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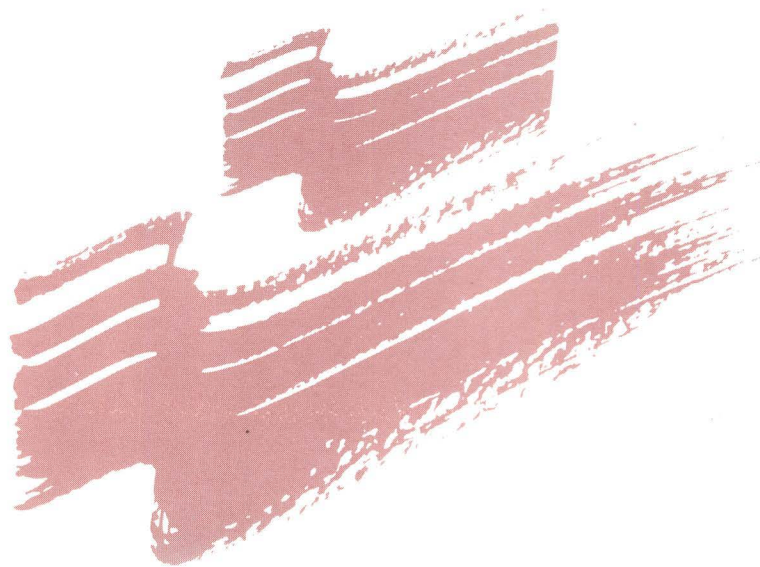
**Federal Highway
Administration**

Number 6
December 1992

SEARCHING FOR SOLUTIONS

A Policy Discussion Series

Examining Congestion Pricing Implementation Issues



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1992

SEARCHING FOR SOLUTIONS
A Policy Discussion Series
Number 6

Examining Congestion Pricing Implementation Issues

Summary of Proceedings:
Congestion Pricing Symposium

Sponsored by the Federal Highway Administration
and the Federal Transit Administration

June 10–12, 1992
Washington, D.C.

The following is a list of other publications in the Federal Highway Administration's "Searching for Solutions: A Policy Discussion Series."

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| Number 1 | March 1992 | Exploring the Role of Pricing as a Congestion Management Tool |
| Number 2 | June 1992 | Exploring Key Issues in Public-Private Partnerships for Highway Development |
| Number 3 | August 1992 | Public and Private Sector Roles in Intelligent Vehicle-Highway Systems (IVHS) Deployment |
| Number 4 | August 1992 | Assessing the Relationship Between Transportation Infrastructure and Productivity |
| Number 5 | August 1992 | Transportation and Air Quality |

Foreword

This report summarizes the results of a symposium on congestion pricing implementation issues sponsored by the Federal Highway Administration and the Federal Transit Administration. The symposium, held in Arlington, Virginia, on June 10–12, 1992, was designed to move the discussion of congestion pricing from the academic tone of scholarly discourse to a more practical exchange of ideas about the problems and prospects for real-world demonstrations of congestion pricing concepts.

In many ways, congestion pricing has become the “issue du jour,” viewed as the way to achieve any number of urban transportation objectives, including congestion relief, mobility enhancement, air quality improvement, energy conservation, and growth management. Congestion pricing has been proposed as a “market-responsive” alternative to more prescriptive command-and-control “demand-management” regulations. To cash-strapped, congested metropolitan areas, it appears to promise not only incentives for more efficient use of road space, but also the generation of large amounts of revenue that can be used to finance transportation improvements.

Yet, despite its widespread acceptance among economists, congestion pricing has not really entered the public domain as an instrument of transportation policy. This lack of public acceptance may result from the failure of transportation professionals to clearly articulate the objectives and the likely effectiveness and distributional consequences of congestion pricing, or it may be that we simply don’t know enough about the consequences of congestion pricing to convince people that “win-win” solutions exist. Whatever the reason for its lack of public acceptance, it is not surprising that symposium participants selected the problem of *selling* the concept of congestion pricing to the public as the most critical issue to be addressed in implementing congestion pricing projects.

Another key implementation issue selected by symposium participants was the need to understand and address the question of who wins and who loses as a result of congestion pricing. With

an urban form built around a transportation pricing structure that does not charge users for the costs of congestion, the introduction of time- and location-specific use charges will clearly impose new costs and change service levels. It remains to be seen whether the efficiencies attributed to congestion pricing can be realized in the face of political opposition that might be generated by those who feel they are losers under a regime of congestion pricing. The use of congestion pricing revenues to compensate those who may be adversely affected was seen by many symposium participants as an important consideration.

In this context of potential solutions and unanswered questions, the Congestion Pricing Pilot Program, authorized by the Intermodal Surface Transportation Efficiency Act of 1991, is intended to provide real-world tests of congestion pricing concepts, tests that will help us learn more about problems of design, implementation, and operation of congestion pricing projects. “To learn, and not to prove,” is the watchword of the Pilot Program. The symposium summarized in this document provided valuable input to that learning process. We look forward to the additional insights that the Pilot Program will provide.

This report is the sixth issue of *Searching for Solutions: A Policy Discussion Series*. This series deals with key emerging highway transportation policy issues such as congestion pricing, privatization, transportation and air quality, and transportation and economic productivity. Issue papers emanate from policy seminars sponsored by FHWA, often with support from other DOT agencies, or from FHWA policy research. We hope this series will help stimulate a wide-ranging exchange of ideas and opinions on key transportation policy issues.

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Executive Summary

More than 160 transportation professionals representing local, State, and Federal government agencies, highway user groups, transit interests, universities, and private industry participated in this 2½-day symposium on congestion pricing. Symposium participants took part in 5 plenary sessions, in which 14 papers were presented and discussed, and in 3 breakout sessions, in which participants were divided into 5 groups and charged with specific tasks related to the implementation and evaluation of congestion pricing projects.

Papers presented during the plenary sessions covered the following topics:

- The past, present, and future of congestion pricing.
- Issues related to pricing and the use of revenues.
- The role of market-based transportation demand management (TDM) strategies.
- Distributional impacts of congestion pricing and the need to stimulate transportation alternatives.
- Technological issues related to congestion pricing.

Breakout sessions focused on developing a variety of lists, rankings, and evaluations related to the implementation and evaluation of congestion pricing projects.

Congestion Pricing—Past, Present, and Future

A congestion price is a charge that reflects, as closely as possible, the marginal social cost of each trip in terms of its impacts on others. Such a charge can be viewed as a user charge that is based on the difference between the cost perceived by a user when entering the traffic stream and the cost actually imposed on all users as a result of the additional delay resulting from that user's entry and movement through the traffic stream.

Concerns about the perceived adverse effects of congestion pricing on local business and low-income groups have prevented its enactment in the United States, even though analytical models have shown significant potential benefits from congestion pricing. The papers presented in this session indicated that past attempts at implementing pricing strategies have not succeeded because too little emphasis was placed on generating local support and because congestion levels were not viewed as sufficiently unacceptable. Implementation has been successful in a few cities outside the United States; the lesson to be learned from those cases, as well as from unsuccessful attempts at implementation, is that congestion pricing will be accepted only if it is one element of a comprehensive mobility improvement package. Because practical experience with congestion pricing is so limited, experiments are needed to evaluate behavioral responses to pricing strategies. Implementing large-scale applications of congestion pricing may not be possible initially, so limited applications on single facilities may be the most desirable approach to evaluating public acceptance. Existing toll facilities or new facilities may offer the best demonstration opportunities. Well-designed demonstration projects, carefully explained and justified, may prove that congestion pricing is politically feasible.

Discussants in this session pointed out that if public approval is to be gained, a congestion pricing plan must include a comprehensive package of revenue use to enhance transit or other mobility alternatives. Further, the public must perceive that a congestion problem exists, must be made aware that auto travel is currently subsidized, and must be convinced that it is receiving a benefit from congestion pricing. Warnings were issued that rationing existing road space is not a long-term solution, that impact mitigation may be very expensive, that congestion pricing is untested, and that "overselling" the concept may make the public wary. The objectives of congestion pricing must be clearly stated, terminology must distinguish between congestion pricing and road tolling or other concepts, and data needs must be clearly identified early in the project. Pricing should be

introduced incrementally to facilitate adjustment of travel behavior. A strong message was that institutional and political issues should be given as much attention as technical issues.

Pricing and the Use of Revenues

The wise use of potential congestion pricing revenues is key to the success of any congestion pricing strategy. The papers from this session introduced a number of measures that may be taken to offset negative impacts, promote social goals, and garner political support for pricing. For example, congestion pricing revenues might be used to reimburse travelers directly, reduce general taxes, or introduce new services, including transportation services. Although the commuter is negatively affected by the fee paid, the effect may be neutral or positive when the value of time saved and the money returned through revenue allocations are considered.

Increasing congestion problems, air quality concerns, and lack of transportation funding are providing new opportunities for congestion pricing—opportunities made possible because of technological advances and legislative emphasis on toll facilities and congestion pricing. Despite these new opportunities, questions about the effectiveness of pricing remain. One author presented a hypothetical case study of the pricing applied to single-occupant vehicles, resulting in an estimated 11-percent decrease in peak travel time, a 15-percent reduction in peak emissions, a revenue surplus with 20-percent travel growth, and a small revenue shortfall with 50-percent travel growth.

Discussants in this session pointed out that the benefits of congestion pricing reach beyond direct transportation impacts. They also stated that effects on productivity and prospects for long-term economic growth must be considered. Congestion pricing proposals should also identify the level of pricing that best controls traffic and captures benefits, and the overall benefits of the project should be evaluated before the distribution of benefits is addressed. It was pointed out that potential revenues from congestion pricing are very large and could be a great fiscal benefit to the State and local area. One commenter felt that, because low transit fares have failed to increase use of public transit, congestion pricing might stimulate the development of more efficient urban

transportation systems. Congestion pricing may be successfully implemented if people understand the full costs of congestion, if they view congestion pricing as the best method of reducing those costs, if they agree with the use of revenues, and if they view congestion pricing as part of a comprehensive plan. The point was made that pricing should be viewed as part of a long-term strategy that includes parking policy and land use alternatives.

The Role of Market-Based Solutions

The objective of this session's papers was to show why market-based solutions for meeting the goal of reducing congestion make sense. In general, TDM policies can be categorized as "command and control," or "market based." One paper pointed out that proponents of market-based strategies consider them to be more efficient ways of achieving clean air objectives, whereas proponents of uniform national command-and-control standards consider this approach more politically acceptable and more equitable than market-based strategies. The point was made, however, that any form of mandated TDM policy, whether market based or command and control, is also regulation because it is imposed and monitored by government. The author presented a more complex way of viewing TDM strategies by distinguishing between performance-based and market-based methods and direct or indirect means. The author contended that direct, market-based measures generally work better, but that indirect, performance-based measures may be easier to implement.

Another author asserted that employer-paid parking stimulates solo driving, which significantly affects congestion and air pollution. A measure that can be taken to remedy this problem is to amend the tax code to allow employees the option of receiving a tax-free cash equivalent in lieu of the parking subsidy. According to the author, the effects of this cash option would significantly reduce solo driving and the average vehicle miles of travel by employees.

Discussants commented that the results of neither command-and-control regulations that have been in effect nor the market-based strategies that are contemplated are cause for rejoicing. Actual and predicted results show only modest reductions in travel compared to anticipated travel

growth. These results raise the question of whether either strategy is worth the cost and effort. It was also pointed out that the parking cash-out proposal may be politically difficult to implement and may not change behavior.

The Bay Area's Experience in Advancing Market-Based Solutions

The luncheon speaker pointed out that the market-based approach sends clear signals in the form of prices that reflect the true costs that driving imposes on society; it also provides convenient, low-cost alternatives to driving alone. The Bay Area Economic Forum has proposed a market-based approach to reducing congestion and pollution that includes a combination of emissions charges, improved inspection and maintenance procedures, congestion prices, a gasoline tax, parking charges, and the provision of additional transit service and high occupancy vehicle (HOV) lanes that would be available simultaneously with the imposition of the new charges.

The market-based approach has been advocated in the Bay Area as a less economically damaging alternative to the command-and-control approaches embodied in Regulation XV in Los Angeles. The Bay Area plan has received extensive favorable publicity, including endorsement by the metropolitan planning organization. However, despite this support, the State Air Quality Control and Maintenance District lacked the legal authority to impose the program. The Forum is now working to broaden the base of support for the market-based approach and is exploring possible demonstration projects that are specifically tailored to the opportunities and conditions that exist in the Bay Area.

Distributional Impacts and Transportation Alternatives

The first paper in this session pointed out that careful consideration must be given to who wins and who loses when congestion pricing is implemented. Suggested winners included current operators and users of HOV lanes, road users who are willing to pay the higher price for spending less time in traffic, businesses that rely on deliveries, and the major recipients of activities funded with

congestion pricing revenues. The losers might include those who cannot afford to pay the increased tolls, drivers on unpriced roads that get additional traffic from those avoiding congestion tolls, and perhaps businesses in the vicinity of the priced roads. It was suggested that the pricing of existing roads could have more significant, diverse effects on the community than the pricing of new roads. Even though fears of adverse effects of congestion pricing on low-income persons may be exaggerated, any plan to implement congestion pricing should carefully consider the impact on income and geographical groupings as well as the best method of distributing program revenues to minimize adverse effects.

Another paper pointed out that market pricing is important for the development of transportation alternatives as well as for the pricing of roads. A comprehensive plan for transportation alternatives should be a part of a congestion pricing strategy. Commercial paratransit alternatives, such as shared-ride taxis, jitneys, and employee vanpools and buspools can help meet the transportation needs of downtown locations, poor neighborhoods, and work centers. Other approaches, such as telecommuting and neighborhood-based telework centers, can also reduce workplace trip demands. A number of policy reforms are needed to stimulate commercial transportation alternatives, including eliminating local controls on market entry, ridesharing, and pricing; limiting State regulations to minimum insurance and fitness standards for intercity carriers and vanpools; and allowing vanpools to operate on a for-profit basis. Congestion pricing revenues could be used to support these options.

Discussants in this session pointed out that evaluating congestion pricing without taking into account the complex system already in place—with its own winners and losers—will not lead to an equitable outcome. A compelling reason for public intervention is to ensure an equitable distribution of costs and services. The demands for trips in urban areas cannot be adequately served by mass transit. Ridesharing must be part of the solution. Parking pricing should also be included, but parking prices need to be high enough to induce both employers and retailers to support congestion pricing rather than pay for employee parking costs. More consumer testing and measurement of public and user attitudes are needed; more emphasis should be given to studying area-based versus facility-based programs and the long-term land-use implications

of congestion pricing. Communities themselves need to better define and clarify the objectives of congestion pricing. Congestion pricing should be introduced in a way that will achieve a high level of compliance and involve significant consequences for noncompliance.

