What can transportation forecasts tell us about congestion pricing?

What performance on the Metro region's existing roads could pricing strategies bring about?

The COO asked staff to estimate staff and cost requirements for conducting a regional pricing study to address a suite of questions (summarized above). Before scoping such an effort it is useful to learn from past forecasting studies that asked similar questions. Forecasting is useful because at this time Metro staff know of no real-world deployment of full **congestion pricing** (*proposed definition: tolling all lanes of multiple roadway facilities across a significant portion of the system in one city or region so that prices change dynamically--in real time or a reasonable approximation thereof--to changing roadway travel demand*).

Good existing studies can help inform Metro's thinking.

Two studies from the Metro region and two from the Seattle region are particularly relevant:

- *Transportation 2040 Transportation Plan Update*. Puget Sound Regional Council. 2010. (T2040-2010).
- *2010 RTP Alternatives Analysis*. Metro. 2008. (RTP-2010)
- *Traffic Choices Study*. Puget Sound Regional Council. 2008. (TCS-2008)
- *Traffic Relief Options study*. Oregon DOT, Metro. 1999. (TRO-1999)

The most important input assumptions for understanding the studies' pricing-related findings are:

- What was the **pricing objective**? In other words, what goal were road prices set to achieve: to optimize system performance, to maximize revenue, or simply by some "rule of thumb."
- What were the **physical and temporal extents** of the priced system? The more physical coverage the less the chance for route diversion, and the more coverage across an entire day the more options for operators to send price signals to travelers.
- What **major capital and operational investments** did the studies test in conjunction with pricing, if any?
- Note that the studies typically derived toll **price ranges** (in $/mile) from the other assumptions listed above.

What comparable performance measures are available across the four selected studies?

The studies produced a variety of forecasted **performance measures**, three of which are (mostly) present in every study:

- **Trips**. Origin-to-destination person-trips that would be made on a daily basis (measures the *amount* of travel).
- Vehicle-Miles Traveled (**VMT**). Total daily miles driven by all vehicles in the system (measures vehicle *distance* traveled.
- Vehicle-Hours Traveled (**VHT**). Total daily time spent travelling by all vehicles in the system (measures *time* vehicles spent traveling).

The measures cited above must be interpreted taken together. For example, with trips (amount of travel activity) held constant more VMT with lower VHT signifies a decrease in congestion since people are able to travel farther in less time.

What scenarios in the four studies are most relevant to Metro's current questions?

The studies analyzed about two dozen pricing scenarios in depth. Of these, five scenarios cover two "bookends" of pricing objectives: system management (three scenarios) and funding roadway expansion (two scenarios):

Scenario	Capital Investments	Pricing Objective
T2040-2010 (Freeways)	Added lanes to or extended most freeways	Optimize/revenue balance: congestion-responsive rates
2010-RTP (Freeways)	Added lanes on selected freeways	Rule of thumb (fixed rates in midday and PM-peak only) applied to *new lanes only* (with Columbia bridges tolls)
TCS-2008 (Freeway Mgmt.)	No road expansion	Optimize (all day congestion-responsive tolls)
T2040-2010 (Sys. Mgmt.)	Arterial operational efficiencies, grade separations	Optimize/revenue balance: congestion-responsive rates
2010-RTP (Sys. Mgmt.)	Arterial operational efficiencies, interchange spacing optimization	Rule of thumb (fixed rates in midday and PM-peak only) applied to *all* lanes (with Columbia bridges tolls)
TRO-1999 (C-Corridor Mgmt.)	No road expansion	Optimize (all day congestion-responsive tolls)
TRO-1999 (B-Freeway Mgmt.)	Added lanes on one key feeder route	Optimize (all day congestion-responsive tolls)

Measures and Assumptions from Selected Pricing* Scenarios from the Four Studies, Compared

