The Cost of Congestion to the Economy of the Portland Region

Prepared for:

PORTLAND BUSINESS ALLIANCE
Leading the way

METRO

PORT OF PORTLAND
Possibility. In every direction.™

OREGON DEPARTMENT OF TRANSPORTATION

Prepared by:

Economic Development RESEARCH GROUP

Table of Contents

EXECUTIVE SUMMARY

The Cost of Congestion to the Economy of the Portland Region

Prepared for: Portland Business Alliance, Metro, Port of Portland and Oregon Department of Transportation
Prepared by: Economic Development Research Group, Inc., Boston, MA
December 2005

Conclusion

The region's economy is transportation-dependent. Despite Portland's excellent rail, marine, highway and air connections to national and international destinations, projected growth in freight and general traffic cannot be accommodated on the current system. Increasing congestion -- even with currently planned improvements -- will significantly impact the region's ability to maintain and grow business, as well as our quality of life.

Action is needed to remain competitive with other regions that are planning large investments in their transportation infrastructure. This report finds that:

- Being a trade hub, Portland's competitiveness is largely dependent on efficient transportation, and congestion threatens the region's economic vitality.
- Businesses are reporting that traffic congestion is already costing them money.
- Failure to invest adequately in transportation improvements will result in a potential loss valued at of *$844 million annually by 2025 – that's $782 per household -- and 6,500 jobs.* It equates to 118,000 hours of vehicle travel per day – that's 28 hours of travel time per household annually;
- Additional Regional investment in transportation would generate a benefit of at least $2 for each dollar spent.

Background

As a first step to addressing the Portland region's rising congestion problem, public and private sector partners commissioned a study to provide base-line information about the relationship between investments in transportation and the economy.

This report does not recommend a level of funding for transportation improvements, nor does it endorse a specific package of improvements. Instead, it is intended as a

springboard for discussions about planning for and investing in the Portland metropolitan region's transportation system.

Congestion and the Economy

1. The region's economy is transportation-dependent, especially on its roads and highways, for the movement of freight.

In comparison with other U.S. metropolitan areas of similar size, Portland's competitiveness is largely dependent on the region's role as a gateway and distribution center for domestic inland and international markets. Some other metropolitan areas have larger bases of research, venture capital, and higher education or are surrounded by greater population centers that enable their economies to be competitive even with more congested highway conditions.

- **"Traded" industries, which bring new money into the region and enable the rest of the economy to prosper, require an efficient transportation system.**

  Portland's economy depends on industries that could locate elsewhere, but have been attracted to the area because of its advantageous trading position. Those industries include computer equipment, wood products, metal products, tourism, publishing, wholesale distribution activities and gateway port activities.

  Because traded industries depend on the movement of freight, reasonably good transportation access must be maintained if those industries are to remain and grow in the Portland area in the years to come.

- **All modes -- roads, transit, air, marine, and freight rail -- are important to an efficient transportation system, but few alternatives exist to a smoothly functioning road and highway system for on-the-clock business travel.**

  Portland is located at the confluence of two navigable rivers and is served by two intercontinental rail lines and an international airport. However, these modes commonly require a road system to get to and from a terminal or parking lot. While alternatives such as rail and bus transit help alleviate congestion for many commuters, these transit services do not meet the specialized needs of business travel for delivery of freight and other services. As many business-related trips are subject to schedule requirements, businesses become "prisoners of congestion," significantly increasing their cost of doing business.

- **In addition to road congestion, there are limitations with rail, air, and**

marine service and connections, which are critical to business needs as well.

2. Congestion is already impacting large and small businesses and hurting their competitiveness.

Interviews with local business leaders reveal how traffic congestion is affecting their operations. Many businesses have already made schedule changes to avoid peak afternoon traffic conditions. However, businesses have expressed a growing concern that the relatively few windows of time when congestion is not a problem are shrinking.

Businesses reported the following impacts of congestion:

- Costs for additional drivers and trucks due to longer travel times;
- Costly "rescue drivers" to avoid missed deliveries due to unexpected delays;
- Loss of productivity due to missed deliveries;
- Shift changes to allow earlier production cut off;
- Reduced market areas;
- Increased inventories;
- Costs for additional crews and decentralized operations to serve the same market area.

Specific examples of how businesses are being harmed by congestion:

- Intel has moved their last shipment departure time up two hours for outbound shipments through PDX because of increased p.m. peak congestion. A missed flight affects production across the globe and can result in costly operational changes.
- Sysco Foods opened a new regional distribution center in Spokane to better serve their market area, because it was taking too long to serve its market from the Portland area; others are following suit.
- Providence Health Systems reported medical deliveries, which have to be rapid and frequent, are getting very difficult on the west side, with routine runs requiring more than four hours. As a result, Providence is planning a relocation of warehousing and support operations at a cost (independent of construction) from $1-1.5 million in 2006/7.
- OrePac has increased inventories by 7% to 8% to mitigate for congestion delays, which represents a lost opportunity for other investment.
- Other businesses have managed to restructure their operations to deal with congestion, but many have reached the point at which operational changes are resulting in real costs. As an example, PGE estimates that it spends approximately $500,000 a year for additional travel time for maintenance crews.

As congestion continues to worsen, businesses in this region will be at a competitive

disadvantage. Businesses that serve local needs either absorb the added costs and reduce their profits, or pass these costs on to the region's consumers through higher prices. Trade-oriented businesses, however, can respond by moving their operations, and the jobs they provide, to locations outside the region.

Failure to address the negative impacts of congestion is likely to result in the loss of jobs as existing businesses expand elsewhere or relocate and the region attracts fewer new businesses. This also has a ripple effect on other businesses and suppliers throughout the region and the state.

Overall Impacts of Congestion on the Economy

Transportation forecasting models show that currently planned transportation investments will not keep up with traffic growth, resulting in severe congestion delays.

This will affect how well the region can compete for new jobs and cost each household an additional 50 hours of lost time annually by 2025. Simply put, congestion reduces the advantage of location, which is particularly troubling for the Portland metropolitan region because its traded industries are dependent on transportation.

The study compares a Planned Investments Scenario, anticipated to be funded over the next twenty years, to an Improved System Scenario, which would double transportation investment over the next 20 years. The Improved System Scenario would result in significantly less congestion growth during morning and afternoon peaks, key times for businesses. It would also save 28 hours of travel time per household annually by 2025.

- **Economic benefit: The total value of benefit from such an investment is $844 million annually by 2025. It also supports 6,500 additional permanent jobs as of 2025, as well as 2,000-3,000 construction jobs annually.**

This total combines the value-added income generated in the region and the value of time savings to individuals. Under a higher investment scenario, businesses are able to convert travel time savings into additional sales, resulting in $426 million a year of value-added benefit and 6,500 jobs. The benefit to businesses would also be complemented by significant time savings and higher quality of life for residents, valued at $418 million a year. This scenario, while not eliminating congestion, will improve reliability, which is also critical to business travel.

- **Return on Investment: Under an Improved System Scenario, each dollar**

invested returns at least $2 in value.

Some significant costs are incurred in the early years of the study period, and benefits continue to phase in over a longer time period. Looking at both the cost stream and the benefit stream in terms of their net present value, the analysis shows a potential benefit/cost ratio of about $2 to every dollar invested.

Next Steps

The stakes are high for the economy and quality of life in the Portland metropolitan region, representing thousands of jobs and billions of dollars.

Many other regions, including Chicago, Atlanta, LA, Houston, Seattle and Vancouver BC, have undertaken similar studies and are taking action to address congestion. Examples from around the country illustrate the range of policies and programs that can be adopted to mitigate future congestion growth. More importantly, these examples demonstrate the need for the Portland metropolitan region to act now to reduce the impacts of congestion and preserve our continued economic competitiveness.

This study is intended to provide useful information to the public, the business community and government decision-makers as they work to formulate transportation policy, projects and funding decisions. The study should be used as a springboard for future discussions about planning for and investing in the Portland metropolitan region's transportation system.

This report also outlined a number of potential tools, such as road and transit capacity enhancement, system management, and pricing strategies that are being considered in other cities, and should also be considered here as we look at solutions. Local business and government leaders should immediately have a discussion about the impacts of congestion and solutions in order to protect and enhance the local economy and quality of life.

ACKNOWLEDGEMENTS

This study was conducted by Economic Development Research Group, Inc., for the Portland Business Alliance, Metro, the Port of Portland and Oregon Department of Transportation. Also contributing to the public funding for this study was Clackamas County, Multnomah County, Washington County, TriMet, the Cities of Portland, Beaverton, Wilsonville and Gresham. Further support came from private businesses including: Intel, Qwest, Ross Island Sand & Gravel, Providence, Platt Electric, Portland General Electric, NW Natural, Portland State University, PacifiCorp, Gunderson, Inc., David Evans & Associates, Portland Spirit, Schnitzer Investment Corp., City Center Parking and Oregon Transfer.

The study was overseen by a Steering Committee comprised of Greg Peden and Marion Haynes of the Portland Business Alliance; Richard Brandman and Bridget Wieghart of Metro; Susie Lahsene of the Port of Portland; Steve Clark of the Portland Tribune; and Matt Garrett of Oregon DOT.

The consultant team conducting this study and writing this report consisted of Glen Weisbrod, Stephen Fitzroy, Lisa Petraglia, Anjali Mahendra and Brett Piercy. The study built on transportation models and forecasts developed by Metro's Travel research and Modeling Services staff, especially Bill Stein. Bridget Wieghart played a critical role in coordinating the analysis process. The consultant team and steering committee are also grateful to the many individuals and businesses who were interviewed and provided data for this report.

All findings and conclusions in this report are those of the study authors and are not necessarily the positions of the study sponsors. Any errors in this report are the responsibility of the consultant team.

1 INTRODUCTION

1.1 Motivation: Economic Competitiveness

As the Portland region moves further into the 21st century, it becomes important to understand the need for transportation facilities to keep up with changes occurring in the region's population and business base. The stakes can be high. Failure to provide sufficient transportation capacity and functionality could potentially increase traffic congestion delays enough to reduce the quality of life for area residents and reduce the competitiveness of the region for business. Since most residents in the region depend on household income generated by good local jobs, the financial well-being of area residents is directly tied to the ability of the region to maintain its position as a competitive location for business investment, expansion and attraction.

To examine these issues, the Portland Business Alliance sponsored this study working in close cooperation with Metro and the Port of Portland. This report examines the costs of traffic congestion to business currently located in the Portland metro area, forecasts for future changes in traffic congestion, and the impact that transportation infrastructure improvements can have on business productivity, competitiveness and growth. The report seeks to address two questions:

> ***The Stakes Can Be High***
> *Failure to provide for future transportation needs can reduce the future quality of life for area residents and reduce the competitiveness of the region for business.*

- How do transportation infrastructure improvements, or lack of improvements, affect the costs and ability of businesses now located in the region to compete locally and globally?

- How do transportation infrastructure improvements, or lack of improvements, affect the competitiveness of the Portland metropolitan region for recruiting and retaining industries targeted by regional economic development efforts?

By addressing these questions, this report seeks to provide a context for better understanding the business case for the next generation of public investments in transportation system upgrades, and the economic risks associated with failure to address congestion growth.

1.2 Study Focus: Traffic Congestion

At the outset, it should be clear that transportation involves a wide variety of modes, including walk, bicycle, bus, train, car, truck, motorcycle, air and marine travel.

These modes serve a broad range of purposes, including health and recreation, shopping and personal business, commuting, freight deliveries and business trips. All modes and purposes are important to consider in broad-based transportation planning. However, from the perspective of maintaining a vibrant and competitive regional economy, it is appropriate to focus in on the most directly applicable and critical issues affecting business activity. This leads to two key observations:

- *Traffic congestion is related to highway system demand and capacity.* Many means of motorized travel -- buses, streetcars, cars, trucks and motorcycles – depend on the region's system of roads and highways. So when traffic is gridlocked, the movement of buses as well as cars and trucks is slowed or stalled. Even travel on modes with their own right-of-way – such as trains, airplanes and ships – commonly require some travel on the road system for access to a terminal. All of these modes are important to consider insofar as they are all affected by highway traffic congestion.

- *Not all of the modes are substitutes.* Public transit can substitute for cars for some commuting trips, depending on the origins and destinations. However, for freight deliveries to homes and businesses, there is necessarily a reliance on trucks using the highway system. For businesses relying on materials from outside suppliers or delivering products to outside customers, there is also need to maintain good truck access to or through airports, marine ports, intermodal rail facilities and cross-state highway routes. Also, business-related trips for sales and service delivery typically require cars or light trucks since they cannot rely on fixed route services for their dispersed travel.

Congestion Effects are Broad
Traffic congestion affects bus service, as well as ground access for air, sea and rail transportation.

The bottom line is that many forms of business-related travel are dependent on the ability of the region's highway system to move vehicles. This report examines the nature of business dependence on the highway system, and the degree of vulnerability to current and future growth in traffic congestion levels. It goes into particular depth to show how congestion affects the many facets of goods movement because that element of business impact is often less well understood by the general public. However, this additional focus on freight is not intended in any way to minimize the ways in which traffic congestion also affects passenger movements, which are also covered.

1.3 Organization of the Report

The report is organized into five chapters:

- Chapter 1 has defined the objective and focus of this study.
- Chapter 2 examines how Portland's regional economy is particularly dependent on transportation for serving broad markets, and thus vulnerable to congestion.
- Chapter 3 uses business interviews to lay out the many facets of impact that congestion has on local business costs, operations and growth strategies.
- Chapter 4 uses transportation models to show the magnitude of current congestion and expected future travel conditions under alternative future scenarios.
- Chapter 5 uses economic models to show the implications of congestion growth for the region's economic future.
- Chapter 6 summarizes the ways in which other regions are also recognizing the economic development consequences of congestion and implementing actions to address it.

2 TRANSPORTATION ROLE IN THE REGIONAL ECONOMY

The geography, location and past development of Portland have made the area an international air and sea gateway, as well as a regional rail and highway hub, with important roles in wholesale distribution that depend on transportation connections.

The economy of the Portand metropolitan area today still depends on a set of primary industries that have been attracted to the area because of its location advantages. They include computer/electronic products, wholesale distribution services, forestry/wood/paper products, publishing and recreation. These primary or "traded" industries serve markets well beyond the region, a factor that makes their future existence and growth dependent on performance of the area's transportation system for delivery of products and services.

As a result of these factors, core industries in the area economy are particularly vulnerable to changes in transportation conditions. Reasonably good transportation access conditions will have to be maintained if those industries are to remain and grow in the Portland area in the years to come.

2.1 Primary (Traded) Industries

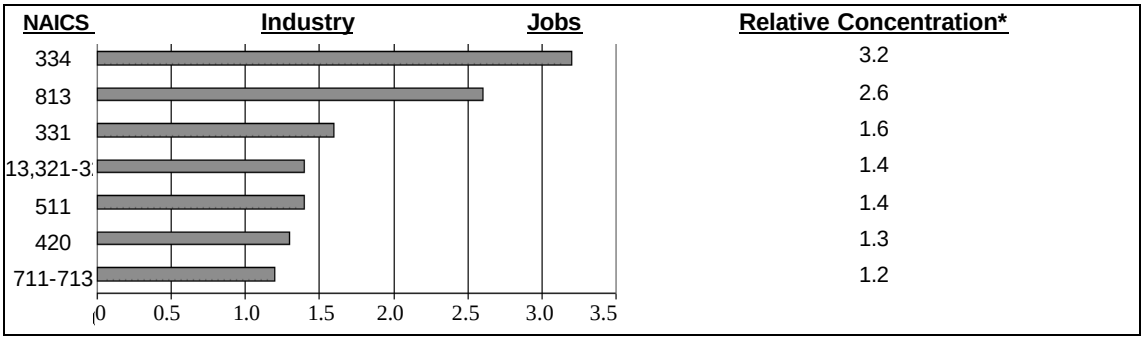
Core Industries. The foundation of Portland's economy is its *primary industries*, also known as *traded industries*. These are the manufacturing, transportation/port distribution, and service activities that are located in Portland but serve broader regional, national and global customer markets. In service of these broader markets they bring money into the regional economy by selling their products and services elsewhere nationally and internationally. They could locate elsewhere but choose to grow in the Portland area because of the area's attractiveness and competitiveness for their operations. They are the foundation of the regional economy, as the money they draw into the region is subsequently re-spent on local "population-serving" industries.

Traditionally, the Portland area's key traded industries have been computer/electronic products, wholesale/distribution services, forestry/wood/paper products, publishing and recreation. Table 2-1 shows how many of these industries play a particularly strong role in the Portland area economy, compared to national averages.

Reliance on Traded Industries. Industries that serve broader customer markets (beyond the Portland area) show up as having higher than normal concentrations of

employment in the area. The industry with the highest relative concentration locally is computer and electronic products; Portland is a major exporter of these products to the rest of the world. The area's metal product, wood/paper and publishing industries also compete for business with other regions of the US and the world. Furthermore, the area's seaport, airport and some of the wholesale distribution facilities serve international gateway and national product distribution functions that compete with other cities in North America. As ports of entry, they provide opportunities for higher value added and traded industries to locate in the area, though such industries are also sensitive to congestion.

Table 2-1. Traded Industries with a High Concentration in the Portland Area



**Relative concentration is measured as the Location Quotient, which reflects the industry's share of local jobs relative to its share of national jobs.*
Source: EDR-LEAP database, compiled by IMPLAN from US Dept of Commerce Regional Economic Indicators Service (REIS), includes self-employed and contract labor in addition to wage and salary employment.

The vitality of the area's economy depends substantially on its traded industries. Many other major sources of jobs – government, education, health care, construction, retailing, personal and business services – actually account for a larger number of total jobs, but they are serving needs of the local population and thus ultimately depend on the traded industries for their continued vitality.

Change Over Time. The nature of the region's traded industries has been evolving over time. Forecasts by the Oregon Employment Department indicate expectations of significant growth between 2002 and 2012 in the high technology industry cluster (growing by more than 15%) and recreation (growing by more than 17%), although losses are expected in the lumber/wood/paper and metals industries. Altogether, the mix of goods and services will be changing, but the importance of traded industries depending on access to outside markets will remain.

2.2 Transportation-Related Industries

Role for International Gateway and Inter-Regional Distribution. In every metropolitan area, the transportation system plays a critical role in serving local needs for commuting, shopping, personal, recreation trips, and local delivery. However, the

> ***Transportation Reliance***
> *Geography and history have made Portland an air and sea gateway, as well as a regional rail and highway hub.*

economy of the Portland Area and its associated transportation system has additional features that do not exist in many other places. In particular, the area's marine port, airport and highway facilities make the area a major trade gateway for movement of people and goods into and out of the US, facilitating important east-west international trade with Asia, and north-south trade with Canada and Mexico. Domestically, Portland is an important link in the west coast corridor trade between the state of Washington and the large markets of California. Key facilities serving long distance travel also create greater demand for ground transportation within the region. These include the following:

- The Port of Portland is recognized as the shortest marine route from the US to Asian markets. The largest sea imports by value are motor vehicles, iron and steel, office machines, petroleum, apparel and footwear. Sea exports include cereals, chemicals, fertilizers, vegetables and fruits, paper and ores. While most bulk cargo travels by train, intermodal containers comprise the key cargo carried by trucks, helping to facilitate just-in-time delivery of manufactured products. The Port's marine terminals handle over 2.5 million tons of intermodal containers.

- Portland International Airport is particularly important for products that are high in value and low in weight, which covers the high-technology industries that are currently among the fastest growing sectors in the region. The largest air imports by value are office and computer equipment, electronic machinery, scientific instruments and telecom equipment. Air exports include transport equipment, chemical materials, vegetables and fruit, in addition to high-tech machinery, instruments and electronic equipment. Essentially all arriving or departing air cargo relies on truck for ground connections.

- Inter-Regional Highways intersect to make the Portland region a hub for long-distance movements. The I-5 corridor is the major north-south spine for movement along the entire west coast from Mexico to Canada. The I-84 corridor is a major east-west spine for movement from Portland through the Cascades to the central and eastern parts of the US. Trucks account for a disproportionately high percentage of total vehicles on both highways. (Trucks account for 5% of all vehicles in the region, but 10% on I-5 to the north, 15% on I-5 to the south and 22% on I-84 to the east of the city.)

Wholesale Trade. While all metropolitan areas need some wholesale activity to support their population-serving retail activities, the Portland area has attracted a wholesale distribution industry that serves broader North American markets. The

> ***Regional Wholesale***
> *Wholesaling in the Portland region accounts for a 30% larger share of total jobs and a 42% larger share of total business output than the national average.*

metropolitan area has approximately 60,000 jobs in wholesaling. The Portland area's wholesale sector has a 30% higher share of total regional employment and a 42% higher share of total regional business output than the national average for this industry. Primary reasons for this high concentration of wholesale activity are the presence of an international sea port and airport, a navigable river system connecting the seaport to the inland areas of Oregon and Washington, and domestic rail/highway connections to the rest of the US and Canada. Together, these factors make Portland an important gateway and distribution center for North America.

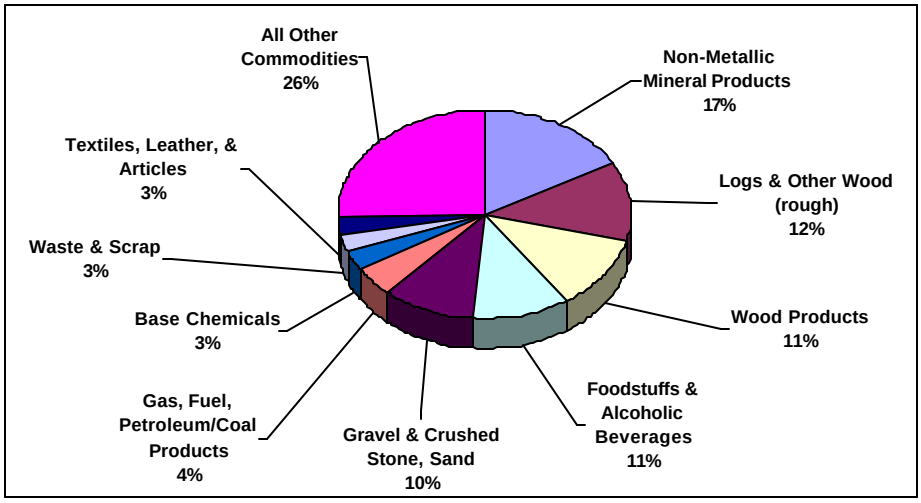
Trucking, Warehousing and Other Transportation Services. The distribution and logistics industry handles a large share of regional economic activity. It is supported by infrastructure that has developed around it, particularly trucking services, export packing, and maintenance and repair operations. A high level of truck services accompanies distribution operations because truck is the dominant mode of transportation used for the distribution of apparel, food, beverages, paper products, general commodities and miscellaneous bulk articles. The goods movement provided by the distribution industry maintains Portland's advantages as a trade hub. The metropolitan area has approximately 12,000 jobs in trucking, 16,000 in warehousing and package delivery services and 18,000 jobs in other elements of transportation including air and rail transportation and related freight logistics and support services.

Typically, larger distribution centers are located at the ports of entry. From these larger centers, goods from marine containers are loaded into smaller domestic containers for shipment to inland regional distribution centers. The majority of these shipments are handled by truck and hence the availability of trucking services is critical. In addition, truck distribution is the key link for moving goods between the manufacturing sector, warehouses and markets in the retail trade sector.

Commodities Moved by Truck. The total value of all commodities shipped to, from and through the Portland area in 1997 was estimated to be $363 billion, according to the latest published Commodity Flow Survey. That survey showed that trucking carried the largest value of goods shipped in the area, at a value of $278 billion or 79% of total value. Nine commodity categories comprise about three-quarters of the total freight tonnage carried by truck in the region. Figure 2-1 shows the distribution of tonnage for these key commodities carried by truck. This also indicates the shares of freight that are directly affected by highway congestion.

> ***Freight Growth***
> *Over $363 billion of commodities move annually through the Portland metro area, with over $278 billion moving by truck.*

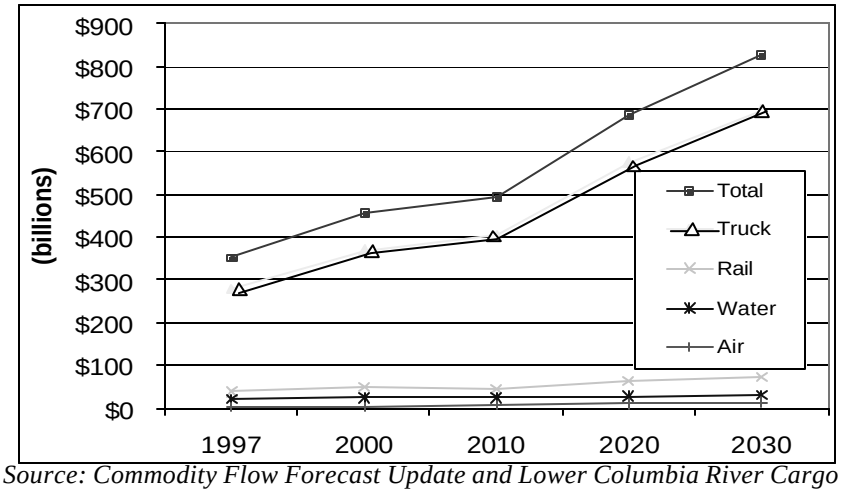
Figure 2-1. Mix of Freight Directly Affected by Congestion
(Percent of Total Tons Carried by Truck within the Portland Region, 1997)



Source: Commodity Flow Forecast Update and Lower Columbia River Cargo Forecast (p.10)

Projections of the region's economy and future freight flows indicate that freight tonnage in the Portland region is predicted to more than double between 2000 and 2030.[1] This is faster than the forecast for regional population growth. They also show that the truck share of total tonnage is expected to grow from 64% today to 73% in 2030. The reliance on trucking is even greater when viewed in terms of dollar value of freight rather than tonnage. Figure 2-2 shows that trucks are expected to account for 84% of commodity movement by value by 2030.

Figure 2-2 Forecast Value of Commodity Shipments by Transport Mode
(billions of US dollars, for the Portland-Vancouver region)



Source: Commodity Flow Forecast Update and Lower Columbia River Cargo Forecast[2]

[1] Regional Freight Data Collection Project, 2005

[2] DRI-WEFA and BST Associates. 2002. Prepared for the Port of Portland, Metro, Oregon Department of Transportation, Port of Vancouver and the Regional transportation Council, p. 49

A 2003 study of the distribution industry surveyed businesses across the region and found that many firms identified the ease of access to highways as key advantages of the Portland region.[3] However, increasing congestion and bottlenecks were identified to be among the key disadvantages that are affecting business expansion.

Jobs in the Economy. Together, wholesaling, transportation and related distribution and logistics companies account for nearly one in 12 jobs, or approximately 106,000 jobs out of the region's total of approximately 1,290,000 jobs in all industries. However, this vastly understates the actual role of transportation-related jobs, because it does not count the driver and mechanic jobs associated with truck and car fleets that are owned and operated by manufacturers, retailers and service businesses. Counting these additional transportation jobs increases the total by approximately 25%, meaning that over 132,000 area jobs (over 1 in 10) are actually providing transportation-related services.[4]

> ***Jobs***
> *Transportation, wholesale, and related distribution activities together account for over 132,000 jobs in the region.*

Of course, these figures still do not count those jobs in key traded industries that are transportation dependent, nor jobs in other local businesses would not be present if not for the core activity of the region's transportation and traded industries.

