Evaluation of Tolling Concepts for a Regional Transportation Plan

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Puget Sound Regional Council
Outline

- Objectives
- Analysis Tools
- Testing Tolling Concepts
- Developing Plan Alternatives
- Evaluating Plan Alternative
- Findings
Planning Objectives

• To advance understanding of the role of toll policy in helping to achieve regional plan goals, including:

  – Improve the mobility of people and goods in the Central Puget Sound region
  – Create an efficient land use pattern for the provision of infrastructure, facilities, and services
  – Promote economic prosperity
  – Protect the natural environment
  – Promote an overall high quality of life
  – Distribute transportation benefits and costs equitably
### Planning Evaluation Criteria

<table>
<thead>
<tr>
<th>Mobility (M)</th>
<th>Economic Prosperity (EP)</th>
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<tbody>
<tr>
<td>1. Travel Time Savings</td>
<td>1. Benefits to High-Wage and Low-Wage Employment</td>
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<td>2. Reliability Benefits</td>
<td>2. Benefits to Industry Cluster Employment</td>
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<td>4. Other User Costs</td>
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<thead>
<tr>
<th>Finance (F)</th>
<th>Environmental Stewardship (ES)</th>
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<tr>
<td>1. Facility Operating Costs</td>
<td>1. Vehicle Emission Cost Savings</td>
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<tr>
<td>2. Capital Costs</td>
<td>2. Runoff From Impervious Surfaces</td>
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<td>3. Operating Revenues</td>
<td>3. Ability to Retain Open Space</td>
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<td>4. Influence of Finance on the Economy</td>
<td>4. Redundancy of Road and Transit Systems</td>
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<tr>
<th>Growth Management (GM)</th>
<th>Quality of Life (QL)</th>
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<tr>
<td>1. Population in Regional Geographies</td>
<td>1. Accident Cost Savings</td>
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<td>2. Employment in Regional Geographies</td>
<td>2. Non-Motorized Travel</td>
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<tr>
<td>3. Jobs and Housing Balance in Counties</td>
<td>3. Redundancy</td>
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<td>4. Population and Jobs in Regional Growth Centers and Jobs in MICs</td>
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<th>Equity (E)</th>
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<tr>
<td>1. Geographic Equity</td>
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<td>2. Income Equity</td>
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<td>3. Distribution of Benefits to Passenger and Freight Users</td>
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<tr>
<td>4. Benefits to Environmental Justice Populations</td>
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Updated Analysis Tools

- Integration of Travel and Land Use (UrbanSim) Models
- New Tour Generation Model
- New Mode Choice Model: with transit sub-modes
- Refined Values of Time for 11 Vehicle Classes
- Toll Optimization Model: ECONorthwest
- New Benefit-Cost Accounting Software
Updated Values of Time

Based on observed data from a tolling experiment (Traffic Choices Study)
HOT Tolling--Toll Optimization Model:
- Mathematical description of how drivers respond to tolls on HOT lanes
- Basic data inputs:
  - Estimates of the number of vehicles that approach the facility by vehicle class
  - Information on the distribution of values of travel time by vehicle class
  - Speed flow relationships for the GP and HOT lane
- Comprehensive outputs, including:
  - Speeds
  - Toll Rates and Revenues
  - User Benefits

Full Facility Tolling--Regional Travel Model:
- Modification of facility volume-delay functions to represent marginal cost toll
- Tolls vary by facility and time period
- Employ Ramsey pricing rules
Plan Analysis Overview

A very deliberate process:

- Analyze broad tolling concepts
- Define tolling elements of Plan Alternatives
- Design other services and investments that follow from the tolling elements
- Evaluate the Alternatives
- Develop a Preferred Alternative and Draft Plan
## Tolling Concepts in 2020

<table>
<thead>
<tr>
<th>2020 Tolling Concept</th>
<th>Geographic Area</th>
<th>Road Network</th>
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<tbody>
<tr>
<td>#1A - HOT Lane Network (3+ HOV Exemption)</td>
<td>4-County Region</td>
<td>HOV System</td>
</tr>
<tr>
<td>#1B - HOT Lane Network (2+ HOV Exemption)</td>
<td>4-County Region</td>
<td>HOV System</td>
</tr>
<tr>
<td>#2 - Selected Facility Tolling</td>
<td>King, Pierce, Snohomish Counties</td>
<td>SR-520/I-90, AWV/I-5 &amp; I-405/SR-167 HOT</td>
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<tr>
<td>#3 - Area Pricing/Parking Charges</td>
<td>4-County Region</td>
<td>Focused on Urban Centers</td>
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<tr>
<td>#4 - Freeway Network Tolling</td>
<td>4-County Region (within UGA)</td>
<td>Limited Access Facilities</td>
</tr>
<tr>
<td>#5 - Full Network Tolling</td>
<td>4-County Region</td>
<td>Limited Access Facilities &amp; Arterials</td>
</tr>
<tr>
<td>#6 – VMT Minimization (Full Network + CO2 Charge)</td>
<td>4-County Region</td>
<td>Limited Access Facilities &amp; Arterials</td>
</tr>
</tbody>
</table>
Tolling Concepts: Findings

