



U.S. Department of Transportation
Federal Highway Administration

Congestion Pricing

A PRIMER:
METROPOLITAN PLANNING ORGANIZATION
CASE STUDIES



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Introduction

BACKGROUND

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the Clean Air Act Amendments of 1990 (CAAA) are responsible for significantly restructuring the transportation planning process across the nation. In order to receive Federal funds, roadway construction or other roadway capacity enhancements must show that the completed project will not result in deterioration of the region's air quality. To achieve this, a region must have as one of its goals a balanced transportation system that provides mobility options across all potential travel modes.

ISTEA also established a new direction for transportation programming across the Nation: for the first time, metropolitan areas were asked to develop a seamless intermodal transportation network that improves air quality and is energy efficient. These metropolitan programs would then be linked to State plans and ultimately a national system that would provide a multi-modal transportation network for the entire country.

What Is "Congestion Pricing"?

Congestion pricing – sometimes called value pricing – is a way of harnessing the power of the market to reduce the waste associated with traffic congestion. Congestion pricing works by shifting purely discretionary rush hour highway travel to other transportation modes or to off-peak periods, taking advantage of the fact that the majority of rush hour drivers on a typical urban highway are not commuters. By removing even 5 percent of the vehicles from a congested roadway, pricing enables the system to flow much more efficiently, allowing more cars to move through the same physical space. There is a consensus among economists that congestion pricing represents the single most viable and sustainable approach to reducing traffic congestion.

Source: FHWA, Congestion Pricing, A Primer: Overview, FHWA-HOP-08-039, (Washington, DC: October 2008).

ISTEA also provided funding for the innovative Congestion Pricing Pilot Program, which encourages implementation and evaluation of road pricing pilot projects to manage congestion on highways through tolling and other pricing mechanisms.

Since that time, road pricing has come to be considered by more and more regions as a potential solution to the dual challenges of declining revenues and increasing congestion. The concept is based on the idea of charging a fee for access to and use of a lane, road, area, or regional network for purposes of generating revenue, managing traffic congestion, or both (see the box below).

Road pricing is called "congestion pricing" when prices are tailored to manage congestion by using a fixed time-of-day schedule or a dynamic system which increases or decreases individual vehicle charges based on congestion levels.

Road pricing in the United States is new and not well understood by the general public and elected officials. The most common form of road pricing in the United States has been high-occupancy toll (HOT) lanes. HOT lanes are converted high-occupancy vehicle (HOV) lanes that are opened to vehicles with fewer occupants than is normally required in exchange for a toll.

Similarly, road pricing may also take the form of "express toll lanes," where new lanes are built adjacent to existing freeways, but their use is subject to a toll.

Road pricing experiments in Europe and Asia have involved "zone pricing," where drivers are charged a fee to enter into and/or drive within a specified high-congestion location. Some zones' access or use fees are regulated by time-of-day, but others have full-time fees in effect.



Figure 1. Types of Road Pricing

Note: Any of these can use “congestion pricing” or “variable pricing” to achieve policy objectives.

As states and regions consider ways to address declining revenues from the motor fuel tax, the concept of distance pricing – charging drivers for each mile they drive on the highway system – is being discussed more and more. This is often referred to as vehicle miles traveled (VMT) fees, or mileage-based user fees. These are typically seen as a revenue mechanism, but could also incorporate a congestion-pricing component. Congestion pricing is perceived by many transportation operations professionals as a tool to manage user demand. Currently, there is typically unused capacity on arterial and transit facilities at the same time that the freeway structure is being overwhelmed by volume. By charging a fee to use the most over-used element of the transportation network, operators seek to encourage road users to seek out alternative routes or modes of transportation, evening out the distribution of goods and people being transported within a network at the same time.

Road pricing often has come about separate from the traditional metropolitan planning process through pilot

projects and demonstrations. As the ISTEA-funded pricing demonstration projects have shown road pricing to be an effective tool, there is a growing need to incorporate road pricing into long-range plans.

This document summarizes the results of a study to examine how road pricing was incorporated into long-range planning in four metropolitan planning organizations (MPOs), providing examples that could support other regions seeking to do the same.

The four case study regions were selected by the Federal Highway Administration (FHWA) based on a previous study, *A Domestic Scan of Congestion Pricing and Managed Lanes* [1] and represent places where road pricing has been included in long-range plans successfully: the Dallas/Fort Worth region, the Puget Sound region, the Minneapolis/St. Paul region, and the San Francisco Bay area.

Not surprisingly, the study of these four regions reveals that each is unique, with its own distinctive history of attitudes, jurisdictional relationships, and politics that influences how pricing is perceived.

The Dallas / Fort Worth Case Study

ROAD PRICING POLICIES GREW OUT OF THE PLANNING PROCESS

The financial constraints and requirements of ISTEA led the North Central Texas Council of Governments (NCTCOG) to look aggressively at tolling as a means to finance its extensive highway expansion needs, and the result was a policy to consider whether corridor improvements could “support” pricing.

NCTCOG started by assuming that all new capacity could be priced. It then approached the financial aspect by looking at the priced and non-priced transportation system as a whole. NCTCOG recognized that each project did not necessarily have to pay for itself, but looking at the system as a whole, toll revenue becomes a revenue source that can be used to reduce overall public expenditures. The result of this perspective is a NCTCOG policy that all new limited access highways should be evaluated for toll potential and all reconstructions should include priced express lanes as appropriate.

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NCTCOG sees pricing as a tool to achieve objectives such as supporting economic vitality, increasing safety, increasing accessibility and mobility, and promoting environmental protection. The latter aspect was of particular pertinence to NCTCOG, since the region was in nonattainment status due to its poor air quality.

When considering plan options, NCTCOG realized that pricing by itself won't necessarily change behavior, but it can work with other elements of the plan to achieve transportation and environmental objectives.

The NCTCOG policies that are in *Mobility 2030: The Metropolitan Transportation Plan for the Dallas/Fort Worth Area, 2009 Amendment*^[2] are the result of years of projects evolving to the point that the need for consistent policy relating to toll setting and use of revenue became clear. These policies are described below.

A WIDE RANGE OF PRICING OPTIONS

There are three types of priced facilities being considered in the region: traditional toll roads, managed HOV lanes (called HOT lanes in other places), and stand-alone express managed lanes which may or may not have HOV priority (see Table 1). Over time, all three types should have a managed component to them, i.e., price differentials by time of day, vehicle type, occupancy, technology. Notably, the Regional Transportation Council (RTC)¹ stated clearly in *Mobility 2030* that it does not support converting existing free lanes to toll roads. Only new lanes on existing gas-tax funded highways will be tolled, since it is against existing policy to turn existing free lanes into toll lanes.

