

Urban Areas Congestion Analysis Update

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WORKING DRAFT

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**Washington State
Department of Transportation**

Why Conduct This Analysis?

In 2003, the State Legislature asked WSDOT to conduct a congestion relief analysis for Puget Sound, Spokane, and Vancouver.

The study is to inform policy makers on:

- How is our transportation system performing today?
- How much will the the urban areas grow over the next 20 years?
- What does this growth mean in terms of future travel demand and congestion?
- What are some of the investment options to accommodate the growing demand?
- What are the costs and benefits of these options?

What the Legislature Asked Us To Do:

“The study must include proposals to alleviate congestion consistent with population and land use expectations under the growth management act, and must include measurements of all modes of transportation”
-ESHB 1163 Sec. 222(1)

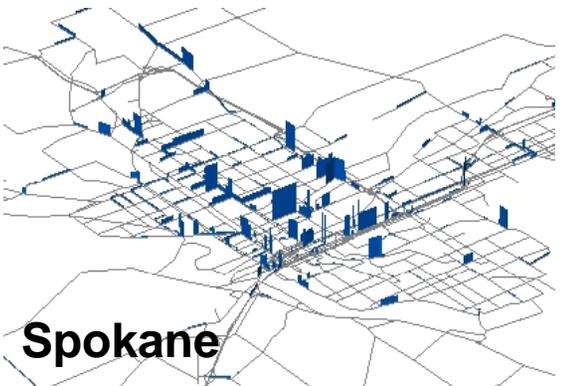
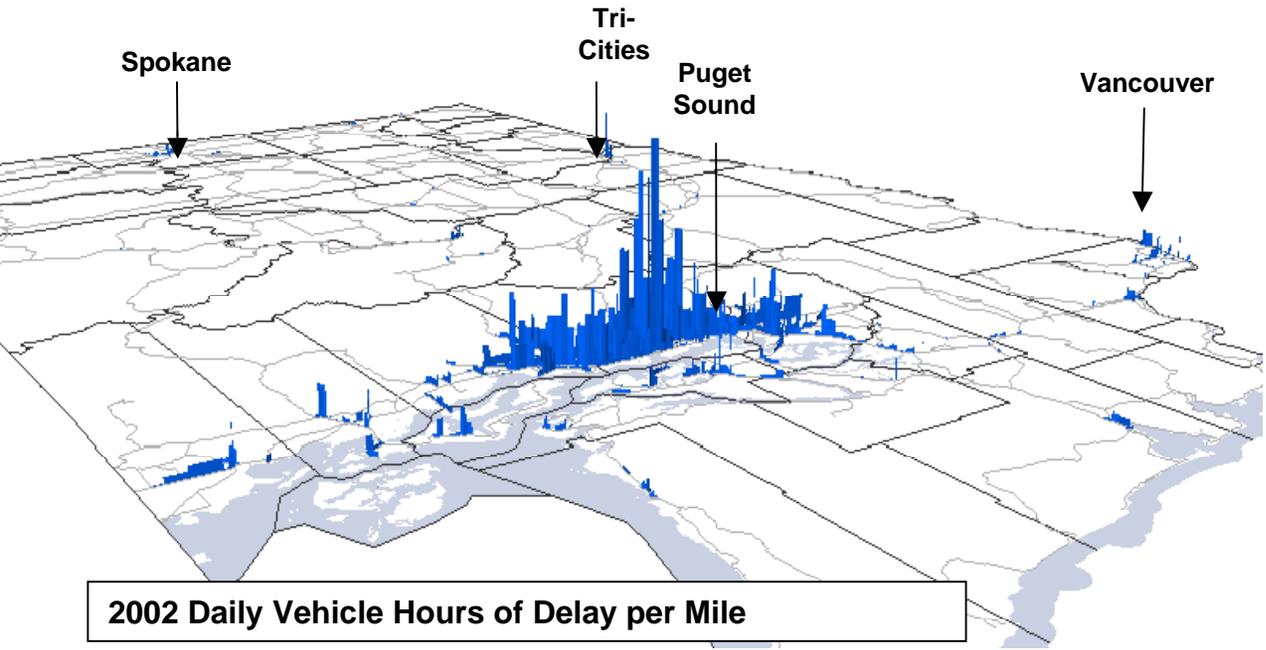
What Is This Study About?

- Analyzed all modes of travel using:
 - Best tools available, but they have limitations
 - Best practices, advised by a panel of experts
- Developed a range of investment scenarios
- Complied with growth management act expectations
- Answered questions such as what level (cost and impact) and mix of transportation investments are needed to achieve various levels of congestion relief?
- Provided information, not a plan, to address congestion.

Cost Estimating

- **Full design standards applied.**
- **The costs include design, right-of-way, construction and environmental mitigation.**
- **A cost estimation tool was developed for this analysis:**
 - The tool differentiates geographic location, land use type and development density.
 - The tool was validated against known projects and checked by DOT project engineers.
 - A risk assessment workshop was conducted to account for uncertainty due to lack of design details.

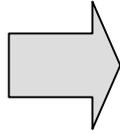
Traffic Delay is Primarily Concentrated in Our State's Urban Areas



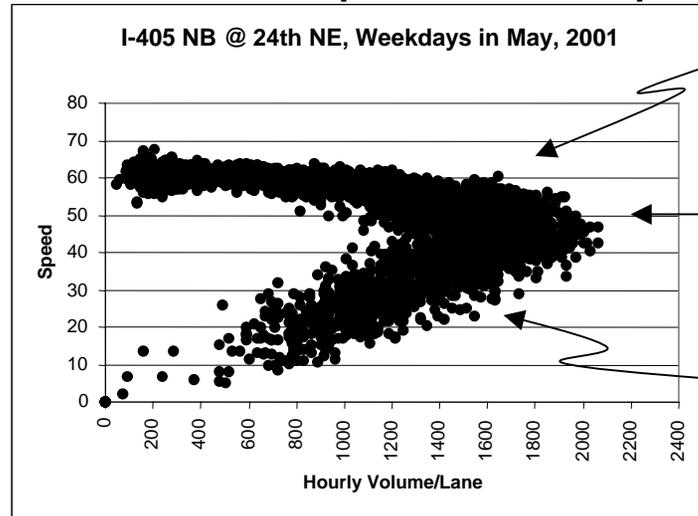
The highest spike depicted on the map is located at the interchange for I-5 and I-90 in Seattle, where the average tally is about **2000 vehicle hours of delay per mile per day**.

Congestion Erodes the Efficiency of Our Roadways

Maximum freeway throughput is typically at speeds of 45-50 mph. This accommodates about 2000 vehicles per hour per lane. System throughput drops dramatically when traffic volume forces speeds to drop below 50 mph.



