

THE ECONOMIC CONTRIBUTION OF WASHINGTON STATE'S PETROLEUM REFINING INDUSTRY IN 2007

ACKNOWLEDGEMENTS

Washington Research Council has produced this report with funding from the Western States Petroleum Association. Washington State's economy is simulated using the Washington Research Council-Regional Impact Modeling, Inc. (WRC-REMI) model, based on a detailed survey of the five oil refiners operating in Washington. The results of this analysis are the sole responsibility of the Washington Research Council, a nonprofit organization committed to objective analysis of economic and public policy issues in Washington State.

1. REPORT OVERVIEW

This report quantifies the impact of Washington's five major petroleum refiners on the state's economy in 2007.

In 2007, the refiners directly provided 2,003 full-time jobs, paying an annual average wage of nearly \$110,000. In addition, the refiners employed, at high wages, 3,144 contract workers on an average day, doing maintenance, capital repair and capital replacement. The refiners indirectly created additional Washington state jobs in industries from which they purchased goods and services, including transportation, construction, utilities and business services. Spending of the income earned in these direct and indirect jobs created even more jobs.

The sum of all these effects was more than 20,000 jobs and one billion dollars in personal income for Washington State in 2007. From this activity, state and local government received \$39.4 million in sales and use taxes and \$79.8 million in business and occupation taxes.

In particular, downstream industries, which distributed refined petroleum products, paid \$407 million in wages to 17,326 workers in 2007. Excise taxes collected by the state from these industries came to nearly \$245 million.

Because of Washington's unique tax structure, a Washington refinery's state and local tax burden is about twice the state and local tax burden of a comparable refinery located in California.

The report updates the economic impact analyses of petroleum refining for 2003 and 2005 previously prepared by the Washington Research Council (WRC 2004 and 2006), drawing upon a survey of Washington refiners conducted by the Council in 2004 and 2008 (Appendix A) and version 9.5 of the WRC-REMI model of the Washington State economy (Appendix B).

2. SUMMARY OF FINDINGS ON REFINERS

Washington's five refineries provide nearly 4 percent of the United States' refining capacity. In 2007 they processed nearly 595,300 barrels of crude oil per day, producing 260,200 barrels of gasoline per day. Gasoline, diesel oil, and jet fuel are the largest finished product categories, representing 43 per-

cent, 22 percent, and 12 percent, respectively, of total production.

Table 2.1: Summary of Multipliers and Economic Impacts

Refining Jobs	Multiplier	Indirect and Induced Economic Effect	Major Petroleum Refiners Total Economic Impact
2,003 jobs	10.16	18,347 jobs	20,350 jobs
	\$507,275	\$728,221,800 personal income	\$1,016,071,600 personal income
	\$20,000	\$33,416,900 sales and use taxes	\$39,416,800 sales and use taxes
	\$30,000	\$8,094,300 B&O taxes	\$79,827,200 B&O taxes

Source: WRC/REMI Model

According to the refiners survey, the five major refineries employed 2,003 workers in 2007, paying them an average annual wage of \$109,215—about two and one-half times the Washington state average.

As illustrated in Table 2.1, these jobs have a total employment multiplier of 10.16, meaning that each direct refining job generates an additional 9.16 jobs

in the state, for a total employment effect of 20,350 jobs resulting from the five refineries.

Petroleum refining’s extraordinarily high capital intensity and high wages are the major reasons for its high jobs multiplier. The WRC-REMI model, which is used here to determine the economic impact of the industry, calculates that each petroleum job adds \$507,275 of state personal income, a total income contribution of more than \$1 billion to the state economy.

The industry is highly taxed and regulated, producing a bounty of tax and fee revenues for state and local government.

The five refiners paid \$182.9 million in state and local taxes in 2007 (Appendix A, Table A-4). Each refining job directly resulted in \$3,099 in sales and use collections and \$35,813 in business and occupation (B&O) tax revenues, for a total of \$77.9 million in sales and use taxes and B&O receipts. In addition, the refiners paid \$70.9 million in hazardous substance tax, \$19.5 million in property tax, and \$8.5 million in regulatory fees in 2007 (Appendix A, Table A-4).

Including the indirect and induced effects, the refining industry generated \$33.4 million in sales and use and \$79.8 million in B&O taxes (Table 2.1)

Table 2.2: Nonfatal Occupational Injuries and Illnesses, 2007
Per 100 Full-Time Employees

	Total Recordable Cases	Recordable Cases Requiring:		Other Recordable Cases
		Days Away from Work	Job Transfer or Restriction	
Private Industry	4.2	1.2	0.9	2.1
Goods Producing	5.4	1.5	1.4	2.5
Natural Resources and Mining	4.4	1.6	0.8	1.9
Construction	5.4	1.9	0.9	2.6
Manufacturing	5.6	1.3	1.7	2.5
Petroleum Refining	1.6	0.3	0.7	0.6
Service Producing	3.8	1.1	0.8	1.9

Source: BLS

Calculations of state and local taxes paid by hypothetical 160,000 barrels-per-day refineries located in Washington and California indicate that the tax burden on refineries in Washington is almost twice that in California (Figure 8.1).

Petroleum refineries have an excellent worker safety rating. In

Table 3.1: Washington's Refineries

Firm	Year Constructed	Location	Major Products	Capacity (barrels/day)
BP Cherry Point (formerly ARCO)	1971	Whatcom County, northwest of Ferndale	Gasoline, diesel oil, jet fuel, calcinated coke	234,000
ConocoPhillips Ferndale (formerly Tosco, BP Oil and Mobil Oil)	Mid-1950s by General Petroleum (subsidiary of Socony-Mobil)	Whatcom County, west of Ferndale	Gasoline, diesel oil, jet fuel, liquid petroleum, residual fuel oil	105,500
Shell Oil (formerly Equilon Enterprises and Texaco)	1957	Skagit County, five miles east of Anacortes	Gasoline, diesel oil, jet fuel, propane, coke, sulfur	147,500
Tesoro (formerly Tesoro Northwest and Shell Oil)	1955	Skagit County, on March Point	Gasoline, diesel oil, turbine & jet fuel, liquid petroleum gas, residual fuel oil	125,000
U.S. Oil	1957	Pierce County, Tacoma Tideflats	Gasoline, diesel oil, jet fuel, marine fuel, gas oils, emulsified & road asphalt	39,000

2007, refineries nationally averaged just 1.6 injuries or illnesses per 100 full-time workers. This low rate compares quite favorably with injury/illness rates of 4.2/100 for private industry overall and 5.6/100 for manufacturing (BLS 2008).

Finally, refiners contribute generously to the communities in which they are located. The five refiners and their employees contributed \$1,944,000 to various community causes in 2007. The firms themselves contributed about 86 percent of this, with the balance provided by firm-sponsored employee giving (Appendix A, Table 5).

