

National Capital Region Transportation Planning Board

**Evaluating a Network of Variably Priced Lanes for the  
Washington Metropolitan Region**

**Final Report**

**February, 2008**

*FUNDED UNDER A GRANT FROM THE FEDERAL HIGHWAY ADMINISTRATION'S VALUE  
PRICING PILOT PROGRAM*

## **Acknowledgements**

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This study was funded under a grant from the Federal Highway Administration's Value Pricing Program through the Virginia Department of Transportation, and was overseen by the National Capital Regional Transportation Planning Board's Task Force on Value Pricing for Transportation.

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## Preface

In this study of the potential for value pricing in the Washington region, several different scenarios for adding new priced highway lanes, pricing existing highways, and enhancing bus services are analyzed and discussed. Prior to reviewing this work, it is appropriate to recognize that the idea of variably priced road facilities with enhanced bus services for the Washington region is not new: in 1959, Professor William Vickrey of Columbia University presented a statement to the Joint Committee on Washington Metropolitan Problems of the US Congress which advocated just such a set of policies. Professor Vickrey's presentation was subsequently published in 1994 in two articles (one in the *Journal of Urban Economics*, and one in *Logistics and Transportation Review*) in order to "rescue it from obscurity" and recognize it to be of "considerable historical interest in the context of urban economic transport theory and policy." In 1996, Professor Vickrey received the Nobel Prize in Economics for this and other pioneering work on pricing.

Some selected quotations from Professor Vickrey's 1959 presentation to Congress provide an excellent starting point and context for the work reported in this study:

*"Under urban conditions we cannot have both free flowing rush hour traffic and the absence of user charges or other constraints on highway use. One or the other of these desiderata must yield."*<sup>1</sup>

*"Recent technological developments in electronics have placed within reach and within reasonable cost the possibility of assessing against the users of metropolitan streets and highways a set of charges that can be tailored about as closely to the costs occasioned by the actual usage as these costs themselves can be estimated. This can be done without interrupting or even slowing the flow of traffic, and at a cost that will be minute compared to the savings produced in inducing a more economical and less congested pattern of traffic flow and a more economical apportionment of traffic between the various available modes of transportation. It would, moreover, go far toward solving the financial problems associated with the provision of the expensive facilities required to provide adequate transportation in a modern metropolis".*<sup>2</sup>

*"Pricing of highway use will thus make it possible to provide at reasonable cost uncongested and speedy transportation anytime, anywhere, and for anyone for whom the occasion is sufficiently urgent to warrant the payment of the corresponding charge. Without pricing, it is*

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<sup>1</sup> Vickrey, William, "Reaching an Economic Balance Between Mass Transit and Provision for Individual Automobile Traffic (1959)", *Logistics and Transportation Review*, 1994

<sup>2</sup> Vickrey, William, "Statement to the Joint Committee on Washington, DC Metropolitan Problems (1959)", *Journal of Urban Economics* **36**, 42-65, 1994

*very likely that during the rush hours this degree of freedom of movement would not be available to anyone at any price.”<sup>3</sup>*

*“It is accordingly of the utmost importance, in evaluating plans for traffic facilities, to consider the various ways by which their use may be suitably controlled.”<sup>4</sup>*

Almost fifty years later, we now take up again the basic principles enunciated by Professor Vickrey and many other distinguished economists, planners and engineers, and present them for public consideration in a new context.

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<sup>3</sup> Vickrey, William, “Statement to the Joint Committee on Washington, DC Metropolitan Problems (1959)”, Journal of Urban Economics **36**, 42-65, 1994

<sup>4</sup> Ibid

## **I Executive Summary**

The National Capital Region Transportation Planning Board (TPB), the Metropolitan Planning Organization (MPO) for the Metropolitan Washington Region, has undertaken an eighteen-month study to evaluate a regional network of variably priced highway lanes. The study was conducted under a grant from the Federal Highway Administration's Value Pricing Pilot Program, and overseen by the TPB's Task Force on Value Pricing.

