



THE ECONOMIC CONTRIBUTION OF WASHINGTON STATE'S PETROLEUM REFINING INDUSTRY IN 2013

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 Economic Models, 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 eco-

1. Report Overview

This report quantifies the impact of Washington's five major petroleum refiners on the state's economy in 2013.

In 2013, the refiners directly provided 2,024 full-time jobs, paying an annual average wage of \$121,114. In addition, the refiners employed, at high wages, 2,727 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 26,060 jobs and almost \$1.8 billion in personal income for Washington state in 2013. From this activity, state and local governments received \$53.4 million in sales and use taxes and \$124.9 million in business and occupation taxes.

Also, downstream industries, which distributed refined petroleum prod-

ucts, paid \$428 million in wages to 16,044 workers in 2013. Excise taxes collected by the state from these industries exceeded \$236 million in 2013.

Because of Washington's unique tax structure, a Washington refinery's state and local tax burden in 2013 was almost three times higher than 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, 2005, 2007, 2009 and 2011 previously prepared by the Washington Research Council (WRC 2004, 2006, 2009, 2010 and 2012), drawing upon a survey of Washington refiners conducted by the Council in 2014 (Appendix A) and the WRC-REMI model of the Washington state economy (Appendix C).

2. Summary of Findings

Washington's five refineries provide 3.4 percent of the United States' refining capacity. In 2013 they processed 572,300 barrels of crude oil per day. Gasoline, diesel oil, and jet

Table 2.1: Summary of Multipliers and Economic Impacts

Refining Jobs	Multiplier	Indirect and Induced Economic Effect	Major Petroleum Refiners Total Economic Impact
2,024 jobs	12.88	24,036 jobs	26,060 jobs
	\$880,142	\$1,445,719,917 personal income	\$1,781,406,866 personal income
	\$26,324	\$43,239,183 sales and use taxes	\$53,380,261 sales and use taxes
	\$61,696	\$14,844,634 B&O taxes	\$124,873,001 B&O taxes

Source: 2014 Refiner Survey, WRC-REMI Model

fuel are the largest finished product categories, representing 42 percent, 26 percent, and 14 percent, respectively, of total production, with gasoline production averaging 257,100 barrels per day.

According to the refiners survey, the five major refineries employed 2,024 workers in 2013, paying them an average annual wage of \$121,114—more than twice the Washington state average.

As illustrated in Table 2.1, these jobs have a total employment multiplier of 12.88, meaning that each direct refining job generates an additional 11.88 jobs in the state, for a total employment impact of 26,060 jobs resulting from the five refineries.

Petroleum refining’s extraordinarily high capital intensity, high wages and extensive use of highly paid contract labor 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 \$880,000 of state personal income, a total income contribution of nearly \$1.8 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 \$268.6 million in state and local taxes in 2013. This total included \$110.0 million in business and occupation (B&O) tax, \$116.7 million in hazardous substance tax, \$24.3 million in property tax and \$5.9 million in sales and use taxes (Table 7.2).

In addition, the refiners \$12.7 million in regulatory fees in 2013 (Table 7.3).

Including the indirect and induced effects, the refining industry generated \$53 million in sales and use and \$125 million in B&O taxes (Table 2.1)

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 three times greater than that in California (Table 8.1).

Finally, refiners contribute generously to the communities in which they are located. The five refiners and their employees contributed \$1.7 million to various community causes in 2013. The firms themselves contributed about 47 percent of this, with the balance provided by firm-sponsored employee giving (Appendix A, Table A.11).

Table 3.1: Washington 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
Phillips 66 Ferndale (formerly ConocoPhillips 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	107,500
Shell Oil (formerly Equilon Enterprises and Texaco)	1957	Skagit County, five miles east of Anacortes	Gasoline, diesel oil, jet fuel, propane, coke, sulfur	149,000
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	42,000

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 west of Ferndale on the Strait of Georgia (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. Now owned by BP, 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 su-

persized 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 3.4 percent of the nation's total refining capacity (EIA 2014a). With this state accounting for 2.1 percent of national petroleum consumption, in-state refineries produce quantities more than sufficient for Washington's needs (EIA 2014b).

