Oregon Transportation Plan Policy Analysis

report

prepared for

Oregon Department of Transportation, Transportation Development Division

prepared by

Cambridge Systematics, Inc.

with

HDR, Inc.

June 2005

www.camsys.com

report

Oregon Transportation Plan Policy Analysis

prepared for

Oregon Department of Transportation,
Transportation Development Division

prepared by

Cambridge Systematics, Inc.
555 12th Street, Suite 1600
Oakland, California 94607

date

June 2005

Table of Contents

List of Tables

List of Figures

List of Figures
(continued)

1.0 Introduction

This report presents the results of the policy analysis conducted for the Oregon Transportation Plan (OTP) update. The introduction summarizes the scenarios analyzed and performance criteria used to evaluate alternatives.

1.1 Scenarios

Seven individual scenarios were analyzed as part of the OTP. They are grouped into the following three types:

1. The **reference scenario** to which all other scenarios are compared;
2. **Sensitivity scenarios** that measure the impact of external changes on OTP performance criteria; and
3. **Policy scenarios** that measure the impact of several potential policy changes on OTP performance criteria.

Each of these three types is described in more detail below.

Reference Scenario

The reference scenario provides the basis for all comparisons. This scenario presents a proposed funding level that allows the state to maintain its current purchasing power and continue to make investments following the priorities laid out in the 1992 OTP. Maintaining purchasing power requires additional funding raised either from existing or new sources. For the purposes of the reference scenario, the OTP used the assumptions from the coordinated ODOT and metropolitan planning organization (MPO) forecast, which include the following:

- The equivalent of a $0.01 annual increase in the state gas tax, beginning in 2006. These additional funds would be dedicated to operations, maintenance, and preservation activities.
- The equivalent of a $15.00 increase in the state vehicle license fee in 2010 and every eight years to 2030. These funds would be available for modernization activities.

Sensitivity Scenarios

Two sensitivity scenarios were analyzed to understand the impact of external economic and policy changes on the behavior of Oregonians and the sensitivity of the analyses. Two types of externalities were considered:

1. **High fuel price** investigates the impact of increases in fuel prices; and

2. **Relaxed land use** investigates the impact of increased availability of land for development across urban fringe and rural areas.

Policy Scenarios

Four policy scenarios were identified to help the OTP Steering Committee make informed decisions as they relate to funding levels, program priorities, and related issues. The four policy scenarios include the following:

1. **Flat funding** assumes that funding levels remain roughly at current levels, leading to an overall decline in purchasing power due to inflation;

2. **Maximum operations** assumes that operational improvements (including highway operational investments made by ODOT and enhanced transit services made by local and regional agencies) will be made at the expense of capacity expansion attempting to make up the difference through technology;

3. **Major projects** assumes that ODOT and other agencies will be able to raise enough funding to meet many of the feasible needs for all transportation modes across the state; and

4. **Pricing** investigates the impact of road pricing strategies in Oregon, primarily focused on the I-5 and I-205 corridor between Eugene and the Oregon/Washington border.

1.2 Performance Criteria

The evaluation of the scenarios for the OTP was based on a set of performance criteria established by the OTP Steering Committee that are intended to address all facets of transportation. The performance criteria are described in detail in the *Performance Measures and Analysis Methodologies Technical Memorandum* produced for the OTP. Eight criteria were identified to support the OTP analysis:

1. **Mobility and accessibility** are defined as reaching desired destinations with relative ease within a reasonable time, at a reasonable cost, and with reasonable choices. These include access to regional, national, and international markets, as well as within a

community. Mobility means an ability to move people and goods to their destinations quickly.

2. **Economic vitality** means a diversified and competitive regional economy with healthy and efficient markets and potential for long-term economic growth. This includes the efficient and competitive movement of people, goods, and ideas.

3. **Effectiveness and efficiency** are defined as maximizing the current and future public and private transportation investments over time, reaching the right target, use of lower cost alternatives, optimal utilization, and system integration.

4. **Equity** is defined as distributing benefits and burdens fairly; consideration of the benefits afforded to and costs borne by all social, economic, and geographic groups of people.

5. **Public support for system and financial feasibility** are defined as Oregonians agreeing with the policy direction; providing for the planning, development, operation, and maintenance of the transportation system; and/or supporting adequate funding.

6. **Reliable and responsive** are defined as providing dependable levels of service by mode within established expectations, and having flexibility or ability to react appropriately.

7. **Safety** is defined as reducing the risk of death, injury, or property loss.

8. **Sustainable** is defined as a transportation system that meets present needs without compromising the ability of future generations to meet their needs. It is operated, maintained, and improved on the basis of positively affecting both the natural and built environments.

1.3 Organization of the Report

The remainder of this report provides the evaluations conducted for each of the alternatives. Section 2.0 summarizes the reference scenario, providing a relatively detailed examination of the likely expected future conditions by performance criteria. Section 3.0 presents the results of the sensitivity scenarios, focusing on a few key metrics that demonstrate the key findings of these analyses. Section 4.0 presents the findings from each of the policy scenarios, again focusing on the key findings and lessons learned from the policy choices that are implied in each scenario.

2.0 Reference Scenario

The reference scenario provides the baseline data to which all other scenarios (sensitivity and policy) are compared. This section presents the results of the reference scenario, with a focus on the likely changes in each of the key performance criteria over time. This section summarizes these changes by mode for each of the performance criteria, and includes detail for many of the performance measures used for the OTP. Sections 3.0 and 4.0 present the differences between the reference scenario and the sensitivity and policy scenarios.

2.1 Summary of Reference Scenario Results

Table 2.1 presents an overview of the expected changes over time in each of the performance criteria for major transportation modes in Oregon. Transportation modes that are relatively self supporting, like aviation, are expected to look relatively similar in the future as they do today. Modes like rail, which has a major existing bottleneck in the Portland area and no funded solution, are expected to see declines across the board. For passenger transportation, the increased investment will work to keep the system functioning in much the same way it does today. These impacts are described in more detail below.

Table 2.1 Reference Scenario Impacts Over Time by Mode

Performance Criteria	Passenger Surface Transportation	Trucking	Rail Freight	Aviation	Ports
Mobility	▼	▬	▼	▬	▼
Accessibility	▬	▼	▬	▬	▼
Economic Vitality	▲		▼	▬	▼
Effectiveness & Efficiency	▬	▲*	▼	▬	▬
Reliable	▬	▬			
Equity	▬	▬	▬	▬	▼
Safety	▬	▬	▼		
Sustainability	▬		▼	▬	▼
Public Support & Financial Feasibility	▬	▬			

▲Improves over time; ▬ No change over time; and ▼Worsens over time.
* Based on a measure of VMT per ton.

■ 2.2 Surface Transportation

Surface transportation includes passenger automobile and transit modes and freight transportation. The primary analysis tool used to assess the performance criteria for passenger surface transportation is the Oregon Statewide Model, an integrated transportation, land use, and economic model for use in transportation planning and policy analyses at the regional and statewide levels. The model provides estimates of the system level impact of transportation investments, as opposed to the local impact. For example, the model will provide a reasonable estimate of shifts in travel time patterns in the state or a region. It will not provide a reasonable estimate of how travel time will change in a particular corridor.

Some of the key inputs to the statewide model include:

- **Land use data –** Estimates of land available for production or residential development.

- **Economic and population growth –** Forecasts of future expected growth in population and employment. These are a starting point for the model and will vary from the inputs based on the model's estimation of the relative productivity of the Oregon economy.

- **Trade relationships –** An input-output model describes trade relationships in the model area. The amount that each sector consumes from each other as a proportion of its total production does not change. As the model estimates economic changes, the economic growth must balance against these relationships.

- **Future transportation system –** The transport portion of model uses a network file that describes the existing road and transit system. This file is varied based on the projects that are proposed as part of a particular scenario.

As described above, the statewide model estimates system-level impacts. Many of the projects identified as part of the OTP analysis are focused on local issues and cannot be seen at the state level. For example, an interchange improvement may significantly reduce local delay, but never be seen when evaluating delay on the state system. Table 2.2 presents the distribution of modernization funding from the current State Transportation Improvement Program (STIP) for several categories. Notably, only the last row "widening and new roads" has the potential to impact the statewide model, and only some of these projects will impact the model. Road widening projects that add a center turn lane, for example, cannot be evaluated via the statewide model.

Table 2.2 Distribution of 2004-2007 STIP Modernization Funds by Category

	Modernization Funds	
STIP Projects	**($)**	**(%)**
Interchanges	$279,100,000	17%
Intersections	$132,800,000	8%
Street improvements	$34,600,000	2%
Realignment, geometrics	$237,200,000	14%
Other (reserves, studies)	$216,600,000	13%
Widening, new roads	$742,400,000	45%

The reference scenario also assumes several transit investments, primarily in the Portland and Eugene-Springfield metropolitan areas. The statewide model includes intercity bus and rail, light rail and commuter rail in Portland, bus rapid transit in Eugene-Springfield, and local bus service in all metropolitan areas.

The remainder of this section describes the reference scenario impacts for surface transportation by performance criteria.

Mobility and Accessibility

Several performance measures assess the impact of mobility and accessibility, including total travel time, travel time by trip purpose, transportation cost, and others. Overall, in the reference scenario travel time is increasing across the state (Figure 2.1). The fastest increase is occurring in Region 1. Region 3 actually shows some slight (though not significant) decline in travel time over time. This decline is a function of the growth of Region 3. This will be shown in more detail below.

For freight movements, there are no significant change in travel time. Because truck movements tend to be spread throughout the day, they are less impacted by peak congestion. To some extent, freight activity may be shifting over time towards existing economic centers (such as Portland), increasing the number of shorter-distance freight trips relative to the number of interregional freight trips. It is also important to note that this analysis only looks at intrastate truck travel.

Figure 2.1 Travel Time Per Commute Trip

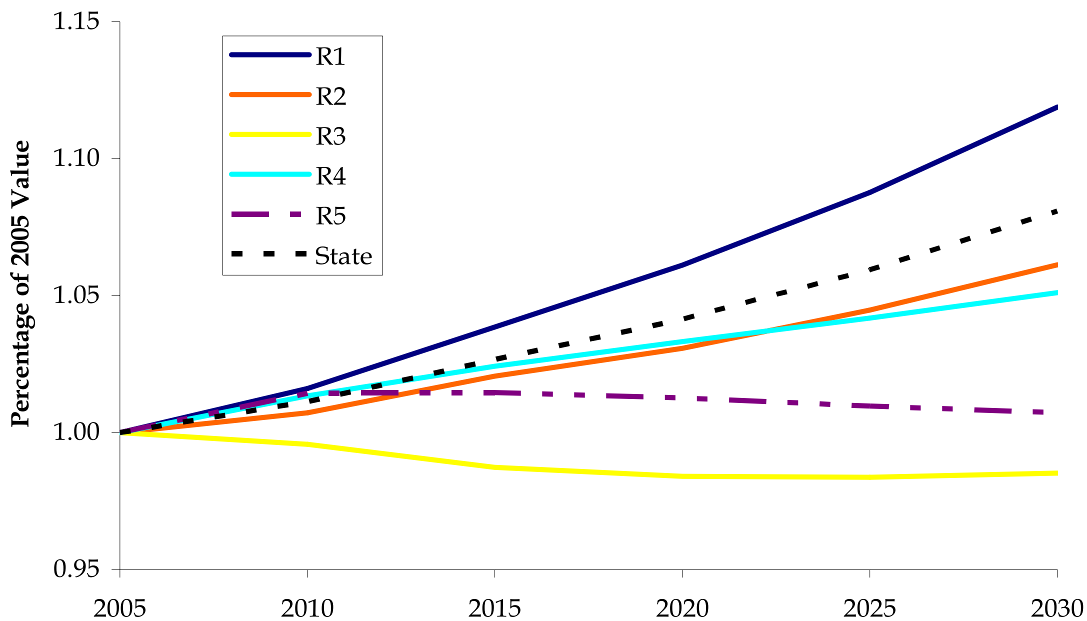
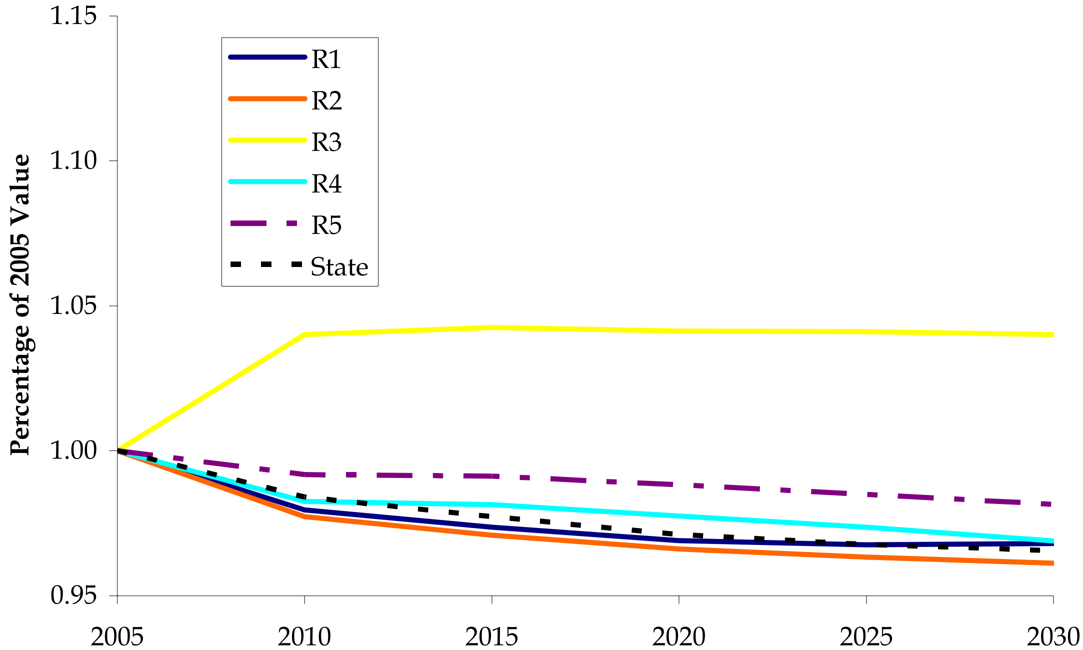


Figure 2.2 Travel Time Per Truck Trip



Economic Vitality

The economic vitality performance criteria assess the growth of the economy, as well as the accessibility of workers to employment. For the reference scenario, economic growth is based on the Oregon Office of Economic Analysis forecast (Figure 2.3). The state as a whole is expected to see over 30 percent economic growth over the timeframe of the plan. Regions 3 and 5 are growing at the fastest rate, though both of these regions and Region 4 start with a much smaller economic base than Regions 1 and 2. In Region 3, in particular, this growth reflects a shift to a stronger local economy, as noted in the shorter commute times described in mobility. The growth of Region 2 leads to some shifting travel patterns between Regions 1 and 2, described in more detail below.

In addition, the density of employment opportunities is growing faster than travel delay. Across all regions, more workers are accessible to employers than they were in the base year (Figure 2.4). Again, Regions 3 and 5 show the greatest increase in the accessibility of workers to their jobs, reflecting the increased efficiency of the local economy. Although Region 1 shows the slowest growth of any region, it is important to note that it also starts with the largest base.

Figure 2.3 Gross Product

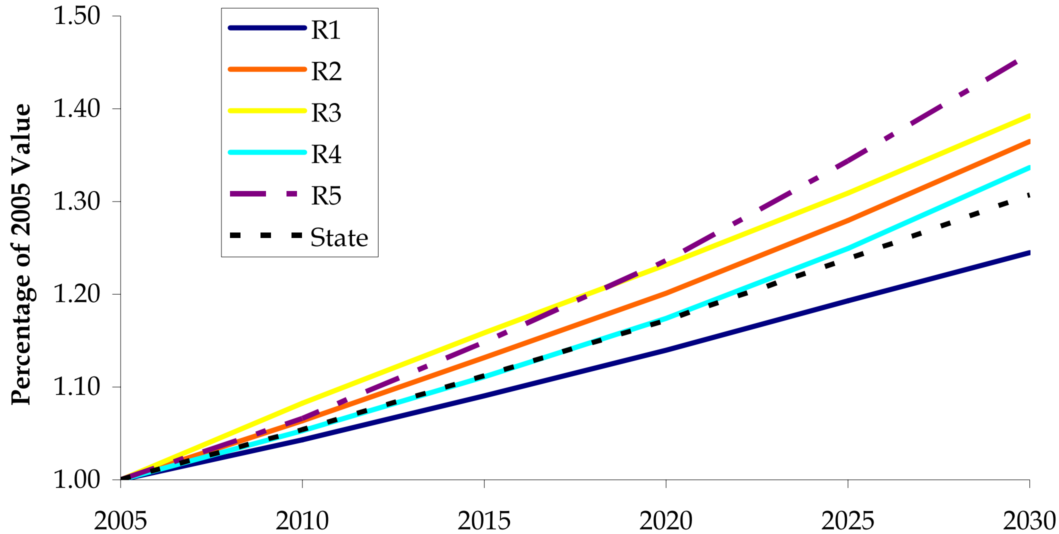
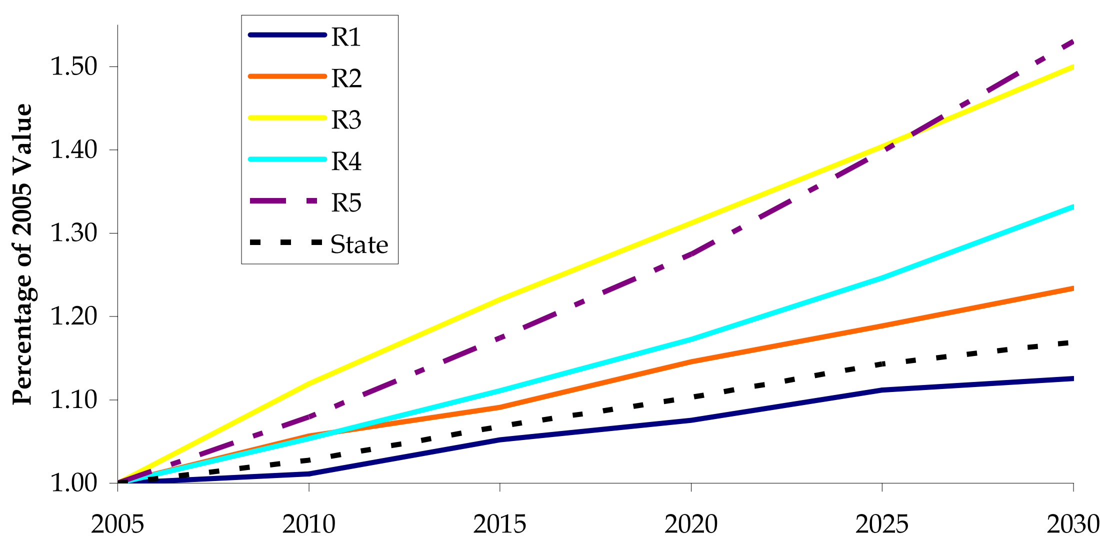


Figure 2.4 Workers Within 30 Minutes of an Average Job



Effectiveness and Efficiency

The primary measure of efficiency used is average trip distance. Figure 2.5 presents the average trip distance by region across the timeframe of the OTP. Although several regions show slight increases in the length of trips, Regions 2 and 3 actually show a decline in trip distance. This decline reflects the growth of these areas and an increase in shorter-distance trips for commuting. Region 2's relationship with Region 1 is shifting, with Region 2 attracting additional employment faster than Region 1 and becoming more self sufficient as an economic region. As noted above, Region 3 is also developing into more of an economic center. Region 5, which shows substantial economic growth relative to its base, has slightly increased trip distances.

Figure 2.6 presents the average trip distance per trip for auto traffic and per ton for truck traffic. On average, trip distances for autos remain unchanged over time. Over time, the average ton-miles of travel for trucks is expected to decline. Shorter truck trips suggest that freight activity is concentrating or growing faster in existing urban areas relative to other parts of the state. Although VMT per ton is decreasing, the cost per VMT is increasing due to increased congestion.

