



THE ECONOMIC CONTRIBUTION OF WASHINGTON STATE'S PETROLEUM REFINING INDUSTRY IN 2005

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 2005.

In 2005, the refiners directly provided 1,767 full-time jobs, paying an annual average wage of nearly \$80,000. In addition, the refiners employed, at comparable wages, 1,676 contract workers on an average day, doing maintenance, and capital repair and replacement. The refiners created additional Washington state jobs in industries from which they purchased good 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 16,000 jobs and three-quarters of a billion dollars in personal income for Washington State in 2005. From this activity, the state received \$27.8 million in sales taxes and \$46.5 million in business and occupation tax.

Additionally, downstream industries, which distributed refined petroleum products, paid \$375 million in wages to 17,755 workers in 2005. Excise taxes collected by the state from these industries came to nearly \$169 million.

The report updates the economic impact analysis of petroleum refining for 2003 previously prepared by the Washington Research Council (WRC 2004), drawing upon surveys of Washington refiners conducted by the Council in 2004 and 2006 (Appendix A) and version 8.0 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 2005 they processed nearly 553,900 barrels of crude oil per day, producing 263,000 barrels of gasoline per day. Gasoline, diesel oil, and jet fuel are the largest finished product categories, representing 46 percent, 23 percent, and 13 percent, respectively, of total production.



According to the refiners survey, the five major refineries employed 1,767 workers in 2005, paying them an average annual wage of \$79,402, about twice the Washington State average.

Figure 2.1: Summary of Multipliers and Economic Impacts

Refining Jobs	Multiplier	Indirect and Induced Economic Effect	Major Petroleum Refiners Total Economic Impact
1,767	9.23	14,542 jobs	16,309 jobs
	\$425,900	\$550,039,300 personal income	\$752,565,300 personal income
	\$15,733	\$20,318,985 retail sales and use taxes	\$27,800,604 retail sales and use taxes
	\$26,340	\$10,612,000 B&O taxes	\$46,542,000 B&O taxes

Source: WRC/REMIModel

As illustrated in Figure 2.1, these jobs have a total employment multiplier of 9.23, meaning that each direct refining job generates an additional 8.23 jobs in the state, for a total employment effect of 16,309 jobs resulting from the five refineries.

Petroleum refining's extraordinarily capital in-

tensivity 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 \$425,900 of state personal income, a total income contribution of more than \$750 million to the state economy.

The industry is also highly taxed and regulated, producing a source of tax and fee revenues for state and local government. The five refiners paid \$175.9 million in state and local taxes in 2005 (Appendix A, Table A-4).

Each direct refining job results in \$15,733 in sales and use collections and \$26,340 in business and occupation (B&O) tax revenues, for a total of \$74.3 million in sales and use taxes and B&O receipts. In addition, the refiners paid \$17.18 million in property taxes in 2005 and \$3.3 million in regulatory fees (Appendix A, Table A-4).

Petroleum refineries have an excellent worker safety rating. In 2005 refineries nationally averaged just 1.4 injuries or illnesses per 100 full-time workers. This low rate compares quite favorably with injury/illness rates of 4.6/100 for private industry overall and 6.3/100 for manufacturing (BLS 2006).

Figure 2.2: Nonfatal Occupational Injuries and Illnesses Per 100 Full-Time Employees 2005

	Total Recordable Cases	Recordable Cases Requiring:		Other Recordable Cases
		Days Away from Work	Job Transfer or Restriction	
Private Industry	4.6	1.4	1.0	2.2
Goods Producing	6.2	1.8	1.6	2.8
Natural Resources and Mining	5.1	1.8	1.0	2.2
Construction	6.3	2.4	1.0	2.9
Manufacturing	6.3	1.5	2.0	2.8
Petroleum Refining	1.4	0.4	0.2	0.7
Service Producing	4.1	1.2	0.9	2.0

Source: BLS

Finally, refiners contribute generously to the communities in which they are located. The five refiners and their employees contributed \$761,000 to various community causes in 2005. The firms themselves contributed about 77 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 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.