3. OIL REFINING IN WASHINGTON STATE

Building and development of the industry. The oil refining industry in Washington State began in the mid-1950s with construction of refineries by Shell in Anacortes (Skagit County) and Mobil at Cherry Point (Whatcom County). Following closely in 1957, Texaco built in Anacortes, and U.S. Oil constructed its refinery on the Tacoma Tideflats. In the early 1970s, in anticipation of the crude oil that would begin flowing from Alaska's North Slope, Atlantic Richfield (Arco) built its refinery at Cherry Point. This plant remains one of the nation's newest refineries. Ownership of all these facilities has been fluid over the years, but today Washington's

refining activity is concentrated at the four major plants in Whatcom and Skagit counties and the U.S. Oil plant in Tacoma. See Table 3.1.

Federal restrictions. Oil companies invest tremendous sums in their facilities in order to maintain their assets, to increase refining capacities, and to remain viable in a highly competitive global industry. In the 1970s, Washington's older oil refineries embarked on major plant modifications in anticipation of the Alaskan crude. Plans for new port facilities on Puget Sound to receive supersized tankers and new pipelines to carry Alaskan oil on to the Midwest were debated. But in 1977, before these plans could be finalized, the Marine Mammal Protection Act came up for reauthorization in Congress. Washington's then-senior senator, Warren Magnuson, preempted these plans by attaching an amendment to the reauthorization bill prohibiting construction of new ports east of Port Angeles.

Geographic isolation. This decision sealed Washington's isolation from the rest of the country's petroleum supplies by preempting pipeline construction to the upper Midwest that would have provided the Northwest with easier access to Eastern and Midwestern distribution systems.

Today, Washington's five refineries make up 3.6 percent of the nation's total refining capacity (EIA 2008a). With this state accounting for 1.9 percent of national petroleum consumption, in-state refineries produce quantities more than sufficient for Washington's needs (EIA 2008b).

Dependence on in-state refining. Other areas of the country—the Midwest and the East—are connected to a larger distribution system that allows their short-term petroleum supply disruptions to be accommodated more easily than those in the West or in Washington State, in particular. The West, which is not connected to the Midwest pipeline systems, gets its crude primarily from the Gulf of Mexico through pipelines from Texas to the California markets, and from Alaska's North Slope by tanker into Anacortes and Cherry Point. To a lesser extent, Washington refineries also receive crude from Alberta, Canada, by pipeline.

Nationally, plant obsolescence and federal and state regulations requiring cleaner products and production processes have resulted in a reduction in the number of operable U.S. petroleum refineries from 301 in 1982 to 150 at the beginning of 2008. Those refineries that remain, however, are more efficient, with nearly as much total refining capacity as was available in 1982. Over the last decade, however, the increased demands of a growing population and economy and an increasing array of “boutique” fuels required by federal and state regulations have strained capacities, with price effects felt throughout the country. While the current recession is providing a respite, capacity constraints will return as soon as the economy recovers.

This constrained supply-demand relationship combines with the West Coast's isolation to produce an economy in Washington that is unusually dependent on its in-state refining capacity. It is this industry and its relationship with the larger Washington State economy that are described in the sections that follow.

4. INDUSTRY IMPACT ANALYSIS

To quantify the impact of Washington State's refineries on its economy, we use the WRC-REMI model to simulate a permanent decrease in refinery employment of roughly 25 percent and measure the resulting changes

in total state employment, personal income, and gross product. Dividing these resulting changes by the change in refinery employment gives “multipliers” that are then applied to the industry’s total employment to calculate total economic impact. For example, in 2007 the five refineries had 2,003 employees. With a multiplier of 10.16, the total impact of the refineries was 20,350 jobs. Similarly, the refinery activities resulted in \$507,275 of state personal income for every direct job, or a total statewide of \$1,016,071,600 in personal income.

The economic impacts of petroleum refining in Washington, however, are broader than those of most other sectors of the economy. If petroleum prices go up, the effects are felt in the price of food and other essential consumer goods, the costs of commuting, and the cost of moving goods to market for businesses throughout the economy. And, unlike products from other sectors, alternative petroleum supplies or substitute products are not readily available in the case of an emergency. In order to fully appreciate the economic value of the petroleum refining industry in Washington, the dire economic consequences possible in a catastrophic scenario must be acknowledged. Foreign product would have to be imported, increased dock and terminal capability would be required, product prices would increase in response to diminished supply availability and stability, and these increases would be felt throughout the economy.

In the sections that follow, Washington’s petroleum refining industry is described under equilibrium conditions by summarizing consumption (Section 5), production (Section 6), and the direct purchases of the five major industry refiners (Section 7). Based on these data, the WRC-REMI model calculates the effect of the five refineries on jobs, income, retail sales and use, and B&O taxes statewide.

Section 8 presents a comparison of taxes paid by hypothetical 160,000 barrels-per-day refineries located in Washington and California.

Finally, in Sections 9 and 10 we provide employment, wage, and tax contribution information on the portions of the transportation, wholesaling, and retailing sectors that operate downstream of the refining process. These petroleum-related activities combine to assure that petroleum products get to their markets in Washington State and beyond. Although they would exist

regardless of the presence of in-state refining, their inclusion here helps to give a complete picture of the petroleum industry in Washington State.

5. PETROLEUM PRODUCT CONSUMPTION IN WASHINGTON

Washington households and businesses consumed more than 152 million barrels of finished petroleum products in 2007, up 4 percent from 1980, according to the Energy Information Administration (2008b). See Figure 5.1. Washington’s 2006 consumption was 1.9 percent of the U.S. total and about 13 percent of EIA’s western Petroleum Administration for Defense (PAD) District V, which encompasses Washington, Oregon, California,