INNOVATIVE STRATEGIES

The excess revenue from priced facilities is available to fund projects on the entire transportation system including other toll facilities, non-toll facilities, and transit-related projects. Excess revenue over and above construction and maintenance/operations expenses is split along the concept of “near neighbor, near timeframe.” This policy is defined as follows:

- Near neighbor:
 - » Seventy-five percent of revenue stays in the county where the revenue is collected; and

¹ The Regional Transportation Council is the independent transportation policy body of the metropolitan planning organization.

Table 1. Existing, Committed, and Planned Road Pricing Projects in the Dallas/Ft. Worth Area

Existing	Committed	Planned
Toll Roads, Bridges, and Tunnels		
<ul style="list-style-type: none"> • Dallas North Tollway • President George Bush Turnpike (PGBT) • Sam Rayburn Tollway • Addison Airport Toll Tunnel • Mountain Creek Lake Toll Bridge • Lewisville Lake Toll Bridge 	<ul style="list-style-type: none"> • SH 161, Traditional toll road, under construction • SH 121 (Sam Rayburn Toll-way), part open, part still under construction 	<ul style="list-style-type: none"> • Trinity Parkway, new toll road • Southwest Parkway, new toll road • President George Bush Turnpike Extension, toll road • SH 360 Extension, toll road • Add main lanes on SH 170, toll road • Loop 9 between I-20 and SH 287, toll road
Managed HOV Lanes		
	<ul style="list-style-type: none"> • I-30 managed HOV lane, new lanes • I-635 (LBJ Freeway) and I-35E • Managed HOV lanes, new lanes • North Tarrant Express, managed HOV lanes, covering routes 183, 820, 35W 	
Express Managed Lanes		
		<ul style="list-style-type: none"> • DFW connector, including four miles of express managed lanes

Source: North Central Texas Council of Governments, via interview.

- » Twenty-five percent of revenue goes to the rest of the region based on the distribution of home locations of toll tag users in January of that year.
- Near timeframe:
 - » Seventy-five percent up front; and
 - » Twenty-five percent over time.

One exception is the North Texas Tollway Authority (NTTA) concession for SH 121, which was paid 100 percent up front. Policies for using the money are established in advance of each transaction under the general guidelines described above. NCTCOG has developed a set of business terms for tollways and managed lane projects resulting in consistent policies regarding:

- Specific toll rates for peak and off-peak periods;
- Treatment of transit vehicles;
- Toll increase provisions;
- Use of comprehensive development agreements (CDA); and
- Disposition of excess revenue.

REGIONAL PERSPECTIVES

ENVIRONMENTAL JUSTICE (EJ) has been a significant regional issue for decisionmakers, and NCTCOG has worked extensively with FHWA, Texas Department of Transportation (TxDOT), and others to address this. NCTCOG has an environmental justice analysis tool that evaluates trip distribution effects and looks at whether people who live in communities that use toll facilities also have access to free facilities.

An emerging view on the environmental justice topic is the importance of evaluating not just who is paying tolls, but how the money is spent. In the case of the NCTCOG region, excess revenues are spent entirely on non-toll projects such as other non-tolled highways or transit. This spending mitigates potential environmental justice concerns. Also, NCTCOG has found that people with low income sometimes place a high value on time because of inflexible job and childcare schedules.

PREPARE FOR THE UNEXPECTED

The State and region have built in a variety of backstops to guard against the unexpected.

Revenue Shortfalls

One of the biggest concerns has to do with toll revenues being lower than expected. In the case of managed lanes, the region has tried to shift as much revenue risk as possible to the private sector. However, the traditional toll roads that will be built will be public projects, meaning that there is no risk transfer.

NCTCOG believes that its toll rates are set conservatively low, at about half the revenue-maximizing rate, allowing them to raise tolls if needed. NCTCOG and TxDOT are considering guaranteed debt service repayment for NTTA's Southwest Parkway and SH 161 projects in the event of lower than expected revenue collections in early years of those facilities. NTTA's system revenues are needed for current construction commitments, which normally would be cross-pledged to new projects. NCTCOG may put aside some programming authority from SH121 revenues (state dollars, kept in the state treasury for assignment to projects by NCTCOG) to use as a form of debt service reserve. This would allow NTTA to issue debt with higher bond ratings and make more money available for project funding.

NTTA would own the roads in question like any other of their properties. The difference would be that debt issued to finance these two roads also would have a financial commitment from NCTCOG and TxDOT to offset revenue shortfalls. These advanced funds would then be repaid with future revenues.

Revenue Leakage

With modern open-road tolling applications, there is an increased temptation for drivers to try to get away without paying tolls. In response to this, the region is developing administrative courts to deal with toll violators to avoid clogging up the regular courts.

Operations

Managed lanes have now been tested in several markets around the United States, and there is a reasonable understanding of how to optimize flow and avoid congested premium lanes. However, each region is unique, and this risk is being managed by setting toll rates by time of day, as opposed to dynamically based on traffic levels. Once there is a history of the demand profile, dynamic pricing will be tried.

COMMUNICATIONS AND CONSENSUS-BUILDING TAKE A LOT OF WORK

In terms of its relationship with the public, NCTCOG uses a full array of communication tools, including press releases, web presence, and presentations. However, even though NCTCOG and TxDOT have been talking about the concept of pricing and tolling for years, they find that the public and policy-makers still have difficulty understanding all of the nuances of the concept. Once projects open however, they find that the complaints stop. For example, when the first tolled segments of SH 121 opened in 2007, NCTCOG did not get many complaints; rather, the feedback was positive since people had the new highway alternative.



Photo credit: d. hughes

People have understood for years that there is not adequate revenue from traditional sources to build the highways and highway lanes that need to be built, so there has been acceptance of tolling for new highways and pricing for highway expansion, but the region still struggles with the concept of how many toll roads and freeways will create the right balance.

The fact that the NCTCOG's road pricing policy is applied consistently throughout the entire region is also helpful to the communication effort.

One challenge, however, has been the complaint of "double taxation." Many feel that the State and local taxes they pay already should cover the costs of building and maintaining the transportation system. NCTCOG approaches this objection with the information that with managed lanes, there will always be a free option, so NCTCOG anticipates that the projects will generally earn public acceptance once the information is out in the public. In addition, NCTCOG staff believe that other considerations have contributed to their success so far:

- Consistent staff at NCTCOG working on these issues for 20 years. If the staff had changed over more frequently, the job would have been more difficult;
- Strong analytical foundation through improving modeling tools;
- Consistent message with respect to the benefits of pricing;
- Policy coordination with elected officials; and
- Desire to create a sustainable transportation system while acknowledging that there is not enough money from traditional sources.