Road Pricing Technology

This session's papers pointed out that, although technological advances have made more types of congestion pricing techniques feasible and easier to implement than ever before, significant technological questions remain. Can technology make efficient pricing possible across all modes? Can technology meet the often conflicting goals of enforcement and privacy? Reasons for implementing electronic toll collection include revenue control, flexibility of pricing, effectiveness of traffic monitoring, customer convenience, increased throughput, and cost reduction. Implementing peak-hour pricing is technologically feasible, but obtaining needed software adjustments may be complicated by regulatory, financial, and managerial problems. One person pointed out that the technology is in place for in-lane point charges and that the ability to charge across multiple lanes will be available soon, but problems still exist with multilane systems in detecting motorcycles and vehicles changing lanes. Although some economic, legal, and privacy issues exist, the most important issue in implementing electronic toll collection technology is that of setting standards. The market—not government fiat—should be used to establish standards. Customer surveys are an essential part of implementing electronic toll collection technology.

Speakers commented that one key to successful implementation was to keep pricing projects simple and convenient for users. The issue of giving commuter discounts (which runs counter to the objectives of congestion pricing) was raised as an issue to be addressed. It was pointed out that congestion pricing may run counter to the objectives of private toll authorities and that congestion pricing goals may run counter to the objectives of the proposed 1992 energy legislation (S. 2166 and H.R. 776). Provisions in the legislation suggest that States consider reducing tolls and taxes as a way of promoting the use of alternatively fueled vehicles. In concluding the session, the moderator reminded the participants that, in implementing congestion pricing, the

transportation community “may try and may fail, but they will truly fail if they don't try.”

Issues Raised in Breakout Sessions

Five breakout groups were asked to address key implementation issues, identify appropriate applications of congestion pricing, and suggest potential uses of congestion pricing revenues. Each group was also asked to complete a special project related to the implementation and evaluation of congestion pricing projects. Implementation issues most often cited were the need to develop public and political support, the need for a clear statement of goals, the need to examine the equity implications of congestion pricing (who wins? who loses?), and the need to clearly identify the intended use of revenues.

Suggested applications of congestion pricing included—

- Fixed-point tolls.
- Regional/areawide tolls.
- Corridor tolls.
- Congestion generators (e.g., airports).
- Existing public or private toll facilities or new facilities.
- Area licensing.
- Peak discounts on alternatives combined with congestion pricing.
- Sale of excess capacity on HOV lanes.
- Areawide parking charges.
- Automatic Vehicle Identification (AVI)-based, finely graduated pricing in downtown areas.

Conclusions

Many symposium participants indicated that congestion pricing can help improve the efficiency of urban transportation systems. The widely held view was that too little attention has been given to dealing with political and other institutional issues. One clear message coming out of the symposium is that public and political support must be generated if congestion pricing projects are to have any chance of success. Support can best be garnered if congestion pricing is included as part of a comprehensive plan

for mobility improvement. The use of congestion pricing revenues to deal with distributional impacts and to finance transportation improvements should be a key part of the comprehensive plan. In addition, it is important—both for purposes of project development and for generating public support—that the

objectives of specific congestion pricing applications be clearly defined. Congestion pricing cannot be imposed from the top. Support must be developed at the local level, and the public must accept congestion pricing as a way to reduce the costs associated with urban congestion.

Introduction

Congestion is one of the major problems facing large cities around the globe today. Over the past two decades, various cities in other countries have proposed or implemented programs aimed at congestion management. One proposed method of reducing congestion is congestion pricing, i.e., charging for roadway use based on the time and/or location of travel to encourage travelers to shift to alternative times, routes, modes, or trip patterns during peak traffic periods. Congestion pricing is not a new concept, but it has drawn serious consideration in the United States only recently as the public has demanded that cities grapple with congestion and its associated problems such as air and noise pollution. Thus, the Intermodal Surface Transportation Efficiency Act (ISTEA) (Public Law 102-240) of 1991 mandates that the U.S. Department of Transportation (DOT) create a Congestion Pricing Pilot Program of five demonstration projects to evaluate the effectiveness of congestion pricing in dealing with congestion problems.

In anticipation of the solicitation for proposals for these pilot projects, DOT's Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) sponsored a Congestion Pricing Symposium at the Key Bridge Marriott in Arlington, Virginia, June 10–12, 1992. The symposium brought together more than 160 transportation officials, economists, and environmentalists from the public and private sectors to identify and discuss key issues that must be considered in

the implementation of congestion pricing pilot projects.

As mandated by ISTEA, the projects will be executed through cooperative agreements with State or local governments or other public authorities. The projects will apply market pricing principles through a number of techniques, such as peak-period pricing to allocate space on crowded highways or parking pricing in congested areas, to alleviate the problem of congestion. The objective of these projects is to monitor, evaluate, and report on the effects of congestion pricing on driver behavior, traffic volume, ridesharing, transit use, air quality, and availability of funds for transportation projects. Reports on these projects will be submitted to Congress every 2 years for a period of 10 years.

During the 2½-day symposium, the participants attended panel presentations and breakout discussions designed to elicit and examine issues related to congestion pricing. This report summarizes the plenary and breakout sessions of the symposium. The participant list is included as Appendix A. Copies of the papers presented at the plenary sessions are available under separate cover upon request to the following address:

Federal Highway Administration
Transportation Studies Division
Attn: Jean Stock, HPP-13
Washington, DC 20590
(202) 366-0570

Opening Remarks

Stephen C. Lockwood, Associate Administrator for Policy at FHWA, opened the symposium by welcoming the participants and noting that the wide range of interests and disciplines represented in the roster of participants reflected the fact that interest in congestion pricing is no longer exclusive to economists. He pointed out that congestion pricing has become the transportation “issue du jour” and has entered the transportation agenda as a serious topic for several reasons: congestion, the Clean Air Act, productivity concerns, the cost squeeze faced by government at all levels, advanced toll road technologies, and this country’s tradition of user-based funding. This interest in congestion pricing was reflected in last year’s FHWA/FTA-sponsored congestion pricing conference, held before ISTEA was enacted.

The impetus for this symposium was the mandate for congestion pricing pilot projects included in ISTEA. The symposium’s purpose was to stimulate serious thinking about congestion pricing in general and to focus discussion on how pilot projects might be implemented. The role of the participants, according to Mr. Lockwood, was that of workers. He urged them to apply their array of talents, insight, and wisdom to the issues, noting that their comments would provide valuable background for those contemplating the implementation of congestion pricing projects.

Thomas D. Larson, Administrator of FHWA, noted that FHWA and FTA, the symposium co-sponsors, are working more closely than ever and have discovered commonality and a common purpose as they have dealt with a broad range of issues. He noted that he was playing the role of cynic as he posed the following questions that he encouraged the participants to address:

- Is pricing market-responsive if it is set by a government agency?
- Who will be driven off the highway system by congestion pricing? How should the equity concerns be addressed?

- What are the likely secondary impacts of congestion pricing?
- What will be done with congestion pricing revenues? Should the funds be used to create or enhance alternative transportation modes?
- Is the right price one that recovers cost or one that alters behavior?

Mr. Larson described the transportation situation in Switzerland, which has one of the world’s best transit systems and where fuel is four times more expensive than it is in the United States. Still, the Swiss have a 7-percent growth in vehicle miles traveled (VMT) per year, compared to 3 to 3½ percent in the United States. What are the implications of this example, he asked, for congestion pricing? Mr. Larson closed by quoting Machiavelli: “There is nothing more difficult to plan, more doubtful of success, or more dangerous to manage than the creation of a new system. For the initiator has the enmity of all who would profit by the preservation of the old institution and merely lukewarm defenders in those who gain by the new one.”

As he welcomed the participants, **Brian W. Clymer, Administrator of FTA**, expressed his pleasure at the opportunity to cosponsor this symposium, noting the spirit of cooperation between his agency and FHWA. He reminded the group that the pleasant parkways built for the Sunday drivers of the 1950’s have become congested freeways for today’s commuters. Although they were built with aesthetic considerations, they are valued now only for peak capacity.

According to Mr. Clymer, the implementation of congestion pricing is an attempt to turn academic theory into public policy. Because people have shown a reluctance to use mass transit, the next approach is to charge them for the use of congested roads. Mr. Clymer warned that congestion pricing is not a panacea and will not solve all the problems related to congestion. Furthermore, the effects of congestion pricing on urban businesses must be considered; congestion pricing should not drive businesses into the suburbs. He noted, however, that congestion pricing could be the most important concept that the transportation

community will deal with in the coming years, stating that it is an idea “whose time has come.”

Larry Schulman, Associate Administrator for Technical Assistance and Safety at FTA, identified the symposium as a “new beginning” for congestion pricing, a topic that has been in existence for some time. The original key themes of transit have been receiving more attention, he said, as the problems of congestion have intensified and radiated out from the cities into the suburbs. Congestion has adversely affected the productivity, air quality, and fuel consumption of the localities involved.

These problems cannot be resolved merely by increasing the capacity of the current transportation system because, as experience has shown, increased capacity results in increased travel and therefore only a short-term reduction in congestion. Moreover, physical and political constraints prevent increasing capacity.

Congestion pricing, on the other hand, encourages changes in travel behavior through (1) shifts in the time or mode of travel, (2) the choice of less congested destinations, (3) the use of high occupancy vehicle (HOV) lanes, (4) telecommuting, (5) compressed work weeks, or (6) the elimination of some trips. Because it also offers a stable revenue source, congestion pricing offers more promise than does adding capacity. Although congestion pricing raises questions of equity, Mr. Schulman maintained that these questions can be addressed.

According to Mr. Schulman, FTA’s predecessor, the Urban Mass Transit Administration (UMTA), began studying congestion pricing as early as the 1970’s. Currently, FTA is seeking creative projects that can be integrated with FHWA demonstration activities through the agencies’ joint task force. This gathering, he concluded, is timely for obtaining the information that will form the basis of future programs.

Session 1—Congestion Pricing: Past, Present, and Future

Symposium Moderator **Ronald F. Kirby**, Director of Transportation Planning at the Metropolitan Washington Council of Governments, set the stage for the first panel presentation by describing the changes in attitudes toward congestion pricing. Although FTA's predecessor, UMTA, funded model congestion pricing projects in the 1970's, they were not successful. However, the topic of congestion pricing now draws a great deal of attention because, though it is still controversial, it has the potential to deal effectively with worsening highway congestion. Mr. Kirby asserted that many of the public's objections to congestion pricing, such as fears that it will cause more delays at toll booths, can be overcome with new technologies such as electronic toll collection. He stated that congestion pricing will become more acceptable as investments in the transportation infrastructure continue to decline and VMT increases, resulting in deteriorating conditions that will cause a major public outcry.

U.S. Experience with Congestion Pricing

Bert Arrillaga, Chief of FTA's Service Assistance Division, asserted that the transportation community is interested in congestion pricing because it will improve regional mobility, and because its benefits in reduced traffic, reduced travel time, and reduced air pollution outweigh its costs. He recommended that lessons learned from attempts at congestion pricing in the 1970's be viewed as guidance for today's congestion pricing projects.

In the 1970's, UMTA attempted to implement areawide congestion pricing by using windshield stickers similar to those used in Singapore. Of the 12 cities invited to participate, Boston, San Francisco, Berkeley, Ann Arbor, and Honolulu responded. Estimates indicated that daily charges of \$2 to \$3, levied for entrance to the downtown area, would result in a 35-percent decrease in congestion. However, because of strong local opposition, the projects

never progressed beyond the planning phase. No demonstrations were performed. The issues that defeated the project were the impact on low-income commuters, the concept of "freedom of the road," legal and enforcement issues, and possible adverse effects on business. However, Mr. Arrillaga noted that congestion was less severe during this time and that the project had other weaknesses: it neglected pricing on feeder corridors, the sample was too small, it did not adequately address enforcement issues, and technological developments were less sophisticated then.

Today, the prospects for implementation of congestion pricing projects are more positive because of two specific factors: implementation of electronic toll collection, and improved public response as a result of increased congestion. San Diego is considering a pilot project in which prepaid permits may be issued for a single occupancy vehicle (SOV) to use HOV lanes, with the revenues to be earmarked for the construction of a light-rail system. According to Mr. Arrillaga, the emphasis on congestion pricing will increase because of increased pollution, the need for revenue, advanced technology for implementation, easier enforcement, and stricter air quality requirements imposed by the Environmental Protection Agency (EPA).

In closing, Mr. Arrillaga recommended that future congestion pricing activities include the following:

- Supporting the development of AVI technologies.
- Initiating an assessment of legal and liability issues.
- Performing a synthesis of past congestion pricing experience, including international experience.
- Developing prototype projects.
- Establishing an evaluation framework.

He advocated that DOT be opportunistic and implement a variety of programs.

Road Pricing: International Experience

Martin Richards, Chairman of England's MVA Consultancy, defined road pricing as a system under which road users incur a charge for the use of congested roads, a charge related to the extent of that use. He also explained that road pricing is one of an array of policy measures to manage the demand for road use, thereby reducing congestion and the environmental impacts of traffic.

Road pricing schemes have been considered for introduction in various cities around the world. In London, congestion pricing was first considered by the Smeed Committee in the early 1960's. As the committee studied the possibilities of congestion pricing, they developed a set of principles that still offer practical guidelines for congestion pricing projects. The Smeed Principles state—

- Charges should be closely related to the amount of road use.
- Prices should be variable to some extent for different roads (or areas) and for different classes of vehicle at different times of the day, week, or year.
- Prices should be stable and easily determined by road users before they embark on a journey.
- Payment in advance should be possible, but credit facilities may be permissible under certain conditions.
- The impact of the system on individual road users should be accepted as fair.
- The method should be simple for road users to understand.
- Any equipment used should be highly reliable.
- The system should be reasonably free from the possibility of fraud and evasion, both deliberate and unintentional.
- The system should be capable of application throughout the country, if necessary, and to a vehicle population of more than 30 million.

In the late 1960's, the Greater London Council proposed a congestion pricing scheme using supplementary licenses. However, this scheme was not implemented, and a broad consensus of the need for congestion pricing did not develop until the late 1980's. In November 1991, London began a 3-year, \$5 million research program whose

goal is to fully and objectively assess the feasibility of implementing road pricing within the London metropolitan area. The research program will assess the following aspects of road pricing: travel choice, performance of the transportation network, the urban economy, social and equity impacts, technology, administration, and public acceptability. Specific activities of the program include (1) assessing the impact of road pricing on travel behavior; (2) forecasting the consequences of road pricing for all modes of transportation; (3) identifying the impacts of road pricing on business, property markets, and major services; (4) assessing the functional requirements of the system as it applies to technology and to administration; (5) evaluating costs and benefits of feasible options; and (6) assessing the attitudes of individuals affected by road pricing.

The only true urban road pricing system in operation is the area licensing system (ALS) that was introduced in Singapore in 1975. The system is based on a simple, supplementary license on paper that permits unlimited entries into the city. Charges vary for the morning and evening peaks, and no charge is levied for leaving the ALS area. Plans to replace the scheme with an electronic system are under consideration.