2.3 Conclusions

A significant part of the Portland area economy is based on the city's location as a gateway port for marine and air movement, and intersection of major cross-continent highway and rail routes. Those facilities have supported the growth of Portland's core of "traded industries" – businesses that produce goods and services for customer markets extending beyond the metropolitan area. These traded industries depend critically on access routes to/from the various port and terminal facilities, as well as general truck movement to, from and through the metropolitan area. For these reason, they are particularly vulnerable to worsening highway congestion. Since they are not merely serving the local area market, they can also have the option of relocating the site of their operations outside of the Portland area if transportation conditions compromise the future competitiveness of locating in this area.

Other businesses are classified as part of the "local-serving industries." They serve local customers and cannot just move away, but they too absorb cost of increasing congestion and can pass them on to local customers in the form of higher prices.

[3] Distribution Study by Martin Associates, 2003
[4] Transportation Satellite Accounts, US Dept of Commerce and Bureau of Transportation Statistics.

3 BUSINESS PERSPECTIVES

From a business standpoint, a major issue for regional competitiveness will be the ability of vehicles to move within and beyond the boundaries of the metropolitan area quickly and easily at key times of the day. The expense associated with congestion delays raises costs of doing business and adversely affects long-term competitiveness for attracting and retaining many industries. However, there are even broader effects on business operations. If the time required to move through and out of the region continues to increase, then there will be further decreases in the ability of some manufacturers as well as transportation and logistics oriented businesses to serve markets outside of the metropolitan area. As this happens, new jobs in transportation, logistics and manufacturing that are serving markets outside of the Portland region will tend to migrate out of the region.

Business perspectives presented in this chapter describe why investments in transportation that reduce congestion are fundamental to preserving the region's ability to compete in national and global markets. Business interviews indicate how congestion – especially in the afternoon – is already a problem. Examples show how business inventories, warehousing decisions, production processes, staff deployment and scheduling are all affected by increasing congestion. Most major businesses have already made changes to their schedules to mitigate peak afternoon traffic conditions. However, there is a growing concern that the relatively uncongested windows of time in which transportation delivery and logistics functions are currently operating may shrink to a level that will make future adjustments more costly and difficult to achieve.

As congestion becomes a day-long condition, businesses can adjust by further changing their deployment of staff, inventory management and delivery areas. However, such changes affect costs and revenues for both local-serving and trade-oriented businesses. Local-serving businesses either absorb added costs and reduce their profits or pass these costs on to people in the region. Trade-oriented businesses though, can and do move their operations to locations outside the region.

3.1 Business Interviews

Interview Process. Interviews with key members of the business community were conducted between April and June, 2005. These interviews were designed to provide background information about operational decision-making and to elicit information and perspectives on transportation issues faced by key businesses in the Portland region. Interviews focused on businesses with a working knowledge of and involvement in transportation issues in the Portland region. They each offered

important insights into how the current state of the transportation system in the region influences business decision-making. Some of these businesses have been operating in the Portland region for over 100 years, and others are relatively recent arrivals to the region. Their efforts to adapt to increasing congestion and to implement innovative ways to solve transportation and logistics problems by constantly refining their business practices has enabled them to sustain their operations in the Portland region and to survive in an increasingly competitive business environment.

The interviews focused on relationships between traffic congestion and the cost, productivity, and efficiency of business activities. The interview format was designed to develop insight into the ways in which each type of business is dealing with congestion, the ways in which congestion affects their operations, and the cost implications of continuing to deal with growing congestion. While many of the details cannot be reported due to the competitive nature of these businesses and the proprietary nature of some of their innovations in management and logistics support, we are able to report the broad outlines of actions taken to-date and to highlight some of the points of view that have been expressed about the concerns of major businesses relative to their future operations in the Portland Metropolitan Area.

Economic Sectors Covered. Sixteen in-depth interviews were completed. The interviewed businesses were grouped into four sectors:

- Major Regional Employers – Providence Health Systems, PGE
- Retail/Wholesale & Distribution – Fisher Farms, Columbia Sportswear, Powell's Books, OrePac, Fred Meyer
- Manufacturing – Blount, Gunderson, Boeing, Intel, Schnitzer Steel
- Transportation & Warehousing – SYSCO, Oregon Transfer, USF Reddaway, George S. Bush Logistics.

These businesses ranged in size from just over 50 to just under 15,500 employees, representing a total of 38,200 full time, part time and seasonal employees. The share of these 38,000 employees included in each business sector is shown in Figure 3-1.

Rather than attempt to design a statistically representative sample of all businesses in the Portland Metropolitan area, the interviews focused on key businesses with transportation-intensive operations. Nevertheless, when viewed in terms of their association with current industrial classifications, these businesses represent or approximately 27.4% of all employees in the selected industry sectors within the Portland Metropolitan Area (see Table 3.1) In some industry groups, such as utilities, apparel manufacturing and computers and electronic parts companies, interviewed businesses covered a very large proportion of the region's labor force employed in these areas. In other transportation-intensive businesses, such as transportation, warehousing and package delivery, transportation equipment, and machinery manufacturing, our interviewees employed between 5% and 23% of the region's labor force. In all, the interviewed businesses included 10% of the region's employment in the eleven industrial groups that are most transportation–dependent.

Figure 3-1. Share of Full Time, Part Time and Seasonal Employees included in Each Business Sector for Interviewed Businesses

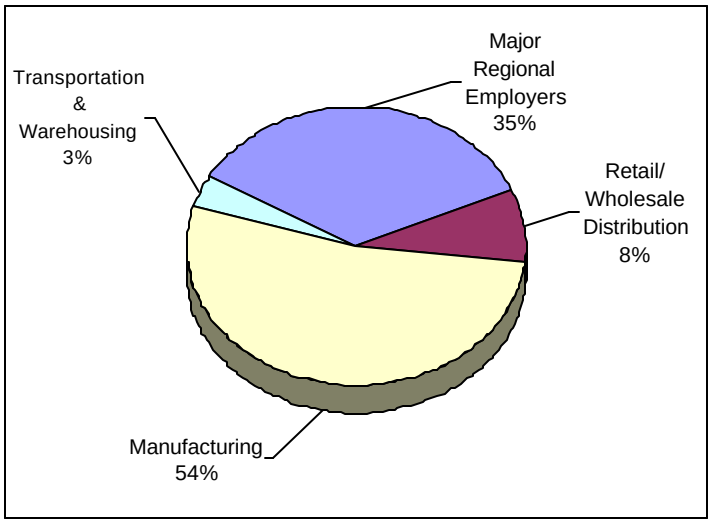


Table 3-1. Breakdown of Employment by NAICS and Business Sector for Portland Metropolitan and Interviewee Employment

	Portland Employment (2002)		Businesses Interviewed (2005)	
	# of Jobs	% of Regional Employment	# of Jobs	% Employment Within NAICS
Crop Production	15.043	1.20%	170	1.1%
Utilities	2.668	0.20%	2.687	100.7%
Apparel Manufacturing	1.113	0.10%	550	49.4%
Wood Products	5.560	0.40%	150	2.7%
Primary Metal Manufacturing	6.308	0.50%	130	2.1%
Machinery Manufacturing	8.864	0.70%	1.000	11.3%
Computer & Electronic Products	36.087	2.80%	15.500	43.0%
Transportation Equipment	9,818	0.80%	2,250	22.9%
Retail Trade	124,514	9.60%	450	0.4%
Transportation, Warehousing & Package Delivery	30,454	2.40%	2,390	5.1%
Health Care & Social Services	113,088	8.80%	10,000	8.8%
TOTAL	**353,517**	**27.4%**	**35,330**	**10.0%**

These businesses employed almost 600 drivers and required 1,890 trailers, 516 tractors and a number of other off-road vehicles in their daily operations. Because we chose businesses that were transportation-oriented, in that they either operated for-hire transportation services or provided substantial in-house logistical support for internal operations, they were responsible for a large number of vehicles and related transportation equipment, and employed a large number of drivers and operators (see Table 3-2).

Table 3-2. Transportation Equipment and Drivers Employed by Interviewees

	Fleet					
	Trucks	**Drivers**	**Vans**	**Trailers**	**Vessels**	**Other[1]**
Major Regional Employers	57	5	2	-	-	5
Retail/Wholesale & Distribution	129	251	19	926	-	-
Manufacturing	19	16	3	3	1	-
Transportation & Warehousing	311	318	14	960	-	55
Total	**516**	**590**	**38**	**1,889**	**1**	**60**

1 *Includes fork lifts and other warehouse vehicles*

3.2 Issues Identified in the Interviews

(A) Cross-Cutting Issues. The logistical requirements and complexities faced by businesses in the Portland region vary significantly. Hence, the need to examine each of the four sectors identified in the previous section. However, there are a few cross-cutting issues that emerged frequently in discussions with representatives of each of the four business sectors. These issues have important implications for the business climate and economic future of the region precisely because they bear directly on either the cost of doing business or the ability to expand business operations to meet the demands of the Portland region. The most significant cross-cutting issues are:

- **Closing "Window of Opportunity" in the Morning Peak Period.** Businesses have adjusted to the long-term effects of evening congestion by shifting operations to the early morning hours. This has proven effective for a variety of reasons and across a number of sectors. However, as morning travel demand continues to grow, available highway capacity is shrinking sufficiently to affect the operations of most of the businesses that have become dependent on efficiencies of operating in this time period. As there is no other feasible time period in which to operate, the effects of a saturated morning peak will result in a much more serious impact on business operations than the effective elimination of the evening peak hours.
- **Increased Costs of Inventory Management and Control.** Most of the efficiencies in supply chain management over the past decade have been attributable to advances in inventory control and management of materials, components, and finished goods in the supply chain. Tight inventory controls and accurate accounting for inventory flows are a factor in both achieving profit margins and, arguably, in the ability of the national and regional economies in many parts of the US to weather the business cycle. The effects of congestion are eroding the significant progress that has been made in inventory management and control by re-introducing uncertainty in shipping and receiving attributable to the over-the-road and "last mile" portion of the supply chain system. The result can be a fallback to looser scheduling, lower targets and additional inventory to allow for uncertainty in delivery times.

- **Delivery Costs** – Beyond the changes in warehousing and inventory management, congestion has remaining effects on the cost of deploying crews for delivery of products and services. These effects can include labor and fuel costs due to longer truck operating hours, fewer deliveries or completed jobs per crew trip, and/or greater reliance on additional truck and van trips when current driver time limits are reached.
- **Localized Effects of Land Use and New Development** - Warehousing was traditionally located in former "edge" areas of the region. Several firms that located in these relatively low-density, open spaces – even as recently as 7 to 10 years ago – are now facing congested roadways and difficulty with access to major arterials (turning movements from gates, ramp congestion). This was especially notable in the Hwy 224/212 corridor and at manufacturing sites along waterfront areas. Expansion is limited both by new and proposed non-commercial land uses and by significantly higher land costs. Using existing facilities with greater intensity is limited to the utilization of existing space in transportation and warehousing operations (e.g., most trailers in use have increased from the 28' to 40' range to 53').

  Retailers and distributors located in and serving urban centers cite increasing difficulty with both deliveries and parking operations as residential activity and traffic congestion increases. Early deliveries of merchandise made necessary by afternoon congestion (as noted above) means that complaints from nearby residential areas (e.g., noise, lack of on-street loading areas) have also increased. Increased mixed uses, such as residential development near active port areas, have produced road congestion that is becoming more noticeable to businesses and manufacturing firms operating in these areas.

The effects of these cross-cutting issues are highlighted specifically as they affect various business sectors in the following discussion. The "last mile" phenomenon refers to the fact that most shipments, whether by air, water or rail, involve some over-land movement on the highway system. Therefore, even for relatively short moves – such as from the airport to a manufacturing plant somewhere in the region, or from a terminal operated by the Port to a local warehouse – some part of the region's highway system is used.

(b) Highway-Related Issues. Although there are a host of unique and special problems faced by each of the interviewed businesses, several issues were identified in many of the discussions conduced for this project. The four most representative issues include the following:

- **Cross-Region Movement** - Most interviewees identified major problems with east-west movements that involve Hwy 26 and Hwy 217. Increased congestion on Hwys 224/212 is most significant for firms located along this roadway. I-5 and I-205 are key congested north-south facilities, with the Wilsonville area and I-5 in the I-84 interchange most frequently cited as major choke points.

- **Evening Congestion-Shortened Operating Time -** All interviewed businesses irrespective of sector have restricted operations after 3PM in the face of congestion (except for Providence Health Systems, which has moved deliveries to the west side until after 6:30PM). This has pushed starting times into the early morning hours for businesses involved in transportation and distribution, with individual characteristics depending on the kinds of services offered (common carriers start earliest).
- **Interchange and Ramp Congestion -** Lack of capacity (or more accurately, growth in traffic that exceeds existing capacity) is one of the most recognized issues for all businesses in the region and is most apparent on arterials leading to the interstate system and ramps connecting these arterials to the interstates.
- **Externalized Effects of Start Times -** Most employers require employees to bear the costs of shifting start times to earlier hours. However, many employees are constrained in their ability to use transit because service cannot be economically offered early in the morning or late in the evenings – typically when early morning and swing shifts begin and end. As warehousing and transportation (driver) employees are dispersed around the region, and because route assignments often change throughout the year, the consistency of reporting times and return times for drivers has seriously reduced the feasibility of car and van-pools for workers in the logistics and transportation industry, as well as the adoption of other traditional TDM strategies.

(c) Non-Highway Issues. Many firms intensively involved in the freight and logistics business depend on non-highway modes of transportation to support their businesses. Regional competitiveness is often significantly influenced by these modes. Although the firms interviewed for this study identified a range of issues and concerns that are highlighted in the business sector summaries, there are three cross-cutting areas that were each mentioned by several interviewees. They are:

- **Poor Class I Rail Service/Reliability -** Service by Class I operators has become noticeably less reliable in the past 3 to 4 years. Shippers with regular rail deliveries report that there is at least one "no-show" every two weeks. This affects trans-loading services and potential for efficiencies offered by carriers who want to make trans-loading a more integrated part of their operations. Missed schedules by Class I railroads increases both labor costs (unloading crews) and inventory costs (to compensate for the expectation of future delivery problems) of firms offering services that depend on meeting tight delivery schedules.

> ***Rail Service and Trucking***
> *Poor rail service can mean more trucks are needed to support goods movement with in a region. It can also mean increased operating costs and reduced productivity as missed trans-loading schedules cost both the time of the trucking and unloading crews and require trucking firms to reschedule their operations. These costs are not immediately recoverable.*

- **Reduction of Ocean Shipping Choices -** Loss of ocean shipping firms has resulted in increased truck operations – primarily from the Port of Tacoma, with

smaller movements from San Francisco and Los Angeles. A relatively new short-line (rail) now operates between Tacoma and Portland, but this is not an efficient alternative for all shippers – especially those without direct access to rail yards operated by these short-lines. Therefore, there has been a significant increase in container movements by truck into the region from the north.

Air Cargo Efficiency Requires Sustainable Traffic
A large proportion of air cargo is moved via overnight truck from San Francisco Airport to the Portland Metropolitan area. Lift capacity is the issue at PDX, especially for manufactured goods. Some manufacturers receive as much as 60% of all air freight through SFO.

- **Air Cargo Capacity** - Capacity to handle air cargo at Portland International Airport is an issue for many businesses involved with low volume or high value cargoes. The issue of capacity is also complicated by access time – especially for those businesses located on the west side of Portland. Many businesses rely in inbound shipments from Asia for materials and components involved in manufacturing. Increasingly, these inbound air shipments move through either Seattle-Tacoma or San Francisco and are trucked to Portland. Outbound shipments also move through these airports because of shipper or capacity issues. Air cargo routing decisions are subject to a complex calculus of cost and capacity, of which congestion in Portland is only one variable. In addition, more outbound shipments of low volume/high value products, such as electronic components, are moving through Hillsboro airport.

3.3 Major Regional Employers

Common Congestion Issues for Regional Employers
Major employers with high levels of "Mission-Critical" service and logistics support operations cannot tolerate missed deliveries or delays.

Two major regional employers were interviewed for this study – Providence Health Systems (PHS) and Portland General Electric (PGE). Although these are very different businesses, they have common characteristics in terms of their need to provide services region-wide and the way that their service delivery points and employees are distributed throughout the region. Both organizations have a limited number of highly-concentrated employment centers and a much larger number of smaller, more widely distributed service centers (PGE has one central load management center located in downtown Portland and nine crew dispatch centers) and clinics (PHS has four hospitals – including the Newberg – and 29 clinics located throughout the region.) They each require rapid responses and cannot tolerate delays/missed deliveries. Both organizations must maintain extensive logistics support functions that can respond to emergencies as well as routine and predictable demands. And the effective management of costs supporting mission-critical supplies and institutional capacity are critical to the success of each organization.

Congestion has affected the ability to deliver services and support for both of these major regional employers. The increasing effects of congestion that have developed in the past 5 to 8 years have been especially challenging. But because the ways that they provide service to the community are so different, they have adapted to the effects congestion in very different ways. Also, the differences in discipline imposed by a competitive market in the case of PHS compared to the discipline imposed through the regulatory environment in the case of PGE has led to important differences in how each organization has responded to the effects of congestion. In both cases, operational efficiency and cost minimization have been driving forces in decision-making and in responding the effects of congestion.

Two Reactions to Afternoon Congestion

- *PGE starts shifts earlier*
- *PHS schedules evening hospital deliveries*

Utility Issues - Portland General Electric. PGE must maintain an extensive system of electric generation, transmission, distribution and customer service. The operational effects of congestion are most apparent in the distribution and customer service side of the company's operations. Over the past ten years, PGE has consolidated its customer service functions and moved into toll-free telephone and internet-based customer service. These decisions have been influenced more by the costs of personnel and facility maintenance than by congestion, although the previous trend toward opening more customer service centers was due, in part, to the difficulty customers were having getting to a limited number of customer service centers. Today, the effects of congestion are influencing PGE's ability to respond to emergency situations and to dispatch maintenance/repair crews. Congestion has also influenced routine services such as meter reading and interoffice conferencing.

PGE is tied to performance benchmarks set by Public Utility Commission (PUC). Rate increases are measured against improvements in responding to outage frequency and duration. Response times are a critical element in meeting these performance standards. There is no provision for the effects of congestion on response benchmarks, so PGE must make provisions to meet or exceed various measures of customer service and system reliability in spite of congestion effects.

PGE has modified its maintenance and emergency repair services in response to various cost pressures and the difficulty of responding in congested time periods. Sites that were developed at the edge of the region 20 years ago have become difficult to access or expand. As a result PGE has consolidated line support centers at three locations (Hillsboro, Beaverton and Wilsonville) and operates smaller yards and crew centers located at 5 other locations. These sites provide flexibility and are less costly to close as land use and traffic pressures mount (see text box). PGE expects to continue responding to changes in land use patterns and the effects of congestion at service center and yard locations as conditions change.

Dispatching emergency crews from yards has proven to be both expensive and inefficient, as getting crew members to the yard and then moving emergency-ready equipment out of the yard can involve extensive delays at peak hours. One method

used by PGE to improve emergency response time involved development of "Eagle Crews". Twenty-five of these one-person crews are pre-positioned and ready to respond to emergency situations. In addition to providing first-response emergency services, they can call in support and equipment from appropriate yards and service centers throughout the PGE system. When not responding to emergencies, these crews provide routine support and maintenance for PGE distribution system components and other customer services.

Other routine maintenance tasks have proven to be less amenable to innovative management and operational changes. Two of the most relevant with respect to congestion effects are tree/line maintenance and increased costs for in-roadway construction. Tree and line maintenance were traditionally done by in-house crews. Increasing travel times from staging areas increased the down-time and travel costs to work sites. Seasonality of this maintenance work as well as increased "overhead" due to travel time increases led to more contracting out. Currently PGE has 36 contract crews working during peak seasons. Equipment staging and storage/parking in urbanizing areas has become more of a problem. Contract crews routinely must travel 5 to 6 miles from staging and storage areas compared to 1 to 2 miles just five years ago. This increases driving time and reduces on-site work time, thus reducing productivity.

Line Maintenance Costs Increase with More Congestion

PGE estimates that the travel time penalties for contract trimming and line crews has increased by between 20 and 30 minutes in the past 7 years. This adds between $30 and $50 per day to the costs for each of the 36 crews currently employed year-round.

Traffic Management Costs

PGE's traffic management costs for in-road construction have risen from 4% of the maintenance budget in 1990 to 10% of the maintenance budget in 2003.

Roadway congestion has also significantly increased the costs of in-street maintenance and repairs. As the volume of traffic has increased, temporary construction signage has been replaced by 1- and 2-person flagging teams. Repair work is also being done more frequently and for longer periods of time in older urban areas as equipment wears out and higher capacity replacement transformers and distribution lines are required to serve increasingly concentrated loads.

Increased congestion has affected personnel movement within PGE. With offices in Salem and Oregon City as well as Gresham and Portland, travel between offices for meetings and project-related team conferences has been adversely affected by congestion. This has increased the on-the-clock travel time for senior managers as well as project and departmental staff. Another example of both the impact of congestion and creative ways to accommodate the effects of congestion involves meter reading. PGE estimates that their meter readers traveled over 1,200,000 vehicle miles per year. The increased mileage and the wear and tear on vehicles, coupled with higher operating costs and slower speeds was reducing the productivity of even their most experienced meter readers. By consolidating meter reading functions in selected locations and by providing mountain bikes for many of the

readers assigned to moderate and high density areas, PGE has reduced vehicle miles by 12% and increased the efficiency of meter reading services.

Health Care Industry - Providence Health Systems. PHS logistics and warehousing services supports one west-side hospital and two east-side hospitals as well as their Newburg Hospital. They also provide medical supplies to 29 clinic operations. They use common carriers for deliveries to other affiliated hospitals in coastal and southern Oregon. Most warehouse and distribution costs are associated with hospital support for the four facilities in the Portland region.

PHS has centralized warehouse operations because direct deliveries to hospitals and clinics from manufacturers and suppliers were too unreliable. (This arrangement also saves money on bulk orders direct from manufacturers.) Their ability to purchase in bulk and provide warehousing, distribution and support to their hospitals and clinics is one of the most important ways that they can cut costs and achieve an economic return on scale for multi-hospital, multi-clinic operations. The ability to keep supply costs low is an important part of the strategic planning for hospital expansion within existing PHS facilities and is a factor in future acquisition and support for other health care facilities in the Northwest.

Increasing Congestion Influences Clinic Deliveries
Deliveries to clinics require drivers to unload and store supplies. With 12 of the 29 clinics located on the West Side, traffic delays and congestion can create significant schedule delays and missed deliveries.

Until the early 1990s, most deliveries scheduled from the PHS warehouse were within the 9AM to 3 PM time periods for both hospitals and clinics. Today, deliveries to nearby hospitals (Providence Portland Medical Center, and to a lesser extent, Providence Milwaukie Hospital) are made in the mornings or late evening hours, and deliveries to clinics are restricted to morning and early afternoon. These changes evolved due to the growing unpredictability of deliveries to hospital receiving areas due to local roadway congestion and the costs involved in staffing hospital loading areas while waiting for deliveries that may be delayed. Also, cost-cutting and tighter staffing schedules required better efficiency in allocating hospital support staff.

Warehouse operations are centralized in one facility located in the Northeast of Portland just off I-84. Inbound warehouse deliveries are cut off at 10AM (most are in by 7:30AM) to allow for sorting and racking. PHS also supports cross-docking for special orders in this time-frame. Cross-docking is critical to keeping supply costs low as manufacturers and distributors can provide significant discounts on bulk orders. Although most bulk orders are destined for one specific hospital, they are received at the central warehouse because manufacturers/providers cannot reliably meet clinic/service center delivery time windows that are often later in the day. These larger orders can be cross-docked at the central warehouse, combined with other stocks destined for each hospital and loaded for delivery in the evening run.

Peak Hour/West Side Congestion Problem for PHS
Congestion in the evening peaks and congestion delay on the West Side are the biggest logistical problems and the most costly problems to solve.

Deliveries to St. Vincent Medical Center, located on the West Side are *dispatched* at 6:30PM and timed to coincide with hospital swing shifts. Timing is important because all deliveries must be unloaded, inventoried, stored and secured for potential immediate use. The time required to accomplish these tasks can be substantial for a full truckload, thereby requiring several hospital staff. Order fulfillment is a critical issue, too. Missing items or mis-filled orders, though rare, must be identified and corrected by early the following day. Separate van crews deliver emergency or mis-filled orders throughout the day. PHS has also added a specialist for suture and specialty supplies. These materials are delivered in a dedicated van.

Medical Support Requires Rapid & Frequent Deliveries
Larger hospitals, like St. Vincent's in the NW, require at least three deliveries per day, with the largest in the evening.

Deliveries to the West Side and to the Newberg Hospital have become very difficult, with routine runs often requiring over 4 hours – the equivalent to half of a regular person shift. These lengthy delivery runs have required more efficiency in logistics management and PHS recently (since 1999) moved to more complex route planning to support backhauls. Backhaul efficiency is of growing importance because PHS generates significant amounts of recycled materials (surgical and non-surgical), plastics and paper. The increasing volumes and loading/unloading times needed to support backhaul operations impose even more constraints on operations. Congestion during backhaul operations is becoming a growing problem because it limits loading times for the evening delivery cycle.

PHS is planning a relocation of warehousing and support operations that will be designed to address both expansion of the number of hospitals served within the region and accommodate new service functions, including reagent centralization, refrigerated supplies and possibly nuclear medical support. These new facilities will require access to a major interstate highway and will require careful examination of routing and scheduling. They expect that relocation costs (independent of construction) will range from $1 to $1.5m in 2006/07. Warehousing capacity is expected to increase by 60% – to 75,000 square feet.

PHS is primarily a customer service business. As such, it requires that all patients have direct physical access to their facilities. Congestion is a factor in customer/patient access and the costs to accommodate both in-patient and out-patient clinical visits is an important consideration in many decisions made by PHS staff and management. PHS has significant visitor/patient requirements (2,500 per day at hospitals alone!) Most access to PHS's major hospitals is via personal auto or taxi because illness, physical limitations and lack of familiarity (coupled with stress of visits) limits the appeal and practical use of transit.

PHS looks at the availability of transit when locating clinics and out-patient facilities. However, the use of transit by non-employees is relatively low. PHS also operates an inter-facility shuttle and promotes transit usage (see text box, above.) Although

participation by employees is high during the day shifts, swing and night shift employee participation drops off. Patient use of transit is quite low.

3.4 Retail/Wholesale and Distribution

Key Findings for Retail/Wholesale & Distribution

- *Regional Distribution Centers Moving Out Of Metro Region*
- *Shift Support Functions to Earlier Start Times*
- *Growth Constrained by Physical and Logistical Capacity*
- *Adding Smaller And More Numerous Delivery Vehicles*
- *Increased Inventory*

The retail/wholesale and distribution sector was represented by interviews with five businesses: Fisher Farms, Columbia Sportswear, Powell's Books, OrePac, and Fred Meyer. These firms represent a wide range of retail- and wholesale-oriented businesses, each of which includes substantial distribution and logistics support. Some firms, like Columbia Sportswear and OrePac are also involved in significant manufacturing operations and require logistics support for these operations, too.