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, which are not connected to the Gulf Coast and Midwest pipeline systems. West Coast consumers are supplied primarily from refineries in California and Washington.

Geographically, the three most important sources of crude oil for Washington refineries are Alaska's North Slope, the Canadian province of Alberta and the Bakken oil field of North Dakota.

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 142 at the beginning of 2014. Those refineries that remain, however, are more efficient, with slightly more refining capacity available today than in 1982.

Over the decade prior to the 2001–03 recession, the increased demands of a growing population and economy and an increasing array of “boutique” fuels required by federal and state regulations strained capacities, with price effects felt throughout the country. The 2001–03 recession provided a respite, but capacity constraints returned at mid-decade as the economy recovered. The situation was exacerbated by hurricane damage to refineries along the Gulf Coast. During 2008–09, high crude oil prices followed by financial crisis induced demand reductions severely squeezed refinery margins. More recently, margins rebounded as increased crude oil production in the U.S. lowered refinery costs, while global product prices remained high.

The 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 increase in refin-

ery employment of roughly 8 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 2013 the five refineries had 2,024 employees. With a multiplier of 12.88 the total impact of the refineries was 26,060 jobs. Similarly, the refinery activities resulted in \$880,142 of state personal income for every direct job, or a total statewide \$1.78 billion 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 sub-

stitute 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 direct 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 9).

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

Finally, in Section 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.

Figure 5.1: Washington State Petroleum Product Consumption (millions of barrels)