Attempts have been made to implement congestion pricing in other cities such as Hong Kong and Stockholm, but the projects have been abandoned or postponed. Hong Kong's abandoned proposal was to use a cellular system and tag technology to charge for each boundary crossing. The level of charge would have varied between cordons, with additional charges during peak periods for vehicles traveling in the direction of maximum flow.

Other international congestion pricing projects include The Netherlands' interurban pricing system, which uses Smart Card technology to impose peak-period surcharges on certain cordons. Three cities in Norway have implemented road pricing systems on simple cordons using an automatic payment option. However, their objective is not congestion management but raising revenues for road construction. Only the Cambridge system is truly based on congestion; charges are incurred only when speeds drop to a certain level.

The lesson that can be learned from all of these examples, according to Mr. Richards, is that public and political acceptability transcends all technical issues of congestion pricing. The failure to

recognize the importance of public response and to make full allowance for that response is bound to lead to failure of any project.

Introducing Congestion Pricing on a New Toll Road

Congestion pricing demonstration projects are needed, according to **Robert W. Poole, Jr., President of the Reason Foundation**, because the concept is still unfamiliar not only to the public but also to the traditional funders of toll roads. Theoretical models exist, but firm expectations of the quantitative effects of congestion pricing and the political dynamics affecting its implementation are lacking.

The most difficult type of project to implement, Mr. Poole explained, is conversion of a free road to a toll facility. The easiest implementation involves conversion of an existing toll facility by changing the flat-rate tolls to variable tolls for congestion management. Another relatively easy implementation is the use of congestion pricing on a new toll facility.

A specific test site, the San Joaquin corridor in Orange County, California, is being proposed for this type of facility. The advantages of this site are the affluence of the area, which lessens equity concerns, and the existing public and media support. If this project is implemented, its goals would be to quantify the impact of congestion pricing, compare the prevalence of ridesharing before and after the project is implemented, and quantify emission reductions. The toll road would use AVI technology, with toll booths set off the main roadway for non-AVI use. Discounts would be given to those who use AVI. The project would test the effects of different levels of peak charges; the test period would be divided into 10 segments, each approximately 6 months long, and the price would be increased by 10 percent during each segment of the test period. Traffic counts would be taken, and surveys will be used to assess the diversion of traffic to corridors and changes in ridesharing behavior. Emissions would also be calculated based on traffic flow and VMT, and equity considerations would be addressed by the provision of a door-to-door van-based transit system.

In conclusion, Mr. Poole informed the participants that this project, if implemented, would have an excellent probability of gaining public

acceptance. However, more quantitative data on congestion pricing is needed. Therefore, more demonstration projects, similar to this one, are also needed.

Discussants

According to **Timothy Hau of the World Bank**, congestion pricing has not been successful in the past because it hurts road users on average. In fact, in the absence of compensation, almost all users of the transportation system are made worse off by congestion pricing. Among those who pay the toll, only a fraction of drivers who value their time very highly will feel that their time saved is worth more than the toll; the vast majority will be made worse off. Those who are tolled off also experience a reduction in welfare because they are “forced” to travel by a less preferred mode or route, or at a less preferred time of day. And those who are already on public transport may be made no better off because they are faced with more crowded buses and subways. Without compensation to travelers, the main beneficiary of congestion pricing is the road authority that collects the tolls. Travelers gain from congestion pricing only through government compensation to them. Mr. Hau believes that this compensation should take the form of road improvements and construction for those who stay on the road and pay, improved and expanded transportation alternatives for those who are tolled off, and/or lower gas taxes, auto registration fees, and other transportation-related taxes to maintain revenue neutrality. Without effective compensation schemes, he concluded, congestion pricing is doomed to political failure.

Peter Koltnow, an independent consulting engineer, identified what he called some common troubling characteristics in the previous presentations: (1) overselling of congestion pricing, (2) inflated promises of benefits, and (3) the view that congestion pricing is a permanent solution to the problem. According to Mr. Koltnow, congestion pricing is a form of rationing, which is a temporary solution by definition. Furthermore, highway users are skeptical about congestion pricing in general, and the concept is untested.

Mr. Koltnow identified what he views as several problems in implementing congestion pricing. First, social engineering must accompany congestion pricing to mitigate its effects on the “losers” and to help it gain political acceptability. Second, congestion pricing is aimed at yesterday’s

target, i.e., those who commute from the suburbs to the central business district (CBD). The proportion of commuters to the downtown areas is shrinking, as is the fraction of total travel that takes place during peak hours. In addition, area-based congestion pricing programs are in reality taxation programs aimed at raising revenues, a task that should be done through legislation. Finally, Mr. Koltnow noted that congestion pricing, road pricing, and road tolling are not interchangeable terms, but they are being used as such. He urged that the terms be defined. He also emphasized the need for data in making decisions related to congestion pricing.

In conclusion, Mr. Koltnow recommended the following steps to make congestion pricing demonstration projects more effective:

- Define data products early in the project.
- Include project termination costs in the plans and terminate the project without hesitation if necessary.
- Establish neutral or balanced governance for the project.
- Measure air quality impacts directly.
- Stimulate accountability by identifying the project with a known local sponsor.

Jim Gosnell, Director of the Southern California Association of Governments, expressed doubt that “the time is right” for congestion pricing. In Los Angeles, peak travel has become less of an issue as the city has spread and evolved into a “24-hour city.” However, air quality is an issue, and the reasons for opposition to congestion pricing (such as equity concerns, personal freedom, economic impacts, etc.) are still valid. He commented that the international experience raises the question of motive; is the objective of congestion pricing to raise money, or is it to increase mobility? In California, for instance, toll roads were added for SOV’s as a way to increase capacity, not to test congestion pricing or demand management. He recommended that, in addition to meeting the Smeed Principles, congestion pricing projects must be able to withstand legal challenges. Mr. Gosnell also reiterated the need for more data to aid in decisionmaking.

In conclusion, Mr. Gosnell offered the following recommendations: first, level the playing field by stopping subsidies to the automobile industry and requiring the industry to share more of the true

cost of congestion; second, consider the impact of congestion pricing on local government finances; and finally, spend as much time in addressing the institutional issues as in dealing with the technological ones. He warned that the transportation community needs to take action because some States are already looking at congestion pricing as a way to raise revenues.

Open Discussion

Several participants had questions or expressed concern about congestion pricing, particularly with regard to the public’s response to its implementation. One participant questioned how agencies can encourage people to buy into congestion pricing, particularly if it is applied to roadways that are currently free. He noted that, although congestion pricing appears to be a good idea at the planning level, problems arise in dealing with the political issues. Users need to see the benefits. Mr. Arrillaga replied that people will respond positively if congestion pricing is adopted on a facility-based system. He commented that users must be educated about the consequences of doing nothing about congestion. Mr. Richards continued that congestion pricing will become more acceptable as people become more accustomed to it.

The fate of Hong Kong’s proposed congestion pricing project exemplified the participants’ concern, and one person asked whether its failure was due to technological or political problems. Mr. Richards responded that it was never implemented for a variety of reasons. First, the issue of privacy was never resolved. Then unrelated events, i.e., a minor recession and increased democratization, contributed to its downfall. He pointed out that each of the international projects that failed neglected to handle political issues. On the other hand, London is conducting social research to endeavor to overcome these problems. The conclusion is that the United States can learn from these mistakes and try to avoid the same pitfalls.

Another concern expressed was the effect of congestion pricing on the center city. A participant commented that reducing access to the city and increasing the cost of doing business there would degrade the CBD. Moderator Ron Kirby pointed out that in the Washington, D.C., metropolitan area most of the congestion is outside the Beltway, i.e., in the suburbs. The panel agreed that the idea is to encourage optimal use of the system.

One participant questioned the difference between implementing congestion pricing and increasing fuel taxes. Mr. Hau replied that the gasoline tax is uniform and therefore does not encourage changes in route or time. Mr. Koltnow countered that charging people to discourage use is a problem. He stated that road users would support increased fuel taxes if they recognize the benefits they will receive. The issue of equity is not as significant as people suppose it to be as long as certain basic principles are followed. For instance, the interstate highway system is totally inequitable,

but the public supported it. One person countered by asking why the interstate highways reflected a good use of social engineering, whereas congestion pricing was viewed as a bad one. According to Mr. Koltnow, the cost of identifying and mitigating the losers in congestion pricing will create major problems. Moderator Ron Kirby commented that the general public does not view the situation in the same way as does the transportation community. The issues can be identified only by the road users.

Session 2—Pricing and Use of Revenues

Symposium Moderator Ronald Kirby introduced the speakers for this panel on the important issue of how revenues from congestion pricing can and should be used.

Using the Revenues from Congestion Pricing

Although congestion pricing is not just another mechanism to raise funds, its potential as a revenue source makes congestion pricing worthwhile, according to **Kenneth Small, of the University of California at Irvine**. The revenues should be used to benefit people, particularly those who pay the fees. If the money is used wisely, most people will benefit. Also, if people are well informed about how the revenues are to be used, they will have fewer objections to congestion pricing. Mr. Small also reiterated the point made by previous speakers that the purpose of congestion pricing is to reduce congestion; therefore, the term should be applied only to pricing schemes based on time of day.

As an example of the revenue to be derived from congestion pricing, Mr. Small introduced a hypothetical pricing scheme for the city of Atlanta. If a toll of 15 cents per VMT were levied on all congested highways and streets, the estimated revenue would be \$425 million, based on estimates of a total VMT of 4.2 billion, collection costs of 10 percent, and reductions in VMT of 25 percent.

Mr. Small contended that the guiding principle in determining the best use of the revenue is to offer widespread benefits by funding a variety of different—although sometimes overlapping—beneficiaries. Dedicating the revenues to transportation is unwise, according to Mr. Small, because their potential use for increased capacity may outrun capacity needs in a regime of congestion pricing, and because this use increases the

scope of government. He proposed that revenues be allocated as follows: one-third to reimburse drivers in general, one-third to reduce general taxes, and one-third to fund new or expanded services. He also gave the following example of how this allocation would work in Los Angeles:

- Reimbursement to drivers would consist of (1) an employee travel allowance of \$10 per month, for a total of \$700 million; and (2) a reduction in fuel taxes of 5 cents per gallon, for a total of \$350 million.
- Reduction of general taxes would include (1) replacement of one-half of the dedicated sales tax, totalling \$530 million; and (2) a rebate on property taxes, eliminating the local highway subsidy, at a total of \$460 million.
- New and expanded services would include (1) new highway capacity funded at a level equal to 20 percent of the present dedicated sales tax fund, totalling \$210 million; (2) increased transit service from an addition of \$1.00 per new rider plus 50 percent, for a total of \$360 million; and (3) business services in employment centers (approximately \$150 per employee in the center), for a total of \$380 million.

Given this scenario, the direct effect on the commuter is negative only in the fee paid, but the effect is neutral or positive in the value of time saved and in the money returned via the revenue allocations. The direct dollar benefit can be estimated as high as \$450 per year for typical solo drivers who place a high value on time; \$360 per year for the carpool commuter; and \$300 for the transit user. For typical solo drivers with average or low values of time, the direct dollar benefits are approximately zero: that is, time savings and money returned just balance the fees paid.

Urban Mobility, Environment, and Transportation Financing: The Role of Tolls

Anthony R. Kane, Associate Administrator for Program Development at FHWA, asserted that he and Patrick DeCorla-Souza, a Community Planner for FHWA, are optimistic about the opportunities that are opening up for congestion pricing. These opportunities are the result of congestion problems, air quality concerns, and lack of funding. They exist because of advancements in electronic toll collection technologies, such as AVI and Smart Cards, and because ISTEA offers incentives for toll facilities and congestion pricing projects on Interstate and non-Interstate highways (as many as three of the congestion pricing pilot projects can be on an Interstate facility). The Federal share of funding for congestion pricing projects is 80 percent. The incentives apply to both public and privately owned facilities, and the tolls may be continued indefinitely.

Despite these opportunities, questions of the effectiveness of congestion pricing in reducing congestion, reducing harmful emissions, and providing needed funding remain. To address these questions, Mr. Kane and Mr. DeCorla-Souza conducted a hypothetical case study of an urban area of approximately 1.5 million inhabitants. The study used regionwide pricing of SOV's at peak periods only, with an average toll of 12.6 cents per peak VMT. The study revealed the following changes resulting from congestion pricing:

- The share of travel for SOV's dropped from 78 to 54 percent, while the share for HOV-2 travelers increased from 17 to 41 percent. To simplify the analysis, the share for buses was assumed to remain at 5 percent.
- The VMT per commuter dropped from 8.83 to 7.90.
- The average travel time per commuter dropped from 31.9 to 28.3 minutes.
- The total daily hydrocarbon emissions dropped from 22.2 to 18.8 tons.
- Financing was also affected positively. Assuming a 20-percent travel growth, the annualized costs dropped from \$206.5 to \$128.5 million. Assuming a 50-percent growth, the costs decreased from \$416.3 to \$320.1 million.

- Daily administrative costs were \$78,000, while revenues generated were \$685,000, resulting in a cost-to-revenue ratio of 0.11.

- The commuter cost savings was a total of \$660,000, including parking and travel time.

The overall impact on mobility was an 11-percent decrease in peak travel time; the impact on air quality was a 15-percent reduction in peak emissions; and the impact on funding was a surplus with the assumption of 20-percent travel growth and a small shortfall with 50-percent travel growth.

The issues that must be addressed to implement such a project, according to Mr. Kane, are both political (equity, public hostility, institutional issues, and use of revenues) and technical (compatibility of the technologies used, price determination, enforcement, and evaluation). In closing, Mr. Kane recommended that peak charges be phased in on existing and new toll facilities, underutilized HOV lanes, parking areas, and pilot facilities.

Discussants

Arlee Reno, Vice President of Cambridge Systematics, Inc., maintained that now is the time to address the important political issues of congestion pricing and that the benefits of congestion pricing need to be demonstrated on a broad scale. The transportation community needs to consider other benefits, such as productivity and long-term economic impacts, in addition to user benefits. Interest in congestion pricing is growing among the general public, but the transportation community must provide scenarios that fully describe its benefits. In closing, Mr. Reno recommended the following steps for evaluating congestion pricing schemes:

- Identify the level of pricing that is best at controlling traffic and capturing benefits.
- Evaluate the overall benefits of the project before addressing the distribution of benefits. Identification of broad benefits will help direct political discussions because the political "payoff" can be shared with the constituency.