Consequences of Congestion for Retail/Wholesale & Distribution. Reactions of interviewees to the effects of congestion and other constraints on their operations in the region are manifest in many ways. However, there are a few important ways that businesses are responding to congestion that have implications for both the competitiveness and the long-term economic trends in the Portland Metropolitan area.

- **Regional Distribution Centers Moving Outside of Metro Region.** The ability to serve both Metropolitan area and non-Metropolitan retail stores and other customers is affected by congestion inside the region. Every one of the businesses reported increased difficulty serving retail outlets outside of metro region. Increased travel times that result from congestion effectively shrink the distribution radius of existing operations, making both existing service and expansion into new regional markets more difficult. The biggest factor in providing logistics support outside of the metropolitan area has to do with the fact that congestion limits the outbound (morning) and especially the afternoon return times. Afternoon returns, which often include backhauls, can create an overtime/over-hours situation for the drivers involved, thereby increasing costs and reducing productivity for both the vehicles and the drivers. This further cuts into the cost-effectiveness of distribution operations because efficient backhaul management is one aspect of logistics management that traditionally provides competitive advantages to these firms. As a consequence, many new retail and distribution centers are being located outside of the region. Some

Serving Growing Markets from Portland Is Becoming More Difficult

Continued growth requires more efficient and expanding service to large markets in the Mid-West and East. Some firms (Columbia) have opened facilities as far away as Kentucky. Others, (Fisher Farms) serving customers 1,000 miles away find local congestion a major factor in extending market area.

companies have even begun locating distribution centers as far away as the mid-western states.

> ***Distribution Centers Generate Significant Traffic***
> *Over 6,000 truckloads per week (inbound + outbound) are required just to operate the Fred Meyer Distribution Warehouses on Highway 212.*

Even local-serving distribution operations have become more susceptible to increased congestion. This is because many distribution warehouses that were located on the periphery of the metropolitan area 10 years ago are now in or near major population growth areas. These developing and more intensely used residential and commercial areas are generating more traffic, which in turn affects access to major highways and access to interstate facilities. Originally, because Portland offered a central location in the Pacific Northwest, many of these distribution centers were established to serve retail locations outside of the Portland region – including eastern Oregon, western Washington State and Northern California. Increased time to travel within the region has affected the ability of regional distribution centers to serve out-of-state retail operations.

- **Shift Support Functions to Earlier Start Times.** Retail operations depend on high volume sales, especially because margins for competitive retailing operations are constantly being reduced. The primary factors driving higher throughput are the need to offer a greater range of products and providing continuous availability of retail stocks in the face of uncertain delivery/delay. Timing of deliveries is critical because it is related to stocking time – the ability to get products on shelves, or from loading docks to in-store storage.

  Congestion has significantly reduced, and in many cases eliminated afternoon stock/merchandise deliveries. Early morning deliveries are now required to support stocking in the morning or during swing shifts. This creates problems in mixed residential areas with noise. Most retailers and produce consignees are reluctant to allow "drop shipments", especially of perishables or high-value retail merchandize. Thus, swing shifts are becoming more common as they are required to load shipments for following day. Some distribution warehouse/loading operations begin these swing shifts at 2:00AM, especially if they distribute beyond the metropolitan area.

  If deliveries are made too early or too late in the day, extra in-store shifts are required. Some retailers must also accommodate "push" shipments from manufacturers where, due to improved logistics and manufacturing efficiencies, order fulfillment is now in matter of days, not weeks.

  > ***Retailers Dictate Deliveries***
  > *Home Depot cut back their 24/7 operating hours. Now, suppliers must deliver at pre-specified times during the day. As major retailers consolidate, they exert more pricing power and a greater ability to dictate delivery times based on their internal stocking schedules and staffing levels.*

- **Growth Constrained by Physical and Logistical Capacity.** Future growth for many retailers in the region is being constrained by both physical expansion and

logistics capacity. Most retailers have set goals for growth at 5% to 10% annually to maintain profit margins and market share. This requires more productivity from their fixed assets (space, labor and vehicles). The addition of larger product inventory and more volume also contribute to this need for greater capacity. Some downtown retailers also feel challenged by parking restrictions and difficulty operating parking facilities.

- **Add Smaller and More Numerous Delivery Vehicles.** Increasing congestion means that it is not possible to make equivalent number of deliveries within a shift or delivery run compared to only a few years ago. Coupled with growth in number of products/deliveries and the proliferation in the number of stores needed to serve a growing population (also a function of increased intensity of activity attributable to mixed use development) the ability to provide adequate inventory requires more drivers/vehicles. The reduction in driver productivity increases costs to distributors, and it adds more trucks and delivery vans to the mix of vehicles already on the region's highways. Many firms have also added smaller and more numerous delivery vehicles to deal with congestion and to provide both flexibility and rapid delivery of urgent or missed orders. Large vehicle drivers often make multiple deliveries from a single pull-over/stop (which can lead to local congestion and parking tickets). Often, congestion in and around delivery locations means that the larger consolidated loads for multiple deliveries are more likely to be delayed, especially toward the end of the run.

Vans and Outsourcing Loads
Missed orders and delays mean lost customers. When larger trucks are held up or delayed, distributors dispatch small delivery vans or hire common carriers to fill missed or delayed shipments. While this keeps customers happy, it adds to costs and increases congestion on the region's roadways. Outsourcing can add 35% to delivery costs.

- **Increased Inventory.** Most retailers and distributors are faced with a rapidly growing inventory. In addition to having to move more of a particular item, they are also stocking a larger number and greater diversity of items. Increases in volume and mix of products mean space constraints have become critical factors in their ability to serve customers and retail outlets. Inventory management and distribution efficiency are the most important factors in achieving the levels of productivity needed to remain competitive. Limited space inside existing warehouses and lack of expansion space encourage just-in-time inventory systems, which are highly dependent on reliable deliveries.

  Reliable delivery schedules allow for efficient "just-in-time" processing, but delays effectively undo those opportunities for business efficiency. As a result, businesses with chronic delivery problems have had to increase inventories by as much as 5% to 8% compared to 5 years ago. Some of that is due to road congestion and some to railroad delays.

Increased Congestion Requires Increased Inventory
OrePac Estimates that the effects of congestion in the past 3 to 4 years have forced them to increase inventory by

3.5 Manufacturing Industry

Key Findings for Manufacturing Businesses
- *Earlier Start Times for Shift Workers*
- *More Conflicts with Non-Commercial Traffic*
- *Earlier Scheduled Deliveries/Shipments*
- *Increased Inventory*
- *Affects Production Elsewhere*

Five manufacturing firms participated in the interviews. These firms included: Blount, Gunderson, Boeing, Intel, and Schnitzer Steel. Although they represent a wide range of manufacturing operations, they all face common congestion-related costs. Some of these issues reflect those already noted in the logistics support part of the retail/distribution sector. However, some of the consequences of congestion noted by manufacturers are slightly different.

- **Earlier Start Times for Shift Workers.** Earlier start times for shift workers are becoming standard as manufacturing output is more constrained by the ability to move finished materials to consignees. Early start times and staggered shifts mean that alternatives to auto commuting have to address very early start times and the effects on second-shift start/end times. In areas where transportation, warehousing and manufacturing are concentrated, and where transit or paratransit [5] services are available, there should be a careful assessment of the ways in which new shift patterns can be addressed. Many manufacturing businesses in the Portland region have relatively high retention rates. Although there is a variety of reasons for this phenomenon, the effect is that these long-term workers tend to notice changes in commuting delays because they can compare their commuting experiences over a relatively long period of time.

Congestion Issue for Workers
Manufacturing workers in Portland are reportedly more likely to complain about congestion because they have seen their commute times lengthen and their commute options as shift-workers are limited.

- **More Conflicts with Non-Commercial Traffic.** Maintaining or improving productivity for transportation and manufacturing firms requires both earlier starts for drivers and late-shifts associated warehousing operations. Congestion in increasingly more populated areas, especially congestion attributable to development of new residential and mixed use activity near traditional manufacturing areas, new residential development near the Portland waterfront, and increases in the numbers of people living close to or in downtown area, are producing many more "conflicts" with heavy industrial traffic. This increases the time it takes to move large loads and

The Productivity Problem
Schnitzer Steel supplies its McMinnville plant using scrap metal arriving by truck and rail, as well as barge, which is off-loaded to a marine slip on its site in the Portland Harbor. Maintaining production in McMinnville requires that 40 trucks make 3 round-trips (turns) per day. When congestion increases the time "per turn" either extra trucks or later runs have to be scheduled. Costs go up and productivity goes down.

[5] This can include public or employer sponsored carpool, van, and/or shuttle services.

routine shipments, and it adds to the difficulty of maintaining traditional routes and fixed delivery schedules. For manufacturing businesses with regular, high-volume movements between sites, congestion and reduced capacity on critical bridge crossings and city streets has significantly increased the time needed to move intermediate products, partial assemblies and raw materials. In many cases, especially where older manufacturing sites are located along waterways or in older industrial areas, introduction of new, mixed use development has combined with traffic congestion to compound delays in routine shipment patterns.

- **Earlier Scheduled Deliveries/Shipments.** Most firms are involved in on-going review of routings and have developed methods for "on-the-fly" rerouting or regular adjustment of departure times, loading and preparation of loads for delivery and other measures. However, some firms – particularly those with large, heavy loads moving between established manufacturing operations, do not have the flexibility to make these adjustments. Slower turn-around between plants requires either adding more vehicles to sustain production, adding shifts, or cutbacks in production schedules.

> ***"Last Call" for Outbound Shipments***
> *Intel has moved their last shipment departure time from 5:30PM to 3:30PM for outbound shipments through PDX in response to increased congestion. A missed flight means loss of inventory and production at the receiving location.*

- **Increased Inventory.** Throughout the 1990s, reductions in inventories increased efficiencies in the manufacturing and transportation sectors. These efficiencies are beginning to erode due to roadway congestion (highways) and reduced levels of service (primarily attributable to poor service form Class I railroads and a reduction in ocean shipping services). Increased variation in delivery times attributable to congestion, more missed deliveries, and other uncertainties related to maintaining services tied to rail deliveries and maintenance of delivery routes has contributed to keeping more inventory on-hand – both in distribution warehouses and in manufacturing operations.

- **Effects on Production Elsewhere.** Many manufacturers operate multiple production facilities throughout the US and in many foreign countries. The location of production on the part of most manufacturing companies is a complex decision that is based on a unique combination of factors such as labor, materials and markets. However, transportation has historically played a role in these decisions. Almost all of the businesses interviewed and several of the retailers who are involved in manufacturing operate globally – with manufacturing on every continent and many regions of the globe (including Africa and the mid-East). However the predominant location of production is in the US and Canada, with Latin American

> ***Delays in Portland Affect Global Production***
> *If Intel experiences delays or missed shipments, it can shut down a production line as far away as Costa Rica, China or the Philippines. These shutdowns can produce a ripple effect on world-wide production and testing operations. They may also have to pay inventory surcharges for various "non-chip" components, and other penalties tied to production delays.*

operations following close behind. This means that for manufacturers, congestion and the ability of the transportation infrastructure in the Portland region to support efficient production processes is an important factor in their decisions about where to locate new product lines, how and where to position various aspects of the intermediate and final production, and where they may best serve growing or emerging markets for their products.

3.6 Transportation and Warehousing

Four firms involved in transportation, logistics support and warehousing operations participated in the interviews. These companies included SYSCO, Oregon Transfer, USF Reddaway, and George S. Bush Logistics.

As with other business sectors, several common themes and concerns emerged. However, these issues affect the transportation and warehousing sector differently than the previously discussed business sectors. One of the most important points that emerged from these interviews is that most of the efficiencies and obvious adjustments to congestion by transportation and warehousing businesses have now been incorporated into their operations. In the future, congestion is likely to begin cutting more deeply into their productivity and operating costs. Key aspects of these effects include the following:

Key Issues for Transportation & Warehousing Industries

- *Warehousing Practices*
- *Delivery/Shipment Patterns*
- *Shift Starts and Relief Drivers*
- *Impaired Cross-Docking Operations*
- *Less Backhaul Efficiency*
- *Increased Stem Times*
- *Reduced Out-of-Region Capacity*

- **Warehousing Practices.** While costs for drivers and equipment have increased as a share of overall expenditures in transportation/ warehousing operations, warehousing operations have become more efficient (using scanners, reducing labor per unit moved, and applying advanced methods for inventory control and management). Although warehousing efficiency has compensated for congestion effects in the past several years, these efficiencies have approached their practical limits and future congestion is more likely to add to non-fuel costs and reduce productivity industry-wide.

- **Delivery/Shipment Patterns.** Shifting early morning dispatches to the 4 AM to 6 AM time slots requires even earlier start times for loading and support personnel (2 AM to 3 AM). Dispatch times are limited by the ability to prepare and load trailers from the time they arrive in the afternoon to the time that they are scheduled to depart in the early morning. The ability of warehouse operations to assemble loads and stage them for loading in the evening shifts, reposition trailers based on available dock/door capacity, and stage trailers for departure is constrained by available time between drop off and whenever trailers with backhaul materials are ready. Increasing the number of trailers on-site is limited

by available space and adds costs for redundant equipment. Very early dispatch times also are limited by the ability of businesses to receive goods in early morning hours (e.g.., stores in urban areas or manufacturing operations).

Transportation and warehousing operations have adjusted scheduling so that most vehicles return to the warehouses or distribution centers by the early afternoon. Most consignees have been able to accommodate these early shipping deadlines into their operations. However, if afternoon congestion trends continue, with the implicit shortening of the window for final outbound shipments, manufacturing and transportation operations will be hard-pressed to maintain current levels of productivity and current final outbound shipment schedules.

- **Shift Starts and Relief Drivers.** In the case of the transportation and warehousing industries, first shift start times for drivers have been moved to very early in the day – often 4 M to 6 AM. This is because afternoon congestion has become a problem for firms with scheduled deliveries or routes, and most firms want to avoid overtime pay or violating state/federal regulations on truck driving hours (typically 11 hours per day within Oregon). Some firms have begun to rely on "rescue drivers" to avoid those situations.

Delays Can Drive Up Costs If Hours-of-Service are Exceeded

The total cost per hour for a driver is between $35 and $55. Sending out a "rescue driver" can double or triple the hourly costs. Rescue driver dispatch usually occurs during periods of heavy congestion. So, costs for these operations can become very expensive.

- **Impaired Cross-Docking Operations.** Efficiency and feasibility of cross-docking operations are tied to the ability of originators to deliver inbound loads within window of time needed to reposition loads for outbound customers – typically very early in the morning. Late inbound delivery creates storage and loading problems. As the communications and inventory control infrastructure required to support cross-docking operations becomes more widespread and more critical to improving efficiency and lowering costs of transportation and logistics, delivery reliability will become an even greater issue in the successful adoption of cross-docking in warehouse and logistics management. To the extent that this practice becomes more integrated into transportation and warehousing operations, consideration will be given to locating new facilities in places where congestion is less of a factor in the variability of scheduled delivery times.

Delivery Productivity is Key to Efficiency

USF Reddaway depends on each driver making 15 to 20 deliveries per 8-hour shift. Increases in stem times and/or delays along the route of even ½ hour can mean missing 2 or more deliveries – even if there are no more congestion-related delays for the rest of the run.

- **Less Backhaul Efficiency.** Backhaul efficiencies are important to many transportation and logistics operations as the ability to support efficient backhauls reduces the number of vehicles, number of operators and time required for normal operations by these firms. Backhaul opportunities and efficiencies are more

significantly impacted by afternoon congestion than outbound shipments. Thus, the vulnerability of backhauls to afternoon congestion is also greater. Many firms that developed sophisticated routing and logistics management practices integrating backhaul management into their processes have more recently noted increased overtime and the need for "rescue drivers" to conform to the new "hours of operation" requirements.

- **Increased "Stem Times"** The time it takes to get from the warehouse to the first stop/delivery (stem time) has increased by about 50% in the past 5 to 8 years. This means that there are more vehicles on the road (to maintain and grow distribution and trucking markets) and routes are changed more often. Also, east-west movements are much more difficult than they have been in the past and have required constant adjustments in scheduling drivers and deliveries.

- **Reduced Out-of-Region Capacity.** Increased stem times and greater travel times required to move through the region have made it more difficult to serve areas outside of the immediate Portland metro area from facilities located inside the metro region. As with the ability of retail/wholesale firms to support out-of-region businesses, this factor is also a noticeable and more significant drag on the region's transportation/warehousing operations where growth outside of the immediate metro region has to be served.

> ***New Warehouses Serve Markets Formerly Covered from Portland***
> *SYSCO has recently opened a Spokane warehouse to serve eastern Washington and the Tri-Cities, as well as places in Oregon such as Pendleton and Milton-Freewater.*

Several interviewees have opened new operations outside the region (especially in areas of Oregon and Washington north and east of the Portland Metropolitan area) to serve growth in markets in Washington State (especially southern and eastern Washington), and markets east of Portland. Service to Southern Oregon and Northern California seem less affected (to-date) by congestion. However, operations in the Wilsonville area are seeing significant afternoon delays. Transportation and warehousing operations have begun to site new centers closer to customers in the western states rather than try to serve these markets from the Portland area. There are many factors contributing to these decisions, but the top three are lack of adequate expansion for major new facilities, lengthening times in moving out of the region, and lack of alternatives to truck transportation (e.g., especially Class I rail and Short-lines).

3.7 Conclusions

Interviews conducted for this project provide important insights into the complex and interrelated effects of congestion that challenge businesses in the Portland region. Congestion – especially in the afternoon – is already a problem. Most businesses

have made accommodations to address peak afternoon traffic conditions. However, there is a growing concern that the relatively uncongested windows of time in which transportation and logistics functions are currently operating may shrink to a level that will make future accommodation costly and difficult to achieve.

Area businesses have found some ways to "work around" problems created by congestion in the transportation systems and continue to deliver efficient and cost-effective service and support within their business sectors. Most often, this involves reorganizing their operations around times when congestion in the region is at its lowest ebb (very early morning hours.) However, managing around the severe afternoon peaks presently characteristic of the transportation system is becoming increasingly difficult because the only alternative – the morning peak hours – are beginning to become congested as well. In many parts of the region, especially where localized early morning congestion on major highways and ramps leading to interstate facilities are reaching capacity, even these attempts to alter operations are facing severe challenges. What is striking in the discussions undertaken for this project is the sense that the operational windows of relatively uncongested highway conditions in the early morning hours and the ability of businesses across the board to work within this window are rapidly being reached.

Operating in a more intensely developed region is also of some concern. As mixed land uses become more prevalent (e.g., along waterfront and in urban areas) and as residential infill and new centers are developed in formerly less heavily populated areas within the urban growth boundary (e.g., residential areas on Sunrise Highway) more pressure is placed on local streets and highways, arterials, and ramp access to the interstate system. Issues range from improved management and design (allowing adequate space for trucks to make left turns, providing adequate lane widths, creating gaps in traffic for turning movements), to added capacity (providing multiple ramp lanes, increasing the number of lanes on arterials and major highways,) to consideration of major new facilities to improve connectivity between parts of the region (providing more capacity for east-west movement).

In Chapter 2, a distinction was made between "local-serving industries" and "traded industries." The *"local-serving industries,"* including the electric utility and hospital suppliers profiled here, have to absorb their additional costs of congestion and then pass them on to their customers in the form of higher rates. Ultimately, residents of the region are likely to end up paying many or most of these costs.

The *"traded industries,"* including the manufacturers and wholesale/ distribution activities profiled here, do have a location choice. If the costs of congestion reduce the competitiveness of locating in the Portland area, they can select other locations for siting their facilities. From a business standpoint, a major issue for regional competitiveness is the ability to move within and beyond the boundaries of the metropolitan area quickly and easily at key times of the day.

Portland is uniquely positioned to competitively serve Northern California, southern

and eastern Washington, and other inter-mountain states. It has historically provided logistical support to the Seattle-Tacoma metropolitan region, and it remains the major gateway for bulk commodities transported through the Columbia River rail/barge system. However, if the time required to move through and out of the region continues to increase, then there will be decreases in the ability of manufacturers and transportation and logistics oriented businesses to serve markets outside of the metropolitan area. As this happens, new jobs in transportation, logistics and manufacturing that are serving growing markets outside of the Portland region will tend to migrate outside of the region.

4 TRAVEL CONDITIONS

Prior chapters have shown the many ways in which the Portland area's business activity and economic base are vulnerable to traffic congestion. The next logical step is to assess how traffic conditions are expected to change in the future, and the relative impact of additional investment to reduce future congestion growth.

Two scenarios are offered for the period from now to the year 2025: (a) a Base Case, referred to as the *Planned Investments Scenario*, that maintains current spending levels to fund modest transportation system improvements, and (b) an illustrative alternative, referred to as the *Improved System Scenario*, that requires additional funding to better meet future transportation needs.

Transportation forecasting models show that the *Planned Investment Scenario* will not keep up with traffic growth, resulting in severe congestion delays. Under this scenario, slower speeds and increasing bottlenecks will add 212,000 more hours of vehicle travel time delay per day than would occur under today's conditions. That represents over 55 million vehicle-hours of additional travel time incurred annually, which is an average of 50 hours of time lost annually per household by the year 2025. These are substantial numbers and the increases in congestion will especially hit truck traffic and have a particularly strong impact on the region's business base.

While the *Improved System Scenario* will not fully solve the congestion problem, it will provide substantial savings by avoiding more than half of that delay. Most importantly, it will disproportionately relieve congestion growth during the morning and afternoon peaks. This will allow businesses to deliver more efficient and cost-effective services during those times. This congestion reduction will allow "local-serving industries," such as the electric utility and hospital suppliers, to avoid having to pass on their additional costs of congestion to their customers. It will also make the region more competitive as a place for manufacturers and wholesale/distribution businesses to remain and grow.

4.1 Profile of Current Travel Congestion

Region-wide Conditions. Table 4-1 shows a metropolitan-wide summary profile of current car and truck traffic, based on year 2000 conditions. It reveals that:

- Afternoon peak period accounts for roughly 18% of total daily trips. Since morning peak accounts for a similar proportion, the peak commuting periods together account for around 36% of total daily trips.

- Truck trips average triple the mileage of car trips, reflecting both long-distance shipping and the multiple delivery nature of many truck trips.
- At a regional level, the average speed is lower in the peak period than the daily average, though the difference appears modest. However, these statistics reflect averages for all travel distributed over all streets and roads in the region, and thus do not show the fact that some key travel corridors experience congestion and much more substantial slowdowns during peak periods.

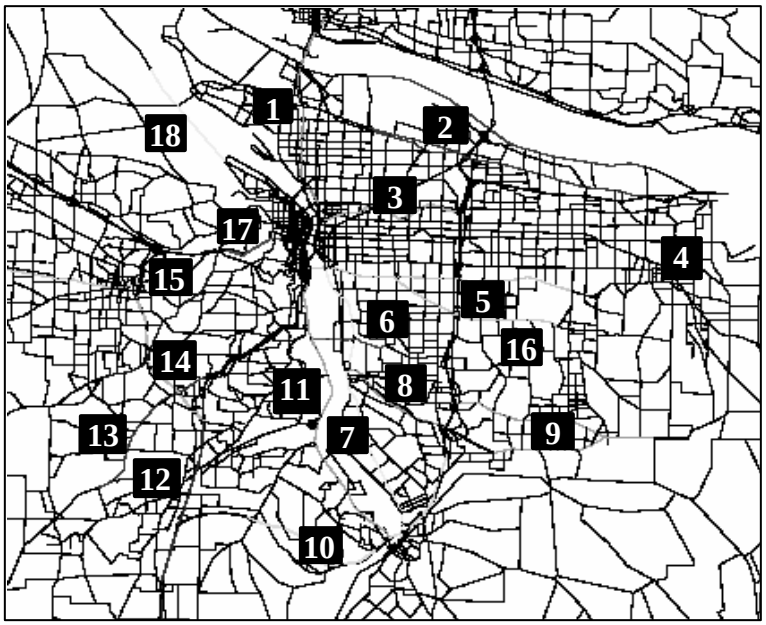
Table 4-1. Current Road Traffic Summary (average weekday)
-- Year 2000 "Current Conditions"

	PM Peak	Daily Total	Cars	Trucks
Vehicle Trips	1,024,623	5,741,846	5,655,592	86,253
Vehicle-Miles of Travel	6,735,165	36,440,729	34,775,204	1,665,525
Vehicle-Hours of Travel	230,901	1,183,558	1,141,223	42,335
Average Miles per Trip	6.57	6.35	6.15	19.31
Average Miles per Hour	29.17	30.79	30.47	39.34

All numbers are per weekday. Source: calculations by EDR Group based on data from Metro

Specific Corridors. There are many key travel corridors throughout the Portland region that are particularly important for commuting flows, for business deliveries, and for longer distance traffic. There are also many key traffic intersections and interchanges that represent bottlenecks restricting those flows. The business interviews cited in Chapter 3 identified specific locations of congestion concern, and analysis by staff of Metro identified additional areas of high congestion delay. The result was a list of 18 congested highway links, shown in Figure 4-1.

Figure 4-1. Location of Identified Areas of Traffic Congestion



1 I-5 North
2 Marine Dr and US 30
3 I-84
4 Troutdale Rd / SE 282nd Ave
5 SE Powell Blvd and SE Foster Rd
6 Sellwood Bridge & SE Tacoma St / Johnson Creek Blvd
7 Hwy 99E
8 Hwy 224
9 Sunnyside Rd and Hwy 212
10 I-205
11 Hwy 43
12 I-5 South
13 Hwy 99W
14 Hwy 217
15 Hwy 210 (Scholls Ferry Rd)
16 Hwy 8 (Tualatin Valley Hwy)
17 US 26 (Sunset Hwy)
18 US 30 (Saint Helens Rd)

While these are not the only locations of traffic congestion in the Portland metropolitan area, they are notable for the geographic spread of their locations, as shown in the map. Together, they account for over 12,600 vehicle-hours of delays every weekday afternoon. While afternoon peak periods tend to have slightly worse traffic congestion than the more spread-out morning peaks, nevertheless these figures indicate that morning and afternoon peak period congestion at these 18 locations altogether total over 5 million vehicle-hours of delay annually. Details of the extent of delay at each of these high congestion areas are provided in the Appendix.

4.2 Future Base Case: Planned Investments Scenario

Definition of Base Case. To assess the need for additional capital investment, it is necessary to define a *base case* representing "normally expected" levels of capital investment and then an *alternative case* representing more aggressive investment in transportation capacity and services for the period from 2000 to 2025. To maximize credibility of the analysis, it is important that these cases be defined in ways that are deemed both realistic and prudent (erring on the side of caution in assessing needs for further spending).