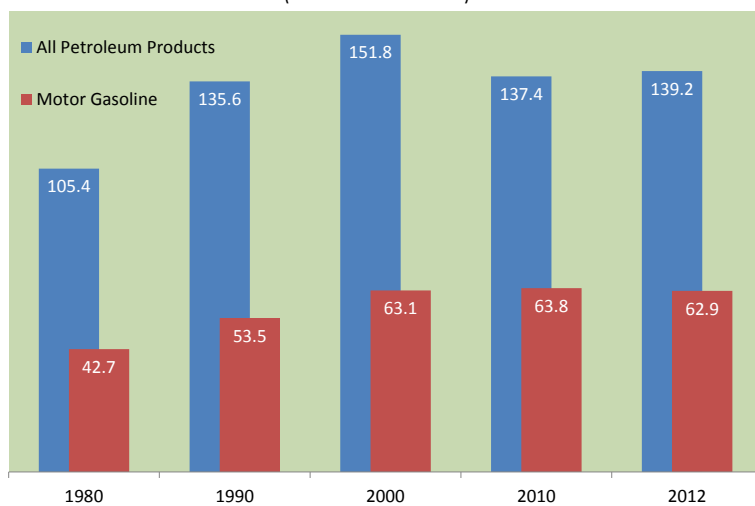


Figure 5.2: Washington Petroleum Consumption Trends

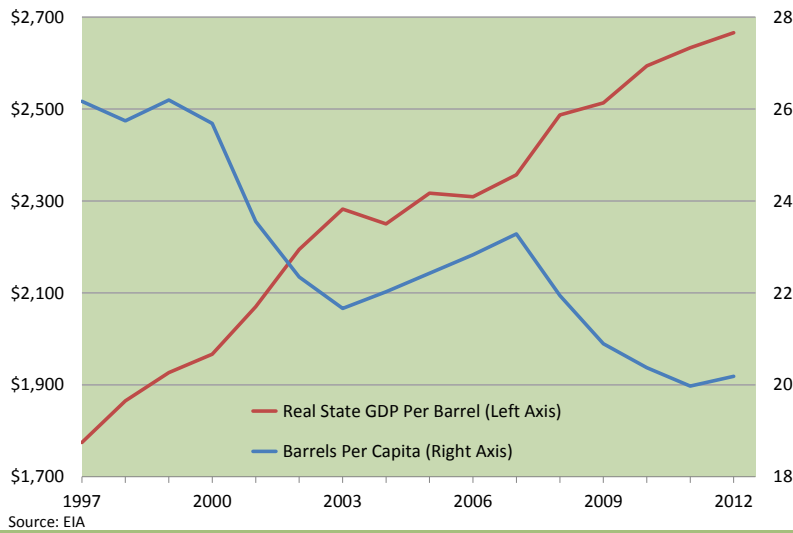
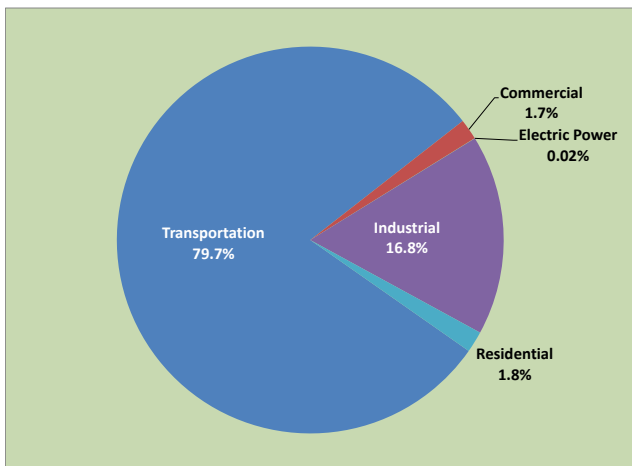
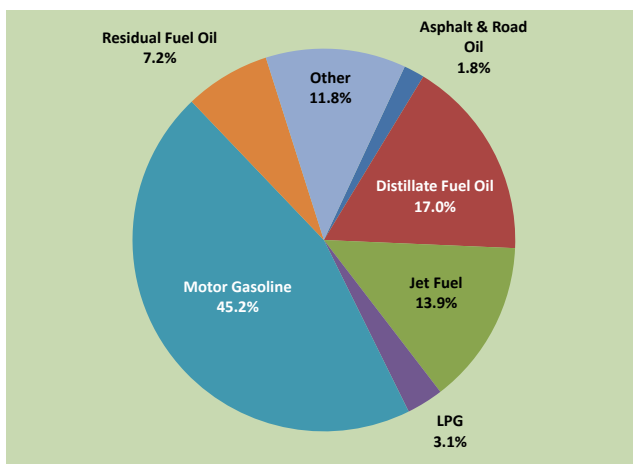


Figure 5.3: 2012 Consumption By Sector



Source: EIA

Figure 5.4: 2012 Consumption By Product (Volume in Barrels)



Source: EIA

5. Petroleum Product Consumption in Washington

Washington households and businesses consumed a bit more than 139 million barrels of finished petroleum products in 2012, up 32 percent from 1980, according to the Energy Information Administration (EIA). (See Figure 5.1.) Washington's 2012 consumption was 2.1 percent of the U.S. total and about 15 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 2012 (EIA 2014b).

As a result of increasing fuel efficiency, petroleum product consumption in Washington declined by 6 percent from 1997 to 2012. Over the period the state's population grew by 22 percent and the output of the state economy (as measured by real gross state product) grew by 41 percent. As a result, per-capita consumption declined by 23 percent, while gross state product per barrel of petroleum increased by 50 percent. (See Figure 5.2)

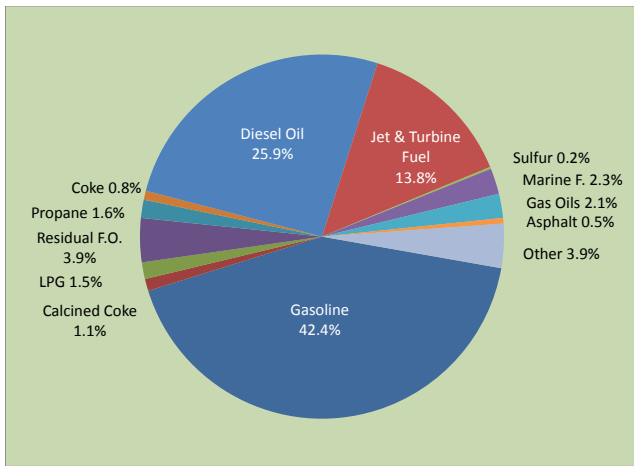
The several broad classes of customers who purchase petroleum products help to explain the state's consumption patterns. Demand for petroleum products from transportation, industrial and residential customers decreased over the fifteen-year period by 3 percent, 17 percent and 41 percent, respectively. Commercial customer demand increased by 33 percent over the period (EIA 2014b).