Table 3.1: Washington's Refineries

Firm	Year Constructed	Location	Major Products	Capacity (barrels per day)
BP Cherry Point (formerly ARCO)	1971	Whatcom County, northwest of Ferndale	gasoline, diesel oil, jet fuel, calcinated coke	232,000
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	102,800
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	121,000
U.S. Oil	1957	Pierce County, Tacoma Tideflats	gasoline, diesel oil, jet fuel, marine fuel, gas oils, emulsified & road asphalt	39,000

Source: 2006 Refiners Survey; EIA

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 Midwest distribution systems.

Today, Washington's five refineries make up 3.6 percent of the nation's total refining capacity (EIA 2006a, Table 1). With this state accounting for 2.0 percent of national petroleum consumption, in-state refineries produce quantities more than sufficient for Washington's needs (EIA 2006b).



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 152 plant closures since 1982; the remaining 149 refineries are more efficient, with nearly as much total refining capacity as was available in 1982. However, the increased demands of a growing population and economy and an increasing array of “boutique” fuels required by federal and state regulations strain current capacities, and the price effects are being felt throughout the country.

This increasingly 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

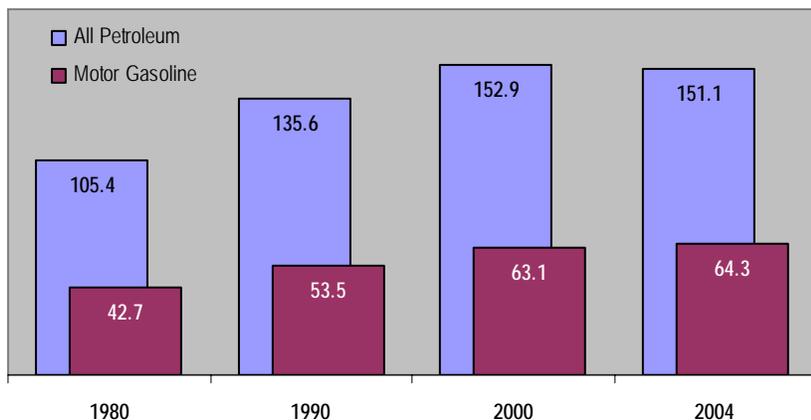
To quantify the impact of Washington State's refineries on its economy, we use the WRC-REMI model to simulate a permanent decrease in refinery employment of roughly 25 percent and measure the resulting changes in total state employment, personal income, and gross product. Dividing these resulting changes 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 2005 the five refineries had 1,767 employees. With a multiplier of 9.23, the total impact of the refineries was 16,309 jobs. Similarly, the refinery activities resulted in \$425,900 of state personal income for every direct job, or a total statewide of \$752,565,300 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

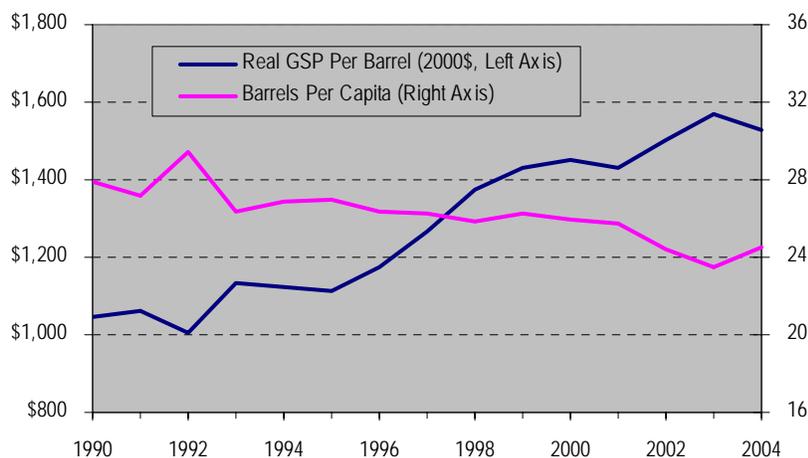


Figure 5.1: Petroleum Consumption in Washington (millions of barrels)



