Puget Sound Regional Council

Puget Sound
Traffic Choices Study

Puget Sound Regional Council
psrc.org

**Washington State
Department of Transportation**

SIEMENS
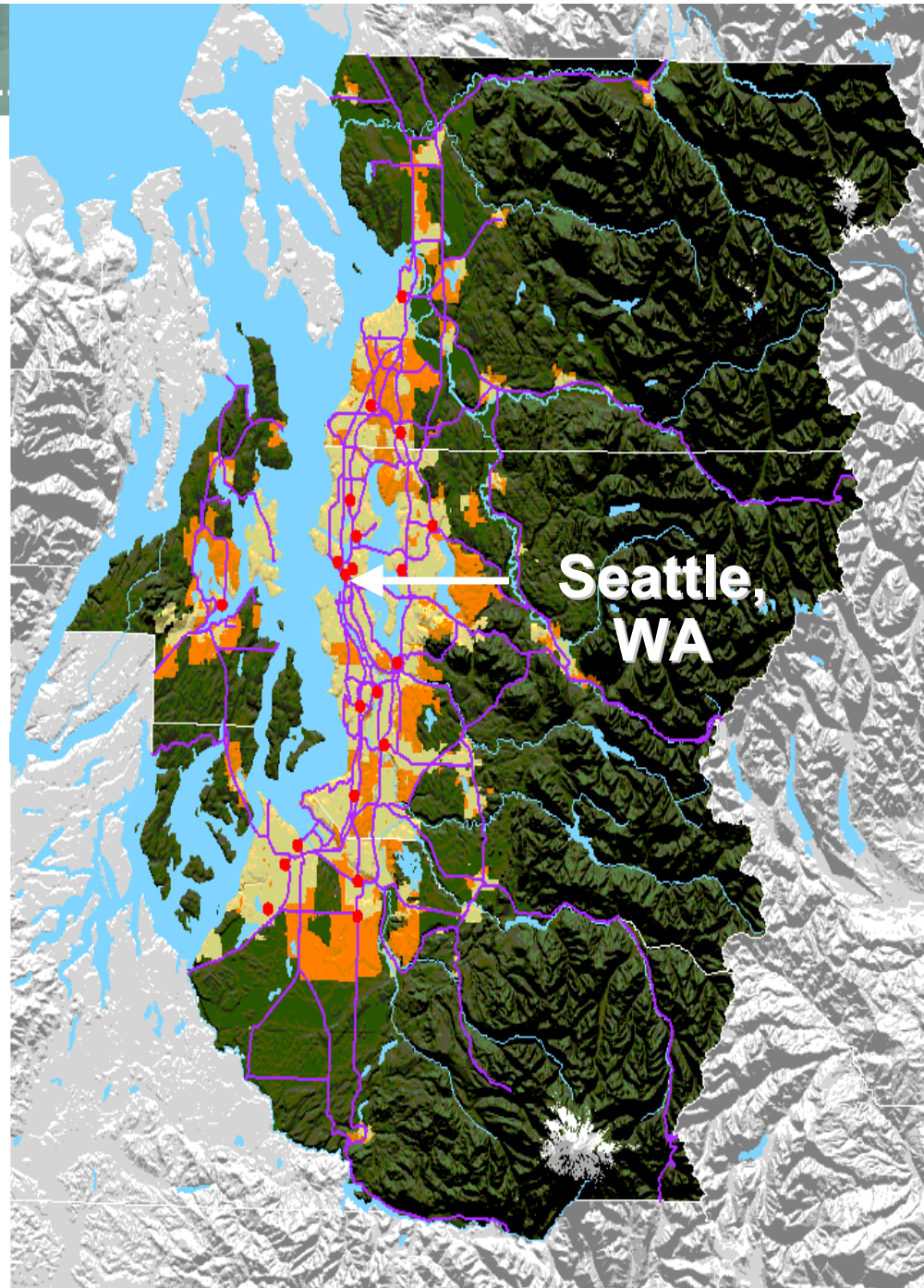
Puget Sound Region

- 3.2 million people

- 1.7 million jobs

- 16,300 sq. kilometers

- Expecting significant growth over the next 25 years

- New growth targeted for existing urban areas

Seattle, WA

Existing Road Finance System

- **System is financially weak**
  - Poor fiscal elasticity of the gas tax, especially with new fuels
  - New capacity costs are rising with urbanization, and preservation and maintenance costs are rising as system ages