Figure 2.5 Average Trip Distance

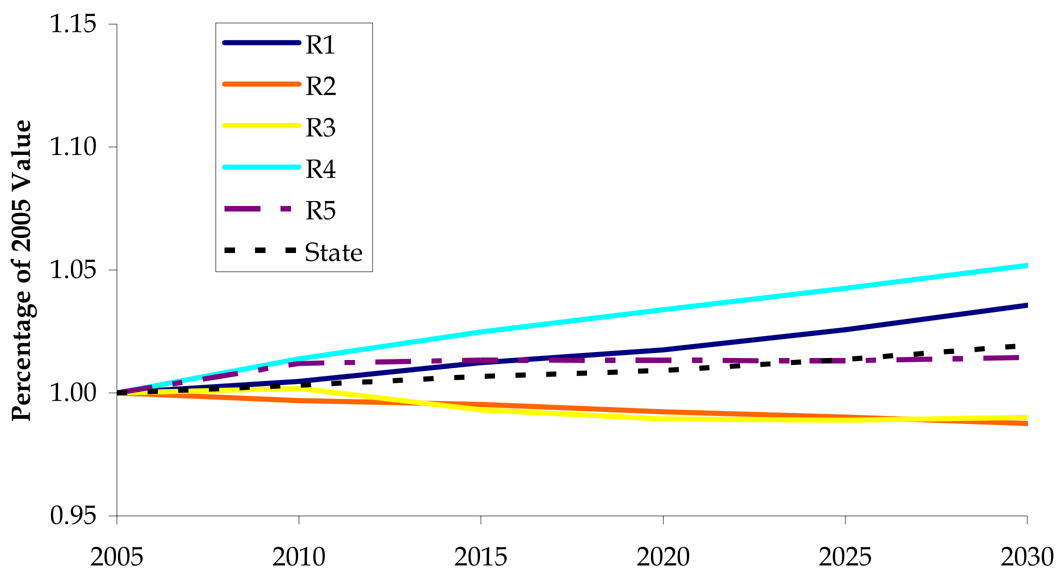
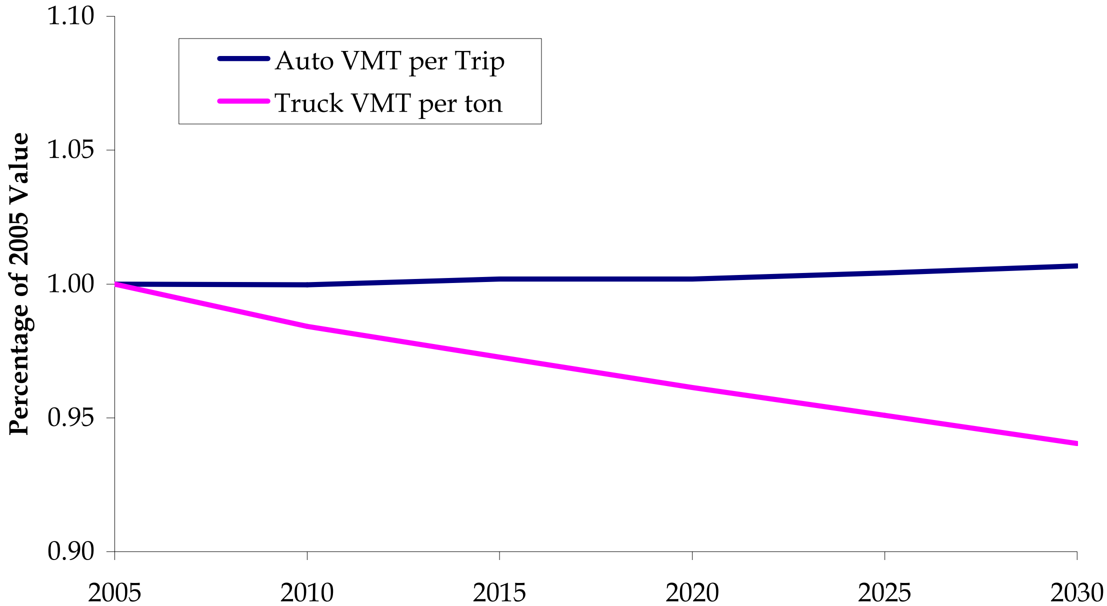


Figure 2.6 Statewide Average Trip Distance, Autos and Trucks

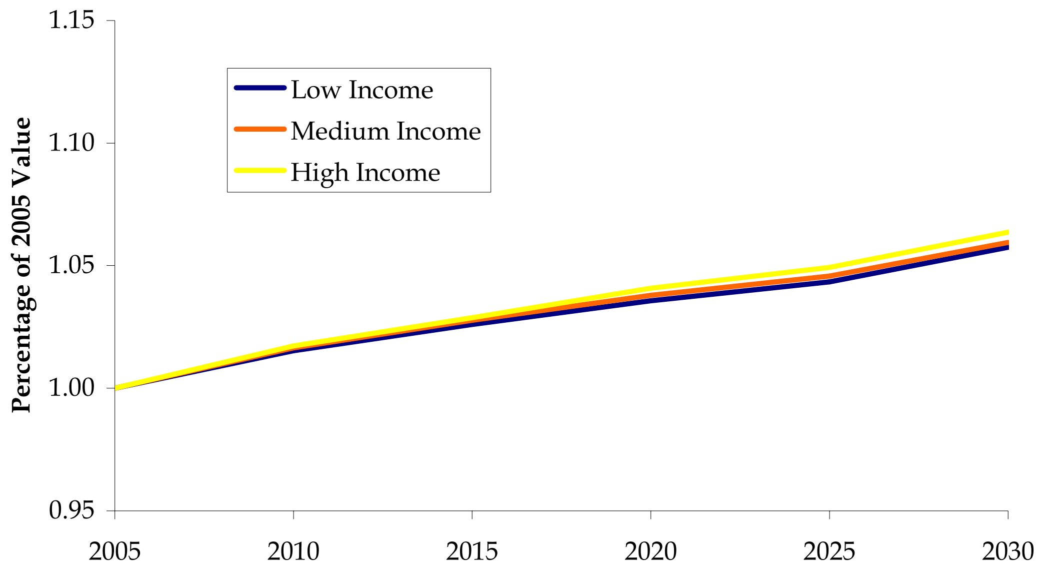


Equity

Average cost per trip by income group is used to measure the equity of transportation investments proposed as part of the reference scenario. In this analysis, travel cost is comprised of several components, including out-of-pocket costs such as maintenance and fuel, as well as the value of time for travelers. The statewide model places households into three income groups – low, medium, and high, using payroll and wage data from the Oregon Employment Department for 1990. Commute trips are categorized by income groups and evaluated for this analysis.

Figure 2.7 presents the change in the cost of transportation for commute trips by the three income groups. Although all three income groups' costs track closely with one another, they start from different bases. Low income groups tend to spend a substantially larger percentage of their income on transportation than medium- and high-income groups – roughly double what high-income households spend on transportation.

Figure 2.7 Transportation Cost as a Percent of Income: Commute Trips



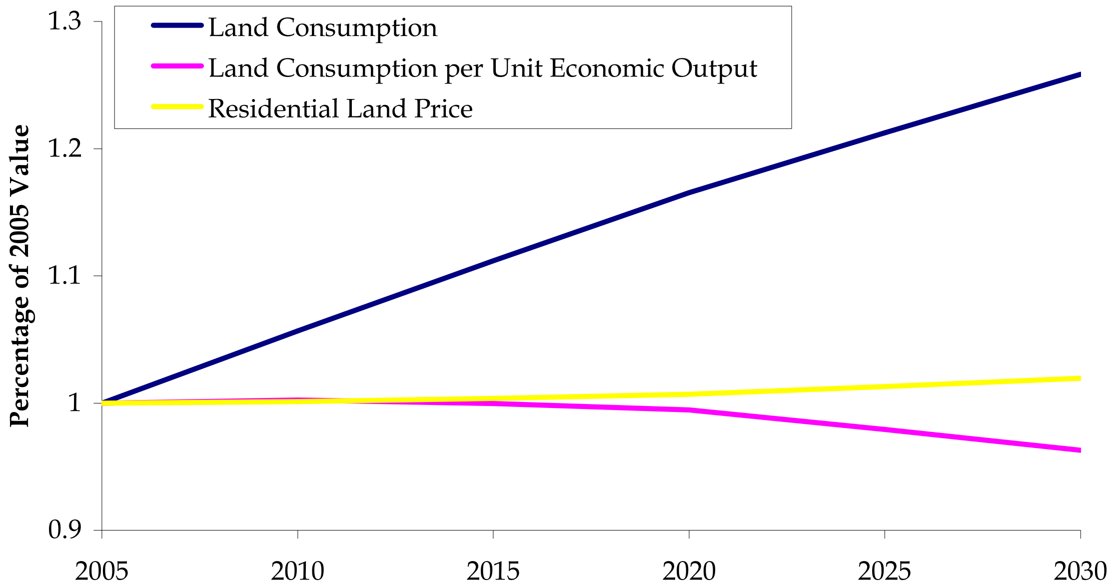
Sustainable

The Oregon model is a combined land use, economic, and transportation model. As such, it estimates the relationship between land use, transportation investments, and the Oregon economy. The sustainability performance measures help describe these relationships. Figure 2.8 presents the statewide change over time for the following three key measures:

1. Total land consumed;
2. Land consumption per unit of economic output (i.e., land used to produce a dollar of goods or services); and
3. Cost of land.

Land consumption will grow over the timeframe of the plan, a natural result of increased population and economic growth. The key measures of sustainability are land consumption relative to economic output and the cost of land. Businesses are expected to use land more efficiently and get more production out of the same amount of land. The cost of land will increase in real terms over time. This suggests that economic activities are concentrating, or that the growth occurs with equal or greater density than current development. This pattern is fairly consistent across the state.

Figure 2.8 Statewide Sustainability Measures



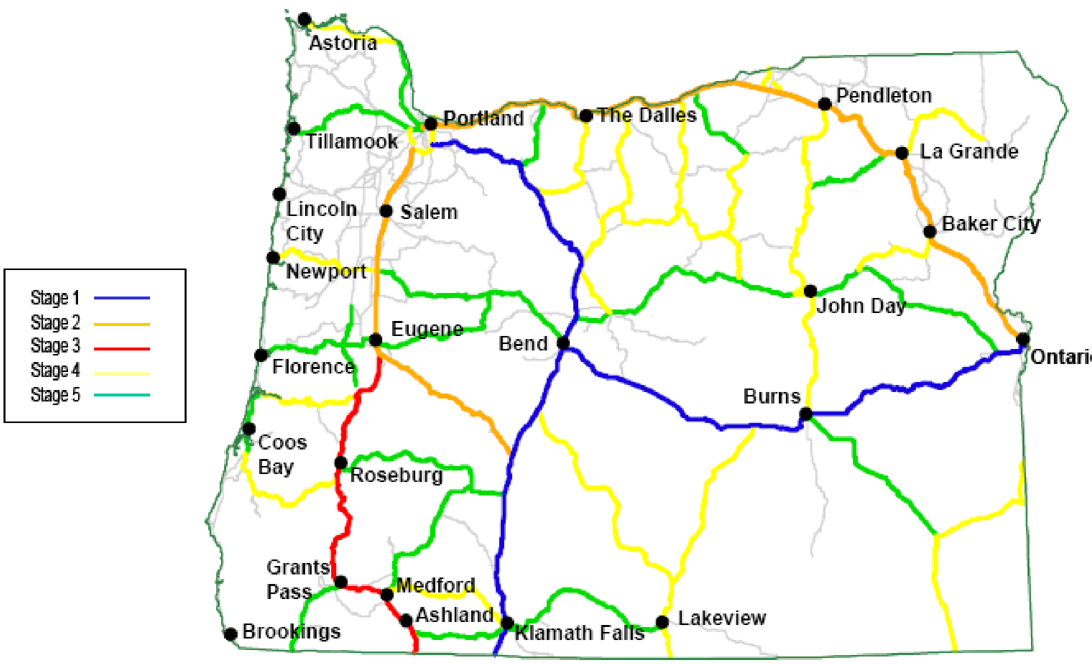
2.3 Highway and Roadway Operations, Maintenance, and Preservation

Operations, maintenance, and preservation strategies refer to the activities that ODOT and local governments do to maintain the existing system, including resurfacing the roadways; maintaining and replacing bridges and other structures; investing in operational strategies, such as Intelligent Transportation System (ITS) technology, incident management, and others; and maintenance activities, such as removing litter, patching potholes, and others. Each of the four primary activities – bridge maintenance and rehabilitation, pavement preservation, operational investments, and maintenance activities – are described in more detail below.

Bridge

The recent passage of Oregon Transportation Investment Act (OTIA) III will provide a $1.3 billion investment in bridges over the next 10 years. ODOT's Bridge Options Study identified 365 interstate and state highway bridges that needed strategic investment to maintain the freight system in Oregon. Of the 365 bridges identified as deficient, approximately 280 will be replaced or repaired as part of OTIA III. OTIA III also provided an additional $300 million for repair or replacement of county and city bridges, $361 million for county and city operations and maintenance, and $500 million for modernization projects. Figure 2.9 presents the expected OTIA III investments in state bridges by phase of investment.

Figure 2.9 OTIA III Investments in State Bridges by Phase



The five stages of the OTIA III program are as follows:

1. **Stage 1 (22 bridges) –** Opens two border-to-border routes for heavy loads, while interstate highway bridges are under construction and/or remain load-limited.
2. **Stage 2 (110 bridges) –** Begins work on I-84 and I-5. Addresses bridges on Highway 58.
3. **Stage 3 (104 bridges) –** Completes the work on I-5.
4. **Stage 4 (77 bridges) –** Improves connections between Astoria, Newport, Coos Bay, and I-5. Addresses Highway 395 and finishes work on U.S. 97 started in Stage 1. Fixes other segments in central and eastern Oregon.
5. **Stage 5 (42 bridges) –** Fixes Highway 126 connection between Eugene and U.S. 97 and Highway 126 connection between Eugene and Florence. Addresses U.S. 199 and

U.S. 26 between Prineville and Ontario. Completes connection between Portland and Astoria.

OTIA funding is partially provided by bonding against future revenues for the State Bridge program. Starting in 2008 and lasting for 25 years, $31 million of the State Bridge program will be used to pay the bonds. Although OTIA III is a substantial investment, it is still less than one-half of the needs identified in the Oregon Economic and Bridge Options report. The report states that $3.5 billion needs to be invested in order to bring interstate, freight, and other key routes up to conditions that allow single trip permit vehicles and the remainder of the state highway system to carry continuous trip permit vehicles. If county and city bridges are also included in the cost estimate, $4.7 billion will be needed to repair and replace bridges in Oregon. Importantly, these bridges are many of the older bridges and include large numbers of historic and coastal bridges that will not be replaced. These bridges will require substantial funding for ongoing maintenance.

Under the reference scenario, some additional portion of these funds will be available. The increase in funding for bridge and other operations, maintenance, and preservation activities will allow ODOT and local governments to continue to address maintenance needs and to repair and replace bridges.

Pavement Preservation

The goal of the state pavement preservation section is to have 77 percent of roads be in fair or better condition. A road that is in fair condition is generally serviceable.

The passage of OTIAs I and II dedicated substantial additional funding to the state pavement preservation program. At the same time, ODOT began a program to use maintenance treatments for low-volume roads (with fewer than 2,500 trips per day, on average), instead of standard preservation treatments. As a result, across the state, roughly 84 percent of roadway miles are currently in fair or better condition. However, a much lower percent of urban pavements is in fair or better condition, because it is much more expensive to replace and repair pavement in urban areas than in rural areas.

With steady funding at 2004 levels that grows with inflation, preservation projects for pavements throughout the state would cost approximately $120 million per year in 2004 dollars. The resulting condition of this investment is shown in Table 2.3. At the statewide level, this is roughly four percent fewer roadway miles in fair or better condition than the goal. Further, the percentage of urban pavements that is fair or better would be roughly seven percent less than those in rural areas, given the higher cost to preserve urban pavements.

Table 2.3 Reference Scenario Pavement Condition, 2004 and 2030

	Percent Fair or Better	
Roadway Class	**Current Conditions (2004)**	**Projected (2030) Conditions**
Interstate	94%	85%
Statewide	89%	75%
Region	84%	70%
District	75%	65%
All State Highways	85%	73%

Source: ODOT Pavement Management Section.

Operations

Operational and ITS investments, travel demand management, transit investments, and other related strategies provide an alternate solution to often costly capacity expansion. These strategies provide alternatives and help ODOT manage demand for existing infrastructure.

The use of ITS strategies is not new in Oregon. Many transportation and law enforcement agencies, trucking firms, and manufacturers have utilized various forms of ITS for many years. ODOT has taken the initiative to improve investment and coordination of ITS strategies to better address statewide needs. Examples of existing ITS infrastructure include the following:

- ODOT Region 1 (Portland) has a traffic operations center that manages ramp meters, variable message signs and closed-circuit TV (CCTV) cameras;
- ODOT has a statewide 511 telephone number that allows users to access travel information;
- The City of Portland operates a centralized traffic signal control system and also manages CCTV cameras, inductive loop detection systems, and variable message signs;
- The City of Salem has 191 of 246 traffic signals interconnected to a central computerized system;
- The City of Medford has variable message signs and surveillance cameras;
- TriMet (Portland region) has a vehicle location system implemented on all its buses, allowing for more efficient dispatch and providing real-time bus arrival information to passengers; and

- ODOT has implemented a commercial vehicle operation system named Greenlight, which uses technology to expedite paper work and inspection process of trucks.

The ODOT Traffic Management Section has also developed ITS deployment plans for future investments for Eugene, Medford-Ashland, Bend, and additional deployments in Region 1. With continued funding at reference scenario levels, ODOT would continue to expand its operational and ITS investments. The benefits of these investments are described in the maximum operations scenario later in this report.

Maintenance

ODOT maintenance activities include installing or repairing guardrails, applying asphalt treatments, improving drainage, conducting pavement striping and marking, conducting bridge maintenance, maintaining roadside vegetation, maintaining traffic signals, and providing snowplow and road sanding treatments. The level of investment in other ODOT activities has a significant impact on maintenance. For example, lower levels of investment in pavement preservation increase the need for additional pothole patching. Similarly, increased investment in operational technologies, such as signals and signs, requires additional maintenance funds to ensure that these investments are functioning properly.

The existing funding level for maintenance is roughly 34 percent below the preferred level of service, which provides acceptable long term outcomes and lessens chances of catastrophic failure. Under the reference scenario, the current level of funding would allow ODOT to meet basic maintenance needs, but not to address deferred maintenance issues, including:

- **Guardrail –** Much of the current guardrail is substandard, requiring a $20 million upgrade.

- **Culverts –** ODOT has not replaced many high replacement cost culverts, accounting for a $50 million backlog in culvert needs.

- **Electrical system –** Older electrical systems are a continual drain on maintenance resources. A $10 million investment to upgrade the electrical system would reduce ongoing electrical maintenance needs by $1 million to $2 million per year.

- **Rest areas –** Most rest areas in Oregon are past their serviceable life, and drain fields are inadequate for the volume of traffic in many cases. A total of $30 million is needed to upgrade rest areas.

2.4 Public Transportation

The reference scenario assumes continued growth and expansion of the public transportation system in Oregon. Table 2.4 presents the major capital expansions for fixed-route transit systems that are part of the reference scenario. These include a light-rail line extension and two new commuter rail lines in the Portland metropolitan area and a fairly extensive bus rapid transit system in the Eugene-Springfield metropolitan area. In addition, each of the major transit operators in Oregon (TriMet, Lane Transit District, Salem Area Transit, Rogue Valley Transit, the City of Corvallis transit system, and the City of Bend transit system) is expected to expand (or in the case of Bend, initiate) bus systems to provide service at the same rate as is available today, 35 annual transit trips per capita.

Table 2.4 Transit Projects Included in Reference Scenario

Transit Line	Year Added
Metro Light Rail (LR) and Commuter Rail (CR)	
LR South (Milwaukie & Clackamas)	2010
CR Beaverton to Wilsonville	2010
CR Beaverton to Salem	2020
Eugene-Springfield Bus Rapid Transit (BRT)	
BRT Franklin (Pilot Corridor)	2005
BRT Pioneer Parkway	2010
BRT W 11th St	2015
BRT Hwy 99 to Barger	2015
BRT River Road	2015
BRT Main St	2015
BRT Coburg	2015
BRT Centennial	2025
BRT W. 18th	2025
BRT Circumferential Route via Beltline	2025
BRT LCC via Amazon Parkway	2025

In addition to fixed-route service, it is assumed that ODOT will continue to fund on-demand transit services for elderly and disabled residents. These programs are funded in part through Federal Section 5310 and 5311 grants, and supplemented by additional funding from the state.

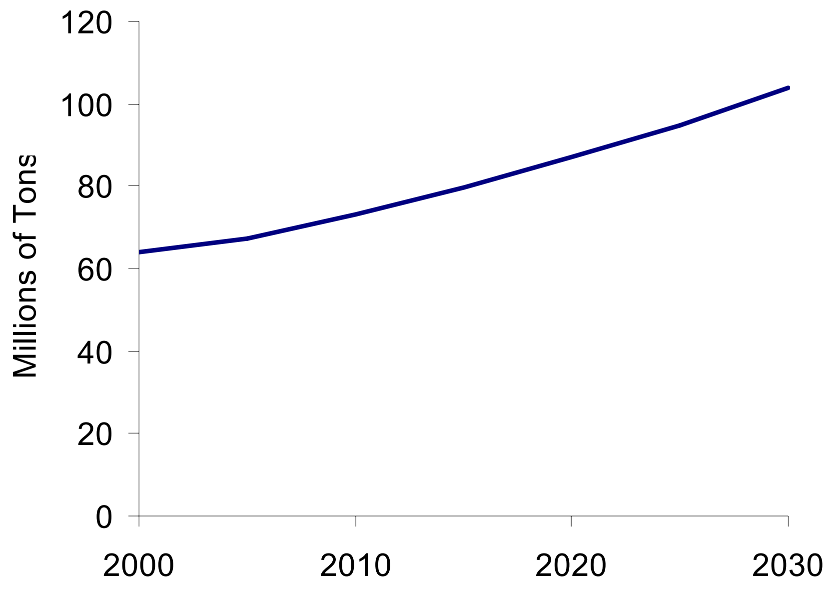
2.5 Freight and Passenger Rail

Investment in rail lines in Oregon comes from both public and private sources. Rail tracks, yards, and other rail infrastructure are typically owned by private railroads. Union Pacific (UP) and Burlington Northern/Santa Fe (BNSF) are the two main rail carriers in Oregon, and they make the primary investments to upgrade tracks, repair and replace signals, invest in train control systems, and other similar improvements.