As shown in Figure 5.3, commercial customers accounted for less than 2 percent of Washington's total petro-

leum product consumption; transportation and industrial customers together accounted for more than 96 percent.

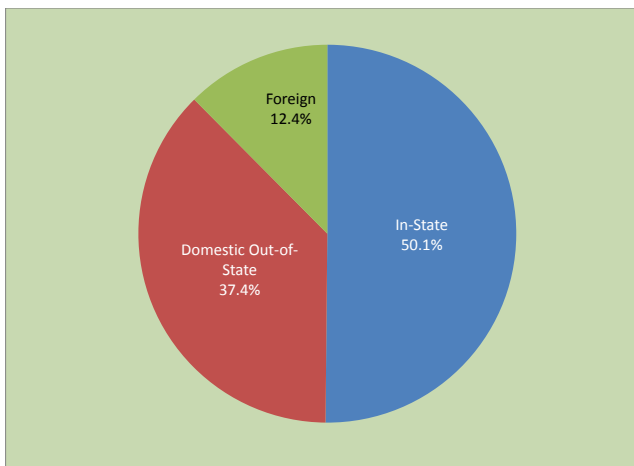
By far, motor gasoline was the largest category of product consumed, at 46.2 percent of the total. (See Figure 5.4)

Figure 6.1: 2013 Washington Production By Product (Volume in Barrels)



Source: 2014 Refiners Survey

Figure 6.2: 2013 Washington Production By Destination (Volume in Barrels)



Source: 2014 Refiners Survey

6. Refinery Production in Washington

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

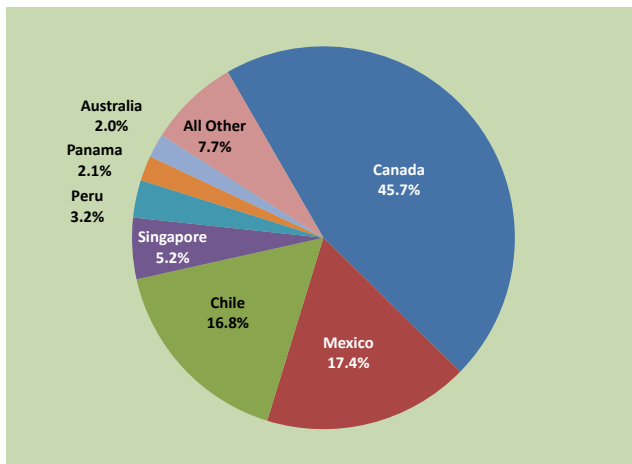
Finished products. Washington's refineries produced 606,200 barrels per day and more than a dozen different products in 2013. Gasoline, 257,100 barrels per day in 2013, is by far the largest product category, accounting for 42.4 percent of the total. Diesel oil and jet fuel are the next largest at 25.9 percent and 13.8 percent, respectively. (See Figure 6.1.)

Gasoline accounted for 45.0 percent of the refineries' total \$25.1 billion in output value in 2013. Again, diesel oil and jet fuel are next, accounting for 28.6 percent and 15.1 percent, respectively.

Markets. In 2013, 50.1 percent of Washington refined product was sold within the state; 37.4 percent of total product was sold domestically outside Washington; and the remaining 12.4 percent was delivered to foreign buyers. (See Figure 6.2.)

The World Institute for Strategic Economic Research (WISER) provides data on the destination of foreign exports of petroleum products from Washington. In 2013, the \$4.8 billion of petroleum products exported from the state amounted to 5.8 percent of Washington's foreign exports. Almost 46 percent of the dollar value of petroleum product exports went to Canada. Mexico was the second most important export market, followed by Chile, Singapore, Peru, Panama and Australia. (See Figure 6.3; Appendix B provides com-

Figure 6.3: Top Export Markets in 2013



Source: WISER

plete listings of export destinations for 2012 and 2013.)