Robert Repetto, Vice President of the World Resources Institute, warned that the importance of revenues in congestion pricing should not be

underestimated. Some World Resources Institute studies show that, if Mr. Small's scheme is implemented in the Nation's large cities, the revenues would be \$50 to \$100 billion; by the year 2000, those revenues could increase to \$75 to \$200 billion. With reduced traffic and fuel use along with averted accidents, the savings would be 5 to 30 cents for each dollar collected. Put into the context of State and local fiscal situations, according to Mr. Repetto, the potential advantages of a user charge make it very attractive. Other taxes of the same potential impose severe burdens because they reduce income or have other high economic costs. States and urban areas are considering their choices of levying road charges for peak demand or imposing activity-based taxes, which are damaging to the local economy. They would prefer to meet future needs through user fees, such as tolls, that reduce demand and put a cap on expenditures.

Martin Richards, of the MVA Consultancy, noted that the transportation community needs to establish what it hopes to achieve through congestion pricing and what to do when congestion occurs. Although most people do not want congestion pricing implemented in their localities, doing nothing is extremely costly and will contribute to the decline of congested areas. One option is to invest in mass transit, but evidence shows that low transit fares alone do not encourage people to leave their cars to use transit systems. Another option is to decentralize cities, but this action merely moves the problem to the suburbs, as can be seen in some U.S. metropolitan areas already. The remaining option is congestion pricing. Currently, individuals do not assess their full costs and the full costs to others when they choose to use cars. User charges must reflect those costs. Congestion pricing must halt the worsening of the general quality of life and the damage to business caused by congestion.

However, compensation must be provided when users change their behavior. Attitudes are critical to the successful implementation of congestion pricing. People will be willing to pay the fees if they understand the full effects of the damage caused by congestion, view congestion pricing as the best method of reducing it, agree with the use of revenues, and view congestion pricing as part of a comprehensive plan.

Open Discussion

The participants had several questions about the studies cited by the panel members. One person questioned why Mr. Small's example severed the link between the need to provide alternatives and the congestion fees imposed. He asked, when the final one-third of the revenues are allocated to new facilities and services, is there an inextricable link between charging the charge and having alternatives available? He was also concerned that, although everyone traveling on the facility during peak times would be charged, only workers would receive compensation. Mr. Small responded that his example was not intended to sever the link between charges and alternatives; however, the link is not absolute, and in some cases the connection may not be made. He also explained that different portions of the program would be directed at different constituencies and that individuals who fail to receive compensation under one portion of the program would likely receive it under another one.

Another person commented that transit use seems to be decreasing in his area because people are waiting for a new, better rail system. He asked why people don't use buses and vans. Mr. Richards responded that the evidence suggests that buses are generally not a socially acceptable substitute for cars in many areas.

One participant expressed surprise that Mr. Small's example showed a reduction in gasoline taxes. In response, Mr. Small indicated that he actually favors higher fuel taxes. However, because he believes that congestion pricing is better than fuel taxes, he recommended that this type of tradeoff be made. The action promotes good public relations and can be a selling point for congestion pricing.

Congestion pricing should not be viewed as a "silver bullet," cautioned one participant. If it is to succeed, it must be viewed as a long-term option, and it must therefore be combined with other long-term options, such as parking pricing, density, land use, and transit-friendly environments. William Vickrey commented that congestion pricing may actually increase VMT in some high-density areas such as Manhattan, because decreased congestion would mean increased mobility for those who continue to drive. Steve Lockwood remarked that the discussions did not give the impression that congestion pricing

improves mobility or service. He asked the panel members if an end-point vision of the systems exists. He commented that it must include a number of services beyond those currently available. The discussions focused thus far on the process and externalities, but from a strict transportation

view, improved mobility had not been demonstrated. Mr. Kane affirmed the ability of congestion pricing to improve mobility. He commented that the transportation community can get a view of enhanced mobility and that it must be part of the vision for congestion pricing.

Session 3—The Role of Market-Based Solutions

Moderator Mark P. Howard, Manager of the Clean Air Project for the National Association of Regional Councils, explained to the participants that the key question for this session is, “Market-based solutions to what?” Mobility is not an end unto itself; it is the means to an end. From an economic standpoint, the objective is to use the market to maximize the public good, however it is defined—i.e., as improved productivity, cleaner air, social equity, or sustainable growth. Road pricing should be part of the efforts to reach these goals.

Market-based solutions are a key aspect of the Clean Air Act of 1990 and are part of ISTEA. Despite a long history of consideration of market-based solutions for mobility, little experience has been gained in this area. Road pricing is not yet a prominent part of the mix of techniques to meet clean air goals. This panel’s objective is to show why market-based solutions to meet the goal of reducing congestion make sense.

A Comparative Analysis of Regulatory and Market-Based Transportation Demand Management Strategies

The purpose of the presentation by **Genevieve Giuliano, of the University of Southern California**, was to compare command-and-control approaches to market-based approaches of transportation demand management (TDM) regarding their efficiency, capabilities, and accessibility. TDM is any policy that promotes shifts from SOV peak period travel to other transportation modes or time frames. Ms. Giuliano explained that interest in TDM has increased, reflected in recent changes in U.S. transportation policy as a response to the following factors:

- Environmental and energy concerns related to dependence on the automobile.
- Growing congestion.

- Continued growth in automobile use despite investment in public transit.
- The perception that providing more highway capacity is self-defeating.
- Growth management concerns.

The current policy dictates focus on a dichotomous choice for congestion pricing: either command and control, or market. Command and control is generally considered to be related to regulation. Ms. Giuliano asserted that, however it is defined, any form of mandated TDM is regulation in the sense that it is imposed and monitored by government. Market-based strategies such as congestion pricing are as much a matter of regulation as command and control strategies are; however, TDM differs in the means used to address the problem. The dichotomous categorization of TDM is limiting because many different policy alternatives exist with a vast array of ways to implement them. Therefore, Ms. Giuliano and her associate Martin Wachs developed a more complex definition of TDM with two dimensions: methods that are either performance-based or market-based, and means that are either direct or indirect. Performance-based methods impose a uniform standard of performance that must be achieved, whereas market-based methods offer incentives or disincentives aimed at changing behavior via the individual’s response to pricing. Direct means place regulation on individuals who are the source of the targeted problem, whereas indirect means place regulations on organizations or institutions. Table 1 shows some specific TDM policies that fall under each combination of method and means.

Like any strategy, these approaches have advantages and disadvantages, which are shown in Table 2. One disadvantage not shown for performance-based approaches is the restriction of personal freedom. Conversely, market-based approaches offer a choice and are therefore more acceptable. In general, indirect means are more

Table 1. Typology of TDM Policies

	Direct	Indirect
Market	Fuel Tax VMT fee Parking fee Congestion pricing	Third-party van subsidies Trip reduction credits
Performance	CA smog control program Alternative drive day Fuel rationing	Trip reduction ordinance CAFE fuel standards Parking space minimums

Table 2. Advantages and Disadvantages of TDM Approaches

Means	Pros	Cons
Performance	Perceived certainty of outcome Equity--uniform treatment	No incentive to perform better than standard Incentive to exaggerate costs of compliance Little relationship between contribution to problem and cost of compliance Administrative and enforcement costs
Market	Incentive to perform better than standard Costs incurred closely related to contribution to problem	Uncertainty of outcome Equity--unfair to lower income groups "License to pollute" Administration and enforcement costs
Direct	Efficient Applies to all members of group Easier to enforce	Less politically acceptable
Indirect	More politically acceptable Costs of regulation less obvious	Inefficient--action vs. performance Discriminatory within population subgroups Administrative burden

politically acceptable because, in targeting an intermediary, they obscure the line between the regulators and those being regulated, and because the costs of regulation are also obscured.

To illustrate, Ms. Giuliano compared a potential congestion pricing scheme to Regulation XV, which is part of California's air quality management plan. Regulation XV requires employers with 100 or more workers at a site to provide ridesharing incentives to achieve specified targets of average vehicle ridership (AVR). Since enforcement began in 1988, AVR has increased by 7 percent, primarily as a result of shifts to carpooling. No changes have been shown in transit use, telecommuting, etc. Case studies of five employer

programs revealed program costs of \$12 to \$263 per peak employee, of which about half constitutes administrative costs. The congestion pricing scheme includes a user charge of 15 cents per VMT. The study showed that congestion pricing, a market-based approach, resulted in a reduction of annual VMT of 4 billion or 5 percent. Regulation XV, a performance-based approach, created a reduction in annual VMT of 325 million or only 0.4 percent. The savings per annual VMT reduced was 67 cents under congestion pricing and only 46 cents under Regulation XV.

From these examples, Ms. Giuliano concluded that the effectiveness of any policy depends on its appropriateness as well as on enforcement. She

noted that direct, market-based measures work better—but indirect, performance-based measures are easier to implement. She offered the following recommendations:

- TDM policies should be applied throughout the region or State.
- TDM policies, whether direct or indirect, should be market-based.
- Congestion and air pollution policy should not be intertwined.

Commuting, Congestion, and Pollution: The Employer-Paid Parking Connection

Most transportation studies are concerned with moving vehicles. However, according to **Donald Shoup, of the University of California at Los Angeles (UCLA)**, most vehicles spend 95 percent of the time parked and even a parked vehicle may be contributing to congestion. Mr. Shoup contended that employer-paid parking has a significant influence on a worker's decision to commute by car or by transit. To remedy this problem, he recommended that employers who offer their employees a parking subsidy should allow those employees the option to receive the cash value of the subsidy if they do not take the parking.

Mr. Shoup cited a survey of large cities indicating that 90 percent of those who drive to work park free. For example, in downtown Washington, D.C., 74 percent of commuters' autos parked at Federal facilities paid nothing for parking and another 22 percent pay a discounted rate. Only 4 percent pay the market rate for parking. Mr. Shoup contended that employer-paid parking would reduce the effectiveness of imposing congestion charges because parking subsidies counteract the congestion charges. In downtown Los Angeles, the average employer-paid parking subsidy is equivalent to about 11 cents per VMT, which is roughly equivalent to proposed congestion pricing charges.

According to Mr. Shoup, employer-paid parking is a type of matching grant; the employer offers to pay for the parking at work if the employee pays the cost of driving to work. However, employees who are unable or unwilling to drive lose the benefit of the parking subsidy. Thus, the parking subsidy encourages people to drive to work rather

than use alternative modes. For downtown Los Angeles, Mr. Shoup's model indicates that only 48 percent of employees drive to work if they pay for parking, whereas 69 percent drive alone if they park free. When differences in socioeconomic characteristics and travel costs are considered, the model shows that employer-paid parking increases the number of solo drivers by 44 percent.

The effects of employer-paid parking on congestion are significant. The average commuter who must pay to park creates only 18.1 VMT per day. The increase in vehicle use that results from employer-paid parking increases this amount to 24.1 VMT per day, an additional 6 VMT per day. In one year's time, this increase amounts to 1,311 extra VMT per employee caused by employer-paid parking.

Employer-paid parking is also costly. An employee saves approximately \$563 per year on parking but spends \$380 more on driving if he or she drives alone. The employee's net savings, therefore, is only \$183 per year. However, the employer spends approximately \$750 per employee per year for parking subsidies, or \$4.10 for every \$1.00 that the employee saves.

Mr. Shoup recommended that employers who offer employees a parking subsidy should also offer employees the option of receiving the alternative of a taxable cash commute allowance. This cash option would have the following benefits:

- Employees who wish to retain an existing parking subsidy would not lose it.
- The choice between free parking or cash clearly shows that parking has an opportunity cost, which is the cash not taken.
- The option is no more costly to employers. In many cases, it would simplify administration by eliminating elaborate schemes for issuing different types of permits. For instance, the UCLA Campus Parking Service administers 240 different types of parking permits that are carefully graded according to the status of the employee or student.
- The lowest paid workers would gain the most after-tax cash and therefore would benefit more from the cash option.
- Federal and State income tax revenues are increased when employees choose the cash option.

- The option offers a strong incentive for employees to rideshare, use transit, ride a bicycle, or walk to work.

According to Mr. Shoup, offering the cash option to employees who now receive employer-paid parking would reduce their solo-driver share by 20 percent and the number of VMT per employee by 17 percent. The results would be reduction of traffic congestion, air pollution, and gasoline consumption and an increase in income tax revenues. Furthermore, these goals would be accomplished simply by letting commuters choose how to spend their own income.

Mr. Shoup characterized the failure to charge motorists for the congestion they create as a sin of omission, i.e., a failure to intervene in the transportation market to raise market prices to reflect social cost. On the other hand, employer-paid parking is a sin of commission, i.e., an act of intervention that reduces the price of parking below the market rate, without even considering the social cost. Ceasing an inappropriate intervention is as important in transportation policy, according to Mr. Shoup, as introducing new interventions to correct for market failure. Therefore, he recommended that the special rule for parking in the Internal Revenue Code be changed to encourage employers to offer their employees the option of receiving, in lieu of a parking subsidy, the fair market value of the parking subsidy, either as a taxable cash commute allowance or as a mass transit or ridesharing subsidy.

This proposal has positive political appeal because it offers people a reward for doing the right thing instead of a penalty for doing the wrong thing. It is a buy back, not a take away. According to Mr. Shoup, its implementation would be a long step in the right direction.

Discussants

C. Kenneth Orski, President of the Urban Mobility Corporation, commended Ms. Giuliano and her colleague, Martin Wachs, for their research on the effectiveness of TDM. However, he expressed disappointment at the results of their studies. Although, as Ms. Giuliano stated, the achieved increase in AVR brought about by Regulation XV is statistically significant, Mr. Orski commented that it is “nothing to brag about,” and reductions in VMT will be offset by just a few months’ worth of growth at the current rates. According to Mr.

Orski, neither is there “cause for rejoicing” at the results of market-based approaches. Although congestion pricing is estimated to reduce annual VMT by about 5 percent, this amount still represents only about 2–3 years of growth.

“Given these modest results,” Mr. Orski asked, “is the game worth playing?” Cynics would argue that neither congestion pricing nor regulation will have more than a fleeting effect on the growth of VMT and vehicle emissions. They would say that the way to meet air quality goals is to improve the technology of clean fuels and engines. Mr. Orski commented that he is not “ready to throw in the towel” on congestion pricing, but admitted efforts at demand management may be more symbolism than reality.

Mr. Orski commented that Mr. Shoup’s proposal for a taxable cash option in lieu of employer-paid parking is an elegant compromise to help change this universal habit. However, according to Mr. Orski, the plan does not consider two factors:

- For most employers, employee parking is a fixed cost, and offering a cash equivalent involves laying out extra cash.
- A cash allowance of \$1.00 actually totals about \$1.70 in taxable cost to account for income and social security taxes.

As an example of the difficulty in changing the current mindset, Mr. Orski pointed to Los Angeles, where only 3 percent of the surveyed employees have included parking prices in their implementation plans to reduce trips.

Sarah Campbell, of Campbell & Associates, maintained that these proposals are merely first steps in undoing nearly 30 years of skewed transportation policy. She compared the cumulative effects of past policies to a mass of tangled spaghetti, but insisted that these conditions should not distract the transportation community from its current course because it is “time to unscramble the spaghetti.” She listed the following steps for achieving the goals:

- Look at nontaxable benefits as a substitute for employer-paid parking. According to Ms. Campbell, an assessment of the value of parking in different regions is needed. She conceded, however, that this task is very difficult. The Internal Revenue Service has attempted it before.