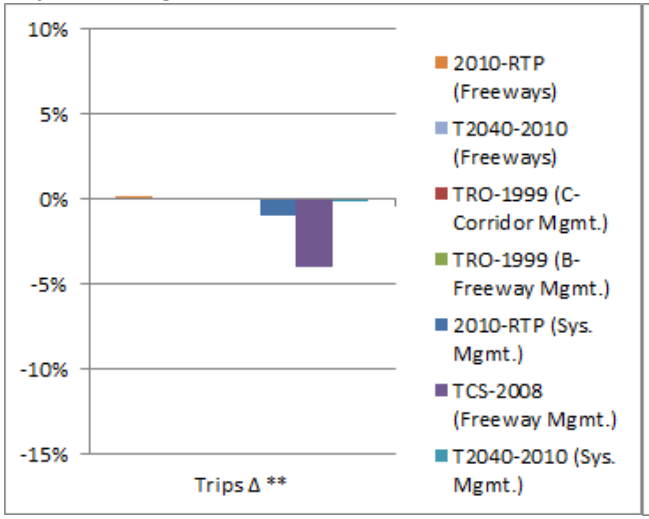
Study	Trips Δ **	VMT Δ	VHT Δ ***	Physical Extent	Temporal Extent	Pricing Objective?	Road Investments	Price Range
2010-RTP (Freeways)	0.20%	6.40%	0.50%	Selected Freeways	Midday and PM Only	Rule of Thumb	Add Freeway Capacity	$0.10/mile peak $0.05/mile midday
T2040-2010 (Freeways)	0.10%	1.50%	-5.50%	Freeway	All day, varied by period	Optimize/Revenue Balance	Add Freeway Capacity	Zero to $0.50+ /mile (full tolling)
TRO-1999 (C-Corridor Mgmt.)	N/A	-0.15%	N/A	Freeway & Parallel Arterials	All day, varied by period	Optimize	None	$0.05 average (full tolling)
TRO-1999 (B-Freeway Mgmt.)	N/A	-0.58%	N/A	Freeway	All day, varied by period	Optimize	Added feeder road capacity	$0.05 average (full tolling)
2010-RTP (Sys. Mgmt.)	-1.00%	-1.30%	-1.10%	Freeways	Midday and PM Only	Rule of Thumb	System Management	$0.10/mile peak $0.05/mile midday
TCS-2008 (Freeway Mgmt.)	-4.00%	-7.00%	-5.00%	Freeway	All day, varied by period	Optimize	None	Zero to $0.50/mile
T2040-2010 (Sys. Mgmt.)	-0.03%	-8.20%	-13.10%	All Arterials & Freeways	All day, varied by period	Optimize/Revenue Balance	System Management	Zero to $0.50+/mile (full tolling)

** Price ranges shown are in forecast year dollars and are thus not directly comparable*

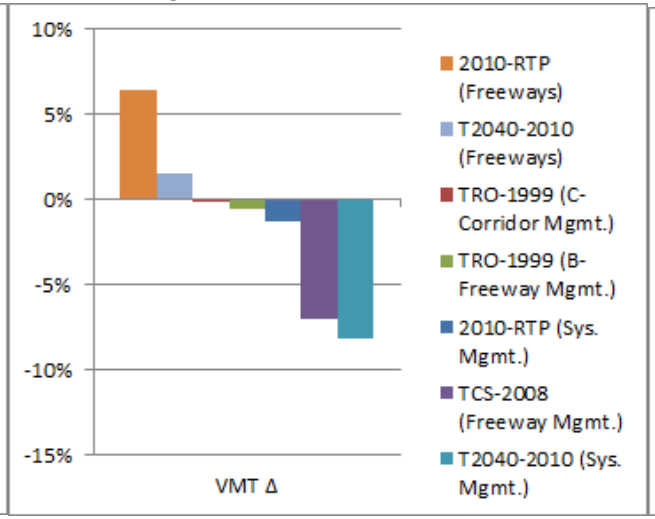
*** 2010-RTP Trips Δ is for auto-mode person-trips only, not total system person-trips as in the other scenarios*

**** VHT Δ for 2010-RTP scenarios is numeric average of the midday and PM peak forecasted values*

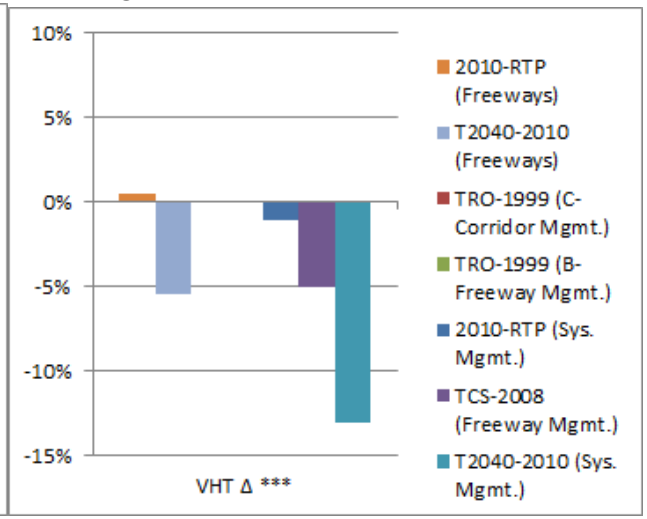
Trips % Change from Future Base Case



VMT % Change from Future Base Case



VHT Change from Future Base Case



Discussion (previous page shows data)

