently, the staged construction plan calls for five lanes of mixed-flow traffic in each direction, with a single and double reversible HOV lane. The number of lanes will change from Dallas to Fort Worth from a one lane reversible to a two, three, and then two lane sections before feeding a concurrent one – one lane section in each direction heading toward Fort Worth. • The project is the D-FW region's first multilane reversible HOV facility, with two reversible lanes operating during the peak periods between proposed wishbone ramps west of Westmoreland Road in Dallas and Northwest 19th Street. • In July 2007, the first six miles opened of the new HOV lanes stretching between Dallas and Fort Worth on Tom Landry Freeway (I-30). The new High-Occupancy Vehicle (HOV) lanes will eventually will stretch between Dallas and Fort Worth on Tom Landry Freeway (I-30). • The first section to open is between the Dallas/Tarrant County Line and Loop 12. The lanes are available to vehicles with two or more occupants, buses, motorcycles and other eligible vehicles, Monday through Friday, from 6:00 a.m. to 9:00 a.m., and from 3:00 p.m. to 7:00 p.m. Other lanes set to open throughout the fall of 2007and early 2008 are on the Central Expressway (U.S. 75), LBJ Freeway (I-635), and East R. L. Thornton (I-30). • Between 2009 and 2010, the I-30 lanes will become the region's first managed HOV facility, allowing access to single-occupant vehicles for a fee. Eventually, the lanes will operate 20 hours a day and extend from I-820 in Fort Worth all the way to downtown Dallas. – Activities planned for the next two quarters of 2008 include: » A draft traffic and revenue study has been returned for incorporation of received comments. This will become a base reference document. » A draft white paper – "Active Transportation Management Strategies Using Managed Lanes (Introduction to Strategies and Techniques)" is being finalized for a broader distribution. » Monitor the operating HOV project for operational needs and measure the traffic volumes. » Hold a technical advisory committee meeting with Local/Regional/State/Federal partners for the project after the managed lane opens in a full HOV configuration in the fall of 2008.

Pricing of New Lanes	Texas: Express Toll Lanes on I-30/Tom Landry in Dallas
	» Incorporate the results of the draft traffic and revenue study to propose a fixed and dynamic pricing tolling structure for this project. » Work through the design of the advanced signing for the project and how the ITS data will be utilized for tracking the performance of the managed lanes on this project.
Cost/Finance/Revenue	• A VPPP grant of $152,000 was awarded in FY 2002 to support a regionwide study of HOT lanes on I-30. In FY 2004, $472,416 was awarded to support implementation of the I-30 managed lanes concept.
Policy/Institutional	• The Regional Value Pricing Task Force is composed of members from the Dallas and Fort Worth TxDOT Districts; Dallas Area Rapid Transit (DART), the regional transit agency serving the Dallas area and managing existing HOV operations in the area; the Fort Worth Transportation Authority (the T), the regional transit agency serving the Fort Worth area; the North Texas Tollway Authority (NTTA), the regional tollway authority; the North Central Texas Council of Governments (NCTCOG), the region's MPO; and the Texas Transportation Institute, active participants in TxDOT-sponsored managed lane research. • Statewide and regional policy requires that as capacity is added in a corridor, it must be re-evaluated for potential toll/managed lane applications, including value pricing.
Outreach/Acceptance	• The I.H. 30/Tom Landry Freeway Corridor Study will include continuous public involvement activities through its environmental study, feasibility study, and corridor study focused on the individual requirements of this corridor. Regular public meetings will be held along with individual stakeholder meetings for more direct public input.
Technology	• The tollway will utilize existing electronic transponder technology.
Equity/Environment	• An equity analysis will be performed as part of the I.H. 30/Tom Landry Freeway Environmental Assessment.
Impacts	• As of September 2007, the VPP project is moving forward with data collection and other activities to measure, monitor, and evaluate the operational HOV project.
Evaluation	• Value Pricing Project evaluation has not yet started, first phase of HOV lane construction has been in operation since July 2007.

Sources:

North Central Texas Council of Governments, Regional Transportation Council, *Interstate Highway 30/Tom Landry Freeway Managed Facility Operational Plan*. Proposal to: Federal Highway Administration, Value Pricing Pilot Program. Submitted Jointly by: Dallas Area Rapid Transit, Fort Worth Transportation Authority, North Central Texas Council of Governments, North Texas Tollway Authority, and Texas Department of Transportation (Dallas and Fort Worth Districts), July 2004.

http://knowledge.fhwa.dot.gov/cops/hcx.nsf/All+Documents/5E961B086ACA8265852570E50056BDB2/$FILE/TX%20DFW%20IH-30%20Managed%20Facility%20Operational%20Plan.pdf.

Table 2.3 Priced Queue Jumps in Lee County, Florida

Pricing of New Lanes	Priced Queue Jumps in Lee County, Florida
Operations	• A priced queue jump is a facility that a motorist can use by paying a toll to bypass severely congested points on the transportation network. It might be a ramp or a bypass lane or lanes. Lee County's plan was to have tolls vary by time of day and be tied in with its existing electronic tolling system. • Based on survey results (see below) candidate Queue Jump sites were screened and narrowed from a preliminary list of 10 potential sites to the top three; U.S. 41 at Hancock Bridge Parkway; Metro Parkway at Colonial Boulevard; and Summerlin Road at San Carlos Boulevard. • Based on survey results, peak-hour usage of the queue jump was set at 25 percent of the traffic stream at the queue jump location. The project team made a judgment that shoulder-peak usage would be 20 percent, off-peak usage would be 15 percent and weekend usage rate would be 20 percent.
Cost, Finance, and Revenue	• In FY 2000, Lee County received $309,280 in FHWA VPPP funding and in FY 2005 received $1,069,120 in additional study implementation funding. • The intent of a queue jump is to generate revenues sufficient to offset the cost of the queue jump and perhaps to fund other transportation improvements. The feasibility study determined that, while the concept was financially feasible on a net present value basis if projected traffic levels were high enough, in each test case the traditional bonding capacity of the queue jump was less than the projected cost of the queue jump. • The project study team determined that if tolls were indexed at the rate of inflation and projected growth in traffic were incorporated into the analysis, "it appears likely that queue jumps could be financially self-supporting."
Policy/Institutional	• The Lee County Board of Commissioners has the legal authority to authorize a queue jump project, but support from and coordination with the Florida DOT and the Lee County MPO would be necessary for bringing any pilot test to the implementation stage.
Outreach/Acceptance	• Since project concept is untested, public involvement deemed critical, both to familiarize motorists with the concept and to gather information about expected responses to the availability of a queue jump. • This was a countywide analysis, so advisory committees were established using the MPO Citizen's Advisory Committee and Technical Advisory Committee. • Public presentations were made to local, regional and state government officials, civic and social organizations within Lee County and at the Federal Highway Administration's Project Partners' meeting in Atlanta, Georgia in October 2001. • A project web site also was created. • Postage-paid mail back surveys were distributed to drivers over a two-week period during February-March 2002, Lee County's peak tourist season. The surveys were designed to gather information about the overall approval of the project concept, acceptable toll levels, likely utilization at various toll prices, and likely reasons for using the queue jump. • Approximately 9,949 surveys were distributed and 1,739 were returned (17.5 percent response rate). • A focus group was convened to explore opinions and perceptions on the queue jump concept, including potential pricing levels, equity issues and any unanticipated issues.

Technology	• The concept plans call for use of Lee County's existing electronic tolling system (see table on Lee County: Variable Bridge Tolls).
Equity/Environmental	• A queue jump project would be expected to reduce emissions due to reductions in congestion. Traffic levels and participation rates may not be high enough at the potential locations to make this effect noticeable in the context of areawide air quality levels.
Impacts	• About 54 percent of drivers responding to the survey indicated a willingness to pay at least a small toll for the use of a queue jump, with the most acceptable ("appropriate") toll rate being in the range of $0.25 to $0.40 per trip. • Focus group participants favored the queue jump concept, with a suggested toll in the range of $0.10 to $0.25 per trip. Some participants recommended a flat rate to have unlimited access to the queue jump at all times.
Evaluation	• Traditional before/after analysis similar to the evaluation framework for the Lee County Variable Bridge Tolls project was proposed, but the project has not yet been implemented

Sources:

Lee County, Florida, www.leewayinfo.com.

Lee County, Florida, *Sketch Plan: Investigation of Implementation of a Value Priced Queue Jump Bypass for the Proposed Summerlin Road/Gladiolus Drive Interchange*, September 2001.

Lee County, Florida, *Value Priced Queue Jump Study, Final Report, January, 2003*

Lee County, Florida, *Executive Summary: Evaluation of the Lee County Queue Jump Study*.

Office of Operations, Federal Highway Administration, *Value Pricing Project Quarterly Report*, July-September 2007.

http://ops.fhwa.dot.gov/tolling_pricing/value_pricing/projtypes/pricednewlanes.htm.

Table 2.4 Express Toll Lanes on Highway 217 in Portland, Oregon

Pricing of New Lanes	Express Toll Lanes on Highway 217 in Portland, Oregon
Operations	• An 18-month study was conducted by the Highway 217 Policy Advisory Committee of Metro Council to evaluate solutions to traffic congestion on Highway 217. The study evaluated several rush-hour toll and ramp meter bypass alternatives in this corridor, including consideration of FAIR (Free and Intertwining Regular) lanes. Value pricing options were integrated into the mix of alternatives being evaluated and considered for implementation. • The Highway 217 corridor is a major north-south route in the Portland metropolitan area, connecting I-5 to U.S. 26. • The Highway 217 Corridor Study, began in 2003, and was a cooperative effort by Metro, Washington County, the Oregon Department of Transportation, TriMet and the cities of Beaverton, Lake Oswego and Tigard. • The Highway 217 Policy Advisory Committee (PAC) completed Phase I, a study of 6 scenarios within the corridor, in the fall of 2004. All of the options studied included improvements to interchanges, arterials, transit, and bike and pedestrian routes in the corridor. Alternatives were evaluated as to how well they addressed the study objectives in terms of travel performance, environmental and neighborhood effects, financial feasibility and cost-effectiveness. • The 6 options considered for review in Phase I are summarized below: – Option 1 – Included arterial, transit and interchange improvements, no new lane on highway, and significantly increased transit service. – Option 2 – Included six lanes without interchange improvements but new lane on highway in each direction. – Option 3 – Included six lanes with interchange improvements and new lane on highway in each direction. – Option 4 – Included six lanes with interchange improvements, a new lane in each direction for carpools, and increased transit service. – Option 5 – Included six lanes with interchange improvements, a rush-hour toll lane in each direction, and increased transit service. – Option 6 – Included six lanes with interchange improvements, a new lane on highway in each direction, new tolled lanes on entrance ramps to bypass meters, and increased transit service. • The PAC made a final recommendation in November of 2005, of two improvement options to study further in Phase II. The options recommended for further study were Option 3, 5, and 6. • Phase II focuses on a more detailed study of how each option could be implemented in terms of public support, environmental and neighborhood effects, financial feasibility and phasing. This evaluation recommended pursuing Options 3 and 5. The Metro Council accepted those recommendations in February 2006. • All of the options improve transportation performance on the corridor. However, the PAC recommended that the general purpose and express toll lane options (3 and 5) be carried forward because of greater public acceptance and the importance of keeping potential financing options open.

Pricing of New Lanes	Express Toll Lanes on Highway 217 in Portland, Oregon
Cost, Finance, and Revenue	• Phases I and II of the study were completed using Value Pricing funding of $400,000 awarded in FY 2002. • The study evaluated potential funding sources for each option during the next 20 years and determined the funding gap or shortfall for each option. All options, except the rush-hour toll option, require major new funding sources: – Option 1 – Cost in 2004 dollars of $544 million with a $505 million funding gap. – Option 2 – Cost in 2004 dollars of $405 million with a $366 million funding gap. – Option 3 – Cost in 2004 dollars of $496 million with a $457 million funding gap. – Option 4 – Cost in 2004 dollars of $522 million with a $481 million funding gap. – Option 5 – Cost in 2004 dollars of $564 million with a $124 million funding gap. – Option 6 – Cost in 2004 dollars of $510 million with a $404 million funding gap. • Both of the recommended options are expected to cost more than $500 million, presenting a significant funding gap with current anticipated highway funds.
Policy/Institutional	• Metro is the directly elected regional government that serves more than 1.4 million residents in Clackamas, Multnomah and Washington counties, and the 25 cities in the Portland, Oregon metropolitan area. • A 20-member policy advisory committee, the Highway 217 Policy Advisory Committee (PAC), was appointed by the Metro Council to study to corridor. The Committee was composed of community members, business representatives and elected officials. • In February 2006 the Metro Council passed Resolution No. 06-3658 adopting recommendations of the Highway 217 corridor transportation plan.
Outreach/Acceptance	• Phase I process offered numerous opportunities for public involvement, including stakeholder interviews, focus groups, two surveys, open houses and meetings with community and neighborhood groups. • Phase II continued the public outreach process through a series of community meetings. The Metro Council will continue to hold public hearings and seek comments.
Technology	• Not evaluated.
Equity/Environmental	• Phases I and II of the studies addressed environmental impacts of projects, the key findings of each option are summarized below: – Option 1 – Option has highest level of environmental and neighborhood impacts due to the number of surface street improvements. – Option 2 – Environmental and neighborhood impacts are low. – Option 3 – Environmental and neighborhood impacts are medium. – Option 4 – Environmental and neighborhood impacts are medium. – Option 5 – Environmental and neighborhood impacts are medium. – Option 6 – Environmental and neighborhood impacts are medium.

Pricing of New Lanes	Express Toll Lanes on Highway 217 in Portland, Oregon
Impacts	• The six options considered for review in Phase I and the key findings of each option are summarized below: – Option 1 – Most expensive option, reduced congestion on surface streets, but does not improve overall drive times or congestion. – Option 2 – Least expensive option but does not resolve merge/weave problems on Highway 217. – Option 3 – Provides the greatest congestion relief and fastest trips for all users of Highway 217. – Option 4 – Provides fast trip for users of carpool lane, but does not increase carpooling and does not relieve congestion on general-purpose lanes. – Option 5 – Provides fast trip for users of the toll lane, reduces overall congestion on Highway 217, provides the most benefits for freight movement in the corridor, has the smallest funding gap, and could potentially be built sooner than other options. – Option 6 – Provides similar improvements as Option 3, but has a smaller funding gap. • Phase II evaluated three of the options described above and found that congestion within the corridor will increase from three to eight hours a day if no improvements are made over the next 20 years. The options recommended to address this need included: – Option A – The general purpose lane offers the most overall congestion relief and the fastest average drive time (saving 3 minutes over base case). However, it is anticipated to have a capital cost of $523 million with an estimated funding gap of $504 million in 2014. Estimated construction completed in 2019. Wetland impacts equal approximately 2.8 acres. Overall congestion relief benefits all trucks. Public acceptance: prefer ease of general purpose lane but concerns about projected construction timeline with traditional funding sources. – Option B – The express toll lane offers some overall congestion relief in general purpose lanes (saves 1 minute) and the fastest travel time for toll lane travelers (saves 8.5 minutes over base case). It offers an incentive for carpool travel and possible transit. Wetland impacts: approximately 3.2 acres. Smallest funding gap with a capital cost of $581 million and an estimated funding gap of $332 million in 2014. Without supplemental revenues, estimated construction completed in 2028. Includes small trucks access toll lane and all trucks use ramp meter bypasses. Public acceptance: more acceptable as funding mechanism but reservations about complexity and feasibility of tolled facilities and about equity for all users. – Option C – The general purpose lane with tolled ramp meter bypass has similar travel benefits as the general purpose lane for all drivers (saves 3 minutes over base case). Significant funding gap with a capital cost $540 million and an estimated funding gap of $449 million in 2014. Projections show limited revenue potential – approximately one-third that of the express toll lane option in 2014. Without supplemental revenues, estimated construction completed in 2042. Wetland impacts: approximately 2.8 acres. All trucks can access ramp meter bypasses. Public comments were much more negative. There was a perception that the tolled ramp meter bypasses are unfair and that people will respond negatively to those who travel on them.

Pricing of New Lanes	Express Toll Lanes on Highway 217 in Portland, Oregon
Evaluation	• The evaluation of the projected impacts was based on regional travel and traffic forecasting models similar to those used in the feasibility studies of many of the other projects described earlier.

Sources:

Metro Council, *Highway 217 Policy Advisory Committee directs Metro to further study options to improve busy highway*. News release: September 22, 2005.

http://www.metro-region.org/index.cfm/go/by.web/id/15834.