- **System performance is declining**
  - Congestion, road conditions deteriorating
  - Land use regulation, transit policy not obviating the problem

- **Gas tax (and other tax-based) finance perceived as unfair**
  - Expensive new capacity that benefits few taxpayers
  - Requires cross-subsidies, among regions, types of users
  - Hence, public support for general tax increase is low

How do we respond to growth in travel demand?

Through a variety of transportation investments:

- Additional Roadway Infrastructure

- High Capacity Transit Investments

- Local Buses (new service and priority treatments)

- Compact Development Patterns

- Employer-based Demand Management

- System Management Technology

But supply and demand remain out of balance!

All these approaches have limited effect, absent accurate pricing.

Future of Road Finance?

- **Conventional road finance is a death-spiral**
  - We levy a low charge on all mileage...
    - …creating excessive congestion during peak periods
  - The congestion prompts road authorities to build
  - But the low charges cannot cover the costs!
- **Value pricing stops the death-spiral**
  - Charges are levied selectively on certain vehicle-miles
  - Controls excessive congestion during peak periods
  - Value pricing generates the revenue to build capacity when it is really needed
  - Revenue is collected from those who burden capacity

Project Objectives

- Generate price response data for use in other analytical efforts.

- Familiarize real people with a "real" application of road pricing.

- Test technology, program design, behavior, as well as public attitudes.

- Investigate and refine policy issues and questions.

Key Attributes of the Project

- Pilot program to study effects of system-wide congestion pricing on traveling public within controlled research environment

- Groundwork for one future finance option for investments in Puget Sound's roadway network

- Use of Existing Off-the-shelf Technology

- GPS-based tracking of vehicles

- GPRS/GSM communications between vehicle and central office

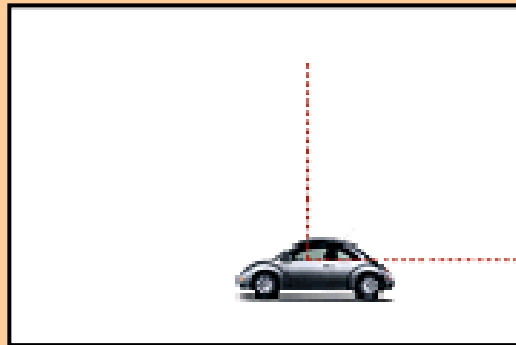- "Hold-Harmless" Billing using Participant Endowment Accounts

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Start-up Period

- • Enroll participants
- • Install in-vehicle equipment
- • Baseline data collection
- • Loaded system test
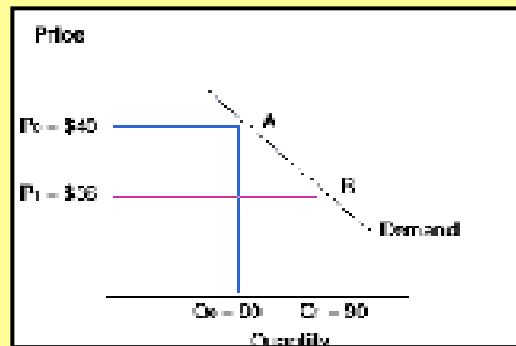- • Develop travel endowment budgets

Active Period

- **In-vehicle toll display**
- **Driver modifies travel or pays toll**
- **Vehicle charged for road use**
- **Tolls levied against endowment accounts**
- **Participants keep unspent account balance**

Analysis Period

- Calculate price elasticities
- Behavioral response
- Technical documentation
- Examine policy areas
- Full documentation of all aspects of the project

Tariff Model for Project

- **Based on theoretical "economic efficient" tolls**
  - Recognition of artificial tolling environment (pricing has no impact on ambient congestion)
  - Desirable to have an imperfect match of toll rates with conditions to generate variability for statistical modeling
- **Research objectives require multi-dimensionality**
  - Ideal: Variation of tolls by time of day, day of week, location, facility type and/or direction of travel
  - Practical: Emphasizes some dimensions while collapsing others
- **Simple, Simple, Simple**