Volume and Speed Relationship

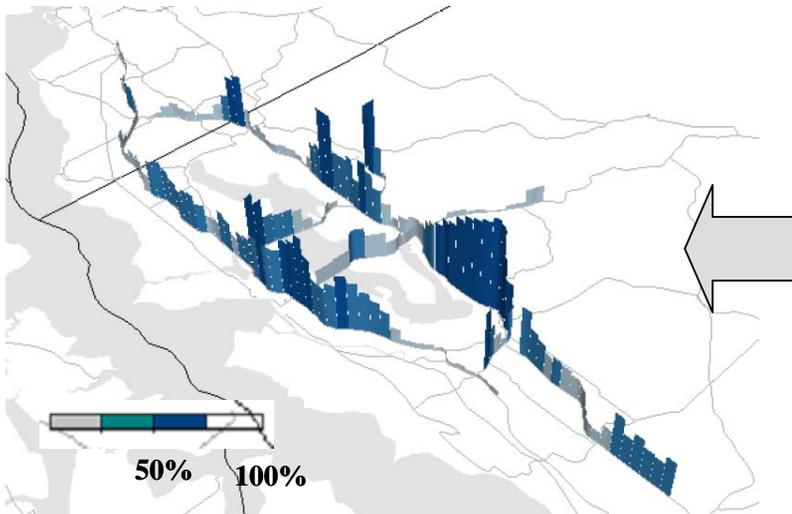


Slightly lower speed, higher throughput

Max throughput is reached at roughly 50 mph

Much lower speed, lower throughput

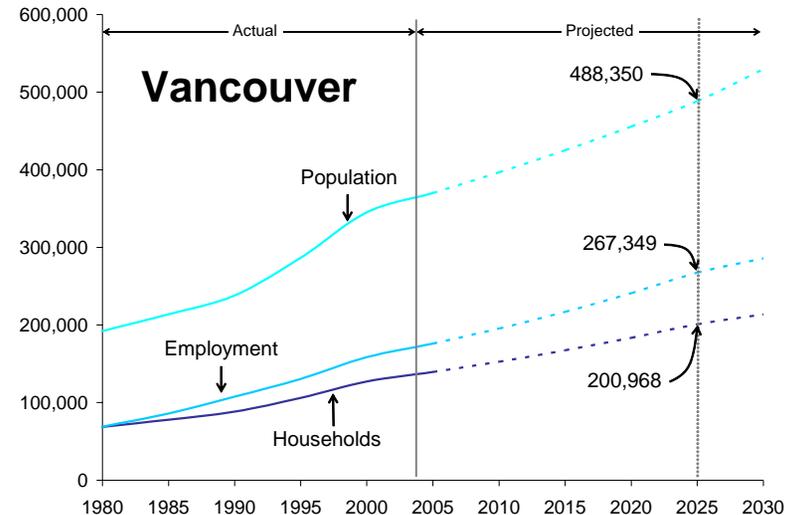
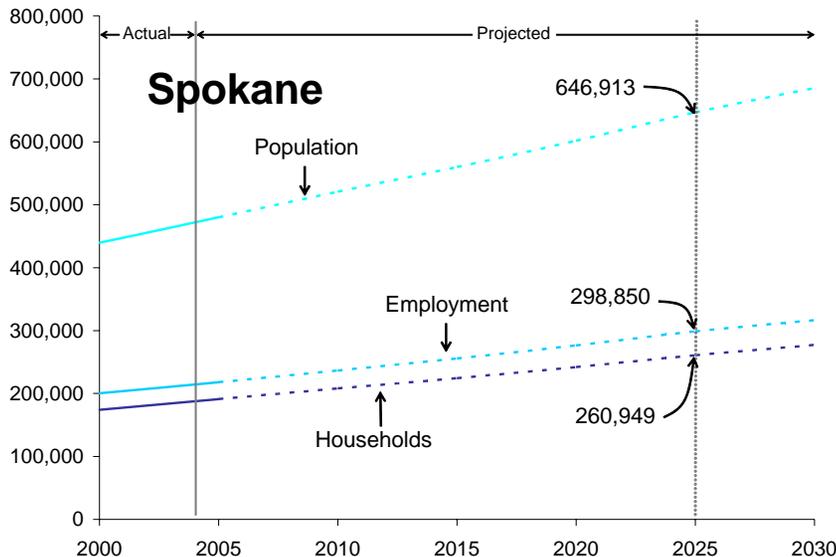
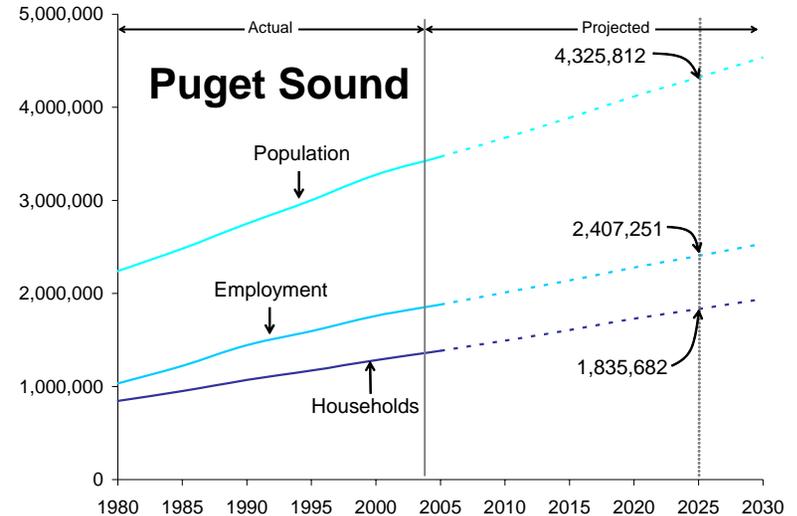
Percent of Throughput Lost Due to Delay on Puget Sound Freeways with Loop Detectors



During the peak period on I-405, congestion reduces the throughput of the 2 general purpose lanes in Renton to the capacity of one free-flowing lane.

How Will Future Growth Affect the Transportation System?

- Washington State will continue to grow at a rapid pace adding approximately 2 million people and 900,000 jobs by the year 2025.
- 69% of the population growth and 79% of the employment growth will occur in three major urban areas: Puget Sound, Spokane and Vancouver.



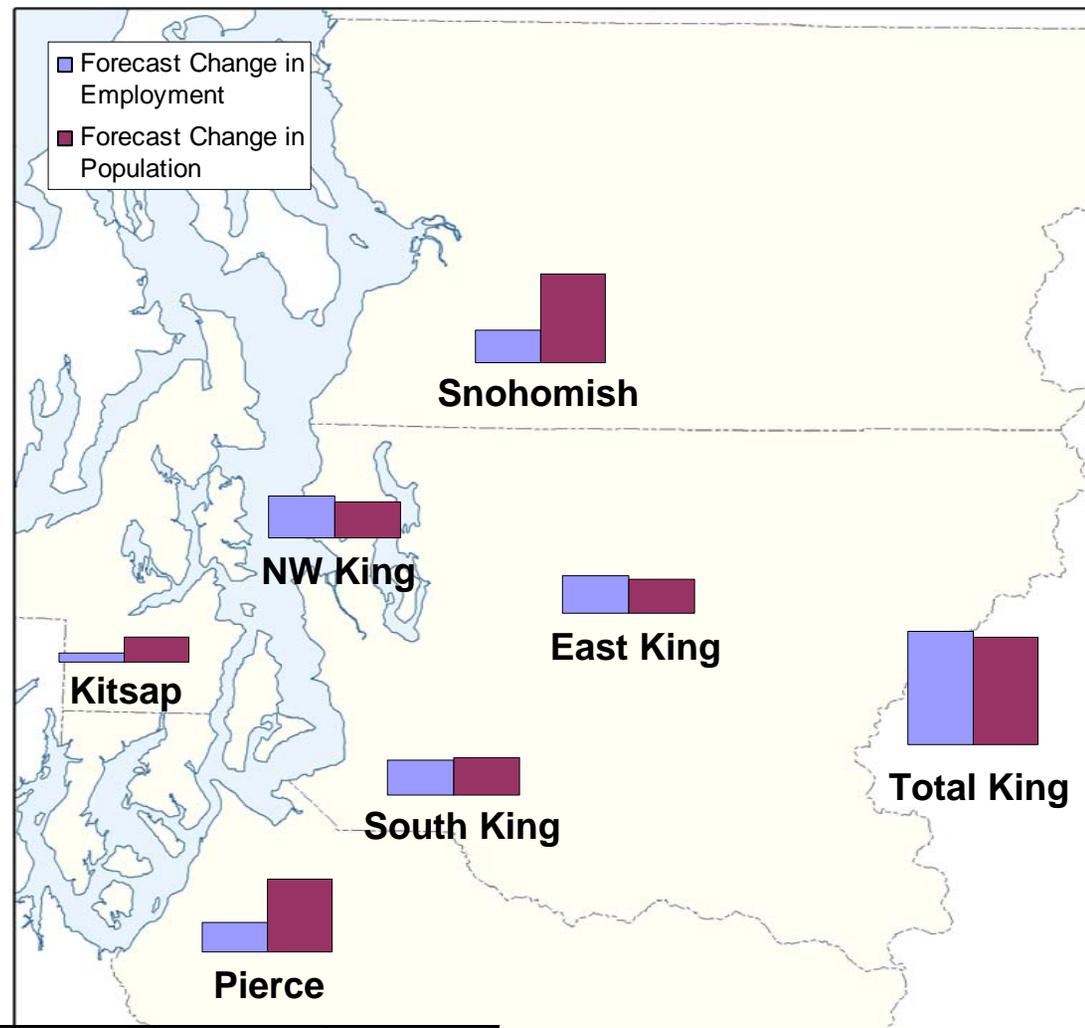
Sources: SRTC, PSRC, RTC, OFM, and WSDOT Data Library.