Despite its successes, the region has had to face public and elected-official backlash emerging out of the aggressive pursuit of public-private partnerships a few years

ago. In 2007, the Texas legislature imposed a two-year moratorium on new partnerships (called Comprehensive Development Agreements, or CDA) that impacted further toll development. Many CDA that were underway were grandfathered and not impacted by the moratorium, but the legislation still created uncertainty.

SUMMARY

An early adopter of tolling, the Dallas/Fort Worth region has continued to pursue aggressively road user fees as a means to fund its extensive backlog of transportation projects. In recent years, the region has embraced new notions of managed lanes as a means of achieving highway expansion. With the region's citizens already familiar with tolling, it has been relatively easy to advance new toll projects, since those toll projects bring with them new transportation options. Acceptance grows once the projects open. The jump to managed lanes is not without its controversies, but given the experience with tolling in the region, is not as difficult as it may be in areas without a history of tolling.

As the region moved from individual project development to more widespread use of tolling and managed lanes for all highway expansion, it also proceeded to incorporate a consistent set of rules in its regional transportation plan. The region has had to address issues such as how to spend excess revenue and whether road pricing projects unfairly impact poorer populations, and it has successfully developed policies and evaluation tools in response.

What sets this region apart from the other case study regions is the extent to which new highways and new capacity are a part of the transportation landscape. The other case study regions are more focused on traffic management than new capacity.

The Puget Sound Region Case Study

A COMPREHENSIVE LONG-RANGE VISION GROWS OUT OF INDIVIDUAL PROJECTS

In the mid-1990s, Washington State was among the first to look seriously at public-private partnerships (PPP) to advance high-cost/high-need projects, and one project emerged from the process – construction of a second span of the Tacoma Narrows Bridge, which would be supported by toll revenues. Although the project evolved from being a concession-style public-private partnership to a more common design-build approach, the result was a new toll bridge in an existing toll-free corridor.

While tolls had been commonly used in Washington to finance bridges in the past, there had been no tolls in the State since 1979. The Tacoma Narrows Bridge project also was notable in that it was the first time a toll had ever been added to an existing toll-free corridor (although the new toll was technically only on the new bridge, which served the southbound direction) in the region. The next individual project to emerge was a four-year HOT lane demonstration on SR 167, which opened in 2008, supported by the Value Pricing Pilot Program.

At the same time, the Washington State Department of Transportation (WSDOT) continued to look at options for replacing the SR 520 floating bridge – a multibillion-dollar project with a substantial shortfall in funding. Tolling, potentially with time-of-day pricing was under study as a possible solution.

When the U.S. Department of Transportation (U.S. DOT) announced its Urban Partnership Agreement (UPA) grant program in 2006, a collaborative group comprising the region, State, and King County applied for a grant that would allow time-of-day tolling on the existing SR 520 Bridge in advance of construction of a new bridge as well as active traffic management and other

complementary actions. Tolling on the existing bridge will begin during the summer of 2011.

While these projects were being studied, designed, and built, the State Legislature began to examine whether and how tolling and road pricing might fit into the future of transportation in Washington State. Some of the groundwork for this had been laid by a prior State Secretary of Transportation who was a passionate believer in the potential for congestion pricing to allow the road network to operate at maximum capacity. The result was a Comprehensive Tolling Study that considered a broad range of policy motivations and applications, evaluated institutional and technical considerations, considered a variety of case studies, and resulted in eight policy recommendations that were mostly adopted by the legislature.

In parallel, the Puget Sound Regional Council (PSRC) received a Value Pricing Pilot Program grant to conduct a traffic choices study to see how travelers change their travel behavior (number, mode, route, and time of vehicle trips) in response to time-of-day variable charges for road use (variable or congestion-based tolling). The traffic choices study received a great deal of public attention and provided valuable behavioral information to feed the PSRC's travel demand model for better analysis of road pricing.

These prior experiences and history of discussion laid the groundwork for further discussion of pricing in the PSRC's long-range plan update called Transportation 2040. Recognizing the potential role that pricing might play in the long-range plan – and acknowledging that road pricing deserved a long, hard look – PSRC created a Pricing Task Force as part of the update process. The driving factors behind the use of tolling and road pricing in the plan were the need for non-tax financial resources and the desire to use price to modify travel behavior.

The Puget Sound Traffic Choices Study

In 2002, the Puget Sound Regional Council (PSRC) conducted a pilot project to see how travelers change their travel behavior in response to variable charges for road use. The project, called the Traffic Choices Study, placed global positioning system (GPS) tolling meters in the vehicles of about 275 volunteer households. The project involved observation of driving patterns before and after experimental tolls were charged for driving on any of the major freeways and arterials in the. **The observed response of drivers to tolls suggests there is a dramatic opportunity to significantly reduce traffic congestion and raise revenues for investment.** Some of the primary conclusions from the study include:

- Motorists made small-scale adjustments in travel that, in aggregate, would have a major effect on transportation system performance.
- When approached systematically, variable road tolling, with investments of toll revenues, could make excessive reoccurring congestion a thing of the past.
- The scale of the revenues confirms the theoretical expectation that “optimal” tolls would support expanding transportation supply when and where it is needed most.
- While most revenues are generated on a small portion of the toll roads, the secondary road network (arterials) should not be ignored, as diversion causes real problems with revenue loss and displaced traffic.
- Users demonstrating a willingness to pay for high value roadways could expect that improvements would be forthcoming.
- Done right, network tolling could provide broad benefits, including lower vehicle emissions, fewer accidents, travel time savings, improved roadway performance reliability, and lower operating costs.
- A conservative analysis of the benefits of network tolling in the Puget Sound region indicates that the present value of net benefits could exceed \$28 billion over a 30-year period.
- Installing in-vehicle tolling devices is a costly logistical challenge, but relying on equipment to come standard with new automobiles won't be practical if it doesn't represent a trusted platform for road tolling.
- The costs for GPS-based tolling systems are dominated by the initial investment in in-vehicle tolling equipment, and the communication of data during operations. Over the last few years, costs have declined dramatically and are expected to continue to come down.

— The Puget Sound Regional Council

Traffic Choices Study – Summary Report A Global Positioning System Based Pricing Pilot Project: Evaluating Traveler Response to Variable Road Tolling Through a Sample of Volunteer Participants (Seattle, WA: 2008)

ROAD PRICING BECOMES AN INTEGRAL COMPONENT

As *Transportation 2040* evolved, all of the plan alternatives had a pricing component. According to PSRC:

Transportation 2040 promotes transportation financing methods, such as user fees and tolls that will sustain maintenance, preservation, and operation of facilities and reflect the costs imposed by users.

- *The plan recommends a phased financial strategy based on less dependence on revenue from current gas taxes and other traditional transportation revenue sources. The new financial strategy calls for moving to-*

ward the implementation of new user fees, including tolls, exploration of a fuel tax replacement, such as vehicle-miles traveled (VMT) charges, and other pricing approaches to fund and manage the transportation system. The financial strategy assumes a nexus between the tax, fee, or toll and the use of the revenues.