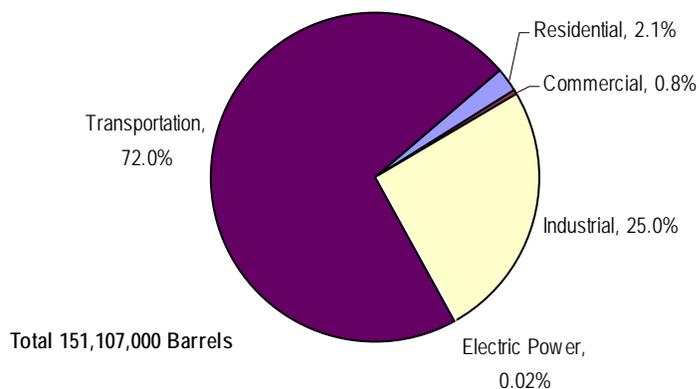
Source: EIA

Figure 5.2: Per Capita Petroleum Consumption Has Declined in Washington



Source: EIA; BEA

Figure 5.3: Consumption by Customer Class, 2004



Source: EIA

(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.

Finally, in Sections 8 and 9 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

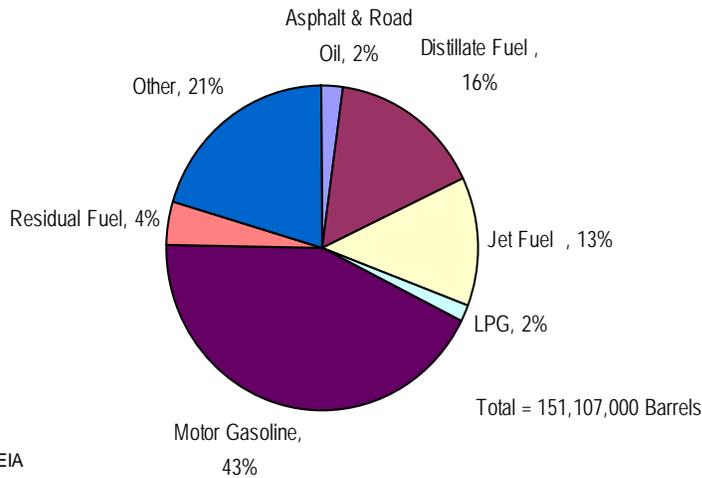
Washington households and businesses consumed more than 151 million barrels of finished petroleum products in 2004, up 43 percent from 1980, according to the Energy Information Administration (2006b, 2006c). See Figure 5.1. Washington's 2004 consumption was about 2 percent of the U.S. total and about 14 percent of EIA's western Petroleum Administration for Defense (PAD) District V, which encompasses Washington, Oregon, California, Nevada, Alaska, and Hawaii. PAD District V represented 14 percent of total U.S. consumption in 2004.

As a result of increasing fuel efficiency, per-capita petroleum product consumption in Washington declined from 1990 to 2004, while gross state product per barrel of petroleum increased by 46 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



Figure 5.4: Washington Petroleum Consumption by Product 2004



products over the fourteen-year period by 6 percent and 50 percent, respectively (EIA 2006b, 2006c).

Transportation and industrial customers, on the other hand, increased their consumption—7 percent and 34 percent, respectively—over the period. As shown in Figure 5.2, by 2004 transportation and industrial customers together account for 97 percent of total petroleum product consumption in Washington State.

The state economy (as measured by real state personal income) 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 5.4 shows that motor gasoline was, by far, the largest category of product consumed, at 43 percent of the total.