Puget Sound

Challenges:

Employment & Population: 2000 to 2025

- Strong residential growth will occur outside of King County
- The majority of the job growth will be in King County



	Forecast Change in Employment	Forecast Change in Population	2000 Estimated Employment	2025 Forecast Employment	2000 Estimated Population	2025 Forecast Population
King	405,269	383,889	1,188,577	1,593,846	1,737,034	2,120,923
East King	132,938	121,024	311,414	444,352	472,829	593,853
South King	123,759	133,979	320,866	444,625	623,713	757,692
NW King	148,572	128,886	556,297	704,869	640,492	769,378
Kitsap	31,751	88,744	83,934	115,685	231,969	320,713
Pierce	105,259	260,060	258,991	364,250	700,820	960,880
Snohomish	116,181	316,701	217,291	333,472	605,986	922,687
REGION TOTAL	658,460	1,049,394	1,748,793	2,407,253	3,275,809	4,325,203

What does this Growth Mean for Puget Sound Travel in the Future?

Dramatic increase in travel demand in Puget Sound:

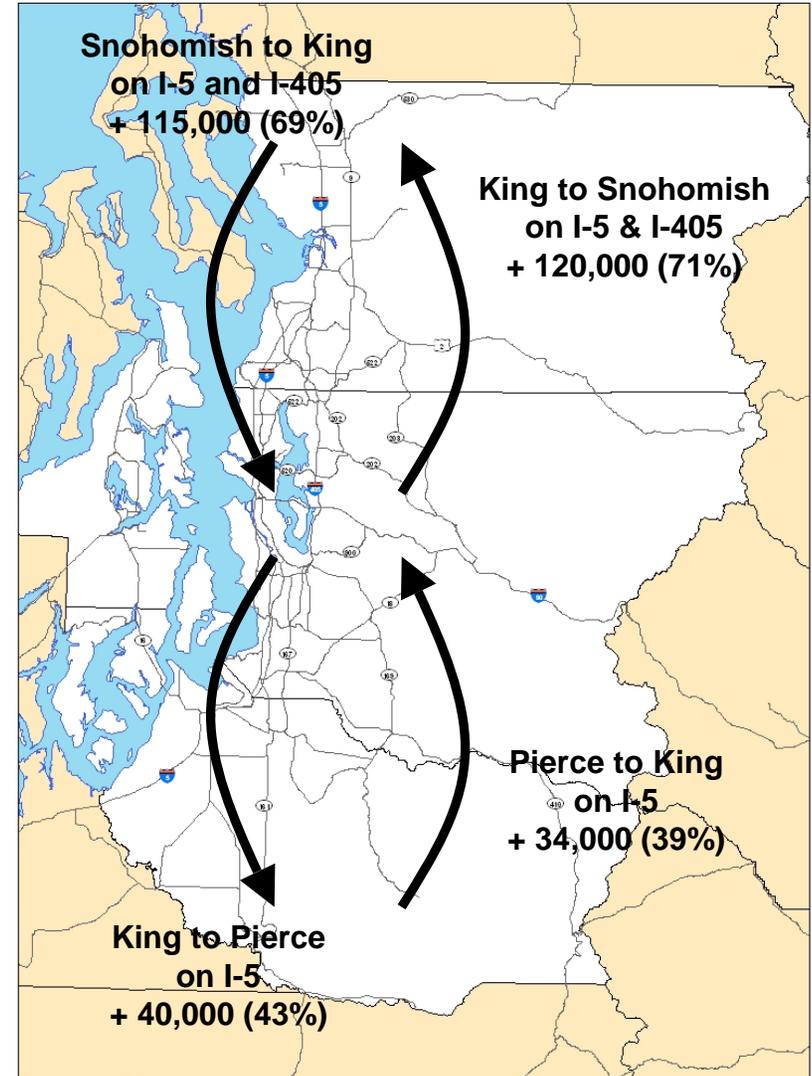
- Person trips will go up 48%, 12m to 18m/day.
- Vehicle miles traveled (VMT) will go up 50%, from 73 to 110 m miles.

Increase in the complexity of travel:

- More suburb to suburb travel. Travel to & from Snohomish County will increase 70%, East King Co up by 53%.

Within the UGA:

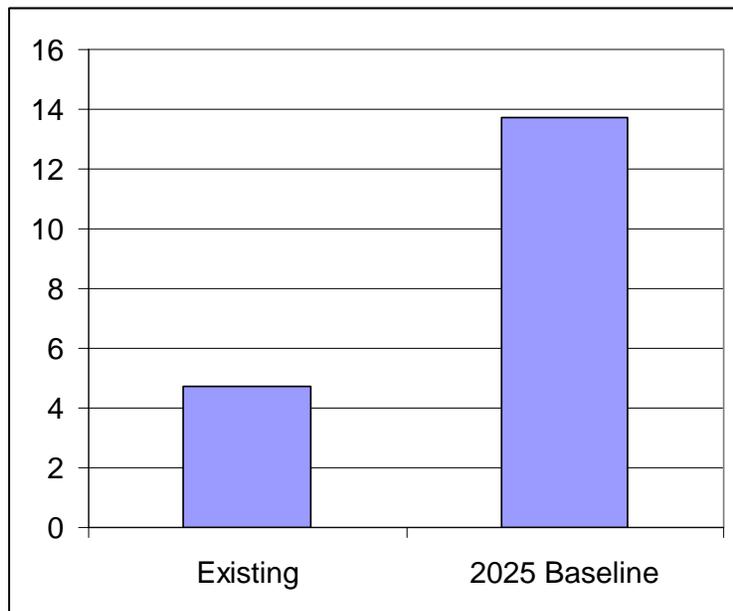
- 65% of employment trips will be to locations other than the 24 designated urban centers



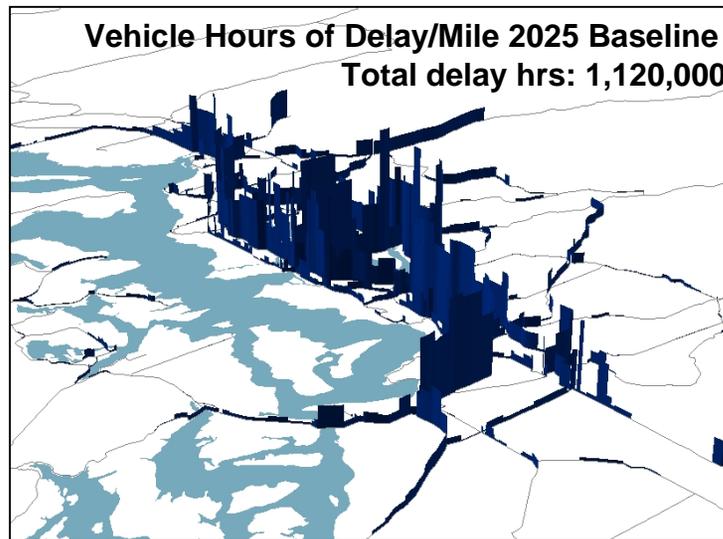
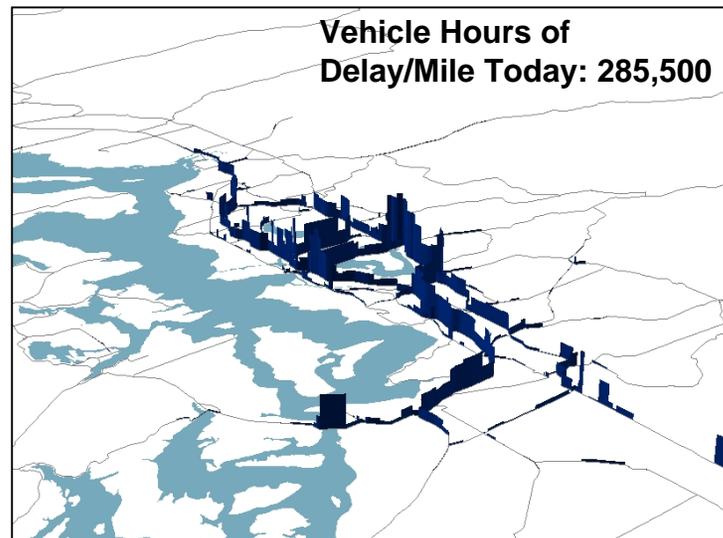
What Will Happen With Traffic Congestion?