Figure 5.1: Washington State Petroleum Product Consumption

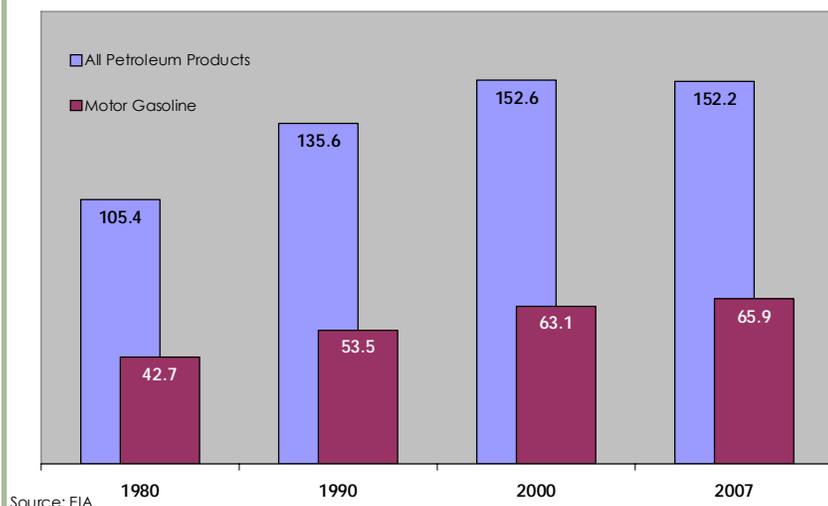
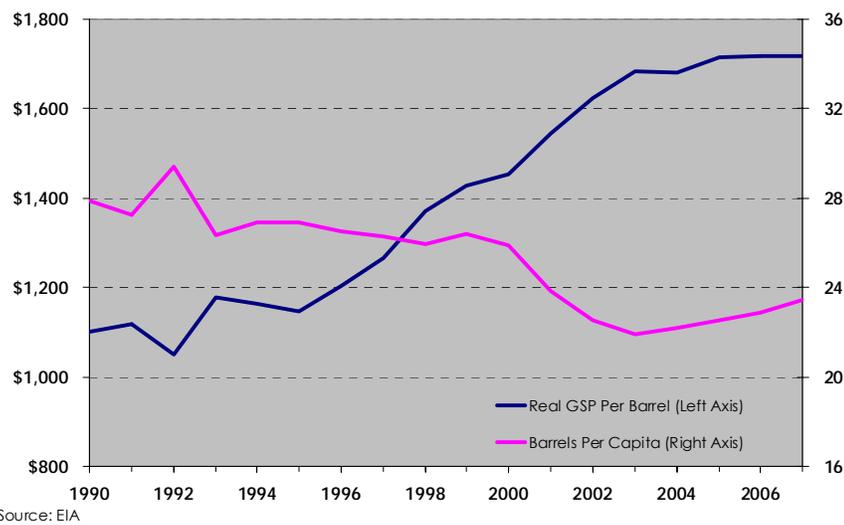


Figure 5.2: Washington Petroleum Consumption Trends



Nevada, Alaska, and Hawaii. PAD District V represented 15 percent of total U.S. consumption in 2006 (EIA 2008b).

As a result of increasing fuel efficiency, per-capita petroleum product consumption in Washington declined from 1990 to 2007, while gross state product per barrel of petroleum increased by 56 percent. See Figure 5.2.

The several broad classes of customers who purchase petroleum products help to explain the state's consumption patterns. Residential and commercial customers reduced their demand for petroleum products over the seventeen-year period by 13 percent and 45 percent, respectively (EIA 2009). Industrial customer consumption decreased by 3 percent, while transportation consumption increased by 18 percent over the period.

As shown in Figure 5.3, by 2007 transportation and industrial customers together accounted for 97 percent of Washington's total petroleum product consumption.

The state economy (as measured by real gross state product) grew at a faster rate than overall petroleum consumption. Therefore, even though petroleum consumption grew, the state economy required less petroleum product for every dollar of economic output. This largely reflects the tremendous growth of software and other high-tech and information-based sectors of the economy, which produce significant economic wealth with relatively little petroleum product.

Figure 5.3: 2007 Consumption By Sector

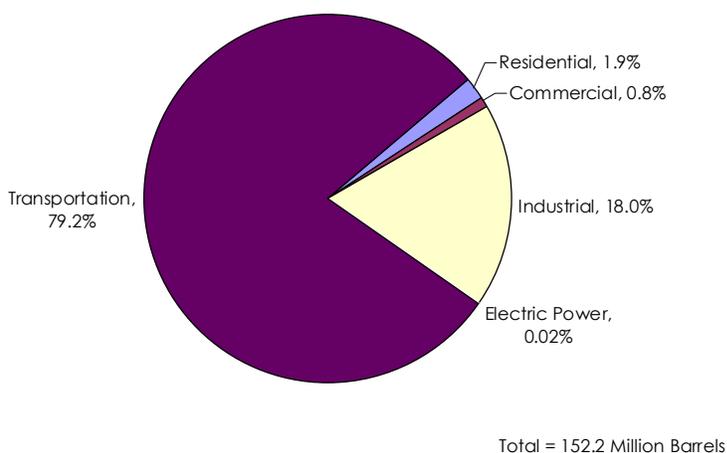


Figure 5.4: 2007 Barrels Consumed By Product

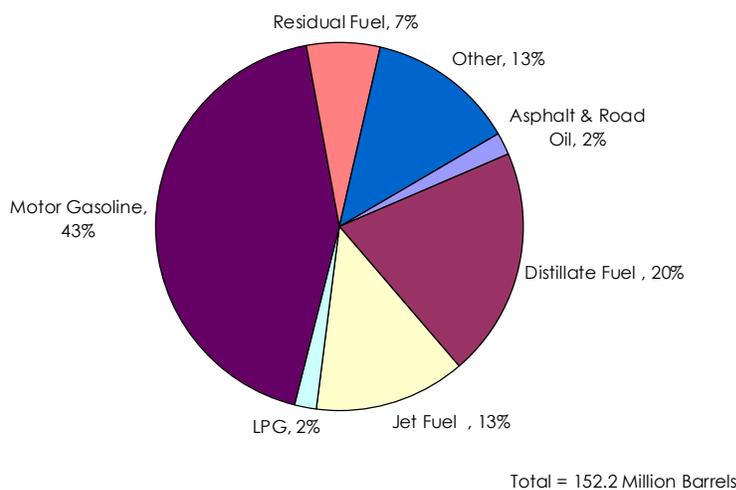


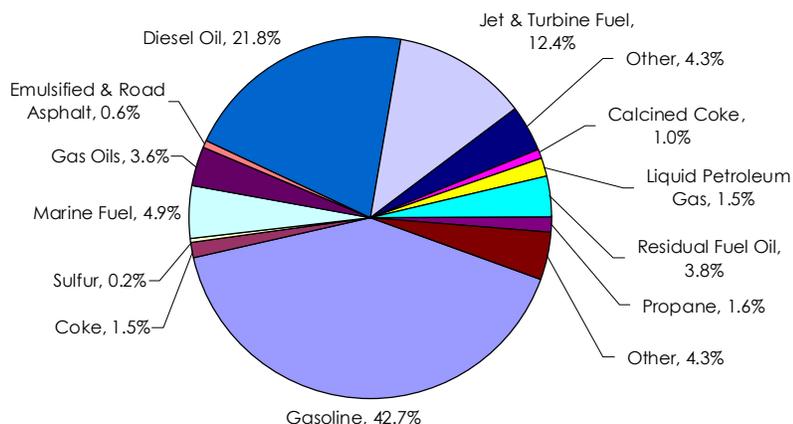
Figure 5.4 shows that motor gasoline was, by far, the largest category of product consumed, at 44.3 percent of the total.