- *The plan assumes the strategy of implementing tolls will start with developing high occupancy toll (HOT) lanes and tolling on individual highway and bridge facilities as they are built. The Plan also gave guidance for the strategy to remain flexible and accelerate the implementation of tolls earlier than 2020 wherever feasible.²*

² Puget Sound Regional Council, “Transportation 2040 Frequently Asked Questions,” available at <http://psrc.org/assets/3175/FAQs.pdf>

“When approached systematically, variable road tolling, with investments of toll revenues, could make excessive reoccurring congestion a thing of the past.”

—Traffic Choices Study
Summary Report

The PSRC General Assembly adopted Transportation 2040 in May 2010. Although pricing is a key feature in the plan, much more work is needed to implement a pricing policy, including State legislation. In the meantime, the following road pricing projects are in the pipeline:

- Nearing Commitment:
 - » I-405 HOT lane corridor, as an extension of SR 167 HOT lane as a one-to-two-lane HOT system with likely approval in 2011.
- Proposals:
 - » SR 509 Extension as a toll road;
 - » SR 167 Extension as a toll road; and
 - » Alaskan Way Viaduct replacement as a toll road.

SOCIETAL CONSIDERATIONS

AIR QUALITY CONFORMITY was not an issue in the PSRC region, but greenhouse gas emissions were a big concern. A desire to be serious about greenhouse gas emission reductions, spurred on by a legislative mandate for significant reductions in greenhouse gas emissions over the next several decades, turned out to be a big incentive for many stakeholders to consider road pricing.

THE CONCEPT OF “EQUITY” was challenging to assess because it was difficult to define. Equity was a concern, however, and dictated how plan alternatives were analyzed and presented. PSRC examined equity in four ways: 1) the geographic distribution of benefits and adverse impacts by county and county subarea, 2) the distribution of benefits and adverse impacts by income groups, 3) the distribution of benefits to freight and passenger vehicles, and 4) an accounting and comparison of benefits of investments to minority and low-income residents.

A “REASONABLY FORESEEABLE” REVENUE SOURCE, OR A BIG RISK?

Financial conformity was also an issue when it came to defining sources of revenue for the financially constrained plan. As plan alternatives were developed, PSRC sized the extent of its transportation improvement plans to the amount of revenue anticipated to be realized through road pricing mechanisms. Since the plan alternatives (and the preferred alternative) all relied on a new, untested source to generate revenue, however, some, including the FHWA, questioned the reliability of the road pricing revenues as a resource to fund transportation system improvements. In addition, road pricing as a revenue source had not yet been authorized by the State and would require additional Federal approvals. As such, road pricing might not be a “reasonably foreseeable” revenue source.

PSRC staff reasoned, on the other hand, that even though other revenue sources such as increased gas taxes had a history, there was little inclination to increase them to the amounts needed to fund needed highway expansion. Therefore, any increase in revenue, whether from a new source or an existing source, would be equally risky.

Revenue Allocation Policies

PSRC has a clear policy to balance revenue with investments. PSRC expects that over time, pricing revenue would be offset by reductions or eliminations of other revenue sources. According to PSRC staff, there was a “general understanding” that a certain portion of toll revenues would go to transit, but the details of this policy have to be worked out in the future.

Washington State has a constitutional restriction on the use of motor fuel taxes for anything other than the highway system (called the 18th amendment). This restriction does not affect toll revenue, but current legislative policy does limit toll revenue to be spent in the corridor in which it was raised, with some flexibility for the Legislature to decide on a case-by-case basis to include non-highway expenditures such as local arterials or transit programs in the definition of the highway corridor.

While PSRC successfully developed several new evaluation tools, well beyond what had existed before either in the region or elsewhere, the additional capabilities

caused some participants in the planning process to be even more critical of the analytical shortcomings of the new system. There was a great deal of new information to absorb, and there were many subtleties that were difficult to comprehend. In the end, PSRC staff had to remind policy-makers that data is meant to aid them, and that choices must be made based on these leaders' best judgment.

EFFECTIVE COMMUNICATION TO AID INFORMED DECISION-MAKING

Treating tolling and pricing as an integral part of plan development was important to the success of PSRC's process. PSRC realized that it could not fund transportation in the same ways it had in the past, so was more open to ideas such as VMT fees and tolling. Once the public understood how the current system was unable to meet the needs of the system and its users, there was more openness to pricing and tolling alternatives. The decision to create the Pricing Task Force opened the door to discussions about pricing issues and allowed conversations about pricing to move forward.

The message that PSRC found most difficult to communicate was an explanation of how pricing would contribute to congestion reduction. PSRC introduced new methods of measuring the value of different investments during the plan update that were difficult for people to understand, with the concept of monetizing benefits and costs being particularly challenging to convey.

Ultimately, however, these measures successfully enabled participants in the planning process to understand the value of different packages. In particular, the new benefit/cost measures highlighted the fact that congestion had a cost, which encouraged those involved in the planning process to take a fresh look at transportation problems and their solutions in non-traditional ways.

In addition, individual projects (SR 520, Tacoma Narrows Bridge, and SR 167) were already in progress, enabling PSRC to point out that the region was in fact using pricing already. This silenced many misgivings against the idea.

Tolling individual projects did not seem to be a big issue, but tolling the whole network was more difficult for those involved in the process to grasp and accept. With 15 years of pricing debate, the professionals knew that

pricing could be an effective way to achieve their goals, but PSRC was worried that "leading with pricing" would be dangerous, sending a message to the public that the decisions were already made. A clear champion for pricing was a former chair of the Washington State Transportation Commission, who was well respected by decision-makers. His support allowed road pricing as a concept to be taken seriously rather than treated as a fringe theory.

Problematic Communications

PSRC experienced problems communicating the concept of parking pricing because the public, stakeholders, and policy-makers did not understand it. The parking pricing idea was supposed to be a surcharge applied at the regional level to dampen demand and raise substantial revenue, but audiences pushed back because they were concerned that these measures would be difficult to apply at a regional level and would require more detailed analysis than was possible in this plan update. PSRC ended up pulling back substantially on this concept.

Although PSRC did not encounter any communications "brick walls" to speak of, communicating full system pricing was a challenge. Also, there were quite a few single-issue stakeholders: those who believed that pricing was "the answer" did not seem to care about economic development, while others focused more on transportation system effectiveness and economics.