Metro Council, *Highway 217 Corridor Study Options*, 2005.

http://www.metro.dst.or.us/library_docs/trans/hwy217_news_4_pgs_4_19.pdf.

Metro Council, *Findings from First Phase of Study*. News Release:

http://www.metro-region.org/article.cfm?articleID=11838.

Metro Council, Highway 217 Corridor Study, *Phase II Overview Report, Study Findings and Preliminary Recommendations*. October 7, 2005.

http://knowledge.fhwa.dot.gov/cops/hcx.nsf/All+Documents/9FFE2840925C018A85256DBB0076BDBE/$FILE/Phase%20II%20Overview.pdf.

3.0 Variable Pricing on Existing Toll Facilities

Table 3.1 Pricing on Bridges and Variable Tolls for Heavy Vehicles in Lee County, Florida

Pricing on Toll Facilities	Pricing on Bridges and Variable Tolls for Heavy Vehicles in Lee County, Florida
Operations	• In August 1998, Lee County, Florida, in cooperation with the Florida DOT and FHWA, implemented value pricing on two toll bridges – the Cape Coral and Midpoint Memorial Bridges. • Under terms of the program, bridge users are offered a toll discount during selected off-peak hours as an incentive to change trip times from peak to off-peak (less congested) hours. • The discount program offered a 50-percent toll discount for two-axle vehicles traveling during times either 30 minutes before or two hours after the 7:00-9:00 a.m. peak traffic period and two hours before or 30 minutes after the 4:00-6:30 p.m. peak traffic period. This amounted to a $0.50 toll discount for users paying the regular toll of $1. For bridge users who took advantage of the option of paying a $40 annual fee to obtain a bridge toll rate of $0.50, the variable pricing option provided a $0.25 saving for travel during the discount periods. • The toll discount is limited to bridge users who pay using an electronic transponder and the discount program applies only to weekday traffic. Of the drivers who obtained a variable toll discount, approximately 94 percent received a $0.25 discount and 6 percent received a $0.50 discount. Approximately 25 percent of all bridge users participated in the variable toll discount program. • Approximately 2.2 million vehicle trips took advantage of the toll discount program from October 2005 through March 2006, nearly a 25 percent increase over the same period a year earlier (URS Report). • Effective November 1, 2007, the toll structure on these bridges was changed to a one-way toll (for a one-year trial period), with tolls for two-axle vehicles raised to $2 but collected only in the westbound direction (heading into Cape Coral). The shoulder peak discount is $1, continuing a 50 percent toll discount. • The *Leeway* tolling system is operated by the Lee County Department of Transportation which is overseen by a 5-member Board of County Commissioners. • The Heavy Vehicle program extends the off-peak toll discount program available to light duty vehicles to vehicles with 3-or-more axles. The program became operational in December 2003. • Vehicles with 3-or-more axles pay a discounted toll when they use the Cape Coral or Midpoint Memorial Bridges during variable pricing hours. The discount was initially 50 percent. The one-way toll rates established in November 2007 continue to provide a 25 percent discount for travel during the shoulder of the peak.

Pricing on Toll Facilities	Pricing on Bridges and Variable Tolls for Heavy Vehicles in Lee County, Florida
Cost, Finance, and Revenue	• Lee County received FHWA VPPP funding of $604,000 in FY 2000, $428,000 in FY 2001, and $200,000 in 2005. • The shoulder-of-the-peak discount program does not generate positive cash flow. (TCRP Report 95) However, the intent of the program was to spread traffic from peak to shoulder times, thereby postponing by years the need for expensive bridge capacity enhancements in this rapidly growing area.
Policy/Institutional	• The discount program was designed to make better use of existing bridge capacity. • The Lee County Board of Commissioners has the administrative authority to implement the projects. • The Board decided to continue the value pricing program on these bridges after completion of FHWA's initial funding support, including the expansion to heavy vehicles.
Outreach/Acceptance	• Lee County engaged stakeholders by establishing three citizen advisory committees consisting of local bridge users and businesses to assist in project planning, design and implementation (Ward). • The focus group technique was used extensively to gauge citizen reaction to introduction of the program. Focus groups were held in March and July 1996. Initial focus group reaction was mixed to negative. Persons with limited time availability were most interested, while retirees and students expressed the least interest. Resistance to automated debiting of checking or credit card accounts was expressed, although the idea of replacing the existing bar code scanning with the use of electronic tolling was universally accepted. The idea of variable tolling by increasing tolls during peak hours was rejected as penalizing those with inflexible schedules, and violating a promise by the County Commission not to raise tolls after an increase in 1994. The idea of introducing the program with off-peak discounts was accepted. Participants indicated that toll reductions of at least 50 percent would be needed to entice people to shift travel to the shoulder of the peak. • Marketing techniques included paid radio and print media advertisements, advertising billboards, point-of-sale displays, newsletters, press releases and media kits, presentations to community groups and employers, and a web site. Newspaper articles and advertisements were found to be the most effective means of communicating the program. Direct mailings and newsletters also were found to be effective. • Extensive advertising campaigns provided information about the variable toll program. A 1999 telephone survey indicated that 90 percent of travelers in Lee County were familiar with the toll discount program (OPS/FHWA). • Marketing efforts for the extension of variable pricing to heavy vehicles began prior to implementation of pricing discounts and increased as the implementation date (December 2003) approached. • Efforts focused on informing heavy vehicle owners/operators and fleet managers of the program. • Public awareness campaign included direct mail distribution of: customer letters, a program newsletter, a self-mailing brochure and application, and press releases to the media. Posters were placed near the bridge lanes. • After the *LeeWay* tolling system was installed, an additional public awareness program was launched, including direct mailings, newspaper advertising, posters and press releases.

Pricing on Toll Facilities	Pricing on Bridges and Variable Tolls for Heavy Vehicles in Lee County, Florida
Technology	• To implement the variable toll discount program, Lee County switched from the use of optical scanning labels to a transponder (*LeeWay*) system with prepaid toll accounts. • Amtech was chosen to supply the Radio Frequency Identification (RFID) system with toll plaza readers and vehicle transponders using "off the shelf" Amtech technology. This would allow future interoperability with the Statewide SunPass system used on other Florida facilities (this occurred in 2004) (URS Report). • As of February 2005, heavy vehicles (vehicles with 3-or-more axles) were required to use the attended lanes on all bridges so attendant could manually indicate the number of axles when the toll transaction was processed. Axle counting and vehicle separation equipment was being installed at the Midpoint Bridge that would allow these vehicles to use electronic tolling lanes. The Cape Coral Bridge is scheduled for rebuilding in the near future at which point axle counting and vehicle separation equipment will be installed so vehicles with 3-or-more axles could be allowed in all lanes. • As of January 4, 2005, 653 transponders had been issued to three-or-more axle vehicles.
Equity/Environmental	• Females were more likely than males to take advantage of the discount program (Center for Urban Transportation Research, University of South Florida cited in TCRP Report 95). The percentage of eligible users not changing their travel time to take advantage of the toll discount was highest for travelers aged 35-54. (Burris, Pendyala and Swenson, 2002 cited in TCRP Report 95). Both of these findings may be associated with the finding that users making work trips were less likely to take advantage of the toll discount program than were users making nonwork trips. • Since the value pricing program had no significant impact on vehicle speeds, queue lengths at toll plazas, average vehicle occupancy, transit ridership, or accidents, there is no significant environmental impact. • Equity concerns were not expressed in either surveys or focus group conducted for this project. • The heavy vehicle program is not likely to have a significant effect on environmental quality since vehicles with 3 or more axles represent less than one percent of total bridge traffic at each toll facility.
Impacts	• Changes in traffic patterns show clearly that drivers alter their travel behavior in response to variable toll pricing, with drivers having more discretion in travel times more likely to change travel behavior. • Approximately 38 percent of eligible participants indicate that the variable pricing program had caused them to alter their tripmaking behavior since the program began(TCRP Report 95). A 1999 survey indicated that half of respondents either "always" or "sometimes" considered the discounts when planning a trip across the bridges. Surveys indicate that of those travelers who altered their time of travel, 71 percent did so at least once per week. However, that was only 32.4 percent of bridge travelers. So, for total bridge travelers, its 23 percent use it at least once per week (Burris, 2001). • Survey respondents' primary reason for obtaining a *LeeWay* account was to save time (43.7 percent), followed by obtaining variable pricing toll discounts (27.5 percent). • Greatest relative traffic shifts occurred during the pre-morning peak, with the elasticity estimate (percent change in traffic/percent change in toll cost) at the Midpoint Bridge being in the upper ranges of demand elasticities found in the literature. Elasticity estimates for other periods are much lower. Elasticity estimates range between -0.36 and -0.03 depending on the time of day. Alternative calculations using log arc elasticities show ranges from-0.02 to -0.24 (TCRP Report 95).

Pricing on Toll Facilities	Pricing on Bridges and Variable Tolls for Heavy Vehicles in Lee County, Florida
	• There was no detectible change in vehicle speeds, queue lengths at toll plazas, average vehicle occupancy, transit ridership, or accidents. There was tremendous growth in traffic at the bridges. Therefore, no change in peak-period queuing should be viewed as a success. The objective of making better use of existing capacity, thereby postponing the need for additions to capacity, was successfully achieved. • The initial intent of the heavy vehicle project was to reduce queue waiting times (heavy vehicles "can be a substantial portion of the queue"). However, since the technology was not initially available to allow heavy vehicle access to the more efficient automated lanes, queues were not reduced during the period of the evaluation study. "In fact, the overwhelming majority of changes in queuing were increases." (*Expansion of Variable Pricing*). • Traffic patterns on the Cape Coral Bridge reflect a reduction in eastbound AVI trips during the a.m. peak (2003 to 2004). For instance, trips at the 8:00 a.m. peak decreased by roughly 25 percent. Cash trips were nearly identical in the two periods, leading study analysts to conclude that variable pricing led to some reduction in peak trips by three-or-more axle vehicles. • There was a similar percentage decrease in peak AVI traffic on the Midpoint bridge, although the relationships were not as pronounced. Similarly, comparison of westbound traffic on both bridges showed a similar pattern though not enough to suggest a definitive impact of variable pricing. • In response to the survey question, "do you adjust the routes or timing of trips due to variable pricing, 50 percent of respondents indicated they do not use the ETC system (so chose "not applicable"). Of the remaining 50 percent, 4 percent indicated they frequently adjust trips and 15 percent indicated they adjust trip "occasionally." Study analysts conclude these responses tend to confirm the modest response to variable pricing by three-or-more axle vehicles. • An additional survey was conducted in February 2005 to determine two-axle vehicle bridge users' response to the expansion of the variable pricing program to heavy vehicles. In this survey, drivers who indicated they usually travel outside the peak period were asked the reason for usually traveling outside rush hour. Just over 10 percent of respondents indicated they shifted travel due to variable pricing (this was before the variable pricing program was discussed). After an explanation of the variable pricing program, 18 percent of respondents indicated they do, at least occasionally change their trip time to take advantage of the off-peak discounts.
Evaluation	• The Center for Urban Transportation Research at the University of South Florida conducted the project evaluation for the Lee County Department of Transportation. • In most cases data collected before implementation (August 1, 1998) were compared with data collected after variable pricing went into effect to determine if differences were statistically significant (at the 5 percent level). • Sources of evaluation data included traffic volume counts, speed measurements, toll plaza queue lengths, travel times, bridge user surveys, focus groups (two in 1996-before implementation, one in 1999-after implementation), and random telephone surveys of bridge users, including those eligible for the bridge toll discounts (i.e., participants in electronic toll collection) and users who were not eligible for the discount program (did not participate in electronic toll collection). Data on vehicle occupancy and transit ridership also were collected. • For the heavy vehicle program evaluation, the data base for evaluation of traffic pattern impacts included all bridge trips taken in the year before and the year after implementation of variable tolling for heavy vehicles (data collected for toll collection purposes-both cash and AVI).

Sources:

Burris, M.W., Pendyala, R.M., and Swenson, C., *Discrete Choice Models of Traveler Participation in Differential Time of Day Pricing Programs*, Transportation Research Board, Washington, D.C., 2002.

Burris, M. W., *Lee County Variable Pricing Project: Evaluation Report*, Tampa: Center for Urban Transportation Research – College of Engineering, University of South Florida, January 2001.

Burris, M.W. and Swenson, C., *Planning Lee County's Variable Pricing Program*, Transportation Research Board, January 1998.

Burris, Mark W., Cain, Alasdair, and Swenson, Chris, *Toll Price-Traffic Demand Elasticity Analysis on Variable Priced Toll Bridges*, Tampa: Center for Urban Transportation Research – College of Engineering, University of South Florida, July 1999.

Burris, Mark W., *Application of Variable Tolls on Congested Toll Road*, Journal of Transportation Engineering, ASCE/July/August 2003.

Lee County, Florida, www.leewayinfo.com.

Lee County, Florida Department of Transportation, *Expansion of Variable Pricing to Heavy Vehicles: Final Report*, CRSPE, Inc, and Cella Assoc., February 2005.

Lee County, Florida Metropolitan Planning Organization, *2030 Long-Range Transportation Plan*, December 2007, page E-11.

Office of Operations, Federal Highway Administration, *Mitigating Traffic Congestion – The Role of Demand-Side Strategies: Lee County Variable Bridge Tolls* (www.ops.fhwa.dot.gov/publications/mitig_traf_cong/lee_case.htm).

URS Corporation, *Traffic Engineer's Semi-Annual Report on the Lee County Toll Facilities for the Period ended March 31, 2006*.

Ward, Jennifer, *Value Pricing: A Synthesis of Lessons Learned*, Hubert Humphrey Institute of Public Affairs, University of Minnesota, Transportation Research Board, 2002.

Table 3.2 Illinois Tollway Value Pricing Pilot Study, Illinois

Pricing on Toll Facilities	Illinois Tollway Value Pricing Pilot Study, Illinois
Operations	• The Illinois State Toll Highway Authority implemented new tolls for trucks and cars in January 2005; Tollway operated program (operates 274 miles of toll roads in northern Illinois, most serving Chicago area). • Truck tolls increased by 100-220 percent (depending on class, plaza, time of day), with average increase 160 percent, but discounts from 25 to 33 percent were offered to trucks paying with I-Pass transponders and traveling off-peak; night travel (10-6) discounted the same amount regardless of payment method; e.g., large trucks went from typical flat mainline rate of $1.25 to $4 daytime peak (I-Pass and cash); $3 daytime off peak (I-Pass) and $4 cash; and $3 overnight (I-Pass and cash). • Passenger car tolls for cash customers also were changed: increased by 100 percent (from about $0.03 to $0.06 per mile), with no change for passenger cars paying with I-Pass transponders; overall increase across cash and electronic paying vehicles was 25 percent since 75 percent paid electronically (first 6 months 2005).
Cost, Finance, and Revenue	• FHWA VPPP funding of $750,000 was awarded in FY 2006. • Revenue generation was an important impetus for the study phase; Tollway had not increased tolls since 1983 and wanted revenues for capital plan (rehab, widening, extension); Tollway also interested in boosting electronic toll payment for possible cost saving, efficiency, and revenue gains. • Wilbur Smith Associates models used to predict revenue changes from electronic payment and varying toll schedules, predicted increase in revenues by about 50 percent under planned increase in truck rate depending on vehicle size, and with doubling of toll for cash paying passenger cars, electronic payment unchanged.
Policy/Institutional	• No new legislative authority or clearances required for Tollway to make toll changes. • Interstate toll policy issue: after a period of negotiation, a resolution approved by the Indiana tolling authority allows I-Pass customers to get the same 40-percent discount as Indiana's I-Zoom drivers (once the electronic tolling is operational); similarly, I-Zoom customers would get the same 50-percent discounts when using Illinois' Tollway system; Indiana drivers with an I-Pass transponder not required to get new I-Zoom to get the Indiana discounts ("Indiana resolves Tollway IPass dispute with Illinois").