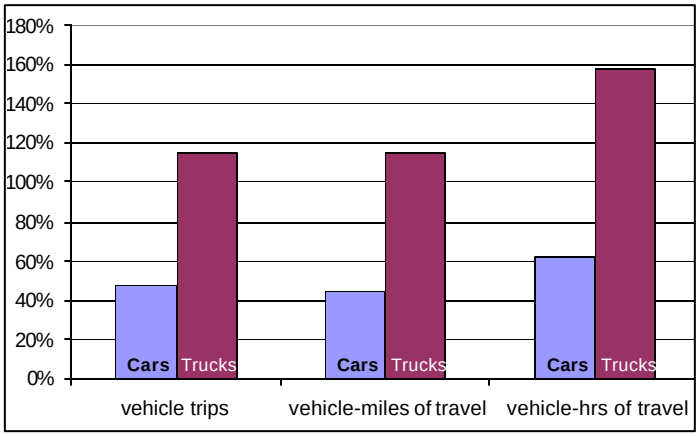
This study has defined the base case as implementation of all transportation capital investments currently planned for the next twenty years – a package costing an estimated $4.2 billion in today's dollars, although that cost would be spread over the period of twenty years. This is referred to as the *"Planned Investments Scenario."* Since full funding to support this scenario has not yet been secured, this could be considered an optimistic assumption. The result of using this definition for the base case is that it will make the incremental benefit of further capital investment (in a more improved transportation system) appear to be smaller than if a more pessimistic base case was adopted. However, this approach will help prevent arguments that the study has intentionally assumed a "worst case scenario" for the base case in order to maximize the apparent benefit of additional transportation investment.

Truck Traffic
Forecasts for 2025 show truck trips growing at more than double the rate of car trips.

Forecast Regional Changes. Figure 4-2 and Table 4-2 show the baseline projection for road traffic. They show the number of car trips growing 48% over the 2000 - 2025 time period, closely matching Metro's mid-level projections for regional population growth. However, the projections show truck trips growing a 116% -- well over double the growth rate for cars. Trips lengths are not expected to change much, so that total vehicle-miles of travel reflect these same increases. However, average vehicle speeds are projected to drop significantly, causing total vehicle-hours of travel to increase at a much higher level, rising 63% for car trips and 157% for truck trips.

Figure 4-2. Planned Investments Scenario: Growth in Trips, Vehicle-Miles and Travel Times, 2000 – 2025

Source: calculations by EDR Group based on data from Metro



In other words, the Metro travel models are forecasting that speeds will slow significantly as traffic becomes increasingly congested, and travel times will increase accordingly. The projected difference is over 212,000 hours of additional vehicle travel time per day in 2025 (compared to what would be the case if year 2000 speeds still applied to all trips in 2025). That represents over 55 million hours of additional travel time incurred annually – representing an average of 50 hours of time lost annually per household. These are substantial numbers and the increases in congestion will especially hit truck traffic and thus have a particularly strong impact on the region's business base.

Base Case Traffic Congestion
Forecasts for 2025 show 212,000 hours of additional vehicle travel time per day due to higher traffic volumes.

Table 4-2. Projection of Road Traffic (average weekday)
-- Current Conditions and 2025 Planned Investments Scenario

	PM Peak	Daily Total	Cars	Trucks
Vehicle Trips				
2000 "Current Conditions"	1,024,623	5,742,615	5,655,592	86,253
2025 Planned Investments Scenario	1,550,878	8,544,485	8,356,715	186,826
Percent Change	51.4%	48.8%	47.8%	116.6%
Vehicle-Miles of Travel				
2000 "Current Conditions"	6,735,165	36,520,585	34,775,204	1,665,525
2025 Planned Investments Scenario	10,086,695	53,987,090	50,279,629	3,603,366
Percent Change	49.8%	47.8%	44.6%	116.4%
Vehicle-Hours of Travel				
2000 "Current Conditions"	230,901	1,188,588	1,141,223	42,335
2025 Planned Investments Scenario	423,827	1,980,852	1,865,176	109,104
Percent Change	83.6%	66.7%	63.4%	157.7%
Average Miles per Trip				
2000 "Current Conditions"	6.6	6.4	6.1	19.3
2025 Planned Investments Scenario	6.5	6.3	6.0	19.3
Percent Change	-1.1%	-0.6%	-2.1%	-0.1%
Average Miles per Hour				
2000 "Current Conditions"	29.2	30.7	30.5	39.3
2025 Planned Investments Scenario	23.8	27.3	27.0	33.0
Percent Change	-18.4%	-11.3%	-11.5%	-16.1%

All numbers are per weekday. Source: calculations by EDR Group based on data from Metro

Public Transit Shares. Table 4-3 shows the projected future mode split under the Base Case Scenario (for motorized modes only) and its change from year 2000 conditions. It indicates that the region-wide transit share of all person-trips is expected to increase over the period from the year 2000 to 2025, for all classes of trips. This result can be attributed to a combination of factors -- the substantial increases in delay for car travel, planned changes in capacity for transit to accommodate additional demand, and assumed changes in land use development patterns over time.

Table 4-3. Projection of Public Transit Share by Trip Purpose
-- Current Conditions and 2025 Planned Investments Scenario
(avg. weekday, motorized modes only)

Trip Purpose	Year 2000 "Current Conditions"	Year 2025 "Planned Investments Scenario
On-the-clock	1.5%	2.1%
Commute	9.2%	12.8%
Personal/Recreation	2.0%	3.7%
Total	**3.9%**	**6.1%**

Source: calculations by EDR Group based on data from Metro

Public Transit
The Base Case has public transit shares increasing substantially, especially for commute trips. However, on-the-clock business trips generally require trucks and delivery vehicles and remain "prisoners of congestion."

In interpreting these numbers, it is also important to note that the regional transit share for commuting trips is over double that of the average for all trips. In fact, the current transit share for commuting trips is even higher in those corridors where there is strong transit service, exceeding 30% for commuting trips along the I-84 and west side corridors. These figures confirm that public transit can be an important means of serving work commuting travel and some personal travel. However, transit services do not meet the specialized needs of "on-the-clock" business travel for delivery of freight or delivery of installation/repair services (usually requiring trucks), and they limited application in serving some of the more spatially diverse and time sensitive requirements for business sales and service calls. As many business-related trips are subject to schedule requirements, they become "prisoners of congestion."

Additional Effects on Regional Travel Conditions. The changes in travel conditions shown earlier are based on forecasts of *average* travel times and speeds. However, it is well known that congestion not only slows traffic speeds, but it also increases *variability* in travel times. When congestion becomes severe (i.e., traffic levels exceed 90% of road design capacity), the frequency of incident-related delays increases dramatically. Under those conditions, any minor accident, flat tire or engine stall can lead to traffic backups and long-lasting slowdowns. This increases the unpredictability of travel times on affected routes. When such traffic incidents occur, the time delays are often double or triple the average delay due to congestion alone. As occurrences become more common, travelers and businesses adjust their

schedules to allow for this uncertainty. The result is further time built into commuter and business delivery schedules.

To account for this factor, transportation researchers have developed the concept of a "variability penalty factor" that is added to average time delay estimates. That factor varies depending on the extent of severe congestion along major travel corridors. This penalty factor is projected to nearly double over the next twenty years, going from an 18% add-on under year 2000 conditions to a 34% add-on under the 2025 Planned Investments Scenario. (Further documentation is provided in the Appendix.)

In addition to affecting travel times in the region, congestion also affects *market access*. As travel speeds slow, the delivery market that a business can serve within any given time period shrinks. So too does the labor market from which a business can draw for its workers. So when regional average speeds slow by 11% (from 30 mph today to 27 mph as forecast for the 2025 Planned Investments Scenario), these market areas shrink accordingly. As congestion also increases schedule uncertainty, the result is yet further shrinkage in job, shopping and delivery market access in addition to the previously cited effects on travelers.

4.3 Capital Investment (Improved System) Scenario

Definition of Illustrative Alternative Scenario. To assess the relative benefit of additional capital investment in regional transportation capacity, it is necessary to define an "alternative case" representing greater investment from now to the year 2025 than the base case of normally expected investment. The purpose of this comparison is to show the potential economic benefit associated with additional investment in an improved transportation system, and the potential cost of failing to do so. To maximize the credibility and usefulness of this analysis, it is important that both the proposed investment scenario (referred to as the Improved System Scenario) and the base case (referred to as the Planned Investments Scenario) be deemed realistic and achievable.

The intent at this point in time is to provide an illustrative example of the magnitude of potential benefits associated with an increase in capital spending, and not to justify any package of specific projects or programs. Yet it is technically impossible to calculate the changes in travel conditions without assuming some mix of projects. Accordingly the authors of this study, working in consultation with Metro and the Portland Business Alliance, decided to use the mix of projects in the current regional plan known as the "2025 Preferred Alternative" as the illustrative *Improved System Scenario* for this report.

The Improved System Scenario represents a $10.4 billion investment in transportation capital improvements over the period from now to 2025, which will provide increased roadway and transit capacity to help meet future growth needs. It represents an

additional $6.2 billion above the $4.2 billion Planned Investments Scenario, which is anticipated to be affordable given traditional funding streams. (All values are in today's dollars.) This scenario of increased capital investment includes a package of many types of transportation capital investments, shown in the box below:

Elements of the Improved System Scenario

- *Rail and road expansions* to maintain access and connections for national and international rail, air and marine freight to reach its destination with limited delay.
- *Major highway expansions* to maintain regional mobility and enhance access to intermodal industrial areas and facilities where goods move from one transportation mode to another.
- *Arterial street expansions* to maintain access to regional highways and to maintain circulation and access between the central city, regional centers and town centers.
- *Increase in transit service* -- including longer hours, increased light rail transit to the central city and regional centers, commuter rail and streetcar service in downtown Portland, plus new bus routes to serving employment areas.
- *New street connections to regional highways* to slow increases in traffic congestion and provide direct alternate routes and, within regional and town centers, to improve access by all modes of travel.
- *Road management* strategies such as ramp metering, signal timing and access management, and transit strategies such bus-only lanes and signal preemption to increase traffic flow and reduce congestion delay.

There are two important notes about this Improved System Scenario:

- First, the level of capital investment assumed by this scenario is deemed to be challenging but possible to finance over two decades with some combination of local, state and federal funds, private financing and/or user fees. Its scale will reduce but not eliminate future increases in traffic congestion.
- Second, the impacts of this scenario were calculated assuming a currently-envisioned package of road and transit system investments, which allowed the study team to calculate the size of region-wide impacts from investing in a regional congestion reduction strategy. However, this does not replace the need for careful evaluation of individual project investments in the future, nor does it preclude the possibility of formulating and later adopting a revised combination of projects or programs to achieve a similar economic impact.

Forecast Regional Changes. Metro's traffic forecasting models show that the Improved System Scenario substantially improves region-wide traffic flow, as shown in Table 4-4. First, there is an 0.7% reduction in total vehicle-miles of travel (VMT). While this percentage appears modest, it represents a savings of over 400,000 vehicle-miles of vehicular traffic *each weekday*. This savings is attributable to two factors: (a) more availability of transit, particularly for commuting trips, and (b)

more capacity on some road routes, reducing the need for diversion of that traffic to longer routes in avoid known bottlenecks.

> ***Reduced Congestion with Additional Investment***
> *Forecasts for 2025 show that the Improved System Scenario would save over 118,000 hours of vehicle travel time per day that would otherwise be lost under the Planned Investments Scenario.*

Even more dramatic are the improvements in travel speeds and savings in travel times. Average travel speeds are projected to improve nearly 5.7% for cars and 4.5% for trucks. As excess travel mileage is also reduced, the net savings in total vehicle hours of travel is even greater: 6.3% for cars and 5.3% for trucks. The overall line impact is dramatic, reflecting a savings of over 118,000 hours of travel delay each weekday. Over the course of a year, that totals over 30 million vehicle-hours of time saved under the *Improved System Scenario* that would be time lost under the *Planned Investments Scenario*. By 2025, the annual savings will represent an average of 27.8 hours for every household in the Portland metro area.

Table 4-4. Improved System Scenario: Impact on Future Road Traffic
--Difference of Improved System Scenario to Planned Investments Scenario, avg. weekday

	PM Peak	Daily Total	Cars	Trucks
Vehicle Trips				
2000 "Current Conditions"	1,024,623	5,742,615	5,655,592	86,253
2025 Planned Investments Scenario	1,550,878	8,544,485	8,356,715	186,826
2025 Improved System Scenario	1,505,052	8,312,630	8,124,215	186,826
Percent Change	-3.0%	-2.7%	-2.8%	0.0%
Vehicle-Miles of Travel				
2000 "Current Conditions"	6,735,165	36,520,585	34,775,204	1,665,525
2025 Planned Investments Scenario	10,086,695	53,987,090	50,279,629	3,603,366
2025 Improved System Scenario	9,974,664	53,584,815	49,837,481	3,563,402
Percent Change	-1.1%	-0.7%	-0.9%	-1.1%
Vehicle-Hours of Travel				
2000 "Current Conditions"	230,901	1,188,588	1,141,223	42,335
2025 Planned Investments Scenario	423,827	1,980,852	1,865,176	109,104
2025 Improved System Scenario	387,597	1,862,024	1,748,300	103,284
Percent Change	-8.5%	-6.0%	-6.3%	-5.3%
Average Miles per Trip				
2000 "Current Conditions"	6.6	6.4	6.1	19.3
2025 Planned Investments Scenario	6.5	6.3	6.0	19.3
2025 Improved System Scenario	6.6	6.4	6.1	19.1
Percent Change	1.9%	2.0%	2.0%	-1.1%
Average Miles per Hour				
2000 "Current Conditions"	29.2	30.7	30.5	39.3
2025 Planned Investments Scenario	23.8	27.3	27.0	33.0
2025 Improved System Scenario	25.7	28.8	28.5	34.5
Percent Change	8.1%	5.6%	5.7%	4.5%

All numbers are per weekday. Source: calculations by EDR Group based on data from Metro

Public Transit Shares. The changes in transit reliance are shown in Table 4-5. The Improved System Scenario increases the public transit share of trips to more than double the year 2000 levels. However, it is clear that the most significant shift is for

commuting to work, which is the class of trips most easily shifted (since users have predictable origins, destinations and times of travel).

Table 4-5. Improved System Scenario: Change in Public Transit Share
-- Difference of Improved System Scenario to Planned Investments Scenario
(avg. weekday, motorized modes only)

Trip Purpose	2000	2025 Base Case	2025 Improved System Scenario
On-the-Clock	1.5%	2.1%	2.3%
Commute to Work	9.2%	12.8%	16.6%
Personal - Recreation	2.0%	3.7%	4.6%
Total: All Trips	**3.9%**	**6.1%**	**7.7%**

All figures are per day. Source: calculations by EDR Group based on data from Metro

Additional Effects on Regional Travel Conditions. The figures shown in Table 4-4 understate the full benefits of the Improved System Scenario because they only reflect forecasts of differences in *average* travel times and speeds. In fact, the avoidance of severe congestion (that would otherwise occur under the Planned Investments Scenario) will also reduce the *variability* in travel times. There will still be a "travel time variability penalty factor" but the Improved System Scenario will reduce growth in that factor to half of what would otherwise occur.

In addition, the increased speeds possible under the Improved System Scenario will also maintain *market access* closer to current conditions, instead of allowing it to degrade as much as predicted under the Planned Investments Scenario.

4.4 Conclusions

Transportation forecasting models show that the base case *Planned Investment Scenario* will not keep up with traffic growth, resulting in severe congestion delays. Under this scenario, slower speeds and increasing bottlenecks will add over 55 million vehicle-hours of travel time occurring annually. Dividing over the expected 2025 population base yields an average of 50 hours of time lost annually per household. These are very substantial numbers and the increases in congestion will especially hit commuter and truck traffic, directly affecting some business operations.

While the *Improved System Scenario* will not fully solve the congestion problem, it will provide substantial savings by avoiding more than half of that delay. Most importantly, it will disproportionately relieve congestion growth during the morning and afternoon peaks. This will allow businesses to deliver more efficient and cost-effective services during those times. This congestion reduction will allow "local-serving industries," such as the electric utility and hospital suppliers, to avoid having to pass on their additional costs of congestion to their customers. It will also make the region more competitive as a place for manufacturers and wholesale/distribution

businesses to remain and grow.

5 ECONOMIC IMPACTS

Earlier chapters showed that Portland area's business activity and economic base are particularly vulnerable to traffic congestion, and that planned transportation system investments will be insufficient to avoid the development of severe congestion delays in the next twenty years, potentially causing significant loss of time and access for residents and businesses.

This chapter calculates the economic stakes involved in transportation capital investment for the Portland area, by comparing economic impacts of an Improved System Scenario against those of implementing only a Planned Improvements Scenario. It considers impacts on business delivery and operating costs, household expenses, and access for product delivery markets and labor markets. Altogether, it shows that the stakes involved for the development and maintenance of Portland's area economy are indeed substantial.

The analysis shows that the benefit of implementing an Improved System Scenario, or the loss associated with not implementing it, will grow each year. The regional impact (counting both income generated and the value of personal time) can exceed $844 million/year by 2025. Over 6,500 jobs can be at stake. A benefit-cost comparison shows that net present value of benefits can exceed the costs by a factor of at least 2 to one. The cumulative benefit is expected to exceed the cost by more than $3.6 billion dollars. These results show that the potential benefit of implementing an Improved System Scenario is large, as is the potential loss associated with failure to do so.

These findings do not endorse any specific transportation policies or projects, but they do show the importance of taking action and the magnitude of potential stakes. They indicate a need for further discussion among residents, businesses and

5.1 Types of Economic Impacts and Benefit Measures

Types of Economic Impacts. While there are many facets of impact associated with traffic congestion under alternative future scenarios, they can be organized into two broad groups which are discussed in Sections 5.2 and 5.3:

(1) Travel cost impacts – including travel time, schedule variability and travel distance impacts, which in turn also affect traveler fuel use, safety, cost of living and business operating expenses. (Section 5.2)

(2) Access impacts – effects beyond the cost of travel, that affect the nature of freight delivery markets, logistics, labor markets and the business productivity of operating in alternative locations. (Section 5.3)

Types of Benefit Measures. The different types of economic impacts can be used to generate three benefit measures. They are discussed in Section 5.4.

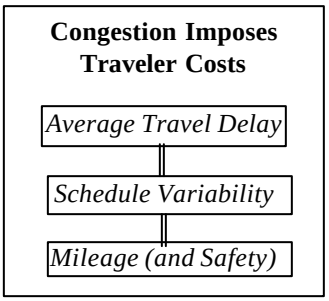
(1) Traveler Benefit – This measure puts a dollar value on benefits to travelers. It includes savings in business costs, household expenses and personal time savings. This is the traditional measure of transportation system efficiency.

(2) Benefit to the Economy – This measure counts growth of the regional economy due to changes in household living costs, business operating cost, productivity and competitiveness. However, it does not count the value of personal time, since that does not directly affect the flow of dollars.

(3) Society Benefit – This measure combines the income-generating value of benefits to the economy together with the value of non-money traveler benefits such as personal time savings. It avoids double-counting to provide the most comprehensive measure of overall impact.

5.2 Traveler Savings from Congestion Reduction

Concept of Congestion Cost. The *traveler cost of congestion* is the dollar value of the additional travel, travel cost and accidents that congestion causes for travelers. The key components of this economic cost are:



- Cost of Time Delay. High levels of congestion forecast for the Planned Investments Scenario lead to increasing travel time delays. These bring along costs for excess engine idling time, driver and passenger time, and truck freight delivery (loading dock and inventory staff) time.
- Cost of Travel Time Variability. When congestion becomes severe, the frequency of incident-related delays increases dramatically. This increases the unpredictability of travel times on affected routes, and causes businesses to adjust their delivery schedules to allow for this uncertainty. The result is a further time cost built into delivery schedules.
- Cost of Excess Mileage to Avoid Congestion Bottlenecks. High congestion delays and gridlock cause some drivers to use longer routes to avoid the congestion backups. Each additional vehicle-mile of travel due to congestion effects leads to a cost associated with additional vehicle fuel use and accidents.

These travel-related costs are calculated on the basis of average daily and average peak period travel speeds and distances. As such they understate the full problem for businesses, since they do not reflect the extent to which some firms discourage their workers from travel on certain corridors and at times of day because of congestion. The result – trucks shifting to alternative routes and earlier or later delivery times, was already reported and confirmed in the business interviews. Such shifts in business operation are absorbed as higher operating costs for those affected businesses, which are in addition to the delays indicated by the table.

Traveler Savings from Implementing the Improved System Scenario. The total annual traveler savings associated with the Improved System Scenario is valued at $789 million/year as of the year 2025. The value of this benefit grows over time, so it is smaller in years before 2025 and greater for years after 2025.

> ***Traveler Savings***
> *The travel time and travel expense savings from implementing the Improved System Scenario is **$789 million per year** as of the year 2025. This is just one element of the total cost of congestion.*

This benefit measure includes the dollar value of all congestion-related travel time, travel expense and travel safety impacts that can be avoided by implementing that scenario in place of the Planned Investments Scenario. These traveler impacts in turn affect business costs, household expenses and personal time savings.

This is the traditional measure of transportation system efficiency. However, it is important to note that this measure does not discriminate between real money cost savings and personal time savings that do not affect the flow of money in the economy. It also does not discriminate between benefits for people and businesses residing in the Portland area and benefits for those that are just passing through the area. A breakdown of these savings is shown in Table 5-1, and these benefits are explained in the text that follows.

Table 5-1. Traveler Time and Cost Savings from Implementing the Improved System Scenario instead of the Planned Investments Scenario
(annual benefit, year 2025)

Category of Impact	Total Annual Benefit	Annual Benefit / Households
(a) Savings in Business-Related Travel Time	$356 million	$323
(b) Savings in Business-Related Travel Expense	$ 9 million	$ 8
(c) Savings in Personal Time Savings	$418 million	$380
(d) Savings in Personal Travel Expense	$ 6 million	$ 5
(e) Total Traveler Savings	$789 million	$716

** includes savings in average travel time plus avoidance of scheduling to allow for travel time unreliability.*
Source: Calculations by EDR Group; see Appendix for further explanation.
Note: All values are in constant year 2005 dollars

(1) Business Time Cost Savings ($356 million) – Businesses save incurring the excess time costs that would otherwise occur under congested conditions. The benefits include reduced driver or traveler time spent en route, as well as reduced scheduling costs related to delivery time uncertainty.

(2) Business Operating Cost Savings ($9 million) – Businesses save incurring the excess expenses that would otherwise occur under congested conditions. The benefits include lower vehicle operating expenses and lower accident costs.

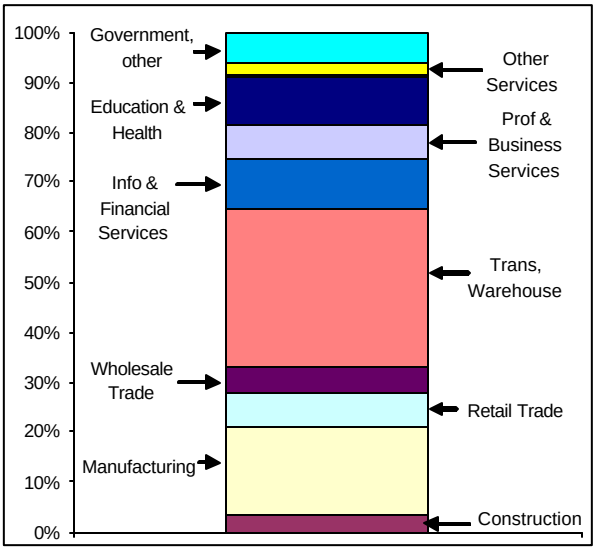
(3) Household Personal Time Savings ($418 million) – Households receive a benefit from congestion reduction in the form of time savings for personal travel (that is not business related). The value of this time savings is considered by transportation planners and economists to be as quite real for purposes of benefit-cost analysis. However, this value does not directly bring dollars in anyone's pocket, so it does not directly affect flow of money in the economy.

(4) Household Personal Expense Savings ($6 million) – Households save incurring the higher cost of living that would otherwise occur under congested conditions. The benefits include lower vehicle operating expenses (fuel, etc.) and accident costs due to fewer vehicle-miles of personal travel. This avoided cost represents additional disposable income. It is relatively small in this case because most of the household benefit is a time savings rather than a driving distance savings.

Local Share of Benefit. The traveler savings discussed above are the savings occurring for traffic moving within the Portland metropolitan area. An analysis of the origin and destination patterns of trips in the region shows that 89% of that benefit goes to persons residing and businesses located within the metropolitan area. In other words, $328 million of the total $365 million of business travel cost savings from the Improved System Scenario affects the Portland metropolitan area's economy.

Types of Businesses Benefiting from Cost Savings. The $328 million of local business travel cost savings associated with implementing the Improved System Scenario is distributed among sectors of the economy. Figure 5-1 shows that the cost savings are greatest for the region's trucking, warehousing, manufacturing and trade sectors. Those are the industries that rely most on truck freight shipment. Also affected are office activities, as higher commuting costs in congested areas have been shown to affect costs of worker compensation.

Figure 5-1. Distribution of Direct Business Cost Savings Among Industries



Unmeasured Additional Business Benefits. Finally, in evaluating benefits of implementing the Improved System Scenario, it is important to note that there are additional types of benefits that are not counted in the current calculations. One type of unmeasured benefit pertains to the special needs of morning business deliveries. Many business deliveries are made early in the morning. The business interviews indicated a distinct possibility that failure to slow the growth of morning peak period congestion could make current morning truck delivery "time windows" no longer viable for trucking/freight transportation in the future. If these "windows" were to close, there would be no other time for shippers to schedule deliveries unless it is in the very late or very early hours – which will bring their own set of financial costs for business and environmental impacts for residents. Issues such as this cannot be fully quantified, but do represent a benefit of implementing the Improved System Scenario, which is over and above the dollar value of business travel cost savings.

5.3 Market Access and Competitiveness Impacts

Market Access Effect on Logistics. Beyond the impact on costs for existing travel (covered in Section 5.2), congestion can have an additional impact of on regional competitiveness for business attraction and expansion. Quite simply, congestion reduces the advantage of location. For example, as average travel speeds slow and travel time variability increases, the *delivery market* that a business can reliably serve within any given time period shrinks. So too does the *labor market* from which a business can draw for its workers.

Congestion Reduces the Advantage of Location

Market Access

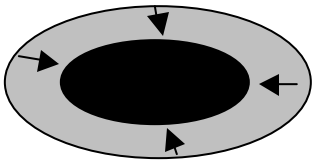
Freight Logistics

Office Activities

Competitiveness

Facing a loss of market access due to congestion, those businesses that depend on delivery of goods and services can respond in several ways. They can adjust their warehousing and logistics processes to stock more inventory, provide distribution from a larger number of locations, deploy more delivery vehicles and drivers, or reduce guarantees for delivery times. All of these adjustments still involve increased costs or reduced revenue that are beyond the direct change in travel time and expense. However, there are thresholds beyond which any particular type of business activity can no longer survive. If the delivery market shrinkage, delivery reliability loss or cost increase for serving outside markets becomes sufficiently large, then businesses become more likely to move some or all of their activities out of the Portland region.

Congestion Shrinks Labor and Delivery Market Areas



Examples offered in the Chapter 2 business interviews show how these effects on business location are already starting to occur for some manufacturing, service and wholesale distribution firms. Of course, there are ways to minimize such losses. Improvement in both transit services and highway travel speeds, as projected for the Improved System Scenario, help minimize the labor market access shrinkage. However, only highway system improvements can help maintain truck delivery market access.

Market Access Requirements of Office Activities. A significant portion of the economy does not depend on the delivery of goods and services via truck, but instead operates through electronic, telephone, mail and courier services. This includes headquarters operations and major back office functions of financial institutions, insurance companies and some business services (such as data processing). It also includes regional and national headquarters offices of retail chains and distribution companies. However, these major office activities still require access; they typically locate where there is broad labor force access for both executives and clerical staff (including both public transit and highway access) and often also good access to a major airport for regional or national travel by executives and sales force employees. For regional activities, road access for sales and service travel is also important.