- Determine the distributional effects of policies to ensure their success.
- Consider very carefully how the revenues will be used. Congestion pricing and TDM policies will be more acceptable to the public if they are tied to appropriate revenue uses that are tied to other benefits.

Ms. Campbell warned that whatever means of implementation is tried, the transportation community must accept some failure; the various schemes have not been thought through very well, and experimentation is still needed. However, she challenged the participants not to let fear of failure deter them from the goals.

Keith Gilbert, of the Automobile Club of Southern California, shared thoughts about how the parking pricing concept presented by Shoup and Willson might be implemented at the 1200-employee Club headquarters facility. The Club's Regulation XV plan has been through two approval cycles. Average vehicle occupancy has been increased from 1.1 to 1.2, short of the goal of 1.5 persons per vehicle.

Problems that might be encountered in shifting to a cash-out option include determining the market price for parking, enforcing parking policies (because of multiple lots with multiple entrances), and deciding how to use any resulting surplus parking acreage.

On the basis of his experience, Mr. Gilbert doubted that people would respond to the cash-out option proposed by Shoup. He stated that different methods of changing behavior (such as punitive charges) would likely be needed to reach goals. Overall, people will not change their actions unless they are "hurt." However, if policies "hurt," they will not be politically acceptable.

Open Discussion

Some participants expressed doubt that the cash alternative to employer-paid parking would work. One person stated his belief that workers would take the cash option and drive anyway. Another participant commented that many firms will be stuck with large parking areas that are not easily converted for other uses. Mr. Shoup replied that surveys indicate that the firms may use extra spaces for visitor parking, and many have other uses in mind. Steve Lockwood reported on a current energy bill in Congress; the House proposal would raise the cap on employer-supplied

commuter benefits for transit to \$60 (from \$21) per month and would impose a \$160 per month cap on the exclusion for parking. The Senate does not oppose the bill because it is revenue neutral. Therefore, it could be passed quickly with little discussion from the transportation community or from the downtown urban versus suburban development community.

Ms. Giuliano's call for a market-based approach struck a chord with one participant, who said that EPA is attempting to answer the call. However, the agency is having difficulty determining what makes up travel demand and how to measure it. What transportation experts know about travel demand, Ms. Giuliano responded, is that it is relatively inelastic, and the most important factor is for people to have the freedom to choose their behavior. Furthermore, significant incentives are necessary to effect changes in the behavior of travelers.

Another participant commented that the transportation community should be circumspect about the claim that the regulatory approach guarantees the outcomes. If that claim were true, he said, the 1970 Clean Air Act would have solved the Nation's air quality problems. He also cautioned against comparing the costs of charging congestion fees and the costs of employer-based transportation management programs. The costs expended by employers in implementing and administering such programs represent real resources that are consumed and gone forever. However, only a small portion of the costs (perhaps 10 percent) are needed to implement and operate a congestion pricing system. Therefore, a cost effectiveness comparison would favor congestion pricing by a margin of about seven to one.

A question was raised about the suitability of special permits for allocating access to highways or other transportation facilities. Ms. Giuliano replied that permits have received much consideration in some areas and that a permit program is beginning in California now. However, she believes that permits will be a "nightmare" to implement and that congestion pricing is a better alternative.

One participant disagreed with assertions that congestion charges and air quality charges should be separate issues. He contended that with AVI technology, fees can be charged on the basis of weather conditions as well as on the basis of the level of congestion.

Luncheon Speech—The Bay Area’s Experience in Advancing Market-Based Transportation Solutions

Michael S. McGill, Executive Director of the Bay Area Economic Forum, presented two “Manichean” scenarios that would confront commuters in the future. The “good” scenario was a market-based approach advocated by his organization. It presented a series of choices to anyone about to travel for work or pleasure: (1) Do I drive during the peak commute period and pay a toll? (2) If I drive, do I travel alone or in a carpool and use HOV lanes? (3) Or, do I travel by transit? (4) If I drive, do I use my cleaner-burning car or my old clunker? (5) If I drive, what will I have to pay for parking at my destination?

The advantage of such a market-based approach is that it sends clear signals, in the form of prices, that reflect the true costs driving imposes on society, and it provides convenient, low cost alternatives to driving alone. Those who want to drive alone will pay for the privilege of doing so, but they will enjoy less congestion; those who do not will be satisfied with their options, which are funded by the fees paid by those who drive.

The “evil” scenario is represented by command-and-control approaches such as Regulation XV in Los Angeles. This approach affects only people who work for large employers, rather than everyone on the road. It offers a commuter the option of paying for parking or of carpooling; however, no new HOV lanes are added. In this scenario, a commuter may drive to work alone, park 10 blocks away, and then walk to a rendezvous spot to join a fellow worker and get in his or her car, so that when they approach their employer’s parking lot and are confronted by a guard at the gate, or are observed by a transportation coordinator watching through binoculars, they will qualify as a carpool and get free parking. In the meantime, their boss is in a foul mood, because she submitted her firm’s Employer-Based Trip Reduction Plan late and was fined \$150,000.

Furthermore, these funds are not used to provide more transit or to add HOV lanes on the highway. Instead, they are used to fund more enforcement staff at the Air District.

It is important to distinguish between a market-based approach and the concept of pricing, such as in congestion pricing or emission charges. The latter sends clear signals to an individual about the consequences of his or her behavior, but it offers no alternatives. The market-based approach takes at least a portion of the funds generated by the fees and charges imposed and uses these funds to provide such alternatives. It is powerful precisely because it offers a combination of incentives and disincentives that are directly related to each other.

The Bay Area Economic Forum is proposing combinations of (1) emission charges (fees based on the level of dirt in a car’s exhaust times the number of miles traveled since the last inspection) and improved inspection procedures with no cap on how much must be spent to clean up the exhaust; (2) congestion prices, i.e., bridge and highway tolls on the most congested portions of the region’s highway network during the peak commute period, a gasoline tax, and parking charges; and (3) the provision of additional transit service and HOV lanes that would be available simultaneously with the imposition of the charges.

The Forum is concerned with maintaining the economic vitality of the Bay Area economy. It decided to advocate use of a market-based approach to combat air pollution after considerable interaction by several key individuals in the Forum and the Bay Area Council. The employer-funded Council, a cofounder of the Forum, had long been involved in efforts to ease traffic congestion. The Council was actively engaged in a debate over what transportation control measures (TCMs) the region should impose to respond to State air

quality standards, which are more stringent than Federal law. The Council feared that the command-and-control approach would be used to the detriment of the economy. At the same time, the Forum's board chairman was a forceful advocate for market-based solutions. So the Bay Area Council and the Bay Area Economic Forum joined forces to produce the Forum report, *Market-Based Solutions to the Transportation Crisis*.

The Forum took a chance in promoting this issue at a time when there was little public awareness of the California Clean Air Act. However, its strategy, to set the agenda for the discussion of solutions to the problem, worked. The report received extensive favorable editorials and many endorsements, including one from the Metropolitan Planning Organization (MPO) that was responsible for submitting the first draft of the TCM plan. Despite all this support and the power of the proposals for reducing traffic congestion and improving air quality, the program was not adopted because the Air District lacked the necessary legal authority to impose it. Instead, State law said it had to use "reasonably available transportation control measures," namely, the kind of command-and-control approaches embodied in Regulation XV.

In closing, Mr. McGill cautioned that each entity involved in implementing the market-based approach tends to favor the aspects of the approach that directly benefit the entity. So, for instance, MPO's tend to favor imposing tolls and gasoline taxes first, but are inclined to defer using those funds to provide more HOV lanes and transit service until later. Air Districts focus only on parking charges, because they have authority to make someone else impose them. Employers like the idea of spreading the burden to everyone, rather than just their own workers, and they get upset when the only part of the package proposed is parking charges. Environmentalists like congestion pricing, but only if it does not reduce congestion, since they like to use it as a means of controlling growth.

Because legislative support for congestion pricing and emission charges is lacking, the Forum is now working with the relevant regulatory agencies at the State and Federal levels to gradually build broad-based institutional support for the market-based approach. It is also exploring possible demonstration projects that are specifically tailored to the opportunities and conditions that exist in the Bay Area.

Session 4—Distributional Impacts and Transportation Alternatives

Panel moderator **Mary Lynn Tischer, of the Virginia DOT**, introduced the speakers on this panel concerned with stimulating transportation alternatives and addressing the distributional impacts of congestion pricing.

Stimulating Transportation Alternatives in Response to Congestion Pricing

Robert Cervero, of the Urban Planning faculty at the University of California at Berkeley, said that market-based pricing was important for both congestion pricing and the development of transportation alternatives. Congestion pricing needs to be part of a comprehensive transportation package that includes adequate alternatives for those who are priced off the roads. Mr. Cervero cited Singapore's transportation package as a good example, noting that it includes efficient rail and other mass transit systems as well as housing grouped around transportation centers. Although Arizona completely deregulated common-carrier transportation in 1982, private transit alternatives failed to materialize because the private sector could not compete against the heavily subsidized public mass transit system and free parking.

Mr. Cervero first enumerated the benefits and costs of commercial transit. The benefits include reduced pollution and fuel consumption, supplemental peak-hour services, enhanced mobility for lower income households, stimulation of automated transportation technologies, and promotion of alternative fuels and electric vehicles. He then explained that the purported costs of commercial transit were not empirically supported, citing generally positive experiences in San Diego, Seattle, Portland, and Indianapolis. Specifically, the problems of excessive competition were generally found in areas such as airports, which would not fall into the congestion pricing arena of regular commuters. Market pricing of airport parking leads to a very captive, price-insensitive market; if parking fees in the general

metropolitan area achieved similar heights because of congestion pricing, there wouldn't be such fierce competition at the airports. Commercial paratransit options include shared-ride taxis in the downtown areas, jitneys (usually illegal) in the poor neighborhoods, and employee vanpools and buspools in the work centers. Other approaches to accessing the workplace (the trip to the workplace being the most likely to be affected by congestion pricing) include telecommuting and neighborhood-based telework centers.

A number of policy reforms should stimulate transportation alternatives, according to Mr. Cervero, including lifting all local controls over market entry, ridesharing, and pricing; limiting state regulations to minimum insurance and fitness standards for intercity carriers and vanpools; and allowing vanpools to operate on a for-profit basis. Mr. Cervero suggested that congestion toll revenues could be used to buy back overinflated medallions, to finance increased enforcement to ensure carriers' fitness standards, to help underwrite the insurance premiums for more casual ridesharing arrangements, and finally to subsidize the users of these alternative transit options. This last option would force the carriers to compete for the patronage of people with handicaps, the elderly, the poor, and other disadvantaged recipients of these subsidies who might otherwise be neglected in "cream-skimming" activities.

Mr. Cervero concluded his talk with a discussion of some of the other inducements to commercial transit. Private carriers believe that HOV lanes are more effective than higher commuting costs because people are more time sensitive than price sensitive. Mr. Cervero believes that HOV lanes are a second-best alternative to true market pricing but are amenable for introducing multiple lanes with differentiated tolls. Finally, he reaffirmed his opinion that congestion pricing and free-enterprise carriers are naturally interdependent and that the only way to make market pricing work is to come up with market transit alternatives.

Implementing Congestion Pricing: Distributional Implications

The second speaker, **Kiran Bhatt, of K. T. Analytics**, discussed the winners and losers of implementing congestion pricing. Only Singapore has effectively implemented and maintained a congestion pricing program; all other attempts have failed in part because of the perceived adverse effect of congestion pricing on low-income persons. Mr. Bhatt emphasized that although the fears may be exaggerated, it is necessary to carefully consider the winners and losers in implementing a congestion pricing program. The winners will include current operators and users of HOV roads, road users who are willing to pay the higher price for spending less time in traffic, businesses that rely on deliveries, and the major recipients of activities funded by congestion pricing. The losers are those road users who cannot afford to pay the increased costs, drivers on unpriced roads in areas that may get additional traffic from those avoiding the congestion-priced roads, and perhaps businesses in the vicinity of the priced roads.

The impact of congestion pricing will depend on the roads and area covered in the program; pricing on new roads would adversely affect a small percentage of the traffic, whereas pricing on an existing road could have more significant, more diverse impacts on the community. All adversely affected parties should be recognized, and mitigating actions should be designed to decrease the adversity. Any plan to implement congestion pricing should carefully study the impact on income and geographical groupings as well as where to best distribute the revenues from the program to minimize adverse effects. Mr. Bhatt emphasized that “we are running out of situations and solutions that would produce no losers,” so each congestion pricing program should be considered alongside other funding and policy initiatives for addressing the same sets of problems. Finally, Mr. Bhatt reiterated the need to develop and assess alternative uses for the revenues from congestion pricing—how the revenues are used is critical to the success of the program.

Discussants

The first of the three discussants, **Michael Cameron, of the Environmental Defense Fund**,

explained that there is a shared understanding that transportation services are fundamentally necessary for individuals, businesses, and communities. Advocates of congestion pricing are looking for a comprehensive package of appropriate pricing policies and revenue expenditures. Compensation schemes require looking at two issues: whether politics or theory determine the vantage point, and whether winners and losers are determined on the basis of congestion pricing alone or in the context of all transportation issues and policies. Although theoretical approaches and political approaches are both valid, they can be very different. The hope is that the theory leads to informed politics. The vision of a transportation system determines how congestion pricing should be considered. Evaluating congestion pricing without taking into account the complex system already in place—with its own winners and losers—will not lead to an equitable outcome, either theoretically or politically. Three market failures in transportation justify public intervention: externalities, natural monopolies, and consideration of the public good. According to Mr. Cameron, equitable distribution of costs and services is the most compelling reason for public intervention.

Byron York, of the Rideshare Company, focused on the needs of commuters, citing several statistics based on Connecticut commuters to suggest new ways of thinking about transportation issues. Of all work trip destinations, 85% are not downtown, where most of the mass transit is focused. Mass transit cannot serve all of the tiny fragments of transportation needs that require trips from everywhere to everywhere. Of the population able to switch to alternative means of transportation, 22% of the current drive-alone commute market in Connecticut already know someone with whom they could share rides. Only 10% of all commuters choose to carpool, suggesting that other incentives—perhaps financial or institutional—are needed. The pricing of parking is a particularly sensitive issue. Employers traditionally cover the cost of parking to make commuting more convenient for their employees. If the primary effect of congestion pricing strategies is intended to be behavioral, these demonstrations should be structured to ensure that the cost factor is borne by the driver/commuter. If the price is partially or totally absorbed by business/employers, as current urban parking is, the effects will be seen more in revenue generation rather than in

behavioral change. Mr. York suggested that congestion pricing and air quality testing could be linked by checking a vehicle's mileage at the same time that emissions are checked and charging a fee based on the mileage. Mr. York recommended further consumer research and testing, studying area-based programs versus facility-based programs, and the long-term implications for land use. He also recommended that a broad-based parking pricing project be included under the Congestion Pricing Pilot Program.