Pricing on Toll Facilities	Illinois Tollway Value Pricing Pilot Study, Illinois
Outreach/Acceptance	• Focus Groups – Before price change, RGS contractor ran six focus groups of I-Pass and cash frequent and infrequent users of facility, in large part to assess feasibility and acceptance of possible HOT and BRT options; findings suggest new HOT lanes far preferred to pricing existing lanes, travel benefits must be substantial, neither carpooling or BRT held much attraction in HOT. • Truckers – Perceptions before price change assessed via interviews with company operators/managers; 23 interviewed on payment method and time-of-day charges; result showed preference for electronic payment and about 20 percent prefer to shift time of trip under time variable pricing but by small amount (15 minutes). • Public Hearing – Tollway held public hearing prior to adopting new tolls in September 2004. • Communication Campaign – "Aggressive sales campaign" by Tollway to promote use of electronic payment and inform users and potential users of new toll structure before and after toll change; Tollway met with "dozens of civic groups and editorial boards" to convey that congestion relief would be forthcoming if enough drivers switched to electronic payment; this message was featured on electronic Tollway billboards starting in mid-November 2004 and highlighted in various media outlets; Tollway also partnered with grocery chain, Jewel-Osco for volume retailer for transponders; between November 2003 and December 2005, Jewel-Osco accounted for nearly three-quarters of total transponder sales, as the number of active I-PASS holders increased from 1.1 million to 2.5 million (Chicago Federal Letter, April 2006).
Technology	• Pricing via vehicle mounted transponder and signal sent to transponder; toll deducted from pre-paid account; some windshields and cars with special features such as GPS require an exterior transponder (license plate tag); about three million transponders currently in use. • Refundable deposit of $10 and $40 in pre-paid tolls is charged at the time of purchase; auto-pay replenishment option available on credit card, with minimum balance and replenishment amounts calculated based on the average usage during the previous six months. • Illinois Tollway's goal was to convert all facilities from a traditional barrier system to an end-to-end open road automated tolling system (RFID technology to allow payments at highway speeds). This has been accomplished recently.
Equity/Environmental	• Evaluators speculate loss of truck trips observed "likely came" more from the smaller independent firms which cannot easily pass on increased cost to customers. • A study of changes in I-Pass ownership trends before/after price changes and the corresponding public awareness campaign concluded there was a "boost in I-PASS ownership ratios across all income groups. In fact, by February 2005 the number of I-PASS accounts nearly equaled the number of the most intensive Tollway users-those likely to be using it for their everyday commute-in the lowest-income group" However, in terms of absolute proportions of I-Pass users, income is a major determinant. The study says, "… high-income ZIP Codes (median-income among working households above $80,000) have more than twice as high a share of likely Tollway drivers as low-income ZIP Codes (less than $60,000)." (Chicago Federal Letter). • No air quality impacts estimated.

Pricing on Toll Facilities	Illinois Tollway Value Pricing Pilot Study, Illinois
Impacts	• Use of Electronic Payment – Advance publicity regarding the advantage to electronic payment and new rate structure itself appears to have increased electronic payment from about 50 percent to over 70 percent in first week after rate change (January 1, 2005); absolute increase went to 1.9 million. • Passenger Car Traffic Diverted from Tollway – Estimated at 3 percent for passenger cars (about 58,940 vehicles per day); impact on passenger car traffic was small since tolls did not go up for cars paying electronically is large proportion of car traffic; using "weighted average" of toll increase on passenger vehicles, the calculated elasticity is -0.11. • Diversion of Trucks from Tollway – Estimated at about 11 percent for trucks; using "weighted average" of toll increase, the calculated elasticity is -0.07. • Truck Diversion from the Peak Period – Was not significant; "modest time-of-day pricing incentives were not effective in shifting the time of commercial vehicle trip-making," according to evaluators; and, "distribution of truck trips by time of day changed very little"; after pricing truck company interviews (limited number – see below) indicate 51 percent of trips in the peak before, and 56 percent after, an increase in peak-period travel (Appendix F). • Trucker Reactions/Perceptions – Interviews with truck companies after toll changes (November 2005) indicated "little change" in overall use of the Tollway or the hourly trip making patterns"; reasons included "inflexibility of delivery times and ability to pass on extra costs … of tolls to their customers"; after interviews indicate "no substantial change in proportion of companies using I-Pass with main reason being much of business is through contractors or owner-operators who make the choice, though there was an increase of 13 percent in overall I-Pass transactions among trucks.
Evaluation	• Before/After Transaction Data – Toll transactions from first 6 months of 2005 compared to the same six months in 2004 before toll change to assess impacts of toll change; last six months of 2005 data not used because construction and substantial gas price changes would cloud findings. • Truck Before/After Survey – Interviews of selected trucking companies (see next point) were carried out before (January 2004)/after (November 2005) pricing, assessing changes in tolls paid, reactions to toll increase. • Trucker Survey Challenge – Among 56 truck companies selected for interview before pricing changes, representing cross section of sizes, area terminals and types of shipments; only 23 interviews were completed, even with offer of $30 and telephone, fax, e-mail possible response methods; in after pricing survey, the 23 companies responding in the before survey were contacted, but only 15 participated, obliging surveyors to add 5 new companies; evaluators indicate stated-preference surveys were feasible to administer to car passengers but not possible to administer to truckers.

Sources:

Illinois Tollway Value Pricing Pilot Study, Final Report, Wilbur Smith Associates, January 2007.

Illinois State Toll Highway Authority (2005). Press Release 03-Jan-05 and 10-Feb-05.

http://www.illinoistollway.com.

Illinois State Toll Highway Authority web information:

http://www.illinoistollway.com/portal/page?_pageid=133,1392806&_dad=portal&_schema=PORTAL.

Chicago Fed letter reference:

http://findarticles.com/p/articles/mi_qa3631/is_200604/ai_n17174749.

Indiana resolves tollway IPass dispute with Illinois, Mike Smith AP Writer, Chesterton Tribune, 6/15/07. See: http://chestertontribune.com/Northwest%20Indiana/6155%20indiana_resolves_tollway_ipass_d.htm.

Table 3.3 Variable Tolls on the New Jersey Turnpike, New Jersey

Pricing on Toll Facilities	Variable Tolls on the New Jersey Turnpike, New Jersey
Operations	• The New Jersey Turnpike Authority operates a 148-mile facility with 28 interchanges. Average daily trips exceed 500,000 vehicles. The variable pricing program was initiated in September 2000 in conjunction with a general toll increase. • The Turnpike Authority introduced E-ZPass toll technology along with the first stage of its time-of-day (TOD) pricing program. • In September 2000, the first stage of the TOD pricing program was introduced by increasing toll levels for cash users (e.g., cash tolls for passenger cars were increased by 20 percent) and peak E-ZPass users (by 8 percent), while charging off-peak E-ZPass users the same toll that was paid in 1991. • The differential between E-ZPass peak- and off-peak tolls for passenger cars amounted to an average of $0.35, or about a 7 percent reduction for off-peak travel. The differential between cash and E-ZPass off-peak averaged about $0.90, or about a 16 percent toll reduction (for adopting E-ZPass and traveling in off-peak hours). • In January 2003 second stage, the general toll level was increased, but time-of-day toll differentials were maintained. The differential between E-ZPass peak- and off-peak tolls now averaged $0.60, or an 11 percent reduction for off-peak travel. The differential between cash and E-Z Pass off-peak was $1.60, or a 25 percent toll reduction. • On average, across all interchanges the passenger peak-hour tolls in 2003 were 15 percent higher than off-peak-hour tolls. • Beginning in January 2006, peak-period toll discounts for E-Z Pass users were eliminated, but the off-peak E-Z Pass toll discounts were continued. Thus, the differential between peak- and off-peak E-Z Pass users is now the same as shown for cash users, above.
Cost, Finance, and Revenue	• FHWA VPPP funding of $477,468 was awarded to the project n FY 2001. • TOD pricing was intended to improve use of capacity, not as a revenue enhancing measure. The combination of higher peak tolls and off-peak toll discounts was use to reach revenue targets.
Policy/Institutional	• The introduction of TOD tolls had the strong support of the Executive Director of the New Jersey Turnpike Authority who wanted to develop marketing strategies that would reduce traffic flows during congested peak periods and make better use of existing Turnpike capacity. The initiative taken by the New Jersey Turnpike Authority stimulated other agencies in the Northeast to consider, and, in some cases, adopt variable toll strategies. • Existing toll agencies can successfully implement variable tolling strategies by implementing off-peak toll discounts along with scheduled toll increases.
Outreach/Acceptance	• There was considerable advertising of the pricing initiative and the program was introduced with minimal opposition from the public or various stakeholders, although there was initial opposition from truckers and the Automobile Club of New Jersey. Focus groups, public hearing, media announcements, hand outs, newsletters, all were utilized leading toward the program implementation. • Strong support was provided by several environmental/transit advocacy groups. • The TOD initiative shared media attention with the toll increase and the introduction of E-ZPass, thereby diluting the public notice it got. A 2004 survey (general public, facility users?) found that the majority of respondents (64 percent) were not aware of any discounts on the New Jersey Turnpike and only 10.5 percent were aware of discounts associated with the time of day.

Pricing on Toll Facilities	Variable Tolls on the New Jersey Turnpike, New Jersey
	• Support by top-level Turnpike Authority (and other state) officials were key ingredients in the successful introduction of TOD pricing.
Technology	• E-Z Pass toll technology was introduced in conjunction with the TOD pricing program.
Equity/Environmental	• Systemwide emissions costs were increasing between 2001-2002 and 2002-2003. After the simultaneous introduction of the first phase of TOD pricing and the E-ZPass deployment, there was a substantial reduction in vehicle emissions costs at the toll plazas as compared to vehicle emissions costs in 2000. It was not possible to isolate the emissions reducing effects of E-ZPass deployment from the effects of TOD pricing, but reductions in delays (and emissions) at toll plazas are much more likely to be related to E-ZPass deployment. • Between 2000 and 2001, there was a reduction in emissions levels as high as 10.7 percent. However, emission levels increased between 2001 and 2003, likely due to increases in overall traffic levels. • User profile by income surveys, the number of survey respondents indicating change in behavior due to pricing was so small that no meaningful results were obtained.
Impacts	• Despite the toll increases that took place when time time-of-day (TOD) pricing was introduced, there was a significant increase in overall traffic demand on the Turnpike. The rate of change in traffic demand was increasing both before and after the introduction of the new toll schedule. • Over the period before and after the first phase of TOD tolls, absolute traffic volumes during the off-peak periods increased at a faster rate (10 percent) than absolute traffic volumes during peak periods (6 percent for the a.m. peak and 4 percent for the p.m. peak). The increase in the percent share of off-peak traffic (1.1 percent) was statistically significant, as was the decrease in the percent share of peak-period traffic (1.7 percent for the a.m. peak and 3.7 percent for the p.m. peak). • After implementation of the second phase of the TOD pricing program the trend in traffic flows was reversed, with absolute traffic flows during peak periods increasing at a faster rate (15 percent and 10 percent) than the traffic increase in the off-peak period (9 percent). The percent share of peak traffic increased while the off-peak percent share decreased. • Analysts posit that the initial shift to the off-peak may reflect response to lower off-peak tolls, but the resulting increase in traffic may have led to slower traffic times, which, in turn, may have reduced the attractiveness of off-peak travel. • A disaggregate analysis was conducted to further explore the reasons for the change in travel patterns. This analysis used traffic and travel-time information for each Turnpike entry-exit pair (tracked same actual users panel style before/after or used test cars – big difference) for the period between three months before and three months after the second stage of the pricing program. The analysis indicated that commuters responded more to congestion (lower travel times) than the slightly higher tolls during the peak "…given the small differential between peak and off-peak period toll levels, most of the users prefer peak periods with lower travel times and higher tolls instead of peak shoulders with higher travel times but lower tolls." • Descriptive analysis of the impacts of TOD pricing (based on 513 passenger surveys collected in June-July 2004) indicate that 7 percent of individuals changed their travel behavior after the first phase of the program. • There was huge reduction in toll plaza delays, though this could be largely attributed to large increase in E-ZPass use.

Pricing on Toll Facilities	Variable Tolls on the New Jersey Turnpike, New Jersey
Evaluation	• Evaluation study conducted by a team from Rutgers University and the Rensselaer Polytechnic Institute. Areas covered were traffic impacts, estimation and analysis of traffic delays and emissions (using a microscopic traffic simulation model of the Turnpike), impacts of TOD pricing on travel behavior, economic value of travel-time savings, demand elasticity, and media/decision-maker reactions to the TOD pricing initiative. • Simultaneous introduction of TOD pricing and E-ZPass toll technology made it difficult to isolate the effects of TOD pricing. • The small number of passenger survey respondents indicating a change in travel behavior due to the TOD pricing initiative made it impossible to draw meaningful conclusions about demographics or behavioral choices. • TOD toll differentials can influence travel behavior, but relatively small differences in toll rates may not have a significant and long-lasting effect, particularly if time savings are realized by traveling in the peak.

Sources:

Evaluation Study of New Jersey Turnpike Authority's Time of Day Pricing Initiative, Final Report (FHWA/NJ-2005-012, May 31, 2005).

New Jersey Turnpike Authority web site, www.state.nj.us/turnpike/index.htm.

Value Pricing Project Quarterly Report, Office of Operations, Federal Highway Administration, July-September 2007.

Table 3.4 Variable Tolls on the Port Authority of New York and New Jersey (PANYNJ) Bridge/Tunnel Crossings

Pricing on Toll Facilities	Variable Tolls on the Port Authority of New York and New Jersey (PANYNJ) Bridge/Tunnel Crossings
• Operations	• Following approval by the PANYNJ Board of Commissioners, variable toll program introduced on March 25, 2001 at the two tunnels and four bridges that connect New Jersey and New York City. • The Governor of each state appoints six commissioners to the PANYNJ Board, each appointment subject to the approval of the respective state senate. The Governors retain the right to veto the actions of the Commissioners. The Board appoints an Executive Director to carry out its policies and manage day-to-day operations. • Only users of the electronic toll collection system (E-ZPass) eligible for variable toll program. • Peak periods are weekdays 6:00 a.m. to 9:00 a.m. and 4:00 p.m. to 7:00 p.m., and Saturdays and Sundays 12 noon to 8:00 p.m. • Variable toll program based on high $6 round-trip cash toll rate combined with varying E-ZPass electronic toll discounts depending on time of day. Passenger vehicles using E-ZPass enjoy a $2 off-peak discount (from the cash toll rate) and a $1 peak-period discount. A $1 carpool rate is available for passenger vehicles carrying 3 or more people. (The latest tolls doubled the dollar discount to $2 between peak and off-peak hours by eliminating E-ZPass peak period discounts. Now, cash and E-Zpass pay $8 peak rate, but E-ZPass holders pay $6 off-peak). • Trucks receive a $1 E-ZPass discount per axle in the off-peak hours and a $2.50 discount during weekday overnight hours (midnight to 6:00 a.m.). • These crossings carried average daily eastbound traffic of 352,000 vehicles, or more than 126 million eastbound (New York bound) vehicles in 2004 (115.2 million autos, 3.1 million buses, 8.2 million trucks). Tolls are collected in the eastbound direction only. In 2006, average daily eastbound traffic on these crossings totaled just over 127 million vehicles (115.5 million autos, 3.1 million buses, 8.4 million trucks).
Cost, Finance, and Revenue	• In 2000, The PANYNJ established an incremental revenue goal of $150 million annually to sustain the $14 billion in projects included in its five-year capital investment program (Muriello and Jiji). It established a two-tiered toll increase (tolls raised more in the peak than in the off-peak period) as part of the program to meet this revenue goal. However, the pricing reform was viewed less as a revenue enhancing measure than as a way of improving the use of capacity when the toll increase was enacted.
Policy/Institutional	• The PANYNJ Board of Commissioners adopted a variable toll strategy for users of the electronic toll collection system in March 2001.