### **1.1 Study Background**

The TPB has had an active interest in variably priced highway lanes since June of 2003 when the TPB, in conjunction with the Federal Highway Administration and the Maryland, Virginia, and District Departments of Transportation, sponsored a successful one-day conference on value pricing for the Washington region. Following the conference, the TPB created a Task Force on Value Pricing to examine how value pricing could benefit the Washington Region. The Task Force developed a set of regional goals for a system of variably priced lanes which were adopted by the TPB in April of 2005, and were designed to "help guide the regional development of variably-priced lanes that work together as a multi-modal system, while addressing the special policy and operational issues raised by the multi-jurisdictional nature of this region." As the framing of the regional goals proceeded at the TPB, three major variably-priced highway facilities were being developed through project planning studies for inclusion in the region's financially constrained Long Range Transportation Plan (CLRP): the Inter-County Connector, the Northern Virginia Capital Beltway HOT lanes project, and the I-95/395 HOT lanes project.

The Intercountry Connector is an 18-mile east-west highway in Montgomery and Prince George's counties in Maryland that will run between I-270 and I-95/US 1. The project will include six variably-priced lanes with express bus service connecting to Metrorail stations. This project was included in the CLRP in 2004, and construction is expected to begin in 2008 with an expected completion date of 2012.

The Northern Virginia Capital Beltway HOT lane project will add four new HOT lanes to a 15-mile segment of the Capital Beltway (I-495). Vehicles with three or more occupants, as well as transit buses and emergency response vehicles, will be able to use the lanes for free; all other vehicles will pay a toll that varies according to levels of congestion and the time of day. This project was added to the CLRP in 2005, and completion is expected by 2013.

The I-95/395 HOT lane project in Virginia was included in the CLRP in 2007. This project will reconfigure the existing HOV facility between Eads Street in Arlington County and just south of the Town of Dumfries from 2 to 3 lanes, and convert those lanes to HOT lanes. The project also includes the construction of a nine-mile taper lane near Dumfries to ease congestion as the HOT lane traffic merges back into the general purpose lanes. Completion of this project is expected by 2010.

## **1.2 Scenario Development**

In order to place these three new projects into a regional context and to assess the potential for a more extensive network of variably priced lanes, the TPB developed and analyzed several different scenarios of variably priced lane networks. Three basic highway networks were defined;

- A. A “Maximum Capacity” network in which two variably priced lanes (VPLs) were added to each direction of the region’s freeways; one VPL was added to each direction of major arterials outside the Capital Beltway; existing High-Occupancy vehicle (HOV) lanes were converted to VPLs, and direct access/egress ramps were added at key interchanges in the VPL network.
- B. A “DC Restrained” scenario in which the new capacity from the “Maximum Capacity” scenario was removed from all of the bridges and other facilities in the District of Columbia, and replaced by variable pricing applied to existing freeway and selected arterial lanes.
- C. A “DC and Parkways Restrained” scenario in which the “DC Restrained” scenario was further restrained by applying variable pricing to the existing capacity on the region’s parkways (Baltimore Washington, George Washington Memorial, Rock Creek, Clara Barton, and Suitland).

The TPB’s regional travel demand model was utilized to forecast the demand and performance characteristics of these scenarios for the year 2030. Starting with base toll rates of \$0.20 per mile, a toll update algorithm was applied to gradually raise the tolls on those VPLs that were congested, until a “free flowing” volume to capacity ratio was achieved. The three networks were then “prioritized” by removing VPLs with low demand (as indicated by low toll rates). Finally, significantly enhanced bus transit services were added to each of the three “prioritized” VPL networks by shortening run times and headways of existing bus services, and adding new routes to sections of the VPL network that had neither current nor planned bus transit routes. In Virginia, vehicles with three or more occupants (HOV 3+) were allowed to use the VPLs free of charge; in the District of Columbia and Maryland only buses were allowed to use the VPLs free of charge.

## **1.3 Scenario Analysis**

The results of the analysis demonstrated that toll rates on the VPL network would have to vary significantly by segment, direction and time-of-day in order to maintain free-flowing conditions. Toll rates ranged from a low of \$0.20 per mile to over \$2.00 per mile on the “maximum capacity” scenario, where all of the VPLs were either newly added lanes or conversions of existing HOV lanes. In the “DC Restrained” and “DC and Parkways Restrained” scenarios, where 43-percent and 56-percent respectively of the variably priced lane miles were existing as opposed to newly added lanes, toll rates were significantly higher on some segments. Where variable pricing was applied to existing capacity on DC bridges, for example, tolls of between \$2.00 and \$5.00 per one way

crossing were required to maintain free-flowing conditions, corresponding to toll rates of between \$3.00 and \$10.00 per mile.