In the Puget Sound, if major efficiency or capital investments are not made:

- Average delay per vehicle trip will increase from 5 minutes to 14 minutes in the pm peak period.
- Truck delays will increase by over 100,000 hours per day in 2025 (300% increase).

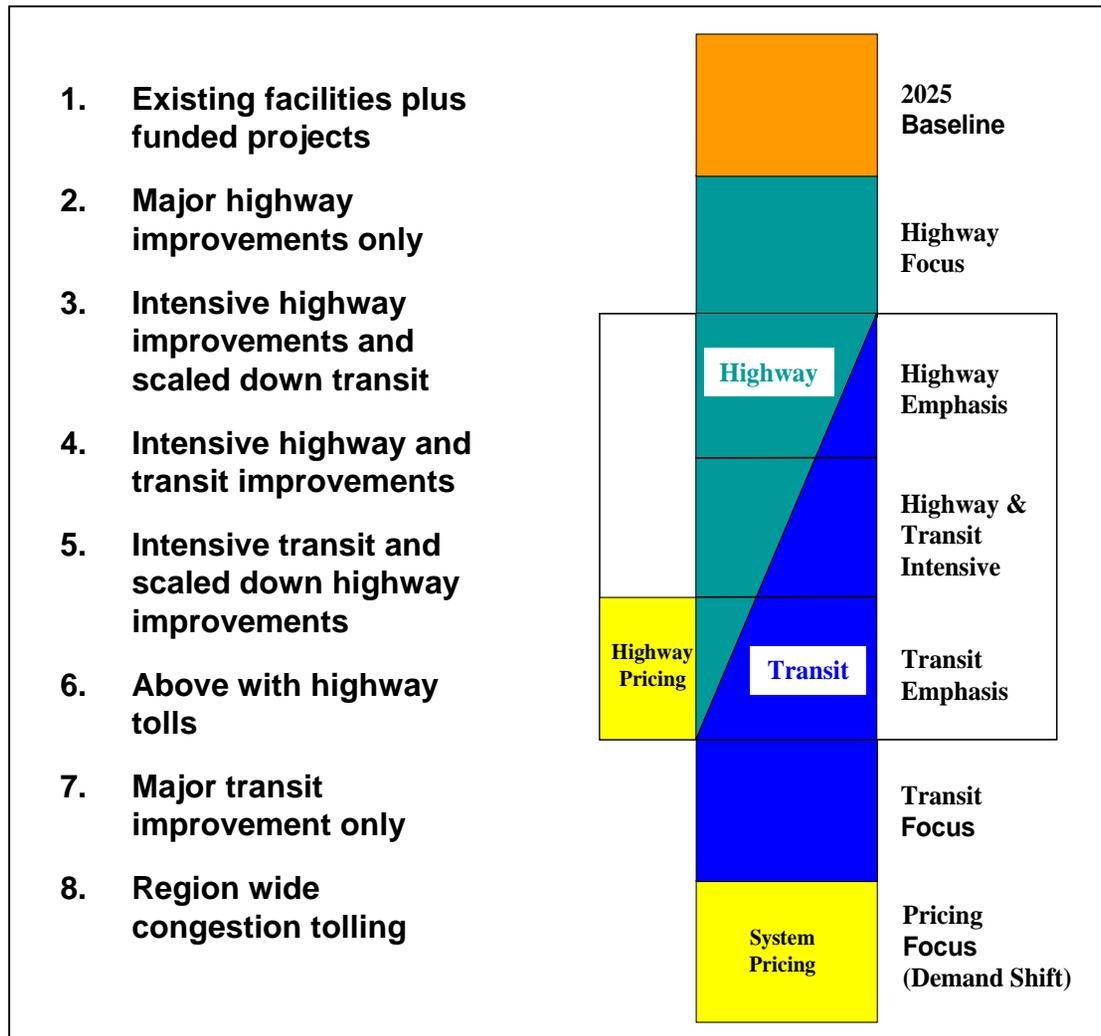


**PM Peak Period Delay
per Vehicle Trip (Minutes)**



What Are Some of the Investment Options to Accommodate the Growing Demand?

A range of scenarios were analyzed.



Puget Sound Analyzed Additional Scenarios:

- HOT lane network,
- Demand & System Management,
- I-5 parallel corridor.

Vancouver analyzed freeway tolling and TDM/TSM.

Can We Solve Congestion with Major Roadway Improvements?

Capacity Added in the Highway Focus Scenario

Urban Area	Freeway		Arterials		Total		Cost (\$Billions)
	Miles	% Increase	Miles	% Increase	Miles	% Increase	
Puget Sound	1,230	52%	730	7%	1,960	16%	\$80-104
Spokane	137	60%	382	25%	518	30%	\$6.8-8.9
Vancouver	100	45%	186	25%	286	29%	\$3.1-4.1

South King Co.

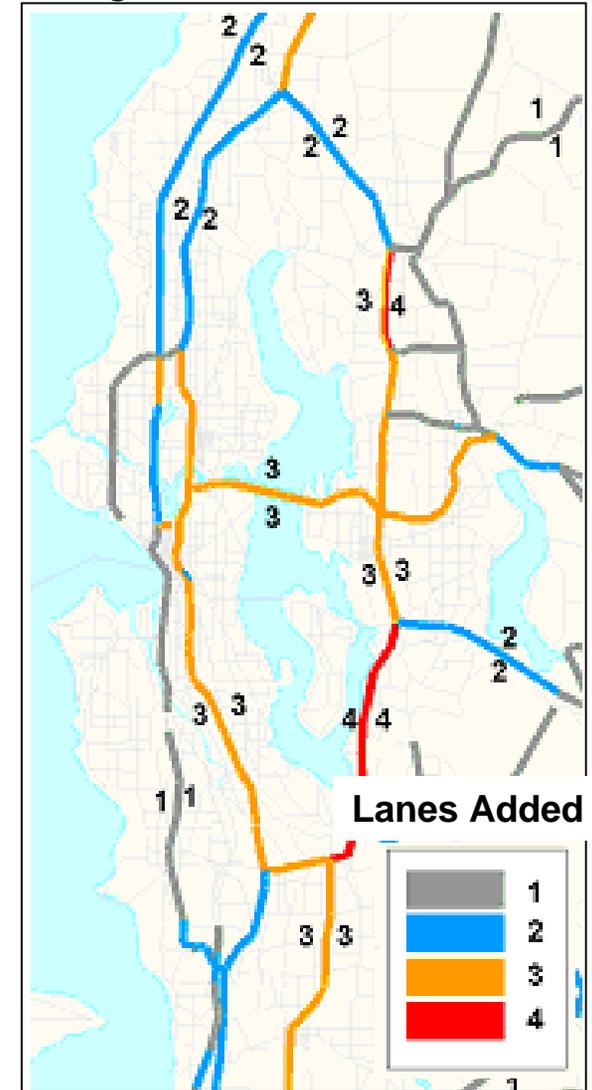
Corridors	Lanes Added/dir.
I-405	4
I-5	2
SR 99	2
SR 167	3
SR 509	1

Snohomish Co.

Corridors	Lanes Added/dir.
I-5	2
SR 99	2
I-405	2
US -2	1
SR 9	1

Adding 1,230 lane miles in the Puget Sound Region is equivalent to the lane miles on I-5 from Vancouver WA to Everett.