Pricing on Toll Facilities	Variable Tolls on the Port Authority of New York and New Jersey (PANYNJ) Bridge/Tunnel Crossings
Outreach/Acceptance	• Initially, Port Authority leadership wanted to implement a straight toll increase to meet revenue goals. Staff of the Tunnels and Bridges unit developed analyses of both straight toll increases and a toll increase incorporating variable tolls. Analyses demonstrated that objectives of variable tolling, such as shifting traffic to off-peak periods, thereby reducing congestion costs and air quality concerns, could be met without detriment to expected revenues. This gained internal champions for the cause of variable tolling, including key PANYNJ leaders and state officials in New York and New Jersey. • Once internal agreement had been reached, the variable toll plan was made public. The external debate, as reflected primarily in news coverage and public hearings, was much more focused on the magnitude of the toll increase than on the variable tolling aspect. Newspaper coverage reflected some positive reaction to the use of congestion pricing, but considerable opposition to the size of the toll increase. • Public statements by PANYNJ to large employers and messages placed in media outlets stressed the value of flexible working hours in allowing employees to take advantage of the toll discount program. • The New York University Wagner Rudin Center for Transportation Policy and Management assessed the acceptability of the variable toll program to opinion leaders and decision-makers before and after implementation of the new toll schedule. • Two sources of information were used in making this assessment: 1) interviews with key stakeholders, opinion leaders, and decision-makers involved in establishing the new toll schedule; and 2) intense review of media statements prior to and immediately following implementation of the new toll schedule. • In general, the opinion assessment concluded that opponents and proponents of the change in toll schedule maintained their pre-implementation views after implementation.
Technology	• E-ZPass is a toll collection system that uses RFID (radio frequency identification) technology to allow a driver to pass through a toll booth and pay the toll without stopping the vehicle. The driver typically pre-pays a month's worth of tolls in advance and is issued a transponder that mounts inside the windshield. E-ZPass transponder does not send account information back to the roadside antennae. A unique transponder identification number is transmitted at roadside, and all account management and financial reconciliation is performed privately in the back office. The PANYNJ (and NJ Turnpike) charge tolls for commercial vehicles via electronic toll collection both via treadle equipment in traditional toll lanes and in highway-speed open-road tolling through road loops and advanced vehicle classification software.
Equity/Environmental	• Combined effects of E-ZPass use and the off-peak toll discount program would be expected to have some positive effect on pollution levels through reduction of peak-period congestion and waiting times at toll collection sites, though air quality impacts have not been quantified.

Pricing on Toll Facilities	Variable Tolls on the Port Authority of New York and New Jersey (PANYNJ) Bridge/Tunnel Crossings
Impacts	• Research found a statistically significant shift in weekday peak-period traffic percent share to the hours just before (5:00 a.m. to 6:00 a.m., 3:00 p.m. to 4:00 p.m.) or after (9:00 a.m. to 10:00 a.m., 7:00 p.m. to 8:00 p.m.) the peak toll rates are in effect for both autos and trucks (Evaluation Study). • Traffic shifts resulted in travel-time savings and an earlier end to the morning peak by as much as 20 minutes at certain crossings. • Overall traffic demand was dampened in 2003 due to sluggish economic conditions in New York City. This led to some shift back to the now less-congested peak periods by off-peak motorists. This may indicate that the effectiveness of a relatively small off-peak toll discount in shifting traffic out of the peak is highly correlated with the level of congestion during the peak period (Muriello and Jiji). • Weekend car and truck traffic percent share did not have a statistically significant effect on peak shoulder traffic. • Study results indicate that 7.4 percent of passenger trips and 20.2 percent of truck trips (including those that increased shipping charges or switched to E-ZPass) changed behavior because of time-of-day pricing. • Time-of-day pricing resulted in an increase on the percent share of peak shoulder traffic for both trucks and cars during weekdays, and short-term pre-peak elasticities are higher than post-peak elasticities during both a.m. and p.m. periods on weekdays for almost all of crossings.
Evaluation	• Evaluation study conducted by a team from the Rensselaer Polytechnic Institute, Rutgers University and New York University. • Three main focus areas of evaluation research: Disaggregate behavioral impacts, aggregate impacts on traffic and transit use, and public reactions to the variable toll initiative. • Focus groups (four with automobile drivers, two with truck dispatchers) and surveys were conducted with passenger car users and truck dispatchers to assess behavioral effects. A total of 505 passenger car users and 200 carriers were surveyed, using computer aided telephone interviews. • Traffic count data classified by vehicle type and hour of day at PANYNJ toll facilities before and after implementation of the new toll schedule were used to quantify effects of the variable toll program on traffic patterns, E-ZPass usage and time of day. • To avoid using traffic data affected by the impacts of 9/11/2001 and/or the various operational restrictions placed at PANYNJ facilities after 9/11, the analyses focused on the time from April-August 2001 for the period after the new toll schedule went into effect. • Media coverage of the toll increase and variable toll program was intensively reviewed.

Sources:

Holguin-Veras, Jose, et al, *Evaluation Study of Port Authority of New York and New Jersey's Time of Day Pricing Initiative*, Final Report (FHWA/NJ-2005-05, March 2005).

Mark F. Muriello and Danny Jiji, *The Value Pricing Toll Program at the Port Authority of New York and New Jersey: Revenue for Transportation Investment and Incentives for Traffic Management*, Transportation Research Record, Volume 1864 (2004).

The Port Authority of New York and New Jersey, *Comprehensive Annual Financial Report* (2004, 2006).

Rudin Center for Transportation Policy and Management, NYU Robert F. Wagner Graduate School of Public Service, *Evaluation Study of the PANYNJ's Value Pricing Initiative, Task 5: Monitoring of Media and Decision-Makers' Reactions* (January 2004).

U.S. Department of Transportation, Federal Highway Administration, *Report on the Value Pricing Pilot Program through March 2004*.

Value Pricing Project Quarterly Report, Office of Operations, Federal Highway Administration, July-September 2007.

www.panynj.gov/CommutingTravel/CustomerRelations/pdf/E-ZPass_fact_sheet.pdf.

Table 3.5 Variable Tolls on the Pennsylvania Turnpike, Pennsylvania

Pricing on Toll Facilities	Variable Tolls on the Pennsylvania Turnpike, Pennsylvania
Operations	• The Pennsylvania Turnpike Commission completed a study of value pricing strategies on urban interchanges in the Philadelphia and Pittsburgh metropolitan areas. The objectives of the study were to analyze the potential of pricing toll facilities to: 1) provide an economic incentive to shift traffic out of peak periods; 2) provide an economic marketing incentive to encourage use of electronic toll collecting; 3) promote the safe and efficient movement of traffic on the Turnpike; and 4) enhance traffic and revenue growth on the Turnpike to help meet forecasted revenue needs. • A value pricing feasibility study began in 2002 and focused on the PA Turnpike's urban ticket interchanges in Pittsburgh and Philadelphia. • Two independent analyses were conducted to address specific concerns of users. The first evaluated the potential to shift existing truck traffic from PA Route 41 to the Turnpike. The second involved the application of an across the board discount for motorcycles using E-ZPass. The motorcycle discount was eventually implemented. • A detailed profile of weekday traffic conditions were developed to provide a baseline for analysis of the impacts of value pricing. • Seven variables were identified which formed the basis of all alternatives studies and included: 1) peak-period hours of application, two or three hours; 2) area of application, urban interchanges or full Turnpike; 3) discount method, fixed or variable; 4) method of time delineation, time of entry or exit; 5) days of application, weekdays or all days; 6) vehicle applicability, passenger cars or trucks; and 7) amount of toll differential between peak and off-peak periods and between cash and E-ZPass users. • A short list of scenarios was identified for further study by PTC, and included: – Scenario 1 – Two hours during peak periods in urban areas with a fixed discount on weekdays applicable to all vehicles. For cash users rates of peak, off-peak, and night tolls rose, E-ZPass rates increased only during peak hours, other rates did not change. – Scenario 3 – Two hours per peak period on the full Turnpike with a fixed discount on weekdays applicable to all vehicles. For cash users rates of peak, off-peak, and night tolls rose, E-ZPass rates increased only during peak hours, other rates did not change. – Scenario 6 – Two hours per peak period in urban areas with a fixed discount on weekdays, applicable to all vehicles. For cash users rates of peak, off-peak, and night tolls rose, E-ZPass rates increased only during peak hours, other rates did not change. – Scenario 9 – Two hours per peak period in urban areas with a fixed discount on weekdays, applicable to all vehicles. For cash users rates of peak, off-peak, and night tolls rose, E-ZPass rates increased during peak hours but at a lower amount than scenarios 1,3, and 6, other rates did not change. – Scenario 15 – All hours on the full Turnpike with a fixed discount on all days of the week applicable to all vehicles. For cash users rates of peak, off-peak, and night tolls rose, E-ZPass rates did not change. – Scenario 17-1 – Two hours per peak period in urban areas with a fixed discount on weekdays, applicable to all vehicles. For cash users rates of peak, off-peak, and night tolls rose, E-ZPass rates increased during peak hours, other rates did not change. – Scenario 17-9 – Two hours per peak period in urban areas with a fixed discount on weekdays, applicable to all vehicles. For cash users rates of peak, off-peak, and night tolls rose, E-ZPass rates increased during peak hours but

Pricing on Toll Facilities	Variable Tolls on the Pennsylvania Turnpike, Pennsylvania
	at a lower amount than other scenarios, other rates did not change. • Based on the above pre-study of value pricing, the PTC applied for FHWA VPPP funding in 2002 to implement value pricing. • The planned phase 2 of this second study effort is to involve implementation of short-term (approximately 12 months) pilot variable pricing programs for both commercial vehicles and passenger vehicles, with emphasis on congestion management in the highly congested Philadelphia region. • The Commission has in place an existing discounted commercial hauler fare collection system for most major trucking firms that utilize the Turnpike system on a recurring basis.
Cost, Finance, and Revenue	• In FY 2001, $776,000 was awarded to study value pricing concepts on the Turnpike. In FY 2002, $800,000 was awarded for implementation of value pricing. The total VPPP funding level was $1,576,000.
Policy/Institutional	• The five-member Pennsylvania Turnpike Commission was created in 1937 by the Pennsylvania Legislature, Act 211, with the authority to construct, finance, operate and maintain a toll highway. • Concurrent with the value pricing study, the Pennsylvania Turnpike Commission (PTC) implemented electronic toll collection (E-ZPass) for travel between the ticket interchanges on its mainline system. The PTC-equipped additional lanes with E-ZPass. This work was accomplished without Federal funds.
Outreach/Acceptance	• Turnpike patrons' and stakeholders' opinion were assessed during two focus groups in Philadelphia and two groups in Pittsburgh. Most participants expressed dislike of variable time-of-travel toll rates. Commuters felt they were exercising their flexibility to travel to the maximum amount possible already. Noncommuters indicated greater likelihood to shift travel time to avoid peak-period tolls. • Each focus group was presented with 18 value pricing messages to be used in future marketing campaigns. The top three messages were: – "EZ Pass saves me time at toll plazas. Now, with value pricing I can save money too." – "Using the Turnpike is less stressful than traveling on other more congested highways." – "Value pricing is an idea whose time has come. It makes sense to use financial incentives to manage traffic congestion." • A series of interviews were conducted with regional stakeholders from PennDOT, the Turnpike Commissioners, Transportation Management Association, City officials. The results of these interviews were significant. Support dropped as the level of knowledge increased. Those with knowledge of value pricing and were close to the proposals expressed concerns of implementing a project. Support increased in direct proportion to stakeholders distance from project. • Stated-preference surveys were administered to drivers using the Turnpike within the designated VP areas. 1,800 surveys were collected and 25 trucking companies were contacted. It was found that relatively large toll differentials would be required to alter motorist travel times. Trucking companies were somewhat more favorable to the value pricing concept, as between 15 and 35 percent of respondents indicated they would shift the scheduling of trucks to take advantage of off-peak discounts or to avoid peak surcharges.
Technology	Not evaluated.
Equity/Environmental	Not addressed in this study.
Impacts	• Of the 11 scenarios tested the three highest scoring were number 3, 17-1, and 17-9.

Pricing on Toll Facilities	Variable Tolls on the Pennsylvania Turnpike, Pennsylvania
	These scored high on revenue impact and impact on interchange and mainline operations at 2002 and 2012 levels. • Scenario 3 was shown to have an annual revenue impact of an increase between 16.7 and 20.7 percent ($62,717,000 to $77,416,000) and total a.m. peak traffic impact of a percent decrease between 16.4 and 21.8 percent. • Scenario 17-1 was shown to have an annual revenue impact of an increase between 19.9 and 24.5 percent ($74,696,000 to $91,657,000) and total a.m. peak traffic impact of decrease between 16.4 and 21.8 percent. • Scenario 17-9 was shown to have an annual revenue impact of an increase between 19.4 and 24.0 percent ($72,757,000 to $89,873,000) and total a.m. peak traffic impact of decrease between 14.3 and 20.2 percent. • An analysis of commercial vehicle only night-time discount value pricing scenarios was completed. Under all scenarios tested, the net revenue loss to the Turnpike was minimal, under the highest percent estimated net revenue loss amounted to 1 percent of total system toll revenue, the lowest percent loss was 0.3 of total system revenue. The net impact on commercial volumes in night-time periods ranged from an increase of 0.2 percent to 0.7 percent as a result of an off-peak discount. • An analysis of the potential for shifting heavy truck traffic from PA Route 41 to the PA Turnpike using discounted toll rates for commercial traffic was completed. Findings showed that the additional time and distance truck drivers would incur using the Turnpike cost them nearly $20 more than using the current Route 41 trip. Thus, after offering toll rate reductions of up to 50 percent on the Turnpike, less than 50 trucks per day were estimated to shift current routing. The net toll revenue impacts was estimated to be a loss of $160,000 at 2003 levels. • An estimate of the toll revenue impacts of providing discounts of 15 to 50 percent for E-ZPass motorcycle patrons was completed. At the highest level of discount (50 percent) the net revenue loss was estimated to be 0.1 percent of total system revenue. As a result, a motorcycle E-ZPass reduction of 25 percent was implemented on July 1, 2003. • Despite the prediction of favorable results the turnpike decided not to adopt variable tolls.
Evaluation	• A detailed logit model was developed based on stated-preference surveys and used to determine the shift potential (of travel to off-peak periods and from cash to E-ZPass users). A regional Turnpike model also was developed to determine toll sensitivity of motorists.

Sources:

Pennsylvania Turnpike Commission, *Summary Report: Pennsylvania Turnpike Value Pricing Study*. Prepared by Wilbur Smith Associates. March 2004.

http://knowledge.fhwa.dot.gov/cops/hcx.nsf/All+Documents/750C4F311CB4924A85256DC500657FE0/$FILE/Summary PA Turnpike Final Report.pdf.

4.0 Regionwide Variable Pricing Initiatives

Table 4.1 Feasibility of Value Pricing in Maryland

Regionwide Pricing Initiatives	Feasibility of Value Pricing in Maryland
Operations	• An 18-month regional pricing study was initiated by the Maryland Department of Transportation in 1999. • The study's objective was to determine the feasibility of a broad range of variable pricing strategies and to develop a series of recommendations for implementation. Possible pilot projects identified for the initial examination included: – I-270 between the Capital Beltway and Frederick County (converting existing HOV lanes to HOT lanes); – U.S. 50 in Prince George's County (converting to-be-constructed HOV lanes to HOT lanes); – Memorial "Bay" Bridge (higher-peak tolls to shift traffic to off-peak times); – Maryland portion of the Capital Beltway (I-495/I-95); – MD 210; – I-95 (between Capital and Baltimore beltways); – Fort McHenry Tunnel; – Baltimore Harbor Tunnel Thruway; – Francis Scott Key Bridge; and – I-95 between the Fort McHenry Tunnel and the Delaware state line. • Early study findings were presented in public hearings in early 2001. Although Maryland's study team had worked closely with a Stakeholder Committee and a Steering Committee to assess the interests of all road users in Maryland, public reaction, as reflected in newspapers and on the radio, was quite negative. Opposition was particularly focused on the possibility of HOT lanes being included in the study's recommendations. As a result the Governor issued a press release on June 21, 2001, calling for the removal of any proposals to study or implement HOT lanes. The Governor's view was that HOT lanes were inequitable and linked an easier commute to a person's ability to pay. The study was stopped and a final report was not issued (Walton, 2005). • In the fall of 2002, the Governor's Office of Smart Growth initiated a revised feasibility study of value pricing options, with a focus on equity issues that arose in the earlier review. The revised study scope included potential use of "credits" or FAIR lanes, use of smart card technology, development of a plan for Public outreach, definition of a concept test plan, and development of an implementation plan and evaluation process. • By 2004, planning studies for several highway projects in Maryland incorporated HOT lane facilities, including new toll lanes being considered on I-270, I-495 (Capital Beltway), I-695 (Baltimore Beltway) and I-95 north of Baltimore. Because these are to be newly constructed facilities the terminology "Express Toll Lanes," is being used to describe them and potentially all vehicles may pay a fee for entry into the

Regionwide Pricing Initiatives	Feasibility of Value Pricing in Maryland
	lanes. • In July 2005, a Value Pricing Pilot program was executed between FHWA, MDOT, and the Maryland Transportation Authority (MdTA) to authorize collection of tolls on new express lanes on the I-95/JFK Expressway in Baltimore. This project is scheduled for completion in 2011. Study is underway for improvement of an additional 10-mile section immediately north of these express lanes, with a possibility of the express lanes being extended. • In 2007, the Maryland State Highway Administration continued with its examination of priced lanes (now being termed managed lanes) on I-270 and I-495 from the I-270/I-370 interchange to the I-495/SR 193 interchange in Virginia. The corridor being studied would connect Maryland's Intercounty Connector (a planned toll facility) with planned I-495 HOT lanes in Virginia.
Cost, Finance, and Revenue	No information
Policy/Institutional	• The Maryland State Assembly reinforced the road pricing examination in its 2001 session by directing the MDOT to examine the potential of variable pricing strategies in highway project planning. • MDOT worked with relevant County and city agencies and Transportation Management Associations in the identified areas, including formation of advisory committees to assist in review of technological options, aid in public outreach and partnership building and contribute ideas and expertise on the design of potential pilot tests.
Outreach/Acceptance	• Public outreach has been a key element of all of the pricing efforts in Maryland, including project brochures, web sites, public meetings, hearings, open house workshops, and local advisory groups.
Technology	• The HOT lane projects on I-270 in Montgomery County and to-be-constructed HOV lanes along U.S. 50 in Prince Georges County would involve the use of monthly "hang tags" serving as passes for entry into existing HOV lanes. Similar to the early version of I-15 in San Diego.
Equity/Environmental	• Because of the history of pricing project development in Maryland, equity has been a major focus of studies and implementation efforts.
Impacts	Impact information unavailable.
Evaluation	• Phase I of the regional pricing study screened alternative pricing strategies to determine which might be appropriate in each corridor and which could be eliminated. • Phase II included technical studies, including travel demand modeling, pricing strategy development, toll collection technologies, enforcement options, equity concerns, legal issues, infrastructure requirements, and lane separation methods.