The public sector also provides some investment in the rail system, primarily in the areas of grade crossing elimination programs, other safety investments, and public funding for passenger rail lines and improvements to accommodate passenger rail on the freight rail right-of-way.

Current forecasts of freight growth in Oregon predict only modest growth for rail and no real change in the share of commodities handled by rail. Total tonnage is expected to grow by 1.7 percent per year (Figure 2.10).

Figure 2.10 Expected Growth in Freight Rail Tonnage



Rail's share of freight transportation is expected to remain flat at 18 percent. Even modest growth in rail traffic in Oregon is compromised by major bottlenecks in the Portland area. Although the system as a whole can handle additional capacity, nearly all freight rail traffic on the UP and BNSF mainlines pass through Portland, effectively constraining the entire rail system in Oregon and the Pacific Northwest. Given the commodity mix in

Oregon and the existence of these bottlenecks, currently there are limited opportunities to divert freight traffic from truck to rail.

Some of the public and private investments expected in the reference scenario include the following:

- Added capacity to the UP mainline to allow for additional passenger service between Portland and Eugene. ODOT would provide $15 million to support this additional service.

- ODOT continued provision of $1 million per year to support short-line railroad infrastructure.

- State and federal programs to continue the elimination of at-grade crossings. These programs amount to roughly $2 million per year.

- Miscellaneous state and federal programs between $30 million and $40 million over the course of the plan to address safety issues as they arise.

- UP plans to address tunnel clearance problems in the Cascade Mountains. This investment will help improve north-south and east-west movements in both Oregon and Washington.

- BNSF construction of a bypass in the BNSF Vancouver Yard that will help improve capacity and throughput in the Portland region. Roughly $85 million, or nearly one-half of all identified rail projects, will be spent on these improvements.

Passenger rail in the reference scenario assumes continued investment by ODOT in passenger rail service on the Cascades line between Eugene and Seattle, including the addition of a fourth train per day in 2010.

■ 2.6 Aviation

Aviation in Oregon varies significantly by the type of airport involved. Portland International (PDX) is a large, primarily self-supporting airport. Funds from landing fees, rents, parking, concessions, passenger facility charges, and other related charges and fees are typically enough to cover the costs of operating and expanding the airport to meet future demand. Some of the other larger commercial airports, such as Eugene, are also self-sustaining. Smaller commercial airports and general aviation airports, on the other hand, require more direct public investments to maintain and expand their operations.

Demand for air travel is expected to pick up following recent declines. The OTP estimates a four percent increase in passengers per year, or three times the number of air passengers by 2030. Portland currently has 90 percent of enplanements in Oregon and is expected to continue with this share over time. A similar story can be told for freight, with just under four percent annual growth in tonnage expected by 2030. Portland currently has 97 percent of freight enplanements in Oregon.

On the general aviation side, the Federal Aviation Administration (FAA) forecasts a growth of 1.5 percent in operations per year through 2020. Operations represent take-offs and landings, while enplanements represent the number of passengers boarded, so this cannot be compared directly. The FAA estimates roughly two percent growth in commercial operations in Oregon per year through 2020, including Portland.

The tripling of demand for air travel will require substantial new investments in infrastructure. PDX has identified $3.5 billion worth of investments that should be made over the next 20 years, including the following:

- Twenty-two additional gates will be needed to support demand by 2020;
- A new passenger terminal will be needed to house some of the additional gates;
- A new roadway will be needed to provide access to the new terminal;
- After 2030, an additional runway will be needed to support growth; and
- New cargo buildings will be needed to support freight growth.

Oregon will also be making a substantial investment in general aviation over the next several years. In 1999, the state adopted a tax on fuel that is primarily used to support runway pavement preservation and modernization projects at general aviation and smaller commercial airports. Recently, federal funding for the aviation trust fund was liberalized to allow for modernization funding, but in Oregon the immediate preservation needs exhaust all existing resources. As a result, spending on modernization activities, such as widening runways, improving lighting, improving access, constructing new hangars, extending utilities and others, are falling behind.

Table 2.5 presents the Oregon Department of Aviation's performance measures used to assess the effectiveness of spending on preservation and basic modernization. The state has caught up with basic runway length and lighting standards and is moving closer to meeting preservation standards. The additional funding from the state aviation fuel tax is largely responsible for the improvement in these measures.

Table 2.5 Oregon Department of Aviation Performance Measures

Performance Measure	2000	2004	Target
Percent of Runways in Good or Better Condition	73%	88%	90%
Percent of Runways Meeting Length & Width Criteria	59%	64%	59%
Percent of Airports Meeting Lighting and Navigational Standards		62%	50%

Source: Oregon Department of Aviation.

2.7 Marine Ports

For the purposes of the reference scenario, it is expected that investments in ports will roughly follow the future demand for marine travel. At a statewide level, marine freight flows are expected to continue a slow, but steady growth. Over the timeframe of the OTP, tonnage on deep draft vessels is expected to grow just under one percent annually, while tonnage on shallow draft vessels is expected to grow by only 0.29 percent annually.

The majority of future demand is expected to take place at the Port of Portland. Portland has, in general, continued to see increased shipping but also has experienced difficulty attracting and retaining containerized shipping in recent years. In 2004, two major container shipping lines ceased conducting business at the Port of Portland.

Other ports are either declining or typically used for niche commodities, including these ports:

- The Port of Newport has had no deep draft calls in the last two years;
- The Port of Coos Bay handles one-third the volume it handled in 1997;
- Several ports continue to see measurable volumes of fresh fish; and
- Some ports, such as Umatilla and Morrow, see niche commodities (fuel oil, waste, and others).

With continued investment at current levels, marine investments would include:

- **Maintenance –** This includes dredging, monitoring, and maintaining jetties and dikes, and other related activities. Dredging is the most significant of these activities, costing roughly $35 million per year.

- **Columbia River Deepening –** The Columbia River is currently a 40-foot channel. To support deeper draft vessels for the Ports of Portland and Vancouver, Washington, as well as other ports along the Columbia, the channel needs to be deepened an additional three feet. This dredging will cost roughly $150 million. Approximately 75 percent of the cost will be covered by the U.S. Army Corps of Engineers (USACE). The remainder will be split between Oregon and Washington.

- **Port Roadway Access and Facilities Upgrades –** Several ports have identified needs for improved access, maintenance dredging, and new infrastructure (such as cranes, gates, etc.). Overall, roughly $275 million has been identified to support these activities. Over two-thirds of these needs are for the Port of Portland.

Two key federal sources are used to fund the major maintenance activities on river channels in Oregon:

1. The Harbor Maintenance Trust Fund (HMTF) is a 0.125 percent ad valorem tax on imports. This funding provides sufficient revenue for operations and maintenance of harbors. In Oregon, this is used for the Columbia River and coastal harbors.

2. The Inland Waterway Trust Fund (IWTF) is a $0.20 fuel tax on barges that is used to fund the construction of lock and dam projects on inland waterways. In Oregon, this is used for rivers like the Willamette.

Nationally, both the HMTF and IWTF currently have surpluses, but given the rate of marine growth in Oregon, these funds are not expected to keep pace with inflation over the course of the plan. Funding for the major channel deepening is not tied to a specific tax, but comes from the USACE general fund, which is funded directly by the federal government. Funding for on port facilities is largely handled through facility charges, rents, and other income derived from the port.

Notably, one major project cannot be completed with the funding identified in the reference scenario – replacing the jetties at the mouth of the Columbia River. The USACE maintains three rubble-mound jetties at the mouth of the Columbia River. These stacks of boulders accelerate the flow of the river, help maintain the depth and orientation of the navigation channel, and provide protection for commercial and recreational ships. Ocean currents and major storms have degraded the condition of these jetties, and the risk of failure in any given year is estimated at 20 percent. If the jetties fail, a substantial volume of sand could be transported into the main river channel, effectively disrupting major commerce on the river. The USACE estimates that some critical repairs can be made of the current jetties at a cost of roughly $14 million. This investment may postpone needed investment in jetty rehabilitation for up to 15 years. The cost for rehabilitation will be much higher, though the USACE has yet to estimate these costs.

3.0 Sensitivity Scenarios

The purpose of the sensitivity scenarios is to understand the implications of two key external changes on the transportation system in Oregon:

1. High fuel prices resulting from higher oil costs; and
2. Relaxed land use development restrictions.

These scenarios are differentiated from the policy scenarios because they are not the result of policy decisions made by ODOT, the OTP Steering Committee, or the Oregon Transportation Commission. There are three key issues the sensitivity analyses address:

1. The impact of fuel price and land supply on transportation behavior. How much more or less will Oregonians drive? How will fuel prices impact travel demand for aviation, shipping, etc.?
2. The impact of fuel price and land supply on available revenue. Will funding keep pace with needs more or less than under the reference scenario?
3. The impact of fuel price and land supply on the ability of the system to perform to the standards of the reference scenario.

■ 3.1 High Fuel Prices

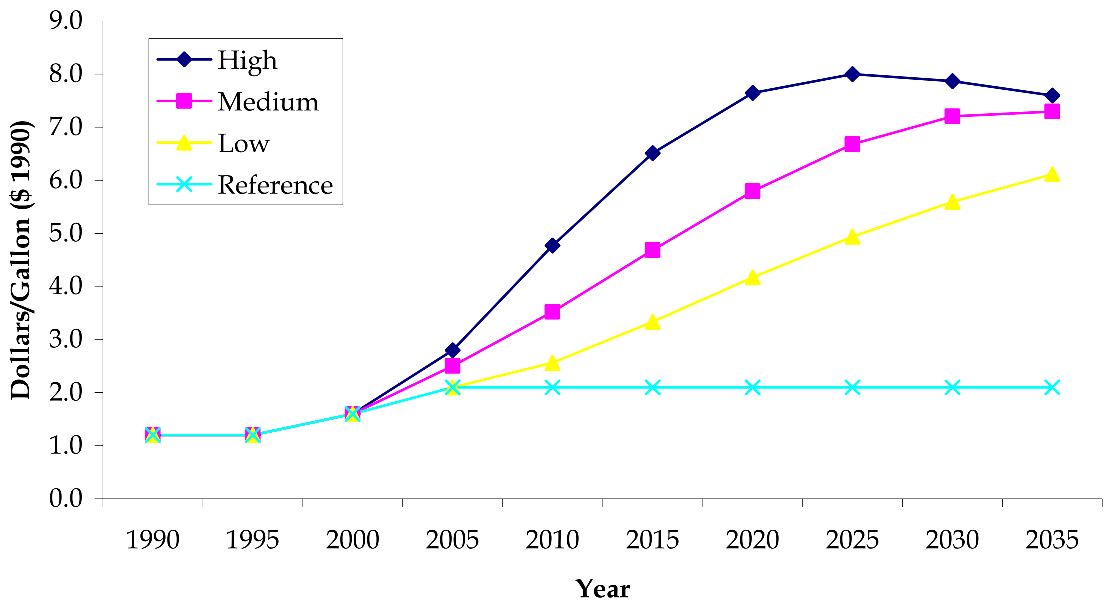
The impacts of high fuel prices on transportation in Oregon were estimated from several sources, including the ODOT Statewide Model and research on fuel price elasticity for aviation, marine, trucking, transit, and other key industries. The results are summarized by mode below.

Surface Transportation

A recent study for the U.S. Department of Energy notes that there is general acceptance among geologists that there is a finite quantity of oil and that, given expected increases in demand, fuel prices will increase.[1] There are significant differences among current projections about when peak oil production will occur, however, or what the response will be from consumers and automobile manufacturers to increasing fuel prices. As a result, the impacts of high fuel prices on surface transportation modes were estimated by manipulating two variables – fuel price and fleet fuel economy. Fuel prices were evaluated using three patterns of increasing price, illustrated in Figure 3.1. Fuel economy response to changing fuel prices was evaluated using two patterns of change in fleet fuel efficiency, illustrated in Figure 3.2.

The combination of these two variables yielded six scenarios that were used to evaluate the effects of high fuel prices. A separate fuel price reference scenario was generated in order to include historical changes in fuel prices from 1990 to 2005. The statewide model base year is 1990, and fuel price was held constant at the 1990 price of $1.04 per gallon. Table 3.1 summarizes this information.

Figure 3.1 Range of Increased Fuel Prices Modeled



[1] Hirsch, Robert L., Roger Bezdek, and Robert Wendling, 2005, *Peaking of World Oil Production: Impacts, Mitigation, and Risk Management*, U.S. Department of Energy.

Figure 3.2 Range of Fleet Fuel Economy Modeled

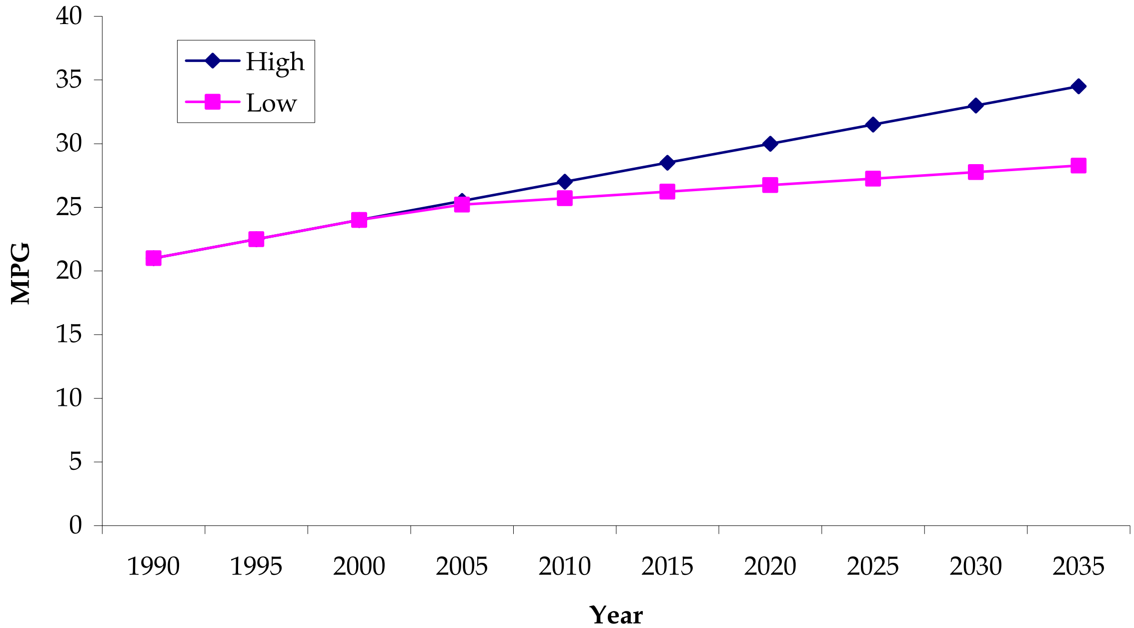
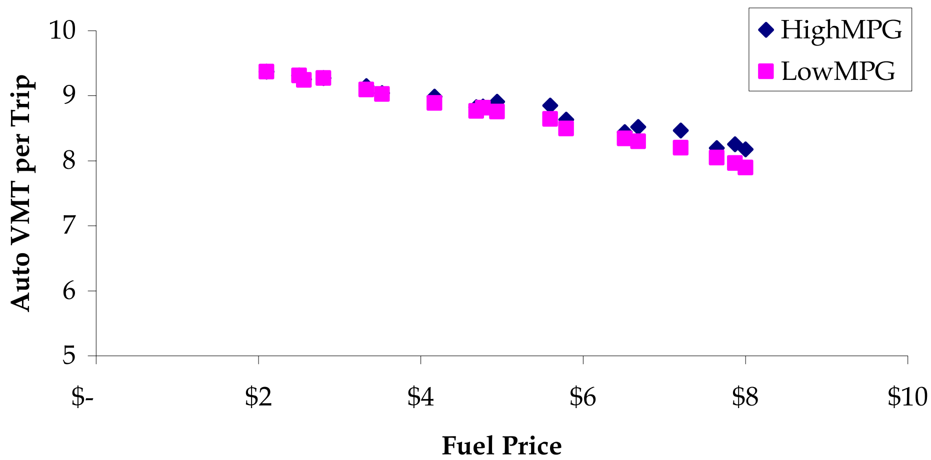


Table 3.1 OTP Fuel Price Scenarios

Scenario	Speed of Fuel Price Increase	Fleet Fuel Economy
Fuel Reference	$2.10 (1990 dollars)	Low
Fuel 1	Low	Low
Fuel 2	Med	Low
Fuel 3	High	Low
Fuel 4	Low	High
Fuel 5	Med	High
Fuel 6	High	High

Overall, the relationship between fuel price and VMT is relatively linear (Figure 3.3). As fuel prices increase VMT decreases. However, VMT does not decrease as fast as fuel costs increase.

Figure 3.3 Relationship Between Fuel Price and Auto VMT per Trip



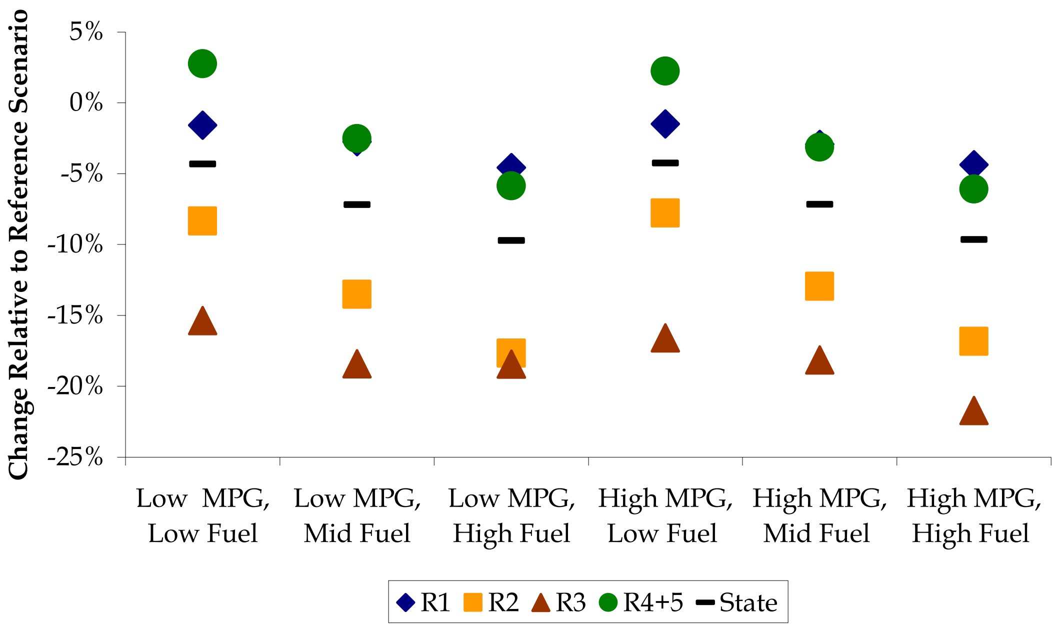
Gross Product – Increased fuel prices are expected to reduce travel and depress economic growth. Figure 3.4 presents a summary of the economic impact of increased fuel price by scenario and region. In the state as a whole, the pattern of fuel price increases has a consistent impact on the economy. More rapid increase in fuel prices has a larger negative impact on gross product, with a slight exception in Regions 4 and 5. For this bi-regional area, slight increases in fuel prices (low fuel price increase scenarios, regardless of fuel economy) slightly increase the overall gross product.

Notably, the impacts of increased fuel price are lowest for Region 1. This reflects the greater density of this region and its ability to provide alternate forms of transportation, due to the well established transit program and street network.

Improved fleet fuel economy has a slight moderating effect on high fuel prices. The economic response is not as negative, but fuel price increases have a larger impact, especially for the highest fuel price scenarios (the high-fuel price, high-fuel economy scenario and high-fuel price, low-fuel economy scenario look effectively the same).

These findings of slower growth are consistent for other similar measures, such as employment and population growth.

Figure 3.4 Gross Product by Fuel Sensitivity Scenario and Region



The economic contraction that results from increased fuel prices can be seen in each of the performance measures used to evaluate scenarios. These impacts include:

- An overall reduction in trip-making;
- Reduced congestion and travel times as a result of fewer trips;
- A reduction in average trip length as individuals move closer to jobs or eliminate longer-distance trips;
- A reduction in the consumption of land; and
- Other related impacts.

These impacts scale directly with the level of fuel price increases. The larger the increase in fuel prices, the greater the reduction in trip-making, travel time, and other measures.

Aviation

The aviation industry as a whole is highly sensitive to fuel prices. In recent years, commercial airlines have been working with declining profit margins. Airline passenger revenue has plummeted from its historical average of 0.95 percent to 0.70 percent of U.S. gross domestic product (GDP), creating a gap of $29.3 billion in an $11.7 trillion economy.

At the same time, average ticket prices are basically unchanged since the late 1980s. As a result, the breakeven passenger load factor for the industry has increased to 80 percent per plane, compared to 65 percent in the mid-1990s.