6. REFINERY PRODUCTION IN WASHINGTON

The data that follow in Sections 6, 7, and 8, unless otherwise indicated, are the aggregated results of a survey of Washington's five major refiners (Appendix A).

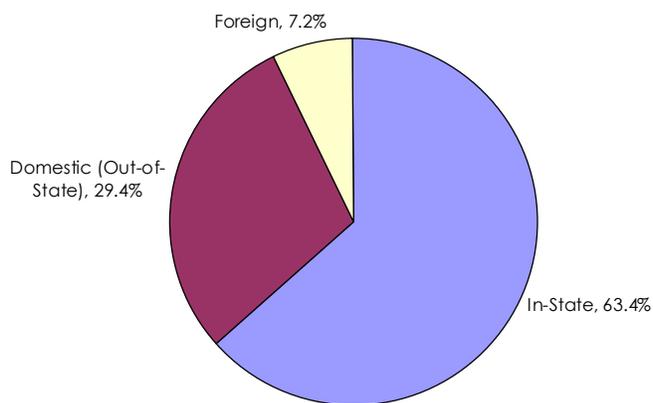
Finished products. Washington's refineries produced 608,800 barrels per day and more than a dozen different products in 2007. Gasoline, at nearly 260,200 barrels per day in 2007, is by far the largest product category, accounting for 43 percent of

Figure 6.1: 2007 Washington Production By Product



Source: 2009 Refiners Survey

Figure 6.2: 2007 Washington Production By Destination



Source: 2008 Refiners Survey

the total. Diesel oil and jet fuel are the next largest at 22 percent and 12 percent, respectively. See Figure 6.1.

Gasoline accounts for about 46 percent of the refineries' total \$19.0 billion in output value in 2007. Again, diesel oil and jet fuel are next, accounting for 25 percent and 11 percent, respectively.

More than 63 percent of Washington refined product is used within the state. In 2007, 29.4 percent of total product was sold domestically outside Washington, with the remaining 7.2 percent delivered to foreign buyers. See Figure 6.2.

Product transport. Finally, 53 percent of all products refined in Washington are shipped by pipeline, primarily to Seattle and Tacoma markets and on to Portland. Of the remaining product, 32 percent is shipped by water, mostly to Portland and other destinations along the Columbia River, with the balance (15 percent) going out by other modes of transport.

7. WASHINGTON REFINERS: INPUTS

Washington refiners spent \$12.6 billion in 2005. This section describes their main areas of expenditure.

Feedstock. Washington's petroleum refineries received nearly 595,300 barrels per day of crude oil and other feedstock inputs (e.g., butane, isobutene, and cat feed) in 2007. The total volume of feedstock fell by a scant 0.1 percent between 2006 and 2007; feedstock costs, however, grew by

11.0 percent from \$14.13 billion in 2006 to \$15.7 billion in 2007. See Table 7.1. The cost per barrel of crude explains most of this increase, as it grew by a bit more than 9 percent over the period.

Table 7.1: Quantity and Value of Feedstock Inputs

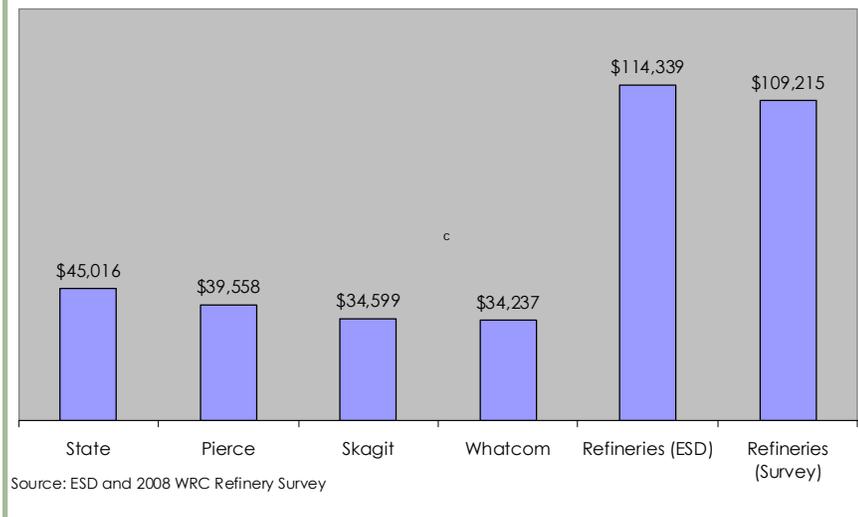
	2006	2007
Total Feedstock Inputs (thousands of barrels/day)	596.1	595.3
Crude Oil	573.1	575.0
Other	23.1	20.2
Total Value of Feedstock Inputs (millions of dollars)	14,102.8	15,652.9
Crude Oil	13,629.8	14,966.1
Other	473.1	686.8

Source: 2008 Refiners Survey

More than 80 percent of crude oil and other feedstock came into the refineries by water in 2005, mostly from Alaska's North Slope. Most of the remaining feedstock came through pipeline from Alberta, Canada.

Labor. Washington's five oil refiners employ 2,003 workers and pay them extraordinarily well. The average annual wage for all Washing-

Figure 7.1: 2007 Average Annual Wages



ton jobs in 2007 was \$45,016. According to the state Employment Security Department (ESD), average refinery pay is nearly two and one-half times the state average. By comparison, information from the refiner survey puts the 2007 average annual wage at \$109,215. (ESD reports a somewhat higher average annual wage for the refineries than our survey found.) See Figure 7.1.

This contrast is even more pronounced when comparing refining wages with average annual wages in Whatcom and Skagit counties where the four largest refineries are located. The average annual wage in Whatcom County in 2007 was \$34,237 while in Skagit County it was \$34,599 (ESD 2008). The average wage at

the four refineries in these two counties in 2007 was \$97,865.

Refinery payrolls totaled nearly \$219 million in 2007. Worker benefits totaled \$69 million, and average total compensation per employee was \$143,709.

Contract labor. Washington's petroleum refiners regularly rely on contract workers to clean and service various parts of their plant facilities and equipment, as well as to conduct scheduled major repairs and upgrades. The number of workers varies from year to year—2,391 in 2006 and 3,144 in 2007—and represents a significant part of the employment base, especially in Whatcom and Skagit counties.

In 2007 refiners paid \$356 million for contract workers, an average of \$113,360 per worker. Although this varies from year to year, about 39 percent of contract labor in 2007 (1,235) was engaged in capital repair and replacement. This cyclical work conforms to a planned schedule that is known well in advance. In 2004, Washington's five refiners reported that

they anticipated spending more than \$1.3 billion on these types of activities over the five years from 2004 to 2008. Of this total, about 29 percent, or \$393 million, would be spent on maintaining the current plant facilities. Another 26 percent—about \$349 million—would be invested in staying competitive within their industry. And 45 percent—about \$592 million—would be spent retrofitting the plants to produce cleaner burning fuels and to conform with new environmental and safety regulations.