Sources:

MDOT to Hold Workshops on Variable Pricing Study, Baltimore Regional Partnership Newsletter, January 16, 2001.

Office of Operations, Federal Highway Administration, *Value Pricing Project Quarterly Report*, July-September 2007.

Value Pricing: History and Experience, Regional Value Pricing Corridor Evaluation and Feasibility Study, North Central Texas Council of Governments, June 2005.

Walton, George, *Maryland's Express Toll Lanes – An Alternative to Gridlock*, Breakout Session of the 12th International HOV System Conference: Improving Mobility and Accessibility with Managed Lanes, Pricing, and BRT: Conference Proceedings (Houston, Texas: April 18-20, 2005).

Table 4.2 FAST Miles in the Twin Cities, Minnesota

Regionwide Pricing Initiatives	FAST Miles in the Twin Cities, Minnesota
Operations	• The Minnesota Department of Transportation is initiating a project to explore the feasibility of implementing the "FAST Miles" pricing concept in the State. • The project's goals are to explore the feasibility of this innovative pricing concept to eliminate recurring congestion on limited-access highway systems using a possibly more publicly acceptable form of road pricing, along with an integrated multimodal strategy to encourage shifts of solo-driving commuters to alternative modes. • The project was originally expected to begin in spring 2007, though the anticipated start date is now spring 2008. • Under the FAST Miles concept, each motorist is provided a number of dollar credits per month, which can be applied to use priced lanes. Once credits are exhausted, the motorist is then charged the going rate to use the priced lanes. • FAST Miles is intended to promote carpooling by allowing motorists to "pool" individual credits. Depending on road use charges, savings for carpoolers and public transit users can be substantial. Occupants of multiple occupancy vehicles are rewarded by both improved access to free flowing traffic lanes and lower use costs. • Unused toll credits can be rebated through reduced vehicle registration fees or property taxes. • The project team is prepared to solicit proposals from private sector and academic partners to execute the first phase of this project since receiving funding in FY 2006.
Cost, Finance, and Revenue	• VPPP grant totaled $60,000 in FY 2006 for outreach and implementation test.
Policy/Institutional	• A panel of pricing experts and local officials will be established to examine the benefits and barriers to implementing FAST Miles.
Outreach/Acceptance	• A task force of national, state, and local leaders will be assembled, with representatives from the VII (Vehicle Infrastructure Integration as per the ITS Joint Program Office initiative) coalition.
Technology	No information available.
Equity/Environmental	No information available.
Impacts	No information available.
Evaluation	No information available.

Sources:

Value Pricing Program Quarterly Report: 3rd Quarter 2007. Federal Highway Administration, Office of Operations (September 2007: Washington, D.C.).

http://www.ops.fhwa.dot.gov/tolling_pricing/value_pricing/quarterlyreport/qtr3rpt07/pdf/qtr3rpt07.pdf.

Table 4.3 Regional Network of Value Priced Lanes in Virginia

Regionwide Pricing Initiatives	Regional Network of Value Priced Lanes in Virginia
Operations	• The study of the potential for value pricing in the Washington region, analyses several different scenarios for adding new priced highway lanes, pricing existing highways, and enhancing bus services. • Since the project was funded by the FHWA in 2003, the National Capital Transportation Planning Board has made substantial progress in examining such a network through a variety of efforts, including: hosting a value pricing conference; the establishment of a TPB value pricing task force; the adoption of goals for a regional system of variably priced lanes; and the inclusion o three major variably priced projects in the constrained long-range regional transportation plan (CLRP). • This study evaluated the potential benefits and performance of a regional network of variably priced lanes. Tasks performed include: – Scenario Development – Development and refinement of three variably priced lanes scenarios. – Scenario A – Add two new toll lanes to each direction of every freeway in the region. Add one toll lane in each direction to major arterials outside the beltway. This scenario only tolls new capacity. – Scenario B – Starting from Scenario A, toll all D.C. river crossings, remove added VPLs from the District and instead toll all lanes of the freeways. Link tolled freeways with additional tolled facilities. Relieve bottlenecks in the variably priced network outside the beltway by adding additional tolled lanes. – Scenario C – In addition to Scenario B, toll the existing parkways in the region. • Scenarios AP, BP and CP are prioritized versions of Scenarios A, B and C, where priced lanes are removed based on lack of demand. • The enhanced transit scenarios APT, BPT and CPT include enhancements to the transit networks that use the variably priced lanes. APT and BPT include reduced run times and headways on existing (2030) bus routes that can operate on the value priced lanes. CPT includes enhanced and new bus routes that operate on the region's parkways. • Scenario Analysis: assessment of potential demand and revenue; potential costs; viability of transit; measures of effectiveness; land use impacts; and connectivity to the regional core and activity clusters. • Assessment of Impacts of Pricing Scenarios on Different Populations: A study of how the pricing scenarios may impact traditionally transportation-disadvantaged groups, including low-income populations, minorities and persons with disabilities. • Initial analysis of "Starting Point" Scenario aimed to ensure free flow and toll rates were varied significantly by segment, direction and time of day. PM peak tolls ranged from $0.20 to $4 per mile in 2010 dollars. • Sensitivity tests of impacts of transit enhancements to portions of the VPL network. Interested in seeing potential changes in: Toll rates, Total revenue, HOV usage, Vehicle miles traveled (VMT), Transit mode-share, and Speeds on mixed use lanes. • Next steps of regional study under the grant from FHWA Value Pricing Pilot Program are to incorporate D.C. bridges and other facilities into an expanded test network, conduct additional sensitivity tests and microsimulation studies, and analyze land use impacts (RMAS).

<table>
<tr><th>Regionwide Pricing Initiatives</th><th>Regional Network of Value Priced Lanes in Virginia</th></tr>
<tr><td>Cost, Finance, and Revenue</td><td>

In 2005, the FHWA awarded in $240,000 in VPPP funding.
Breakdown of costs for the variably priced scenarios, in millions.

<table>
<tr><th>Cost/Scenario</th><th>A</th><th>B</th><th>BP</th><th>C</th><th>CP</th></tr>
<tr><td>New VPL to VPL Interchange</td><td>$7,700</td><td>$7,000</td><td>$6,400</td><td>$7,000</td><td>$6,400</td></tr>
<tr><td>New VPL to GPL Interchange</td><td>$22,700</td><td>$22,700</td><td>$20,100</td><td>$22,700</td><td>$20,100</td></tr>
<tr><td>Widened non-VPL Interchange</td><td>$0</td><td>$0</td><td>$0</td><td>$0</td><td>$0</td></tr>
<tr><td>Non-Separated New VPL</td><td>$0</td><td>$0</td><td>$0</td><td>$0</td><td>$0</td></tr>
<tr><td>New VPL Lane Mile</td><td>$32,900</td><td>$30,700</td><td>$20,900</td><td>$30,700</td><td>$20,900</td></tr>
<tr><td>Converted Existing Lane Mile</td><td>$1,500</td><td>$2,100</td><td>$2,100</td><td>$3,600</td><td>$3,600</td></tr>
<tr><td>Total</td><td>$64,800</td><td>$62,500</td><td>$49,500</td><td>$64,000</td><td>$50,900</td></tr>
</table>

Twenty-Year Revenues, in millions, $2010, based on 2030 demand.

<table>
<tr><th>Jurisdiction\Scenario</th><th>A</th><th>B</th><th>BP</th><th>C</th><th>CP</th></tr>
<tr><td>Washington, D.C.</td><td>$800</td><td>$10,200</td><td>$10,000</td><td>$11,700</td><td>$11,800</td></tr>
<tr><td>Maryland</td><td>$20,800</td><td>$22,800</td><td>$19,300</td><td>$33,000</td><td>$30,300</td></tr>
<tr><td>Virginia</td><td>$12,700</td><td>$12,800</td><td>$12,100</td><td>$15,100</td><td>$15,000</td></tr>
<tr><td>Regional</td><td>$34,300</td><td>$45,800</td><td>$41,500</td><td>$59,800</td><td>$57,100</td></tr>
</table>
</td></tr>
<tr><td>Policy/Institutional</td><td>National Capital Region Transportation Planning Board Value Pricing Task Force created in the fall of 2003 to examine the benefits of value pricing for the Washington region. Goals approved by TPB in April 2005.</td></tr>
<tr><td>Outreach/Acceptance</td><td>Not addressed in this study.</td></tr>
<tr><td>Technology</td><td>This study utilizes the TPB regional travel demand model to forecast the demand and performance characteristics of a network of variably priced lanes for a series of scenarios. The model represents the region's jobs and households with over 2000 transportation analysis zones (TAZ), and includes tens of thousands of links in highway and transit networks. Each model run takes approximately 16 hours of computer processor time.</td></tr>
</table>

<table>
<tr><th>Regionwide Pricing Initiatives</th><th>Regional Network of Value Priced Lanes in Virginia</th></tr>
<tr><td>Equity/Environmental</td><td>Example of results from the demographic assessment of the 2006 CLRP.
<table>
<tr><th colspan="4">Number and percent of minority, low-income and disabled individuals located in areas experiencing change in accessibility to jobs by automobile, 2002 to 2030</th></tr>
<tr><th>Change in jobs within 45 minutes by automobile</th><th>Moderate to Significant Loss (<- 100,000)</th><th>Minimal Change (-100,000 to 100,000)</th><th>Moderate to Significant Gain (>100,000)</th></tr>
<tr><td>General Population</td><td>958,000
21%</td><td>2,819,000
62%</td><td>768,000
17%</td></tr>
<tr><td>African American</td><td>448,000
36%</td><td>598,000
48%</td><td>193,000
16%</td></tr>
<tr><td>Asian</td><td>48,000
15%</td><td>205,000
64%</td><td>68,000
21%</td></tr>
<tr><td>Hispanic/Latino</td><td>90,000
21%</td><td>252,000
60%</td><td>80,000
19%</td></tr>
<tr><td>Low-Income</td><td>134,000
28%</td><td>251,000
52%</td><td>100,000
21%</td></tr>
<tr><td>Disabled</td><td>154,000
24%</td><td>375,000
58%</td><td>113,000
18%</td></tr>
</table></td></tr>
<tr><td>Impacts</td><td>

Initial results of the impacts of enhancing transit service levels on Beltway and I-95/395 HOT Lane transit routes concluded the following impacts:

Decrease in toll rates and HOV use;
Increase in transit use;
Slight increase in VMT;
Total revenue essentially unchanged; and
Slight increase in speeds on mixed use lanes;
Findings to date include:
Toll levels will have to vary by segment, direction and time of day;
Transit services will affect demand and toll levels, and need to be explicitly incorporated;
Full network of VPLs has higher value than the sum of the individual segments (the “network effect”);
Access and egress issues need to be addressed; and
Summary of changes in measures of effectiveness across scenarios, as a percentage change from the base 2006 CLRP.

<table>
<tr><th></th><th colspan="5">Scenario</th></tr>
<tr><th></th><th>A</th><th>BP</th><th>B</th><th>C</th><th>CP</th></tr>
<tr><td>Regional VMT</td><td>4%</td><td>2%</td><td>3%</td><td>2%</td><td>2%</td></tr>
<tr><td>HOV Use</td><td>12%</td><td>17%</td><td>9%</td><td>9%</td><td>5%</td></tr>
<tr><td>Transit Use</td><td>3%</td><td>5%</td><td>5%</td><td>6%</td><td>6%</td></tr>
<tr><td>Annual System Toll Revenue[a] (Millions)</td><td>$1,700</td><td>$2,100 (21%)</td><td>$2,300 (33%)</td><td>$3,000 (74%)</td><td>$2,900 (67%)</td></tr>
<tr><td>Average Bridge Toll[b]</td><td>N/A</td><td>$2.61 (-4%)</td><td>$2.70</td><td>$3.00 (15%)</td><td>$2.97 (-1%)</td></tr>
</table>
[a]Compared to Scenario A; [b]Compared to Scenario B.</td></tr>
</table>

Regionwide Pricing Initiatives	Regional Network of Value Priced Lanes in Virginia
Evaluation	• Study scenario assumptions include: – All scenarios are for the year 2030, and all toll values and revenue calculations are in 2010 dollars. – Variable tolls will be used on the lanes to prevent congestion and maintain freely flowing traffic. – Occupancy requirements for all HOV lanes will be increased to at least three people or more, based on planning assumptions in the region's long-range plan. – The variably priced facilities will be physically separated from the other lanes, where possible. – Access and egress points will be primarily focused around the regional activity clusters. – At least one variably priced lane will be provided in the peak direction.

Sources:

Ron Kirby, Director of Transportation Planning Metropolitan Washington Council of Governments, *An Analysis of a Regional System of Variably Priced Lanes in the Washington Region – Initial Results*. Presentation to the TPB Technical Committee, November 3, 2006

http://www.mwcog.org/uploads/committee-documents/tlhcVlk20061027140630.pdf.

National Capital Region Transportation Planning Board, *Evaluating a Network of Variably Priced Lanes for the Washington Metropolitan Region*. Draft for Discussion, December 5, 2007.

http://www.mwcog.org/transportation/meetings/detail.asp?COMMITTEE_ID=130&EVENT_ID=3843&MONTH_CHOICE=1&DAY_CHOICE=30&YEAR_CHOICE=2008.