Unlike many industries, it is difficult for airlines to pass fuel cost increases along to the air traveler. The Air Transportation Association of America (ATAA) estimates that 80 percent of passengers are discretionary travelers and only 20 percent travel for business. On average, ATAA estimates that discretionary passengers are only willing to pay $200 for a round trip flight (this is an average of trips of all lengths).

All U.S. airlines are losing money, except for Southwest. Importantly, one of the key reasons Southwest remains profitable is due to hedges the airline took against future fuel price. Currently, Southwest is purchasing fuel at $25.00 a barrel, less than one-half the current price for other airlines. However, these hedges expire next year, which will have a significant impact on Southwest's bottom line.

Nationally, the impacts of high fuel prices, combined with limited ability to recoup costs, produces substantial negative impacts, including the following:

- **Increased passenger costs –** As increased costs are passed on to passengers, significant dips in passengers will be expected. The Portland International Airport Master Plan (1999) projected that a 50 to 100 percent increase in the cost of fuel would increase the cost of air travel by five to 15 percent. The result would be a reduction in the 20-year passenger forecast of four to 12 percent.

- **Reduction in service –** Airlines have already begun to reduce service to less profitable routes. The hub and spoke system – which has been the mainstay of the air transportation system for many years – may fail altogether. The most profitable carriers, such as Southwest, operate air service in clearly defined profitable corridors. The smaller spokes tend not to be part of their network. As would the hub and spoke system breaks down, many smaller airports (such as Pendleton) will be unable to continue service. The impact on the economy of these areas could be very substantial.

- **Airline bankruptcies and mergers –** Several airlines have been through bankruptcy proceedings recently, and most are currently losing revenue. Up until recently, U.S. Airways has been identified as the carrier most likely to be liquidated through bankruptcy. The recent announced merge with America West, however, means that the U.S. Airways brand will stay afloat. The industry may well see an increase in merger activity (e.g., Southwest and American Trans Air) in response to decreased demand and intense competition.

- **Potential for labor strikes –** Nearly every airline has been working to restructure labor contracts over the last several years in response to declining revenue and rising costs. And, though many of these have been successful, recent examples have presented new issues. United Airlines recently canceled its stand-alone pension plan and nearly canceled the labor contract with its maintenance workers altogether. Rising fuel costs and a limited ability to increase prices would increase the potential for labor strikes as airlines continue to search for operating efficiencies in other areas.

- **Declining airport revenue –** On-site airport revenue from landing fees, concessions, parking, and other sources will decline. These sources are tied directly to overall air travel demand. This would lead to reduced airport concessions. If a major carrier fails, some airports may be unable to sustain their current level of activity.

- **Reduced general aviation –** Currently, general aviation users pay no charge for an "instrument flight plan," which costs the FAA $440 per operation (take off or landing). Declining revenue may cut into the FAA's ability to provide these services for free. Combined with increasing fuel costs, general aviation may see a steep decline across the nation.

The ATAA estimates that the price of jet fuel will average $53.00 dollars per barrel, or $1.55 per gallon, over the next 12 months.[2] It is estimated that for every penny increase in the price of a gallon, annual operating expenses for the airline industry increases by $186 million. Every $1.00 increase in the price of a barrel of crude puts another 5,500 airline jobs at risk.

Airlines have taken some steps to reduce or mitigate fuel consumption, including newer fleets, single-engine taxis, lower cruise speeds, onboard weight reduction, fuel efficient wing tips, and access to more traffic lanes in the sky. These measures increased fuel efficiency 18 percent to 45 miles per gallon. Airline productivity has risen 17 percent since 2000 due to a reduction of the number of airplanes in service and an overall decline in unit operating costs (excluding fuel). In addition, new planes are under development that are more fuel efficient due to the use of lighter composite materials. The Boeing 787 Dreamliner is expected to use 20 percent less fuel than planes of a comparable size. However, given the current financial state of the airline industry, fleet turnover will take some time.

Public Transportation

Transit agencies in Oregon spend between four and seven percent of their operating funds on fuel. The largest operating cost for transit agencies is labor, but fuel is a growing component. The American Public Transit Association (APTA) conducted a survey during the first three weeks of June 2004 on the impact of motor fuel price increases on transit service. Nearly 100 transit agencies from across the country participated in the survey. Annualizing the cost of the price increases in the first one-half of 2004 shows that the increases are costing public transit agencies in the United States $154 million above price levels from the previous year.

In fiscal year 2003, TriMet spent $127 million on bus operations, $8.7 million of which was for fuel. For the current fiscal year, TriMet's fuel costs already exceed the budget by

[2] Remarks made by John Heimlich, Vice President and Chief Economist for the ATAA, to the Congressional Economic Leadership Institute in April 2005.

$1 million, and the agency anticipates that it will spend an extra $3 million by the end of the fiscal year. Lane Transit spent just over $700,000 on fuel and lubricants for its bus fleet in fiscal year 2001 to 2002, and has budgeted over $1 million for the 2004 to 2005 fiscal year. Lane Transit's overall budget has been between $22 million and $24 million over the last several years, with fuel representing three to five percent of the budgeted total. The district has experienced significant fuel cost overruns, however.

At the time of the APTA survey, fewer than 10 percent of respondents had raised fares in response to increased fuel cost, but 28 percent anticipated raising fares if fuel prices continued at their current levels. Also, 21 percent anticipated service reductions due to high fuel prices. Most of the agencies that have taken action are from areas with a population less than 200,000.

TriMet has both raised fares and reduced service in response to fuel cost increases. TriMet raised fares by five cents in April 2005 to cover high diesel prices. In late May 2005, TriMet made a proposal for an additional 10-cent increase. One-half of the proposed fare increase is to keep pace with inflation, and the other one-half to cover high diesel prices. TriMet also reduced service, cutting low-ridership trips on 26 routes on June 5 due to high diesel costs. Finally, TriMet has taken measures to operate its buses more efficiently, including making transmissions and axle adjustments, reducing engine idling, and checking tire pressure more frequently. These measures are estimated to save the agency $600,000 annually.

National research on transit indicates that transit fares have an elasticity of -0.33 to -0.22, though these tend to vary significantly by demographics, income level, car ownership, distance traveled, and other factors. This indicates that each dollar increase in fares will depress ridership between 22 and 33 percent.

Increased fuel costs can also lead to increased ridership, because increased fuel costs have a disproportionate impact on automobile travel. Unlike transit, fuel is the primary daily cost for automobile travel. Although capital costs (automobile purchases) are significant, these are typically thought of as sunk costs, and the majority of transit users continues to use an automobile for many trips. From the APTA survey, two of five respondents reported ridership growth as a result of increased fuel prices. After adjusting for the number of passengers carried, however, the new growth in ridership was less than one-half a percent.

National research on price elasticity indicates that automobile fuel price increases yield measurable increases in transit ridership. A summary of studies conducted in Europe indicated that a 10 percent rise in fuel prices increases transit ridership by 1.6 percent in the short run and 1.2 percent in the long run. The decline in the long term is a function of increased use of more fuel-efficient vehicles.

Freight and Passenger Rail

Railroads would be impacted in two major areas if fuel were to increase to $5.00 a gallon: 1) increases in their operating costs; and 2) diversion from other modes. They would probably also respond by making changes to how they market their services.

Increased Operating Costs

To only the UP railroad, a one-cent increase per gallon in the cost of fuel translates into more than a $20 million annual cost increase systemwide. However, fuel is a smaller percentage of rail operating costs than it is for the trucking industry. For the most part, rail carriers have been improving fuel efficiency by purchasing newer locomotives, changing operating practices, and gradually moving to more efficient hybrid switching locomotives in areas with air quality problems. Increases in the cost of diesel will accelerate these activities. The railroads are also the only form of land transportation that can electrify their operations with known and proven technology.

Diversion from Other Modes

Railroads always experience some diversion from the other modes with even modest increases in the cost of diesel fuel. It is anticipated that this trend would be accelerated if fuel prices were to increase to $5.00 per gallon. History also shows that much of this traffic reverts to the previous mode when the cost goes down. Railroads would probably be wary of committing large amounts of capital to expand service, unless there was a demonstrated long-term increase in fuel price.

Railroad capital investments, by their very nature, are long term. Freight and passenger cars last 20 to 30 years, track lasts 40 to 50 years, and locomotives can operate for years with periodic systematic upgrades. In addition, the U.S. railroad supply industry has contracted to fit normal annual capital needs. Currently, there are only a few suppliers of air brake equipment, two major locomotive builders, a handful of freight car builders, and no domestic builder of intercity passenger cars. Lead time for expansion in some cases requires two or three years. Only with a long-term spike in fuel prices would any significant expansion in the supply industry occur.

If the growth in fuel prices is short term or unknown, the railroad industry would probably make adjustments in how they market their product lines. Unit train and current large loyal customers would be given preferential treatment, even though their rates would probably increase due to higher operating costs. New customers would be accommodated depending upon their product mix and profitability to the railroads. It is possible that some low-value, short-haul products might be jettisoned in favor of new customers that produce higher profits.

The ability to accommodate additional traffic is also impacted by the velocity of equipment through the system. Too much traffic might clog terminals, thereby, reducing the effective capacity of the system. One temporary response is to increase the financial penalties to shippers that fail to load/unload cars in a timely manner, but that is a temporary solution to real capacity increases. Even with increased fuel prices, railroads would be unwilling to take on new customers, if it detracts from their ability to provide service to key existing customers.

A permanent and dramatic rise in the price of fuel could also lead to a substantial increase in public and private investments in capital for system expansion. The American Association of State Highway and Transportation Officials (AASHTO) Bottom Line Report estimated that a doubling of current annual capital investment (termed "aggressive investment") would result in rail attracting an additional nine percent of intermodal traffic and two percent of carload commodities that currently move by truck or water. This also assumes that the railroads do not loose (or jettison) any traffic they presently carry.

The nine percent increase in intermodal traffic could be greater in the I-5 corridor if these improvements permitted shippers in the Puget Sound area to enjoy second morning delivery times to the Los Angeles basin. However, any investments would need to be a three-state effort and not confined just to Oregon.

This doubling of current investment would cost $10.2 billion to $11.2 billion annually nationwide. The railroads have the financial capability to generate about $6 billion to $7 billion per year within their own resources, leaving a public share of just over $4 billion annually, or $83 billion over a 20-year timeframe. Based on rail mileage per state, Oregon would be responsible for just under two percent of this bill, or $82 million a year.[3]

Rail Passenger Service

Rail passenger service is faced with some of the same issues as rail freight: system capacity, long lead times for improvements, no excess fleet, and a lack of domestic suppliers for rail equipment.

Past history has shown that, in times of increased fuel costs, travelers look to passenger rail for service. Again, like freight, once the crisis has passed they return to other modes. Providers of passenger rail, whether commuter or intercity, look to a long-term trend in order to justify the purchase of equipment and the related expenses of more capacity.

Any excess in system capacity would be fought over by the freight and passenger interests. Passenger service has a tendency to consume capacity at a greater rate than freight due to its need for higher speeds. Higher speeds cause more situations where trains overtake other trains and shorten the time for meeting other trains. Given capacity constraints on the rail system in Oregon, public policy may have to determine whether freight or passenger rail is more important to the overall state interest or how to balance these important needs.

---

[3] American Association of Highway and Transportation Officials, *Freight-Rail Bottomline Report*, 2004.

3.2 Relaxed Land Use Restrictions

The ODOT Statewide Model includes assumptions about the availability of land for development that is used as part of the estimates of economic productivity in the model. This scenario was based on an assumed 10% increase in land zoned for development in urban fringe and rural areas.

Table 3.2 presents the acreage that was added to the Portland metropolitan area urban growth boundary since its formation in 1979. Across that entire timeframe, roughly 10 percent additional land has been added to the urban growth boundary.

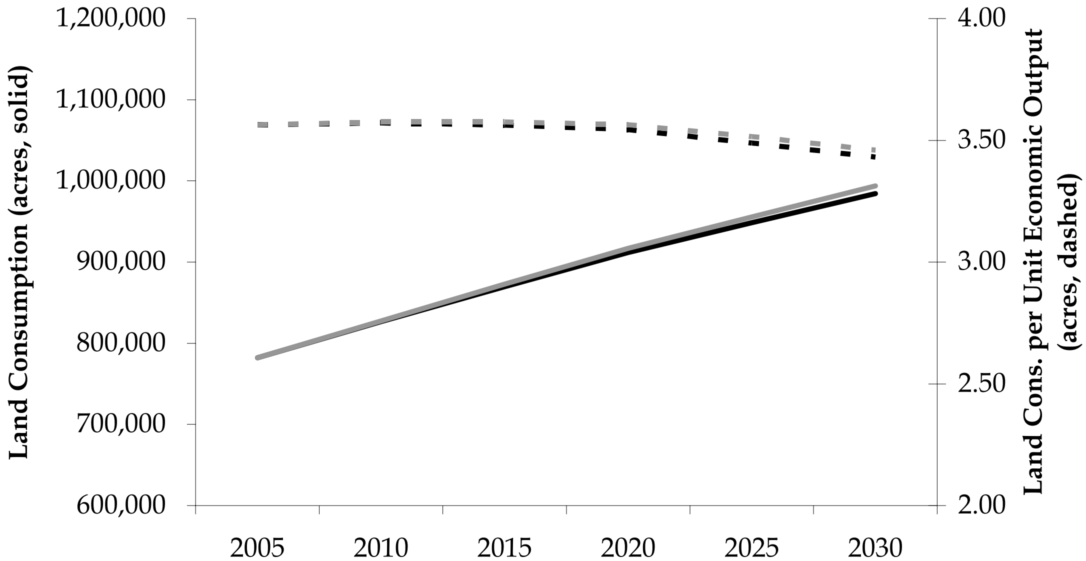
Table 3.2 Changes in Portland Metropolitan Area Urban Growth Boundary, 1979 to 2005

Year	Acres Added	Total Acres	Percent Growth
1979 (base)		244,000	
1998	3,500	247,500	1.4%
1999	380	247,880	0.2%
2002	18,638	266,518	7.5%
2004	1,940	268,458	0.7%
Total	**24,458**		**10.0%**

Source: Metro

Increasing the supply of consumable land is expected to increase the quantity of land consumed. Figure 3.5 presents total land consumption (shown as solid lines) and land consumption per unit of economic output (shown as dashed lines) in the reference (black line) and relaxed land use (grey line) scenarios.

Figure 3.5 Impacts of Relaxed Land Use Scenario



System-level transportation impacts of allowing additional land for consumption are negligible statewide. Total land consumed increases negligibly over the reference scenario. The productivity of that land also declines slightly as more acres are consumed.

Because the impacts on land consumption are minor, the system-level transportation impacts on most other performance measures are also negligible. At the system level, there is enough available land in the reference scenario that the additional land put into use does not stimulate additional economic growth in the state. Population and economic growth in Oregon does not require a tremendous amount of new land. A significant contrast to this is the Southwest, where states such as Arizona are expected to double in population over the next 30 years, requiring substantial new land development to keep pace with growth. In addition, many other states do not use urban growth boundaries to manage land use densities, increasing the total area of land needed to continue to support development.

However, at the local level, the impacts of increased developable land use are potentially significant. Increased available land will increase the costs of providing infrastructure (such as water, sewer, and others), will make transit less accessible to residents, and may increase congestion on local roads. These impacts cannot be seen at the system level, because the relaxed land use scenario does not have a significant impact on the overall economy of Oregon and its regions. In effect, the impact is expected to be concentrated within the zones, rather than between them. Identification of the impacts requires detailed analysis at the local level, which is beyond the scope of this analysis.

4.0 Policy Scenarios

This section presents the analysis of the policy scenarios. The following four policy scenarios were analyzed in comparison to the reference scenario:

1. Flat funding;
2. Maximum operations;
3. Major improvements; and
4. Pricing.

4.1 Flat Funding

The primary question addressed by the flat funding scenario is what happens if no new funding sources are identified and existing funding is not increased to support transportation in the future. This leads to the declining real purchasing power of traditional state and federal funding sources. The available funding and the impacts of its reduction are addressed below by transportation mode.

Surface Transportation

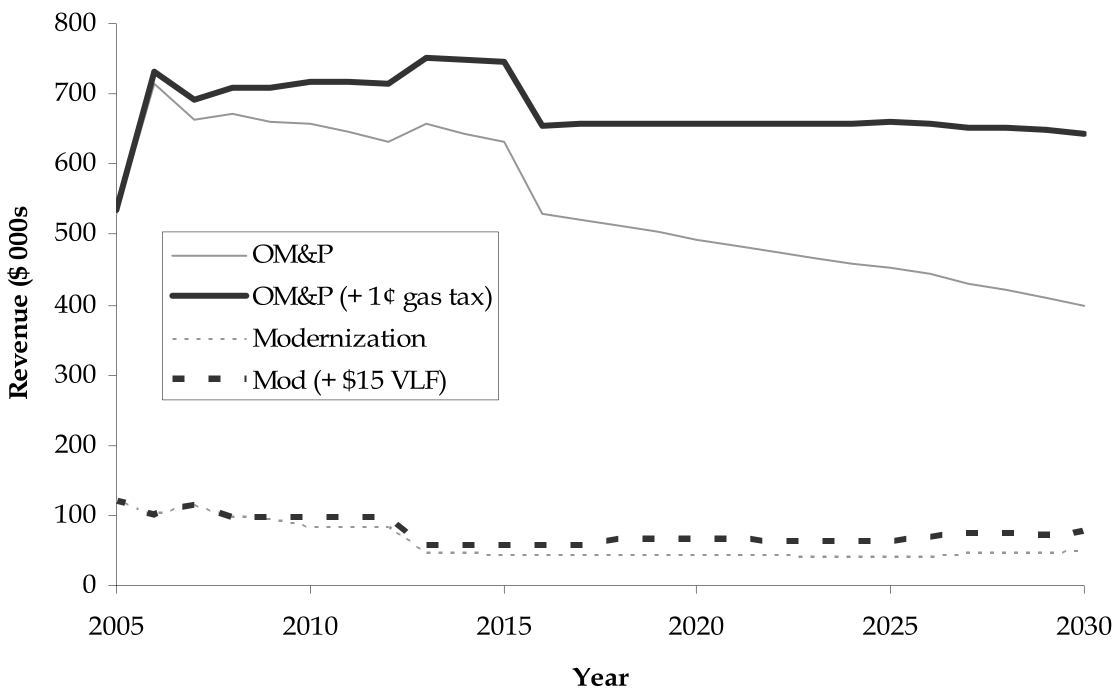
Total highway funding available in the flat funding scenario was based on the forecasts of funding available to MPOs and work conducted for the Hudson Institute to estimate the expected growth in the federal transportation trust fund.

State funding was estimated based on the coordinated ODOT/MPO forecast. The key assumption is that no additional funding would be available above what is generated through current state sources (primarily gas taxes and vehicle license fees). Although existing funds are expected to grow with increased population and vehicle travel, they will not keep pace with inflation without new sources or increases in taxes or fees.

Federal funding was estimated based on estimates of the expected growth in vehicle travel across the U.S. The reference scenario assumed federal fund growth with inflation. These assumptions were adjusted as follows. First, through the period of the proposed federal reauthorization bill, the ODOT/MPO forecast estimates were used at 98 percent of their value to reflect provisions in the new bill that increase the minimum guarantee for states. Under the most recent federal legislation, Oregon received more federal funds than it paid into the trust funds. Relative to other states, it received 102 percent of its payments to the trust fund. From 2010 on, federal funds are expected to grow at a rate of 2.16 percent per year. This corresponds to the expected yearly growth in federal revenue estimated by the Hudson Institute report, *2010 and Beyond: A Vision of America's Transportation Future*.

Across the timeframe of the plan, the flat funding scenario yields about 20 percent less in funding. It is important to understand, however, that the decline in funding is not constant across the funding period, but gets worse with time as inflation continues to erode the spending power of the state's existing funding sources. In 2030, the flat funding scenario will yield only 62 percent of the funding of the reference scenario. Figure 4.1 presents the total highway funding available for the flat and reference scenarios during the timeframe of the plan.

Figure 4.1 Highway Funding by Scenario Expenditure Type



For major modernization projects, the primary impact is to shift some of the projects identified in the reference scenario into future years. At the system level, there is only a slight difference between the flat funding and reference scenarios on overall performance. However, at the local level, there is likely to be a significant impact on capacity. As noted above, only about one-half of the modernization funding is for widening projects, and only a portion of this funding actually increases capacity on the state transportation system. For example, a highway may have enough capacity to handle the trips on it, but there could be significant delay at the highway interchanges if they were not reconstructed to handle increased demand. This could cause increased delay both on the ramps and in the city. Some of the major projects identified in the reference scenario would occur later (e.g., in 2025 instead of 2020) under the flat funding scenario, but with little net effect on capacity of the state system in 2030.

Highway and Roadway Operations, Maintenance, and Preservation

As described above, spending on operations, maintenance, and preservation activities would be expected to decline by roughly 20 percent without the extra funding identified as part of the reference scenario. The impacts of this decline are described for each of these key programs.

Bridges

Although OTIA III will repair and replace numerous cracked bridges that would have severely compromised the ability of the state highway network to handle freight, there are a number of bridges that were not addressed, including historic and coastal bridges, numerous local bridges, and bridges on secondary freight routes. The $1.3 billion for OTIA III represents less than one-half the amount of bridge needs identified from the ODOT Bridge Options Report.