Puget Sound Sub Area



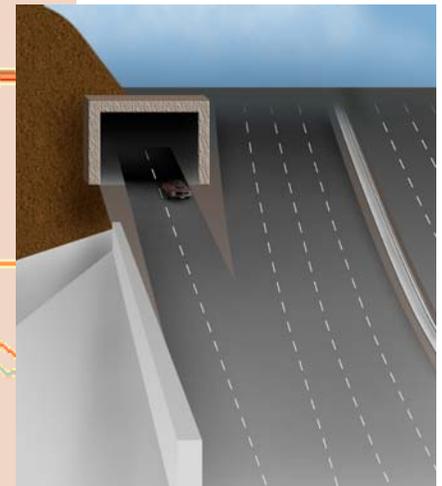
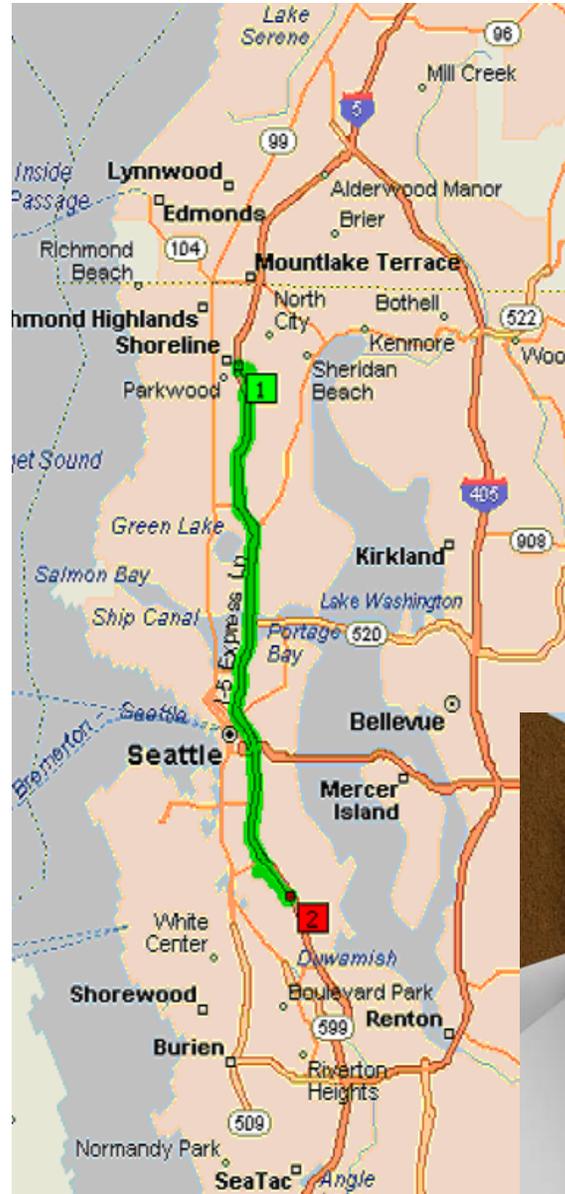
How Could a Larger Roadway Be Built Through Areas Like Downtown Seattle?

It is not easy or cheap:

Example: I-5 through Seattle

Building a tunnel would cause less impact and disruption to downtown business, but the cost to build the tunnel would be \$10-\$25 billion (if built today-2004 dollars) depending on the configuration.

For example a tunnel with 3 lanes each direction, it would cost over \$10 billion and would reduce congested hours from 10 hours/day to 7 hours/day in the year 2025. (8 hours currently)



Can We Solve Congestion with Major Transit Improvements?

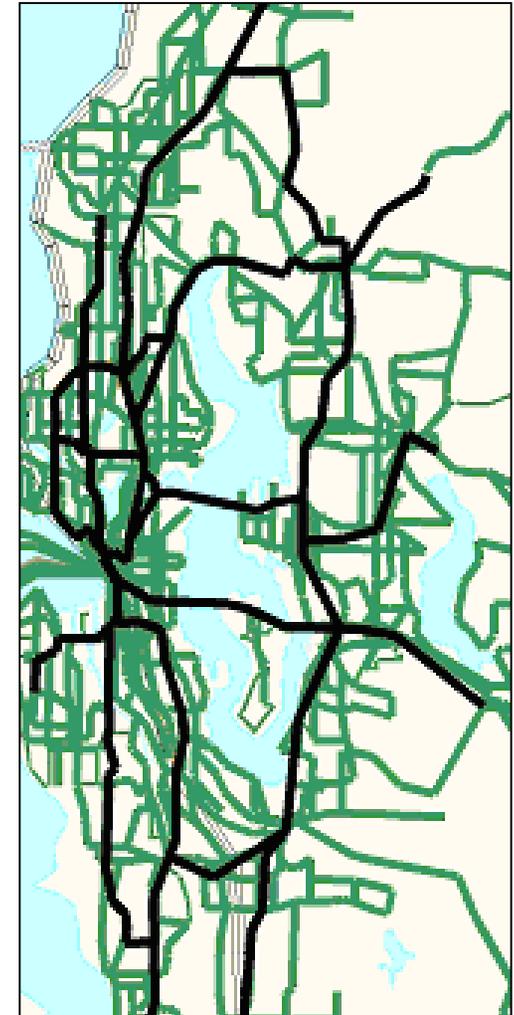
Services Added in the Transit Focus Scenario

	Puget Sound		Vancouver		Spokane	
	Units	% Increase	Units	% Increase	Units	% Increase
Daily Service Hours	26,000	104%	1,336	149%	1,750	38%
Miles of HCT	176	490%	21	N/A	31	N/A

Key service elements of network:

- All buses and HCT lines ran every 10 minutes or better in the peak period and 15 minutes or better in the off peak.
- In Puget Sound-3 times the service hours we currently have.
- New P & R lots were included at most HCT stations & express bus hubs outside of the urban core areas:
 - ✓ 57 new lots
 - ✓ 300 stalls/lot, or 17,000 total stalls.

Puget Sound Sub Area



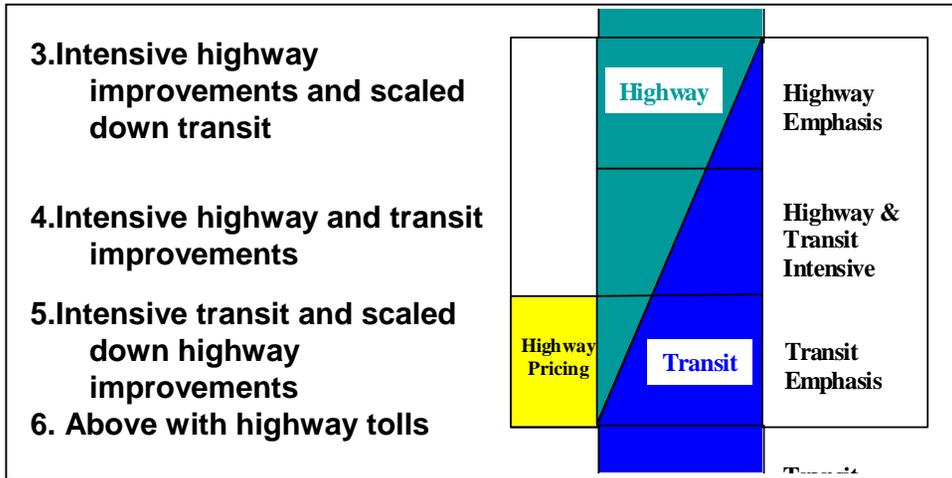
- HCT 10 min headway
- Bus \leq 10 min headway

Does Charging Tolls Reduce Congestion?

- The computer model was used to simulate variable pricing/tolls up to 50 cents per mile.
- The toll rates varied depending on the amount of congestion/delay in the system. The more congestion the higher the toll.
- Travelers patterns are assumed to change; use other routes, shift to transit or carpools, shorten trips, change their time of travel or eliminate some trips.
- There are implications related to social equity, public perception and economic vitality that have not been analyzed.
- Great caution should be taken in relying on conclusion from this analysis because of challenges presented to the computer modeling and the very uncertain ability to assess the cost and political acceptability of implementing the approaches.
- System wide pricing is estimated to cost about \$300 million dollars annually to implement.

How do Combinations of Strategies Perform?