SUMMARY

Road pricing in the Puget Sound region incubated over the course of almost two decades, starting with a few individual projects, and culminating with a long-range transportation plan that calls for the most extensive application of road pricing for both revenue and traffic management in the United States. The process was not without its setbacks, but a combination of leadership by high profile elected officials and appointees, and willingness to expend the resources to develop and apply state-of-the-art analytical tools provided a strong base from which to advance. Analysts also took the time and made the effort to communicate their findings and work with stakeholders over the years. This contributed to increased public understanding of the implications of both action and inaction with respect to the region's transportation system.

Minneapolis/St. Paul Region Case Study

TWO DECADES OF INTEREST IN PRICING

Pricing policy began to be mentioned during the 1992-1993 period in Metropolitan Council planning documents³ as an option for consideration following a directive from the State Legislature instructing the Minnesota Department of Transportation (Mn/DOT) and the Metropolitan Council (the region's MPO) to study and implement, where appropriate, congestion pricing, toll roads, and a mileage-based tax.

The State recognized the potential public acceptance hurdles around road pricing and encouraged a public outreach process to begin discussion of the concept. At the direction of the legislature in 1995, Mn/DOT and the Metropolitan Council undertook the Minnesota Road Pricing Study that included a comprehensive public outreach process using such techniques as a citizens' jury, focus groups, opinion leaders survey, personal interviews, and a telephone survey. The process was designed to uncover acceptability issues and frame acceptable pricing options. The results of the study indicated some support for road pricing depending on how the collected revenues are used and what those revenues replace or supplement.

A DECADE OF TRIAL AND ERROR

Advocates at Mn/DOT first proposed I-394 HOT lanes as a demonstration project in 1997. However, lack of sufficient consensus, especially among legislative and local decision-makers, combined with lack of public support, led to failure of the proposal. In 1995-1996 Mn/DOT launched the TransMart Public-Private Partnership (P3) Toll Road Initiative. The proposal was blocked by a State law that allowed any community in the path of a toll road to have veto power, a power exercised by one such community.

In 2000/2001, a Value Pricing Advisory Task Force was formed that included State legislators and city officials, enabling consensus to form around testing pricing on the underutilized HOV lane on I-394. Complementing the Advisory Task Force's efforts was the I-394 Express Lane Community Task Force, which was formed to help citizens and stakeholders fully understand the project and its goals and to provide an effective vehicle to give advice and guidance during project development. Through this process, task force members became an informed voice for the project and an essential part of an extensive education, outreach, and public involvement process that became critical to the success of the I-394 MnPASS project.

The influence of the Advisory Task Force recommendations and the recognition that pricing should be tested in the Twin Cities Region led directly to the introduction of legislation authorizing conversion of HOV lanes to HOT lanes. With that authorization, and with support of both the Governor and Legislature, Mn/DOT launched the I-394 MnPASS HOV lane conversion to a HOT lane.

The Federal Value Pricing Pilot Program supported the demonstration project on I-394. The I-394 express lanes opened in May 2005 and involved conversion of existing underutilized HOV lanes over a distance of about 9 miles in one direction and 12 in the other. The lanes are dynamically priced during peak hours in the peak direction and remain free to buses, 2+ HOVs, and motorcyclists. The lanes are free to all users during off-peak periods (and in the nonpeak direction during the peak periods). The I-394 project goals are to maintain traffic flow and alleviate congestion in the corridor. Fifty percent of net revenues after payment of capital and operating costs are to be dedicated to transit.

³ The Metropolitan Council is the regional planning agency serving the Twin Cities seven-county metropolitan area.

While the I-394 MnPASS lanes were being implemented, Mn/DOT undertook the MnPASS System Study, which examined the potential for a system of toll lanes without HOV priority to relieve congestion. The study resulted in a memorandum of understanding between Mn/DOT and the Metropolitan Council to consider tolled express lanes in all expansions of the highway system.

In September 2009, building on public support of I-394, the I-35W express lane opened, with 2+ carpools being free and dynamic pricing in the peak periods. A portion of the 16-mile-long facility uses a converted shoulder lane available at the most congested times. Potential express lanes are being investigated on other corridors.

Pricing Experience Influences a Long-Range Plans

The Metropolitan Council's 2030 Transportation Policy Plan (TPP) encourages pricing in tandem with a mix of strategies, including:

- HOT lanes;
- Bus-only shoulder lanes; and
- Priced dynamic shoulder lanes to mitigate congestion.

Pricing options also appear under optimizing Highway Performance, Pricing, Multimodal Investment, Multimodal Systems, and Optimizing Trunk Highways.

While pricing is one of the five “key components” of the TPP to cope with “limited resources” and is cast as fully consistent with stated transit and HOV strategies, road pricing revenues are a secondary motivation; the primary motivation is efficiency, mobility, and congestion management. As a result, the main justifications for pricing derive from the Congestion Management Plan.

The TPP projects the needs and capabilities of the highway system 50 years into the future. In the context of a long-range plan, pricing and managed lanes are important components. The Transportation Finance section of the TPP also references pricing as among priority strategies for obtaining Federal contributions to multimodal efforts.

In late 2009, the Metropolitan Council and Mn/DOT began collaboration on two related efforts aimed at creating short- and long-term visions for the highway system in the Twin Cities region with the intent of informing another TPP update. The goal of the first study was to

identify methods and improvements to achieve the greatest efficiency from the region's highway system and manage congestion from a system-wide perspective. Rather than focusing on building capacity alone, the new strategy will focus on improvements that build on existing management strategies and provide relief to identified problem areas throughout the system.

Pricing is one of the five “key components” of the Twin Cities’ Long-Range Plan to cope with “limited resources” and is cast as fully consistent with stated transit and HOV strategies.

A second study was intended to analyze and make recommendations for the next generation of MnPASS managed lane projects. Whereas the first study focused on the long-term perspective, the second focused on short-term implementation opportunities (2-10 years).

Based on the analysis performed, a long-term vision for a managed lane system was developed and has been included in a TPP update that was formally adopted in November 2010. The draft TPP update calls for developing managed lane corridors either within the existing right-of-way, or with minimal additional right-of-way. The managed lane vision includes almost 102 miles of managed lanes, but these are not funded. The fiscally constrained plan calls for funding of a 3.9-mile I-35E MnPASS lane and other, unspecified MnPASS projects.

ROAD PRICING REVENUE POLICY

On the I-394 HOT lane, Minnesota Statute specifies that excess revenues (after capital, and operations and maintenance costs) are to be devoted to capital improvements in the corridor and to transit enhancements in the priced corridor on a 50/50 basis. On the I-35W UPA project, revenue also is dedicated to corridor transit and capital improvements by formula.

Roles of Agencies

Mn/DOT has had a sustained interest in congestion pricing and has consistently devoted staff resources to the topic. Mn/DOT staff working on intelligent transportation systems (ITS) introduced the idea of road pricing, conducted studies, and worked with the University of Minnesota over several years, waiting for the right opportunity to propose road pricing.