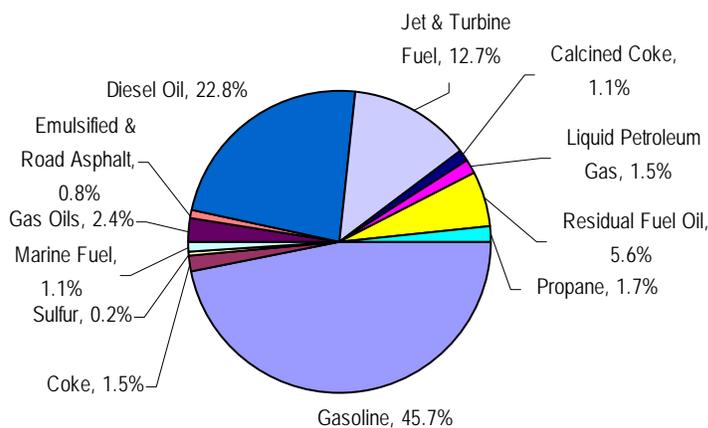
6. REFINERY PRODUCTION IN WASHINGTON

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 575,500 barrels per day and more than a dozen different products in 2005. Gasoline, at nearly 263,000 barrels per day in 2005, is by far the largest product category, accounting for 46 percent of the total. Diesel oil and jet fuel are the next largest

at 23 percent and 14 percent, respectively. See Figure 6.1.

Figure 6.1: Product Refined in Washington by Volume, 2005

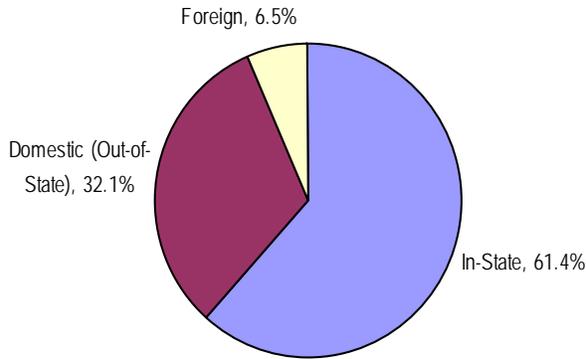


Gasoline accounts for about 51 percent of the refineries' total \$13.2 billion in output value in 2005. Again, diesel oil and jet fuel are next, accounting for 27 percent and 14 percent, respectively.

More than 61 percent of Washington refined product is used within the state. In 2005, 32 percent of total product was sold domestically outside Washington, with the remaining 6.5 percent delivered to foreign buyers. See Figure 6.2.



Figure 6.2: Sixty-one Percent of Shipped Product Stays in Washington



Source: 2006 Refiners Survey

Product transport. Finally, 52 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, 36 percent is shipped by water, mostly to Portland and other destinations along the Columbia River, with the balance (12 percent) going out by other modes of transport.

7. WASHINGTON REFINERS: DIRECT PURCHASES

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

Feedstock. Washington's petroleum refineries received nearly 578,200 barrels per day of crude oil and other feedstock inputs (e.g., butane, isobutene, and cat feed) in 2005. The total volume of feedstock required did not grow significantly between 2004 and 2005; feedstock costs, however, grew by more than 34 percent from \$8.3 billion in 2004 to \$11.2 billion in 2005. See Figure 7.1. The cost per barrel of crude explains most of this increase, as it grew by 34 percent over the period.

Nearly 87 percent of crude oil and other feedstock came into the refineries by tanker 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 1,767 workers and pay them extraordinarily well. According to the state Employment Security Department (ESD), average refinery pay is more than twice the state average. The average annual wage for all Washington jobs in 2005 was \$40,705. By comparison, information from the refiner survey puts the 2005 average annual wage at \$79,402. See Figure 7.2.

This contrast is even more pronounced when comparing refining wages with total average wages in Whatcom and Skagit counties where the four largest refineries are located. The average annual wage in Whatcom County in 2005 was \$31,118 while in Skagit County it was \$31,382 (ESD 2006). The average wage at the four refineries in these two counties in 2005 was \$79,310.