Compared to the “Maximum Capacity” scenario, the “DC Restrained” scenario had lower system-wide vehicle miles of travel (VMT) and some 38 percent higher system-wide toll revenue. Moving from the “DC Restrained” to the “DC and Parkway Restrained” scenario produced a further reduction in system-wide VMT, and a further 32 percent increase in system-wide revenue.

In terms of financial feasibility, a comparison of the forecasted revenues versus costs for each of these scenarios found that because of the high costs of building new interchanges and new lane miles for newly added VPLs, only the “DC and Parkways Restrained” scenarios generated revenues close to covering costs. As would be expected, applying variable pricing to existing HOV or general purpose lanes generated revenues significantly in excess of costs. Where new VPLs are added to the network, revenues might equal or exceed costs on some segments with favorable demand, toll levels and construction costs. In many segments of the system, however, it appeared that revenues would not be sufficient to offset capital and operating costs. As would be expected, the tolling of existing facilities is very cost effective, raising revenue over ten times greater than the cost of converting the existing facilities, when taken over a 20-year period. On average, facilities adding new toll lanes appear to raise enough revenue over 20 years to cover half of the capital costs of adding the new lanes and ramps.

The addition of extensive transit service to the VPL networks resulted in system-wide increases in transit use of around 4 percent; decreases in HOV use of between 4 and 15 percent; small decreases in regional VMT; and decreases in total system revenue. In a few “high transit demand” corridors, high quality transit could have a significant impact on transit use, HOV use and total system revenue, though the costs of transit service provision typically exceed the new revenue generated.

#### ***1.4 Impacts of the Scenarios on Land Use and Population Groups***

An effort was made in this study to assess the impacts of these VPL scenarios on land use patterns and different population groups in the region by looking at changes to accessibility to jobs and households effected by the scenarios. The results showed moderate impacts on the accessibility to jobs, the measure of interest to households. Very few zones experienced significant changes in accessibility to jobs by highways: some zones in Loudoun, Fairfax and Montgomery counties experienced increases, while some losses were experienced in the regional core in scenarios with high tolls on DC bridges. Accessibility to jobs by transit improved in all three scenarios, particularly in zones around the Beltway and in other major radial and circumferential corridors.

Changes in accessibility to households by highways were minimal. Gains in accessibility to households by transit were found near major interchanges in the VPL network, with the most significant gains near interchanges on the Capital Beltway. Changes in accessibility to households by highways were minimal. These results suggest that a VPL network may encourage employers to locate at key VPL interchanges where they can

enjoy significant increases in accessibility to the region's workforce, and that over time the VPL network could have measurable impacts on employer location decisions.

The accessibility changes noted for different population groups were fairly evenly distributed across the various groups, based on their current and projected residential locations. Since the VPL networks were all quite comprehensive in their coverage of the region, this result is not surprising.

### ***1.5 Topics for Further Consideration***

The three variably priced lanes scenarios analyzed in this study have suggested some key considerations for expanding the region's VPL network. Among these are:

- Because in many locations it may not be financially feasible to add new VPLs, future work activities should assess the impacts of tolling more existing lanes.
- More detailed "drilling down" to specific segments is needed to assess the relative benefits and costs of adding new VPLs to the network.
- More attention should be devoted to detailed specification of bus rapid transit (BRT) and other high quality transit services.
- More explicit consideration should be given to the impacts of VPL facilities on trucks, recognizing that new HOT lanes typically do not provide access to trucks..
- Geometrics of parkways and overpasses need to be examined in detail to assess the feasibility of applying variable pricing and increased bus transit to the region's parkways.
- The availability of right-of-way may be a key constraint on the addition of new VPLs on certain portions of the regional network.
- Potential chokepoints within the VPL network and at access and egress points need in-depth analysis to ensure that delays and back-ups do not occur.
- The results of this study should be incorporated into several ongoing corridor studies that may be considering variably priced lanes, including the Southern and Western Mobility Studies, the 14<sup>th</sup> Street Bridge EIS and the I-66 Corridor Study.
- Public education and outreach about the potential benefits and impacts of variable pricing to manage congestion will be essential because of the limited experience with such strategies in the Washington region. Experience in cities like Stockholm and London could be very valuable in this regard.

Ongoing work under the TPB's Scenario Study provides an excellent opportunity to pursue these considerations. During the next phase of the Scenario Study, specific segments of these three VPL networks could be identified as high priorities for expanding the VPL network beyond the three facilities currently included in the region's Constrained Long Range Plan (CLRP).