The VMT forecasts tell the main story about the potential effects of different pricing strategies. Absent any major roadway expansion, pricing strategies lower overall demand for distance traveled. The Metro *2010-RTP (Sys. Mgmt.)* scenario had the least extensive tolling regimen (it applied rule-of-thumb rates during only two periods of the day) and the *TRO-1999* scenarios tolled only a single facility or a single corridor, while the *T2040-2010 (Sys. Mgmt.)* scenario had the most extensive tolling policy with all arterials and freeways priced dynamically at rates balanced between system-optimization and revenue-maximization. The *TCS-2008* scenario struck a middle ground by tolling all freeways dynamically with the objective of optimizing system performance and keeping diversion relatively low. In each step from least-aggressive to most- extensive pricing the forecasts show progressively larger VMT reductions.

The two freeway expansion scenarios add nuance to this story. The Metro *2010-RTP (Freeways)* scenario had both more limited tolling (only new lanes at fixed rates during only midday and PM peak periods) and less proportional roadway capacity expansion system-wide than the PSRC *T2040-2010 (Freeways)* scenario. The *T2040-2010 (Freeways)* scenario showed less VMT increase than the Metro scenario despite its relatively greater system expansion. Together the expansion scenario forecasts suggest that pricing in conjunction with expansion still lessens demand but the impacts depend on the amount of capacity expansion and the nature of the pricing policy applied.

The trip and VHT forecasts are consistent with this story (allowing for the fact that the trip-making forecast techniques differed across analyses): broader pricing applications would probably create minor reductions in trip-making which would likely be offset as more capacity expansion is included in the scenario. The VHT data taken together with the VMT data suggest that pricing can indeed lessen congestion. The most obvious example is in the PSRC *T2040 (Sys. Mgmt.)* scenario where pricing reduced VMT but reduced VHT even more, indicating that travel speeds increased.

What general themes emerge about congestion pricing from the studies' forecasts?

- Absent any capital investments, **dynamic pricing would likely mitigate congestion** (note the VMT and VHT reductions)
- **Congestion pricing can likely manage travel demand even with road capacity expansion** depending on the pricing strategy employed (note the smaller VMT increase in the T2040-2010-freeway scenario relative to the 2010-RTP-freeway scenario)
- **Optimized congestion pricing can likely manage demand and congestion without greatly suppressing trip-making** (note the very small decreases in trips in the *T2040-2010 (Sys. Mgmt.)* and *2010-RTP (Sys. Mgmt.)* scenarios)

What scale of performance changes might the Metro region expect from pricing based on these studies?

- The studies' forecasts suggest that **congestion pricing could be expected to reduce system VMT in the range of 1% to more than 8%** depending upon the pricing objective and the type of capacity investments made (if any).

What other findings from the studies are noteworthy?

- The PSRC Transportation Choices Study (*TCS-2008*) tested real-world, in-vehicle Global Positioning System toll transceivers and corollary back-end business systems, proving that **it is technologically feasible today to implement accurate open-road tolling.** Related information suggests this can be done at a price of less than $100 per vehicle.
- The PSRC Transportation Choices Study (*TCS-2008*) experiment gave the test participants the possibility of saving real money to simulate the economic trade-offs travelers would make in real-world congestion pricing conditions. The results strongly confirm the hypothesis that **travelers will change their travel patterns in response to congestion pricing**.
- **Carefully-designed pricing strategies can realize pollutant emissions reductions** through VMT reduction.
- The strong evidence that congestion pricing can affect travel choices in ways that mitigate congestion is accompanied by equally strong public opinions on the general desirability of congestion pricing: **public opinions tended to be more accepting of pricing applied to new facilities than pricing applied to existing infrastructure**.
- **Benefits tend to be positive** in those studies that performed such assessments, assuming that revenues are re-invested in the transportation system.
- In theory, **congestion pricing is a tool that meets multiple objectives**: creating environmental benefits, system management benefits, and transportation revenue.