Figure 7.1: Quantity and Value of Feedstock Inputs

	2004	2005
Total Feedstock Inputs (thousands of barrels/day)	577.6	578.2
Crude Oil	566.8	553.9
Other	10.8	24.3
Total Value of Feedstock Inputs (millions of dollars)	8,329.9	11,200.7
Crude Oil	8,181.3	10,680.1
Other	148.6	520.6

Source: 2006 Refiners Survey

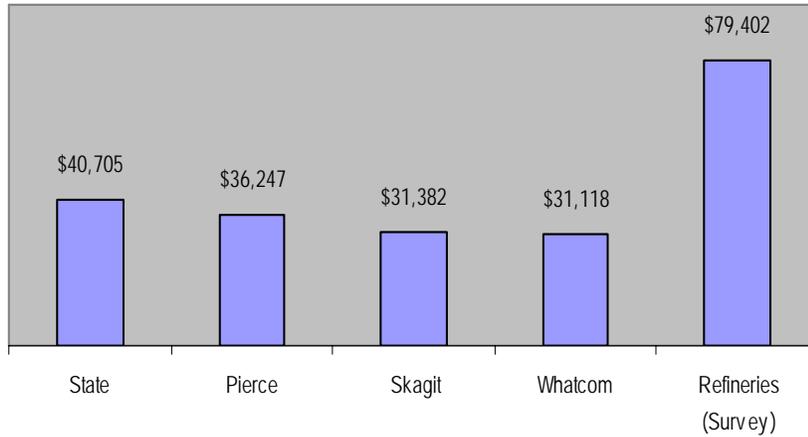
Refinery payrolls totaled over \$140 million in 2005. Worker benefits totaled \$62 million, and average compensation per employee was \$114,617.

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

Figure 7.2: 2005 Refining Wages Greatly Exceed Local and State Averages



Source: ESD and 2006 Refiners Survey

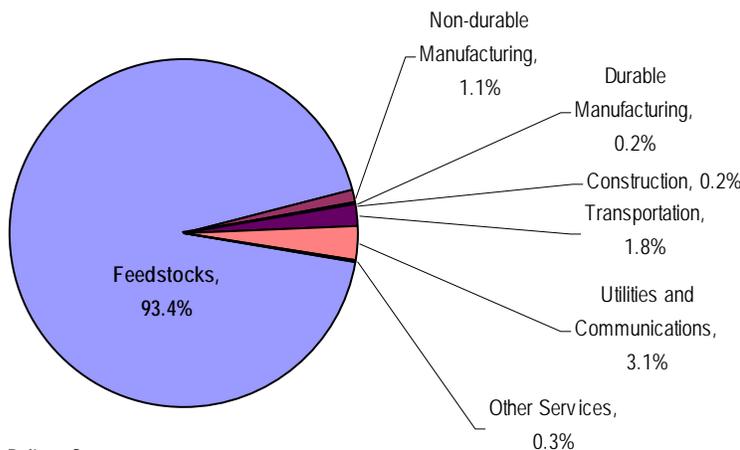
varies from year to year—1,163 in 2004 and 1,676 in 2005—but nonetheless represents a significant part of the employment base, especially in Whatcom and Skagit counties.

In 2005 refiners paid nearly \$198 million for contract workers, an average of \$117,915 per worker. Although this varies from year to year, about 71 percent of contract labor in 2005 (\$132.5 million) 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.

Nonlabor operating expenditures. Nonlabor operating expenditures are mostly for feedstocks—crude oil, intermediately processed crude (to be refined further into higher grade products), and chemicals and catalysts to be applied to the crude to produce various final products. These purchases show up in two categories: feedstocks and nondurable manufactured goods (primarily intermediate petroleum products and chemicals). Combined, these two categories account for about 95 percent of all nonlabor operating expenditures.

Figure 7.3: Feedstocks Dominate Nonlabor Operating Expenditures



Source: 2006 Refiners Survey

Significant amounts are also spent on utilities and transportation, which together account for \$587 million in 2005. Utilities expenditures, including electricity, gasoline, and communications, totaled \$370 million in 2005, and transportation totaled \$217 million. Transportation expenditures were primarily for waterborne and pipeline transport of in- and outbound product (Appendix A, Table 3).