As congestion increases under Planned Investments Scenario conditions, it will reduce the future attractiveness of the Portland region for attracting and retaining these office activities. However, improvements in both transit services and highway systems, as projected for the Improved System Scenario, would help to maintain worker access and thus enhance the ability of the region to attract and expand its base of office activities.

Access Effects on Economic Competitiveness. The long-run impact of congestion on regional economic development cannot be viewed in isolation. It must be viewed in terms of how it affects overall regional competitiveness for business site location decisions, which affects attraction, retention and expansion for regional and national

firms that serve markets beyond the Portland region. In this respect, the effect of congestion on business site location and investment decisions can be deceiving. Even when the term "congestion" is not stated as a business site selection criterion, it ends up affecting a variety of other site selection factors, as shown in the box that follows:

Congestion Effects on Location Competitiveness for Business Attraction

- At the point when a business site selector is screening competing urban areas, congestion can affect the availability of a workforce with required skills, especially for firms seeking more specialized and larger workforces at a single location.
- Congestion can also affect accessibility to transportation routes and terminals, and transportation shipping costs, especially for firms with heavy freight shipping requirements and broad scale delivery markets.
- Within a region, congested areas can have higher wage rates to compensate for the more difficult worker commute.
- At the point of screening specific sites, congestion can affect land costs, and it will clearly affect travel times for truck access to suppliers, customers, ports and intermodal terminals.
- When congestion becomes a sufficiently sized problem at a region-wide scale, then it also becomes a quality of life issue that influences where people choose to live and how much they pay for housing, as well as accessibility to cultural and recreational assets and leisure time available.

Competitiveness Differences Among Cities. The relative impact of congestion in any region is affected by the area's transportation dependence and its other (non-highway related) strengths and weaknesses. For instance, San Jose and Boston have high living costs and traffic congestion, but they have economic bases that rate very high in terms of educational institutions, technology R & D and venture capital. Los Angeles and New York have even higher levels of congestion but they each have unique economic bases focusing on specialty tourism, entertainment and financial services, as well as international connections.

The report on *Economic Development Strategy for the City of Portland* (Portland Development Commission, 2002) provided detailed comparison of Portland's advantages and disadvantages for a broad set of population and business location factors, compared to eleven other metropolitan areas. Additional comparisons were developed as part of this study, using a geographic information system to further evaluate the Portland region's market access and costs relative to those same cities. [6] These various comparisons show a consistent set of findings:

[6] Austin, Denver, Las Vegas, Minneapolis-St. Paul, Phoenix, Sacramento, Salt Lake City, San Diego, San Jose and Seattle.

Relative Advantages & Disadvantages of the Portland Area for Business Attraction

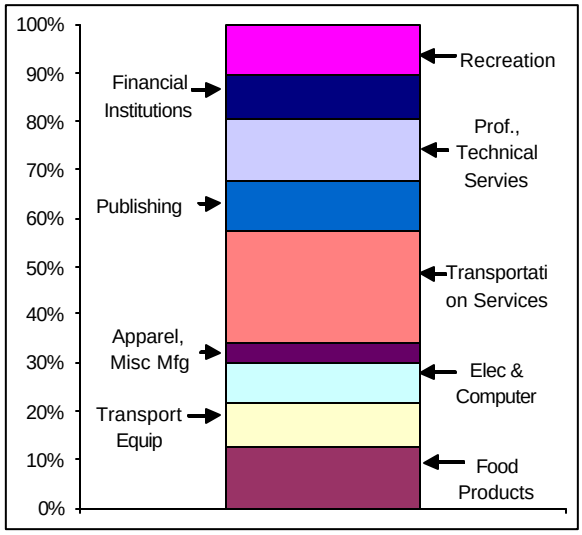
- The region's labor costs, worker skills and non-labor costs are mixed but generally in the middle of the range of other cities, neither advantageous nor an absolute obstacle.
- The region's research and funding base is not particularly strong. It ranks relatively low in R & D, research institutions, universities and venture capital industries, which are relatively low in sensitivity to traffic congestion.
- The region is relatively strong in transportation-reliant manufacturing industries as well as transportation-related wholesaling, trucking, rail and air freight.
- The region's location away from most other major markets has made its transportation connections to outside areas particularly important. This includes international air and marine ports and the road connections to them.
- The region has a pattern of land use and development that makes vacant land for industrial development relatively scarce. This increases the importance of preserving good access to/from available sites.

In summary, the Portland region tends to lack the types of institutions and location advantages that reduce transportation dependency. Many of the region's core industries and relative strengths are, in fact, reliant on transportation connections.

Improved System Scenario: Business Attraction Impact. A business competitiveness and targeting model was used with a "geographic information system" to calculate how the future congestion scenarios would affect size of the population base within commuting range, and the business base within delivery range of Portland.[7] The system also calculated how these scenarios would affect access to the airport, marine port and intermodal rail facilities. The model estimated how changes in these various elements of access would affect productivity for various industries and hence the region's competitiveness for attracting and expanding them. The analysis showed that the Improved System Scenario would retain greater regional economic competitiveness than the Planned Investments Scenario. Figure 5-2 shows a breakdown of affected businesses, which are largely those dependent either on access to skilled labor or delivery access to broader national markets. The scale of affected employment and business output is discussed next, in Section 5.4.

[7] Transportation Economic Development Impact System; see Appendix for further information

Figure 5-2. Portland Area Industries Most Affected by Market Access Changes



5.4 Overall Economic Impact

Economic Analysis System. The Transportation Economic Development Impact System (TREDIS) is a framework for evaluating regional economic impacts of transportation scenarios, encompassing traveler impacts (as discussed in Section 5.2) as well as market access effects (as discussed in Section 5.3). It also includes impacts for both freight and passenger travel, and for both public transit and road transport modes. These effects can be summarized in terms of three categories:

- Economic Impact of Travel/Time Cost Changes – Business travel time and expense changes affect local cost of doing business, while household expense savings affect local cost of living. Changes in these cost savings end up shifting local spending patterns and prices, affecting local business activity and investment, and thus employment for some industries. The economic analysis system also recognizes that not all of these changes are absorbed in the local economy; some are passed on to customers outside of the region.

- Economic Impact of Travel Access Changes – Changes in access times also lead to effective changes in labor market and product delivery market areas, as well as access to intermodal transportation connections. These access changes end up shifting productivity and thus regional competitiveness for attracting various manufacturing, service and office industries.

- Economic Value of Personal Time Changes – Changes in travel time for personal (non-business) trips have a value to society. However, they do not directly affect the flow of dollars in the economy, so their value is counted separately from the calculation of impact on the regional economy.

The methodology for calculating these impacts is described in the Appendix.

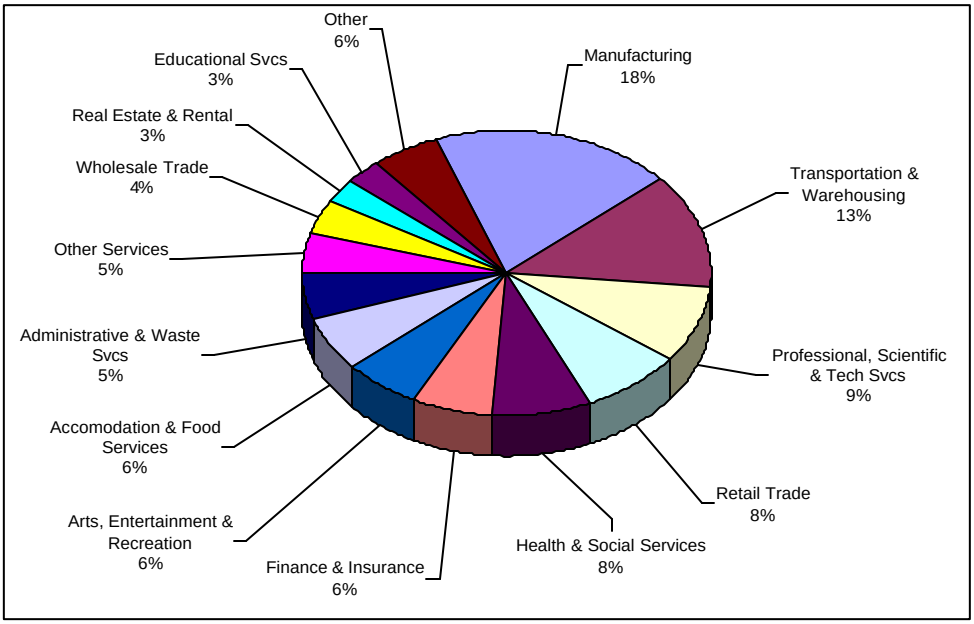
Findings on Regional Economic Impacts. The findings on economic impacts are presented in Table 5-2 on the next page. This table shows the economic benefit of implementing an *Improved System* instead of just allowing the *Planned Investments* scenario to occur. Alternatively, it can be interpreted as the loss that would occur if the region fails to implement an improved system and instead only implements currently planned investments.

As transportation forecasts are for congestion to continue growing, and since the Improved System Scenario would be implemented over twenty years, the benefits of implementing this scenario will also grow larger over time. All numbers shown here reflect annual impacts as of the target year 2025. Benefits for earlier years will be smaller and benefits for later years will be even larger.

Metro Area Economy - Part I of Table 5-2 shows impacts on the regional economy, which can be measured in terms of either total Business Sales ($848 million/year) or as the portion of those business sales that is additional income produced in the region (referred to as Gross Regional Product or Value Added, totaling $426 million/year). In any case, an estimated 6,500 continuing jobs are at stake.

The impacts shown here reflect net change in the regional economy attributable to travel-related cost changes (from Section 5.2) and additional market access changes affecting business productivity and competitiveness (from Section 5.3), plus additional impacts on other industries that are affected by business supplier orders and worker spending. The overall impacts are distributed widely across the region's economy, as shown in Figure 5-3.

Figure 5-3. Distribution of Employment Impacts on the Regional Economy of the Portland Metropolitan Area



source: economic model analysis by EDR Group

Table 5-2. Economic Impacts of Implementing the Improved System Scenario instead of the Planned Investments Scenario
(Annual Impact as of 2025)

Part I -- Impact on the Metropolitan Area Economy	***Annual Impact (2025)***
(A) Total Growth of ***Business Output*** [1]	$848 million
(B) Portion of Business Output (A) that is ***Value Added*** (i.e., additional personal + corporate income generated) [2]	$426 million
(C) Total ***Jobs*** supported by the Additional Value Added	6,500 jobs

Part II - Total Benefit to the Region	***Annual Impact (2025)****
Additional Income Generated in the Economy *(from B above)*	$426 million
+ Additional Value of Personal Time *(from Table 5-1-C)*	$418 million
+ Additional Value of Air Quality Improvement	*not measured*
= **Total Benefit to the Region**	**$844 million**

* *All values are as of the target year 2025, but are expressed in constant 2005 dollars*
[1] Output is the total business revenue or sales volume.
[2] Value Added is the output minus the cost of materials. It thus represents the total of income paid to workers and net corporate income that is either reinvested in the firm or distributed to its owners. It also represents the change in Gross Domestic Product (GDP) of the region.

Total Benefit to the Region - Part II of Table 5-2 shows the total economic value of benefit to the region, which is the sum of the impacts on income produced in the economy *plus* the value of non-money impacts that do not directly affect the flow of dollars in the economy (such as time saved on personal and shopping trips). Congestion changes also have air quality impacts that represent additional benefits, though their value has not been calculated for this study. If they were added, the total benefit of implementing an Improved System scenario (or the loss from failing to implement it) would be even larger.

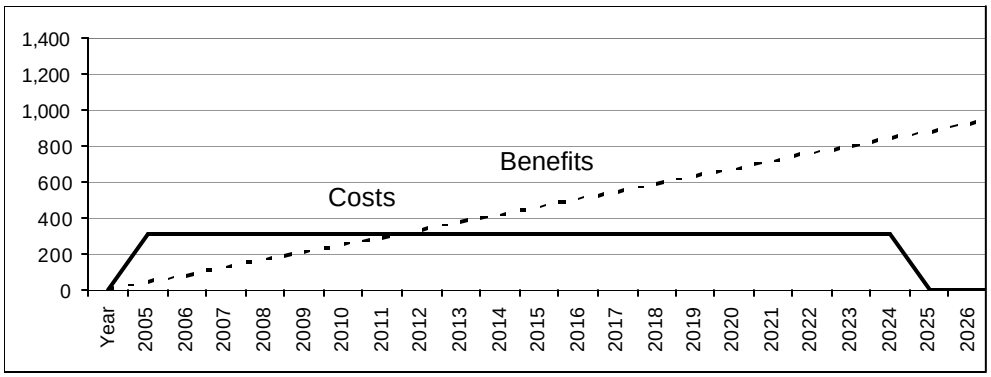
The impact for the Portland regional economy is estimated to be approximately **$844 million per year** as of the year 2025, as shown at the bottom of Table 5-2.

Benefit- Cost Analysis. The full impact of implementing an Improved System Scenario instead of the Planned Investments Scenario is a stream of additional benefits and additional costs occurring over time. Benefit-cost analysis portrays those streams of benefits and costs and then discounts future year impacts to adjust for the time value of later year impacts. In that way, the present value of all benefit and cost streams can be examined in a consistent format.

Benefit and Cost Streams**.** Expressed in constant year 2005 dollars, the additional cost of implementing an Improved System is estimated to be $6.2 billion, which would be distributed over a twenty year period (averaging $310 million/year). The

additional benefits to the region will grow annually as additional transportation investments are made, reaching the benefit level of $844 million (as shown by the bottom line in Table 5-2) by the year 2025, and then continue to grow annually for another ten years or until the early projects come to the end of their useful life. Figure 5-4 shows the relative size of benefits and costs over time, before any discounting is done. It shows that there are additional costs of an Improved System in the early years, but that the benefits grow larger than those costs after a few years.

Figure 5-4. Comparison of Benefits and Costs of Implementing the Improved System Scenario instead of the Planned Investments Scenario
(non-discounted, annual cost in millions of constant 2005 dollars)



Net Present Value**.** The benefits and costs do not all occur at the same time. Since there are costs incurred in the early years, and benefits phase in over a longer time period, it is necessary to represent both the cost stream and the benefit stream in terms of their "net present value." This involves reducing future year costs and benefits by a discount rate that reflects the time value of money. While there is no firm agreement on discount rates, most states use a discount rate in the range of 5% to 7%. These discount rates represent the time value of money *over and above the rate of inflation*. Benefit-cost analysis involves comparing the discounted present value of all benefits and costs.

Table 5-3 shows the present value of all benefits and costs after adjusting for the time value of money beyond just inflation, assuming a standard 5% discount rate. The results shown here indicate that implementing the Improved System Scenario instead of the Planned Investments Scenario provides very large net benefits – over $3.6 billion greater than the present value of capital costs. Altogether, the benefit/cost ratio is roughly two, indicating that there is a public benefit of two dollars for each one dollar of capital investment in transportation system enhancement.

Table 5-3. Benefit-Cost Analysis of Implementing the Alternative Case Instead of the Planned Investments Scenario

	Discount Rate	Net Present Value (NPV*)
NPV Benefit [1]	5%	$7,431,132,000
NPV Cost [2]	5%	$3,778,518,000
NPV Benefit – Cost	5%	$3,652,614,000
NPV Benefit / Cost Ratio	**5%**	**2.0**

* *Expressed in constant 2005 dollars, and further discounted to reflect their "present value"*

[1] Discounted net present value of the stream of annual benefits to the region, as defined in Part II of Table 5-2, and illustrated in Figure 5-4.

[2] Discounted net present value of the stream of added costs distributed over twenty years, as illustrated in Figure 5-4. The total is less than $6.2 billion because costs in future years are discounted to their present value.

Conclusion. Future congestion growth can have substantial impacts on jobs, income and business sales in the regional economy. The calculations provided here indicate that the economic payback can clearly justify a more aggressive approach to transportation capital investment in the region over the next twenty years.

> ***Return on Investment***
> *The economic benefits of a more aggressive transportation system improvement program are large, exceeding $844 million annually by the year 2025. The net present value of future benefits over thirty years exceeds costs by over $3.6 billion dollars, and the economic return on investment for the Portland region is in the range of 2 to one.*

More to the point, the results here indicate that potential stakes for the economy and residents of the Portland area are very large – representing thousands of jobs and hundreds of millions of dollars every year. These stakes can be seen as the benefit of implementing an improved system. However, they can also be seen as the potential loss associated with failing to increase transportation investment and instead just relying on currently planned improvements.

The margin of the difference between benefit and cost figures is also striking. The numbers are sufficiently large so that assumptions about what constitutes an Improved System Scenario could be changed within a wide range and yet the present value of total benefits could still exceed the value of total costs by billions of dollars.

These findings point to the importance of further dialogue among residents,

businesses and government agencies to refine future plans for transportation investment in the region. It is quite possible that future plans could lead to even more effective results than the illustrative Improved System Scenario defined for this study.

6 CASE STUDIES

Citizens, business leaders and planners in a number of urban areas around North America have become concerned about the potential for severe congestion in the future and the possibility of significant economic consequences if the issue is not appropriately addressed. Business and civic leaders in other urban areas have also been studying the problem of rising congestion and are now taking action to address it. Those cases reinforce the value of this study as a starting basis for additional public discussion.

Examples from around North America also illustrate the range of policies and programs that can be adopted to minimize future congestion. They include capital investments to increase the capacity of highway and transit systems, transportation system management and prioritization strategies to enhance the efficiency of existing facilities, and pricing schemes that shift demand so that traffic most needing a facility can still move effectively while other traffic is shifted to alternative times, facilities or services. These examples provide a potentially useful basis for developing local action plans for the future.

This chapter highlights two types of examples that are relevant to the Portland region:

- Examples where a regional economic impact study was conducted to assess the regional economic consequences of congestion and alternative scenarios (Section 6.1).
- Examples of different types of solutions that have been adopted, or being considered for adoption, to address congestion in various metropolitan areas (Section 6.2).

These examples are described in summary fashion in this report; further details are provided in the Appendix.

6.1 Regional Economic Impact Studies

Selection of Case Studies. There are eight efforts in other cities that roughly parallel the Portland case in that they included studies of the economic costs of looming urban traffic congestion, and the economic benefits of taking action to address the problem. They are: (1) Vancouver BC, (2) Chicago, IL, (3) Atlanta, GA, (4) Milwaukee, WI, (5) Houston, TX (6) Los Angeles, CA, (7) Seattle, WA and (8) Toronto, ON. Major similarities and differences among these studies are described in the text that follows,

and key findings are summarized in Table 6-1 which then follows. More detailed descriptions of these case studies are also included in the Appendix to this report.

Comparison of Study Processes and Outcomes. The various studies of congestion and economic development implications have some key similarities and differences in terms of sponsorship, analysis methods, defined scenarios and recommended actions:

- **Sponsor –** Like Portland, several of the other case studies also involved private business organizations as sponsors or co-sponsors working together with government planning agencies (Vancouver BC, Chicago, Milwaukee). However, others were funded and conducted solely by government agencies (Atlanta, Houston, Los Angeles).

- **Traffic and Economic Analysis Methods.** Like Portland, all of the case studies included traffic modeling to establish the severity of expected future congestion, along with some form of economic model to calculate the cost to business and implications for economic competitiveness.

- **Planned Investments Scenario and Improved System Scenarios** – Like Portland, most of the case studies involved comparison between an explicitly defined Planned Investments Scenario that assumed financially constrained conditions and a proposed package of improvements that would require additional financing (Atlanta, Chicago, Vancouver). However, a few merely compared future conditions to existing conditions to calculate the change in congestion costs (Houston, Milwaukee).

- **Recommended Actions** – All of the case studies led to findings that additional capital investment in transportation system capacity was needed, and they subsequently led to action plans to raise funds and seek approval for some specific capacity expansion projects. However, the case studies varied in the mix of recommended solutions. Some included rail and/or bus transit investment as part of the solution for business delivery problems (Atlanta, Los Angeles, Vancouver BC, Toronto), some recommended tolls and other user fees to help raise funds and facilitate traffic flow (Chicago) and others focused only on investment to expand highway capacity (Milwaukee, Houston).

Comparison of Study Findings and Recommendations. Table 5-1 summarizes each of the case studies in terms of findings and recommendations. Additional information can be found in the Appendix on the organizations involved, issues addressed, study scope, and links to web resources for further information for each case.

Table 5-1. Studies of the Regional Economic Impact of Congestion

Name / Location / Sponsor	Findings	Recommendations
Economic Impact Analysis of Investment in a Major Commercial Transportation System for the Greater Vancouver Region ***Vancouver, BC, Canada***	• Cost of congestion expected to exceed $800 million by 2021 • AM peak-hour regional road traffic projected to grow by 39% in terms of trips and 54% in terms of vehicle hours • 7,000 -16,000 jobs and $500 million to $1 billion could be lost due to inadequate infrastructure investment	• Implementation of a broad series of highway, arterial road, light rail, freight rail, bridge and tunnel projects to minimize future congestion costs and increase economic competitiveness.
Chicago Metropolis Freight Plan: "Assessing the Economic Impacts of Congestion Reduction Alternatives" ***Chicago, IL***	• Current cost of congestion estimated at more than $4 billion/year • Metroplan recommendations would have a positive impact on business sales of nearly $4 billion	• Expand highway capacity • Implement user fees on highways • Develop a more formal system of truck routes • Modernize public transit to increase attractiveness • Better use of existing rail infrastructure
Mobility 2030, Regional Transportation Plan of the Atlanta Regional Commission (2004) *Atlanta, GA*	• % of freight currently moves via truck • sportation system must accommodate than 2.5 million people and 1.3 million by 2030 • ent of freeways/arterials with more than 2 s of daily delay will increase from 39% to	• Improve access to intermodal facilities • Expand freeway and cross-regional arterial road system • Implement HOV lanes • Expand public transit system • "Smart Corridors" with ITS for better monitoring and control
The Economic Benefits of Transportation Investments, 2003 *Milwaukee, WI*	• way construction has not kept up with travel demand • of congestion in the Milwaukee metro stimated at $390 million in 2000. • gestion currently affects 17% of the state's critical roadways, growing to more than a third by 2020.	• $22 billion investment in the regional highway system.

Continued next page

Table 5-1 (cont.) . Studies of the Regional Economic Impact of Congestion – continued

Name / Location / Sponsor	Findings	Recommendations
Texas' Future: A Look at the Next 25 Years of Roadway Supply, Demand Cost and Benefit, 2003 *Houston, Dallas, San Antonio and Austin, TX*	• Cost of congestion estimated at $46 billion over the last decade • Will require $38.5 billion more than current investments over the next 25 years just to maintain existing congestion levels • $78.2 billion is needed to meet regional congestion reduction goals	• Highway and freeway expansion in each of the four metro areas
Long Range Transportation Plan for Los Angeles County, 2001 *Los Angeles, CA*	• Improvement scenarios would cost $13-15 billion through 2020 • Increase in personal income would exceed investments by $8 billion during the period.	• Expand rail transit system in conjunction with freeway system
FAST – Freight Action Strategy for Everett-Seattle-Tacoma, 2004 *Seattle, WA*	• Puget Sound ports have lost 11.9% of market share since 1998 • Losing competitiveness relative to Vancouver, Canada	• A multi-phase program to improve efficiency and reliability of freight transit through grade separations, truck access routes and ITS
Ontario Strategic Transportation Directions (2002) and Central Ontario Freight Plan (2004) *Ontario, Canada*	• Central Ontario plays a critical role in the lorth American economy .ising congestion is threatening to undermine ıe efficient movement of goods through the :gion 'he cost-competitiveness of Central Ontario s a business location is becoming threatened	• Establish private-public partnerships including a regional goods movement coordinating body • Improve the transportation planning, funding and decision-making process by including it in the regional economic development and land use strategy • Implement a regional truck route system • Improve incident (accident) management and investigation • Improve transit to reduce SOV use

6.2 Congestion Management Projects

Congestion is an indication that demand is approaching or exceeding the design capacity of transportation infrastructure. As the number of vehicles entering a highway approaches the physical capacity of the facility, traffic speeds slow to a crawl and overall vehicular throughput of the facility declines. There are three basic approaches for addressing this problem: (a) increase capacity of highway and transit infrastructure, (b) improve management of infrastructure use to increase throughput, and (c) impose pricing systems that shifts demand so that traffic most needing the facility can move effectively while other traffic is shifted to other times of day, or other facilities or services.

Any or all of these elements can be relevant for the Portland region in the future. The nature of these approaches are summarized here. While the approach of expanding road and rail system capacity is well known, some of the approaches for traffic management and pricing are new and experimental. Examples of these newer approaches are described in further detail in the Appendix.

(a) Investment in Capacity Expansion of Highway and Transit Infrastructure

Infrastructure Capacity Expansion. The traditional approach to address future congestion is to invest in additional transportation system capacity to meet the projected increase in traffic demand for access to and within air and marine ports, intermodal rail, industrial parks and town centers. This includes:

- *Highway system expansion.* Major highway widening as well as construction of new, reliever routes to maintain regional mobility for freight and passenger movement.
- *Arterial street expansion.* Widening arterial streets and bridges to improve access to the regional highway system and maintain circulation and access for freight and passenger movement.
- *New intersection connections.* New interchanges and intersections designed with special turn lanes and signals to reduce turning delays and facilitate alternate routes using arterial roads for freight and passenger movement..
- *Expanded transit service.* Increase in light rail transit facilities and services, commuter rail and streetcar services, expansion of transit service hours, and implementation of new bus routes serving employment areas.

Mode Choice Options. Besides just increasing capacity to meet projected demand, there are some opportunities to reduce congestion by encouraging alternative modes of transportation. Specifically, expansion of transit services and freight rail services can help to divert a portion of travel demand away from reliance on cars and trucks

on the highway system, although not all classes of passenger and goods movement will find those options to be viable alternatives. A current study of the National Cooperative Highway Research program is entitled, *Rail Freight Options for Relieving Highway Congestion*[8] and that study is examining cases where expansion of railroad capacity could help address congestion. The study is not yet complete, but is focusing on identifying the circumstances in which this option is truly viable.

All of the regional case studies presented in Table 6-1 included the traditional approach of expanding the capacity of highway and arterial road systems, including new bridges, tunnels, overpasses, ramps and intersection connections. In addition, several of those case studies (Atlanta, Los Angeles, Vancouver BC and Toronto) included expansion of rail transit and bus services as a way to further relieve highway congestion and thus facilitate truck movements that require use of the highway system. The Alternative Case (2025PF) Scenario considered for the Portland area also included expansion of highway, arterial road and transit system capacity.

(b) Infrastructure Management.

Transportation System Management. In addition to direct construction of additional capacity, many of the previously discussed cases also include "transportation system management" policies and programs to improve the functionality of existing facilities. These include:

- **Freeway performance** enhancement strategies such as "Smart Corridors" involving ramp metering, signal timing and access management controls for on-ramps as well as incident detection for main routes;
- **Intersection performance** enhancement strategies such as additional turning lanes and turning signals, and
- **Transit performance** enhancement strategies such bus-only lanes and signal preemption for buses and streetcars.

Designated Freight Corridors. The concept of "rationalizing" the region's transportation system refers to actions that optimize the placement and use of facilities and services. Usually this means allocating space and assigning priority for various types of vehicles (cars, buses, trucks, bicycles) and various types of trip purposes (commuting, freight movement, etc.) on relevant roads and corridors.