Martin Richards focused on the confusion about the objectives of congestion pricing and on as-yet-unexplored topics. Mr. Richards opined that there will be no real progress until the objectives are defined by communities themselves. Some of the objectives put forth aim to satisfy clean air requirements, reduce energy consumption, increase economic efficiency, and control growth. His concern was whether the objectives sought to correct short- or long-term deficiencies; the discussion so far had focused on the impact of congestion pricing on individuals rather than on the corporate interests of truckers, doctors, and businesses. Mr. Richards also maintained that not enough attention had been given to the problem of urban sprawl and other land-use issues, including whether the freedom to build where one pleases is too fundamental to regulate. The problems of regulation also come into play when discussing how to enforce compliance with congestion pricing. Mr. Richards emphasized the need for a system that would achieve a high level of compliance because the risks of noncompliance could be high. Because enforcement is most likely to involve tracing noncompliant vehicles through license

plates, a significant proportion of illegal plates could seriously affect enforceability. The experience of poll tax in the United Kingdom demonstrates the ineffectiveness of unpopular measures to which there is widespread resistance. Success of a regulation requires a high level of compliance and significant consequences for noncompliance.

Open Discussion

Several issues emerged in the open discussion following the panel. One question concerned long-term implementation strategy. Mr. Richards emphasized that because alternatives must be in place before congestion pricing is implemented and because governments tend to move glacially, congestion pricing must be part of an area's long-term strategy. Another question was posed about what alternatives are available now. The government, according to Mr. Cervero, has tried public transit for 15 to 20 years, but the public system has not met the needs that he feels could be better determined and served by the market. He advocated giving the money previously poured into public transit back to the people and shifting the public sector's role to safeguarding distributional equity.

Mr. Lockwood questioned the likelihood of creating a market-based transportation system anytime soon, saying that success depends on the underlying vision, planning, and infrastructure of the government. Another participant stressed the importance of carefully analyzing the current system to adequately evaluate new ideas like congestion pricing.

Session 5—Road Pricing Technology

In addition to the acute congestion that we face now as well as increased environmental consciousness, today's advances in technology have spurred interest in congestion pricing, according to Panel Moderator **Mark Norman, of the Institute of Transportation Engineers**. Although technology does not make policy, technological advances have made more types of congestion pricing techniques feasible and easier to implement than ever before. As has been stated, the major challenges to implementing congestion pricing are institutional; however, a number of technical questions do exist. These questions include the following:

- Can and should technology drive transportation policy decisions? In turn, can and should transportation policymakers drive the technology?
- Can technology make total transportation pricing possible across all modes, as opposed to just road pricing?
- At what point does the need for standards counteract the damper that standards can place on innovation? What can be done to minimize the impacts of standards on new development?
- How can technology be used in congestion pricing to meet the often conflicting goals of enforcement and privacy?

Current Roadway Pricing Technology Issues

Steven Rooney, President of SR Associates, informed the participants that the technology is in place to implement congestion pricing. AVI technology is relatively new, but the industry is growing. Development of the technology is more likely to occur in a greater variety of directions on facilities where congestion management (not revenue) is the primary objective. Among the technologies that have been applied to roadway pricing are the following:

- Optical character readers record license plate numbers and digitize them. This application

has been tried in France; however, it lacks the ability to perform the rapid transactions necessary to read multiple plates at one time.

- Optical infrared barcode scanners have been used in the United States on bridges. They are inexpensive and serve well as an intermediate technology, but they are easy to counterfeit and cause environmental problems.
- Conductive loop technology requires active tags, making the vehicle vulnerable to electrical failure.
- Radiofrequency identification (RFID) is the technology most frequently used in present toll-road applications. It falls into the following three categories, depending on how the transponder is energized: active (acquires energy from the vehicle), semiactive (uses an internal battery), and passive (receives energy from the transmission from the reader).
- The most common type of system uses semiactive modulated backscatter technology. These systems are highly accurate (99.5 percent) and are effective at vehicle speeds of 100 miles per hour or more.
- The SAW technology uses lithium crystals to send an acoustical wave to the tag; the signal is modulated and sent back.
- Smart transponders are an attempt to address some of the current technological issues, such as the length of transmission for read-write tags.

According to Mr. Rooney, four principal reasons exist for implementing ETC technology: (1) revenue control, in acting as the cash register of the system; (2) customer convenience, because it eliminates stopping to pay tolls; (3) expanded throughput; and (4) cost reductions (of approximately 50 percent), because the need for toll booth staffing is eliminated.

Certain technological issues do exist. The need for read-write tags and increasingly high data rates has spurred much discussion in the industry. Although established communications

protocols do exist, the State of California wants its own protocol, which does not match any existing equipment. Such questions of compatibility can be problems or opportunities, depending on the point of view. Multimodal issues are arising as more people who are not vehicle oriented enter the field of congestion pricing. This issue is an important one in the area of payment methods. Peak hour pricing is an issue for software development. Despite these technological issues, according to Mr. Rooney, implementation of congestion pricing projects is certainly feasible from a technological viewpoint.

Electronic Toll Collection

The purpose of the study conducted by **James V. Halloran III, of the Reason Foundation**, was to compare ETC technology with the requirements or issues that might prevent its implementation. According to Mr. Halloran, ETC provides the following benefits: it allows maximization of revenues while equipment and personnel costs are minimized, permits unrestricted traffic flow, provides a means of monitoring traffic, and allows flexible pricing over very small increments so that it can be fine-tuned to the requirements. The legislative impetus for using ETC in California, according to Mr. Halloran, is a bill by Quentin Kopp of the Senate Transportation Committee. The three key issues in this bill are the following requirements:

- ETC should require no speed reduction.
- Only one tag should be required per vehicle owner.
- Multiple sources should be available for acquiring the tags.

The ETC system is based on three major elements: the reader (an antenna), which is located in the roadbed, on the roadside, or overhead; the tag (a transponder), which is in the vehicle; and the “back room” equipment, which is the network that operates the system. Because of the size of the tags, tags tend to drive the technology. The two basic types of tag technology are read-only tags (similar to compact disks in that a person can listen to them but not record on them) and read-write tags (similar to cassette tapes in that one can read data on them and then record other data on them). In general, two types of communications protocols will be used for ETC systems in California: time division multiplexed access (TDMA), which

uses a digital signal and divides time into very small increments, allowing a number of tags to respond in a short time; and spread spectrum, which uses an analog signal with a narrow band of frequencies.

Mr. Halloran maintained that there really are no technical issues that will prevent ETC from becoming a reality. However, the following issues must be addressed:

- **Safety.** This issue may be difficult to resolve because of microwave radiation from the antennas. Some toll road authorities fear that the distance between the antenna and the vehicle will require such high power for signal transmission that it will be harmful to occupants of the vehicle.
- **Reader location effects.**
- **Reliability and accuracy.** Results show that these concerns are unfounded.
- **Security.** The same precaution should be used with the tags as with ignition keys: they should not be left in the car. Tags can be affixed to the car so that they cannot be removed without destroying them. Stolen tags or stolen vehicles with tags are very easy to track and detect. Tampering can be deterred with encryption systems.
- **Metallized windshields.** The interference created by metallized windshields can be avoided by placing the tag in a side window or leaving a blank space in the coating for placement of the tag.
- **Growth capability.** A read-write system is needed if the toll authority plans to implement other IVHS capabilities.

According to Mr. Halloran, although some economic, legal, and privacy issues do exist, the most significant issue in the implementation of ETC technology is that of setting standards. Mr. Halloran asserted that standards should be set de facto by the market, not by fiat. As an example, Mr. Halloran cited the video cassette recorder market and Sony’s decision to guard Beta technology. The market therefore was flooded with the video home system (VHS) technology, and it became the standard even though Beta is a superior technology. According to Mr. Halloran, standards are a process, not a product, and should therefore not be set in concrete—particularly in the early stages. In Mr. Halloran’s view, the proposed California standards are too restrictive;

no single off-the-shelf system can meet them. Furthermore, they fail to meet the State's own guidelines. The standards are unpopular because the principal vendor of the specified technology is not from California. In light of these problems, Mr. Halloran made the following recommendations regarding the setting of standards:

- Stick to performance and functional standards.
- Conduct "shootouts" to ensure that the equipment meets the requirements.
- Set reasonable communications and interface standards.
- Let the marketplace decide.

Discussants

The Oklahoma toll road is successful, according to **Richard Ridings, Chief Executive Officer of the Oklahoma Turnpike Authority**, because the Authority surveyed its customers to determine their needs and studied other operational systems before implementing the system. The staff studied both read-write and read-only systems. The contract was then awarded to Amtech, and equipment was purchased through competitive bids.

According to Mr. Ridings, most of the issues confronting ETC systems have been overcome in the Oklahoma system. Privacy is not an issue because billing can be accomplished through direct computer transmission to trucking companies, etc. Transponders (tags) can be placed in the windshield or even in the license plate. Antennas can be placed under bridges and in the pavement; however, antennas in the pavement tend to be damaged by adverse weather conditions. Security is accomplished through camera surveillance; however, enforcement is not a significant problem because fines are severe (\$87) and citations can be mailed to the offender's home.

The benefits have surpassed expectations. The system was implemented to meet two objectives: (1) reduce operating costs and pass savings on to the customer and (2) reduce congestion at the major intersections of the interstate system and the connector to it. Operations costs are only one-tenth of the costs of a manual collection system. Congestion has been eliminated because approximately 25 percent of the customers use the ETC system. Furthermore, no accidents have occurred on the ETC lanes, and accidents in general have

been reduced by approximately 25 percent in the 2 years that the system has been operational.

Mr. Ridings maintained that the Oklahoma Turnpike Authority has the world's first congestion pricing project, although no one realized that it was such a project when it was implemented. From this experience, he recommended that, whatever type of system is implemented for congestion pricing projects, the key is to "keep it simple."

Neil D. Schuster, Executive Director of the International Bridge, Tunnel and Turnpike Association, asserted that tolls used for road financing and tolls used for congestion pricing are two separate things. Toll, however, are inherently a congestion pricing tool; drivers who know they must pay a toll each day are more likely to seek passengers to share the expense. Agencies also use tolls to meet some of the same goals: greater capacity of existing roads, productivity, lower operational costs, etc.

A significant advantage of ETC technology is its convenience to the user, which brings it a great deal of motorist support. This support is crucial to the successful implementation of congestion pricing projects. Also, because the need for toll plazas and plaza expansion is diminished, their construction can be delayed, thereby delaying or avoiding the problems that road construction brings.

According to Mr. Schuster, his organization has no position on congestion pricing. However, they acknowledge that congestion pricing is the logical way to pursue the problems currently facing the country's urban areas. They believe that the use of ETC technology is one of the best ways to implement a congestion pricing scheme.

Other countries are also testing congestion pricing schemes. Norway has a system with a variety of pricing schemes. The tolls at some booths have a flat rate all day; others have varying prices that depend on congestion. If vehicles pass through two particular toll booths that are near each other, a toll is charged only on the first one. The system must take all of these variations into account, and it is operating successfully. France is also testing a congestion pricing scheme; early results show it to be effective in causing people to shift travel times.

Mr. Schuster concluded with describing what he views as issues of congestion pricing as it relates to toll financing. He said that distinctions must be made among existing toll roads, new toll

roads, and existing non-toll roads, and certain questions must be answered before implementing each type of project. Toll agencies typically give commuters a discount for public relations and political reasons; however, this practice runs counter to the objectives of congestion pricing. Before a congestion pricing project can be implemented on an existing toll road that gives discounts, this issue must be addressed. The amount of the toll must be carefully considered; it must be acceptable to politicians and to the motoring public. The thrust to increase privatization in the transportation infrastructure is another issue that must be considered. If congestion pricing is aimed at decreasing market shares, this goal runs counter to the objectives of private toll authorities. Private operators question whether congestion pricing revenues will be available to compensate for the tolls lost when commuters change their travel behavior. Finally, congestion pricing goals may compete with the proposed energy bill provisions to reduce tolls and taxes for alternately fueled vehicles.

John J. Gaudette, Bechtel Corporation's Operations Manager for the Central Artery Tunnel Project, remarked that although the technology to implement ETC technology and congestion pricing have been available for approximately 20 years, the political climate had made these schemes unacceptable. However, the political climate has now changed. Regulation has changed to incorporate more market-based approaches. Multimodalism has also been accepted, as indicated by the cooperation of FHWA and FTA in cosponsoring this symposium. Mr. Gaudette contended that the issues in a railcar procurement are much more complex and difficult to address than those of a congestion pricing problem.

Mr. Gaudette recommended that the objective of congestion pricing should not be to solve all the problems of regional mobility. He reminded the participants that the theme of this symposium was not to look at a global perspective, but to consider demonstration projects and evaluate ideas. He advised them not to get "hung up" on unimportant issues. He said to remember the nature of the "deal," which reflects opportunism, the coming together of political forces, and a perspective that stresses willingness to accept risks. Above all, he urged the participants not to forget the golden rule of revenues: "Them with the gold rules." He said discussion of how to use revenues to solve broader social problems may be

irrelevant for this symposium because it is not clear that the transportation community will control the revenues. In closing, he urged the participants to "dream big, implement small, and demonstrate fast."

Open Discussion

The participants' questions and comments for this session centered on four issues related to the use of ETC technology for congestion pricing: privacy, areawide pricing (i.e., entrance and exit charging as opposed to point charging), reliability, and protection against fraud. Finally, one participant insisted that the use of revenues is an important issue.

In response to the question about how to protect privacy, Steve Rooney explained that both the Oklahoma toll road and the Dallas toll road have an account system similar to a Swiss bank account in which the account is paid in cash and the user remains anonymous. However, of the 125,000 users in Oklahoma, virtually no one uses this option. He contended, therefore, that the privacy issue is merely a marketing concern. He maintained that if privacy were a concern to users, it certainly would be so in States such as Oklahoma and Texas, where people generally are opposed to regulation.

Mr. Halloran informed the participants that areawide pricing is technically possible by using a read-write system, which can indicate on the tag the time of entry and exit. Areawide pricing can be done with a read-only system, but this approach requires additional infrastructure. Some questions exist, according to Mr. Rooney, concerning the transaction requirements. Although some people contend that a read-write system handles all of the necessary transactions, others believe that an additional "audit trail" is necessary. However, this question is an administrative matter, not a technical issue.

Martin Richards commented that the technology is in place to perform in-lane point charges, and the ability to charge across multiple lanes will be available soon. However, problems still exist with multilane systems in detecting motorcycles or vehicles changing lanes. Enforcement also still poses some problems in multilane systems.

Maintaining the reliability of the systems while still meeting all of the various requirements was

another concern raised by one participant. Mr. Rooney replied that transferring equipment from one system to another can create problems because of the differing requirements. However, the industry is very customer service oriented and is working to resolve those problems.