Taxes. The five refiners contributed \$175.9 million in state and local taxes in 2005. The hazardous sub-



Figure 7.4: Taxes Paid by Refiners in 2005

(million of dollars)

Retail sales and use tax	5.0	2.8%
Business and occupations tax	35.9	20.4%
Property tax	17.1	9.7%
Unemployment compensation tax (state only)	0.5	0.3%
Industrial insurance premium	0.5	0.3%
Hazardous substance tax	68.3	38.7%
Oil spill tax	8.8	5.0%
Petroleum products tax	1.8	1.0%
Motor vehicle fuel tax	22.0	12.5%
Special fuel tax	11.0	6.2%
Other	5.4	3.1%

Source: 2006 Refiners Survey

stance tax, captured the largest share of total taxes paid—\$68.3 million, more than 39 percent. See Figure 7.4.

Ranking second was the state B&O tax, \$35.9 million, 20 percent of the total. Next in line were the motor vehicle fuel tax (\$22.0 million) and the special fuel tax (\$11.0 million). Petroleum products and oil spill taxes combine at \$10.6 million to make up most of the balance. Several of these taxes are unique to the petroleum refining industry. For example, revenues from the oil spill tax are paid into a trust fund for oil spill cleanup. When the account is fully funded the tax is suspended; when it is short, the tax is resumed. The petroleum products tax revenues are used 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.

Figure 7.5: Regulatory Fees Paid by Refiners in 2005

(dollars)

Air operating registration and permit fees	1,214,000	36.7%
Waste disposal fees	968,000	29.2%
Wastewater discharge fees	460,000	13.9%
Building inspection fees	58,000	1.8%
Building permit fees	579,000	17.5%
Other	33,000	1.0%

Source: 2006 Refiners Survey

Fees. In addition, the refiners paid another \$3.3 million in regulatory fees in 2005. These included their air operating registration and permit

fees (37 percent), waste disposal fees (29 percent), wastewater discharge fees (14 percent), and building inspection and building permit fees (19 percent). See Figure 7.5.

8. 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 9.23. Applying this multiplier to the 1,767 direct refinery jobs in 2005 gives a total state employment impact of 16,309 jobs.

This is an unusually large employment multiplier. In comparison, the Washington State Input-Output 1997 Study (2004) calculates that the employment multiplier for manufacturing overall is 2.74. Part of this difference arises because the WRC-REMI is more comprehensive than the simple input-output model. Foremost among the channels of impact 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 6.76. When we run such a WRC-REMI simulation for the larger petroleum and coal products manufacturing sector (of which petroleum refining is a sub-sector) the employment multiplier is 4.95. This is nearly identical to the 4.86 multiplier that the Washington Input-Output Model gives for petroleum and coal products manufacturing.

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 \$425,900 of state personal income. At 2005 employment levels, the industry adds three-quarters of a billion dollars—\$752,565,300—to state personal income.

In 2005 state and local sales and use taxes averaged \$0.03694 for each dollar of state personal income. With the income multiplier of \$425,900, each petroleum refining job results in \$15,733 in state and local sales taxes or a total of \$27,800,604.

The refiners directly paid \$35.9 million in B&O taxes in 2005. Based on data developed by the Washington State Tax Structure Study Committee (2002), we calculate that the average effective B&O tax rate across industries is 1.03 percent, accounting for “pyramiding.” Applying this rate to refiners purchases of contract labor, nonlabor and non feedstock operating expenditures, and capital expenditures gives a figure of \$10.6 million for the B&O taxes imbedded in the refiners’ payments to suppliers. Total



B&O taxes generated by petroleum refining in 2005, then, were \$46.5 million or \$26,340 per direct job.

9. 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.