Toll Area Map

- **Coverage Area**
  - Cascade foothills to Puget Sound
  - Everett to Sea-Tac Airport
- **Freeways & most major arterials**
  - ~ 6,600 links
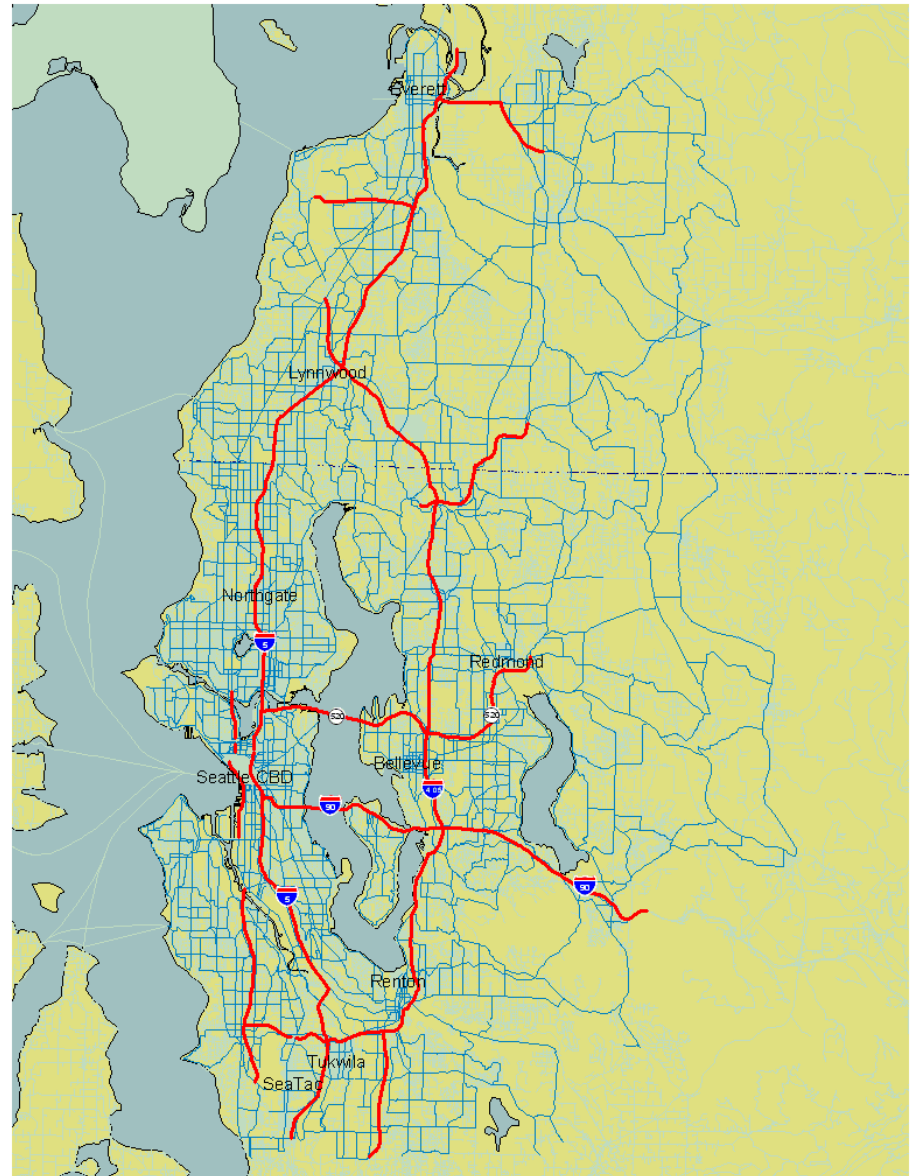
Toll Schedule