Full System Tolling
• Travel time savings relative to base: $1.7 billion/year
• Transit demand increase in many corridors
• General reduction or mitigation of congestion extent (but not completely)
• Revenue: $6.1 billion/year

Freeway System Tolling
• Travel time savings relative to base: $0.8 billion/year
• Transit demand increase in freeway corridors plus some others
• Increased congestion on arterials in several areas
• Revenue: $1.9 billion/year

Area Pricing (Parking Management)
• Travel time savings (cost) relative to base: ($0.002 billion)/year
• Little change to transit demand
• Little change to general congestion extent
• Revenue: $104 million/year
• Conclusion: Best used as a demand management tool in conjunction with other strategies

HOT One-Lane
• Travel time savings relative to base: $0.124 billion/year
• Little change to transit demand
• Little change to general congestion extent
• Revenue: $79 million/year
• Conclusion: Maximizes use of HOV lane capacity in peak periods

Note: analysis did not program the revenues into further investments
The efficient pattern of decision making consists of
  – first establishing a pricing policy to be followed in the future,
  – then planning adjustments to fixed capital installations according to a benefit-cost analysis,
  – and then eventually determining prices on a day-to-day or month-to-month basis in terms of conditions as they actually develop
  – William Vickrey, Nobel Laureate
Plan Alternatives

Baseline
• *Uses adopted revenue sources to fund committed projects*
• *Starting point for comparing other alternatives*

Alternative 1
• *Includes High Occupancy Toll lane network on most of the highway system*
• *Designed to make our existing transportation system more efficient*

Alternative 2
• *Includes a 2 HOT lanes on much of the freeway system*
• *Adds substantial roadway and transit capacity*

Alternative 3
• *Uses tolls to pay for major highway improvements*
• *Traditional funding would support new transit, and a better connected bicycle and pedestrian network*

Alternative 4
• *Uses tolls from the highway users to manage the roadway system and to fund a broad array of programs*
• *Improves the system including roadway bottlenecks, transit and non-motorized travel options.*

Alternative 5
• *Investments would be funded through tolling freeways and arterials*
• *Largest expansion of high capacity transit, bus service, and dedicated bicycle and pedestrian facilities*
Annual Revenues and Costs Relative to the 2040 Baseline (millions of 2008 dollars)

- Facility Operating Costs
- Facility Capital Costs
- Economic Cost of Taxes
- Parking Charge Revenues
- Operating Revenues

Alt 1
Alt 2
Alt 3
Alt 4
Alt 5

Finance
Air Quality

Change from 2040 Baseline in Annual Emission Reduction Benefits (millions of dollars)

- CO2
- CO
- NOx
- VOC
- PM2.5

Alt 1
Alt 2
Alt 3
Alt 4
Alt 5
Plan Alternatives: Present Value of Benefits and Costs 2010-2040
(2008 Dollars)

Alt 1  Alt 2  Alt 3  Alt 4  Alt 5
Total Benefits
Total Costs
Net Present Value

Benefit Cost Results

Plan Alternatives: Present Value of Benefits and Costs 2010-2040
(2008 Dollars)
Some Specific Tolling Findings

- Setting of tolls rates is a challenging and important exercise
  - Partial facility tolling (HOT lanes) – requires highly distributed values of time
  - Partial network tolling – must consider diversion consequences; we employed a Ramsey pricing approach
  - Time of day tolling – dependent upon reasonable treatment of time of day choice
  - Large-scale tolling – tolls feed back through trip distribution and generation

- In the case of HOT lanes defining the counterfactual lane management policy has a strong influence upon the outcome of the assessment

- Cordon pricing, area pricing, and parking pricing are generally clumsy approaches to congestion amelioration

- Time-of-day pricing across a broad network of facilities produced large user benefits
Some Findings for Planning

- **Setting broad tolling policy first is the theoretically preferred approach** – and has practical advantages for developing internally consistent planning alternatives.

- **The planned use of revenues matters a lot** – revenues can be much larger than the direct benefits to users from toll management.

- **A careful design of complementary measures is essential** – large capital investments can dissipate resources and other management efforts can be redundant or counterproductive.

- **Tolls that vary by vehicle or user class aid efficiency and fairness** – should each class pay proportional to its received benefits?

- **There is no substitute for proper economic (benefit-cost) assessment** – e.g. changes in consumer surpluses cannot be approximated with aggregate measures of demand (speeds, vmt, and vht).
Next Steps

Developing a Preferred Alternative and Draft Plan

- Establish agreement on the appropriate role/extent of tolling (new facilities, broader roadway system, etc.)
- Establish general guidance on how toll revenues should be used (dedicated to tolled facilities only, or broader use)
- Establish whether toll policy should be used to address other objectives such as climate policy
- Tailor projects/investments based on specific answers to the issues stated above
Questions

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