Product transport. Finally, 47.8 percent of all products refined in Washington was shipped by pipeline in 2013, primarily to Seattle and Tacoma markets and on to Portland. Of the remaining product, 39.1 percent was shipped by water, to Portland and other destinations along the Columbia River as well as to foreign customers; 10.2 percent went by truck; and 2.9 percent went by rail.

7. Washington Refiners: Inputs

Washington refiners spent \$23.5 billion on feedstocks and other inputs in 2013. This section describes their main areas of expenditure.

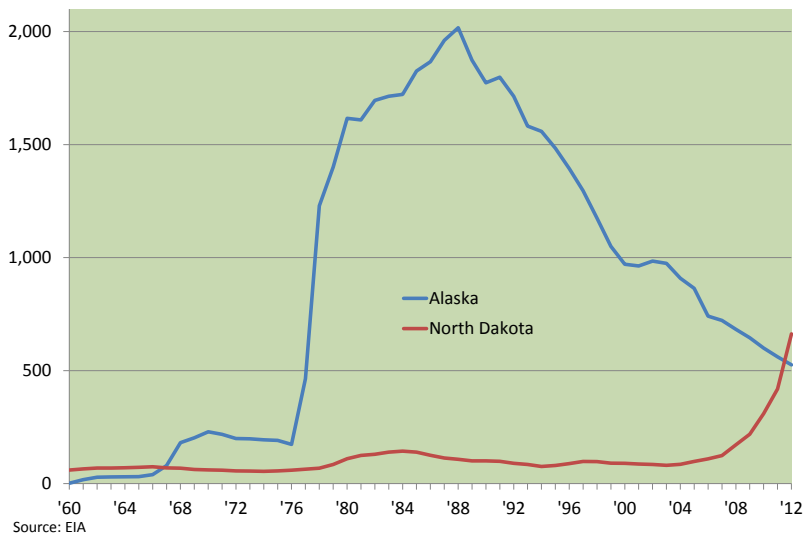
Feedstock. Washington's petroleum refineries received 591,300 barrels per day of crude oil and other feedstock inputs (e.g., butane, isobutene, and cat feed) in 2013. The total volume of feedstock in 2013 was 8.9 percent greater than 2012. The value of 2013 feedstocks was \$22.5 billion, up 8.8 percent from 2012. (See Table 7.1.)

In 2013, 60.5 percent of crude oil came into the refineries by water, 27.2 percent came by pipeline; and 12.3 percent came by rail. Of the

Table 7.1: Quantity and Value of Feedstock Inputs

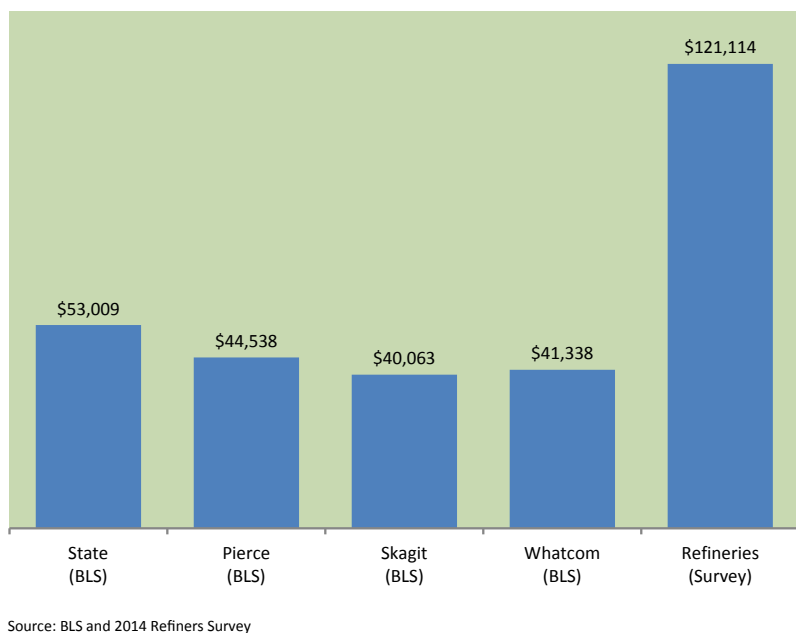
	2012	2013
Total Feedstock Inputs (thousands of barrels/day)	542.9	591.3
Crude Oil	528.4	572.3
Other	14.5	19.0
Total Value of Feedstock Inputs (millions of dollars)	20,673.0	22,494.4
Crude Oil	20,296.5	22,012.1
Other	376.5	482.3