| Time of Day | Toll Rates per Mile* | | | |
| | Monday thru Friday | | Saturday & Sunday | |
	Freeways	Non-Freeways	Freeways	Non-Freeways
Midnight	No Charge		No Charge	
1:00 AM				
2:00 AM				
3:00 AM				
4:00 AM				
5:00 AM				
6:00 AM	$0.40	$0.20	$0.10	$0.05
7:00 AM				
8:00 AM				
9:00 AM	$0.15	$0.075	$0.20	$0.10
10:00 AM				
11:00 AM				
Noon				
1:00 PM				
2:00 PM				
3:00 PM				
4:00 PM	$0.50	$0.25		
5:00 PM				
6:00 PM				
7:00 PM	$0.10	$0.05	$0.10	$0.05
8:00 PM				
9:00 PM				
10:00 PM	No Charge		No Charge	
11:00 PM				

Elasticity of Trip Demand

- HH unit of analysis = 300 (450 vehicles)
- Various trip types (details by time of day, day of week, etc.)
- Substitutability (transit availability, HH type, survey responses)
- HH type (income, size, fleet, transit accessibility)
- **Data Estimates:**
  - **10 months of travel data (before and after tolling)**
  - **500,000 individual trip records**
  - **20,000,000 time/location stamps**
- The behavioral response we are expecting to observe will be at the margin

Systems Requirements

- 300 participant households (450 in-vehicle meters)

- High degree of roadway network resolution

- Proven, tested, safe equipment and installation

- High-level data capture accuracy (GPS / GSM)

- Secure, reliable back office system

Treatment of Travel Data

- Current demonstration system involves high resolution location information leaving the vehicle to be stored in the central system.

- Trade-off: limiting the extent of data that leaves the vehicle versus preserving audit/dispute functionality.

- OBU processing and storage capabilities are primary limiting factors. This can be changed… … it is only technology.

- At this time, edge-heavy processing systems are less reliable than center-heavy processing systems.

Vehicle Trips

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kitchenm | Fri Feb 18, 2005 | 12:27:07 PM

| Home |
| Project |
| **My Account** |
| Balance |
| Invoices |
| Charged Links |
| Charged Trips |
| Personal Data |
| Troubleticket |
| **Datamgmt** |
| Participants |
| Vehicles |
| OBUs |
| Users |
| **Tariffmgmt** |
| Calendar |
| Version |
| Model |
| Links |
| Calendar Create |
| **Systemgmt** |
| File Upload |
| File Search |
| System Parameters |
| System Parameterset |
| System Log |
| Troubleticket (PSRC) |
| **Participant's View** |

Participant's View

Select a participant and vehicle to get their bookings, lookup invoices and search locationstamps.

Participant	PSRC	TEST-VEHICLE ▼	**Choose Participant**
Vehicle	99999_01	Ford Focus station wagon ▼
From	02/01/2005
To	02/18/2005

| **Search Trips** | **Search Invoices** | **Show Account** |

31 result(s) found!

Trip ID	From - To	Total [miles]	Tolled [miles]	Zero Tolled [miles]	Non Tolled [miles]	Links	Locationstamps
1371763291/59355/44	Tue Feb 1, 2005 - 06:45:19 - Tue Feb 1, 2005 - 06:52:24	2.56	0.00	0.00	2.56		Show Locationstamps
1371763978/59356/44	Tue Feb 1, 2005 - 06:56:41 - Tue Feb 1, 2005 - 07:20:04	11.45	0.00	0.00	11.45	Show Links	Show Locationstamps
1371769985/59624/44	Tue Feb 1, 2005 - 08:38:21 - Tue Feb 1, 2005 - 09:10:38	12.33	1.21	0.00	11.12	Show Links	Show Locationstamps
1371796689/60314/44	Tue Feb 1, 2005 - 16:01:52 - Tue Feb 1, 2005 - 16:22:32	10.13	7.52	0.00	2.61	Show Links	Show Locationstamps
	Wed Feb 2, 2005 -						

Trip Details (Charged Road Links)