Starting in 2008, debt service for OTIA III will leave $54 million available to the bridge section for regular maintenance and replacement activities. About one-half of this funding will be available for maintenance, and one-half to replace deficient bridges. Numerous bridges on local, district, and regional routes will have delayed repair or replacement schedules as a result. Many of these bridges will be unable to carry the heaviest loads (greater than 80,000 gross vehicle weight). This can have significant impacts on the Oregon economy, because the production of heavy goods, including timber, gravel, and agricultural products, makes up almost one-half of the economy in southeast, northeast, and northwest Oregon. The key economic impact of these investments will be smaller than the $120 billion worth of lost production that was identified without OTIA III, which is replacing and repairing bridges along key freight routes.

Most significantly, without new funding, the condition of Oregon's bridges will resume a slow, but steady decline. In 2030 and beyond, the bridge program will likely have only enough funding for minor maintenance. As the physical condition bridges on Oregon's key freight routes declines again, the state will be faced with difficult choices and the need for a new wave of major investments. Some of these long-term costs can be avoided through regular maintenance.

Pavement

With declining purchasing power, the preservation scenario for pavement activities would cost approximately $98 million per year in 2004 dollars. Based on this funding, pavement conditions are projected to decline significantly, as compared to the reference scenario (Table 4.1).

Table 4.1 Expected Pavement Condition, Flat Funding Scenario

Roadway Class	Percent Fair or Better	
	Reference	Flat Funding
Interstate	85 %	70 %
Statewide	75 %	60 %
Region	70 %	50 %
District	65 %	50 %
All State Highways	73 %	57 %

Source: ODOT Pavement Preservation section.

The decline in pavement conditions is not linear, as purchasing power of flat dollars erodes due to inflation. Urban pavements, which cost more to preserve, are expected to have worse pavement conditions – roughly four percent worse for urban roads than for rural roads. Maintenance budgets will need to increase as pavement conditions decline in order to keep poor pavement drivable. By 2030, declining pavement quality will require an additional $10 million for patching. It is likely that this additional funding would come from the Preservation program, which would reduce the amount of preservation that can be accomplished with the budget even further.

Maintenance

The impact of declining purchasing power on maintenance would be felt across the board. The ODOT Maintenance Section identified a number of programs that would be impacted by reduced funding, including the following:

- **Low volume roads –** This program provides short-term maintenance treatments to roads with an average of fewer than 2,500 vehicles per day to save on more substantial resurfacing costs. This program could be reduced by up to $6 million per year, but larger investments would be needed in the future due to lack of treatment of these roads.

- **Contingency –** This funding could be reduced by up to $2 million per year, but that would yield potential delays to STIP projects if any extraordinary damage repairs were necessary.

- **Public information –** Eliminating ODOT's toll-free number for road conditions would save some funding, but would deviate from ODOT's practice of improving safety and public goodwill.

- **Physical plant –** ODOT would likely close two maintenance stations and reduce the maintenance of facilities. This would lead to increased overtime and fuel costs as highway sections would be located further from maintenance stations. Fewer maintenance facilities would also increase the backlog of projects.

- **Sanding and plowing –** ODOT Maintenance estimates that over $7 million per year could be eliminated by a severe reduction in sanding on state highways and an additional $2 million per year from reduced snow plowing. These reductions would lead to more frequent and longer winter closures of mountain passes and increase the probability of accidents. The increased costs to private citizens would likely exceed the savings from program reductions.

- **Landscaping –** Up to a $2 million reduction per year would eliminate landscaping and other maintenance outside the immediate roadway area.

- **Delineators and markings –** A $3 million per year reduction would eliminate delineators on tangent sections and marking and eliminate repair of damaged guardrail. In addition, ODOT would use short-lived paint, instead of durable pavement markings. As a result, drivers would only have fog stripes to navigate.

- **Surface maintenance –** A $4 million per year reduction in surface maintenance would result in potholes not being repaired as fast as they are reported.

The reductions cited above represent the impacts of a 10 percent decline in maintenance funding. The 20 percent decline that would result as part of the flat funding scenario would require even deeper cuts and worsening of the physical condition of the roadway system. Some of the effects of these program reductions might not be felt in the short term, but the long-term costs to remediate the problems of reduced funding would be even greater.

Operations

ODOT's operational investments include technologies that are used to help the transportation system operate more efficiently and safely. New investments in the operations system would largely disappear as a result of flat funding, as the Operations Section would only have enough funding to maintain and operate its existing system. Some of the impacts of this would include the following:

- No new ITS deployments in regions outside of Portland. As described above, ITS deployments have been identified for Eugene-Springfield, Medford, Salem, and Bend. The upfront costs of ITS investments would essentially make it impossible to implement these under the flat funding scenario.

- ODOT Operations would likely be unable to provide new signals and other traffic control devices. This would primarily impact urbanizing areas that do not have signal systems in place. Without additional funding, many of these areas would experience potentially significant congestion and safety issues that result from nonexistent or substandard traffic control.

Public Transportation

Transit is funded through a mix of public investment, fares, and indirect charges, such as payroll taxes. In Oregon, payroll taxes are the largest single contributor to transit fares in the Portland metro area and Eugene-Springfield. Both indirect charges and fares are not expected to be impacted as a result of flat funding.

If funding for public transportation remains at current levels, it is predicted that per capita ridership would fall an estimated 26 percent by 2030. Currently, there is one public transportation vehicle for every 2,250 Oregonians. Keeping current funding levels would result in having one vehicle for every 3,140 Oregonians. This flat funding scenario would freeze costs, fleet size, services, and performance at 2004 levels, and assumes no adjustment for inflation or population, with per capita ridership levels declining as population increases.

On-demand transit services beyond those required by federal law would likely be hit hardest by a decline in federal and state funding for public transportation. On-demand transit provides service to elderly and disabled residents all across the state. Urban fixed route services would also be cut to adjust to reduced funding.

Freight and Passenger Rail

ODOT commits a relatively low level of public funding to the rail system. Most of the costs of maintaining and expanding the system are borne by private freight rail operators. As a result, there are few major differences expected between the flat and reference scenarios as they impact rail. The reference scenario does assume that ODOT will provide funding to help purchase an additional train set on the Cascades line between Eugene and Portland that may not be possible under the flat funding scenario.

Given existing bottlenecks in the freight rail system, rail would not be able to capture any increase in commodities carried. Virtually all increases in freight tonnage would be carried by trucks and water. The average condition of the rail plant in Oregon would continue to decline, especially on the short-line rail system.

The one substantial area of public investment in rail is in grade crossing elimination programs, which have received $2 million to $3 million per year historically. These programs may be reduced or funded through other means under the flat funding scenario.

Aviation

For aviation, there are few major differences expected between the flat funding and reference scenarios. Portland and several of the other commercial airports in the state are largely self-financing. A combination of passenger facility charges and airport-specific fees, leases, airline charges, and concessions makes up the majority of the funding sources for these airports. Given the expected growth in air travel, these airports will continue to have funds to operate their existing facilities and expand these facilities to meet new demand.

Smaller commercial airports, such as Pendleton, and most general aviation airports rely more on public funding and would be impacted in the flat funding scenario. The recent state fuel tax has provided a dedicated funding source that helps ensure the quality of these airports. As the purchasing power of this funding source declines with inflation, the general aviation system will also decline. Deficiencies will increase in various areas of the aviation system, including runways and taxiways, lighting systems, instrumentation, weather reporting, facility capacity, meeting FAA dimensional standards, and airport protection. Because this funding source was enacted relatively recently (1999), the inflationary concerns are not as significant as for the state gas tax.

Maritime and Ports

As with many of the other modes, public funding is only one part of the overall funding picture for ports. Ports are largely quasi public-private entities that are able to raise funds through terminal leases, industrial development, and shipping fees. These funds are typically enough to cover investments in capital equipment and operations for the ports. Outside of Portland, most ports in Oregon are economic development agencies first and ports second. That is, most other ports outside of Portland generate more revenue from redevelopment than they do from port activities.

Public funding is crucial to maintaining navigable channels. As described above, there are two key federal funding sources to maintain existing channels such as the Columbia and Willamette Rivers – the Harbor Maintenance Trust Fund and the Inland Waterways Trust Fund. These sources help pay for major projects, such as maintenance dredging and channel deepening, maintenance of jetties and dikes, and other related activities.

With less buying power, there would be a reduction in channel maintenance for the Columbia River. The channel depth of the river would be reduced from the currently authorized 40 feet to approximately 38 feet. This would result in the decline in competitiveness of Oregon's marine economy as cargo volumes, vessel operations, and business activity are reduced due to the increase in the draft constraint and would impact activity at grain and mineral bulk terminals. With no marine-related development, there would be an increase in demand for a new petroleum products pipeline between Portland and Northern Washington. Decreased depth of the river not only affects the Port of Portland, but all facilities along the Columbia River in both Oregon and Washington.

Fewer funds would also reduce the channel depth of the Willamette River, from 40 feet to between 30 and 35 feet. At 35 feet, grain and mineral bulk terminals would close. At 30 feet, virtually all other deep-draft terminal vessel operations and related business activity would end.

Another major concern from flat funding relates to the jetties at the mouth of the Columbia River. The USACE estimates that the Columbia River jetties have a 20 percent of failure any given year. Failure of the jetties would significantly disrupt deep-draft navigation on the Columbia and Willamette Rivers for a period of time. Over 40,000 jobs that are generated by maritime activity and Oregon and Washington ports on the Columbia and Willamette Rivers would be in jeopardy.

4.2 Maximum Operations

The maximum operations scenario identifies the expected impacts of shifting funding from modernization to operational investments. Operational investments, such as ITS, provide a means to improve the fluidity of the transportation system and reduce the need for extra capacity. As described above, transportation agencies in Oregon have already begun to make ITS investments throughout the state, and the ODOT Traffic Management has identified additional locations for ITS deployments.

The maximum operations scenario was evaluated using several tools and existing studies:

- **ODOT statewide model** was adjusted from the reference scenario by shifting 23 percent of modernization funding out of capacity expansion projects and assuming it is applied to operations. The only operational enhancements modeled were urban transit improvements. Transit waiting times were reduced by one-half and city bus speeds were increased by five miles per hour.

- **ODOT ITS deployment studies** provided analyses of ODOT's existing and proposed investments in ITS deployment for several urban areas, including Portland, Eugene, Salem, and Medford.

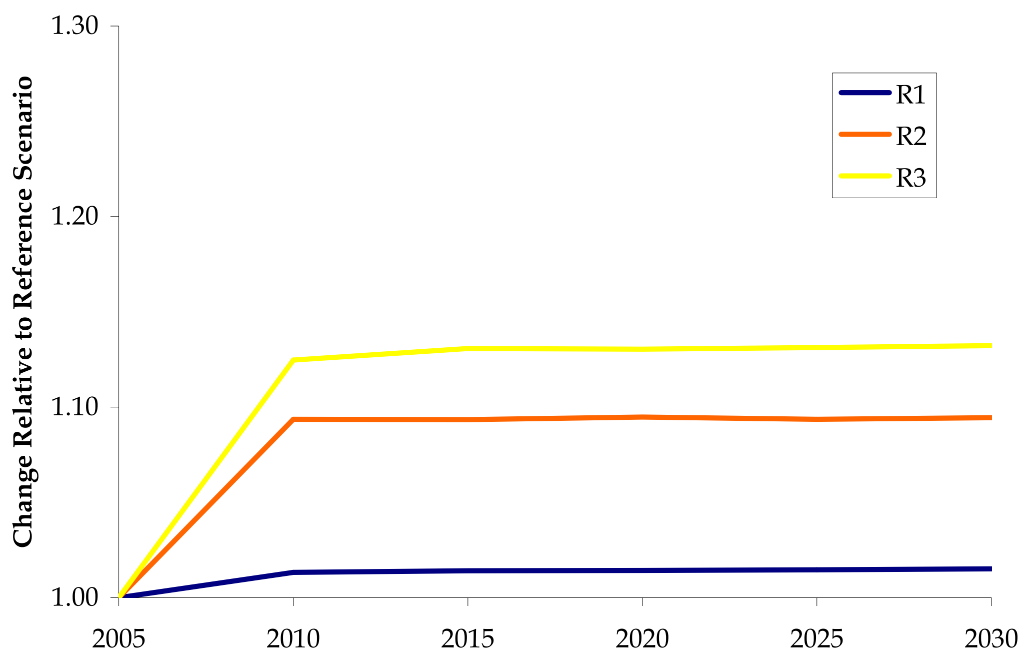
- **National research** on "full" ITS deployments in Seattle, Cincinnati, and Tucson were used to estimate the potential benefits of maximizing operational investments.

Statewide Model Results

The statewide travel model shows only slight changes in many of the performance measures used for this analysis. The primary changes that impact the model are the increased transit service and the reduction in spending on modernization. As described above, the reduction in spending on modernization primarily impacts the local transportation network and cannot be seen at the system level analyzed by the model. In addition, many of the benefits of operational investments cannot be evaluated using the statewide model. Additional tools and data used to evaluate these impacts are described below.

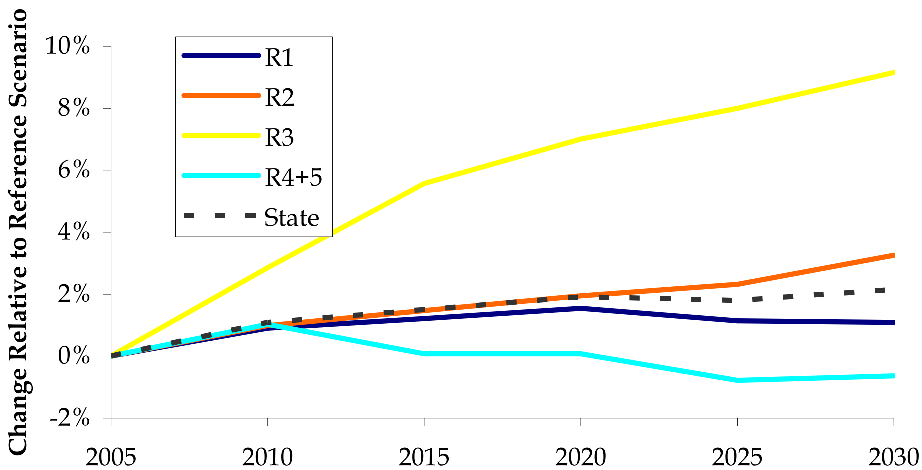
Because the operations strategy includes significant improvements to transit in urban areas (reduced wait times and improved speeds), transit availability and use are expected to jump significantly. Figure 4.2 presents the change in the percent of trips that have a viable transit option. Only Regions 1, 2, and 3 are shown because they have significant transit investments. From the perspective of the statewide model, a transit option is considered viable if it is one of the top three economically efficient (i.e., faster and/or cheaper) paths between any two points. This does not mean that transit is used for a particular option, but that it is possible. Notably, Region 1 changes the least in the maximum operations scenario, because it starts with the greatest base of available transit options. In 2005, over 90 percent of trips in Region 1 have a viable transit option in the statewide model.

Figure 4.2 Change in Transit Availability, Maximum Operations Scenario



The impacts of this increased transit availability are reflected in improved economic output, changing transportation costs, and changing patterns of development. Total employment is expected to grow a bit faster in the maximum operations scenario than in the reference scenario (Figure 4.3). Growth is expected to be strongest in percentage terms in Region 3. Notably, the investments from the maximum operations scenario occur primarily within the Willamette Valley (Regions 1 and 2), but the impacts are felt across the state. This reflects the economic linkage between the various regions of the state. All parts of the state rely on the services and employers that are located only in the Willamette Valley.

Figure 4.3 Change in Employment, Maximum Operations Scenario



Overall, transportation costs do not change for most income groups (Figure 4.4). Regions 2 and 3 experience slight declines, and Regions 4 and 5 experience slight increases in transportation costs across all income groups. Region 1 remains essentially flat. The changes shown in Figure 4.4 are not large enough to suggest a significant change in costs. The changes are a function of marginal changes in transit use across the regions. Because there is currently limited transit use in Regions 4 and 5, even a small increase can have some impact on costs and travel times.

Figure 4.4 Change in Transportation Costs by Income Group, Maximum Operations Scenario

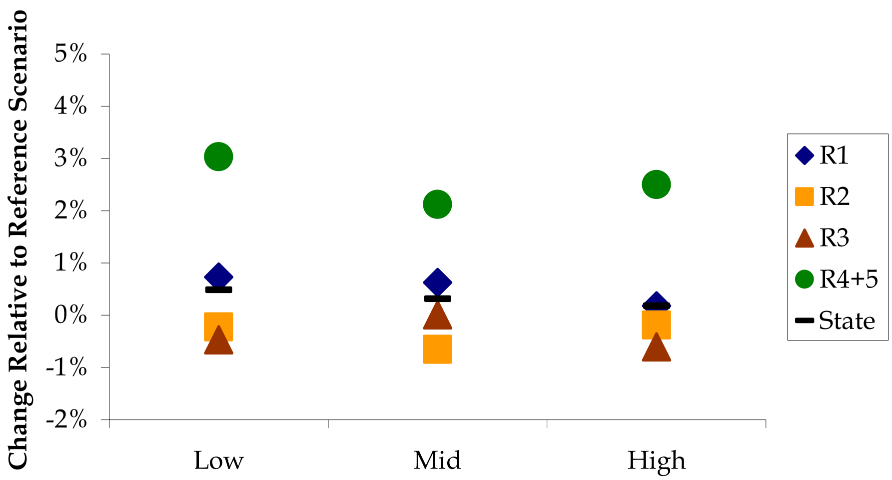
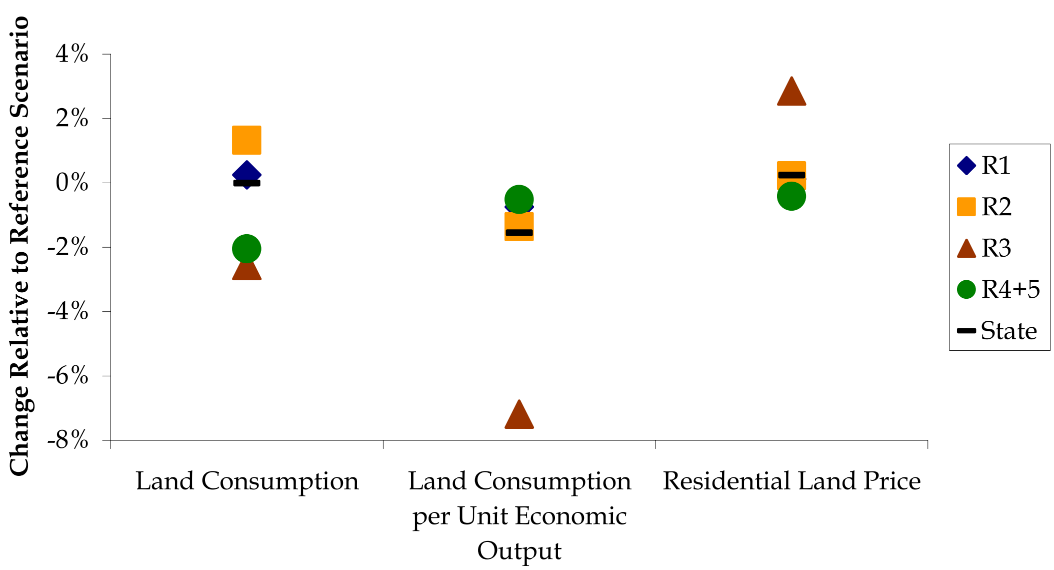


Figure 4.5 presents the expected land use changes as a result of the maximum operations scenario. Land consumption shifts slightly from Regions 3, 4 and 5 into Region 2, compared to the reference scenario. This shift in land consumption suggests the concentration of growth in Region 2 that results from additional investments in the Willamette Valley. Notably, even though land consumption declines slightly in Region 3, the economic growth is greater in this region per unit of economic output.

Figure 4.5 Change in Land Consumption, Maximum Operations Scenario



ITS Deployments in Oregon

ITS deployments have been shown to have a positive impact both in Oregon and nationally. ODOT has developed ITS deployment plans for several areas of the state, including additional deployments in Region 1, and new deployments in Eugene, Salem, and Medford. ODOT is currently conducting an analysis of potential deployments in Bend. Region 1 already has significant freeway management strategies in place and is looking towards arterial management strategies. Some of the benefits from various deployments include the following:

- Ramp metering on I-5 produced a 61 percent reduction in travel time and 43 percent reduction in accidents on some segments. Note that the benefits described here are for particular corridors or segments, and as a result are greater than when measured for the entire system.

- Ramp metering on I-205 was shown to nearly double travel speeds on that facility (from 30 to 58 miles per hour), reducing total travel time by at least 16 minutes.

- Since 1995, the ODOT and the Oregon State Police have operated an incident management program in the Eugene-Springfield metropolitan area, including incident response vehicles equipped with electronic message boards, temporary traffic control devices, flat tire repair gear, gasoline, jumper cables, water, and other essentials. An evaluation of the impacts of this program on I-5 in Lane County found a 35 percent reduction in incident related delay.

In addition, ODOT has conducted simulations of ITS deployments in Eugene using the ITS Deployment Analysis System (IDAS), a sketch planning tool developed by the FHWA to evaluate the impacts of ITS deployments in urban areas. Table 4.2 presents the results of that analysis for an overall system and two key components.