One form of rationalization is the development of **transit priority routes** where buses and streetcars are assigned special lanes and/or special priority for passing through signalized intersections or road crossings.

Another form of rationalization is the development of **freight priority routes** which

[8] Reebie Associates and Economic Development Research Group for NCHRP, 2005.

are typically arterial streets where signs, road width, intersection geometrics, ramps and vehicle parking areas are all designed to facilitate truck movement. Designation of such routes and their design features can maximize the effectiveness of truck movement on those corridors while minimizing negative impacts on neighborhoods. In some cases, this may also include the development of grade separated truck and/or rail routes for access to ports or other intermodal freight terminals.

Examples of freight priority routes span a range from clarifying truck routes along existing arterial streets to the development of truck priority and truck-only routes. Examples of this wide range of priority routes (described in the Appendix) are:

- Regional Truck Route System for Chicago
- Puget Sound FAST Corridor – Port Access Routes
- Alameda Corridor – freight-only grade-separated route to port
- Washington - Wenas Corridor Truck Routing.
- World Trade Bridge Route - Laredo, TX.

(c) Highway Pricing Policies

Pricing (tolls) can be implemented to achieve a number of goals – from raising revenues to managing the volume of traffic on priced (tolled) and unpriced (free) lanes and highway facilities. Pricing can also be used to achieve a more optimal mix of vehicles through special HOV (High Occupancy Vehicle) reserved lanes and HOT (High Occupancy Toll) lanes that can be used by any vehicle. Both approaches can help to expand "usable capacity" by improving the operations of existing highways. There are three classes of pricing policies: pricing on existing roads, pricing on new lanes and cordon tolls.

Pricing on Existing Roads - Most of these projects involve the conversion of existing HOV (high occupancy vehicle) lanes to HOT (high occupancy toll) lanes. Examples (described in further detail in the Appendix) are:

- California - HOT lanes on I-15 in San Diego
- Texas - HOT Lanes on Two Radial Corridors in Houston (I-10) and US 290)
- Minnesota - HOT Lanes on I-394 in Minneapolis
- Colorado - HOT lanes on I-25/US 36 in Denver
- California - Alameda County
- Other Projects Under Study: I-680 SMART Carpool Lanes in Alameda County, CA; HOT lanes on I-95 in Miami-Dade County, FL ;and HOT Lanes on I-75 in Atlanta, GA.

Pricing on New Lanes – These are projects in which new highway lanes are built specifically as HOT lanes. This allows them to have fully private funding. Examples (described in further detail in the Appendix) are:

- California - Express Lanes on State Route 91 in Orange County.
- Other Projects under Study: California - HOT lanes in Median of Route 1 in Santa Cruz County, CA; Express Toll Lanes on C-470 in Denver, CO; Express Lanes on I-4 in Orlando, FL; HOT Lanes on I-40 in Raleigh/Piedmont, NC; Managed Lanes on I-35 in San Antonio, TX; and HOT Lanes on State Route 167 in the Puget Sound Region, WA.

Use of Toll Roads – Unlike the preceding examples of tolls on only some lanes, these projects provide for time-of-day pricing and special truck pricing policies on toll roads. These policies can serve to encourage off-peak truck movements. Examples (described in further detail in the Appendix) are:

- Florida - Variable tolls for Heavy Vehicles in Lee County.
- New York and New Jersey -- Variable Tolls.
- California - Peak pricing on San Joaquin Hills Toll Road in Orange County
- Other Projects under Study: Variable tolls with open road tolling in Broward County, FL; Pricing options on Florida Turnpike in Miami-Dade County, FL; Illinois Tollway Value Pricing Study in Chicago area; Northern Ohio Freight Efficiency Study; Express Bus/HOT Lane in the Lincoln Tunnel, NY-NJ; Variable tolls on the Northwest Tollway in the Chicago area; and Variable tolls on the Pennsylvania Turnpike in Philadelphia

Cordon Tolls – The most extreme form of road pricing is the development of a "cordon" line around the most heavily congested part of an urban area, with a system of daily charges put on vehicles that enter the area. Typically, persons living inside the cordon area and government vehicles are excluded from the tolls. Examples (described in further detail in the Appendix) are:

- London Commercial District Pricing
- Singapore Cordon Pricing
- Other Project under Study: Cordon pricing in Lee County, FL; Tolls on East River and Harlem bridges in New York City.

6.3 Conclusions from the Case Studies

The Portland region is far from alone among metropolitan areas in facing increasing traffic congestion. Other metropolitan areas have also faced concern about the transportation and economic development consequences of rising traffic congestion, and have taken action to address them. The experience of these other areas fall into five key categories:

1) **Process.** Portland is following a general process that has been successfully implemented in other regions, in which business representatives have joined

to work together with local governments to examine the nature of congestion problems, stakes for economic competitiveness, and options for addressing them.

2) **Study.** This study addresses issues of economic competitiveness in similar ways as other regions, which have found that such findings can be of critical importance in establishing the business case and economic need for taking action to invest in future transportation projects and program to reduce future congestion growth.

3) **Range of Actions.** Essentially all of the regional plans have identified the need for expanding effective transportation system capacity through infrastructure investment. Most support an integrated package of arterial road, highway and transit infrastructure projects. Technologies and policies to optimize use of these resources are also important and should be implemented to the extent possible, but they are not a full substitute for expansion of infrastructure capacity.

4) **Focus on Freight.** Increasing development of regional, national and international markets are raising the importance of freight movement, and urban areas across the US are responding by adding projects and policies designed specifically to improve freight flow.

5) **Pricing.** There is great interest at the current time in experimental programs using electronic systems to charge tolls that vary by time of day, type of vehicle and sometimes level of congestion. In theory, such projects can meet a variety of differing goals: (a) to help reduce overall traffic volumes by encouraging use of high occupancy vehicles, (b) to facilitate faster truck movements during off-peak times along designated routes levels, and/or (c) to raise revenues that help pay for infrastructure investments. Care must be taken in viewing these projects, because they generally do not address all three of these goals.

Economic Development
RESEARCH GROUP

2 Oliver Street, 9th Floor, Boston, MA 02109
Telephone 617.338.6775
Fax 617.338.1174
e-mail info@edrgroup.com
Website www.edrgroup.com

APPENDIX

Backup Material for the Cost of Congestion to the Economy of the Portland Region

Prepared for:

PORTLAND BUSINESS ALLIANCE
Greater Portland's Chamber of Commerce

METRO

PORT OF PORTLAND
Possibility. In every direction.™

Prepared by:

Economic Development RESEARCH GROUP

September 16, 2005

Table of Contents

APPENDIX A. TRANSPORTATION ROLE IN THE REGIONAL ECONOMY

This appendix presents additional tables of detail on the economic base of the region.

A-1 Backup for Table 2-1 Concentration of Industries in the Portland Area

(comparison to National Average)

		Portland Employment (2002)		Location Quotient (Relative Concentration)
		# of Jobs	% of Total	
334	Computer & Electronic Products	36,087	2.8%	3.2
813	Professional, Civic, Other Organizations	60,835	4.7%	2.6
331	Primary Metal Manufacturing	6,308	0.5%	1.6
322	Paper Manufacturing	6,477	0.5%	1.6
511	Publishing Industries (except Internet)	10,802	0.8%	1.4
420	Wholesale Trade	59,554	4.6%	1.3
533	Franchising	302	0.0%	1.3
531	Real Estate	45,314	3.5%	1.2
321	Wood Products	5,560	0.4%	1.2
113	Forestry & Logging	1,363	0.1%	1.2
316	Leather & Allied Products	500	0.0%	1.2
524	Insurance Carriers & Related Activities	24,060	1.9%	1.1
711-713	Amusement & Recreation	28,752	2.2%	1.1
611	Educational Services	24,972	1.9%	1.1
339	Miscellaneous Manufacturing	6,590	0.5%	1.1
323	Printing & Related Support Activities	6,410	0.5%	1.1
111	Crop Production	15,043	1.2%	1.1
541-551	Professional Scientific, Technical, Services	106,392	8.2%	1.1
532	Rental & Leasing Services	8,342	0.6%	1.1
561	Administrative & Support Services	71,448	5.5%	1.0
230	Construction	82,595	6.4%	1.0
332	Fabricated Metal Products	12,168	0.9%	1.0
481-487	Transportation	30,454	2.4%	1.0
814	Private Households	15,696	1.2%	1.0
811-812	Repair, Maintenance, & Personal Services	42,475	3.3%	1.0
491-493	Warehousing & package delivery	16,184	1.3%	1.0
525	Funds, Trusts, & Other Financial Vehicles	1,815	0.1%	0.9
333	Machinery Manufacturing	8,864	0.7%	0.9
721-722	Accommodations, Eating & Drinking	83,058	6.4%	0.9
337	Furniture & Related Products	4,444	0.3%	0.9
621-624	Health Care & Social Services	113,088	8.8%	0.9
562	Waste Management & Remediation	2,468	0.2%	0.9
521-523	Monetary, Financial, & Credit Activity	32,875	2.5%	0.9
441-454	Retail Trade	124,514	9.6%	0.9
327	Nonmetallic Mineral Products	3,460	0.3%	0.9
513	Broadcasting	10,721	0.8%	0.9
512	Motion Picture & Sound Recording	2,778	0.2%	0.8
514	Internet & data process svcs	3,158	0.2%	0.8
326	Plastics & Rubber Products	5,011	0.4%	0.8
920	Government & non NAICS	133,859	10.4%	0.8
312	Beverage & Tobacco Products	1,200	0.1%	0.7
336	Transportation Equipment	9,818	0.8%	0.7
311	Food Products	8,796	0.7%	0.7
221	Utilities	2,668	0.2%	0.6

335	Electric Equipment, Appliances, etc.	1,939	0.2%	0.5
314	Textile Product Mills	727	0.1%	0.5
115	Support for Agriculture & Forestry	2,376	0.2%	0.4
212-213	Mining & Support Activities	1,299	0.1%	0.4
315	Apparel Manufacturing	1,113	0.1%	0.4
112	Animal Production	2,791	0.2%	0.3
325	Chemical Manufacturing	1,957	0.2%	0.3
324	Petroleum & Coal Products	242	0.0%	0.3
313	Textile Mills	481	0.0%	0.2
114	Fishing, Hunting & Trapping	152	0.0%	0.2
211	Oil & Gas Extraction	0	0.0%	0.0
	TOTAL	**1,290,355**	**100.0%**	

Source: EDR-LEAP database, compiled by IMPLAN from US Dept of Commerce Regional Economic Indicators Service, includes self-employed and contract labor in addition to wage and salary employment.

A-2 Backup for Report Figure 2-2
Forecast Value of Commodity Shipments by Transport Mode (billions of US dollars, for the Portland-Vancouver region)

Mode	1997	2000	2010	2020	2030
Truck	$278	$371	$405	$575	$697
Rail	$37	$48	$45	$62	$74
Water	$22	$25	$26	$29	$31
Air	$3	$5	$6	$10	$13
Pipeline	$11	$9	$12	$12	$12
Total	$351	$458	$494	$688	$827

Source: Commodity Flow Forecast Update and Lower Columbia River Cargo Forecast[1]

Further Detail on Section 2.2 Inter-Regional Highway Corridors.
The Portland region has two major interstate highways serving long distance travel:

- The I-5 highway corridor is a major north-south spine for passenger and truck freight movement along the west coast from Mexico to Canada. The San Francisco – Portland – Seattle portion of the highway has very heavy long truck movements delivering goods and services between these cities.

- The I-84 highway corridor is a major east-west spine for passenger and truck freight movement from Portland through the Cascades to the central and eastern parts of the US.

Along both highways, trucks account for a disproportionately high portion of total vehicles (between 10% and 22%) -- which is far higher than the 5% average truck share in the metro area. Figures A-3 and A-4 show results of the national commodity flow survey, in terms of the flow of freight tons and number of daily trucks moving

[1] DRI-WEFA and BST Associates. 2002. Prepared for the Port of Portland, Metro, Oregon Department of Transportation, Port of Vancouver and the Regional transportation Council, p. 49

to, from and between counties within the Portland area. It shows that the I-5 and I-84 corridors indeed account for the largest share of total freight movement.

A-3. Tons of Freight Flow To, From & Within the Portland Area, 1998

A-4. Number of Daily Trucks Going To, From & Within the Portland Area, 1998 (avg. daily

Source: US DOT, FHWA, Freight Analysis Framework

Of course, there are many other key highway corridors that serve more localized access needs for the airport, seaport and major industrial areas, and thus are also critical for business. They include, among others:

- I-205
- Hwy 99
- Hwy 217
- Hwy 8 (Tulaltin Valley Hwy)
- Hwy 43
- Hwy 210 (Scholls Ferry Rd)
- US 26 (Sunset Hwy)
- Marine Drive

APPENDIX B. TRAVEL IMPACTS

B-1: Vehicle Hours of Delay at Key Corridors – Year 2000 (Peak PM Period, Average Weekday)

Key	Highway	Segment	Veh Hrs of Delay
1	I-5 North	Mill Plain Blvd in Vancouver WA to I-84	2,780.13
2	Marine Dr and US 30	NE 33rd Dr to NE 223rd Ave	400.83
3	I-84	I-5 to I-205	1,418.39
4	Troutdale Rd / SE 282nd Ave	I-84 to US 26 (Mt Hood Hwy)	36.77
5	SE Powell Blvd and SE Foster Rd	Ross Island Bridge to SE 174th at Powell, and SE Powell to SE Jenne Rd	807.21
6	Sellwood Bridge & SE Tacoma St / Johnson Creek Blvd	Hwy 43 to SE Harney St (at SE 45th)	153.52
7	Hwy 99E	Ross Island Bridge to Oregon City Bridge (downtown Oregon City)	996.37
8	Hwy 224	Hwy 99E to I-205	198.17
9	Sunnyside Rd and Hwy 212	I-205 to Hwy 212 (Sunnyside Rd) & Rock Creek to SE 232nd Dr (Hwy 212)	312.68
10	I-205	Stafford Rd Interchange to Hwy 212	846.72
11	Hwy 43	SW Bancroft St (South end of couplet) to I-205 in West Linn	447.14
12	I-5 South	Hwy 217 to Wilsonville interchange	862.74
13	Hwy 99W	I-5 to SW Cipole Rd in Tualatin	750.97
14	Hwy 217	Hwy 10 (Beaverton-Hillsdale Hwy) to I-5	870.40
15	Hwy 210 (Scholls Ferry Rd)	US 26 (Sunset Hwy) to SW 135th Ave in Tigard	397.76
16	Hwy 8 (Tualatin Valley Hwy)	Hwy 217 to SW 229th Ave	718.76
17	US 26 (Sunset Hwy)	I-405 to SW Skyline Blvd (Sylvan interchange)	500.20
18	US 30 (Saint Helens Rd)	NW Kittridge to NW 107th Ave (north of St Johns Bridge) in Linnton	109.17

Source: Metro, all figures are daily totals for 2-hour afternoon peak period

B-2 Further Detail on Delay Along Key Corridors - Year 2000

Corridor ID	Length (Miles)*	Total VMT	VMT with V/C >= 0.9	Veh Hours of Delay
1	18.67	133,419	41,531	2,780.13
2	45.78	68,201	9,895	400.83
3	10.21	114,251	51,946	1,418.39
4	13.20	9,361	221	36.77
5	30.73	71,976	27,620	807.21
6	5.42	9,956	7,233	153.52
7	21.79	87,101	33,674	996.37
8	5.82	19,177	4,267	198.17
9	13.04	28,490	10,472	312.68
10	19.49	146,812	39,240	846.72
11	20.84	45,259	22,275	447.14
12	16.87	167,573	27,030	862.74
13	11.48	45,404	35,323	750.97
14	9.87	81,005	29,788	870.40
15	12.78	29,174	14,707	397.76
16	11.70	47,712	37,570	718.76
17	4.35	48,476	27,098	500.20
18	8.34	22,380	8,784	109.17

B-3 Corresponding Breakdown for Year 2025 Planned Investment Scenario

Corridor ID	Length (Miles)*	Total VMT	VMT with V/C >= 0.9	Veh Hours of Delay	VHT increase over Year 2000	percent VHT increase over 2000
1	18.72	161,013	93,036	4,218.69	1,439	52%
2	47.50	94,049	54,789	965.18	564	141%
3	10.21	122,636	67,582	1,838.73	420	30%
4	13.20	16,093	4,624	167.27	130	355%
5	31.12	86,231	49,761	1,434.79	628	78%
6	5.36	12,915	11,154	506.18	353	230%
7	21.78	121,444	83,731	3,035.47	2,039	205%
8	8.30	32,936	23,670	485.58	287	145%
9	22.02	69,723	39,676	1,104.99	792	253%
10	19.49	181,718	113,560	3,592.79	2,746	324%
11	20.80	60,712	36,943	1,797.90	1,351	302%
12	17.01	226,954	190,912	5,579.77	4,717	547%
13	11.50	56,599	55,377	1,946.74	1,196	159%
14	11.14	104,063	82,032	1,813.66	943	108%
15	13.28	35,794	22,484	646.34	249	62%
16	11.98	52,310	48,443	781.48	63	9%
17	4.35	54,558	34,347	982.37	482	96%
18	8.34	34,037	26,713	520.24	411	377%

APPENDIX C. METHODOLOGY FOR CALCULATING ECONOMIC IMPACTS

The Transportation Economic Development Impact System (TREDIS) is a framework for evaluating regional economic impacts of transportation scenarios that affect both freight and passenger travel, both transit and road transport modes, and market access effects on competitiveness as well as travel time effects on existing travel. It uses accepted regional models to calculate economic impacts, and follows economic evaluation principals to distinguish impacts on the regional economy from transportation efficiency impacts. Elements of this system are shown in Figure C-1.

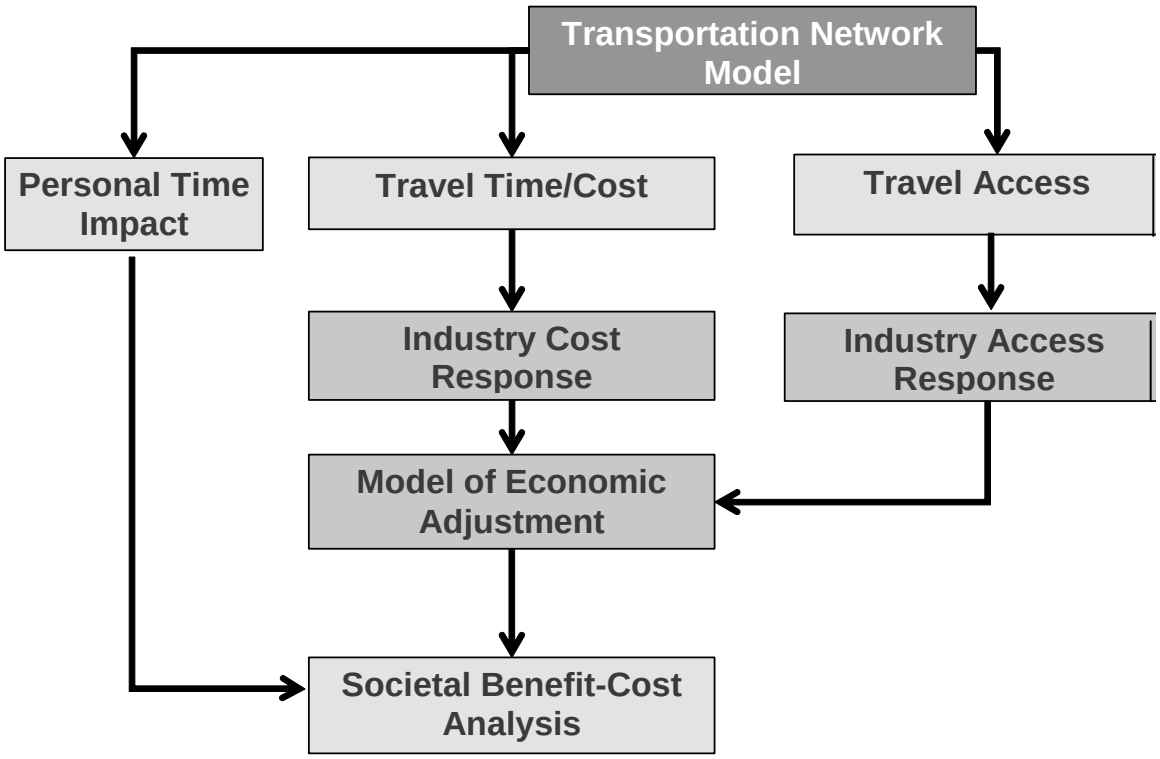
- Travel/Time Cost Impact -- The business (time and expense) operating cost savings and personal expense savings are determined from the transportation network forecasting model. They are then used in the economic analysis to calculate industry responses to those cost changes. This shows how those cost savings end up shifting spending patterns and prices, expanding business activity and investment and increasing employment for various industries. The economic analysis system also recognizes that some benefits are passed on as lower prices benefiting businesses outside of the region.

- Travel Access Impact – The access time impacts are determined from the transportation network forecasting model and then used in a geographic analysis system to calculate access effects on labor markets and product delivery market areas as well as access to intermodal transportation connections. The economic analysis then calculates how these access changes end up shifting productivity and regional competitiveness for attracting various manufacturing, service and office industries.

- Personal Time Impact – Personal time savings has a value that is fully considered in the calculation of total benefits to society. However, the personal time savings does not directly affect the flow of dollars in the economy, so it is excluded from the calculation of impact on the regional economy.

Figure C-1 shows how these three elements are considered in the TREDIS analysis.

C-1 Schematic Showing Elements of the Transportation Economic Development Impact System



For this study, the TREDIS framework combines information from a variety of components. It builds on results of Metro's regional transportation models to forecast traveler cost impacts and access time impacts of alternative scenarios. It uses the IMPLAN input-output model for the Portland region to calculate inter-industry relationships, applied together with industry cost response factors developed from studies by Economic Development Research Group. It uses the Local Economic Assessment Package to calculate competitiveness effects of access changes. It then applies accepted evaluation principals to distinguish impacts on the regional economy from transportation benefit/cost impacts. Additional information on this methodology is provided in the Appendix.

Framework Overview. TREDIS allows transportation planners to evaluate the full economic development impacts of transportation investments through a process involving three components:

(1) Translating Access and Cost Changes into Industry Impacts. The first components translates transportation model and analysis information into data

useful for detailed economic analysis. This model collects and evaluates how changes in any highway, rail, air and/or port project may affect a combination of market access (within the region or to outside areas) and transportation costs. Both the access and the cost changes are calculated based on details of the spatial nature of the travel time and market access changes, and how they differentially affect combinations of specific modes and industries. It functions as a pre-processor that provides input to the core model.

(2) Industry Responses to Cost and Access Changes. The core model has three parts. (1) The first part is a cost response module that calculates how changes in businesses operating costs lead to local income and growth in affected industries, and also lead to provide cost savings and growth in other beneficiary industries. (2) The second part is a market access module to identify how changes in access to inter-modal terminals, international trade borders and ports, as well as expanded access to specialized worker skills, materials and customer markets, can lead to additional productivity and business growth over time. (3) The third part calculates losses, gains and shifts occurring as regional economies adjust over time.

(3) Impact/Benefit Accounting System. This final component processes information from the other modules in order to re-portray them in terms of various economic impact and economic benefit measures. It separates various elements of travel efficiency, cost savings, productivity and social benefit measures to portray benefits from the differing perspectives of federal, state and local agencies. It also separates impacts on income and business sales from the economic value of other social benefits that do not directly affect the flow of dollars in the economy.

Assumptions Regarding Calculation of Direct Economic Benefits. The "direct economic benefit" of congestion reduction is the dollar value of the time savings, cost savings and accident reduction savings for travelers. The components of direct economic benefit from congestion reduction are described below:

- **Reduction in the Cost of Time Delay.** High levels of congestion forecast for the Base Case lead to increasing travel time delays. These bring along costs for excess engine idling time, driver and passenger time, and truck freight delivery (loading dock and inventory staff) time. Reductions in congestion brought about by the Alternative Scenario will reduce these average time delays and thus save some of those costs. The value of time saved per hour per vehicle is calculated using the following factors:

Mode	Trip Purpose	Engine Idling Cost per hr. delay	Person Cost per hr. delay (A)	Delivery Cost per hr. delay
Pass Car/ Lt.Truck	On-the-Clock	$2.02	$26.68	$0.00
Pass Car/ Lt.Truck	Commute	$2.02	$13.34	$0.00
Pass Car/ Lt.Truck	Personal/Rec	$2.02	$13.34	$0.00
Freight Truck	On-the-Clock	$8.80	$35 .00	$0 - $48 (B)

(A) Driver and passenger time for business travel is valued at rates shown here; for personal and recreation travel it is valued at ½ of these rates. These rates are per person and must be multiplied by

the average number of persons per vehicle.
(B) varies by commodity; average of $20 is used here.
Source: FHWA, Highway Economic Requirements System and National Cooperative Highway Research Report 463, Economic Impacts of Congestion, National Academy Press, 2001.)

- **Reduction in Cost of Travel Time Variability.** When congestion becomes severe (i.e., traffic levels exceed 90% of road design capacity), the frequency of incident-related delays increases dramatically. Under those conditions, any minor accident, flat tire or engine stall can lead to dramatic backups and long-lasting slowdowns. This increases the unpredictability of travel times on affected routes. As such occurrences become common, many businesses adjust their delivery schedules to allow for this uncertainty. The result is further costs of the additional time built into delivery schedules. Reductions in congestion brought about by the Alternative Scenario will reduce this variability and make travel times more predictable, saving additional money for businesses.

  The "variability penalty factor" shown below is a multiplier put onto time delay costs to reflect variability in travel time. That factor varies depending on the extent of severe congestion along major travel corridors. It is lowest for the year 2000, highest for the Base Case and somewhat lower for the Alternative Scenario.

Scenario	Variability Penalty
2000	0.18
2025 FC	0.34
2025 PREF	0.27

Source: National Cooperative Highway Research Report 463, "Economic Impacts of Congestion", 2001 and Traffic Management Workshop, 2004: "Searching for Trip Time Reliability Benefits" by Matt Ensor.

- **Reduction in Cost of Excess Mileage to Avoid Congestion Bottlenecks.** High congestion delays and gridlock cause some drivers to use longer routes to avoid the congestion backups. Each additional vehicle-mile of travel due to congestion effects leads to a cost associated with additional vehicle fuel use and accident rates. Reductions in total vehicle-miles of travel brought about by the Alternative Scenario will bring benefits in the form of savings in these mileage and accident costs. The value assigned to changes in vehicle-miles of travel for cars and trucks is shown as follows:

Mode	Distance $ per mile	Accident$ per mile	Total $ per mile
Pass Car/ Lt.Truck	$0.26	$0.07	$0.35
Freight Truck	$1.34	$0.07	$1.43

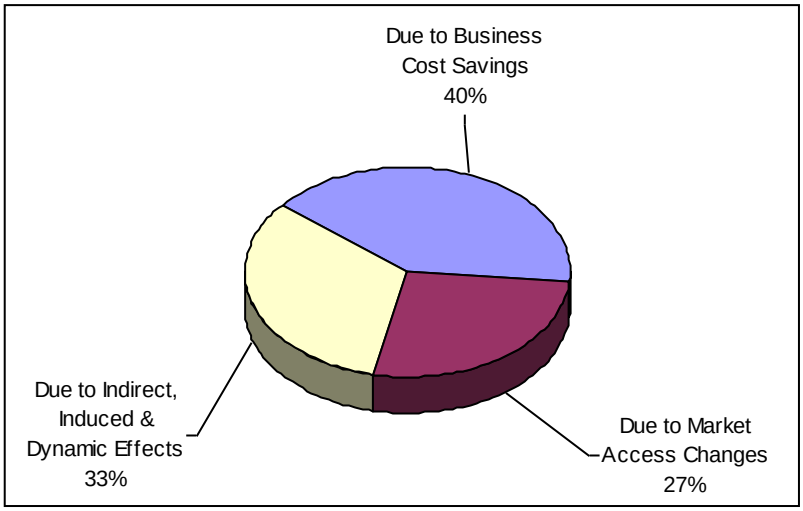
Source: FHWA, Highway Economic Requirements System, AAA (Your Driving Costs, 1997 edition); and ATA Trucking Information Services.