The Metropolitan Council has worked together with Mn/DOT over the years in the planning for toll lanes. Generally, strategies planned for implementation in a corridor or subarea must be accepted by Mn/DOT and adopted by the Council as consistent with the policy plan. As the region's transit operator, the Metropolitan Council also is a stakeholder with respect to transit operations in priced corridors.

In terms of the Federal role, the VPPP provided pivotal support for the I-394 HOT lane project and the Federal UPA grant supported the I-35W project. The Federal UPA grant also encouraged increased collaboration between State and local agencies as a condition of the grant.

COMMUNICATIONS AND CONSENSUS-BUILDING

The guiding communication philosophy with respect to road pricing in Minnesota is to leave “no question unanswered” in all interactions. Also, and very importantly, Mn/DOT acknowledged that it is impossible to anticipate all possible outcomes of a demonstration. Assurance was given that if the project worsened conditions, adjustments would be made. In fact, that was necessary in the early weeks of operation on I-394 MnPASS.

The Metropolitan Council has attempted to target its communications efforts toward the anticipated interests of key affected parties. For example, for the I-35W project, Metro Transit conveyed the transit benefits in workshops for transit riders. When drivers are the audience, travel-time reliability and free-flow conditions are the main concerns.

In general, outreach and public communication efforts have deemphasized revenue generation in favor of improved congestion management and improved travel options, remaining far away from any hint at pricing of existing lanes. When the issue of income equity arose, project proponents were able to reference findings from other projects (e.g., I-15 in San Diego) that showed little in the way of income equity impacts.

The Metropolitan Council has also attempted to develop information on subjects appropriate to specific stakeholder groups; i.e., technical staff, local government, other regions, and the public. The Council's public relations office maintains lists for opt-in registration to receive e-mail updates, meeting notices, and invitations to specific professional, civic, and community organizations to participate in plan development.

In addition, there have been extensive consensus-building and stakeholder involvement activities throughout the consideration of road pricing in the Twin Cities metro area. An I-394 MnPASS HOT Lane Community Implementation Task Force was formed in 2004 to guide the department through project implementation. Representatives from the community included six city councils, citizen representatives, American Automobile Association (AAA), trucking association, transit-oriented groups, and state legislators. The Task Force met monthly and visited California's SR 91 and I-15 projects to guide project design.

In addition, the University of Minnesota and Mn/DOT sponsored public roundtables on “Rethinking Transportation Finance,” organized legislative seminars on road pricing, and held stakeholder workshops twice a year. An important feature of consensus-building first for I-394 and continuing thereafter involved a “grass tops approach.” The approach reached out to elected officials and community leaders who then can communicate with their constituents to get support first of elected officials before the public. Another communication tactic was keeping the media informed.

Mn/DOT also has been diligent about assessing public reaction along the way. For example, survey work to evaluate I-394 showed that the MnPASS lanes were benefiting transit vehicles and there was not much effect on carpools. Surveys also showed support from 75 percent of the population.

Secrets for Successful Communications

- Leave no question unanswered.
- Target the interests of key affected parties (e.g., hold a workshop for transit riders to convey transit benefits).
- Deemphasize revenue generation; focus on improved congestion management and improved travel options.
- Develop information on subjects appropriate to specific stakeholder groups like technical staff, local government officials, other regions, and the public.
- Work with an organization such as the Humphrey Institute, which can ensure objectivity in pricing discussions and serve as a reputable, neutral party in public roundtables, legislative seminars on road pricing, and stakeholder workshops.
- Obtain the buy-in of elected officials and community leaders who can then share the pertinent information with their constituencies

MANAGING RISK THROUGH INCREMENTAL DEVELOPMENT

The Twin Cities region has been successful at developing pricing projects and policies in a methodical way, demonstrating concepts, and then moving on. This has allowed the region to test, evaluate, and incrementally develop HOT lanes in the region and gradually address enforcement, technology, and merge/weave operational risks. There also have been lower profile technical studies, to test concepts such as mileage-based user fees.

SUMMARY

Road pricing has been a topic of interest in the Twin Cities since the mid-1990s. Despite early defeats on project proposals, continued persistence by agencies and public officials has led to two projects moving forward, and recognition of pricing as a fundamental element of

the long-range transportation plan. To date, the region has achieved significant advances in the use and advancement of road pricing policies and mechanisms:

- The 2030 TPP encourages pricing in the form of HOT lanes and priced dynamic shoulder lanes to mitigate congestion.
- In addition, the Metropolitan Council has collaborated with Mn/DOT in investigating an expansion of the MnPASS system that might be accomplished in the near term.
- Lead agencies in forwarding pricing have demonstrated the importance of incremental steps and decision-maker involvement to gaining successful projects.
- The agencies also have demonstrated the importance of an open and responsive planning and communication process attentive to concerns of affected parties.

San Francisco Bay Area Case Study

YEARS OF PLANNING GIVE RISE TO ROAD PRICING

Road pricing in the Bay Area was first considered in the early 1990s when the San Francisco Bay Area Metropolitan Transportation Commission, which functions as the region's metropolitan planning organization (MPO) convened the Bay Area Congestion Pricing Task Force to consider time-of-day pricing on the Bay Bridge. The task force, composed of business and environmental group stakeholders, secured one of the earliest grants from the FHWA congestion pricing pilot program. That initial effort did not move forward, but the success of HOT lanes in other parts of the country led to interest in the Bay Area to try this approach.

The next serious foray into congestion pricing was led by the Alameda County Congestion Management Agency (ACCMA), which developed a plan for a HOT lane on I-680 through the Sunol Grade that links the Tri-Valley area to Fremont and Santa Clara County. The ACCMA has been evaluating improvement alternatives in the I-680 corridor since 1990. With the help of a Value Pricing Pilot Program grant received in 2002, the southbound-only HOT lane opened to traffic on September 20, 2010.

As familiarity and acceptance grew around the potential of HOT lanes, other HOT lane studies and plans followed, including I-580 Tri-Valley area, and SR 85 and U.S. 101 in Santa Clara County, which are expected to open in the coming years. Studies on the potential for installing HOT lanes in other parts of the Bay Area have also been conducted, including Sonoma and Marin Counties on U.S. 101.

Bay Area Express Lane Network

With growing interest in HOT lanes around the Bay Area, MTC realized the need for a coordinated approach to HOT lanes in the region. In 2006, the agency planned a network of HOT lanes sharing design, finance, and operational characteristics. In 2005, MTC included an 800-mile network of HOT lanes in its regional long-range transportation plan *Transportation 2030*.

The HOT network follows the layout of the 2002 update of the Regional HOV Master Plan, and assumes a regional express bus system operating on the network. For the express lane network, existing carpool lanes would be converted to express toll lanes and the revenue would be used to finance completion of the carpool/express lane system as well as other important transportation projects and transit operations in the express lane corridors.