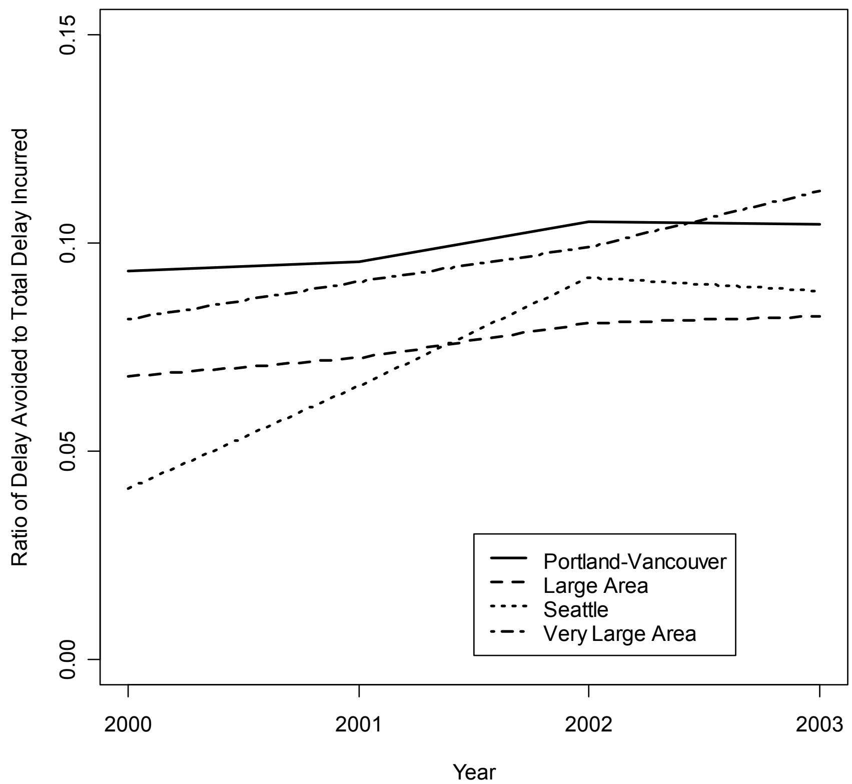
Table 4.2 Proposed ITS Deployments in Eugene

Deployments	Impacts	Benefit/Cost
Ramp metering on Beltline Highway	• Delay reduced 55 hours per day • 55 more gallons of fuel consumed per day[a] • 7 percent fewer accidents per day	Even with increased fuel consumption, benefits are valued at $1.2 million. Cost to implement is $230,000, yielding a benefit-cost ratio of 5:1.
Traffic responsive signal timing on Gateway Street	• $135,000 annual benefit from enhanced user mobility • $1,000 annual benefit from reduced fuel consumption • $10,000 annual benefit from reduced emissions	The total benefits were estimated at $146,000, with costs at $27,500, resulting in a benefit-cost ratio of 5:1.
Systemwide investments, including ramp metering, railroad crossing monitors, dynamic message signs, transit signal priority, traffic responsive signal coordination, incident detection and response, highway advisory radio, and CCTV cameras	• 9 percent reduction in crashes • 100 hours of delay saved per day • 24,000 gallons of fuel saved • 10 percent emissions reduction • 67 percent improvement in travel time reliability	The annual value of the benefit is estimated to be $25 million and the cost to implement is $2.4 million, yielding a benefit-cost ratio of 10.5:1.

a Increased fuel consumption is likely the result of additional idling on arterials and freeway on ramps, due to the ramp meters.

The recent Texas Transportation Institute (TTI) Urban Mobility Study examined the potential benefits of operational strategies in urban areas throughout the nation. The TTI report notes that delay could be significantly worse without several strategies and investments. In particular, Portland's existing transit service represents an overall delay savings of 40 percent (i.e., delay would be 40 percent higher if no transit was used). Operational strategies contribute another 10 percent of current delay that is saved. For both transit and operational strategies, Portland is more like very large cities (Los Angeles, New York, etc.) than cities its own size (e.g., Seattle, Sacramento, New Orleans). Figure 4.6 presents the contribution of operational strategies to congestion delay avoidance for Portland, Seattle, large urban areas, and very large urban areas, as defined in the TTI Urban Mobility Study. Very large urban areas are defined as having a population over three million, and large urban areas have population over a million.

Figure 4.6 Contribution of Operational Strategies to Congestion Delay Avoidance



ITS Deployments – National Examples

Three recent case studies of ITS deployments in Seattle, Cincinnati, and Tucson have shown improvements to key performance criteria, such as mobility (delay, vehicle speed, and travel time); environmental impacts (emissions); and safety (crash rate). For each of these case studies, a set of "full" ITS deployments was examined to help understand the maximum benefits that can be realized through current technologies. Table 4.3 presents the strategies implemented as part of the full ITS deployment in these cities.

Table 4.3 Full ITS Deployments Evaluated in National Studies

Strategy Type	Deployments
Arterial Traffic Management Systems	• Central control signal coordination covering all urban intersections • Emergency vehicle signal preemption for all urban intersections • Transit vehicle signal priority for a portion of urban intersections and transit vehicles • Highway advisory radio for major arterial corridors • Dynamic message signs
Freeway Management Systems	• Central control ramping metering for 35 to 75 percent of on-ramps • Highway advisory radio for 70 to 100 percent of freeway miles • Dynamic message signs coverage for 100 percent of freeway miles
Transit Management Systems	• Fixed-route automated scheduling and automatic vehicle location (AVL) for all fixed-route transit vehicles • Security systems for Seattle and Cincinnati on all fixed-route transit vehicles, major transfer stations, and park-and-ride locations • Electronic transit fare payment for all fixed-route transit vehicles
Safety Related	• Incident detection, verification, response, and management with service patrol vehicles on all freeways and expressways • Emergency vehicle control service and AVL for all emergency vehicles and telemedicine for all ambulances • Railroad crossing monitoring systems at 5 percent of major at-grade rail crossings
Traveler Information	• Telephone and web-based traveler information systems with 40 percent of market penetration • Kiosk-based traveler information at all major transit transfer stations
Commercial Vehicle Operations	• Weigh-in-motion and safety information exchange at all check stations • Combination screening and clearance-credentials and safety on vehicles with 40 percent of market penetration
Supporting Deployments	• Management center for traffic and transit • Emergency management • Information service provider center • Closed Circuit Television (CCTV) for all freeways, expressways, and urban arterials • Loop detectors for all freeways, expressways, and signals

The FHWA's IDAS software tool, along with locally validated travel demand models, were used to predict traffic conditions for each of the three cities for the two deployment scenarios:

- No operations and ITS deployments; and
- Full operations and ITS deployment.

This all-or-nothing approach to analyzing the impact of strategies is used to isolate the full costs and benefits of the operations and ITS deployments. A summary of the results of these analyses for several performance measures is presented in Table 4.4.

Notably, the cost-benefit ratios scale with the populations of the cities. One of the key findings of this analysis is that the benefits increase proportionally with population, but that there are large upfront costs (such as traffic or transit management centers) that are relatively fixed. As a result, smaller urban areas will experience fewer of the benefits that are presented here for relatively large urban areas. The Tucson metropolitan area includes just under a million people. There are also specific ITS strategies targeted for rural areas, though there have been few major analyses of the benefits of these systems.

Table 4.4 Annual Benefits of Full ITS Deployment (2003 $ Millions)

	Seattle		Cincinnati		Tucson	
Benefit	**Improvement**	**Value**	**Improvement**	**Value**	**Improvement**	**Value**
Travel time	3.7%	$337	4.0%	$267	7 hrs per resident	$113
Incident delay	3.2% recurring	$502	11.7% recurring	$305	5.6% recurring	$110
Crashes	8% fatal 3% injury and property	$136	9% fatal 3% injury and property	$85	7% fatal 3% injury and property	$57
Emissions	16% CO 17% HCO 21% NO	$181	22% CO 18% HCO 25% NO	$140	10% CO 12% HCO 16% NO	$50
Fuel consumption	19%	$409	24%	$293	11%	$86
Other		$46		$71		$40
Total benefits		**$1,610**		**$1,160**		**$481**
Average annual cost		**$132**		**$98.2**		**$72**
Benefit-cost ratio		**12.2**		**11.8**		**6.3**

Vehicle Infrastructure Integration (VII)

The FHWA has been examining the concept of a completely intelligent transportation system, where technology in vehicles and in the roadway would "speak" to one another to minimize crashes and provide real-time traffic information to both vehicles and transportation agencies.

The FHWA estimates that just less than one-half of crashes in the U.S. each year are a result of vehicles leaving the road or traveling unsafely through an intersection. The idea behind VII is that the technology in the road could provide a warning to a car when it leaves its lane, provide a warning to other cars when a car is moving too quickly towards a red light to stop, apply the brakes to a vehicle that is entering into the path of another vehicle, and have other similar applications.

The VII concept is relatively new, but the technology behind it is already appearing in vehicles. GPS units, tolling sensors, and sophisticated computers are already part of many vehicles. Agencies have already invested funds in Global Positioning System (GPS) devices, loop detectors, cameras, traffic centers, and other related technology that would support VII. This technology has not been deployed at the quality or quantity that would be necessary to implement a VII initiative.

The performance benefits of a functioning VII system would be substantial. The potential reduction in crashes is an obvious safety benefit, but this would also have a major benefit for mobility as well. Across urban areas in the U.S., between 52 and 58 percent of delay is a function of incidents, which include crashes, special events, and other nonrecurring events that impede traffic. [4]

Travel Demand Management

Travel Demand Management (TDM) or Transportation Options programs are an operational strategy that can relieve congestion by reducing the number of trips being taken. A variety of TDM programs have been implemented over the years throughout the Portland metropolitan region. In the past 10 years, programs have been designed in collaboration with large employers to reduce drive-alone commute trips as required by the Oregon Employee Commute Options rules. However, because less than one-third of all trips are made for work purposes, future TDM strategies will expand their focus to trips made for non-work purposes as well.

The core TDM strategy implementation in Portland over the last decade has been the employer outreach program, and this will continue to be the mainstay of TDM efforts over the next 10 years. The Regional Travel Options (RTO) program, implemented in 2003, identifies several programs for funding, including employer initiatives, car matching and

[4] TTI Urban Mobility Report

ridesharing programs, work schedule change programs, marketing tools, and local community programs. In 2003, $1.2 million were provided to the RTO program from ODOT's Congestion Mitigation Air Quality and Surface Transportation Program funds (both are FHWA programs).

Another program developed in Portland is TravelSmart, an initiative by the City of Portland and TriMet to encourage the use of environmentally-friendly modes throughout the day and not just for work trips. This program was launched in 2002 in an area of southwest Portland and involved providing information on alternate transportation modes to a subset of 600 households that were interested in participating in the program.

Based on the survey conducted for the RTO program from 1996 to 2003, non-drive-alone trips to work increased from 26 to 31 percent. This is consistent with findings at the national level. The TravelSmart program showed a reduction in car travel by nine percent and an increase of eight percent in walking, cycling, and public transit. This represented a reduction in VMT of 12 percent. Given the participation rate of programs, such as TravelSmart, when TDM strategies are viewed at the regional or system level, the reduction in VMT is greatly diminished. National studies have shown that employer-based TDM programs to reduce drive-alone trips have a regional impact on VMT of less than one percent.

Rail Freight and Passenger

In recent years, railroads have taken advantage of technology to reduce costs and improve service. Recent technological innovations include improved train control systems, larger rail cars, and computers to track cars and assist in dispatching. However, the bulk of these technological improvements has taken place, and no nationally significant advances are on the horizon.

Current technology improvements are associated with making locomotives more efficient and helping shippers keep track of their shipments. Improved train control systems are being studied, but have not been placed into service in any meaningful manner. Until a safety case can be proven, these systems act as overlays to existing train control systems, but do not add capacity to the system. The major impact of these systems may be to reduce train locomotive crew sizes and the railroads' bottom line, but not to increase the competitiveness of the rail mode.

In Portland, there is one major operational improvement that could benefit rail. The I-5 Trade Corridor Study recommended that the railroads in the Portland area consolidate their local dispatching activities in a joint facility. Experience has shown that in instances where this has taken place, the fluidity of the rail system has shown a marked increase in efficiency. Because two major rail carriers (UP and BNSF) operate in the Portland market, public investments may be necessary to facilitate the installation of such a system.

The improved fluidity of the system in Portland could increase capacity on mainlines and reduce travel times on the I-5 corridor from Seattle to Los Angeles. This improvement has the potential to make rail competitive with trucks in the Seattle to Los Angeles corridor by making second morning delivery by rail a realistic possibility. Over the short term (within the next five years), reduced travel times on the West Coast could double growth rates in this market before capacity constraints prevent further growth.

4.3 Major Improvements and Pricing

The major improvements and pricing scenarios are closely related and are therefore evaluated together. Table 4.5 lists highway major improvements and pricing scenarios that were evaluated for the OTP. In addition, major improvements were identified for operations, maintenance, and preservation and for each of the transportation modes identified above. These are described in detail later in this report.

Table 4.5 Major Improvements and Pricing Scenarios

Scenario	Description
Major Improvements 1	• Additional projects from Regional Transportation Plans beyond those in the reference scenario • Projects of Statewide Significance
Major Improvements 2	• Major Improvements 1 • Additional lanes on I-5 (Eugene to I-205) and I-205 (I-5 to Washington border)
Roadway Pricing – all lanes	• Major Improvements 2 • Pricing on all lanes in the I-5 and I-205 corridor; \$0.05 per mile on I-205 and \$0.025 per mile on I-5
Roadway Pricing – added lanes	• Major Improvements 2 • Pricing on added lanes only; separate scenarios for cars, trucks, and all vehicles

Surface Transportation

The impacts of the major improvements and pricing scenarios are described by performance criteria. For most cases, the impacts from the maximum operations scenario are also shown for comparison purposes. All of the changes described are relative to the reference scenario.

Mobility

Mobility is measured primarily using several indicators of travel time. At the systemwide level, there were no significant changes in commute travel time with the first wave of major improvements (Figure 4.7). The addition of lanes between Eugene and Portland does have a significant impact on total travel time for the three regions on the I-5 corridor. This effect is most pronounced for Region 3, which is relatively more dependent on the economy of the Willamette Valley (Regions 1 and 2).

Roadway pricing has an economic concentrating effect; economic activity increases faster in Regions 1 and 2 than in the rest of the state. This is caused in part by a major decline in travel time as capacity is increased on the major Interstates within these regions. Regions 3, 4, and 5, by contrast, show increased travel times as more distant markets become more accessible due to reduced congestion. More distant regions can afford to compete for business as transport costs decrease.

Similar impacts can be shown for freight travel time. Figure 4.8 presents average travel time to the Port of Portland. Notably, freight traffic benefits substantially from roadway pricing due to the increase in physical capacity and the reduction in use of these facilities by passenger vehicles. Pricing allows for much faster freight movements in the I-5 corridor, which provides for some tradeoff against the increased cost. The value of time for freight trips is more than double than that for business trips, and four to eight times that for commute trips.

Figure 4.7 Average Travel Time per Commute Trip

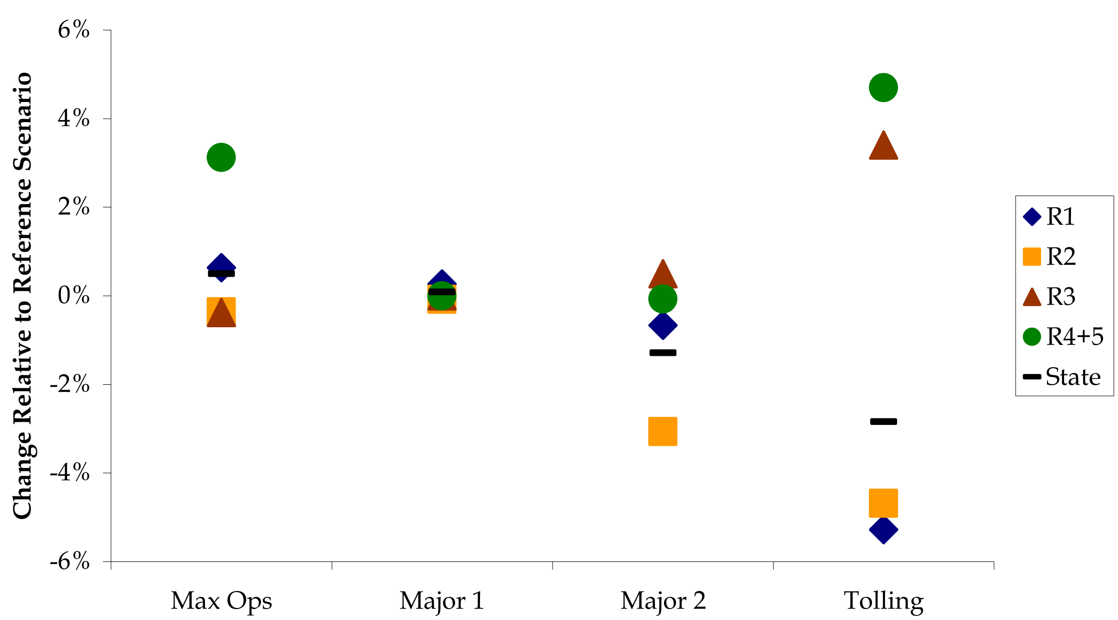
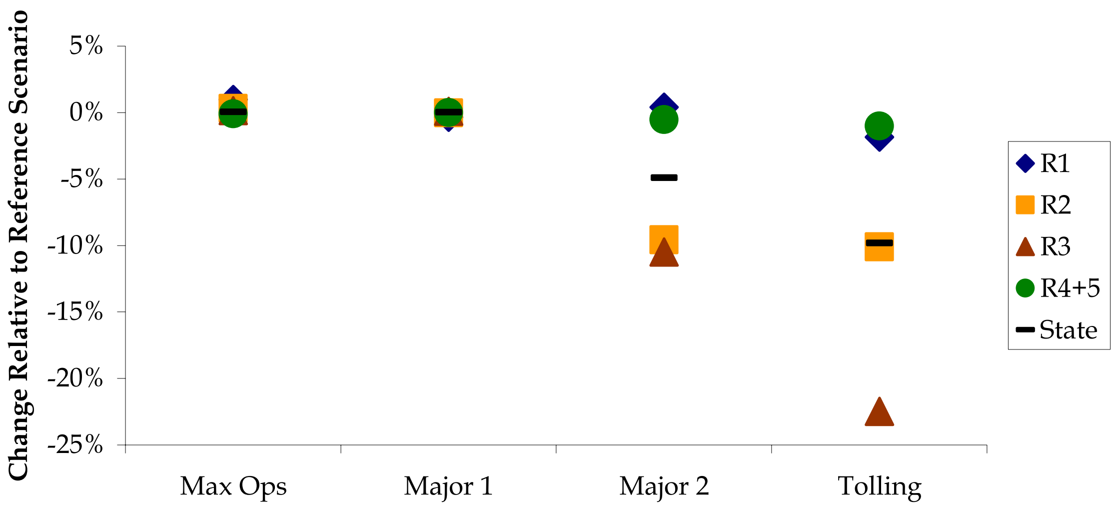


Figure 4.8 Average Travel Time to the Port of Portland

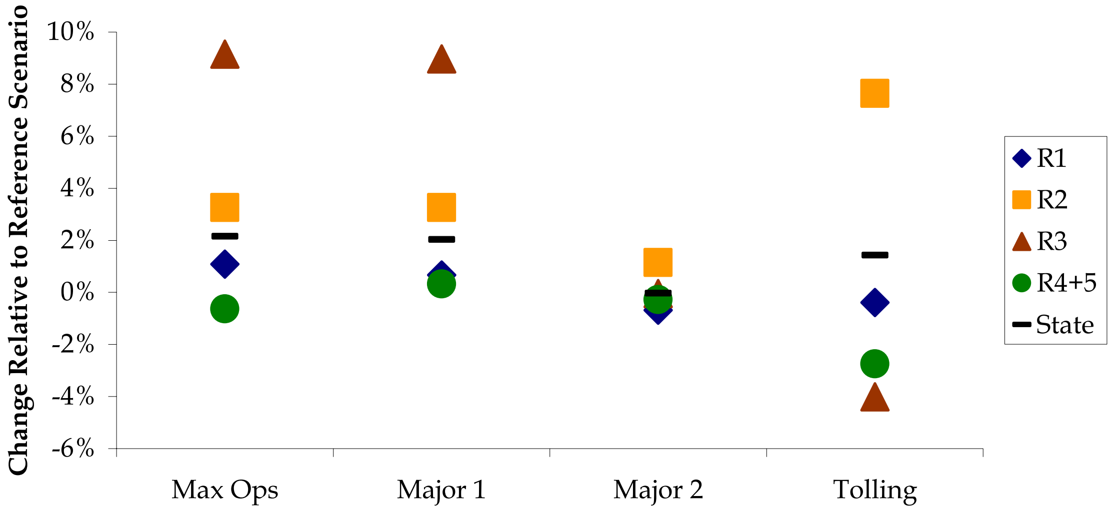


Economic Vitality

Economic vitality was measured using employment change and access to employment by residents. Total employment is expected to increase in most major improvement scenarios (Figure 4.9). Notably, the changes are quite similar between the maximum operations and first major improvement scenarios. In both cases, Region 3 is benefiting substantially from investments in Regions 1 and 2. Road pricing has only a slight positive impact on employment, but does cause a substantial shift in the location of employment. Region 2 grows much faster, and Regions 3, 4, and 5 all grow slower than the reference scenario.