Allocation of Direct Economic Benefits to Households and Businesses. Every savings in miles and minutes of travel represents a benefit to households or to businesses. Those benefits accrue to these parties as follows:

- Travel expenses and driver/freight time savings for business travel generally accrues to businesses in the form of operating cost savings.
- Travel expense savings for commuting and for personal/recreation travel generally accrue directly to households as a cost of living savings.
- Commuting time savings tends to be reflected over the long term half in business wage rates (which represents a business cost savings) and half as a value of personal time savings (that has a dollar value although it does not directly affect the flow of dollars in the economy).
- Personal/recreation travel time savings also represents a benefit that can be valued in dollars but does not affect the flow of dollars in the economy.

The table below shows the relative roles of transportation costs, market access changes and other dynamics of the regional economy in affecting total economic impact on the regional economy of the Portland Metropolitan Area.

Distribution of Job Impacts from Implementing the Improved System I nstead of the Planned Investments Scenario for the Portland Metro Area



APPENDIX D. ADDITIONAL TABLES ON ANALYSIS OF COMPETITIVENESS

This appendix presents additional detail on regional strengths and weaknesses.

D-1 Employment Concentration: Comparison of Among Metro Regions

NAICS	Sector	Portland	Austin	Denver	Las Vegas	Phoenix	Salt Lake City	San Francisco	San Jose	Seattle
334	Computer & Electronic Products	3.2	4.3	0.5	0.1	2.3	1.2	1.4	3.6	1.0
813	Religious, Civic, Professional, Org.	2.6	1.0	0.6	0.5	1.3	0.8	1.6	5.1	0.6
331	Primary Metal Manufacturing	1.6	0.2	0.1	0.0	0.5	0.6	0.5	0.0	0.2
322	Paper Manufacturing	1.6	0.0	0.4	0.1	0.3	0.5	0.3	0.1	0.6
511	Publishing Industries (except Internet)	1.4	1.8	1.5	0.5	0.6	0.6	2.0	1.6	3.3
420	Wholesale Trade	1.3	1.2	1.2	0.7	1.1	1.2	0.9	0.5	1.1
533	Lessors of Nonfinancial Intangible Assets	1.3	0.5	2.5	1.2	5.1	1.8	1.6	0.5	0.8
531	Real Estate	1.2	1.0	1.5	1.6	1.5	1.4	1.3	1.0	1.3
321	Wood Products	1.2	0.4	0.3	0.4	0.8	0.5	0.1	0.3	0.8
113	Forestry & Logging	1.2	0.0	0.1	0.0	0.0	0.0	0.0	0.1	1.2
316	Leather & Allied Products	1.2	0.1	0.6	0.2	0.4	0.1	0.6	0.3	0.2
524	Insurance Carriers & Related Activities	1.1	1.2	1.2	0.7	1.2	1.2	1.0	1.0	1.1
711-713	Amusement & Recreation	1.1	0.8	1.2	1.8	1.0	1.3	1.3	1.3	1.3
611	Educational Services	1.1	0.7	0.9	0.3	0.6	0.8	1.0	0.8	0.9
339	Miscellaneous Manufacturing	1.1	1.3	0.9	1.0	0.6	3.1	0.8	1.0	1.0
323	Printing & Related Support Activities	1.1	0.7	0.9	0.6	0.7	1.3	0.7	0.5	0.9
111	Crop Production	1.1	0.4	0.1	0.0	0.3	0.1	0.2	0.0	0.1
541-551	Professional Scientific, Technical, Svcs	1.1	1.3	1.3	0.8	1.0	1.2	1.8	1.1	1.2
532	Rental & Leasing Services	1.1	0.8	1.3	1.6	1.4	1.2	1.2	0.9	1.1
561	Administrative & Support Services	1.0	1.1	1.1	1.2	1.6	1.1	0.9	0.9	0.9
230	Construction	1.0	1.1	1.4	1.7	1.4	1.0	0.9	1.0	1.0
332	Fabricated Metal Products	1.0	0.3	0.6	0.2	0.7	0.6	0.4	0.9	0.6
481-487	Transportation	1.0	0.5	1.0	1.2	0.9	1.3	1.0	0.4	1.0
814	Private Households	1.0	1.0	0.9	0.6	0.8	0.5	1.5	0.7	1.0
811-812	Repair, Maintenance, & Personal Svcs	1.0	0.9	1.1	0.9	1.0	1.0	1.0	0.9	1.0
491-493	Mail, package delivery & warehousing	1.0	0.5	1.2	0.7	1.0	1.1	1.1	0.7	0.9
525	Funds, Trusts, & Other Financial Vehicles	0.9	1.2	3.5	2.7	1.6	4.0	2.4	0.2	1.1
333	Machinery Manufacturing	0.9	0.5	0.4	0.1	0.4	0.6	0.4	0.2	0.5
721-722	Accommodations, Eating & Drinking	0.9	1.0	1.0	2.8	1.0	0.9	0.9	1.0	0.9
337	Furniture & Related Products	0.9	0.5	0.7	0.6	0.9	1.3	0.4	0.6	0.8
621-624	Health Care & Social Services	0.9	0.8	0.8	0.6	0.8	0.7	0.8	0.7	0.9
562	Waste Management & Remediation	0.9	0.7	1.9	1.0	0.7	1.5	1.1	0.9	0.8
521-523	Monetary, Financial, & Credit Activity	0.9	0.8	1.5	1.2	1.5	1.9	1.7	0.9	1.0
441-454	Retail Trade	0.9	0.9	0.9	1.0	1.0	1.0	0.8	0.9	1.0
327	Nonmetallic Mineral Products	0.9	1.1	1.1	1.2	1.0	0.8	0.5	0.7	0.8
513	Broadcasting	0.9	1.1	2.3	1.0	1.1	1.0	1.3	2.2	1.3
512	Motion Picture & Sound Recording	0.8	0.7	0.6	1.0	0.6	2.2	1.2	0.5	0.6
514	Internet & data process svcs	0.8	1.5	1.6	0.3	1.4	2.4	1.5	0.7	0.7
326	Plastics & Rubber Products	0.8	0.3	0.4	0.3	0.5	0.5	0.3	0.1	0.5
920	Government & non NAICS	0.8	1.5	0.9	0.7	0.8	1.0	0.9	1.4	1.1
312	Beverage & Tobacco Products	0.7	0.2	2.6	0.1	1.0	0.5	0.8	0.4	0.7
336	Transportation Equipment	0.7	0.1	0.5	0.0	0.9	0.4	0.3	0.2	3.4
311	Food Products	0.7	0.3	0.6	0.3	0.4	0.7	0.6	0.2	0.7
221	Utilities	0.6	0.4	0.7	1.1	1.1	0.8	0.9	0.5	0.3
335	Electric Equipment, Appliances, etc.	0.5	0.5	0.1	0.2	0.3	0.3	0.4	0.4	0.4
314	Textile Product Mills	0.5	0.1	0.5	0.2	0.3	0.5	0.2	0.1	0.6
115	Support for Agriculture & Forestry	0.4	0.1	0.2	0.0	0.3	0.1	0.1	0.0	0.2
212-213	Mining & Support Activities	0.4	0.8	0.8	0.2	0.5	1.0	0.2	0.5	0.2
315	Apparel Manufacturing	0.4	0.1	0.2	0.1	0.2	0.5	1.1	0.1	0.6
112	Animal Production	0.3	0.7	0.2	0.0	0.3	0.2	0.1	0.3	0.2
325	Chemical Manufacturing	0.3	0.5	0.2	0.2	0.3	0.7	0.8	0.1	0.3
324	Petroleum & Coal Products	0.3	0.1	0.6	0.0	0.1	0.6	3.8	0.0	0.4
313	Textile Mills	0.2	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.0
114	Fishing, Hunting & Trapping	0.2	0.0	0.1	0.0	0.2	0.2	0.3	0.4	3.2
211	Oil & Gas Extraction	0.0	0.3	2.8	0.0	0.5	0.2	0.1	0.1	0.3

Source: EDR-LEAP (Local Economic Assessment Package), utilizing data from BEA and IMPLAN.
(Note: Employment measures based include self-employed, contract labor and government workers as well as regular wage and salary employees.)

D-2 Employment Growth: Comparison Among Metro Regions

NAICS	Sector	Portland	US	Austin	Denver	Las Vegas	Phoenix	Salt Lake City	San Francisco	San Jose	Seattle
111	Crop Production	3.1%	-2.9%	-5.9%	-6.8%	-4.6%	-0.4%	-11.9%	0.4%	-2.3%	-7.0%
112	Animal Production	11.0%	8.1%	13.6%	13.3%	-3.2%	-0.8%	1.3%	6.8%	13.3%	3.1%
113	Forestry & Logging	-26.5%	-4.9%	-56.3%	-17.1%	-100.0%	-45.2%	50.7%	-57.4%	-43.5%	1.8%
114	Fishing, Hunting & Trapping	-19.8%	12.3%	8.7%	3.6%	-100.0%	46.2%	-12.1%	4.2%	-2.9%	1.1%
115	Support for Agriculture & Forestry	-0.2%	1.1%	-5.0%	3.4%	-2.8%	-14.4%	-1.7%	-29.8%	-10.1%	-6.5%
211	Oil & Gas Extraction	-100.0%	-5.7%	-25.6%	-8.4%	-100.0%	21.0%	-16.6%	-34.4%	-50.3%	77.8%
212-213	Mining & Support Activities	-1.2%	2.9%	3.3%	-5.2%	-14.4%	-19.6%	-9.9%	-7.7%	-6.5%	-3.6%
221	Utilities	-10.9%	-4.9%	3.1%	-14.5%	-6.0%	5.5%	-14.5%	-4.3%	-21.4%	-16.3%
230	Construction	-0.8%	0.2%	-1.5%	6.3%	1.4%	4.1%	-3.8%	2.4%	1.2%	1.5%
311	Food Products	0.2%	0.4%	5.2%	1.5%	-0.6%	1.3%	2.1%	-3.4%	4.8%	-5.0%
312	Beverage & Tobacco Products	-3.2%	-0.6%	5.5%	1.7%	-0.9%	2.4%	-9.5%	4.5%	4.9%	3.2%
313	Textile Mills	-10.6%	-6.8%	-3.0%	5.2%	36.0%	-15.1%	7.6%	-3.3%	6.3%	-7.1%
314	Textile Product Mills	-7.7%	-4.4%	-11.2%	-1.4%	-7.7%	-10.5%	-15.9%	-3.5%	-4.4%	-4.0%
315	Apparel Manufacturing	-14.9%	-13.6%	-3.3%	-12.7%	3.5%	-5.6%	-0.2%	-17.9%	-6.4%	-11.0%
316	Leather & Allied Products	0.8%	-11.5%	22.2%	-25.5%	-18.5%	7.9%	-0.6%	-1.2%	15.4%	-23.2%
321	Wood Products	-4.1%	-3.8%	-11.4%	0.3%	5.2%	1.0%	-2.0%	-7.1%	0.2%	-12.7%
322	Paper Manufacturing	-3.2%	-3.6%	-7.4%	-4.8%	11.1%	5.8%	3.1%	-7.6%	-1.5%	1.6%
323	Printing & Related Support Activities	-5.1%	-3.6%	-0.6%	-3.4%	2.7%	-6.3%	-2.7%	-9.2%	-8.0%	-2.9%
324	Petroleum & Coal Products	-0.3%	-2.9%	12.4%	-0.4%	-100.0%	10.3%	0.5%	4.5%	0.5%	7.6%
325	Chemical Manufacturing	-5.9%	-4.5%	2.9%	-2.7%	4.6%	-11.4%	-4.1%	-5.5%	-4.0%	-0.8%
326	Plastics & Rubber Products	-4.7%	-3.0%	7.2%	-2.6%	3.5%	-4.0%	-7.7%	-4.0%	-16.4%	-2.0%
327	Nonmetallic Mineral Products	-3.4%	-2.6%	3.2%	1.9%	5.0%	-0.7%	-3.8%	-5.0%	-3.5%	-5.4%
331	Primary Metal Manufacturing	-4.3%	-4.8%	30.3%	-6.8%	-21.4%	-2.9%	-6.5%	-2.3%	9.6%	-5.2%
332	Fabricated Metal Products	-3.3%	-2.5%	-8.0%	-1.3%	-4.2%	3.5%	-0.8%	-8.9%	-8.2%	-1.9%
333	Machinery Manufacturing	-4.4%	-4.7%	-9.3%	-5.9%	9.1%	2.3%	4.8%	0.5%	-0.3%	-2.8%
334	Computer & Electronic Products	-4.8%	-5.3%	-5.8%	-4.1%	2.0%	-5.7%	-7.9%	-0.2%	-5.2%	-4.4%
335	Electric Equipment, Appliances, etc.	-0.1%	-5.3%	0.7%	-14.2%	12.6%	-8.2%	1.0%	-11.9%	-5.3%	5.0%
336	Transportation Equipment	-3.9%	-3.9%	-6.3%	-2.7%	-12.9%	-5.5%	-10.4%	-5.4%	-6.1%	-7.1%
337	Furniture & Related Products	3.1%	0.0%	6.2%	7.5%	10.1%	1.5%	1.4%	-0.5%	4.0%	3.8%
339	Miscellaneous Manufacturing	-1.8%	-2.0%	2.3%	-6.8%	9.0%	1.9%	0.1%	2.3%	0.9%	-0.8%
420	Wholesale Trade	-4.0%	-3.2%	8.1%	-1.3%	1.4%	-1.3%	-2.8%	-4.7%	-7.1%	-4.1%
441-454	Retail Trade	-1.7%	-0.3%	1.7%	-1.2%	4.6%	2.0%	-0.7%	-0.6%	-0.2%	0.1%
481-487	Transportation	0.1%	1.7%	2.6%	2.8%	10.0%	4.9%	1.5%	-2.0%	0.3%	1.6%
491-493	Mail, package delivery & warehousing	6.6%	6.4%	4.0%	7.1%	7.3%	6.9%	2.3%	2.9%	-1.3%	5.3%
511	Publishing Industries (except Internet)	3.7%	-6.0%	2.4%	-6.0%	-4.6%	-7.8%	-11.2%	-2.4%	-5.3%	11.1%
512	Motion Picture & Sound Recording	-11.1%	-4.4%	-12.6%	-12.1%	2.0%	-6.4%	4.0%	2.7%	7.4%	-11.4%
513	Broadcasting	2.6%	2.9%	5.9%	3.1%	7.7%	7.0%	-0.4%	1.5%	1.2%	4.5%
514	Internet & data process svcs	-0.3%	6.1%	3.3%	2.9%	-5.4%	18.2%	21.8%	-4.6%	-2.6%	-15.2%
521-523	Monetary, Financial, & Credit Activity	-0.1%	1.8%	6.7%	1.9%	8.0%	4.2%	8.1%	4.3%	2.3%	4.3%
524	Insurance Carriers & Related Activities	1.4%	-1.2%	-1.4%	0.2%	5.8%	2.1%	-0.6%	-1.7%	-4.8%	0.1%
525	Funds, Trusts & Ot. Fin. Vehicles	4.9%	12.3%	16.4%	17.1%	27.0%	10.3%	23.2%	21.6%	22.9%	10.5%
531	Real Estate	16.2%	9.7%	10.3%	22.5%	18.6%	20.2%	18.7%	13.9%	10.4%	10.4%
532	Rental & Leasing Services	7.2%	6.9%	7.0%	6.7%	9.0%	8.6%	12.4%	1.6%	-0.6%	4.6%
533	Franchises	-9.0%	-8.5%	-20.5%	-10.5%	-11.5%	13.5%	-14.9%	-8.4%	-1.8%	-14.3%
541-551	Professional Scientific, Technical Svcs	6.6%	7.0%	10.3%	6.3%	8.9%	6.5%	7.9%	8.9%	13.6%	6.5%
561	Administrative & Support Services	-1.2%	0.0%	-1.6%	-0.8%	6.2%	2.1%	4.0%	-7.2%	-9.8%	-2.3%
562	Waste Management & Remediation	3.9%	8.9%	19.5%	26.9%	28.1%	6.1%	12.4%	17.9%	17.4%	10.6%
611	Educational Services	2.2%	0.1%	9.5%	1.0%	2.8%	3.3%	-0.4%	1.7%	-1.3%	3.3%
621-624	Health Care & Social Services	4.7%	2.6%	4.5%	3.8%	6.6%	4.2%	3.0%	4.4%	7.2%	4.4%
711-713	Amusement & Recreation	9.0%	3.7%	6.6%	6.3%	6.0%	4.0%	7.4%	10.6%	6.8%	5.6%
721-722	Accommodations, Eating & Drinking	1.8%	2.3%	5.3%	2.5%	-2.8%	3.1%	2.3%	2.0%	1.2%	2.7%
811-812	Repair, Maintenance, & Personal Svcs	2.7%	3.8%	5.7%	4.0%	6.8%	6.2%	4.4%	2.6%	6.1%	3.9%
813	Religious, Civic, Professional, Org.	25.2%	1.4%	0.2%	-5.5%	6.5%	14.0%	-2.2%	12.9%	19.7%	-3.9%
814	Private Households	20.1%	10.1%	16.0%	16.0%	22.9%	14.6%	8.6%	19.6%	20.9%	18.4%
920	Government & Non-NAICS	3.5%	1.0%	0.0%	3.3%	4.7%	4.6%	1.9%	3.1%	2.9%	3.5%

Source: EDR-LEAP (Local Economic Assessment Package), utilizing data from BEA and IMPLAN.
(Note: Employment measures based include self-employed, contract labor and government workers as well as regular wage and salary employees.)

Table D-3 Competitive Factors: Comparison Among Metro Regions

	Portland	Austin	Denver	Las Vegas	Phoenix
Cost Factors (as labeled)					
Average Labor Cost (per year in manufacturing)	$53,219	$61,342	$49,255	$43,553	$55,179
Average Electricity Cost ($/kWh)	$0.05	$0.06	$0.05	$0.09	$0.06
Average Total Tax Burden per Person ($ per year)	$575	$762	$729	$461	$460
Average Housing Cost ($ for a single family home)	$170,377	$128,880	$176,291	$139,500	$127,249
AverageRental Cost ($ per month)	$603	$621	$671	$648	$576
Market Factors (as labeled)					
Population (1000's)	1,927,881	1,249,763	2,157,756	1,375,765	3,251,876
Population Density (population per square mile)	799,016	593,961	1,302,649	173,900	317,203
Skilled Workers (% with bachelor's degree or higher)	28.74%	36.68%	34.00%	17.30%	25.13%
Labor Force Participation Rate (%)	69.20%	71.30%	71.93%	65.10%	63.68%
Transportation (avg. minutes, peak period)					
Access to Commercial Airport	29	40	45	11	20
Access to Freight Marine Port	22	243	782	297	425
Access to Rail Intermodal Loading	24	101	21	23	13
Technology (1-10)					
Broadband Access	8.3	8.5	9.8	6.0	9.6

(continued from above)	Portland	Salt Lake City	San Francisco	San Jose	Seattle
Cost Factors (as labeled)					
Average Labor Cost (per year in manufacturing)	$53,219	$49,146	$54,071	$69,094	$21,984
Average Electricity Cost ($/kWh)	$0.05	$0.05	$0.11	$0.10	$0.06
Average Total Tax Burden per Person ($ per year)	$575	$614	$541	$573	$504
Average Housing Cost ($ for a single family home)	$170,377	$160,038	$353,718	$449,461	$208,567
AverageRental Cost ($ per month)	$603	$582	$881	$1,093	$662
Market Factors (as labeled)					
Population (1000's)	1,927,881	968,858	4,123,740	2,442,980	3,053,750
Population Density (population per square mile)	799,016	1,130,514	4,420,287	1,354,503	618
Skilled Workers (% with bachelor's degree or higher)	28.74%	27.47%	38.51%	39.56%	32.38%
Labor Force Participation Rate (%)	69.20%	71.19%	65.76%	67.00%	69.29%
Transportation (avg. minutes, peak period)					
Access to Commercial Airport	29	24	26	14	35
Access to Freight Marine Port	22	791	17	28	19
Access to Rail Intermodal Loading	24	17	20	46	23
Technology (1-10)					
Broadband Access	8.3	9.7	10.0	9.9	9.1

Source: EDR-LEAP (Local Economic Assessment Package), utilizing data from BEA and IMPLAN.
(Note: Employment measures based include self-employed, contract labor and government workers as well as regular wage and salary employees.)

APPENDIX E: REGIONAL ECONOMIC IMPACT STUDIES

There are eight case studies that roughly parallel Portland, in the sense that they involve studies to document the severity of looming urban traffic congestion, and the economic benefits of taking action to address the problem. They are: Vancouver BC, Chicago, Atlanta, Milwaukee, Houston, Los Angeles, Seattle and Toronto. Each of the case studies of regional economic impacts is summarized in terms of five parts: (1) Organizations involved, (2) Issues addressed, (3) Study scope, and (4) Study Findings, and (5) Recommended Actions. Links to web resources for further information are also shown.

Case Study 1 – Vancouver, BC

"Economic Impact Analysis of Investment in a Major Commercial Transportation System for the Greater Vancouver Region", Greater Vancouver Gateway Council. 2003.

Organizations. The Greater Vancouver Gateway Council (GVGC) is an organization of port and transportation business leaders who are concerned with the continued performance of Greater Vancouver's multi-modal gateway facilities. However, the Gateway Council has also obtained broader formal involvement (as resource members) of public groups including the four western provincial governments, regional chambers of commerce, Vancouver Board of Trade, WESTAC (Western Transportation Advisory Council), and federal Department of Western Economic Diversification. The Gateway Council obtained a grant from the federal Department of Western Economic Diversification for a study of the region's marine, air, road and rail international gateways and the importance of addressing congestion that could constrain their future capacity to operate.

Issues. The Gateway Council had worked with B.C. Dept. Of Transport and the Greater Vancouver Transportation Authority (GVTA) to develop a proposal for the "Major Commercial Transportation System" – a set of 52 surface transportation (road, rail and transit) improvements intended to expand capacity and improve the functionality of the region's ports, gateways and freight transportation systems. Total cost of the proposed system, to be built over a 20 year period, would be $5 billion (2002 dollars). One of the interesting aspects of this plan was that it included expansion of rail rapid transit as a component of the commercial transportation system. The reasoning was that trucks are facing increasing congestion traveling to/from downtown and port areas, and it can be easier to shift cars off of the road (to transit) than it is to shift freight onto short distance rail.

Study Process. The Gateway Council organized a committee of the local business leaders, the regional transportation planning agency, provincial Transportation Department, and federal Department of Western Economic Diversification, to oversee a research study. The study measured the economic role of Vancouver International Airport, Vancouver's major marine ports, the railroad system and trucking industry in supporting the economy for Vancouver, BC and the rest of Western Canada. The study then focused on analysis of the regional economic development consequences of investment (vs. failure to invest) in road and rail system improvements needed to address rising traffic congestion and the insufficiency of existing infrastructure to sustain future growth of gateway transportation systems.

The analysis process centered on four elements: (a) a detailed traffic simulation model, (b) railroad facility supply/demand forecasting, (c) a four province set of input-output economic models, and (d) analysis and forecasting of the impact of infrastructure scenarios (base case and new investment scenarios) on future jobs and business growth.

Study Findings. The study found that traffic congestion is significantly raising costs for the regional transportation sector, and these costs are expected to exceed $800 million per year by the year 2021. The study found that the between 1999 and 2021, AM peak-hour road traffic in the Greater Vancouver region is expected to grow by 39% in terms of vehicle-trips, and Vehicle Hours Traveled (VHT) would increase by 54%. The average driver is expected to spend 10% more time due to longer delays and slower speeds.

The analysis of future scenarios about infrastructure investment showed that 7,000 - 16,000 jobs and $500 million - $1 billion of annual Gross Domestic Product are at stake and would be lost if the adequate infrastructure investments are not made. This information is now being used by local, provincial and federal agencies to help inform future planning and decision-making.

Recommended Actions. The report recommended implementation of a broad series of highway, arterial road, light rail, freight rail, bridge and tunnel projects to minimize future congestion costs and increase economic competitiveness.

Link for further info: http://www.gvgc.org/home.html (click on Infrastructure Plans)

Case Study 2 – Chicago, IL

The Chicago Metropolis Freight Plan -- (Ch.7) Assessing the Economic Impacts of Congestion Reduction Alternatives

Organizations. Chicago Metropolis 2020 is a membership organization of area business and civic leaders concerned with planning for the future of the metropolitan area. Metropolis 2020 was spun off of The Commercial Club of Chicago, and formally includes representatives from business, labor, civic, religious and

governmental organizations. Half of the representatives on the Executive Council members of The Commercial Club of Chicago.

Issues. The group has focused on a series of 21st century issues facing the metropolitan area. A key issue was the fact that Greater Chicago, like many urban areas, it has been facing increasing traffic congestion, which has raised concerns about implications for future freight movement and economic competitiveness. The stakes are especially high in that region because it is a center of freight activity with nearly $1 trillion in freight flowing annually on roads in the region.

The group assembled a team of consultants to develop a study of "Transportation and Land Use – Freight." The idea was to examine broad issues of regional transportation and traffic congestion (considering passenger as well as freight movement), and also examine the particular issues facing freight movement.

Study Process. The objective of the study was to identify the different impacts and options for addressing traffic congestion (passenger and freight). The Chicago Metropolis 2020 plan recommended some key actions such as the creation of an efficient system of truck routes in cooperation with the State, regional, and local governments, developing a system of user fees on the most congested roads in the region to reduce delays and promote efficient use of the roads, and strengthening the arterial highways that are critical to freight movements.

The study focused on the expected economic impacts of potential road improvement and toll pricing strategies to reduce traffic congestion in the metropolitan area. The analysis process centered on four elements: (a) a detailed traffic simulation model, (b) a regional economic model, and (c) analysis and forecasting of the impact of infrastructure and policy scenarios (base case and new investment/pricing) on future jobs and business growth. Estimates of regional economic impacts in terms of jobs, earnings, and business sales were generated by evaluating how changes in traffic levels, speeds and costs would affect logistic costs for the area's industries and subsequent regional economic growth.

Study Findings. The study found that costs of congestion in the Chicago metropolitan area are having an increasingly significant impact on the regional economy. Congestion costs to Chicago area businesses, truckers and commuters were estimated at over $4 billion per year.