As MTC and its partner agencies proceed, they hope to accelerate delivery of some portions of the express lane network and reduce costs through a "rapid delivery design" approach that fits express lanes within existing rights-of-way.

The next step in HOT lane development will be corridor studies for each part of the network to specify exact configurations, costs and revenues, and operations.

MTC's Transportation 2035 Plan

The Transportation 2035 plan evaluated the HOT lanes network with express bus enhancements as both a general transportation strategy—along with regional freeway operational improvements and regional rail expansion—and as a specific investment. The evaluation applied the same performance measures that MTC uses to evaluate all project candidates in the planning process:

- Benefit/cost ratios;
- Collision reduction;



Photo credit: Dean Birinyi

- Delay reduction;
- Reduction of carbon dioxide and particulate matter emissions;
- Reduction of vehicle miles traveled; and
- Affordability of for low-income house-holds.

MTC also developed a legislative framework for the express lane network that addresses issues such as the roles and responsibilities of the key players, use of revenue, and project development processes.

CONGESTION PRICING ON THE BAY BRIDGE

The 1989 Loma Prieta earthquake brought down a part of the San Francisco–Oakland Bay Bridge’s upper deck of the onto the lower and vividly demonstrated the vulnerability of the bridge to earthquakes. Since then, rising concerns about the susceptibility of all aging bridges in the Bay Area to earthquake damage, especially the heavily traveled Bay Bridge, combined with waning State funding for needed upgrades, has turned the tide of pub-

lic opinion. Most interest groups came to support raising tolls if revenues were devoted to seismic retrofit and operations/ maintenance for bridges.

Revenue Allocation

MTC was able to piggyback successfully on the need for a toll increase in 2009 by proposing peak pricing as both logical and familiar in terms both of paying more when demand is greatest, and of dampening congestion. While there was initially some concern that the State, which owns the Bay Bridges, might decide to channel revenues to other purposes, the committee was able to put this fear to rest. It made know that because the Bay Area Toll Authority (BATA), which is empowered specifically with toll setting and revenue allocation powers, is governed by MTC, it is therefore subject to local control. In addition, BATA policy clearly states that bridge toll revenues are dedicated to bridge operations and maintenance, with excess revenues being devoted to bridge transit.

As a result, while some commuters continued to raise objections, major stakeholder support held and the new peak toll schedule went into effect on July 1, 2010.

SFpark

On April 21, 2011, the City of San Francisco launched “SFpark,” a federally funded pilot project run by the SFMTA that uses new “smart” parking management technologies and pricing policies to make it easier and faster to park in San Francisco. SFpark works by collecting and distributing real-time information about where parking is available so drivers can quickly find open spaces.

To help achieve the right level of parking availability, SFpark periodically adjusts meter and garage pricing up and down to match demand. Demand-responsive pricing encourages drivers to park in underused areas and garages, reducing demand in overused areas. SFpark real-time parking availability and pricing information is available via *SFpark.org*, the SFpark app for the iPhone and an open data stream for outside app developers. The system enables the monitoring of parking availability and price adjustment to meet availability goals using:

- Variably priced, networked multi-space meters and in-street sensors;
- Variable pricing in 13 City-owned parking garages; and
- Nineteen variable message signs to communicate parking availability and prices.

This project is being led by the San Francisco Municipal Transportation Agency. Funding also provides for improved methods of parking payment, enhancements to the regional 511 traveler information system, and vehicle infrastructure integration technology pilot testing.

The City anticipates that better parking management will reduce street congestion and result in cleaner air, improved safety, and faster transit times.

Congestion Pricing in the City and County of San Francisco

In addition to regional initiatives, the San Francisco County Transportation Authority (SFCTA) has been studying congestion pricing for the downtown area of San Francisco since 2004, when a zone system was explored in the Countywide Transportation Plan of that year. The plans currently being considered involve charging a fee to cross or travel within a downtown zone or to cross major portals leading into San Francisco. To date, the proposals have met with strong resistance, especially from the business community, which contends that economic impacts in San Francisco may be unlike those in London and Stockholm where zone schemes similar to that proposed for the city exist. At present, this proposal is not included in the Regional Transportation Plan..

CHALLENGES AND CONSENSUS-BUILDING

Successful adoption of the new HOT network in the region required building consensus among many stakeholders. This consensus grew around the principle that revenues collected in a corridor should be returned to

the same area for HOT development and operations. Much of the consensus-building occurred as MTC and regional partners developed proposed enabling legislation that mandated 95 percent of revenues to be returned to the collection location and 5 percent be a “backstop” for areas where net HOT lane revenues decline due to the San Francisco HOT lanes “siphoning off” drivers who would adjust their routes away from other existing tolled roadways. Though the legislation ultimately failed to progress, MTC is pursuing authority to implement the network under existing State law that allows for additional HOT lanes in northern California. MTC expects the principles developed through hard won consensus will endure.

SOCIETAL CONSIDERATIONS

ENVIRONMENTAL GROUPS raised concerns about the HOT network as “new highways in sheep’s clothing,” contributing to more travel and emissions. When reviewing the air quality impacts of the HOT lane network compared to regular HOV lane network, MTC estimated that CO emissions would be reduced by 10 million tons over 40 years because HOT reduces wasteful stop-

and-go travel for more vehicles. There also would be expected CO₂ and NO_x emissions decreases. However, specific new HOT lanes will require Environmental Impact Report (EIR) analysis.

But environmental concerns are one of several reasons the original enabling legislation failed to progress. Other reasons included efforts by the State professional engineers' union to seek guarantees for all work (which goes beyond current law), and a need to update revenue projections based on current economic trends.

ROADWAY DESIGN ISSUES such as merging, ingress, and egress were another important point to be resolved by Caltrans and MTC. Caltrans preferred separate acceleration and deceleration lanes with no mixing in general purpose lanes, increasing the freeway footprint. MTC, however, desired less expansion. The result is that final details of design were not settled and will be worked out as corridor plans develop.

INCOME EQUITY was brought up in early planning for the I-680 HOT lane, but devoting significant revenues to transit patronized by lower-income groups has blunted criticism, as has independent analysis by academics at San Jose State.

COMMUNICATIONS

MTC carefully framed its public communications and outreach materials (web site, press releases, etc.) on the topic of HOT lanes to communicate some specific thoughts to the public. Some of the ways the committee did this was to:

- Emphasize expediting the development of the HOV network over and above what regular funding would allow, with tolls from the HOT lanes contributing needed revenue;
- Emphasize the return of revenue to the corridors where that revenue was generated;
- Call HOT lanes “express lanes” to emphasize the concept of speedy travel;
- Explain the HOT concept, rationale, and timeline on the MTC web site and indicate that it is a well-tested concept;
- Emphasize the attractiveness of expanding HOV and transit use;

Gaining consensus took time and effort. A special HOT Lanes Executive Committee was formed that included representatives from Caltrans, county congestion management agencies, BATA, and California Highway Patrol. Although automobile, truck, environmental, business interests, and cities were not formally represented on the committee, they were active through standing advisory committees for development of the Transportation 2035 Plan.