Non-labor operating expenditures. Non-labor operating expenditures are mostly for feedstocks—crude oil—and intermediate processed crude (which will be refined further into higher grade products) and chemicals and catalysts to be applied to

Figure 7.2: 2007 Non-Labor Operating Expenditures

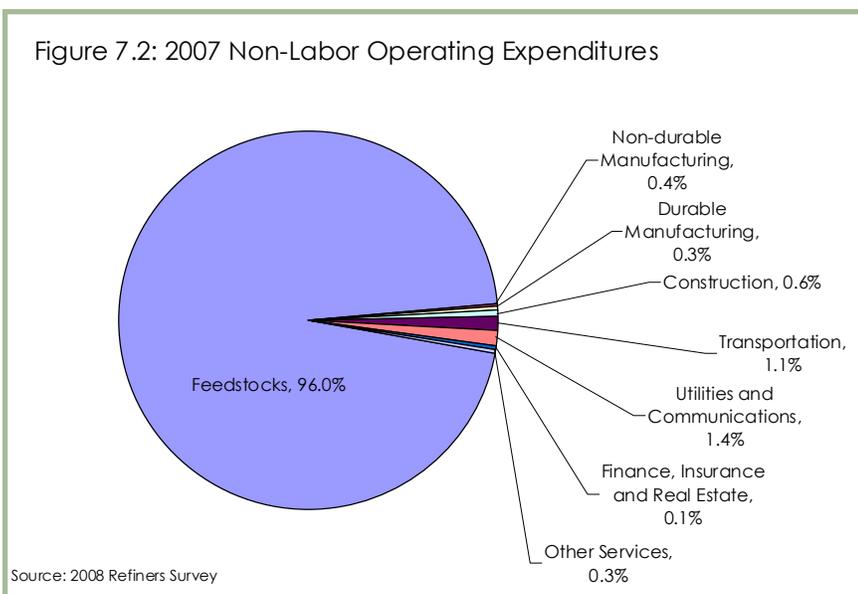


Table 7.2: Taxes Paid by Refiners in 2007
(million of dollars)

Retail sales and use tax	6.2	3.4%
Business and occupation tax	71.7	39.2%
Property tax	19.5	10.7%
Unemployment compensation tax (state only)	1.4	0.7%
Industrial insurance premium	0.2	0.1%
Hazardous substance tax	70.9	38.7%
Oil spill tax	9.1	5.0%
Motor vehicle fuel tax	0.4	0.2%
Other	3.5	1.9%
Total	182.9	

Source: 2008 Refiners Survey

the crude to produce various final products. These purchases show up in two categories: feedstocks and non-durable manufactured goods (primarily intermediate petroleum products and chemicals). Combined, these two categories account for about 96 percent of all non-labor operating expenditures.

Significant amounts are also spent on utilities and transportation, which together account for \$420 million in 2007. Utilities expenditures, including electricity, gasoline, and communications, totaled \$236 million in 2007, and transportation totaled \$184 million. Transportation expenditures

were primarily for waterborne transport of inbound and outbound product (Appendix A, Table 3).

Taxes. The five refiners contributed \$182.9 million in state and local taxes in 2005. The business and occupation tax captured the largest share of total taxes paid—\$71.7 million, more than 39 percent. See Table 7.2. Refineries are subject to this tax under either the manufacturing or wholesaling categories, at the rate of 0.484 percent.

Ranking second was the state hazardous substance tax, \$70.9 million, just shy of 39 percent of the total. The rate on this tax is 0.7 percent of wholesale value. Petroleum products constitute a large portion of the products subject to the tax.

Next in line was the property tax, \$19.5 million and 11 percent of the total tax bill.

The fourth most costly tax in 2007 was the oil spill tax at \$9.1 million and 5 percent of the total. The oil spill tax is one of several taxes unique to the petroleum refining industry. It is a tax of 5 cents per barrel on crude oil or petroleum products that are transported by ship or barge in Washington waters and offloaded at an in-state marine terminal. Of the proceeds, 4 cents are paid into the oil spill administration account and 1 cent into the oil spill response account. When (as is currently the case) the oil spill response account is fully funded the 1 cent tax is suspended; when the account is short of funds, the tax is resumed.

Table 7.3: Regulatory Fees Paid by Refiners in 2005
(dollars)

Air operating registration and permit fees	1,241,937	14.6%
Waste disposal fees	1,661,360	19.5%
Wastewater discharge fees	545,349	6.4%
Building permit fees	120,000	1.4%
Other	4,937,800	58.0%
Total	8,506,446	

Source: 2008 Refiners Survey

Similarly, the petroleum products tax revenues are dedicated to fund the pollution liability insurance program, which assists owners of underground storage tanks in obtaining insurance for upgrading and replacing tanks and preventing leaks. This tax is only collected when the pollution liability insurance program account balance is below a trigger value and is not currently being collected.

The refineries reported paying \$6.2

million in sales and use taxes. Currently the sales and use tax rate paid by the two Skagit County refineries is 8.2 percent; the rate paid by the two Whatcom County Refineries is 8.5 percent; and the rate paid by the Tacoma refinery is 9.3 percent.

Fees. In addition, the refiners paid \$8.5 million in regulatory fees in 2007. These included their air operating registration and permit fees (\$1.2 million, 15 percent), waste disposal fees (\$1.6 million, 20 percent), and wastewater discharge fees (\$545,000, 7 percent). See Table 7.3.

Table 8.1: Taxes on a 160,000 Barrels Per Day Refinery
(millions of dollars)

	Washington	California
Corporate Profits Tax		\$ 18.1
Business & Occupation Tax	\$ 24.5	
Hazardous Substance Tax	\$ 28.4	
Property Tax	\$ 6.5	\$ 9.4
Sales & Use Tax	\$ 1.7	\$ 1.7
Oil Spill Tax	\$ 2.3	\$ 2.9
	\$ 63.5	\$ 32.1

8. COMPARISON WITH TAXATION OF CALIFORNIA REFINERY TAXATION

Table 8.1 compares the taxation of hypothetical 160,000 barrels-per-day refineries in Washington and California. These calculations are based in part on financial information revenue and cost data from the Energy Information Agency’s Financial Reporting System (EIA 2008, Table T 19).

We focus on six major taxes. One of these taxes—the corporate income tax—is levied

in California but not in Washington. Two of these taxes—the business and occupation tax and the hazardous substance tax—are levied in Washington but not in California. The remaining three taxes—the sales and use tax, the property tax and the oil spill tax—are levied in both states.

The overall tax burden in Washington, \$63.5 million, is about twice as high as that in California, \$32.1 million. This is largely due to the fact that the Washington refinery pays considerably more in B&O and hazardous substance taxes than the California refinery pays in corporate income tax.