Of the 7 scenarios modeled 4 involved combinations of strategies.



Transit Emphasis Scenario:

Example: I-5 Corridor in Seattle

- Adds 1 more lane/direction
- Adds HCT capacity (LRT and Monorail) Extensions
- Much lower cost than Highway Focus

Example: I-405 Scenario)

- Delay reduced significantly when 2 lanes per direction is added.
- Cost increased substantially when more than 2 highway lanes are added each direction, with marginally better congestion benefits

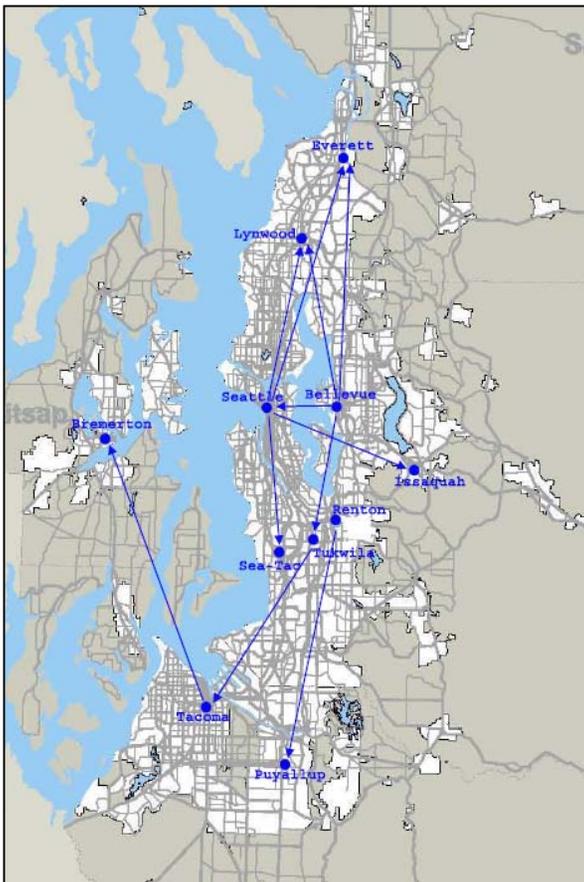
Freeway Lane Miles and Annual Bus Hour Equivalents in Each Scenario Tested

	Existing	2025 Baseline	Highway Focus	Transit Focus	Pricing Focus	Mixed: Highway and Transit Intensive	Mixed: Highway Emphasis	Mixed: Transit Emphasis (and with Pricing)
Freeway Lane Miles	2,320	2,360	3,590	2,360	2,360	3,370	3,370	2,970
Annual Bus Equivalent Revenue Hours	3,900,000	7,500,000	7,500,000	15,200,000	7,500,000	12,500,000	11,000,000	12,500,000

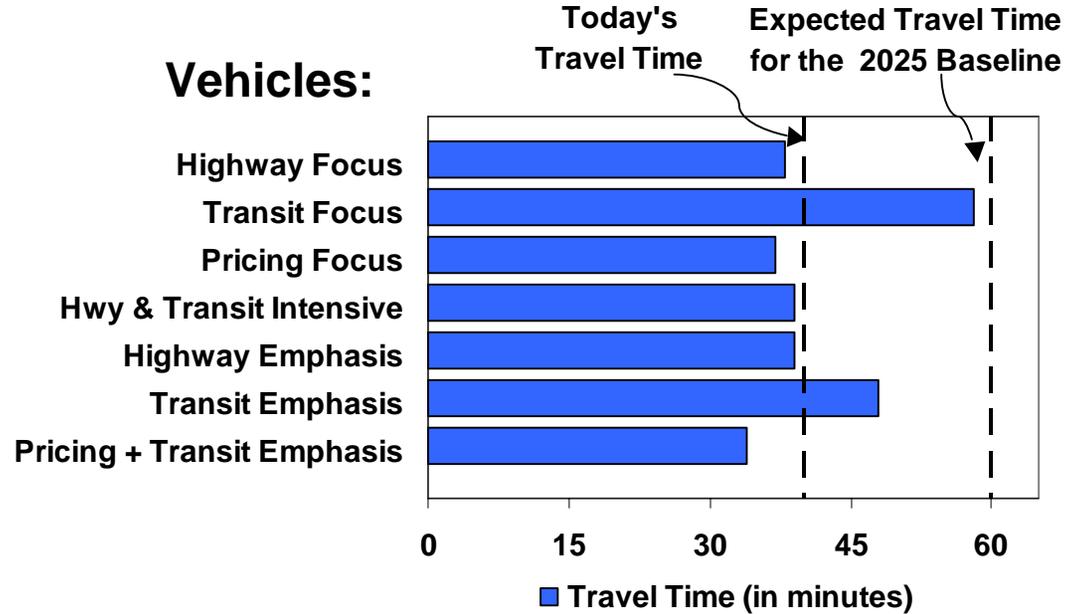
How do the Scenarios Compare?

Puget Sound – Average of Travel Time Changes for Selected Commutes

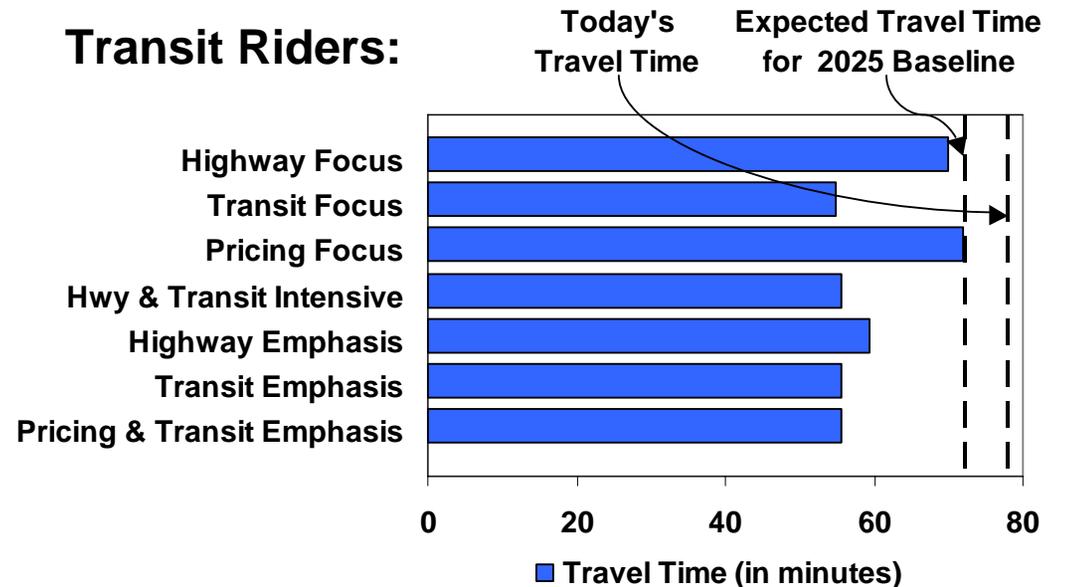
The study looked at the travel times for vehicles and transit riders using known commutes.