Figure 7.1: Crude Oil Production, Alaska and North Dakota, (1,000 BBL/D)



crude oil, 46.2 percent was Alaskan, 18.4 percent was Canadian from conventional sources, 8.7 percent was Canadian from oil sands and 13.9 percent was from North Dakota. The remaining 12.8 percent came from a number of other places.

Figure 7.2: Average Annual wages



This represents a noteworthy change from 2003 when 90.4 percent of crude came by water from Alaska and no crude came to Washington by rail from North Dakota. Driving this change was the precipitous decline of crude oil production in Alaska and growth of production in North Dakota, as shown in Figure 7.1.

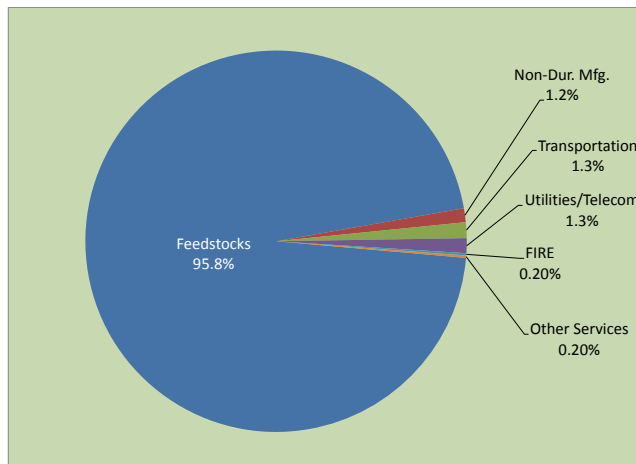
Labor. Washington's five oil refiners employed 2,024 workers in 2013 and paid them extraordinarily well. The refiner survey puts the 2013 average annual refinery wage at \$121,114. According to the U.S. Bureau of Labor Statistics (BLS), the overall statewide average wage was \$53,009 in 2013, less than half of the refinery average wage. (See Figure 7.2.)

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 2013 was \$41,338 while in Skagit County it was \$40,063 (BLS 2014).

Refinery payrolls totaled nearly a quarter of a billion dollars in 2013. Worker benefits totaled more than \$90 million, and average total compensation per employee was \$165,870.

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—2,843 in 2012 and 2,727 in 2013—and represents a significant part of the employment base, especially in Whatcom and Skagit counties.

Figure 7.3: 2013 Non-Labor Operating Expenses



Source: 2014 Refiners Survey

In 2013 refiners paid \$412.9 million for contract workers, an average of \$151,417 per worker.

Forty-one percent of contract workers in 2013 (1,128 workers) were engaged in capital repair and replacement, at a cost of \$91.7 million. In addition to this contract labor, the refiners made \$100.5 million in construction and other capital expenditures. Purposes included safety and environmental compliance, efficiency

improvements and capacity expansion.

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 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 more than 97 percent of all non-labor operating expenditures.

Significant amounts are also spent on utilities and transportation, which together accounted for \$609.1 million in 2013. Utilities expenditures, including electricity, gas and communications, totaled \$294.6 million in 2013, and transportation totaled \$314.5 million. Transportation expenditures were primarily for waterborne transport of inbound and outbound product (Appendix A, Table A.7).

Taxes. The five refiners contributed \$268.6 million in state and local taxes in 2013 (See Table 7.2).