- Show that HOT principles would result in more throughput and reduced delays;
- Show that benefits would be commensurate with revenues collected in a particular corridor;
- Make known that only existing highway rights-of-way would be used;
- Tailor designs to each corridor, but use consistent geometries and signage.
- Highlight the economic benefits for the economy through congestion management, health and safety, and equitable mobility options.

SUMMARY

After early attempts to implement/introduce congestion-pricing on the Bay Bridge, the Bay Area began looking at HOT lanes as other regions successfully implemented road pricing projects. The impetus began at the county level, but as several counties initiated studies, the MTC undertook comprehensive studies on a system of toll lanes that would have consistent operating characteristics and standards.

Through extensive analytical studies, out-reach, and consensus-building, MTC included a network of approximately 800 miles. The network promised to accelerate development of the long planned HOV network by adding the HOT component.

Aside from the regional HOT lane system, the Bay Area Toll Authority recently adopted time-of-day tolls designed to spread demand and alleviate congestion, and the San Francisco County Transportation Authority is studying a cordon pricing concept similar to that enacted in London several years ago.

Lessons Learned

REGIONAL ROAD PRICING POLICY GREW FROM INDIVIDUAL PROJECTS

One element that all four regions had in common, however, is that none began with a broad concept of road pricing as an integral part of their long-range transportation vision. Rather, in all regions, individual project proposals introduced the metropolitan area to the congestion pricing mechanism.

As projects were successfully implemented, transportation officials saw a growing need to include policies on pricing in long-range plans. By incorporating road pricing into long-range plans, states and regions could create processes and plans that were consistent in the application of the policy, in the allocation of revenues, and in design and technology applied.

EFFECTIVE COMMUNICATION IS A CHALLENGE EVERYWHERE

Communication of road pricing concepts and consensus-building can be difficult, especially when those concepts are unknown and untested. All regions found that continuous engagement is necessary to maintain support and visibility for tolling and pricing.

PRICING AS ONE ELEMENT OF A COHESIVE TRANSPORTATION PLAN

All four regions found that including road pricing strategies as an element of a cohesive transportation plan was effective at gaining acceptance for the concepts. This meant integrating project lists, road pricing concepts, and decisions about how to handle potential revenue, showing that these pieces all worked together.

DEVELOPING THE RIGHT TOOLS FOR THE JOB

All regions struggle with developing the right models to provide the analysis to support difficult public policy decisions surrounding pricing. These models generally rely on a four-step process of forecasting:

- 1) Demand for travel (trip generation);
- 2) Destination(s) for travel (trip distribution);
- 3) Mode of travel (mode choice); and
- 4) Route of travel (trip assignment).

All regions found that the basic four-step travel demand models are not well suited to the complex changes that extensive road pricing can bring about. As a result, the different visions of road pricing in each region have shaped the type of analysis tools that were developed.

Each of the four case study jurisdictions acted to improve the sensitivity of their modeling tools to pricing related policy choices, and each recognized a need for continued improvement to make these tools relevant, useful, and accessible to policy makers.

Modifications to the modeling tools included changes that improved sensitivity to expected re-routing of traffic (Twin Cities, Dallas/Fort Worth), the choice of mode for travel (San Francisco Bay Area), and the demand for travel (San Francisco Bay Area, Puget Sound Region). Both Puget Sound and San Francisco also developed off-model tools for optimizing tolls.

Improvements to the modeling tools were also identified in each area, including suggestions for:

- Using travel survey and household income data,
- Using parcel level land use data, and
- Conducting before and after studies to increase estimation accuracy for both the travel demand for travel mode.

Because local and regional issues must be a factor in decisionmaker’s thinking, additional refinements included:

- Incorporating environmental justice analysis for specific locations and household categories,

- Improving sensitivity to walking and bicycling trips,
- Accounting for differences in people’s value of time, and
- Improving sensitivity to system management and parking policies.

Table 2 summarizes the modeling enhancements completed in each case study area.

Table 2. Case Study Modeling Summary

Case Study	Recent Modeling Enhancements	Planned Modeling Enhancements
Dallas/Fort Worth	<ul style="list-style-type: none"> • Improved sensitivity to traffic assignment 	<ul style="list-style-type: none"> • Before & After studies • Survey data collection for behavioral changes
Puget Sound Region	<ul style="list-style-type: none"> • Improved sensitivity to traffic assignment • Improved sensitivity to land use and distribution of trips (activity-based trip generation) • Off-model Toll Optimization tool 	<ul style="list-style-type: none"> • Improved sensitivity to: <ul style="list-style-type: none"> » Household income » Pedestrian and bicycle trips » System management • Parking management
Minneapolis/St. Paul	<ul style="list-style-type: none"> • Improved sensitivity to traffic assignment 	<ul style="list-style-type: none"> • Improved sensitivity to: <ul style="list-style-type: none"> » Household income » Differences in a person’s value of time
San Francisco Bay Area	<ul style="list-style-type: none"> • Improved sensitivity to traffic assignment • Improved sensitivity to land use and distribution of trips (activity-based trip generation) • Improved mode choice modeling • Off-model Toll Optimization tool 	<ul style="list-style-type: none"> • Improved sensitivity to: <ul style="list-style-type: none"> » Household income categories for equity analysis » Differences in a person’s value of time

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5. Developing Procedures for the Determination of Mobile Source Air Toxics (MSAT) and EJ Impacts, presentation by Dan Lamers, NCTCOG to IBTTA Facilities Management Workshop, April 28, 2008.

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The PSRC web site has considerable information about the plan and the analytical details on its web site. In particular:

- Transportation 2040.
<http://psrc.org/transportation/t2040/t2040-pubs/final-draft-transportation-2040/>; and
- Transportation 2040: Draft Environmental Impact Statement.
<http://www.psrc.org/transportation/t2040/t2040-pubs/trans2040-deis/>.

These appendices in particular shed light on analytical techniques:

- Appendix E: Technical Description of the Modeling Framework;
- Appendix K: Data Analysis and Forecasting at the PSRC: New Tools Within and Integrated Modeling Framework; and
- Benefit/Cost Analysis web page, with several helpful references: <http://www.psrc.org/data/models/benefit/cost-analysis/>.

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SAN FRANCISCO BAY AREA CASE STUDY

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2. HOT Principles.
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3. HOT Lane Analysis.
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