5.0 Making Driver Costs Variable

Table 5.1 Simulation of Pricing on Atlanta's Interstate System and GA 400 Variable Pricing Institutional Study in Atlanta, Georgia

Making Driver Costs Variable	Simulation of Pricing on Atlanta's Interstate System and GA 400 Variable Pricing Institutional Study in Atlanta, Georgia
Operations	*GA 400 Variable Pricing Institutional Study in Atlanta in Atlanta* • The State Road and Tollway Authority (SRTA), is proposing to study the institutional challenges and feasibility of moving from a fixed-priced toll to a variably priced toll system of GA 400 Extension. • The GA 400 extension is a 6.2-mile tolled facility located in Fulton County, Georgia and provides a critical link between the northern portion of Atlanta's Bypass (I-285) and I-85 en route to downtown Atlanta. • SRTA will examine the introduction of two different methods of variability: 1) varying the prices charged to GA 400 Extension users by method of payment (electronic toll collection versus cash); and 2) varying the prices charged to GA 400 Extension users by time of day. • The goal of this variable pricing study is to examine the feasibility and viability of using variable pricing techniques to shift traffic congestion on the GA 400 Extension and on the rest of the GA 400 corridor. • The major tasks of the proposal include thorough examination of the Toll Authority's internal processes and procedures; legal, contractual and bond covenants; conceptual traffic and revenue forecasts necessary to meet financial obligations; and development of an implementation plan. The study will produce reports identifying key issues as well as model documents for other toll authorities considering similar conversions. • Pre-implementation study funds were awarded in 2006. *Simulation of Pricing on Atlanta's Interstate System* • The purpose of the Commute Atlanta Study is to allow evaluation of the impacts of pricing policies on travel behavior, and will provide data from real-world experience to improve the ability of regional travel demand models to estimate the impacts of various types of pricing alternatives. • The Commute Atlanta study is the largest instrumented vehicle travel behavior study ever conducted. • The Phase I test was designed to assess the effects of converting fixed automotive insurance costs into variable driving costs by monitoring one full year of baseline travel activity for approximately 285 participating households. Approximately 500 vehicles in these households are equipped with instrumentation that monitors the vehicle speed and position for every trip. Travel diaries and employer commute options surveys were collected from each participating household and employer (as well as from a control group). The one-year baseline data collection effort began in August 2003. • The Phase II effort of the Commute Atlanta study ran from October 2005 through June 2006. In Phase II of the study, the impact of mileage-based insurance incentives was examined. Households that reduce their household miles of travel will receive quarterly insurance rebates in accordance with their mileage-based rate schedule

Making Driver Costs Variable	Simulation of Pricing on Atlanta's Interstate System and GA 400 Variable Pricing Institutional Study in Atlanta, Georgia
	(annual insurance premium divided by baseline mileage). Households that continue their pre-existing driving patterns or increase travel will not be penalized. • In Phase III, risk-based incentives (insurance rebates as a function of where, when, and how the vehicles are driven) will be examined. The research team will monitor the changes in driving patterns and will use statistical analyses of household characteristics, vehicle travel, and relevant employer survey data (parking costs, transit accessibility, etc.) to examine the relationships between the incentives offered and subsequent travel behavior changes. • Also in Phase III, real-time congestion pricing will be implemented for approximately 100-120 participating vehicles. Phase III uses a similar simulation approach. However, in this effort a 20 cent per-mile congestion surcharge will be assessed to commute trips undertaken under congested freeway conditions (speeds < 40 mph). Households that shift their commute travel out of peak congested periods will retain a significant portion of the incentive account. • In May 2007, Phase III recruitment of new participants began with deployment in June 2007. The re-recruitment process for the 49 Phase III candidate households that currently are in the study continued. The existing households will begin the pricing experiment in May 2007, while the new households are being recruited, allowing the research team to obtain preliminary estimates of incentive disbursements for the larger sample that will follow in June 2007.
Cost, Finance, and Revenue	*GA 400 Variable Pricing Institutional Study in Atlanta* • In 2005, the FHWA awarded $444,000 in pre-implementation study funds. *Simulation of Pricing on Atlanta's Interstate System* • In 2004, the FHWA awarded $1,180,863 in pre-implementation study funds.
Policy/Institutional	*Simulation of Pricing on Atlanta's Interstate System* • The Georgia Institute of Technology, School of Civil and Environmental Engineering currently is conducting the Commute Atlanta Study.
Outreach/Acceptance	*GA 400 Variable Pricing Institutional Study in Atlanta in Atlanta* • Public Outreach – Resources will be provided to hold workshops and town hall style meetings along the GA 400 corridor to educate and receive input from citizens, businesses, and other interested parties on the potential for changing the toll characteristics of the GA 400 Extension.
Technology	*Simulation of Pricing on Atlanta's Interstate System* • The volunteer households have installed a GT Trip Data Collector in their vehicles. In total, 500 instrumented vehicles will be included in the study. • The on-board instrumentation and data transmission protocols employed in the Commute Atlanta Study were developed by a partnership between Georgia Tech, Altius Solutions, and Cingular Wireless. The instrumentation and software were designed to Georgia Tech specifications and provide a very robust data collection solution. The on-board equipment tracks second-by-second vehicle position, speed, acceleration, and up to 10 engine and emissions-related parameters. Six additional data lines can allow researchers to collect information from on-off sensors (e.g., seat-belt use or windshield wiper status) and could be used to turn on or off additional on-board devices. Data are transmitted via a cellular connection and a communications port enables the on-board equipment to send and receive data to and from almost any additional computing or scientific device carried on-board the vehicle. To date, the researchers have demonstrated this capability by collecting and integrating data from a SEMTECH-D (by Sensors, Inc.) on-board emissions measurement system and have connected the equipment to monitor the engine

Making Driver Costs Variable	Simulation of Pricing on Atlanta's Interstate System and GA 400 Variable Pricing Institutional Study in Atlanta, Georgia
	computers on a MARTA bus.
Equity/Environmental	*GA 400 Variable Pricing Institutional Study in Atlanta in Atlanta* • Equity Analysis- Resources will be provided to analyze the most current socioeconomic data for the GA 400 corridor. An equity analysis tool developed by Georgia Tech for SRTA's use in analyzing the equity impacts of toll facilities will be used to determine any equity issues that should be addressed by SRTA. • Air Quality – Resources will be provided to perform preliminary estimates of air quality emissions changes on the GA 400 Extension using a variably priced toll collection system. Data collection and modeling will be performed to determine the potential air quality benefits derived from this operational change. *Simulation of Pricing on Atlanta's Interstate System* • The research team established income, household size, and vehicle ownership groupings that reflect the distribution of households in the Atlanta region. A specific number of single-person, middle-income, single-automobile households are targeted for inclusion in the study.
Impacts	*GA 400 Variable Pricing Institutional Study in Atlanta in Atlanta* • Preliminary results are not available at this time. *Simulation of Pricing on Atlanta's Interstate System* • Results from Phase II of the Commute Atlanta Study revealed that more than half of the households reduced their travel and more than $15,000 in incentive checks for associated with decreased travel were issued. The research team currently is undertaking detailed case study and statistical analyses of household travel response (by trip type) as a function of household demographics, travel mode constraints, and relevant employer incentives (parking costs, transit accessibility, etc.) to examine the relationships between gasoline price increases, the incentives offered, and changes in travel behavior changes.
Evaluation	*Simulation of Pricing on Atlanta's Interstate System* • Households were selected for participation through a random-stratified sampling process. NuStats, a nationally-recognized travel survey consulting firm, worked with Georgia Tech to conduct the household recruitment.

Sources:

State Road and Tollway Authority of Georgia, *GA 400 Variable Pricing Institutional Study*. FHWA Value Pricing Pilot Program Integrated 10-Point Detailed Proposal (DP) and 6-Point Sketch Plan (SP), Submitted March 15, 2005.

http://www.knowledge.fhwa.dot.gov/…/$FILE/9%20GA%20SR%20400%20Institutional%20Study.pdf

Commute Atlanta Study, Update September 5, 2003.

http://knowledge.fhwa.dot.gov/cops/hcx.nsf/All+Documents/576F0BF7699DFB7385256DC5006AEF58/$FILE/Commute%20Atlanta%20Overview.pdf.

Georgia Institute of Technology, *Commuter Choice and Congestion-Based Pricing on Atlanta's Interstate System*. Submitted to the Federal Highway Administration of the U.S. Department of Transportation. Prepared by Randall Guensler and Jennifer Harper Ogle, Atlanta, Georgia, July 15, 2004.

http://knowledge.fhwa.dot.gov/cops/hcx.nsf/All+Documents/576F0BF7699DFB7385256DC5006AEF58/$FILE/GA%20Pricing%20Atlantas%20Interstate.pdf.

Commute Atlanta Study web site, available at http://commuteatlanta.ce.gatech.edu/.

Ogle, J., Guensler, R., and V. Elango (2005). *Commute Atlanta Value Pricing Program: Recruitment Methods and Travel Diary Response Rates*, Transportation Research Record No. 1931; pages 28-37. National Academy of Sciences; Washington, D.C.

http://commuteatlanta.ce.gatech.edu/Resources/05-2504.pdf.

Elango, V., R. Guensler, and J. Ogle. Day-To-Day Travel Variability in the Commute Atlanta Study. 86th Annual Meeting of the Transportation Research Board, Washington, D.C., January 2007.

http://commuteatlanta.ce.gatech.edu/Resources/07-0538.pdf.

Table 5.2 Mileage-Based User Fee Regional Outreach and Variablization of Fixed Automobile Costs in Minnesota

Making Driver Costs Variable	Mileage-Based User Fee Regional Outreach and Variablization of Fixed Automobile Costs in Minnesota
Operations	• The Minnesota Department of Transportation completed a demonstration project to simulate effects on vehicle-use from conversion of certain fixed costs of owning and operating an automobile to variable per-mile costs, such as lease costs and insurance premiums. • The project's goals were to: simulate explicit price signals about travel decisions; to better understand transportation price elasticities and how they vary by vehicle ownership/lease arrangement, income, location, annual mileage driven and other factors; to gauge driver acceptance of user-based fees and the appropriate price signals necessary to affect travel behavior changes; and to identify strategies that may be employed to institutionalize the policies and techniques learned during the demonstration. • The project is known as the Pay-As-You-Drive pilot and involved a market assessment and an experimental field test. Both studies helped estimate the level of interest in the pay-as-you-drive approach, the nature of the market for the concept, the response of drivers to price signals (price elasticities) that are based on miles driven, and the overall effect of the program on vehicle-miles traveled and traffic congestion. *Pay-As-You-Drive Market Assessment* • Market study included telephone survey of 401 randomly selected households in the Twin Cities region, a telephone survey of 100 additional households with recent experience with vehicle leasing. • 297 self-selecting households (of the 401 random selection) with vehicle acquisition and insurance tradeoff questions complete a supplemental stated-preference mail survey. *Pay-As-You-Drive Field Test* • Experimental field test included 130 participants whose travel behavior was measured under priced and nonpriced conditions in a longitudinal study. The 130 participants were divided into: 1) several experimental groups for which per-mile pricing was simulated; and 2) a control group. The experimental group was given an account based on the number of miles they drove during a one-month control period. The account was debited based on per-mile charges. Participants kept any money left in the account at the end of the experiment period. • Participants also were post-surveyed to assess attitudes and propensity towards pay-as-you-drive products. • Pricing protocols were assigned randomly and ranged from $0.05 to $0.25 per mile. • Pricing structure for experimental groups was varied for peak and nonpeak travel. • Participants self-reported odometer readings for other nonpriced household vehicles so that the impact of vehicle substitution could be measured.
Cost, Finance, and Revenue	• VPPP grant totaled $1,050,931 in FY 2001.
Policy/Institutional	• This was a limited experiment, with no broad institutional requirements.
Outreach/Acceptance	• Participants were surveyed regarding their acceptance of the pay as you drive concept.

Making Driver Costs Variable	Mileage-Based User Fee Regional Outreach and Variablization of Fixed Automobile Costs in Minnesota
Technology	• The electronic device, CarChip, was plugged into the vehicle's OBD II port and recorded data about each trip the participant made, including mileage and time of travel. Participants mailed the CarChip's back to the study team on a periodic basis, and were then given electronic statements of their activity.
Equity/Environmental	Not evaluated.
Impacts	*Pay-As-You-Drive Field Test* Measurable impacts of the study included: • Average miles per vehicle, per day declined 8.1 percent, between unpriced and priced travel periods, during weekends. Mileage fell 6.6 percent during weekday peak-period travel times. In all other comparison cases, the average mileage during priced periods was lower than for unpriced periods. • The time-of-day pricing treatments show inconsistent results, with some of the highest pricing levels showing increases in the average daily miles traveled. Average daily mileage for vehicles priced at $0.05 per mile and for vehicles priced at $0.20 per mile was 12 percent and 23 percent higher, respectively, than the average unpriced mileage. These results may be due to small sample sizes. • Driving behavior also was measured through a regression analysis that sought to relate reductions in average daily mileage to the peak and off-peak charges, time period of the experiment, vehicle characteristics (such as the level of comfort), and socioeconomic characteristics of the household (age, income, vehicle availability, and attitudes toward driving in general and associated costs). The following conclusions can be drawn from this analysis: – The higher the peak price is, the higher is the reduction in average daily mileage. The negative coefficients of the peak price variables indicate that relative to a base peak price of $0.05 per mile, pricing at higher rates causes households to reduce their driving of the priced vehicle(s). – If one or more unpriced vehicles are available, a household may shift some of the driving from the priced to the unpriced vehicle(s). The coefficient of "unpriced vehicles in households" is negative, indicating a substitution effect between vehicles available within households. – If one or more vehicles in the household are leased, the household is very likely to reduce driving. This effect is strong, likely because households that already are used to leasing autos are more aware of the associated costs. *Pay-As-You-Drive Market Assessment* Market research surveying 410 metro area drivers regarding the potential for mileage-based leasing products found that: • Three-quarters of the drivers who said they are definitely planning to lease their next vehicle also are interested or very interested in participating in a mileage-based program. Two-thirds of drivers who say they will probably lease their next vehicle are interested or very interested in the concept. • Overall, 25 percent of the original metro area drivers surveyed said they were interested or very interested in a mileage-based program, and 30 percent of those in the lease over-sample group were interested or very interested. • The vast majority of drivers own the vehicles they use and plan to purchase (not lease) their next vehicle.

Making Driver Costs Variable	Mileage-Based User Fee Regional Outreach and Variablization of Fixed Automobile Costs in Minnesota
	• Although drivers say they want to reduce the cost of owning and operating their vehicles, they are generally unwilling to modify their habits to accomplish this. • Respondents were asked in a stated-preference survey to choose among a standard insurance option and two mileage-based options (one with higher fixed monthly cost and a lower mileage-variable cost or one with a lower fixed monthly cost and a higher mileage-variable cost). The standard insurance option was the most preferred, with 68 percent of respondents. The two potential mileage-based insurance options each were preferred by 16 percent of the respondents, for a total of 32 percent. • The survey also revealed-preferences for the insurance versus the leasing versions of PAYD, with 25 percent of the stated-preference survey respondents probably or definitely interested in mileage-based insurance compared to 16 percent of respondents expressing similar interest levels in mileage-based leasing. *Pay-As-You-Drive Field Test* Significant findings indicate that: • Wide-scale per-mile pricing would result in a measurable, but small, reduction in vehicle mileage. • On a percentage basis, the greatest reduction in mileage would occur on weekends. Weekday peak-period travel would be reduced by more than weekday off-peak period mileage. • Mileage reductions from per-mile pricing are seasonal, with the highest reductions during summer months. • Some households could reduce their mileage under per-mile pricing at significantly higher levels than most households. Specifically, households that could reduce their mileage the most are those that: – Have other unpriced vehicles to which they could transfer their trips; – Have leased vehicles (probably because they are more accustomed to monitoring the mileage on vehicles); or – Have household members that actively think about automobile ownership and operating costs. • Households that are less likely to reduce their mileage under per-mile pricing are those that: – Share the use of one or more of their vehicles among household members; or – Have a head of household who is more than 65 years old. • Higher per-mile charges do not necessarily increase mileage reduction of households. • Results from the field test showed that households already willing/able to change driving behavior will do so with low per-mile cost incentives. However, those households unable to change their behavior do not do so even under relatively higher cost incentives. Therefore, elasticities vary with individuals and the marginal effect of per mile prices may sharply decrease at relatively low-mileage incentives. This poses difficulties in designing targeted policies to fit broad populations. As a result, PAYD concepts, if implemented, would likely be targeted to niche markets:

Making Driver Costs Variable	Mileage-Based User Fee Regional Outreach and Variablization of Fixed Automobile Costs in Minnesota
	– Introducing and packaging PAYD products to the public is important. The following observations emerged from the market and field tests: – Target to the most receptive markets, as described above, in areas where significant travel options exist; – Explain the concept extremely clearly; – Structure the product so as to manage the degree of risk and uncertainty which the buyer would experience, such as by setting upside mileage limits on how high the variable costs could go; – Enable people to opt out if they are not comfortable with the product, and; – Provide significant cost savings potential.
Evaluation	• The project was managed by Mn/DOT. Cambridge Systematics conducted the market research and experimental components and administered the work of sub-consultants GeoStats and Market Line Research. • The experiment design was driven by a desire to conduct the most robust, statistically valid experiment on potential changes to driving behavior due to pay-as-you-drive pricing given the availability and capability of the technology to record mileage, as well as time and budget constraints.

Sources:

Value Pricing Program Quarterly Report: 3rd Quarter 2007. Federal Highway Administration, Office of Operations (September 2007: Washington, D.C.).

http://www.ops.fhwa.dot.gov/tolling_pricing/value_pricing/quarterlyreport/qtr3rpt07/pdf/qtr3rpt07.pdf.

Minnesota Department of Transportation, *Mileage-Based User Fee Demonstration Project Technology Inventory and Assessment*. Prepared by Cambridge Systematics, Geo Stats. July 2003.

http://knowledge.fhwa.dot.gov/cops/hcx.nsf/All+Documents/A343FA0F1E07A15F85256DC00073F3E2/$FILE/MnDOT%20MBUF%20tech%20assessment%20final%20report%2009-03.pdf.