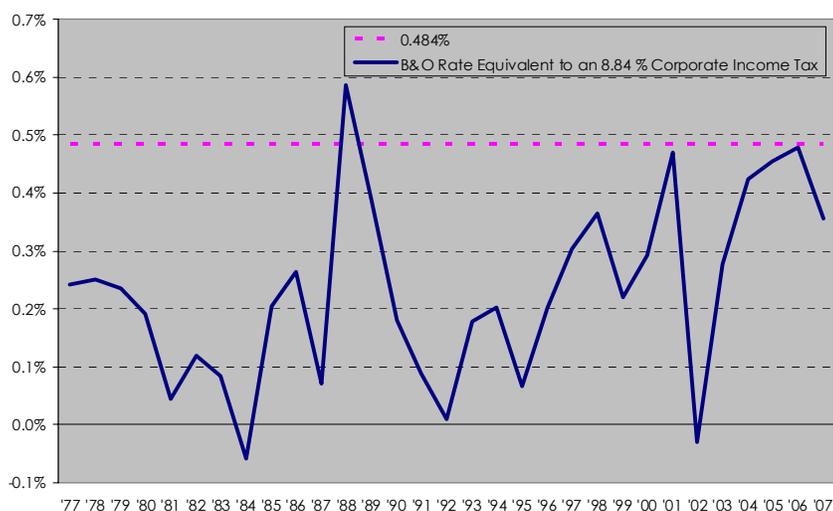
Corporate income tax. California’s primary business tax is a corporate income tax. To avoid the complications inherent in state-level income taxation of multi-state businesses, we assume that the corporation owning the refinery does business only in California. California’s corporate income tax rate is 8.84 percent. Based on EIA data for 2007, we estimate the taxable income for a 160,000 barrels-per-day refinery to be \$204.7 million and the corporate income tax due to be \$18.1 million.

B&O tax. The B&O tax is Washington’s primary business tax. It is a tax on a business’s gross receipts. Our 160,000 barrel per day refinery has refined product sales of \$5,069 million. This results in a B&O tax obligation of \$24.5 million at the manufacturing/wholesaling rate of 0.484 percent. This is 36 percent more than the corresponding obligation under the California income tax.

The B&O tax is a tax on gross income, without any deductions for the costs of producing the goods or services sold, while the corporate income tax is a tax on net income, after deduction of these costs. The B&O tax tends to be burdensome (compared to a corporate income tax) on low margin businesses. Refining is a low margin business. The EIA data show that over the period 1977–2007 the margin on refined products averaged less than 4 percent of revenues.

For each year 1977–2007 we have calculated the B&O tax rate that would generate the same tax obligation for our 160,000 barrel refinery as gener-

Figure 8.1: B&O Rate Equivalent to 8.84% Corporate Income Tax



ated by the 8.84 percent California corporate income tax. These rates are graphed on Figure 8.1. As can be seen, the revenue-equivalent B&O rate varies considerably from year to year as the profitability of the industry varies. For two years (1984 and 2002) the refinery actually loses money and the equivalent B&O rate is negative. For only one year (1988) is the refinery so profitable that the California corporate income tax would raise more revenue than the 0.484 percent B&O. Over the 31 years the average revenue-equivalent B&O rate is 0.23 percent, a bit less than one-half the 0.484 percent that Washington refineries pay.

Hazardous substance tax. Returning to taxes listed in Figure 8.1, the hazardous substance tax is a second gross receipts tax levied by Washington state. Applying an effective rate of 0.56 percent to gross receipts of \$5,069 gives a \$28.4 million hazardous substance tax obligation for the 160,000 barrel per day Washington refinery. (Based on our survey, we use the 0.56 percent effective rate rather than the statutory 0.7 percent rate to account for various deductions and credits including the credit for product shipped out-of-state in vehicle fuel tanks.)

Property tax. Comparing property tax burdens is complicated by the variation of effective property tax rates from location to location, due to variations in assessment practices and statutory tax rates. The most careful studies of effective property tax rates are those conducted by the Massachusetts Taxpayers Association (MTA), which compare rates for the largest city in each state. For 2007, MTA calculates the effective tax rates to be 0.818 percent for Seattle and 1.175 percent for Los Angeles. We estimate the taxable value of a 160,000 barrel per day refinery to be \$800 million. The property tax burdens are thus \$6.5 million for the Washington refinery and \$9.4 million for the California refinery.

Sales and use tax. In Washington, the state sales and use tax rate is 6.5 percent; local rates vary from 0.5 percent to 3.0 percent. On April 1, the California state sales tax rate was increased temporarily from 6.25 to 7.25 percent. Local rates in California vary from 1.0 percent to 4.0 percent. Our calculations use the 2007 rates for Ferndale, Washington and Long Beach, California (8.4 percent and 8.25 percent, respectively). We estimate the value of transactions subject to sales and use tax to be \$20 million. The Washington sales and use tax burden is thus \$1.68 million, while the California burden is \$1.65 million.

Oil spill tax. Both states impose an oil spill tax of 5 cents per barrel. As we noted above, in Washington, 1 cent of the 5 cents is currently suspended. We assume that for both refineries, 58.4 million barrels are subject to the tax. The oil spill tax burden is \$2.3 million in Washington and \$2.9 million in California.

9. PETROLEUM REFINING INDUSTRY: INDIRECT AND INDUCED ECONOMIC IMPACTS

The economic impact of refineries on the state's economy can be divided into three primary categories: direct, indirect, and induced effects:

- The **direct** effects are those in the industry itself—the refinery jobs and payroll, and the taxes paid by the refiners.
- The **indirect** economic effects include the jobs, wages, and taxes of upstream suppliers of the refineries—not only the suppliers of crude oil, but also the construction companies and contract workers used for plant maintenance and repair and the office product and equipment suppliers, for example. These figures were captured in the survey completed by the five refiners. The indirect economic effects also include the jobs, wages, and taxes of suppliers’ suppliers; of the suppliers’ suppliers’ suppliers; and so on up the supply chain.
- Finally, the **induced** effects are the jobs, income, and taxes contributed by firms in industries that supply daily consumables and services—e.g., food, dry cleaning, banking—to workers holding the direct and indirect jobs.

The relationship between the direct jobs, income, and tax effects in an industry and their indirect and induced effects are captured by multipliers, which are calculated using the WRC-REMI model of the Washington State economy.

The employment multiplier for the petroleum refining industry is 10.16. Applying this multiplier to the 2,003 direct refinery jobs in 2007 gives a total state employment impact of 20,350 jobs.