The user fees option itself was expected to reduce truck travel times by 5.5%, generating regional economic benefits of $2.1 billion per year in direct savings, $4.6 billion in increased sales and creation of over 9,300 jobs. The planned additions of lane-miles on key arterial roads along with other transportation improvements planned for the region over the next 25 years would reduce total truck travel time by 6%, generate annual savings of $3.9 billion in increased sales, and 17,314 new jobs. The study found that the recommendations for congestion-reducing interventions in the Chicago metropolitan region would have significant economic impacts as

compared to a base case. The expected increase in business competitiveness from this plan stems from its mix of industries and their ability to reap high productivity benefits from transportation-related savings. As compared with the base case, business sales would increase by approximately $3.6 billion under the Metropolis Plan as result of direct travel-related savings. The total impact on business sales would be almost $4.0 billion greater as compared to a 'business as usual' setting.

Recommendations. The recommended action plan included:

- highway capacity expansion;
- implementation of user fees on highways;
- development of a more formal system of truck routes (in which road designs, regulations and signalization all facilitate improved truck movement);
- transit modernization to make public transportation more attractive;
- better use of existing rail infrastructure;
- reinforcing the use of expressways for long trips, for which they were originally intended, and the use of arterial streets for shorter trips.

Link for further info: http://www.chicagometropolis2020.org/10_40.htm

Case Study 3 – Atlanta, GA

Mobility 2030, Regional Transportation Plan of the Atlanta Regional Commission. 2004.

Organizations. The Atlanta Regional Commission (ARC) is the regional planning and intergovernmental coordination agency for ten counties in the metropolitan area, as well as the City of Atlanta. The Atlanta region is facing rapid growth with three of the fastest growing counties in the nation and an expected population of 6 million by 2030. This realization led the ARC to develop the Mobility 2030 plan in collaboration with other planning agencies including Georgia Dept. of Transportation (GDOT), Georgia Regional transportation Authority (GRTA), Metropolitan Atlanta Rapid Transit Authority (MARTA), county and city officials, advocacy groups, and the public. The aim of the plan was to adopt the strategies that would have the greatest impact on transportation system performance in the most cost-effective manner.

Issues. The innovative process followed included the development of a financially unconstrained Aspirations Plan, released in 2003, that was based on inputs from all jurisdictions and results from technical studies. This plan was then financially constrained and projects were prioritized for three time frames, short-term (2005-2010), mid-term (2011-2020), and long-term (2021-2030). The development of the final plan involved an extensive public participation process between 2002 and 2004, supported by stakeholder involvement in ten teams that addresses the different issues critical for development of the plan.

The Atlanta region is large in area and low in density, leading to important transportation challenges that need to be resolved. The Mobility 2030 plan focused on five major transportation systems in the region: the Freeway and Cross-Regional Arterial Road system, the Managed Lane/ High Occupancy Vehicle (HOV) system, the Regional Transit system, a system of Smart Corridors, and the Bicycle and Pedestrian Facility system, including air quality and environmental justice priorities for the region. Today, the Freeway and Arterial System handles about 94% of the total person trips in the region and accounts for the largest required capital expenditures.

Study Process. To estimate the transportation performance impact of the Mobility 2030 plan, the current travel times and congested lane-miles on different corridors were compared with three scenarios for 2030: a no-plan scenario, the Aspirations Plan ($74 billion), and the constrained plan ($523 billion). Capital expansion and improvements, travel demand management strategies, and bottleneck relief measures are key components of the Mobility 2030 recommendations.

Study Findings. The analysis revealed that over 2.5 million additional people and an additional 1.3 million jobs are forecast between 2000 and 2030. The freeway and arterial lane miles with more than two hours of daily delay are expected to increase from 39% to 69% of all freeway lane-miles by 2030 if nothing is done to improve flow in these corridors. In addition, the Atlanta region is one of the busiest freight distribution centers in the southeast and in the nation. The congestion problems in the region are further intensified because 92.7% percent of the freight moved through the Atlanta region is shipped via truck. Improving truck service to inter-modal hubs is a key planning need. While the study focused only on traffic delay measurement and not the economic development consequences, the economic severity of the problem and the need for corresponding action was quite clear.

Recommendations. The study recommended implementation of a series of actions including expansion of freeway and cross-regional arterial road systems, expanded implementation of managed "High Occupancy Vehicle" (HOV) lanes, expansion of the regional transit system and implementation of a system of "smart corridors" that have intelligent transportation systems installed for better monitoring and control.

Link for further info:
http://www.atlantaregional.com/transportationair/plandocumentation.html#RTP

Case Study 4 – Milwaukee, WI

The Economic Benefits of Transportation Investments, Transportation Development Association of Wisconsin, 2003.

Organizations. The Transportation Development Association of Wisconsin, a state-wide, nonprofit organization, which includes regional public agencies (such as county highway departments) and private sector members (transportation, construction and

other businesses). TDA has a history of collaborating with Wisconsin Dept. of Transportation.

Issues. TDA Wisconsin worked together with staff of Wisconsin DOT to commission a study of the role of transportation industries in the economy and the economic impact of investing in additional transportation infrastructure. Part of the effort was documenting the economic activity and employment generated by the state's highway system, deepwater ports, aviation industry, transit, and freight railroads. However, the largest part of the effort was to assess how rising congestion, particularly in the Milwaukee metro area, would affect the state economy.

Study Process. The study used statewide and metro traffic models to evaluate the extent of traffic growth and traffic delay on roads, focusing on both state-wide and regional levels. It then applied an economic model to forecast the impacts on future economic competitiveness and growth.

Study Findings. The study found that new highway construction in Wisconsin has not kept up with rising travel demand. The costs of time delays and fuel consumption associated with congestion in the year 2000 were estimated to be $390 million just for Milwaukee and Waukesha counties (the Milwaukee metro area). Today, roadway congestion is a problem on 17% of the state's most critical roadways, but the Wisconsin Department of Transportation projects that congestion would affect almost one-third of key roadways by 2020. Given these facts, this study established the positive impacts of investing about $22 billion in Wisconsin's highway system as identified in the 2020 Wisconsin State Highway Plan, which would be $5.8 billion more than required to simply maintain current performance conditions over the next twenty years.

It was concluded that additional investment is expected to generate about $9.7 billion of macroeconomic benefit comprising travel cost and time savings for personal trips, and higher efficiency for businesses through on-the-clock time and money savings. The additional highway investment would bring in about 4,800 new jobs per year on average by reducing costs to businesses, and enabling them to increase output and to hire additional workers. This does not count additional jobs that would be supported by highway construction and routine maintenance activities.

Recommendations. The recommendations focused on need for highway and freeway system expansion in the Milwaukee metropolitan area.

Link for further info:
http://www.tdawisconsin.org/resources/pdfs/WITDAComplete.pdf

Case Study 5 – Houston, Dallas, San Antonio, and Austin, TX

Texas' Roadways — Texas' Future: A Look at the Next 25 Years of Roadway, Supply, Demand, Cost and Benefits, 2003

Organizations. The Governor's Business Council (GBC) in Texas is a non-partisan non-profit corporation that provides advice and counsel to the Governor of Texas on matters of economic development. Its members comprise leaders of small, medium, and large corporations, of both for-profit and non-profit status.

Issues. Rising levels of congestion in the four largest metropolitan areas of Texas were being indicated by the Texas Transportation Institute's Travel Time Index. The four metropolitan areas mentioned represent 68% of the population and 56% of vehicle travel, but over 95% of travel delays in the state. The problem is exacerbated by the fact that these same areas are expected to absorb 80% of the population growth over the next 25 years. It was recognized that the travel delays to passenger and freight transportation activity in those areas were threatening to restrict economic growth in the state. Concern was raided that continuation of the status quo would in fact lead to a future scenario with substantially restricted economic growth.

In the year 2000, the Travel Time Index (TTI) values in Houston, Dallas, San Antonio, and Austin ranged from 1.38 to 1.23. This group proposed that the state should adopt a 25-year goal of reducing the TTI in all areas to 1.15, which means that travel during peak periods should take no more than 15% longer than non-peak travel.

Study Process. The analysis identified alternative policy actions that could provide the congestion relief goals in the four metropolitan areas, as well as at the border. Three different scenarios for policy actions were developed. The study examined costs of congestion and costs of implementing alternative scenarios for congestion reduction.

Study Findings. Traffic congestion in the metropolitan areas of Houston, Dallas, San Antonio, and Austin over the last ten years alone was shown to represent $46 billion in increased fuel consumption and travel delays. Of these, Houston is the most congested in terms of the TTI index (1.38), though Dallas-Fort Worth faces the highest overall dollar costs of congestion. To maintain existing congestion levels alone would require $38.5 billion more than what is expected to be spent over the next 25 years. To meet the TTI scenario of 1.15, an annual addition of 1,500 lane-miles needs to be made to the road network in the metropolitan areas at a cost of $78.2 billion over the next 25 years (all costs in 2000 dollars).

The report estimated the cost to the average household in each of the scenarios, along with the benefits expected from reductions in travel delays and fuel consumption. The benefits in each case were found to be higher than the costs, and exclude additional benefits such as those from air quality improvements, and reduced stress. The analysis showed that an expenditure of $78 billion over 25 years to achieve a TTI value of 1.15 would yield over $500 billion in net benefits to the state. Every billion dollars of capital investment in the road network was also expected to generate about 38,000 jobs.

Recommendations. The recommendations focused on need for highway and freeway system expansion in the four metropolitan areas.

Link for further info: http://www.texasgbc.org/reports2.htm

Case Study 6 – Los Angeles, CA

Long Range Transportation Plan for Los Angeles County, LA County Metropolitan Transportation Authority, 2001.

Organizations. Over the period of 1998-2001, the Los Angeles County Metropolitan Transportation Authority worked with public and private groups to develop alternative scenarios for long-range investment in highways, rail transit and bus services within the region.

Issues. The Long Range Transportation Plan (LRTP) was designed to guide investment and determine financing over a 20-year period (2000-2020). There were four alternatives, involving different combinations of rail, bus and highway system investment within the region. Each alternative had a specific list of projects included. One scenarios had rail transit extensions to North Hollywood, East Side, Mid-City and Pasadena while other scenarios had lesser rail transit with more bus system expansion. All of the scenarios also had additional highway investments. The base case kept current rail, bus and highway systems with spending only as required to maintain those facilities.

Study Process. The study had two parts: (1) The first part was application of a regional transportation model covering both car, truck, bus and rail transit modes. The model was applied to calculate differences in usage, travel times and level of service for each mode under alternative scenarios. Reliability and accident rates were also evaluated. (2) The second part was application of a regional economic model to analyze the effects of project financing, project spending and project impacts on travel time and cost for businesses and households.

Study Findings. The study found that the improvement scenarios would cost $13-15 billion (in constant 1998 dollars), but lead to over $8 billion more personal income in the region by the year 2020, compared to the base case.

Recommendations. The study recommended implementation of rail transit system expansion in conjunction with freeway expansion as part of a balanced system of transportation investments aimed at maximizing economic development in the region.

Source: http://www.edrgroup.com/edr1/consulting/2_8/P007-054-Los-Angeles-MTA.shtml

Case Study 7 – Seattle, WA

FAST -- Freight Action Strategy for Everett-Seattle-Tacoma, 2004.

Organizations. To organize a cooperative effort addressing regional freight flow constraints, the Washington State DOT and the Puget Sound Regional Council collaborated the state's Freight Mobility Strategic Investment Board, the Transportation Improvement Board, as well as representatives from each of the major ports (Everett, Seattle and Tacoma), cities, counties, railroads and trucking association.

Issues. The focus of concern was the declining competitiveness associated with the region's three ports, and bottlenecks affecting freight movements on the I-5 and other key corridors. The objective was to address decline in competitiveness for the region's transportation gateways and associated industries, and develop a regional freight action plan.

Study Process. The collaboration process started in 1996, and led to a series of studies of the region's freight movement via rails, roads and shipping ports. These studies compiled data on the nature and regional importance of these freight movements, and examined ways to smoothen freight flows through the central Puget Sound region of Washington State. This led to the identification of priority projects needed to address bottlenecks to improve the efficiency of freight movement as well as safety for cars, trucks and trains. The collaboration group also meets periodically to evaluate progress and re-strategize. Starting in 2003, there were additional planning workshops which brought together public and private sector participants to discuss key issues and opportunities.

Study Findings. The economic research showed that Puget Sound ports have lost 11.9% of foreign market share bound for the US since 1998, and have lost competitiveness to the Port of Vancouver for Midwest-bound freight. It examined reasons for this loss and found that international shippers care about cost, reliability, and travel time for the total trip of their products, and choose routes that offer the best value for their customers. The conclusion was that moving freight efficiently into, through and around the Puget Sound region is critical to the region and national competitiveness. The study identified the need for intermodal connections among marine, rail, truck and air need to become more reliable and efficient, and for the entire region to become a less congested, more reliable, and more accessible transportation system. It found that the nearly 1 in 3 jobs in Washington relate to international trade and are dependent on the ports.

Recommendations. For Phase I, fifteen projects were identified that would help freight carried through road, rail and shipping ports to move more efficiently through the region. Projects include

- grade separations (overpasses) between arterial roads and railroad lines, intermodal rail yard access routes,

- truck access routes, and
- "intelligent transportation systems."

The projects were designed to improve regional safety as well as economic competitiveness. Most of the Phase I projects are underway or complete. Ten additional projects were added for phase II.

Link for further info: http://www.wsdot.wa.gov/mobility/fast/

Case Study 8 –Toronto, ON

Ministry of Transport Ontario (MTO): Ontario Strategic Transportation Directions (2002) and Central Ontario Freight Plan (2004).

Organizations. Transport Canada, and the Ministry of Transport Ontario (MTO) spearheaded the study, while approximately 120 organizations provided input.

Issues. The MTO initially conducted a study of *Strategic Transportation Directions,* which focused on opportunities to expand facilities and capacity using intelligent transportation systems. The MTO then supported the Central Ontario Smart Growth Panel in addressing gridlock issues and in attaining the government's vision for managing how communities grow. The Strategic Directions study identified the need for a separate *Freight Plan* and the smart growth panel supported this effort.

Key objectives addressed in the Strategic Transportation Directions process included:

- *Economic Development* -- supporting provincial and regional economic development, enhancing the economic competitiveness of Ontario's industries, and improving the efficiency of trade corridors and gateways.
- *Fiscal Management* -- maximizing use of existing facilities and developing innovative approaches to financing new and improved facilities.
- *Environmental Quality* -- supporting Smart Growth principles and promoting balanced transportation to reduce energy consumption and emissions.

Key needs addressed in the Freight Plan were :

- Need to examine and understand goods movement trends and issues, and how goods movement infrastructure is essential to economic development and competitiveness.
- Need to better relate information on urban freight flows relate into planning decisions, and integrate freight interests into the government planning processes.
- Need to look beyond just infrastructure solutions to examine policy, operations and the role of freight transport within firms.
- Need to recognize and address growth management and other quality-of-life goals for Ontario's communities

Study Process. The MTO initiated a process of stakeholder consultations together with a study to provide strategic directions for supporting freight activities in Central Ontario for the next ten to twenty years. It focused on integrating goods movement

interests in government planning processes in support of policy development, and in enhancing private sector productivity. It had five components: (1) Quantify and place in perspective Ontario's economic competitiveness, and the importance of efficient goods movement to maintaining and enhancing this position; (2) Develop a quantitative and qualitative profile of the demographic and goods movement characteristics of Central Ontario, (3) Identify information that is needed to make sound decisions regarding goods movement strategies, (4) Identify issues of concern to stakeholders and (5) Develop a broad strategy with actions, priorities and long-term directions.

Study Findings. The study examined Central Ontario's economic competitive position in North America, and then analyzed the importance of efficient goods movement to maintaining and enhancing this position. This included an examination of trends in truck, air, rail, marine and pipeline goods movement and a profile of existing conditions in the transportation network. It also analyzes the economic, trade and demographic factors that influence the demand for goods movement today and in the future. The study also discussed issues and challenges that were raised by stakeholders.

Recommendations. There were three recommendations: (1) To establish ongoing private-public *partnerships* including a regional goods movement coordinating body. (2) Improve the process for planning, funding and decision-making with an integrated, region-wide economic development, land use and transportation strategy. Also, ensure that industrial lands and major employment sites are properly protected, and manage congestion for all road users through improved suburban development and recognition that changes are inevitable and should be accommodated. (3) Ensure the flow of goods movement in Central Ontario through a series of inter-related initiatives including:

- a strategic goods movement network with a regional truck route system
- improved incident management to mitigate the impacts of variability in congestion
- invest in solutions to improve incident management and investing in solutions to alleviate bottlenecks
- increase the service levels of existing transit services, promote other ways to get drivers out of their autos, and expand the higher-order transit network.

Links for further info:
Strategic Directions: www.itscanada.ca/english/documents/OntarioStrategicPlan.pdf
Freight Plan: http://www.itransconsulting.com/main/main.asp?type=Papers&sub=goods

APPENDIX F: CONGESTION MANAGEMENT PROJECTS

This appendix presents additional detail on selected infrastructure management and pricing projects and policies.

(1) Designated Freight Corridors.

The concept of "rationalizing" the region's transportation system refers to actions that optimize the placement and use of facilities and services. Usually this means allocating space and assigning priority for various types of vehicles (cars, buses, trucks, bicycles) and various types of trip purposes (commuting, freight movement, etc.) on relevant roads and corridors.

One form of rationalization is the development of transit priority routes where buses and streetcars are assigned special lanes and/or special priority for passing through signalized intersections or road crossings.

Another form of rationalization is the development of freight priority routes which are typically arterial streets where signs, road width, intersection geometrics, ramps and vehicle parking areas are all designed to facilitate truck movement. The designation of such routes and their design features can all serve to maximize the effectiveness of truck movement on those corridors while minimizing negative impacts on neighborhoods. In some cases, this may also include the development of grade separated truck and/or rail routes for access to ports or other intermodal freight terminals.

Examples span a range from truck routes along arterial streets to truck priority and truck-only routes:

- **Regional Truck Route System for Chicago.** The Chicago Freight Plan recommended development of a Regional Truck Route System to replace what had become a haphazard, inconsistent and poorly enforced set of truck routes in the metropolitan area. This new system would fill in gaps in the existing system, eliminate duplication where not required, and integrate the truck routes with the location of interchanges on the Illinois tollway system. Where full-time designation of truck routes is not feasible on some arterials due to loadings during peak commuting hours, there could be "time of day truck route designations." The recommendations also included development of a centralized comprehensive information source for truckers and trucking companies.

- **Puget Sound FAST Corridor – Port Access Routes.** The FAST Corridor includes a series of projects for improving freight flow. Besides road/railroad grade separations, it includes a set of port and rail yard access projects that are essentially truck routes to those facilities. Examples include: (a) Port of Tacoma Road which allows trucks to flow into and out of the Port of Tacoma while passing over SR509 and parallel railroad tracks; (b) S. Spokane Street Viaduct with widened lanes to improve the direct link used by 45% of the Port of Seattle's truck traffic to go between I-5 and the West Seattle freeway; and (c) Atlantic St. overpass and freeway ramps to separate ferry and freight traffic to the Port of Seattle terminals from local vehicle traffic.

- **Alameda Corridor.** The Alameda Corridor in southern Los Angeles County, California is a depressed, grade-separated route that provides truck-only roads and freight-only railroad tracks connecting the ports of Long Beach and Los Angeles to highways connecting to central Los Angeles. The configuration of the corridor circumvents more than 200 rail crossings via bridges, underpasses, overpasses and street improvements that separate freight trains from street traffic and passenger trains. The project's lynchpin is the Mid-Corridor Trench, which carries trucks and freight trains in an open trench that is 10 miles long, 33 feet deep and 50 feet wide.

- **Washington - Wenas Corridor Truck Routing.** This is an example of smaller scale truck routing that helps separate trucks from local street traffic. State Route 823 is the primary link between the City of Selah and surrounding areas including Yakima and Interstate 82. Planned improvements that will route truck traffic away from the congested downtown streets, and provide better access to the city's industrial areas.

- **World Trade Bridge, Laredo, TX.** Beginning in the 1980s, increasing trade volumes at the US-Mexico border crossing began to cause serious congestion in downtown Laredo near the Juarez-Lincoln Bridge. In 1991, representatives from Laredo, TX, Nuevo Laredo and Juarez, Mexico and other regional stakeholders convened to devise a solution. The favored plan was a "Truck-Only" bridge over the Rio Grand, which would separate heavy trucks from pedestrians and passenger cars through the port of entry. The project was funded in 1995 and the bridge, dubbed the "World Trade Bridge" opened to traffic in 2000.

(2) Highway Pricing on Existing Roads.

Most of these projects involve the conversion of existing HOV (high occupancy vehicle) lanes to HOT (high occupancy toll) lanes. Examples:

- **California - HOT lanes on I-15 in San Diego.** San Diego's "Fastrak" pricing program was implemented in April 1999. Single Occupancy Vehicle drivers

pay a toll each time they use the Interstate 15 HOV lanes. The unique feature of this pilot project is that tolls vary dynamically with the level of congestion on the HOV lanes. Toll collection are automated and the tolls can vary in 25-cent increments as often as every six minutes to help maintain free-flow traffic conditions on the HOV lanes. The tolls are used to fund an express bus service on the same corridor.

- **Texas - HOT Lanes on Two Radial Corridors in Houston (I-10) and US 290**). Houston's "QuickRide" Value Pricing Pilot Program consists of automated High Occupancy Toll (HOT) lanes on the Katy Freeway (I-10W) and the Northwest Freeway (US 290W). The Katy Freeway is a 13 mile route, serving over 219,000 vehicles per day and 28,585 person-trips per day. Its HOV lanes were converted to HOT lanes through the QuickRide program in 1998. The Northwest Freeway is a 15 mile route, serving over 235,000 vehicles per day, and over 20,500 person-trips per day. The QuickRide program was implemented on it in 1999. On both highways, Under this program, two-person carpools (HOV2) use the HOV lane for $2 per trip during peak hours, while larger carpools (HOV3+) and buses use the lane for free. Funding from FHWA has supported TxDOT and METRO in the continuing expansion of the QuickRide program.

- **Minnesota - HOT Lanes on I-394 in Minneapolis.** The I-394 "MnPASS Lanes" program was implemented in Spring, 2005. The project was funded and constructed through a public/private partnership involving the State of Minnesota and private firm Wilbur Smith Associates. The private firm has funded 20 percent of the project's estimated $10 million cost. Carpoolers and bus users have free access and priority use. Drivers of single occupant vehicles use the lanes on an as-needed basis by paying tolls that are automatically collected.

- **Colorado - HOT lanes on I-25/US 36 in Denver.** Seven miles of "Downtown Express" lanes on the North 1-25 highway are scheduled to open in December 2005.

- **California - Alameda County.** Interstate 880 in Alameda County is a major congested freeway with one high-occupancy vehicle (HOV) lane. In addition, it has three contiguous lanes in each direction for approximately 17 miles, from just south of Oakland to Fremont. This corridor connects the Port of Oakland and Oakland International Airport with high technology companies in Santa Clara and southern Alameda counties and with goods distribution centers to the east. Congestion is exacerbated by the fact that this corridor has the highest volume of truck traffic in the region. Due to reservations expressed by local officials, conversion of the HOV lane to a HOT lane has been stalled.

(3) Pricing on New Lanes.

These are projects in which new highway lanes are built specifically as HOT lanes. This allows them to have fully private funding. Examples:

- **California - Express Lanes on State Route 91 in Orange County.** The State Route 91 (SR 91) Express Lanes in Orange County, California opened as a four-lane toll facility in 1995. Today, the Express lanes capture 11% of total daily traffic. The lanes are located on a 10-mile section of one of the most heavily congested highways in the U.S. Toll revenues have been used to pay for construction and operating costs.

  As of November 1, 2001, tolls on the facility vary between $1.00 and $4.75, with the tolls set by time of day to reflect the level of congestion delay avoided in the adjacent free lanes, and to maintain free-flowing traffic conditions on the toll lanes. All vehicles must have a "FasTrak" transponder to travel on the express lanes. Vehicles with three or more occupants pay a reduced toll. In November 2002, average daily traffic on the Express Lanes was 26,000 vehicles per day, bringing in over $29 million of revenue. On average, 75 percent of the daily traffic is from high occupancy vehicles (HOVs), and 25 percent is from toll paying customers.

(4) Use of Toll Roads.

Unlike the preceding examples of tolls on only some lanes, these projects provide for time-of-day pricing and special truck pricing policies on toll roads. These policies can serve to encourage off-peak truck movements. Examples:

- **Florida - Variable tolls for Heavy Vehicles in Lee County**. The "LeeWay Program" was implemented in 1998 on two toll bridges crossing the Caloosahatchee River -- both primary commuter corridors in the area. The program involves giving toll discounts of 50% just before and just after the peak traffic periods to entice commuters out of peak hour travel and distribute traffic more uniformly over different times of the day. The two bridges, Midpoint Bridge and Cape Coral Bridge began as toll bridges, and the Leeway Program provides incentives for commuters to reduce their tolls.

- **New York and New Jersey -- Variable Tolls.** Variable tolls for trucks are available on the New Jersey Turnpike, NYNJ Port Authority Interstate Vehicle Crossings, and on the Hudson River Crossings in New York. All use the EZPass Program.

- **California - Peak pricing.** Variable pricing for peak periods has been implemented on the San Joaquin Hills Toll Road in Orange County, CA.

(5) Cordon Tolls.

The most extreme form of road pricing is the development of a "cordon" line around the most heavily congested part of an urban area, with a system of daily charges put on vehicles that enter the area. Typically, persons living inside the cordon area and government vehicles are excluded from the tolls. Examples:

- **London Commercial District Pricing.** Congestion pricing took effect in February, 2003. Between the hours of 7:00 am and 6:30 pm, drivers entering an area bounded by "Inner Ring Road" must pay £5.00 via cell phone text messaging or at sidewalk kiosks. Some users, such as seniors or local residents, are eligible for discounted rates. Weekly and monthly passes are also available at discounted rates. The toll is enforced using an advanced network of cameras that check license plates against a database of paid users.

  After several months of congestion pricing, London's Commission for Integrated Transport conducted a study of the program's impact. The study, completed in September, 2003, consisted of surveys of businesses and stakeholders from different business categories. It found that nearly 25% of survey participants supported the charge, a little over half held mixed views or were neutral, and the remaining quarter held a negative opinion of the charge. The greatest level of support was observed among courier services. Also supporting the study was large companies that adapted their travel and delivery schedules. The greatest level of opposition was found among convenience store owners and other small businesses. The study found that while the charge reduced congestion, resulting in shorter and more predictable travel times, events in the larger economy (a general economic slowdown, SARS outbreak and closures of key Tube lines) made it difficult to determine a precise economic impact.

- **Singapore Cordon Pricing**. Singapore, a city-state the size of Seattle, embarked implementing the famous "Area Licensing" scheme in 1975 specifically to control severe road congestion. This was a manual system of tolls for multiple entries into the restricted central zone. Electronic road pricing (ERP) became operational in Singapore in 1998, replacing the manual congestion pricing scheme. Studies found that the system has raised about US $1 billion per year and significantly reduced car travel, as well as inducing mode shift to public transport. However, critics indicate that some business activities and hence some congestion have merely moved to other locations outside of the cordon line.

2 Oliver Street, 9th Floor, Boston, MA 02109
Telephone 617.338.6775
Fax 617.338.1174
e-mail info@edrgroup.com
Website www.edrgroup.com