Minnesota Department of Transportation, *Mileage-Based User Fee Demonstration Project Work Plan*. Prepared by Cambridge Systematics, et al. December 2003.

http://knowledge.fhwa.dot.gov/cops/hcx.nsf/All+Documents/A343FA0F1E07A15F85256DC00073F3E2/$FILE/MnDOT%20Mileage_Work%20Plan_all-in-one.pdf.

Minnesota Department of Transportation, *Mileage-Based User Fee Demonstration Project: Pay-As-You-Drive Experimental Findings*. Final Report MN/RC – 2006-39A. Prepared by Cambridge Systematics, et al. March 2006.

http://www.lrrb.org/PDF/200639A.pdf.

Minnesota Department of Transportation, *Mileage-Based User Fee Demonstration Project: Market Assessment Survey Results*. Final Report MN/RC – 2006-39B. Prepared by Cambridge Systematics, et al. March 2006.

http://www.lrrb.org/PDF/200639B.pdf.

Minnesota Department of Transportation, *Mileage-Based User Fee Demonstration Project: Potential Public Policy Implications of Pay-As-You-Drive Leasing and Insurance Products*. Final Report MN/RC – 2006-39C. Prepared by Cambridge Systematics, et al. March 2006.

Table 5.3 Mileage-Based Road User Fee Evaluation in Oregon

Making Driver Costs Variable	Mileage-Based Road User Fee Evaluation in Oregon
Operations	• The 2001 Oregon Legislature established the Road User Fee Task Force "to develop a design for revenue collection for Oregon's roads and highways that could replace the current system for revenue collection." The task force recommended that the Oregon Department of Transportation conduct a pilot evaluation program of the Oregon Mileage Fee Concept that would study: 1) the feasibility of replacing the gas tax with a mileage-based fee based on miles driven in Oregon and collected at fueling stations; and 2) the feasibility of using this system to collect congestion charges. • ODOT launched a 12-month pilot program in April 2006 designed to test the technological and administrative feasibility of this concept. • Implementation and study 2002-2005, Pilot program period 2006-2007. • Phase I of study demonstrated in-vehicle technology. Twenty vehicles were equipped with on-board mileage reading devices a trial period for technology and to establish baseline-driving conditions in 4-month period. • Phase II of experimental study was a 5-month pilot program, including 285 volunteer vehicles, 299 motorists and two service stations in the Portland-metropolitan area that concluded in April 2007. • Three groups participated in the pilot study: – A "control" group of 10 vehicles in which technology was tested but no fees were assessed; – A fixed-fee "VMT" group of 95 vehicles that was subject to a flat mileage fee of 1.2 cents per mile, and; – A variable-fee "rush hour" group of 102 vehicles that paid mileage fees based on place and time of travel. Mileage fees were discounted to 0.43 cents for travel during off-peak hours in certain zones and adjusted upwards to 10 cents for peak travel in congested zones and times. • The pilot study design held participants harmless by offering positive cash balances based on individuals' baseline driving records, peak-travel charges were then subtracted from these endowment accounts with any positive balance paid to the participant. This provided an incentive to modify travel behavior. • Oregon Department of Transportation administered the pilot program, Oregon State University, College of Engineering was contracted to provide technical design and evaluation services, Portland State University provided public-opinion research, and two fueling stations owned by Leathers Fuel Co. of Portland participated. • Reports to Legislature published 2003 and 2005. Final report published November 2007
Cost, Finance, and Revenue	• Total project cost was $2,935,679. VPPP grant equaled $2,163,949 in three grants over six years. State of Oregon contributed $771,730. • Program costs included equipment and administration to service stations, on-vehicle devices to drivers, and administration and collection to DOT. Planning, design, and implementation costs accounted for 40 percent of budget, pilot operations 50 percent, and evaluation and other costs 10 percent. • Mileage-fee designed to be revenue-neutral for State. Flat fee of 1.2 cents per mile charged, current gas tax is 24 cents per gallon; congestion-pricing fee of 10 cents per mile was charged to rush hour group.

Making Driver Costs Variable	Mileage-Based Road User Fee Evaluation in Oregon
Policy/Institutional	• Enabling legislation enacted in 2001 established The Road User Fee Task Force, a 12-member group created by the Oregon Legislature in 2001, to oversee evaluation of the Oregon Mileage Fee Concept. • Legislation mandated revenue neutrality, so that revenue from mileage-fee pilot not exceed that collected from gas taxes. • Privacy protection concerns dictated that there be no central data storage or transmission of vehicle location or trip data – only vehicle identification, total zone mileage, and purchased fuel totals collected by State.
Outreach/Acceptance	• Task Force held three public hearings before implementation, made 25 formal presentations across the country during the pilot, invited other state officials to visit, and regularly updated U.S. DOT, ODOT, and Oregon Legislature. • Study participant communications included regular updates of endowment account balances and information through newsletters. • Initial media reactions were negative due to inaccurate assumptions about the mechanics of the program, including data collection, pricing, operations, etc. Reporting accuracy improved over time and media began to report favorably on the program, according to program evaluators. • From outreach efforts, the broad public concerns were identified as: privacy protection, mileage rate setting equity (flat versus tailored fee, varied fees for high versus low-fuel efficiency vehicles), fairness in system, technological reliability, and the cost of implementation to the state, businesses, and vehicle owners.
Technology	• Hybrid transponder used GPS signals to identify zone location and used the vehicle's odometer to tabulate miles traveled within zones. • Fueling stations equipped with RFID reader detected on-vehicle device at pump; on-vehicle device transmitted mileage information and identification number; central accounting system assessed mileage fee and deducted gas tax, charges administered at point-of-sale in the exact same method as a typical gas-tax transaction. • Operational performance varied with technological adaptation as the pilot program constantly changed or updated technology to overcome problems or to better the system. Common problems included: 1) 77-80 percent accuracy in pump-to-vehicle identification, i.e., 20 percent of the time participant vehicles were not identified and charged gas-tax alone; and 2) each vehicle had to have custom installation of on-vehicle device – there was no universal system across vehicle manufactures and vehicle ages. • Mileage readers and fee assessments were proved to be highly accurate and were double-checked by car odometers and fuel purchases.
Equity/Environmental	• Economic equity or environmental assessments were not explored, but will be addressed in future studies.

<table>
<tr><th>Making Driver Costs Variable</th><th>Mileage-Based Road User Fee Evaluation in Oregon</th></tr>
<tr><td>Impacts</td><td>Participants reduced average miles driven per day by:
<table>
<tr><th>Measure/Group</th><th>Average Total Miles per Day</th><th>Average Peak Miles per Day</th><th>Average Off-Peak Miles per Day</th></tr>
<tr><td>Control</td><td>-0.7 %</td><td>+17 %</td><td>-6 %</td></tr>
<tr><td>Flat-Fee VMT</td><td>-13 %</td><td>+11 %</td><td>-12 %</td></tr>
<tr><td>Rush Hour</td><td>-16 %</td><td>-16 %</td><td>-14 %</td></tr>
</table>
(Note: All findings considered statistically significant.)
Other statistically significant findings include:
• There was a 22 percent reduction in peak-hour miles traveled for the group that was charged more for peak hours.
• All participants with transit access reduced VMT by 0.7 miles per day.
• Participants with children under 16 reduced VMT by 0.7 miles per day.
• Participants who self-identified with the attitude that they would always drive increased VMT by 4 miles per day, regardless of pricing group.
• Twelve of 84 households in the rush hour group reported that a household member began using public transit to save money. Ten of 79 households in the flat-fee group reported mode changes to transit.
• Qualitative evaluation of the program by managers and owners of service stations reported that technological integration with existing computer systems and equipment installation was a burden, but reported no change in workload of service station attendants or fueling operations.
• Surveyed dissatisfaction among participants was mostly a result of temporary pilot problems and not a reaction to concept.
• 91 percent of pilot program participants agreed that if the program were enacted statewide they would continue paying the mileage fee in lieu of the gas tax.</td></tr>
<tr><td>Evaluation</td><td>• The study was nonrandom and biased by participant self-selection and program influence (increased interest and knowledge in transportation alternatives may have caused some behavior changes).
• Evaluation criteria established by the Road User Fee Task Force included: 1) Administrative feasibility; 2) Cost; 3) Net Revenue Generation Capability; 4) Hardware and Software; 5) Precision; 6) Evasion Potential; 7) Usefulness of Phasing and Planning Potential; 8) Adaptability to Congestion Pricing; and 9) Public Acceptance.</td></tr>
</table>

Sources:

Oregon's Mileage Fee Concept and Road User Fee Pilot Program: Final Report. Oregon Department of Transportation, Office of Innovative Partnerships and Alternative Funding (November 2007: Salem, Oregon).

http://www.oregon.gov/ODOT/HWY/RUFPP/docs/RUFPP_finalreport.pdf.

Value Pricing Program Quarterly Report: 3rd Quarter 2007. Federal Highway Administration, Office of Operations (September 2007: Washington, D.C.).

http://www.ops.fhwa.dot.gov/tolling_pricing/value_pricing/quarterlyreport/qtr3rpt07/pdf/qtr3rpt07.pdf.

Table 5.4 Global Positioning System (GPS)-Based Pricing in the Puget Sound Region, Washington

Making Driver Costs Variable	Global Positioning System (GPS)-Based Pricing in the Puget Sound Region, Washington
Operations	• The project is the first large-scale operational test showing the feasibility of areawide road use and congestion-based charging. The Traffic Choice Study was designed explicitly to capture behavioral response to network tolls in an experimental setting. • Pre-toll data collection operations for the project began in February 2005. Toll operations began on July 1, 2005 and were completed on March 31, 2006. • During the field test, the project team fielded hundreds of customer service calls, issued over 4,000 billing invoices, logged over 100,000 data transactions to the central system, and recorded over 750,000 individual participant trip records. • In the pilot field test, mileage meters were placed in the vehicles of over 257 households and over 400 voluntary participants. • Randomly selected from an enriched pool of potential participant households. • Different prices per mile were imposed depending upon the location (type of roadway) and time of travel on all major roads in the Puget Sound region. • Drivers were made aware of the pricing both though toll maps, tariff model graphics, and other printed material, in conjunction with real-time read-out on the in-vehicle meter, as well as on web pages. • At the start of the pilot, each participating household was provided a unique travel endowment account based on their baseline travel behavior. • Any cumulative in-vehicle meter charges were debited against this balance. Any funds remaining in the account at the end of the pilot were kept by the participants. This "hold-harmless" study design gave participants the opportunity to participate without committing their own funds, yet also gave them the incentive to adjust their driving behavior so as to enjoy the surplus remaining in the account at the end of the experiment.
Cost, Finance, and Revenue	• FHWA VPPP funds of $1,800,000 awarded in 2002 and supplemental grant of $600,000 awarded in 2005. • Revenue and cost estimates difficult early on, and only sketch analysis results are available. Final numbers depends upon final equilibrium toll values. • Preliminary revenue estimates for time, distance, place tolling proceeds (order of magnitude) could equal approximately $1.5-$2.5 billion per year. • Preliminary cost estimates for a distance tolling system could equal initialization costs of approximately $0.75-$1.5 billion and operations could equal 5-10 percent of proceeds.
Policy/Institutional	• Administered by the Puget Sound Regional Council. The region's long-term transportation plan Destination 2030 recommended planning, designing, and implementing a roadway pricing demonstration program. • The Puget Sound Regional Council is the regional transportation, economic and growth planning agency for the central Puget Sound region of Washington State. The Regional Council serves as a forum for cities, counties, ports, transit agencies, tribes, and the State to coordinate on important regional issues.
Outreach/Acceptance	• Survey responses both substantiate the data results and provide evidence for a causal relationship. Seventy percent of participants stated they changed their behavior in response to the tolls.

<table>
<tr><th>Making Driver Costs Variable</th><th>Global Positioning System (GPS)-Based Pricing in the Puget Sound Region, Washington</th></tr>
<tr><td>Technology</td><td>

Project participants were equipped with GPS/GSM tolling on-board units for OBU-based tolling. Meters communicated to central system via GPRS.
Used Siemens ITS off-the-shelf tolling system solution. Siemens was responsible for developing the software, providing the in-vehicle on-board units and integrating all the systems and components.
By relying on in-vehicle meters, the need for expensive wayside antennae is eliminated, and even arterial roads can be priced cost-effectively.
Web-based participant accounts were established, and the user interface successfully provided access to household-level travel information, account balance, invoices, and customer support.
Toll values were displayed in the participant on-board-units along with the name of the road being tolled.

</td></tr>
<tr><td>Equity/Environmental</td><td>Not available in preliminary analysis.</td></tr>
<tr><td>Impacts</td><td>

Almost 80 percent of the households drove less and/or reduce their exposure to tolls in other ways!
Preliminary analysis estimated short-run demand elasticities in the range of -0.12, which translated into approximately 10 percent reduction in vehicle use during peak travel times, with considerably more traffic reduction on specific facilities. Results suggest there is a practical opportunity to reduce wasted time resources and convert them to significant revenues for investment:

During the a.m. peak travel period (6:00 a.m. to 9:00 a.m.).
Tolls could reduce household automobile trips approximately 10 percent.
Tolls could reduce vehicle miles traveled approximately 4 percent.
During the p.m. peak travel period (4:00 p.m. to 7:00 p.m.).
Tolls could reduce household automobile trips approximately 6 percent.
Tolls could reduce vehicle miles traveled approximately 11 percent.

Estimated Elasticities with Regard to Variable Costs of Automobile Use
<table>
<tr><th>Metric</th><th>A.M. Peak</th><th>Midday</th><th>P.M. Peak</th><th>Evening</th><th>Night (Early A.M.)</th></tr>
<tr><td>Trips</td><td>-0.1610</td><td>-0.1560</td><td>-0.0996</td><td>-0.1290</td><td>0.0532</td></tr>
<tr><td>VMT</td><td>0.0531</td><td>0.1806</td><td>-0.1803</td><td>0.0491</td><td>0.3326</td></tr>
<tr><td>Hours</td><td>0.0019</td><td>0.2483</td><td>0.0795</td><td>0.0970</td><td>0.5346</td></tr>
</table>

Detailed analysis of the behavior data were carried out over the subsequent 6 months and beyond.
To date the project has contributed significantly to knowledge related to the application of road use charging. Valuable information collected included: road user choice and behavior under a broadly implemented and sustained tolling treatment; proof of technical applications and systems design; and assistance in identifying and understanding key policy variables and requirements.
Also, the project team will begin processing participant payment and conduct some qualitative research relating to participant experiences and perceptions.

</td></tr>
</table>

Making Driver Costs Variable	Global Positioning System (GPS)-Based Pricing in the Puget Sound Region, Washington
Evaluation	Key methodological features included: • True price incentive. • Baseline and experimental treatments (tolls). • Controls for self-selection, attrition, seasonality, etc. • Time-of-day pricing. • Multiple sources of price information (in-vehicle display, accounts, invoices).

Sources:

Puget Sound Regional Council, Traffic Choices Study, available at http://www.psrc.org/projects/trafficchoices/index.htm.

Aubrey Davis and Matthew Kitchen, Puget Sound Regional Council, *Puget Sound Traffic Choices Study*. Presentation to Washington State Transportation Commission, November 2006.

http://wstc.wa.gov/AgendasMinutes/agendas/2006/Nov14/Nov14_BP2_PSRC_TrafChoicesStudy.pdf.

6.0 Other Pricing Projects

Table 6.1 Car-Sharing in the City of San Francisco, California

Other Pricing Projects	Car-Sharing in the City of San Francisco, California
Operations	• Nonprofit City Car Share operates. • Reaches 4,000 drivers; launched in 2001, the service has 90 vehicles available in more than 40 locations in SF and East Bay. • Agency under authority of SFCTA. • Makes agreements with transit, businesses and building owners, insuring car/driver and managing reservations.
Cost, Finance, and Revenue	• In FY 2000, FHWA VPPP funding of $742,000 was awarded for the study. • Most users spend less than $2,000 a year. • Cheaper than taxis or rental cars for most trips, more expensive for longer trips. • Membership dues are $10 per month; then $5 per hour and $.40 per mile for most cars; application fee of $30 and a refundable security deposit of $300. • Reported revenue of about $2 million in 2003, from membership fees and government grants.
Policy/Institutional	• Nonprofit formed in cooperation with cities of Berkeley and Oakland. • Competing with for profit Zipcar and Flexcar in region.
Outreach/Acceptance	• Formed with support of public interest trusts, coalitions and associations.
Technology	• Cars have an embedded on-board computer that captures your member number, mileage, and share time. • Users hold a small plastic fob next to a reader to relay unique code; engine will not turn without it. • On-board computer updated with reservation schedule verifies you; car keeps a current roster by wireless link to garage wall panel.
Equity/Environmental	• Fuel consumption and related emissions fell for members versus controls; not statistically significant for either group (03 and 06). • "Result" probably due to reduced vehicle ownership, more fuel efficient car-share vehicles (03) or shorter trips, higher occupancy versus controls (06). • Possibly hard to serve low-income groups profitably by commercial operators. As demonstrated in Seattle, car sharing for low-income probably requires public subsidies, but can achieve social objectives.