Vehicles:

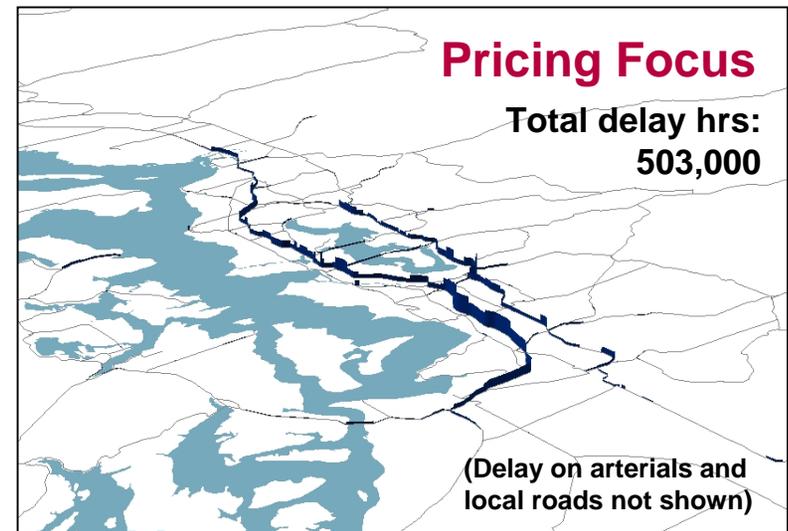
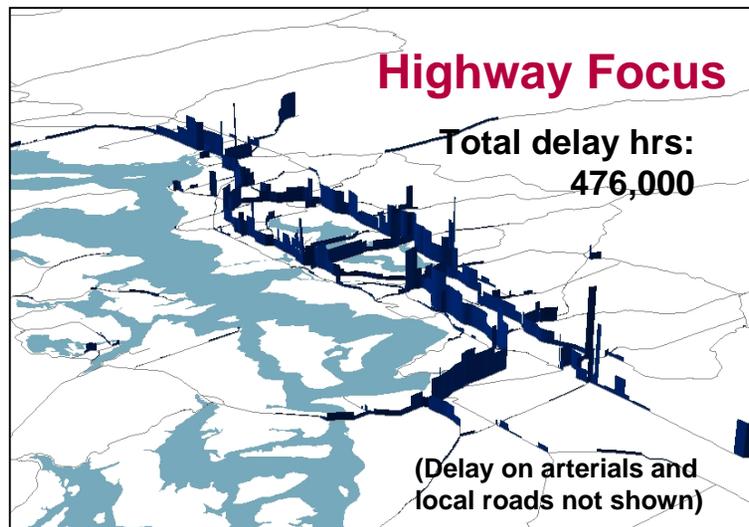
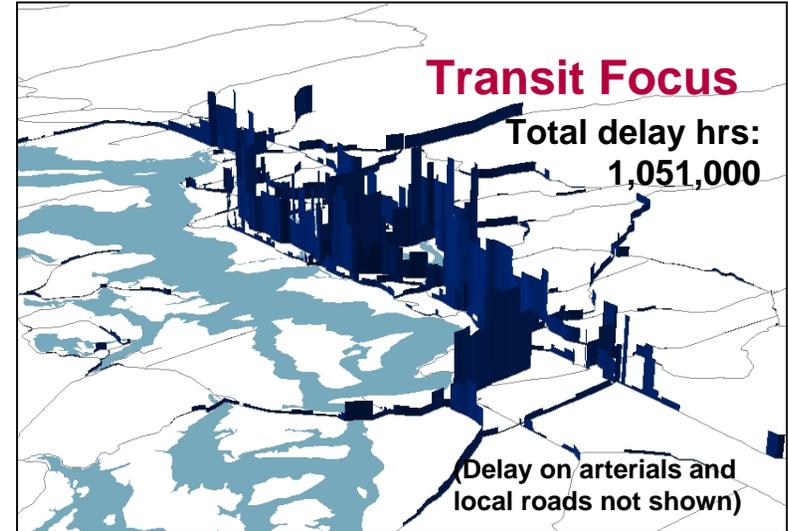
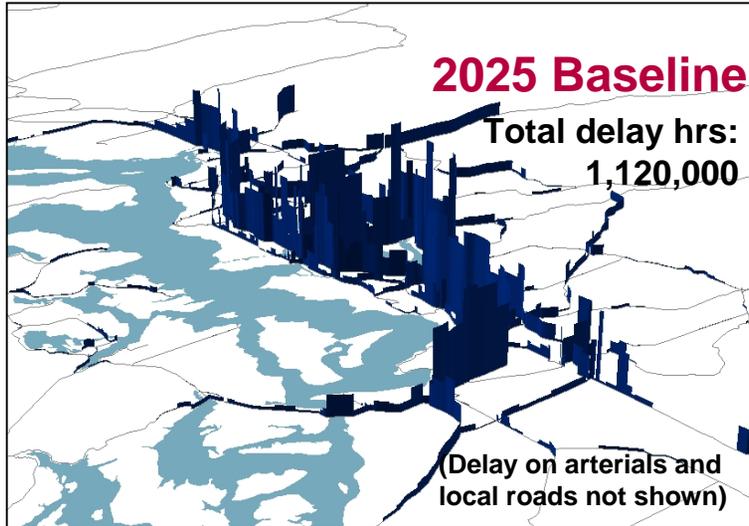


Transit Riders:



How Do They Perform?

Vehicle Hours of Delay Per Mile Comparison



What Are The Relative Cost and Benefits of The Scenarios?

Annual Thousand Person Hours of Delay Reduced per Million Dollars of Investment*

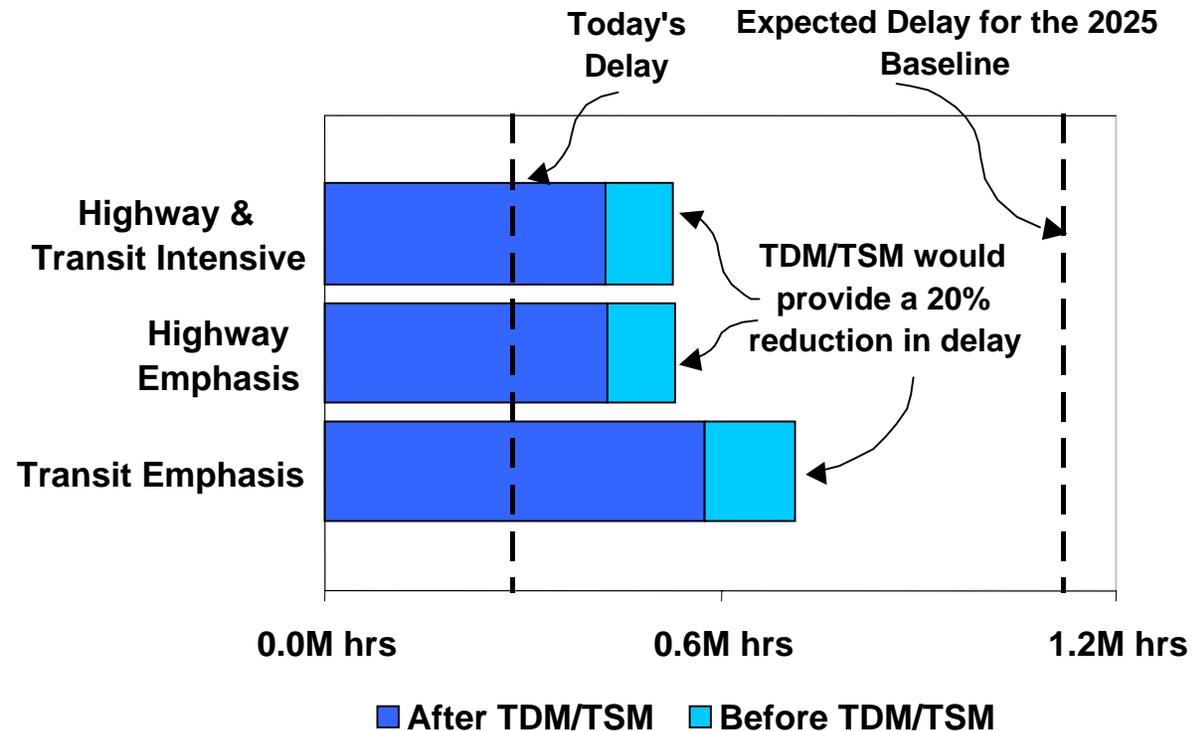
Adding pricing to the mixed transit and highway capacity investments increases highway efficiency and improves the cost-effectiveness of the same scenario without pricing.



*Pricing Focus Scenario (not shown) indicates much higher reductions per million dollars of investment—thousands of hours of reduced delay. Great caution should be taken in relying on this conclusion because of challenges presented to the computer modeling and the very uncertain ability to assess the cost and political acceptability of implementing the approaches.

Can Other Demand Management or Efficiency Improvements Reduce Congestion?