Table 7.2: Taxes Paid by Refiners in 2013

	(Millions)	% of Total
Retail sales and use tax	\$5.9	2.2%
Business and occupation tax	\$110.0	41.0%
Property tax	\$24.3	9.0%
Unemployment compensation tax (state only)	\$1.1	0.4%
Hazardous substance tax	\$116.7	43.5%
Oil spill tax	\$8.3	3.1%
Petroleum Products Tax	-	-
Motor vehicle fuel tax	\$0.5	0.2%
Other	\$1.7	0.6%
Total	\$268.6	

Source: 2014 Refiners Survey

Table 7.3: Regulatory Fees Paid by Refiners in 2012 (dollars)

Air operating registration and permit fees	2,061,000	16.4%
Waste disposal fees	1,330,000	10.6%
Wastewater discharge fees	820,600	6.5%
Building Inspection Fees	8,344,913	66.3%
Building permit fees	35,000	0.3%
Other	109,000	0.9%
Total	12,700,513	

Source: 2014 Refiners Survey

The state hazardous substance tax—\$116.7 million—comprised the largest share of total taxes paid, 43.5 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.

Ranking a close second was the business and occupation tax, \$110.0 million, 41.0 percent of the total. Refineries are subject to this tax under either the manufacturing or wholesaling categories, at the rate of 0.484 percent.

Next in line was the property tax, \$24.3 million and 9.0 percent of the total tax bill.

The fourth most costly tax in 2013, \$8.3 million, was the oil spill tax. 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. The 1 cent response tax was last collected during the 3-month period from January 1

to March 31, 2013. Through a credit, the tax is effectively eliminated for crude oil or petroleum products exported from the state.

The petroleum products tax is another tax unique to the petroleum industries. Revenues from this tax are dedicated to 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 suspended when the pollution liability insurance program account balance exceeds a trigger value. The trust fund balance reached the trigger in the first quarter of 2010. The tax was suspended on April 1 of that year and remains suspended today.

The refineries reported paying \$5.9 million in sales and use taxes in 2013. Currently the sales and use tax rate paid by the two Skagit County refineries and the two Whatcom County refineries is 8.5 percent, while the rate paid by the Tacoma refinery is 9.5 percent.

Fees. In addition, the refiners paid \$12.7 million in regulatory fees in 2013. These included their air operating registration and permit fees (\$2.1 million, 16.4 percent), waste disposal fees \$1.3 million, 10.6 percent), and building inspection fees

(\$8.3 million, 66.3 percent). (See Table 7.3.)

8. Comparison with Taxation of a California Refinery

Table 8.1 compares the taxation of hypothetical refineries that processed 160,000 barrels of crude oil per-day in Washington and California in 2013.

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 2013 tax burden in Washington, \$75.8 million, is almost three times the burden in California, \$26.3 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 financial information from Tesoro Corporation’s 2013 Form 10-K filed with the U.S. Securities and Exchange Commission, we estimate the taxable income for a 160,000 barrels-per-day refinery to be \$161.7 million and the corporate income tax due to be \$14.3 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 \$6.78 billion. This results in a B&O tax obligation of \$32.8 million at the manufacturing/wholesaling rate of 0.484 percent. This is more than twice 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 making 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 more burdensome than a corporate income tax for low margin businesses such as refining.

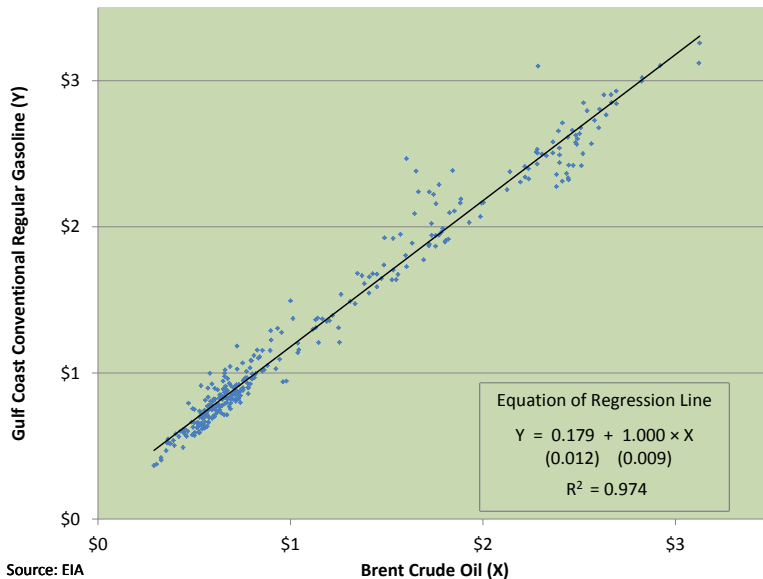
Refinery margins are particularly low when crude oil prices are high. In the