Table 9.1: Covered Employment and Wages by Industry, 2005

Industry (NAICS Code)	Firms	Wages Paid	Average Employment	Average Annual Wage
Petroleum Bulk Stations and Terminals (424710)	21	\$24,390,657	497	\$ 49,076
Other Petroleum Merchant Wholesalers (424720)	83	\$50,922,472	1,254	\$ 40,608
Gasoline Stations With Convenience Store (447110)	1,323	\$203,267,005	13,160	\$ 15,446
Other Gasoline Stations (447190)	135	\$28,942,845	1,387	\$ 20,867
Heating Oil Dealers (454311)	42	\$29,184,647	692	\$ 42,174
LPG and Bottled Gas Dealers (454312)	19	\$20,881,083	542	\$ 38,526
Other Fuel Dealers (454319)	14	\$767,907	46	\$ 16,694
Pipeline Transportation (486)	8	\$16,161,849	177	\$ 91,310

Source: ESD

Of the total finished products produced by Washington's refineries, 52 percent leaves through pipeline to markets in Seattle and Tacoma and beyond. Another 36 percent goes by water to Seattle and Portland, with the remaining 12 percent of product shipped by rail or truck. About 61 percent of the value of this product—\$8.1 billion in 2005—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 2005, the most recent year for which such data are available, there were about 1,645 employers in these downstream industries. Together, they paid \$375 million in wages to 17,755 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 9.1 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:

- Pipeline transport employs a few highly paid workers—177 workers make more than \$91,000 per year on average.



- Bulk stations and terminals, wholesalers, and fuel oil dealers employ about 3,031 workers and pay an average of more than \$41,600 per worker per year.
- Gasoline stations generate a large wage bill with a lot of lower-wage and part-time jobs. In 2005, this industry's 1,458 employers paid total wages of \$232 million to 14,574 workers.

Taxes. The state DOR reports excise tax data on these same industries (2004c). As shown in Table 9.2, total excise taxes due from the downstream industries totaled \$169 million in 2005.

Table 9.2: 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)	6,198.9	1,908.3	9.3	18.1	27.4
Gasoline Stations (4471)	8,160.6	6,717.8	32.3	86.2	118.5
Fuel Dealers (45431)	682.4	611.3	2.9	20.0	22.9
Pipeline Transportation (486)	22.1	22.0	0.314	0.060	0.373

Source: DOR

Gasoline stations paid nearly \$119 million in excise taxes or about 70 percent of the total industry excise taxes paid (excluding refining). Wholesalers (16 percent), fuel oil dealers (14 percent), and pipelines (0.2 percent) made up the difference.

**APPENDIX A: RESULTS FROM THE 2006 SURVEY OF WASHINGTON REFINERS**

	2004	2005
Table A-1: Feedstock Inputs and Product Outputs		
Total Feedstock Inputs (thousands of barrels per day)	577.64	578.19
Crude Oil	566.81	553.90
Other	10.83	24.29
Total Value of Inputs (thousands of dollars)	8,329,921	11,200,709
Crude Oil	8,181,333	10,680,123
Other	148,589	520,586
Total Product Output (thousands of barrels per day)	583.04	575.46
Gasoline	261.23	263.01
Diesel oil	136.11	131.39
Jet and turbine fuel	79.93	73.20
Calcined coke	6.97	6.39
Liquid petroleum gas (LPG)	3.99	8.82
Residual fuel oil	34.74	32.43
Propane	9.83	9.72
Coke	8.09	8.69
Sulfur	0.54	1.17
Marine fuel	6.10	6.40
Gas oils	15.19	13.93
Emulsified & road asphalt	4.60	4.60
Other	15.72	15.71
Total Value of Output (thousands of dollars)	9,922,153	13,220,374
Gasoline	5,080,168	6,729,866
Diesel oil	2,557,058	3,580,670
Jet and turbine fuel	1,405,593	1,905,563
Calcined coke	124,363	105,355
Liquid petroleum gas (LPG)	83,831	131,638
Residual fuel oil	394,605	485,052
Propane	115,076	137,208
Coke	62,867	91,597
Sulfur	1,066	1,126
Marine fuel	66,056	95,714
Gas oils	290,583	305,225
Emulsified & road asphalt	58,807	61,718
Other	245,827	362,767



Table A-2: Mode of Transport and Destination in 2005
(thousands of barrels per day)