Another participant commented that areas with a high percentage of commercial travel also have a high potential for fraud; e.g., tractor-trailers may try to use tags meant for cars. Mr. Halloran explained that ETC and AVI systems are generally used in conjunction with treadle or loop systems that help identify the type of vehicle. One person questioned whether the technology allowed different pricing of HOV's and SOV's. Mr. Rooney responded that the card-based technology allows for detecting two cards in one vehicle, but that does not necessarily mean that two people are occupying the vehicle. Detection of this type of fraud depends on enforcement.

In the Cambridge proposal, the system is triggered when a vehicle enters the downtown area; pricing is determined by how many stops are made. However, this system is still in the planning stages. One disadvantage of this system is its economic efficiency—it has counterproductive incentives.

Another participant commented that the distribution of revenues is important to the success of congestion pricing because people are accustomed to the free use of roads. If they must begin paying for road use, they want to know that the fees they pay (which are not taxes) will be used to good benefit.

As he closed this session, Moderator Mark Norman reminded the participants that in implementing congestion pricing, the transportation community “may try and may fail, but they will truly fail if they don't try.”

Closing Remarks

Symposium Moderator Ron Kirby noted four frustrations that have been associated with the transportation community: (1) Build it and they will come (highway); (2) build it and they won't come (rail system); (3) don't build it and they won't come (urban planning); and (4) don't build it and they will come anyway. He said that transportation is perhaps the only industry in which too much demand is associated with failure, and that congestion pricing is a means of addressing these continuing frustrations.

Mr. Kirby summarized the symposium by quoting several issues that the speakers and participants raised during the 2½ days. Among the quotes he cited were the following:

- "The more one considers congestion pricing, the more one realizes how much sense it makes but how difficult it will be to implement" (Steve Godwin).
- "The focus has been too much on mechanisms and not enough on benefits" (Ken Orski).
- "Congestion pricing demonstrations should be part of a package of overall solutions" (Martin Richards).
- "Relieving congestion is not necessarily the same thing as improving air quality" (Ken Small).
- "Public perceptions may not be the same as those of the transportation community" (Kiran Bhatt).
- "Congestion pricing projects won't progress unless the objectives are clear" (Martin Richards).
- "The use of revenues is important" (everyone).
- "The end vision is important" (paraphrasing Steve Lockwood).

He noted, however, that some issues were missing from the discussions. Among the missing issues, he said, were the following:

- Truckers and other commercial highway users could benefit from congestion pricing and might well support the projects.

- From the metropolitan viewpoint, the potential spillover of traffic onto local streets is a hot issue.
- The revenue potential is an attractive element for gaining support from cities because they are struggling to obtain the funds to maintain and expand transportation facilities.
- The public must be involved in crafting congestion pricing schemes. The idea of implementing congestion pricing must originate from the public. The transportation community should include congestion pricing among the alternatives presented to the public and allow the public to craft the plan.

In closing, Mr. Kirby complimented FHWA and FTA for organizing and conducting this symposium to help promote the implementation of congestion pricing demonstration projects.

Bert Arillaga, of FTA, also quoted several of the participants in summing up the issues of congestion pricing. He pledged that FTA will support the congestion pricing demonstration projects mandated by ISTEA and will work together with FHWA to see them through. He also asked the attendees to take the debate over congestion pricing to the local areas and to sell the concept on the basis of its merits.

In closing, he thanked FHWA for the opportunity to cosponsor this symposium and the participants for their work in forming the recommendations from the breakout groups.

Steve Lockwood, of FHWA, commented that congestion pricing is the plan for all seasons. This symposium, he said, helped move congestion pricing from an academic abstraction. During the conference, the participants helped to "turn over some stones" that had not been turned before. The conference showed that the most significant issues in implementing congestion pricing are not technical; they are political and institutional. The issue of distributional impacts is clearly of great importance. Mr. Lockwood noted that the symposium uncovered the need to define congestion pricing and, especially, its objectives. He also

noted that some components of congestion, such as long-distance travel and the movement of goods and materials, were not discussed; these components make up approximately one-half of traffic during peak periods.

Mr. Lockwood informed the participants that another *Federal Register* notice will be issued to invite participants to participate in the Congestion Pricing Pilot Program by submitting proposals for demonstration projects. This notice will have guidelines for evaluating potential projects. These projects should focus on learning, not on proving, according to Mr. Lockwood.

The participants at this symposium provided a service, Mr. Lockwood said, noting that he was impressed by the number of participants who remained throughout the symposium. He also expressed his appreciation to the speakers; the breakout chairpersons; and the FHWA, FTA, and conference staff.

In closing, Mr. Lockwood cautioned the participants and the transportation community to consider congestion pricing plans very carefully, citing the proverb, "Be careful what you ask for; you might get it."

Breakout Sessions

During the 2½-day symposium, participants were assigned to one of five breakout groups, which met during three sessions. Each breakout group was given four objectives: three to be completed by all of the groups, and one that was unique to each group. The following objectives were given to all groups:

- Select and rank the five most important issues that must be addressed to implement a successful congestion pricing project.
- Develop a list of four broad types of congestion pricing projects. For each type, list two specific examples of projects that might serve as useful demonstrations. Assess the effectiveness of the specific projects in the following areas: economic efficiency, environmental impacts, energy conservation, traffic impacts, ease of collection and enforcement, and likelihood of implementation.
- Develop a priority list of potential uses of congestion pricing revenues, identify the ranking criteria used, and identify the pros and cons of each use.

The unique objectives for each group were as follows:

- Group A: Develop a checklist of considerations/activities for development of congestion pricing pilot projects.
- Group B: Develop a list of criteria for evaluation of congestion pricing projects, list data needs for each criterion, and develop a list of guidelines for monitoring and evaluating major types of congestion pricing applications.
- Group C: Develop a list of the most significant distributional impacts of congestion pricing and list steps that can be taken to ameliorate each impact.
- Group D: Develop a list of research priorities (including purpose, objectives, and tasks) for congestion pricing.
- Group E: Develop a list of issues related to congestion pricing technologies. List greatest technological needs for successful implementation of congestion pricing.

The following sections summarize the breakout discussions.

Issues That Must Be Addressed To Implement a Successful Congestion Pricing Project

Within each breakout group, all participants suggested one or two issues that they believed should be addressed if congestion pricing is to be successfully implemented. Each group then voted to determine the five most important issues. Listed below are those issues that ranked in at least one group's top five:

- How can public and political support for congestion pricing be developed?
- Who wins and who loses because of congestion pricing?
- How should revenues generated by congestion pricing be used?
- What are the objectives of congestion pricing in particular and the transport system in general?
- What are the true costs of congestion, and to what extent will congestion pricing reduce congestion and improve air quality? The potential benefits of congestion pricing need to be quantified and effectively communicated to those who will benefit.
- What data are needed to effectively forecast the impacts of congestion pricing, and what data need to be collected during the application of pricing in order to evaluate its effectiveness?
- Are there adequate transportation alternatives for those who cannot afford to pay congestion charges?
- Is congestion pricing consistent with the goal of increasing overall mobility?
- Is the technology used to collect and enforce the congestion charges efficient, user-friendly, and reliable?

- Have the necessary institutional relationships been developed?

A list of suggested issues that did not rank in the top five in importance can be found in Appendix B.

Types of Demonstration Projects and Their Potential Effectiveness

For this objective, Groups A, C, D, and E produced tables (Tables 3 through 6) that contain

proposed types of congestion pricing demonstration projects and effectiveness ratings for each type.

Group B’s discussions identified several options to affect driver behavior. These options can be classified into the following categories:

- Options that require payment such as imposing a toll on a non-toll road, increasing tolls during peak periods on existing toll roads, charging fees to use HOV lanes, and increasing parking costs at the destination.

Table 3. Congestion Pricing Projects Identified by Group A

Type of Project	Criteria for Assessment					
	Economic Efficiency	Environmental Impacts	Energy Conservation	Traffic Impacts	Ease of Collection & Enforcement	Likelihood of Implementation
Point Tolls (would appear at one point only, such as a bridge, tunnel, or fixed point on a roadway and would vary by time and occupancy):						
Cordon	Unknown	Positive	Positive	Beneficial	Beneficial	Easy collection; physical spot checks for enforcement
Choke point	Sound	Sound	Good	Good	Good	Easy
Region tolls:						
Areawide, with stickers initially for vehicle identification, moving to AVI	Good	Positive	Positive	Variable depending on fee	Easy	Dependent on privacy concerns related to AVI
Parking (monthly or daily permit on every car)	Good	Good	Positive	Variable depending on fee	Relatively easy, but more difficult to enforce than road pricing	Good
Corridor tolls:						
Transit	Poor	Good	Good	Good	Easy	High
Highway (occupancy- and congestion-based VMT pricing)	High	Good	Good	Small	Difficult	Unknown due to untested public acceptance
Creative public-private partnerships:						
Private IVHS subscription with discounts for transit use or other congestion-reducing actions	Good	Uncertain	Uncertain	Uncertain	Easy collection, difficult enforcement	Dependent on demand, but private sector is interested in IVHS
Allowing stationary source to mobile source emission trades	Good	Neutral	Neutral	Positive	Difficult enforcement because reductions may be reflected only on paper	Unclear, dependent on response from environmental community

Table 4. Congestion Pricing Projects Identified by Group C

Type of Project	Grading Criteria*					
	Economic Efficiency	Environmental Impacts	Energy Conservation	Traffic Impacts	Ease of Collection & Enforcement	Likelihood of Implementation
Congested, already tolled facility or network (Hudson River Crossing or San Francisco Bay Bridge)	A	A (major disagreement)	A (major disagreement)	C	A	B
Area licensing scheme (ALS) (Singapore)	A	A	A	A	C	O
Expanded ALS incorporating all social costs	A	A	A	A	C	O
Peak discounts on alternatives in combination with congestion pricing	B/C	A	B	A	A	B (disagreement)
Sale of excess capacity on HOV lanes to SOV travelers (Orange County, California, State Road 91)	A	B	B	A (as long as facility doesn't become congested)	A (with AVI)	A
AVI-based, finely graduated pricing in downtown area (Cambridge)	A	A	A	A	B	C
Areawide parking charges	A	A	A	A	C	B
Construction mitigation action	B	B (depending on how revenues are used)	B	No agreement	C	O

*A, meets criteria to high degree; B, meets criteria to a moderate degree; C, meets criteria to a low degree; and O, does not meet criteria.

Table 5. Congestion Pricing Projects Identified by Group D

Type of Project	Criteria for Assessment					
	Economic Efficiency	Environmental Impacts	Energy Conservation	Traffic Impacts	Ease of Collection & Enforcement	Likelihood of Implementation
Adjustment of existing toll	High	Low	Low	High	High	High
Areawide approach	Very High	High	High	High	Medium	Low
Corridor approach	Medium	Low	Low	High	High	High
Market-based strategy	Very High	Medium	High	High	High	Low
Comparative analysis to other alternatives	Low	Medium	Medium	High	High	Medium

Table 6. Congestion Pricing Projects Identified by Group E

Type of Projects	Criteria for Assessment*					
	Economic Efficiency	Environmental Impact	Energy Conservation	Traffic Impacts	Ease of Collection and Enforcement	Likelihood of Implementation
Restricted roadways: Conversion of an existing facility to HOV	Good	Advantageous	Good, could be further enhanced with bus use	Potential problems	Possible problems	High
Create additional HOV lane(s) within existing rights of way	Good	Advantageous	Minimal	Merge problems at exits	Extremely difficult	High
Toll facilities/channelized roadway pricing: An existing urban or suburban revenue-neutral toll facility with AVI capacity	High	Positive on the roadway itself; may be negative for alternative routes	Effective	Possible negative effects on alternative routes	Appropriate technology exists	High
Peak period tolls on an existing, untolled facility with a parallel transit line that has excess capacity	Depends on point of view	Positive; alternate routes could suffer adverse effects	Positive; alternate routes could suffer adverse effects	Positive; alternate routes could suffer adverse effects	Requires new system	Moderate at best
Areawide systems:** A zone/cordon system that covers all access points to the area	8	6	6	8	3	3
A linear/radial zone system based on corridors	8	7	7	6	7	5
Access Control: A cordon system that would control and regulate commercial vehicle access to a CBD	Increased productivity	Noise and possible emissions reduction	Reduced fuel consumption	Positive	Feasible	High
Multimodal electronic fare media ("smart cards") to set fares according to current local needs	Market-driven pricing very flexible	Reduced noise and pollution	Reduced fuel consumption	Reduced VMT	Achievable	High

*Assessment criteria for some projects were rated on a 1-10 scale, with 5 being neutral and 10 being positive.

**These projects were also given a level of effectiveness/efficiency rating of 8.

- Options that reduce the user costs of alternatives to SOVs, such as low-cost, convenient, time-saving mass transit; employer subsidy of employee mass transit use; and employer or government subsidy of ridesharing.

Participants listed the following four broad types of congestion pricing projects and specific examples that might serve as useful demonstrations:

- Congestion generators—airport tolls (such as those used in Houston and Los Angeles) and HOV lane pricing.
- Choke points (increasing tolls during peak periods on existing toll facilities with high congestion)—a large urban facility with a high level of transit use, and a medium to

small urban facility with a low level of transit use.

- Privately owned and operated toll facilities such as the Dulles Toll Road Extension.
- Other TDM projects—packages of services for a specific area such as those provided in Seattle.

Regardless of the type of projects chosen, participants agreed that the following questions must be addressed for successful implementation:

- Geographically, how large an area will be targeted for congestion pricing—only one corridor or an entire system?
- How will the congestion pricing program be implemented? Will an infrastructure be created by building toll plazas and adding HOV

lanes, or will an existing infrastructure be modified by changing toll pricing, converting road shoulders to accommodate HOV lanes, using AVI, and instituting licensing and permits?

- How will enforcement be handled—honor system, police, visual inspection at a check-point, or electronic monitoring?

Once behavior has changed, the effects of that change must be evaluated. This evaluation must consider the effects on the following factors:

- Air quality. How should the effects be measured?
- Alternative routes. How were they affected?
- Users. Was commute time shortened? Where did displaced users go?
- Attitudes. How was the change viewed by the public and politicians?
- Revenue. How much was generated? How will it be used?

Uses of Congestion Pricing Revenues

It is likely that any comprehensive application of congestion pricing will generate large amounts of revenues. (Ken Small has estimated that congestion pricing in Los Angeles would generate \$3 billion annually.) How such revenues are used will be a politically sensitive issue and will be critical to the acceptance and ultimate success of any congestion pricing project.

Each group developed a list of potential uses of revenues and the pros and cons of each use. The lists are consolidated in Table 7.