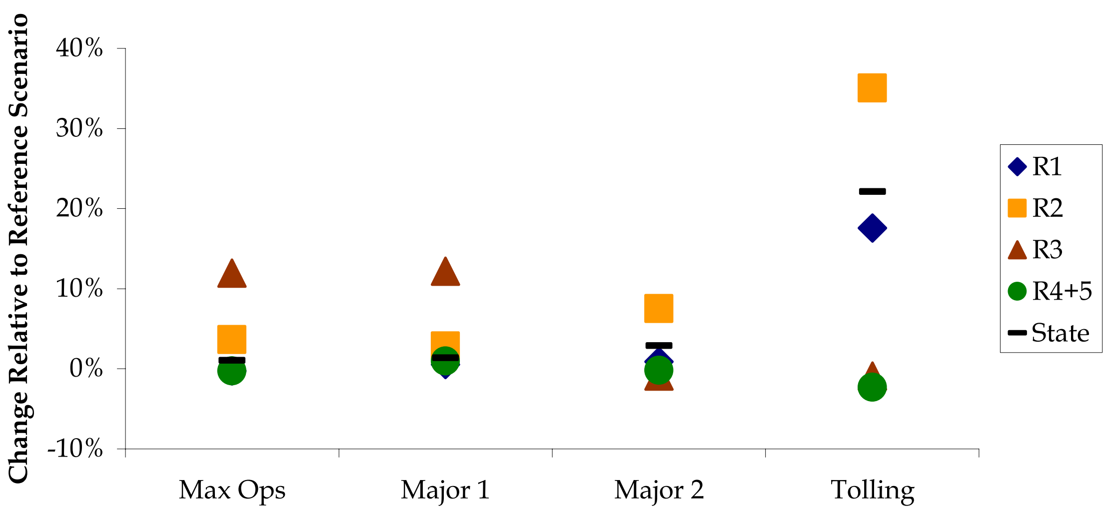
The major improvements 2 scenario does not show economic improvement because the addition of freeway lanes encourages longer commutes. The model sees these as increased costs for employers and this limits the economic benefits. In reality, the commute costs are paid by the household rather than the employer and therefore some employment increases should occur.

Figure 4.9 Total Employment



Similar impacts can be seen for the location of workers relative to employment (Figure 4.10). Again, road pricing tends to concentrate economic activity in the Willamette Valley, with Region 2 producing substantially improved access to jobs; and Regions 3, 4, and 5 showing a slight decline, relative to the reference scenario.

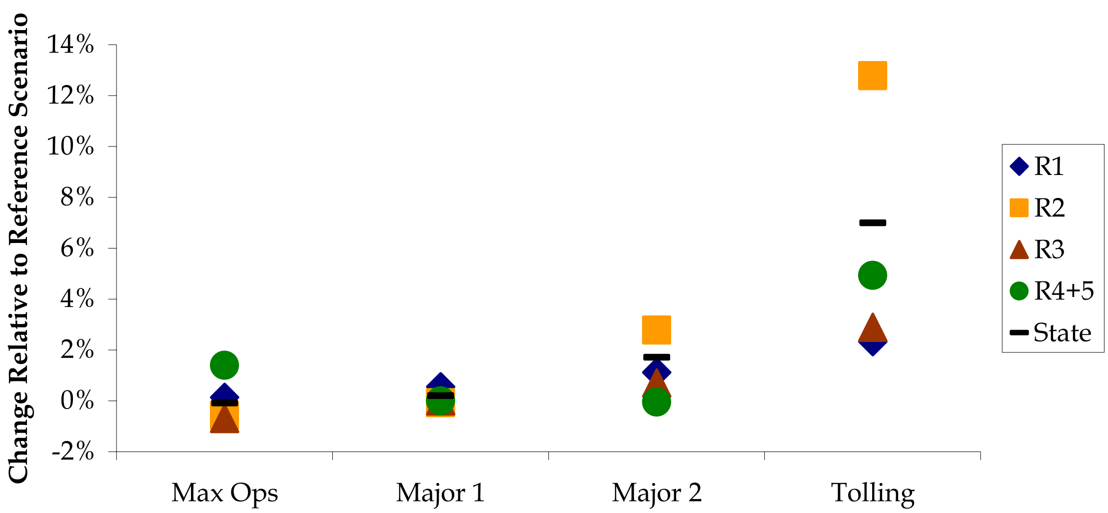
Figure 4.10 Workers Within 30 Minutes of an Average Job



Effectiveness/Efficiency

Effectiveness and efficiency are measured using the average trip distance. Scenarios that improve effectiveness will produce shorter trips, reducing the overall VMT on the system. Most of the scenarios have only minimal impact on the average length of commute trips, with the exception of the road pricing scenario (Figure 4.11). With tolls on the major state highway in Region 2 (I-5), searches for alternate routes increase the total length of trips for this region. Other regions also experience increases, though the effects are more muted.

Figure 4.11 Average Trip Distance, Commute Trips



Equity

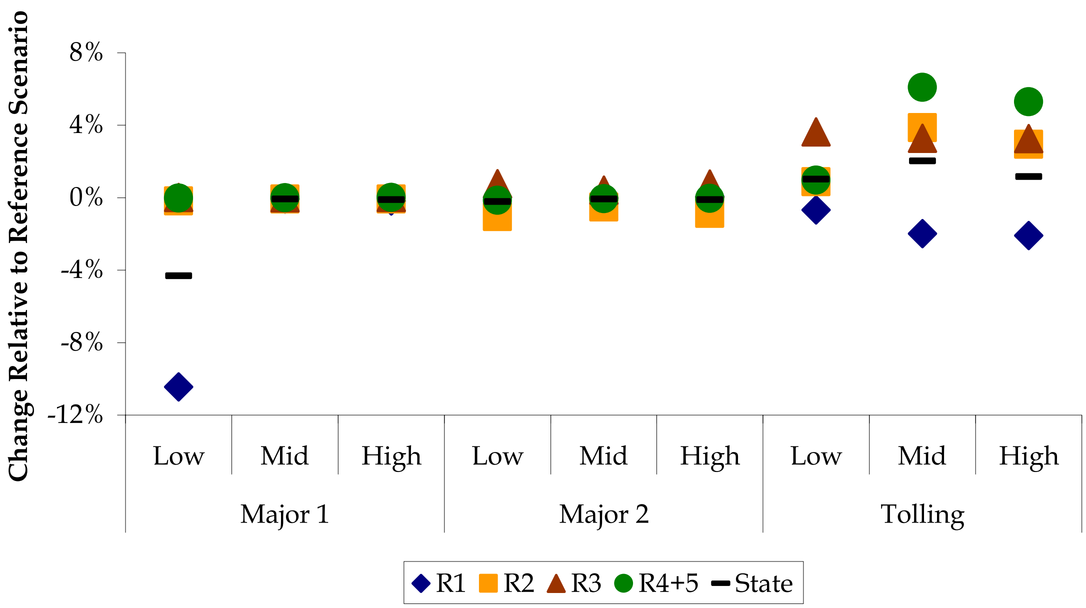
Equity was measured using the average cost per commute trip by income category. Average cost per trip includes both out-of-pocket costs (gas, tolls, etc.) and the value of travel time. The first major improvements scenario provides benefits to low income workers in Region 1 in the form of reduced transportation costs (Figure 4.12). None of the other regions is impacted by the major improvement scenarios. Notably, adding lanes to I-5 and I-205 does not change costs significantly for any groups. As expected, tolling increases costs on average, although there are some interesting variations among the groups. These variations can be explained by the following factors:

- On average, tolling adds cost to each trip, driving up costs. This is mitigated somewhat by the time savings that result from a decline in travel time.
- Value of time is higher for higher income groups. As a result, tolls may actually decrease trip costs for shorter trips because of the time savings.

- Travelers in Region 2 attempting to find alternate routes (see the discussion of average trip distance) will pay more (in time) for these longer trips. These costs will be relatively higher for mid- and high-income groups, because of higher values of time.

- Outside of Region 1, trips using the tolled facilities are likely to be longer (especially in Regions 3, 4, and 5). Longer trips show less of a tradeoff between time and tolling cost (e.g., 15 minutes of time saving are negligible in a four-hour trip). Because most of the congestion relief is in Regions 1 and 2, there is not enough time savings to counteract the impact of the toll for mid- and high-income groups.

Figure 4.12 Transportation Costs by Income Group, Commute Trips

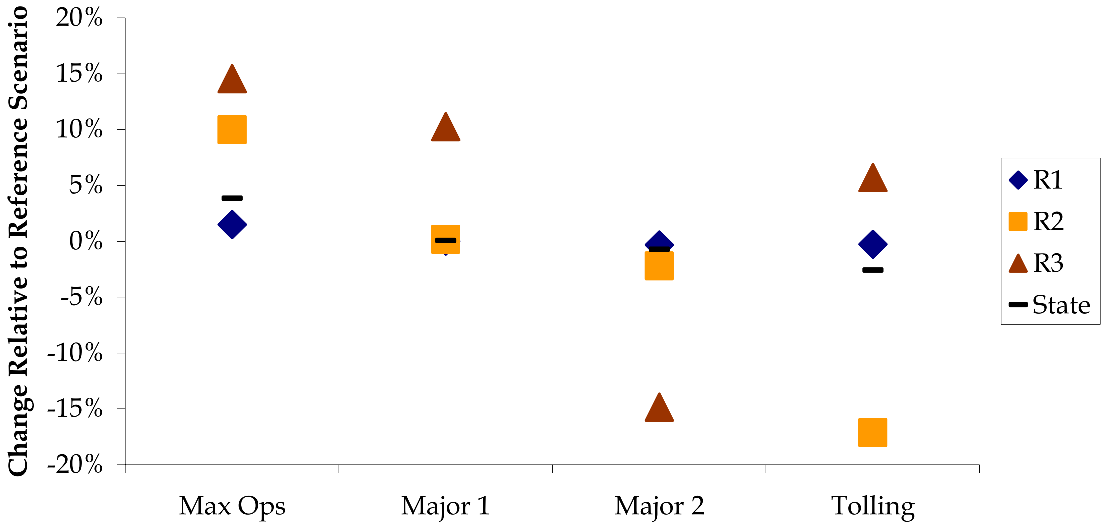


Reliable/Responsive

The availability of transit options was used to measure the reliability/responsiveness criteria. This measure captures the existence of alternatives to highway travel. Figure 4.13 presents the change in transit viability relative to the reference scenario for Regions 1, 2, and 3. Regions 4 and 5 are not included because they do not have substantial existing fixed-route transit systems.

Relative to the reference scenario and the maximum operations scenario, major improvements and roadway pricing tend to reduce the viability of transit (Figure 4.13). In particular, the scenarios that add lanes to I-5 and I-205 reduce the costs of highway travel, which makes transit a less attractive mode.

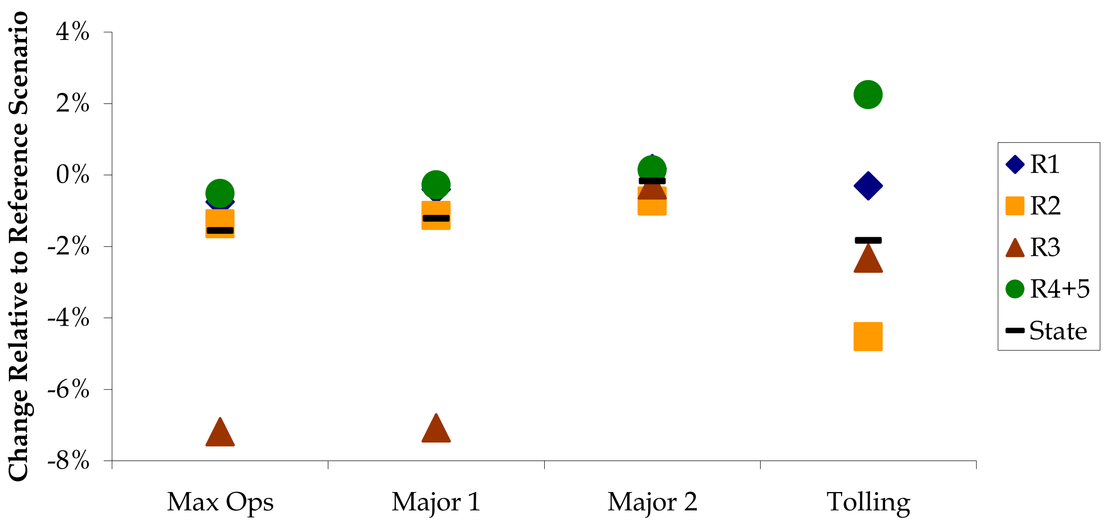
Figure 4.13 Percent of Trips with a Viable Transit Option



Sustainable

Sustainability was measured using land consumption, change in land consumption relative to economic output, and land price. Figure 4.14 presents the change in land consumption per unit of economic output for each scenario relative to the reference scenario. A decline in this measure suggests that economic growth is handled more efficiently. The economic growth experienced in Region 3 under the maximum operations and major improvements scenarios is reflected in the greater efficiency of land use. At the state level, the difference from the reference scenario is less than two percent, except for the roadway pricing scenario. In this scenario, an economic shift from Regions 4 and 5 to Region 2 is apparent.

Figure 4.14 Land Consumption per Unit of Economic Output



Public Support/Financial Feasibility

Major improvements and roadway pricing require new funding, either through indirect sources (for major improvements) or direct charges (from tolling). The cost of the projects of statewide significance and earmarked projects are provided in Table 4.6.

The cost of adding lanes to I-5 and I-205 was estimated from several sources. The *State of the Interstate Report* for I-5 that was completed in 2000 provided an estimate of improvements to I-5 in Regions 2 and 3. The total cost for these improvements was nearly $4 billion, but included substantial improvements to I-5 in Medford and replacement of a number of structures that are likely to be replaced as part of OTIA III. For I-205, there are no existing studies that provide information about the costs of widening. Information from the I-5 report suggests that these costs may range between $15 million and $50 million per mile, depending on the terrain, existing right-of-way, and level of urban development. I-205 passes through areas of varying development and may face constraints to widening at some locations.

The total length of I-5 and I-205 between Eugene and the Washington border is 120 miles. Many segments in Region 2 will be able to be widened a relatively low cost, given the flat terrain and existing right of way. The cost for the entire project would be between $2 billion and $3 billion, depending on the need to replace or widen existing structures, the need for right-of-way purchase, and other factors.

Table 4.6 Projects of Statewide Significance and Earmarked Projects

Region	Project Name	Description	Cost ($M)
1	Columbia River Crossing (I-5 Trade Corridor)	Columbia River vehicle & transit crossing improvement, STIP funding is for EIS	$1,000.00
1	I-5 to OR 99W Connector	Tualatin-Sherwood connector Phase 1 Arterial Connection	$53.00
1	OR 212/224: Sunrise Corridor	Construct new 4-lane facility from I-205 to OR 212/135th Ave	$216.00
1	I-205: Columbia River to I-5	Reconnaissance studies of I-205 segments	$0.24
1	I-405: Loop Analysis	Analysis for I-405 freeway loop's future and prioritization of loop projects	$0.20
1	I-5: Delta Park – Lombard/ Victory Boulevard Phase 1	Widen I-5 between Victory and Lombard interchanges	$100.00
1	OR 217: Tualatin Valley Hwy – U.S. 26	Widen Hwy 217 to 6 lanes between U.S. 26 interchange and Tualatin Valley Hwy	$33.60
2	U.S. 20: Pioneer Mountain-Eddyville (Lincoln County)	Reconstruction & improvement of U.S. 20 (Corvallis-Newport Highway)	$165.00
2	OR 99W: Newberg-Dundee Bypass	Complete EISs, buy ROW, construct bypass (or other alternative)	$350.00
3	OR 62: Corridor Solutions Unit II (Medford)	Unit 1 already underway = $37.3M	$40.50
3	I-5: Fern Valley Interchange (Unit 2A)	Reconstruct freeway ramps to improve safety and capacity, reconstruct connection road from OR 99 to Phoenix Rd, and replace 2 bridges	$31.78
4	U.S. 97: Modoc Point – Algoma, Ph 2, Units 2 & 3	Realign and make safety improvements on U.S. 97 from Modoc Point to Algoma.	$13.00
4	U.S. 97 Reroute Phase 1, Unit 2 (Redmond) (Maple/Negus)	New N/S route for U.S. 97 through Redmond; improvements to U.S. 97 and OR 126 intersection; new northern interchange	$61.55
Total			**$2,064.87**

Pricing – Financing and Demand Management

Several additional pieces of information are available to describe the impacts of the roadway pricing scenario. These include the additional model runs that evaluated the impact of pricing lanes on I-5 and I-205 and recent national examples of toll lanes in the U.S.

The roadway pricing scenario examines the impact of placing tolls on key transportation facilities in Oregon. These tolls are intended to help cover the cost of providing additional capacity in key corridors. For the purposes of the OTP, only the added lanes to I-5 and I-205 (described above) were tolled.

Tolling Added Lanes Only

Two pricing levels were estimated for three types of facilities – auto only, truck only, and mixed traffic.

Pricing levels vary widely across tolled facilities in the U.S. Older toll facilities, such as many of the turnpikes in the Northeast, tend to have relatively low toll levels – between $0.05 and $0.35 per mile. Truck tolls at these facilities are much higher and are typically estimated on a per-axle basis, rather than a flat rate for all vehicles.

Recent tolled facilities have used higher price levels, between $0.20 and $0.50 per mile, but these charges are typically estimated as congestion-based. That is, they vary by time of day and direction. On I-15, for example, the charges are set by both expected congestion, as well as the actual flow of the facility. As more vehicles use the toll lanes, the price is increased – up to as much as $0.80 or $1.00 per mile to ensure a continuous free-flow facility.

For the OTP, a high price and low price were estimated for each of the three tolling scenarios (auto only, truck only, and mixed traffic), yielding six scenarios. The high and low prices are shown by the type of road segment they were applied to in Table 4.7.

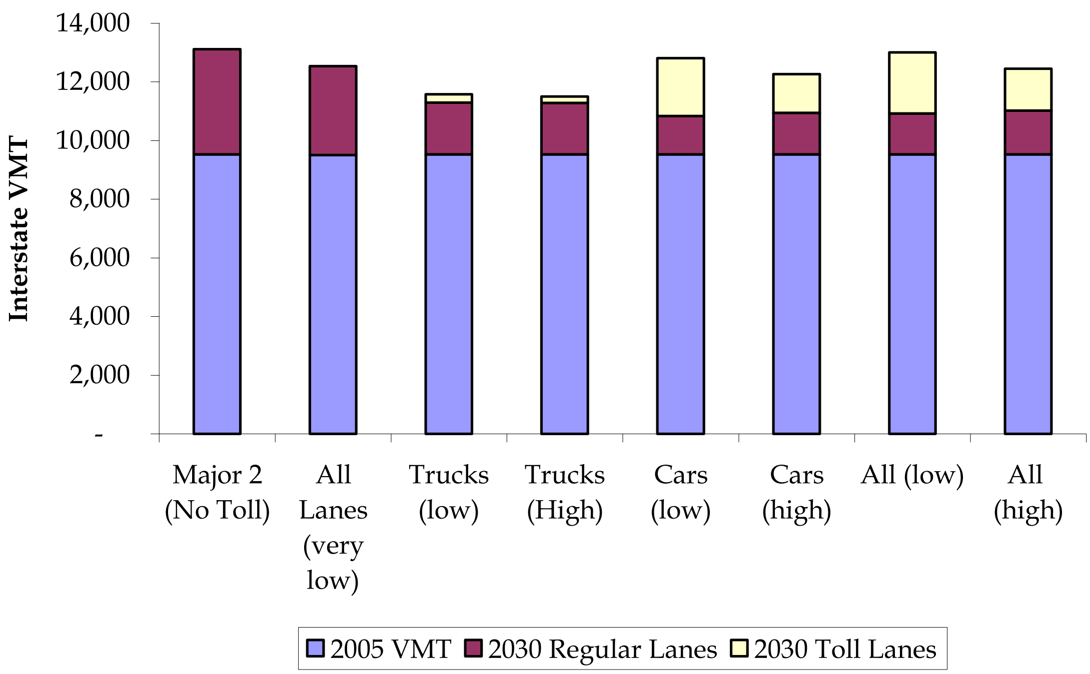
Table 4.7 Tolling Scenarios – Pricing Assumptions

Segment Type	High Price (Per Mile)	Low Price (Per Mile)
Rural segments	$0.15	$0.10
Urban segments	$0.30	$0.20

Figure 4.15 presents the impacts of these tolling scenarios on total VMT on interstates in Oregon. The scenarios in Figure 4.15 include:

- "Very low" tolls for all vehicles on all lanes of the facilities considered – 5 cents per mile on I-205 and 2.5 cents per mile on I-5;
- "Low" tolls (see Table 4.7) for the added lanes only, modeled separately for only trucks allowed, only autos allowed, and all vehicles allowed; and
- "High" tolls (see Table 4.7) for the added lanes only, modeled separately for only trucks allowed, only autos allowed, and all vehicles allowed

Figure 4.15 Interstate VMT by Tolling Scenario



Toll Lanes in Other States

Several other states and regions have pursued roadway pricing strategies in recent years. These recent examples, as well as existing tolled facilities such as turnpikes, were used to identify potential pricing levels and expected revenue generation and impacts of tolled facilities. Three recent tolling projects are of particular interest:

1. **SR 91 in Southern California –** This project provided tolled lanes along SR 91 in Orange County. These lanes are available for use by both toll paying and high-occupancy vehicles (HOV).