Other Pricing Projects	Car-Sharing in the City of San Francisco, California
Impacts	• Large proportion of trips made off-peak, possibly moderating congestion relief (06 and earlier reports). • 3/10 trips "would not have been made" (06 report). • Prior mode survey shows high proportion of transit, walk, bike, carpool or new trip; 68 percent of trips are added vehicle trips (03). • Car ownership decline: 73 percent versus 43 percent controls reduced car ownership 2001-2003; in 06 report Table 5 shows very mixed result: controls reduced "2 or more cars" versus members; members show more "reduce by one" and less likely to increase vehicles versus controls, but no statistical test here. • VMT decline for members versus controls (6.46 VMT per day, 03), but not statistically significant in 03 or 06 report; "adjusted for mode and occupancy did get significant result in 06 report, but not clear what means.
Evaluation	• Early adopters may not represent later adopters; long-term evaluation (at least two years) important. • Creating evaluation design not easy: controls made up of applicants who initially registered but did not join may not be fully comparable to joiners. • Mailbacks and financial incentives boost response rates.

Sources:

http://knowledge.fhwa.dot.gov/cops/hcx.nsf/docs/29AB105A2787964C85256DB100641EFE?opendocument&%20Group=Value%20Pricing&%20tab=REFERENCE.

Robert Cervero and Yu-Hsin Tsai, *San Francisco City CarShare: Travel-Demand Trends and Second-Year Impacts* (August 1, 2003). Institute of Urban and Regional Development. IURD Working Paper Series. Paper WP-2003-05. See: http://repositories.cdlib.org/iurd/wps/WP-2003-05.

http://www-iurd.ced.berkeley.edu/pub/WP-2006-07.pdf.

http://www.citycarshare.org/partners.do#nonprofits.

http://sanfrancisco.bizjournals.com/sanfrancisco/stories/2005/08/01/daily32.html.

http://www.wired.com/wired/archive/9.10/streetcred.html?pg=4.

Table 6.2 Cash Out of Parking in King County, Washington

Other Pricing Projects	Cash Out of Parking in King County, Washington
Operations	• King County Metro received a grant in 2001 from the FHWA in part to reduce commuter parking via promotion of parking cash out to downtown Seattle employers. • Cash out concept tested allows employees to give up their parking in exchange for a monthly cash amount; employers negotiate with parking/building managers to pay for fewer monthly parking spaces; parking/building managers then may offer the relinquished spaces at higher hourly parking market rates.
Cost, Finance, and Revenue	• FHWA VPPP funding of $499,280 and $98,832 was awarded in FY 2001 and $419,500 awarded in FY 2000. • King County offered employers both a financial incentive and technical support in administering cash out: $125 a month per employee receiving free parking prior to program implementation; after 9 months, additional $125 per employee relinquishing free parking space. • Potential employer/developer costs: cash out may reduce employer parking costs for employees as parking demand is reduced and less parking is leased; developers may gain from reduced parking supply and more land development potential. • Administration: no results assessed in King County; national experience suggests costs tend to be small once program is integrated into payroll; typical program requires approximately two minutes per employee per month for administration (Shoup, 1997); firms that own employee parking facilities may incur financial costs if they cannot lease or sell excess parking capacity (Shoup, 1997, found $2 per month average net cost per employee among eight employers studied).
Policy/Institutional	• No public policy changes instituted; promoted as a voluntary program among participating employers. • The project served to inform city staff about a parallel effort to begin carsharing in Seattle. The Parking Cashout project led Metro staff to recognize the market for "business carsharing" among employers in the Seattle CBD. This market for business carsharing has expanded considerably over the last few years. Also, The Parking Cash Out grant provided King County Metro the opportunity to form a partnership with both the City of Seattle and the Downtown Seattle Association, a partnership which is in place today to help increase transit ridership and reduced SOV usage in Downtown Seattle. • Trip reduction law was in effect in the project area at start up, requiring employers with 100 or more employees commuting to work during the a.m. peak period to implement trip reduction strategies (94 employers in the study area were affected by the CTR law in 2001).

Other Pricing Projects	Cash Out of Parking in King County, Washington
Outreach/Acceptance	• Market Potential: initially, downtown Seattle seemed ideal for cash out: good transit; parking leases are unbundled from floor space leases; parking limited and prices high; significant transit pass promotions; law encouraging employer action to reduce SOV; estimate of potential participating employees was about 1,000; based on up to 52,000 employees downtown Seattle with parking subsidy (Kodoma, 2001, King County, 2000), 2 percent which might be affected. • Outreach: Staff worked with existing King County Employer Transportation Representatives (ETR) to market cash out; ETR's work with employers affected by the state Commute Trip Reduction (CTR) law; staff also presented at meetings in downtown Seattle (representing 27 employers), and distributed brochures at transportation fairs; ETRs presented cash out option to a total of 11 employers, three eventually elected to implement; also worked through Downtown Seattle Association (DSA) to reach employers not affected by the CTR law, size 25 and 99 employees; in 2002, the DSA made 744 sales calls; only three employers agreed to a presentation, and none elected to participate in the program. Sales staff at Metro and lower level ETC's (Employee Transportation Coordinators) for employers could not grasp the concept of Parking Cashout well enough to develop an effective sales pitch and follow through. • Market Penetration: All efforts resulted in three businesses and 18 employees participating. • Employer/employee Acceptance: minimal probably due to parking subsidies already eliminated for most employees, extensive bus pass program already operating; decrease in King County and downtown employment reducing employer interest in "something new"; smaller employers without ETRs hard to reach; core of employees believing they must have a car for work (44 percent of those of 100K in salary claim this need, in part because of "working late"). • Building/parking management acceptance: wanted to keep tenants and maintain revenues with office vacancies on the rise and parking prices appearing to decrease; would not renegotiate tenant leases to change monthly parking spaces; concept viable only where demand outstrips supply, and spaces can be sold daily. • Employer Transportation Representatives acceptance: cash out added size and complexity to sizeable existing package of employer; also "hard to process" for some ETRs, and difficult to communicate to upper management. • Overall Market Conclusion: avoid marketing to outside sales employees, high-income workers, brokers, and others who need cars, have irregular work hours; careful not to add cash out to already sizeable employer trip reduction program offerings; analyze market potential in depth. An economic downturn in 2001 in Seattle created high-vacancy rates in downtown office buildings, probably affecting the acceptance of cash out.
Technology	Study did not evaluate technology options.
Equity/Environmental	• No demographic breakdown of participants or potential market given for King County program. • Generally: may be progressive if lower-income employees opt for cash and voluntarily choose automobile alternatives.

Other Pricing Projects	Cash Out of Parking in King County, Washington
Impacts	• Participation: 13 continuing employee participants at end of one year across three employers. • SOV trip reduction: 114 weekly SOV trips reduced. • Transit: 98 weekly new transit trips attributed to program. • Projection, best case: marketing consultant estimated contact with 683 potential candidate companies, 10 percent response rate, 25 percent company adoption rate gets 17 participating companies; 3 participants per company gains 51 parking spaces affected, max. • Overall: "We have concluded that the employer market for cash out in downtown Seattle, even with added incentives, is too small and fragmented to be cost-efficiently targeted." • Impact potential from experience elsewhere: Shoup (1997) found that total vehicle trips declined by 17 percent after cash out was introduced at various urban and suburban worksites.
Evaluation	• Evaluation report prepared by Metro and City of Seattle staff, with some overview findings from marketing consultant. • Evaluators assessed the program internally and from the employer's perspective (A Qualitative Assessment of the FlexPark Product and Sales Strategy: Employment Transportation Coordinator Interviews) to get at employer and employee barriers. • Marketing consultant estimated best case scenario by screening employers in downtown, ruling out high-paid professionals with irregular work hours and sales-based firms, firms under 50 employees.

Sources:

http://knowledge.fhwa.dot.gov/cops/hcx.nsf/384aefcefc48229e85256a71004b24e0/a19c77018189d09f85256dba0063d8f4?OpenDocument.

General cash out: http://www.vtpi.org/tdm/.

See: On-line TDM Encyclopedia – Commuter Financial Incentives Commuter Financial Incentives Parking Cash Out, Travel Allowance, Transit and Rideshare Benefits.

7.0 Other Studies

Table 7.1 Fair Lanes with Dynamic Ridesharing in Alameda County, California

Other Studies	Fair Lanes with Dynamic Ridesharing in Alameda County, California
Operations	• A feasibility study, completed in 2005, applied the FAIR lanes concept of variable tolling to two specific freeway segments in Alameda and Santa Clara counties in California: I-580 and I-680. • The FAIR (Fair And Intertwined Regular) lanes concept rewards drivers choosing to use general purpose lanes, instead of adjacent HOT express lanes by providing credits to those drivers that can be used on HOT lanes at another time. The intent is to improve the public acceptability of HOT lanes and address concerns that HOT lanes are only affordable by the wealthy. • During the study, the lane concept was renamed HOT/Credit lanes to better communicate the project's scope, intent, and comprehension with the title. • A separate pilot program also was funded by FHWA to evaluate new travel options through electronically assisted dynamic ridesharing. • There were two components to this study: HOT lane Credits Study (FAIR Lanes); and Dynamic Ridesharing Study. *HOT/Credit Study* • Completed in August 2005, the HOT/Credit (HOT/C) Lanes feasibility study examined two potential corridors: – The I-580 corridor of Greenville Road/Altamont Pass Road to the east and the I-580/I-680 junction to the west; and – The I-680 corridor of Route 237 (Santa Clara County) to the south and Route 84 (Alameda County) to the north. • Due to political concerns and the physical characteristics of the corridors (neither freeway segment has convenient, parallel free routes), a modified version of the FAIR lanes concept, the HOT/Credit Lane, was developed and studied instead. • The study analyzed key aspects of the FAIR lanes concept, including: toll revenues, impact on vehicle volumes and speeds, travel forecasting, freeway operations, and public perceptions. • The economic and performance impacts of 14 alternative policy scenarios were analyzed in terms of revenue generated and traffic measures, such as vehicle speeds and volumes. The 14 policy scenarios evaluated included the following categories: – Conventional HOV lanes, with no tolling and no HOT/C credits. – Conventional HOT lanes, with free passage for HOV, tolling for non-HOVs, but no HOT/C credits. – HOT lanes with HOT/C credits for low-income users only (Limited Eligibility). – HOT Lanes with HOT/C credits to all users regardless of income (100 Percent Eligibility). – The variables used to create the policy alternatives were: 1) Credit rate in which eligible users earn a "free" trip on the HOT lane.

Other Studies	Fair Lanes with Dynamic Ridesharing in Alameda County, California
	2) Low-income only versus all users eligibility criteria for HOT/C lanes credits. 3) Two-person or more versus 3-person or more definitions of an eligible carpool. *Dynamic Ridesharing Study* • *RideNow*, a test program at the Dublin/Pleasanton BART station, operated from November 2005 to May 2006. An automated system allowed BART commuters to use web- and telephone-based systems to find carpool partners on a "real-time" basis and offered preferred parking incentives at BART stations for participation.
Cost, Finance, and Revenue	• VPPP funding in FY 2002 equaled $595,250 for the two studies. The total cost of the *RideNow* pilot program was $213,000 from pre-planning and marketing through 6 months of operation.
Policy/Institutional	• This was a limited duration experimental study requiring little broad policy or institutional support. • The work was led by the Alameda County Congestion Management Agency.
Outreach/Acceptance	*HOT/Credit Study* • The HOT/C study conducted focus groups with frequent users of I-580 and I-680 and completed a public opinion survey of residents in Alameda County and the surrounding communities. • Results suggested that concerns about income equity are not a major determinative factor in public acceptance of HOT lanes, but rather the broad context in which tolls are presented (congestion management versus revenue generation for improvements) is the most sensitive to public opinion. • Polling indicated that HOT/C was not well supported by the public.
Technology	• The *RideNow* pilot developed an automated telephone and web database system matched carpoolers based on time of travel. BART patrons could call when on the train and the software would recognize their train and itinerary and provide possible matches. • There was no specific technology evaluated in the HOT/C portion of the project.
Equity/Environmental	• Equity concerns, as they pertain to low-income users, may be important to elected officials, transit advocates, and other leaders, but they do not appear to be as important to the general public, as found in public surveys and focus groups conducted as part of this study. • Decision-makers would need to determine that this equity concern is significant enough as an impediment to adoption of HOT lanes that it warrants introducing a complications into the toll structure, operation, and administration into the HOT lanes. They also may wish to consider other ways to address this perceived equity issue.
Impacts	*HOT/Credit Study* • The HOT/Credit Lanes study identified the following key findings: – Addition of HOT/C users would modestly reduce speeds in HOT lanes. – Modest travel-time savings for corridor commuters in both HOT and general purpose lanes, would occur with the HOT/C proposal. – HOT lane revenues are very sensitive to HOT/C credit rate and eligibility criteria settings, and would likely decrease under any scenario. – HOT/C would be relatively inexpensive to implement if HOT lanes already were operational. – There is high risk that users with accumulated HOT/C credits may utilize them during the same peak period on the same day, thereby causing drivers to

Other Studies	Fair Lanes with Dynamic Ridesharing in Alameda County, California
	simultaneously shift to express lanes, reducing travel time in HOT express lanes. *Dynamic Ridesharing* • A total of 244 people expressed interest in *RideNow* between October 2004 and when the program terminated 18 months later, but only 121 (50 percent) actually registered with the program. • At the conclusion of the 6-month pilot, 141 ride matches out of 1,170 ride requests were made – a 12 percent matching success rate. • The study found that dynamic ridesharing could be further facilitated with reserved premium parking spaces at participating BART stations, on-demand backup services such as guaranteed rides home by taxi-cab, and in-station electronic information screens providing necessary details about individual ride matches. • Recommendations indicated The RideNow program should be simplified; Ridesharing programs could be more successful and cost-effective if incorporated into regional programs; person-to-person marketing strategies worked best.
Evaluation	• The HOT/C study conducted focus groups with frequent users of I-580 and I-680 and completed a public opinion survey of residents in Alameda County and the surrounding communities. The study analyzed toll revenues, impact on vehicle volumes and speeds, travel forecasting, freeway operations, and public perceptions. The economic and performance impacts of 14 alternative policy scenarios were analyzed in terms of revenue generated and traffic measures, such as vehicle speeds and volumes. • Dynamic Ridesharing was evaluated by tracking response to the test program, including those expressing interest and proportion actually registering over an 18 month test period. Also tracked were ride matches as a proportion of ride requests

Sources:

Alameda County Congestion Management Agency, *HOT Credit Lanes Feasibility Study*. Prepared by Parsons Brinckerhoff Quade & Douglas, Inc, et al., August 2005.

http://knowledge.fhwa.dot.gov/cops/hcx.nsf/All+Documents/4067E2FECD8228E9852570660056B26B/$FILE/hot_credit_lanes_feasibility_study_final.pdf.

Alameda County Congestion Management Agency, *RideNow*! *Evaluation Draft Report*. Prepared by Nelson Nygaard. September 2006.

http://www.accma.ca.gov/pdf/reoccurring_reports/congestion_management_program/4113_ACCMADynamicRidesharing.pdf.

Alameda County Congestion Management Agency, *FAIR Lanes and Dynamic Ridesharing Using New Ridesharing Options to Assist Implementation of "FAIR" Value Pricing San Francisco Bay Area Demonstration and Evaluation Project*. Proposal to the Federal Highway Administration Value Pricing Program.

www.ridenow.org/fhwa_proposal.doc.

1200 New Jersey Ave SW
FHWA-HOTM-1, Room E86-204
Washington, DC 20590

Publication #FHWA-HOP-08-023