Mode of Transport	Pipeline	Waterborne	Other
Inputs			
Crude Oil	70.67	495.33	-
Other	2.79	11.39	9.22
Outputs			
Gasoline	176.11	63.01	18.22
Diesel oil	68.21	49.04	12.33
Jet and turbine fuel	43.31	25.45	4.94
Calcined coke	-	-	6.39
Liquid petroleum gas (LPG)	-	-	8.90
Residual fuel oil	-	32.57	-
Propane	-	-	9.82
Coke	-	5.48	3.21
Sulfur	-	-	1.12
Marine fuel	-	6.40	-
Gas oils	-	13.83	-
Emulsified & road asphalt	-	0.30	4.40
Other	6.25	8.21	0.95
Destination of Output			
	In-State	Domestic (Out-of-State)	Foreign
Gasoline	158.50	104.73	2.70
Diesel oil	78.50	52.39	0.79
Jet and turbine fuel	54	13	7
Calcined coke	-	-	6
Liquid petroleum gas (LPG)	9	0	0
Residual fuel oil	24	2	7
Propane	9	0	0
Coke	0	2	6
Sulfur	1	-	-
Marine fuel	6	-	-
Gas oils	5	7	3
Emulsified & road asphalt	4	0	-
Other	7	5	3



Table A-3: Operating and Capital Expenditures

	2004	2005
Employment and Contract Labor		
Total (thousands of dollars)	328,638	400,151
Total payroll (thousands of dollars)	136,054	140,303
Total employee benefits (e.g. health, pension, social security, etc.)	65,388	62,223
Total on-site employment (number of FTE employees)	1,750	1,767
Total Contract Labor Cost (thousands of dollars)	127,195	197,625
Service and maintenance	55,820	65,130
Capital repair and replacement	71,375	132,494
Total Contract Labor (number of FTE workers)	1,163	1,676
Service and maintenance	499	491
Capital repair and replacement	664	1,185
Operating Expenditures Other Than Labor or Feedstock (thousands of dollars)		
TOTAL	482,590	583,911
Non-durable Manufacturing	109,125	136,572
Petroleum products	15,248	18,058
Durable Manufacturing	1,290	1,290
Construction	16,321	18,594
Transportation	195,766	216,818
Rail	15,303	14,809
Trucking	3,729	6,376
Automobiles	-	-
Waterborne	168,317	187,462
Air	8,869	8,623
Utilities and Communications	268,701	370,036
Electricity	65,835	80,959
Gas	187,005	269,096
Finance, Insurance and Real Estate	5,205	5,890
Business Services	22,772	19,275
Other Services	8,212	9,888
Capital Expenditures Other Than Labor (thousands of dollars)		
Total	134,440	255,621
Equipment	97,773	190,328
Materials and Supplies	36,668	65,293

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

	2004	2005
Taxes	158,794	176,349
Retail sales and use tax	4,046	4,966
Business and occupations tax	33,392	35,930
Property tax	13,166	17,135
Unemployment compensation tax (state only)	581	524
Industrial insurance premium	443	519
Hazardous substance tax	57,292	68,322
Oil spill tax	9,120	8,801
Petroleum products tax	7,991	1,800
Motor vehicle fuel tax	19,914	21,974
Special fuel tax	8,568	10,997
Other	4,281	5,380
Regulatory Fees	3,278	3,312
Air operating registration and permit fees	1,197	1,214
Waste disposal fees	1,010	968
Wastewater discharge fees	439	460
Building inspection fees	55	58
Building permit fees	551	579
Other	26	33

Table A-5: Other

	2004	2005
TOTAL Food Services (thousands of dollars)	1,015	986
Associated with contract labor	697	667
Associated with business visitors	318	319
TOTAL Hotel and Motels (thousands of dollars)	2,300	2,674
Associated with contract labor	1,223	1,560
Associated with business visitors	1,077	1,114
TOTAL Other Trade and Services (thousands of dollars)	448	467
Associated with contract labor	341	357
Associated with business visitors	107	110
TOTAL Charitable Contributions (thousands of dollars)	759	761
Corporate	599	585
Firm-sponsored employee giving	160	176
Estimated visitors from outside Washington	911	936



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 8.0 of the WRC-REMI model. Our previous analysis (WRC 2004) used version 5.5.

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