2. **I-15 in San Diego, California –** This project is an eight-mile, two-lane, reversible toll facility in the median of I-15. Access is only allowed at the north and south ends of the project, and HOVs and motorcycles may use the lanes for free.

3. **Minnesota DOT's MNPass work –** This project examined tolling options for most roadways in the Minneapolis-St. Paul urban area. The first of these toll roads was implemented along I-394 in May 2005.

Each of these examples uses dynamic or congestion-based pricing and allows for HOVs as well. These lanes are known as high-occupancy toll (HOT) lanes. The two California examples are able to pay for both capital and operating costs. The I-15 toll lanes, for example, fund a bus service in the corridor.

Research on toll lanes in Minnesota suggests that smaller urban areas may be able to cover operating costs and only some portion of capital costs for toll lanes. The average cost recovery ratio for the system proposed for the Twin Cities was 22 percent.[5] That is, over three quarters of the capital cost of building the new lanes would have to be covered by standard public sources. Some segments analyzed as part of regional toll network in the Twin Cities covered over 50 percent of the capital costs, but none covered the entire cost. Legislation that enabled the toll lanes on I-394 requires that one-half of the revenue be dedicated to repaying the capital cost, and the other one-half to fund bus transit service in the corridor. Notably, the I-394 HOT lanes were a conversion from existing HOV lanes, as opposed to construction of new toll lanes and were therefore less expensive than building new lanes.

All of the proposed toll lanes in the U.S. have been effective as a congestion management strategy. The findings presented above (in Figure 4.15) that suggest reduced VMT are reflected across the U.S. For example, the MNPass study of toll lanes in the Minneapolis-St. Paul metropolitan area suggests that a toll lane system for the region could save over 175,000 hours of delay by 2030 and reduce vehicle travel on the highway network by close to 285,000 miles per day.

Highway Operations, Maintenance, and Preservation

As identified through the OTP needs analysis, the reference scenario funding levels are well below the "preferred" level of service for ODOT's operations, maintenance, and preservation activities. The following sections provide information about these needs and the funding required to achieve these needs.

[5] The cost recovery ratio is determined by comparing the present value of the net revenue stream (i.e., total toll revenues minus operating costs) to the present value of the capital cost stream (i.e., annual debt service payments).

Bridges

The feasible needs that were identified in the Bridge Options report, but not funded in OTIA III will require funding of $85 million per year over the 25 years of the OTP. The preservation unit of the Bridge Section identified a need of $20 million per year for paint, movable bridge, and corrosion-protection projects. If preliminary engineering and right-of-way acquisition costs are also incorporated, the cost would increase to $25 million. These funds are primarily needed to continue maintenance and rehabilitation for historic, moveable, and coastal bridges.

A category has been programmed into the STIP called Major Bridge Maintenance, a need identified by the Bridge Program Unit of ODOT. Currently, $5 million a year has been programmed for 2004 to 2008, and will increase to $20 million per year starting in 2008. These funds are used for repairs that are more routine than maintenance, but less than bridge rehabilitation, such as emergency structural repairs.

Full funding of the bridge program will yield a system that allows for freight movement across the state. Out of a total of 2,680 state bridges, OTIA III will address 365 bridges along the most significant freight routes in the state. Many other bridges will face load restrictions, either at the 105,000 pound level or the 80,000 pound level. Under the major improvements scenario, many of these bridges would be replaced or rehabilitated. Not all bridges would be replaced – the state has numerous historic and coastal bridges that cannot be replaced, but will require substantial additional maintenance. Under the major improvements scenario, $25 million a year would be dedicated to the maintenance of these structures.

Pavement Preservation

The goal of the preservation program is to preserve the state highway system at a condition of 90 percent fair-or-better overall by 2015 and continuing through 2025 (Table 4.8).

Table 4.8 Preferred Level of Service for Pavement Condition

Roadway Class	Percent Fair or Better
Interstate	95%
Statewide	93%
Regional (Non-Low Volume)	90%
District (Non-Low Volume)	85%
Low Volume Roads	85%

Preservation activities are focused on highways in fair condition to ensure that these highways do not reach poor condition. Focusing on poor condition roads would reduce the overall condition of the roadway system, because these repairs are much more expensive than those for fair condition facilities.

Low volume roadways (with fewer than 2,500 vehicles per day on average) would be maintained consistent with 2004 funding levels. This program maintains an 82 percent fair or better rating on low volume roads.

The preservation program has improved pavement conditions over the past several years; however, the largest gains have been to rural highways and low volume highways. These roadways have been favored for investment over those highways that need extensive rehabilitation, which are typically in higher volume urban areas. Raising conditions to feasible needs requires a large increase in funding to make needed improvements to these higher volume segments, but costlier sections of highway.

Total cost to achieve the preferred pavement levels of service is provided in Table 4.9. The total cost is about 30 percent higher than is available under the reference scenario.

Table 4.9 Pavement Preservation Costs, Major Improvements Scenario

	Cost
Interstate	$67 million/year
Non-Interstate	$91 million/year
Low Volume Road Shortfall	$ 2 million/year
Total Preservation Need	**$160 million/year**

Maintenance

For maintenance activities, the preferred level of service for the major improvements scenario allows acceptable long-term outcomes and reduces the chance of catastrophic failure with transportation infrastructure. The level of expenditures that is required to reach preferred service levels would be 34 percent greater than what was expended in 2004. Total preferred level of service is provided in Table 4.10.

The additional maintenance funding would ensure that maintenance problems on the state highway system were addressed quickly and that maintenance would not be deferred. Some of the potential benefits of additional maintenance funding could include the following activities:

- Regular patching of roadways and shoulders would address potholes and related issues and would could extend the life of existing pavements;

- Clearly marked and delineated roadways provide potential safety benefits;
- Additional funding for roadside vegetation would improve the aesthetics of the state highway system and help ensure that roadway signs are visible to travelers;
- Additional funding to clear of snow and ice would reduce road closures and provide access to recreational facilities; and
- Other related benefits.

Table 4.10 Maintenance Funding, Major Improvements Scenario

Program Area	Preferred Funding
Surface and shoulders	$40,600,690
Drainage	$13,495,674
Roadside vegetation	$36,650,334
Traffic services	$42,419,520
Structures	$11,441,579
Snow and ice	$35,106,109
Extraordinary maintenance	$7,790,714
Permits	$4,687,380
Total	**$192,192,000**

In addition, to achieve the desired levels of service, approximately $110 million will be needed to address deferred maintenance costs. These are one time funding requirements in addition to the annual increases described above. Over the course of the plan, addressing these deferred needs would cost an additional $4.2 million per year. The deferred needs include the following:

- $20 million to improve substandard guard rails;
- $50 million in backlogged culvert replacement needs;
- $10 million to update older electrical systems; and
- $30 million to upgrade rest areas to desirable levels.

Public Transportation

The preferred level of transit service from the *Oregon Public Transportation Plan* was used to estimate the feasible needs for public transit in Oregon. This level of investment will increase the fleet size to nearly 2,700 from the current 1,558 vehicles. Ridership is expected to increase from 35 to 42 trips per capita by 2030 – a 60 percent increase in overall transit ridership. Total transit ridership in the state would be 205 million trips annually, at a cost of $817 million per year.

These increases in transit ridership reflect the following assumptions:

- Ridership increases with population growth and service increases to reach the per capita target;
- Costs increase over the planning cycle as a function of population growth and service increases;
- Capital costs in urban areas increase based on the preferred scenarios in local RTPs; and
- Non-urban capital costs increase to meet the per capita ridership target.

Freight and Passenger Rail

Freight and passenger rail needs for the major improvement scenarios have been identified by rail type, including needs for short line, mainline, and port facilities related to freight movements, as well as passenger rail needs.

Altogether, needed rail improvements in Oregon amount to $465 million over the next 25 years or almost $19 million annually. It is assumed in the estimates that short lines upgrade their infrastructure to accommodate heavier rail cars, that main line railroads offer enhanced services to compete with interstate truck services, that I-5 rail capacity improvements in the Portland area be made to reduce congestion and train interference, and that smaller ports upgrade their rail capacity.

Short Lines

For its *2001 Oregon Rail Plan*, ODOT surveyed the 16 short-line railroads serving the state at that time to determine future needs. The eight respondents identified that principal needs involved mainly rehabilitation of track and bridges, but also included needs for some equipment and some debt financing. A major rehabilitation need was related to the use of 286,000-pound cars, which are popular with shippers and Class I railroads and are about nine percent heavier that previous maximum car weights. Many of the short-line railroads do not have the underlying track and structures that are capable of supporting these heavier cars. The needs identified in the survey responses totaled $70 million.

To quantify total statewide needs for all short lines, national rail studies were used to estimate needs in the *Oregon Rail Plan*. As rail ties have an average 40-year life cycle, Oregon's short line railroads need to install 100,000 new ties each year at an estimated cost of $5.5 million. If all rail sections with 90-pound rail and less were replaced, short lines would require $186 million (in 2004 dollars). Bridges would constitute another $60 million. Therefore, a total need for short lines would be close to $250 million over the course of the plan, exclusive of equipment, debt financing, and other items.

Main Lines

The two main line railroads in Oregon identified needs pertaining to tunnel clearances along parallel I-5 corridor routes, linking the Pacific Northwest with California and the Southwest. Improved tunnel clearances would allow two nine-foot, six-inch containers stacked one on top of another, enhancing the attractiveness of these routes for traffic currently moving by truck. BNSF has identified five tunnels that have an improvement cost of $6.3 million, while UP has identified 20 tunnels with an improvement cost of $10 million.

Rail transit time also needs to be improved to attract I-5 truck traffic. The I-5 Rail Capacity Study from 2003 identified improvements in the Portland area at a cost of $115 million, and would increase train speeds and improve access to critical yards and junctions.

Major improvements to the main line rail system will help shift freight traffic from trucks to rail by improving rail travel times in the Seattle to Los Angeles freight corridor. With all of the modernization identified above, rail traffic would be expected to increase rapidly until rail's share of freight tonnage reaches between 20 and 25 percent. Once this level has been reached, rail traffic will continue to grow, but at a slower rate of 1.75 percent per year. Even with all of the improvements, there are only certain commodities for which shippers will use rail. Notably, the freight rail system also faces constraints in Washington and California that impact the ability to attract additional traffic from trucks.

Passenger Rail

Passenger rail improvements in Oregon are focused mainly on the Willamette Valley corridor, where objectives include increasing the number of daily round trips, increasing train operating speeds to 79 mph where possible, and reducing travel time between Portland and Eugene to two hours or less. Necessary track and signal improvements and closing of hazardous crossings are estimated to cost at least $100 million. The cost of additional train sets could require an additional $40 million.

The combination of increased speeds and more frequent service could mean that the Cascades line (which operates between Eugene and Seattle) would be able to cover operating expenses, though these trains would continue to require subsidies for several years. This assumption depends on a number of operational factors, including equipment used and times of operation. Two trains in 2003 cost about $4.8 million to operate, and costs will increase with each train added to corridor, up to $10 million per year with the fifth train in 2015. Currently the two Cascades trains have 243 seats each. Increasing service to five trains per day would require replacing the existing train sets. The new train sets would likely hold 275 passenger each, providing a total of 1,375 seats per day in each direction.

Between 1977 and 1997, Amtrak provided service on its *Pioneer* train, connecting communities along the south side of the Columbia River between Portland to Ontario and with service on to Boise and Salt Lake City. Resuming service between Portland and Boise would require operating support, infrastructure upgrades and equipment acquisition. An update on costs needs to be completed if service is to be reconsidered. In addition, funding concerns for Amtrak mean that Oregon, California, and Washington are at risk of losing the once-a-day service on the Coast Starlight train between Los Angeles and Seattle. The costs of retaining this service have not been estimated.

Two commuter rail corridors have also been identified as part of the major improvements scenario. The Wilsonville to Beaverton corridor would require $105 million for capital costs and $2 million per year for operations. The cost of extending this service to Salem would include an estimated $85 million in capital expenses and an additional $4 million per year for operations.

Aviation

Aviation needs for the major improvements scenario are described separately for the Portland International Airport and other public use airports.

Portland International Airport (PDX)

Future airport needs are based on the 2000 Portland International Airport Master Plan. By 2030, the number of enplaned passengers is expected to be double the number in 1998. Air cargo is predicted to nearly triple 1998 levels by 2030, despite predicted declines in average freight yield. The preferred investment alternative for PDX includes terminal expansions, a second passenger terminal, and a new access roadway. Table 4.11 lists the estimated cost of improvements to PDX.

It is expected that PDX airport improvements will be funded without state funds. These improvements will be funded through the FAA grants, airport facility fees, and other airport funds. Surface transportation improvements, as identified in the regional transportation plan or the local transportation improvement program, may require state funds. As a result, there is no difference between the reference and major improvement scenarios as it impacts PDX.

An additional $201 million in needs have been identified in the Metro Regional Transportation Plan for surface transportation improvements to the Columbia Corridor.

Table 4.11 Estimated Cost of PDX Improvements Through 2030

Facility	**Estimated Cost ($2004 millions)**
Terminals	$1,829
Parking	$606
Runway	$466
Roads and Transit	$353
Other	$204
Total	**$3,457**

Other Public Use Airports

An additional $48 million per year are needed for the preservation and modernization needs of the 100 public use airports (other than Portland International). Roughly $12 million are for preservation needs and $36 million are for modernization to comply with the FAA dimensional standards. Addressing preservation needs will not require additional funding, as the recently instituted fuel gas tax provides sufficient funding to cover these needs. Minor modernization needs, however, are largely not covered by existing sources, especially at general aviation airports. Modernization needs include:

- Widening and lengthening runways to meet Federal Aviation Administration (FAA) standards;
- Providing standard lighting on runways;
- Developing or redeveloping hangars, cargo facilities, and other airport buildings; and
- Other related investments.

For several selected commercial airports, an additional $15.1 million annually has been identified for major modernization (Table 4.12). Much of this funding will be obtained directly from the airports. Some smaller airports may require public funding, but the overall public costs of these improvements will be relatively low. The improvements identified will help ensure that these airports can continue to provide service to passengers and freight. Each of these airports has potential capacity constraints that will require additional terminal facilities, runways, or other major modernization projects.

Table 4.12 Modernization Needs at Eight Selected Airports

	Modernization Need ($2004)	Plan Period	Average Annual Modernization Need ($2004)
Aurora	$5,270,000	2004-2009	$1,318,000
Bandon	$2,390,000	2004-2009	$598,000
Bend	$4,000,000	2004-2009	$1,000,000
Hillsboro	$90,000,000	2005-2025	$4,500,000
Independence	$1,110,000	2004-2009	$278,000
Medford	$35,000,000	2000-2020	$1,750,000
Redmond	$99,875,000	2005-2030	$4,994,000
The Dalles	$2,645,000	2004-2009	$661,000
Total			**$15,099,000**

The major improvements scenario would not include a direct subsidy to air service at any commercial airports in Oregon. Airports such as Pendleton are currently at risk of losing commercial air service, due to increased costs to airlines and declining revenue. Under any of the scenarios, commercial service to some airports in Oregon is likely to disappear.

Marine Ports

Like airports, marine ports are able to fund most on-site activities from existing funding sources. On-site improvements include cranes, road access improvements to existing facilities, dock and pier replacement, property acquisition, water and sewer lines, environmental restoration, and administrative costs.

Federal funding is available for many of the maintenance activities for the channels that support Oregon's ports. Table 4.13 presents the annual maintenance funding needs for several key activities. This includes a major project to deepen the Columbia River channel to 43 feet. It does not include the cost to reconstruct the jetties at the mouth of the Columbia River. Cost estimates for this project are not currently available, but estimates range from at least $50 million to $200 million.

Dredging of the Columbia River will have the most significant economic impact on Oregon. Over 80 percent of vessels use in trans-Pacific trade cannot use the Columbia River channel fully loaded. This increases the costs to bring goods into the ports along the Columbia River. This has had a direct impact on containerized shipping at the Port of Portland, with two of three container shipping lines pulling out of Portland in the last year. Deepening the channel may help the Port of Portland attract new shipping lines.

Table 4.13 Annual Channel Maintenance Funding Needs

Maritime Project Category	Annual Average Feasible Need ($2004)
Maintenance Dredging	$35.25
Roadway / Access and Maritime Projects	$11.02
Jetty and Pile Dike Monitoring and Repair	$3.18
Jetty and Pile Dike Reconstruction	$1.84
Columbia River Channel Deepening (Federal portion)	$3.84
Columbia River Channel Deepening (Oregon portion)	$1.11
Total	**$56.24**

As described above, reconstruction of the jetties at the mouth of the Columbia River is essential to maintain deep-draft navigation on the Columbia and Willamette Rivers. Reconstructing the jetties would help maintain the 40,000 jobs involved with maritime activity and Oregon and Washington ports on the Columbia and Willamette Rivers.

5.0 Summary Findings

This report provided an in depth examination of the OTP scenarios using several performance criteria. This summary provides a quick overview of some of the key lessons that tie this analysis together. Some of the summary points are specific to scenarios or performance criteria, but overall they are intended to cut across the various scenarios and criteria used.

1. Flat funding will create a potential crisis in the Oregon transportation system and economy.

The existing funding base is not sufficient for ODOT to meet some basic goals, especially highway and roadway preservation. Without new funding, there will be steep declines in pavement and bridge conditions, roadway maintenance, and other related programs. The impact of these will be felt through higher user costs, increased safety hazards, increased customer complaints, and other related issues.

Flat funding also means that several key freight transportation modes will be less likely to grow. New investments to the marine and rail infrastructure have potential economic and transportation benefits that are unlikely to be realized in the flat funding scenario. These benefits include shifting goods movement from truck to marine and rail, expansion of traffic at the Port of Portland, and others.

2. It is difficult to impact mobility on the statewide highway system without substantial new investments in capacity.

Mobility on the state highway system, as measured by travel times, does not change significantly for most of the scenarios analyzed. Many of the improvements identified as part of the OTP scenarios are for the local transportation system. These investments – to interchanges, local streets, and others – will undoubtedly have an impact on overall mobility, but are not visible at the interregional scale that is used in this analysis.

Adding lanes to the I-5/205 corridor is the only investment that significantly impacts the mobility of the statewide system. When combined with tolling, this investment has the greatest ability to reduce congestion. Although a toll lane strategy would require additional investigation, it has the potential to help cover some of the costs of this major investment and help manage the demand on the transportation facility.

3. All of the state benefits from investments in the Willamette Valley

Oregon's regions do not have separate, individual economies, but are tied together and heavily dependent on key infrastructure and businesses in the Willamette Valley. The Port of Portland and Portland International Airport are two key examples of infrastructure that benefit the entire state. The movement of goods among Oregon's regions is key to keeping the entire economy functioning. Because other regions depend on certain types of businesses and services in the Willamette Valley, investments to both roadways and transit can improve the economy of these areas.

4. Operational investments have the ability to help manage capacity, but some of the benefits have already been realized.

ODOT has been making substantial operational investments in the Portland metro area that are paying dividends in terms of the fluidity of the transportation system. Without adding capacity, investments in freeway management have helped increase speeds and throughput of the freeway system. A number of additional investments have been implemented or identified, including incident response, arterial management in Portland, freeway management in other urban areas, and others. New investments in operational strategies would continue to provide mobility, safety, and other benefits. However, national research shows that larger benefits from operational investments accrue to larger urban areas. Smaller urban areas will benefit from these investments as well, but the impact will be less noticeable.

Speeding up the transit system, by providing transit priority in existing corridors and expanded transit service, can have a significant impact on the entire transportation system. Delay is already 40 percent lower in the Portland metro area than it would be without transit. Additional investments that increase transit's ability to provide competitive service to driving in existing and new corridors will have benefits for all travelers.

5. There is a sufficient supply of land available at the statewide level to accommodate economic growth.

Given the growth that is expected in Oregon, there appears to be enough land available to accommodate the projected development. It is important to note that this is a statewide, not local finding. If more land becomes available in a particular region, development is likely to be less dense, resulting in potential congestion and related impacts. If land development is severely restricted in a particular region, economic growth will be hampered and will become more expensive. Given existing information about the availability of land, however, this does not appear to be an issue.

6. Growing fuel prices could disrupt the Oregon economy.

Although the timing and the rate of growth are in question, it is certain that the cost of fuel will increase over time. The faster fuel prices increase, the greater the shock on the Oregon (and U.S. and international) economy. Technological innovation (e.g., hybrid technology, fuel cells, composite materials, and others) may help alleviate or eliminate these concerns, but given recent trends in fuel economy, this is an area of serious concern. The U.S. economy as a whole is heavily dependent on transportation and therefore fuel. The aviation industry is already seeing some of the impacts of increased fuel costs and could see a substantial reorganization if fuel prices continue to increase. It is clear from existing evidence that fuel costs will require close scrutiny in coming years.