Date/Time	Link Name	Length [miles]	USD/mile	Cost [USD]	Tariff Version/Model	Status
Wed Feb 2, 2005 - 07:30:01	55141567--Delridge-Way-SW	0.13	0.200	0.025	61| Final 01/15/2005| valid| 42| Non-Freeways| Sat Jan 15, 2005 - 00:00:00 - Fri Dec 31, 2010 - 00:00:00	charged
Wed Feb 2, 2005 - 07:33:52	32033204--West-Seattle-Fwy	0.55	0.200	0.109	61| Final 01/15/2005| valid| 42| Non-Freeways| Sat Jan 15, 2005 - 00:00:00 - Fri Dec 31, 2010 - 00:00:00	charged
Wed Feb 2, 2005 - 07:35:38	32043205--West-Seattle-Fwy	0.11	0.200	0.021	61| Final 01/15/2005| valid| 42| Non-Freeways| Sat Jan 15, 2005 - 00:00:00 - Fri Dec 31, 2010 - 00:00:00	charged
Wed Feb 2, 2005 - 07:36:07	32053339--West-Seattle-Fwy	0.14	0.200	0.028	61| Final 01/15/2005| valid| 42| Non-Freeways| Sat Jan 15, 2005 - 00:00:00 - Fri Dec 31, 2010 - 00:00:00	charged
Wed Feb 2, 2005 - 07:38:05	32083257--Alaskan-Viaduct	1.22	0.400	0.488	61| Final 01/15/2005| valid| 41| Freeways| Sat Jan 15, 2005 - 00:00:00 - Fri Dec 31, 2010 - 00:00:00	charged
Wed Feb 2, 2005 - 07:39:04	32573209--Alaskan-Viaduct	0.52	0.400	0.210	61| Final 01/15/2005| valid| 41| Freeways| Sat Jan 15, 2005 - 00:00:00 - Fri Dec 31, 2010 - 00:00:00	charged
Wed Feb 2, 2005 - 07:39:35	32093210-S-Alaskan-Viaduct-St	0.22	0.400	0.086	61| Final 01/15/2005| valid| 41| Freeways| Sat Jan 15, 2005 - 00:00:00 - Fri Dec 31, 2010 - 00:00:00	charged
Wed Feb 2, 2005 - 07:39:53	32103211-Alaskan-Way-99	0.12	0.400	0.049	61| Final 01/15/2005| valid| 41| Freeways| Sat Jan 15, 2005 - 00:00:00 - Fri Dec 31, 2010 - 00:00:00	charged
Wed Feb 2, 2005 - 07:40:08	32113212--Alaskan-Viaduct	0.23	0.400	0.092	61| Final 01/15/2005| valid| 41| Freeways| Sat Jan 15, 2005 - 00:00:00 - Fri Dec 31, 2010 - 00:00:00	charged
Total		**3.23**		**1.110**		

Fairness of Road Pricing

- Direct use charging addresses existing horizontal inequalities
  - Across users groups
  - Across geography

- Issues of vertical equity may remain, and are best addressed through a comprehensive treatment of public taxation and allocation policies

- Road financing that improves overall economic efficiency leaves greater societal resources available to address equity concerns

Privacy

- Privacy questions involve what data leaves the vehicle, and what safeguards are in place to limit its availability and use.

- It may be necessary to design an approach where only "generic" facility use data is used by a central billing system.

- Audit/dispute functions can be preserved through temporarily storing detailed location data within the vehicle.

- Ultimately, any charging system must be verifiable and enforceable.

Outlook

- Project will show feasibility of GPS-based solution for tolling applications in US

- Successful operational results may influence long-term planning and policy making in the Seattle region and elsewhere

- Important policy questions such as privacy and equity will be better understood

- Large-scale deployment of a GPS-based tolling solution depends on a viable business model and <u>public acceptance</u> of underlying concepts

- Other possible applications are fleet management, commercial vehicle operations, and integration with traveler information systems

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http://www.psrc.org/projects/trafficchoices/index.htm

Note (added after the presentation):

GPS data are collected second-by-second for individual units, which are usually associated with individual vehicles or persons. But there is a strong analogy between these data points and atmospheric molecules. The real usefulness of such data comes in recognizing patterns at the macro level, such as weather fronts and wind flows.

Consider the various scales of temporal and spatial data represented in the following graphic. There is a strong need for developing methods to analyze and forecast patterns in the aggregate. These will include methods for determining when the behavior represented by one set of data is the "same" as the behavior represented by another set.