This is an unusually large employment multiplier. In comparison, the 2002 Washington State Input-Output Study (2008) calculates that the employment multiplier for manufacturing/construction overall is 2.52. Part of this difference arises because the WRC-REMI is more comprehensive than the simple input-output model. Foremost among the impact channels omitted from the simple input-output model are immigration and investment. When we run the WRC-REMI model with these channels turned off, the employment multiplier for petroleum refining is only 7.12. This is actually less than the 9.56 multiplier that the Washington Input-Output Model gives for petroleum and coal products manufacturing (the “three-digit” sub-sector of manufacturing that contains the petroleum refining industry).

Several additional factors contribute to the industry's large multiplier. First, petroleum refiners pay high wages. As a result, the employment induced by refinery employee spending is relatively great. Second, the petroleum industry ranks high in the ratio of in-state supplied intermediate inputs (including contract labor) to employee income. For this reason, indirect employment is relatively high. And some of these indirect jobs (contract labor, in particular) pay unusually high wages.

The WRC-REMI model calculates that each refining job results in an additional \$507,275 of state personal income. At 2007 employment levels, the industry adds \$1,016,071,600 to state personal income.

In 2007 state and local sales and use taxes averaged \$0.03900 for each dollar of state personal income. With the income multiplier of \$507,275, each petroleum refining job results in \$16,683 in state and local sales taxes or a total of \$39,416,800.

The refiners directly paid \$71.7 million in B&O taxes in 2007. In 2007 state B&O taxes averaged \$0.01112 for each dollar of personal income. Multiplying this rate into \$728.2 million—the increase in state personal

Figure 10.1: Covered Employment and Wages by Industry, 2007

Industry (NAICS Code)	Firms	Wages Paid	Average Employment	Average Annual Wage
Petroleum Bulk Stations and Terminals (424710)	18	\$33,069,068	614	\$53,858
Other Petroleum Merchant Wholesalers (424720)	77	\$61,853,067	1,379	\$44,854
Gasoline Stations With Convenience Store (447110)	1,322	\$206,684,857	12,538	\$16,485
Other Gasoline Stations (447190)	108	\$30,875,504	1,260	\$24,504
Heating Oil Dealers (454311)	40	\$34,954,055	766	\$45,632
LPG and Bottled Gas Dealers (454312)	19	\$23,018,844	548	\$42,005
Other Fuel Dealers (454319)	9	\$830,849	44	\$18,883
Pipeline Transportation (486)	7	\$15,571,352	177	\$87,974

Source: ESD

income we ascribe to the 2,003 refinery jobs net of the wages and benefits of the refinery workers—gives \$8.1 million additional induced and indirect B&O tax revenue, for a total of \$79.8 million, or \$39,854 per direct job.

10. WASHINGTON PETROLEUM INDUSTRY: DOWNSTREAM ACTIVITIES

Washington's petroleum refiners rely on a number of industries to distribute their product to consumers. These include transportation (pipelines, barges, trucks, and rail) and transportation support facilities (terminals, stockyards, and bulk stations), wholesalers, and retailers (gasoline stations and fuel oil dealers).

These downstream industries exist as a result of petroleum product consumption in our economy, not as a result of petroleum refining. Presumably, if the refineries were gone or if they had never existed in Washington, finished petroleum products would be imported to terminal and stockyard facilities, transported to retail destinations within the state, and sold to consumers through systems much like those that currently exist, together with similar job, wage, and tax effects. Even so, their direct economic contribution is substantial and their role in the larger petroleum industry is crucial. This section describes the employment, wages, and taxes associated with these industries.

Of the total finished products produced by Washington's refineries, 53 percent leaves through pipeline to markets in Seattle and Tacoma and beyond. Another 32 percent goes by water to Seattle and Portland, with the remaining 15 percent of product shipped by rail or truck. About 65 percent of the value of this product—\$12.3 billion in 2007—is delivered to retailers for consumer sales within the state of Washington (Appendix A).

Jobs and wages. According to detailed data reported to the state ESD for 2007, the most recent year for which such data are available, there were about 1,600 employers in these downstream industries. Together, they paid \$407 million in wages to 17,326 workers. These are all workers covered by ESD's unemployment insurance program for these industries, so the number includes both full-time and part-time workers. Table 10.1 shows these data for each industrial classification with their corresponding North American Industrial Classification System (NAICS) codes.

Among the downstream industries there are three broad tiers of employment and pay:

Figure 10.2: Taxable Income and Taxes Due by Industry
(millions of dollars)

Industry (NAICS Code)	Gross	Taxable	B&O Tax	Other Excise	Total
Petroleum Products Wholesaling (4247)	12,854.8	11,803.8	57.1	26.5	83.7
Gasoline Stations (4471)	9,878.3	8,308.2	40.0	93.7	133.7
Fuel Dealers (45431)	727.2	673.6	3.2	24.2	27.4
Pipeline Transportation (486)	31.4	D	D	D	D

Source: DOR

D: Not disclosed

- Pipeline transport employs a few highly paid workers—177 workers make about \$88,000 per year on average.
- Bulk stations and terminals, wholesalers, and fuel oil dealers employ about 3,351 workers and pay an average of more than \$45,800 per worker per year.
- Gasoline stations generate a large wage bill with a lot of lower-wage and part-time jobs. In 2007, this industry's 1,430 employers paid total wages of \$237.6 million to 13,796 workers.

Taxes. The state DOR reports excise tax data on these same industries (2008). As shown in Table 10.2, total excise taxes due from the downstream industries totaled \$244.8 million in 2007.

Gasoline stations paid nearly \$133.7 million in excise taxes or about 55 percent of the total industry excise taxes paid (excluding refining). Wholesalers (34 percent), and fuel oil dealers (11 percent) made up the remainder.

APPENDIX A: RESULTS FROM THE 2008 SURVEY OF WASHINGTON REFINERS

	2006	2007
Total Feedstock Inputs (thousands of barrels per day)	596.14	595.27
Crude Oil	573.07	575.04
Other	23.08	20.22
Total Value of Inputs (thousands of dollars)	14,102,824	15,652,919
Crude Oil	13,629,769	14,966,115
Other	473,055	686,803
Total Product Output (thousands of barrels per day)	611.10	608.80
Gasoline	274.18	260.18
Diesel oil	131.29	132.82
Jet and turbine fuel	67.69	75.33
Calcined coke	6.40	6.00
Liquid petroleum gas (LPG)	10.57	9.20
Residual fuel oil	22.99	23.10
Propane	9.30	9.64
Coke	6.08	8.87
Sulfur	1.04	1.22
Marine fuel	27.85	30.03
Gas oils	26.31	22.10
Emulsified & road asphalt	4.04	3.96
Other	23.36	26.37
Total Value of Output (thousands of dollars)	17,461,300	18,957,086
Gasoline	8,412,693	8,759,004
Diesel oil	4,526,130	4,832,695
Jet and turbine fuel	1,762,561	2,157,007
Calcined coke	134,815	126,396
Liquid petroleum gas (LPG)	152,269	176,605
Residual fuel oil	417,519	26,389
Propane	148,552	749,421
Coke	127,479	146,602
Sulfur	496	2,050
Marine fuel	737,085	867,052
Gas oils	590,574	532,473
Emulsified & road asphalt	96,302	80,393
Other	354,826	500,998