Special Objectives

Group A's special objective was to develop a checklist of considerations or activities for the development of congestion pricing pilot projects. The most important consideration, the participants agreed, is that a readily available alternative mode of travel must exist in an area before a congestion pricing project can be implemented. The group also agreed that the following 10 activities are critical to the successful implementation of congestion pricing pilot projects:

- Set up a stakeholders' advisory group. (Get policymakers to endorse policies.)
- Ensure that the public participates.
- Establish clear objectives.
- Develop an experimental design. (Create a comprehensive data collection system and monitor progress by milestones.)
- Identify projects that include alternatives. Improve and design new cost-effective options for the affected market.
- Develop a financial plan. (Identify a local funding source, determine the cost of implementation, and specify the intended use of revenue.)
- Ensure that the implementing agency can implement the project.
- Conduct market research.
- Design and implement a public information campaign.
- Develop an implementation plan. (Investigate legal issues and enforcement procedures and check for consistency of the technology with standards for the market.)

Group B was assigned the task of developing a list of criteria for evaluating congestion pricing projects, determining the data needs for each criterion, and suggesting major considerations in choosing a project. The participants recommended the following criteria:

- A comprehensive approach to evaluating the impact of congestion pricing projects must be developed, considering traffic flow patterns, vehicle occupancy rates, transit alternatives, revenue generated, commuter demographics, and air quality. A historic view of the situation should be undertaken, and uncontrollable elements such as changes in fuel prices and inflation should be considered.
- Political and public support are essential to the success of any project. The attitudes of politicians and the public should be solicited, surveyed, and tracked during the course of the program.
- Clear and measurable goals for the project and a clear definition of success must be established. Baseline data should be developed, using explicit methods of measurement—physical, survey, and simulation.

Table 7. Uses of Revenue Identified by One or More Groups

Use of Revenue	Pros	Cons
Improvements/ expansions of highways	Replenishes declining revenues Improves short-term mobility Accommodates growing demands Generates growth and improved productivity for the region Is politically acceptable Supplies benefits directly to user Maintains tradition that user pays Relieves congestion Is perceived as user fee, not tax	Additional capacity counters environmental and congestion concerns Defeats goal of shifts to other transportation modes Would create need for more parking Would perpetuate urban sprawl May simply replace money shifted out of transportation Raises issues of additional capacity versus maintenance Could be inefficient
Improvements/ expansions of alternative modes in general	Increases public acceptance Expands overall transportation system; provides greater mobility and throughput Compensates losers by providing alternatives or people "tolled off" Reduces tax burden of supporting other modes Improves air quality and other environmental factors Reduces VMT and UHT Leads to a balanced match for business/residential concerns	Alternative modes could expand beyond demand Perceived misuse of funds could anger road users and create political liability Could have small effect on VMT/UHT Requires high cost to implement and administer, especially for low density areas Provides no benefit to losers Extends suburban sprawl Would require cold, hard starts in concentrated areas
Improvements/ expansions of transit	Dedicated funds can be leveraged No new framework needed Is efficient and provides environmental benefits Provides increased traveler options in the long term	Requires unfunded operating and maintenance Non-highway users benefit from highway funds (possible political problem) May encourage inefficient transit investment Requires employer flexibility
Improvements/ expansions of non-transit modes, such as ridesharing and telecommuting	Could reduce congestion Telecommuting would reduce need to travel Could improve air quality Provides an alternative to fixed-route systems Provides opportunity for social interaction Represents savings to individuals	Serves only a minority of the community Could detract from transit ridership Requires enforcement costs Carries potential for costs for new construction Carries political liability May be ineffective use of revenue
Provision of transportation-related facilities, such as daycare centers and parking lots	Makes alternatives more attractive Enhances the political feasibility of congestion pricing projects Could be administered relatively simply May foster public-private partnerships	Users of facilities are not necessarily those who are underwriting them Takes away from other possible uses Requires employer flexibility
Provision of user discounts for alternative modes	Reduces some congestion Improves other modes Has positive environmental impact	Does not directly benefit those who pay fees Could be ineffective use of funds Allows for no long-term cost recovery
General tax relief	May help achieve generic equity goals Some economic efficiency General welfare improvement "Sells" politically	Costs too much May be inefficient Makes it difficult to determine who is affected May create other problems (e.g., reducing fuel tax may lead to increased consumption)

Use of Revenue	Pros	Cons
Reduction of transportation taxes	Is most politically acceptable because of revenue neutrality Keeps financing issues within the direct user community	Provides no money for alternatives May have little impact on TDM or emissions Raises equity issues
Provision of subsidies to low-income groups	Gains public support; perception of fairness needed for acceptance Promotes acceptance of pricing by "losers" Reduces economic disincentive of additional cost Protects employment opportunities Indirectly supports alternative modes Is humanitarian	Does not directly improve transportation system Difficult to implement High administrative costs Difficult enforcement, fraud likely Targets special groups for benefits Difficult to identify losers and quantify loss Raises mobility versus equity issues Political/public acceptability problem (perception of welfare) Raises many questions re: form of compensation; credit/discount on congested roadway or for transit; tax credit; direct payment
Contribution to transportation trust funds	Is local choice	Creates unobligated balances Creates decisionmaking problems
Emission reduction programs	Is acceptable to the public Would provide more transit alternatives Could fund other air quality strategies	May not be the most appropriate use of funds Measuring direct air quality benefits would be difficult
Public education and marketing	Increases public acceptance Creates constituency Enhances project longevity Increases use of alternative modes Aids measurement of the project's ability to meet its goals	Creates possibility of oversaturation Creates perception of government propaganda or a nonproductive use of funds

Unexpected consequences must be considered.

- Before a project begins, consideration must be given to the existence of possible problems to be corrected through congestion pricing (an inadequate level of service, an air quality hot spot, an unacceptable level of congestion). If a problem exists, is congestion pricing the most efficient solution? What alternatives are available—demand elasticity, land-use density, pricing structure, marketing programs? What is the history behind the project? Did the public demand a solution, or do metropolitan planning boards

support the project? How long has the problem existed—3 months, 3 years, a decade?

- A valid project should have general applicability. The project should be transferable to a number of locations, not designed to treat a unique local condition. It should be governed by a list of data needs and guidelines for monitoring. These guidelines should help determine whether changes were induced by congestion pricing or other considerations and, conversely, whether congestion pricing caused rippling effects beyond its original intent.

Group C's special assignment was to develop a list of the most significant distributional impacts of congestion pricing and to list steps to ameliorate each impact. As group members developed their list, they noted that not all distributional impacts are negative. Although congestion pricing will create some "losers," it will also leave some "winners." The losers are those who value the toll more highly than they value their time, those who cannot afford the toll, those who have no alternatives, merchants who serve congested corridors, users of alternate routes that will become more congested, the environment (as a result of longer commute times over the entire network), and emergency users. Winners are those who value their time more highly than they value the toll, the government entity that receives the revenue, HOV service providers, HOV mode users, and SOV travelers (who will derive more HOV-type benefits). Notwithstanding this caveat, the group identified the distributional impacts, with steps to ameliorate each one, as shown in Table 8.

Group D's special assignment was to develop a list of research priorities (including purpose, objectives, and tasks) for congestion pricing. They identified the following research activities:

- Producing a primer or handbook (similar to the American Association of Highway Transportation Officials (AASHTO) "Orange Book") with examples of implementation strategies.
- Developing procedures for evaluating the effectiveness of congestion pricing plans, including prediction of the impacts on congestion, air pollution, and different population groups and markets. Several participants stated that the potential effects of congestion pricing on commercial traffic had been given too little consideration when congestion pricing plans were being developed.
- Diagnosing local support and determining the type of public relations outreach program needed to sell congestion pricing plans.

Table 8. Distributional Impacts and Amelioration Steps

Impact	Steps
Diversion of traffic	Implement areawide pricing Pour money into neighborhoods for noise abatement, flow improvement, new security
Shift to second-choice mode of transportation	Provide tax cuts Improve services of alternatives Lower price of alternatives
Shift to second-choice time (work hours)	Allow staggered hours--flextime
Money out-of-pocket	Provide tax cuts
Residence relocation	Provide tax cuts
Business relocation	Moving into area: needs no amelioration Forced out: offer tax incentives
Air quality	Improved: needs no amelioration Diminished: Unknown
Transit use	To increase: Increase service capacity, lower price Crowd alleviation: Unknown
Pricing some people "out" with no alternatives	Implement a voucher system
Other impact issues	Access for emergency use (hospital trips)

The group noted that it would be necessary to overcome any backlash that results from the public relations effort. The participants expressed concern that groups such as automobile clubs would present strong opposition to congestion pricing.

- Determining the best technological fit with the congestion pricing scheme by testing and evaluating the effectiveness and reliability of different technologies. Participants recommended that the five demonstration projects should use five different technologies.
- Investigating institutional or jurisdictional issues in congestion pricing. The objective of this research would be to understand the roles and capabilities of organizations involved in congestion pricing planning and operations. The three tasks of this research would be to monitor and assess various institutional arrangements for tolling, analyze the legal issues involved, and evaluate private versus public toll collection.

Group E's special assignment was to develop a list of the technological needs and issues that must be addressed for successful congestion pricing projects to be implemented. As for technological needs, the group was quick to point out that almost all of the technology needed to implement the programs has been developed and produced, and needs only to be fine-tuned. The group also listed the following needs:

- High reliability.
- System accuracy.
- Technology for full multilane or cross-lane reads. Current systems can track vehicles only within a lane; if the vehicle switches lanes, it is "lost."

- Technological compatibility and coordination with IVHS technologies.
- Technology capable of determining vehicle occupancy levels.
- Vehicle classification technology for multilane facilities to ensure that the proper electronic licenses are being used (e.g., technology that can determine the size of a vehicle so that it can identify a truck using a car sticker).
- Technology for an online clearinghouse facility for credit transfers and for keeping track of multimodal smart card accounts.

For technological issues, Group E listed the following:

- Privacy safeguards must be in place. The possibility of read-write-erase programs was mentioned.
- How will technology deal with nonsubscribers and infrequent users of the system?
- How should pricing be phased in?
- How can technology be made tamper proof?
- Procurement issues—Who will buy equipment? Who will supply it? Who will regulate procurement?
- How can real-time pricing information for routes be communicated to highway users?
- How many providers of technology are there?
- Enforcement—How will it be carried out? Who will be responsible?
- Audit trails must exist for each transaction. How will this be accomplished?

Appendix A

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Appendix B

Additional Issues Identified by the Breakout Groups

This appendix contains a list of issues believed to be critical to the success of congestion pricing projects. The issues were suggested during the breakout sessions but did not rank in the top five in importance for any of the breakout groups. Those issues that did rank in the top five are listed in the Breakout Sessions section of this report.

- How will the system be designed? How can different congestion pricing measures be compared? What are the tradeoffs between an areawide system and a corridor- or facility-based system?
- Will SOV's be allowed to buy use of HOV facilities?
- Will congestion pricing effect mode change, and how can this ability be evaluated?
- What type of toll collection system can be used for congestion pricing?
- Can a congestion pricing system be revenue neutral?
- Can congestion pricing be applied in tourist areas?
- How will congestion pricing affect visitors to a locality? Can they be expected to pay the cost of the area's congestion?
- How can a workable location where congestion is a priority be determined?
- What are the implications of moving people out of cars through congestion pricing?
- Will congestion pricing be able to overcome the negative perceptions of non-highway modes of travel?
- Can congestion pricing be implemented in combination with all-day parking and tolls?
- Will congestion pricing have long-term effects?
- Can the project provide users with continuous feedback on pricing? The price must be clearly observable.
- Will congestion pricing data be independently collected and audited?
- How can the public be educated about the existing subsidy to automobiles?
- Mass transit is not the only other mode of transportation; the public must be educated about their alternatives.
- If electronic vehicle or driver identification is used to gather data, how will the project guard against misuse of data?
- Will commercial business district (CBD) or non-CBD corridors be considered for pricing projects, and what are the implications?
- How will AVI standardization, or lack of it, affect the project?
- How will alternate routes be affected? What will be done to keep these routes from becoming congested in turn?
- How and by whom will congestion pricing be enforced? Can prices based on vehicle occupancy be enforced? What will be the public's attitude toward compliance?
- A demonstration project should have applicability beyond the test area.
- How and by whom should the pricing structure be determined?
- Can or should government be allowed to function as a monopoly in congestion pricing activities?

- Should charges be levied for air quality impacts? For other environmental and social costs?
- Will bureaucratic rigidity hinder the project?
- What other environmental impacts besides air quality should be considered?
- Can the project be integrated with other system elements, such as land-use and transportation plans?
- Is congestion pricing the carrot, the stick, or both? How can congestion pricing be presented as an incentive program rather than a disincentive program?
- Can adjustments to demographic changes be made?
- Can the project be packaged with complementary services?
- A better definition of “efficiency” is needed. Do we want to achieve economic efficiency? Efficiency in terms of increased mobility? Do we want to move people or goods or both?
- How much revenue will congestion pricing generate?
- How will congestion pricing be linked to IVHS elements, especially in routing information?
- If congestion pricing revenues are to be used to provide or build alternative modes of transportation for those “priced off,” a significant time lag will occur between implementation of congestion pricing and provision of alternative modes.
- If congestion pricing is implemented (especially on an areawide rather than a corridor-based scheme), it will limit access to certain destinations. What alternatives will be provided?
- There is a need to increase average vehicle occupancy.
- Planners must maintain an action-oriented mentality and focus on implementation issues.
- There is a need to discern between regulatory-based and marketing-based approaches to congestion pricing.
- Technological compatibility (from region to region, and also between modes) is necessary.
- Legality must be considered, especially regarding privacy rights.
- Risk-sharing needs to be addressed.
- What will be the impacts of congestion pricing on metropolitan areas as a whole?
- We should think of commuters as consumers and conduct tests to determine price sensitivity.
- What would happen if employers decided to underwrite employees’ congestion fees the way they currently subsidize parking for employees? How can this be discouraged?
- Privacy issues need to be considered, given the capabilities of AVI technology.
- Planners should be careful not to “oversell” and cause the public to have unrealistic expectations.
- The people who pay the fees need to be able to see the results.
- What can be done to diminish the reluctance of investors to implement congestion pricing systems? The benefits (or profits) of congestion pricing accrue rapidly only with a large-scale program; but no one is willing to implement a large-scale program without having seen a successful small-scale program. Conversely, no one is willing to implement a small-scale program because it will not accrue significant benefits.
- Congestion pricing can be viewed as a marketing tool whose purpose is to lose market share.
- The distinction among tolls, congestion pricing, and vehicle occupancy pricing needs to be made clearer.
- The Washington, D.C.-based Metrorail system currently uses a congestion pricing mechanism (with different fares depending upon the time of day), as one participant noted. Also in the Washington metropolitan area, tolls are charged for the actual distance traveled. The public has accepted these systems and may be open to a similar system on roadways.

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HE 336 .C64 E95 1992

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NOV. 22 1994

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100000252435

Publication No. FHWA-PL-93-008
HPP-13/12-92(5M)E