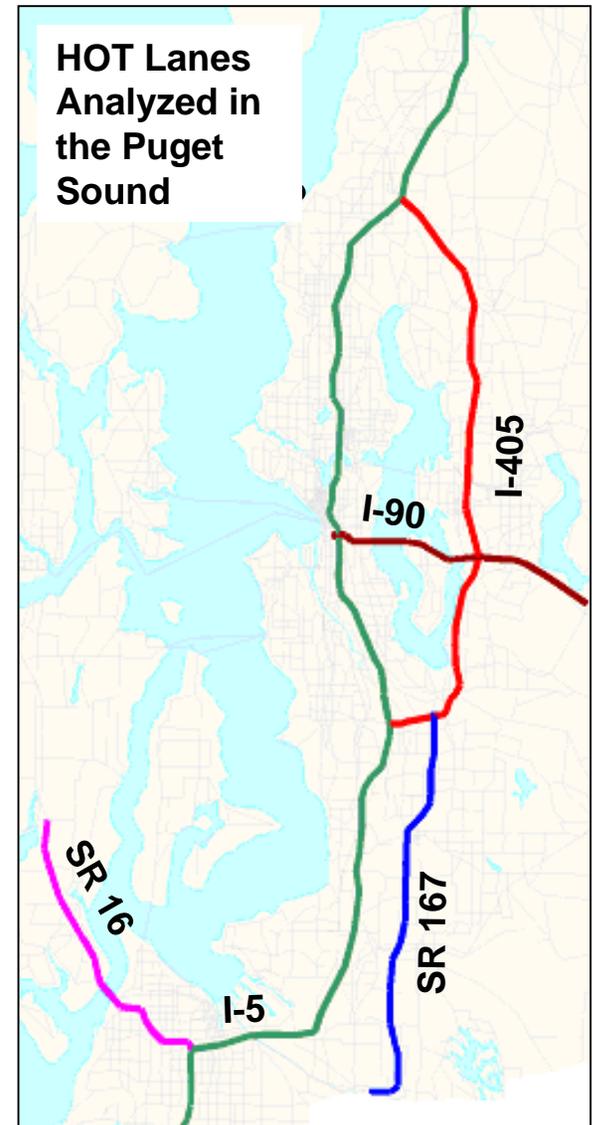
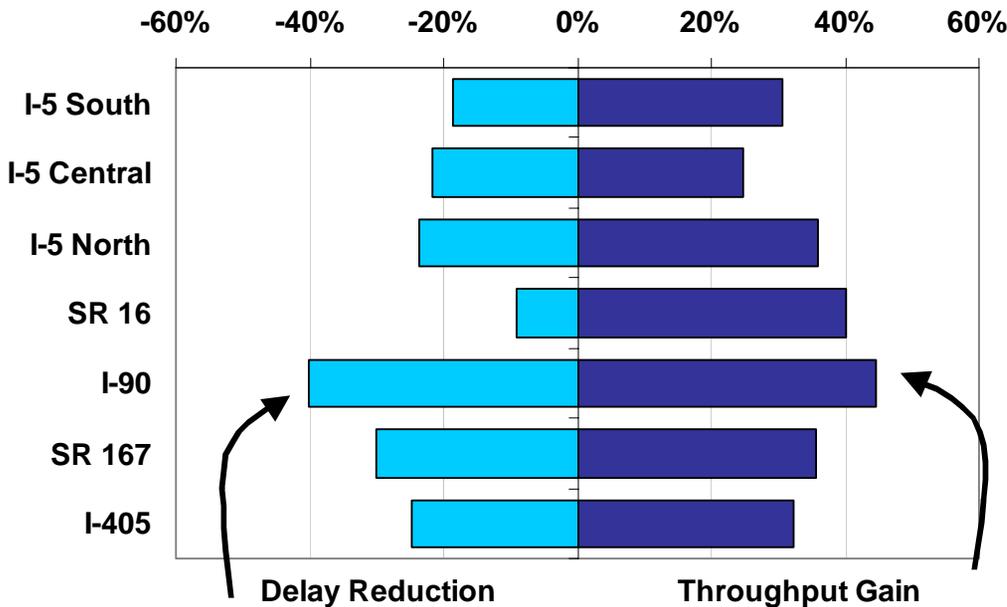
- Puget Sound and Vancouver analyses showed that Travel Demand Management (TDM) and Transportation System Management (TSM) help reduce congestion by using the existing system more efficiently.
- This would involve implementing a much more aggressive TDM program, such as parking pricing, flexible work schedule, telecommuting, etc. over and above those already in place.



High Occupancy Toll Lanes (HOT)

- A sketch analysis of a HOT lane network in the Central Puget Sound region.
 - ✓ added new HOT lane and
 - ✓ converted existing or planned HOV lane.
- The study indicated that HOT lanes not only reduces delay, but also makes system more efficient.

How a HOT Lane Network, in Addition to a Mixed Highway and Transit Improvement Scenario, Could Further Reduce Delay and Improve Throughput



Overall Findings

- **Growth will occur:**

The state will grow, without substantial transportation improvements, congestion will get much worse – total delay could increase threefold.

- **There is no single solution:**

- ✓ Adding major highway capacity is effective, but it's costs are high.
- ✓ Adding major transit service in heavily traveled corridors can serve more trips during peak periods, but it does little to relieve system wide congestion.
- ✓ Region wide tolling is very effective, but will be difficult to implement.
- ✓ Strategies must be tailored to the corridors, land uses and markets they serve.

Overall Findings (cont.)

- **Cost Effective Options Exist:**

Other work done by WSDOT indicates that strategically located corridor and bottleneck investments do have benefits that exceed the cost.

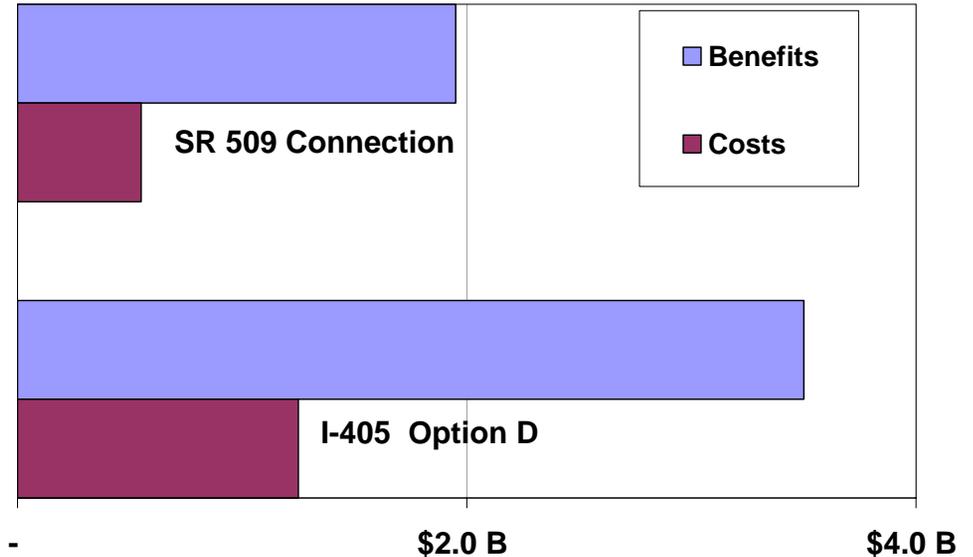
- **Pricing/Tolls:**

Targeted pricing/tolling shows as a very promising strategy for fighting the growing demand and capacity imbalance, especially when it is combined with capacity improvements (transit and/or roadway) and needs to be more fully explored.

- **TSM/TDM:**

Travel demand and system management opportunities offer considerable promise in reducing delay with relatively low costs.

Examples of Benefit Cost Comparison: SR 509 Connection and I-405 Projects



Recently completed economic analysis of the SR 509 connection and I-405 bottlenecks projects indicated that carefully selected corridor and targeted bottleneck investments can yield benefits that far exceed the project costs.

Next Steps:

1. Complete Phase 1 and finalize the reports for Vancouver and Spokane in March.
2. Start central Puget Sound Phase 2 February, including the following two important components:
 - Improve the regional models to better reflect peak spreading and mode shift in responding to changes in policy (i.e., pricing) and/or transportation supply.
 - Develop and analyze two to three additional transportation scenarios, focusing on evaluating pricing and managed lanes.