**Table A-2: Mode of Transport and Destination in 2007
(thousands of barrels per day)**

Mode of Transport	Pipeline	Waterborne	Other
Inputs			
Crude Oil	107.70	468.13	-
Other	1.41	11.30	7.51
Outputs			
Gasoline	166.50	70.88	20.60
Diesel oil	86.39	33.55	12.29
Jet and turbine fuel	46.94	27.43	1.00
Calcined coke	-	-	6.00
Liquid petroleum gas (LPG)	-	-	9.24
Residual fuel oil	19.80	3.92	-
Propane	-	-	9.63
Coke	-	3.93	4.94
Sulfur	-	-	1.25
Marine fuel	-	30.11	-
Gas oils	-	23.35	-
Emulsified & road asphalt	-	-	3.87
Other	1.82	3.75	21.29
Destination of Output			
	In-State	Domestic Out-of-State	Foreign Out-of-State
Gasoline	157.96	98.87	1.15
Diesel oil	96.75	33.76	1.72
Jet and turbine fuel	48.24	17.05	10.08
Calcined coke	0.40	-	5.60
Liquid petroleum gas (LPG)	7.28	1.97	-
Residual fuel oil	12.20	0.26	11.27
Propane	8.64	0.20	0.79
Coke	2.98	-	5.88
Sulfur	0.98	0.28	-
Marine fuel	19.04	8.42	2.64
Gas oils	4.01	14.68	4.67
Emulsified & road asphalt	3.87	-	-
Other	23.30	3.56	-

Table A-3: Operating and Capital Expenditures

	2006	2007
Employment and Contract Labor		
Total (thousands of dollars)	562,250	644,237
Total payroll (thousands of dollars)	190,508	218,757
Total employee benefits (e.g. health, pension, social security, etc.)	63,505	69,093
Total on-site employment (number of FTE employees)	1,825	2,003
Total Contract Labor Cost (thousands of dollars)	308,237	356,387
Service and maintenance	134,151	183,172
Capital repair and replacement	174,087	173,215
Total Contract Labor (number of FTE workers)	2,777	3,144
Service and maintenance	1,423	1,909
Capital repair and replacement	1,354	1,235
Operating Expenditures Other Than Labor or Feedstock (thousands of dollars)		
TOTAL	545,626	699,978
Non-durable Manufacturing	55,228	57,380
Petroleum products	14,861	15,013
Durable Manufacturing	48,432	55,806
Construction	27,446	96,059
Transportation	153,183	184,407
Rail	15,078	17,084
Trucking	6,115	6,621
Automobiles	-	-
Waterborne	135,118	165,094
Air	11,950	12,693
Utilities and Communications	205,528	235,723
Electricity	85,390	94,325
Gas	120,138	141,398
Finance, Insurance and Real Estate	14,847	16,886
Business Services	33,878	44,648
Other Services	7,084	9,069
Capital Expenditures Other Than Labor (thousands of dollars)		
Total	172,688	168,246
Equipment	100,342	115,683
Materials and Supplies	72,346	52,563

Table A-4: Taxes and Fees (thousands of dollars)

	2006	2007
Taxes	166,693	182,934
Retail sales and use tax	4,067	6,207
Business and occupations tax	76,117	71,733
Property tax	16,435	19,544
Unemployment compensation tax (state only)	1,299	1,352
Industrial insurance premium	160	160
Hazardous substance tax	58,396	70,859
Oil spill tax	7,577	9,121
Petroleum products tax	-	-
Motor vehicle fuel tax	250	409
Special fuel tax	-	-
Other	2,391	3,549
Regulatory Fees	6,990	8,506
Air operating registration and permit fees	1,164	1,242
Waste disposal fees	1,566	1,661
Wastewater discharge fees	533	545
Building inspection fees	-	-
Building permit fees	80	120
Other	3,648	4,938

Table A-5: Other

	2004	2005
TOTAL Food Services (thousands of dollars)	1,427	1,399
Associated with contract labor	1,075	889
Associated with business visitors	352	510
TOTAL Hotel and Motels (thousands of dollars)	1,490	3,150
Associated with contract labor	895	2,430
Associated with business visitors	595	720
TOTAL Other Trade and Services (thousands of dollars)	265	265
Associated with contract labor	125	125
Associated with business visitors	140	140
TOTAL Charitable Contributions (thousands of dollars)	1,288	1,944
Corporate	1,019	1,681
Firm-sponsored employee giving	269	263
Estimated visitors from outside Washington	4,975	3,485

APPENDIX B: ABOUT THE WRC-REMI MODEL

The Washington Research Council uses a model of the Washington State economy constructed especially for WRC by Regional Economic Models, Inc. Because it allows supply and demand to respond to changes in prices and wages, and permits substitution among factors of production, the WRC-REMI model is more elaborate than the standard input-output models commonly employed to estimate regional economic impacts (Treyz 1993).

The core of the standard input-output model is a catalog of interindustry purchases for the region in a base year, arrayed in an input/output matrix. The model assumes that as a specific industry's production increases or decreases, its purchases from the region's other industries will change proportionately. Likewise, the industry's employment will change by the same proportion that its output changes.

Based on these assumptions, the model traces the cascading effects as one industry's increase in output stimulates an increase in the output of other industries (and its own). These effects are distilled in multipliers that measure how a change in the demand for the output of one industry will affect the total output of the local economy, or how a change in the employment of one industry will affect the total output of the local economy (Chase, Bork, and Conway 1993).

But the standard input-output model is incomplete. It fails to model the numerous capacity constraints within the economy, the processes that set prices for goods and services and the responses of consumers and producers to changes in these prices. In the input-output model, industry and labor supply are perfectly elastic—so prices and wage rates do not matter.

Prices and wages do matter in the WRC-REMI model. The model divides the state into two subregions: the four central Puget Sound counties (King, Kitsap, Pierce, and Snohomish) and the balance of the state. There are 53 industrial sectors within each subregion. Within each subregion the model tracks interindustry transactions, much as an input output model would.

Unlike an input-output model, however, the WRC-REMI model incorporates a number of significant behavioral responses to changes in prices and costs: The wage rate depends on the supply and demand for labor, migration and labor force participation rates respond to changes in wage rates, and consumer purchases of specific goods and services respond to changes in relative prices and personal income. In addition, producers substitute among production factors in response to changes in relative factor costs, market shares respond to changes in regional production costs, and investment rises in response to increases in output.

This report uses version 9.5 of the WRC-REMI model. Our previous analyses used version 5.5. (WRC 2004) and version 8.0.

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