Table 8.1: Taxes on a 160,000 Barrels per Day Refinery, 2013
(millions of dollars)

	Washington	California
Corporate Profits Tax		\$ 14.3
Business & Occupation Tax	\$ 32.8	
Hazardous Substance Tax	\$ 34.8	
Property Tax	\$ 5.4	\$ 6.6
Sales & Use Tax	\$ 1.6	\$ 1.6
Oil Spill Tax	\$ 1.2	\$ 3.8
	\$ 75.8	\$ 26.3

Source: WRC calculations

Figure 8.1: Monthly Average Spot Prices May 1987 – August 2014
Gulf Coast Conventional Regular Gasoline vs. Brent Crude Oil
2009 Dollars Per Gallon



long run, the prices refiners pay for crude oil passes directly through to the prices they receive for products, as Figure 8.1 illustrates. On the figure we have plotted the monthly average U.S. Gulf Coast spot price of conventional regular gasoline against the monthly average spot price of the benchmark European Brent crude oil from May 1987 to August 2014. The slope of the regression line through the data points is almost exactly equal to one.

Hazardous substance tax. Returning to the taxes listed in Table 8.1, the hazardous substance tax is a second gross receipts tax levied by Washington state. Applying an effective rate of 0.513 percent to gross receipts of \$6.78 billion gives a \$34.8 million hazardous substance tax obligation for the 160,000 barrel per day Washington refinery. (Based on our survey, we use the 0.513 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. We assume that the Washington refinery is located in the city of Anacortes and that the California refinery is in the city of Martinez. (Shell and Tesoro have refineries in both of these cities.) Based on the taxes paid by the Shell and Tesoro refineries in Anacortes, we estimate that the taxes that would be paid by a 160,000 bbl./day refinery in Anacortes to be \$5.4 million. Based on the difference in property tax rates between Anacortes and Martinez, we estimate that such a refinery in Martinez would pay \$6.6 million in property taxes.

Sales and use tax. In 2013, the combined state and local sales tax rates was 8.5 percent in both Anacortes and Martinez. Based on the survey of Washington refineries, we estimate transactions subject to the sales and use tax to be \$18.8 million and the amount paid to be \$1.6 million.

Oil spill tax. Both states impose an oil spill tax. The rate in Washington is 5 cents per barrel. As we noted above, in Washington, 1 cent of the 5 cents is sometimes suspended, and the full 5 cents was only collected in the first three months of 2013. We assume an effective rate of 2.125 percent to account for the credit for product exported from the state. The oil spill tax rate in California is 6.5 cents per barrel, with no credit for exported product. We assume that for both refineries, 58.4 million barrels crude oil are subject to the tax. The oil spill tax burden is \$1.2 million in Washington and \$3.8 million in California.

9. Petroleum Refining Industry Direct, 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 12.88. Applying this multiplier to the 2,024 direct refinery jobs in 2013 gives a total state employment impact of 24,036 jobs.

This is an unusually large employment multiplier. In comparison, the 2007 Washington state Input-Output Study (2014) calculates that the employment multiplier for manufacturing/construction overall is 2.65. Much of this difference arises because the WRC-REMI model incorporates a number of significant behavioral responses to changes in prices and costs that are not picked up by a simple input-output model: 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

Table 9.1: Impact of a 160,000 Barrel Per Day Refinery

565 Direct Jobs	+6,915 Additional Jobs Elsewhere in the State Economy
\$92.2 Million Direct Compensation	+\$399.5 Million Additional Personal Income Elsewhere in the Economy
\$73.7 Million Direct Taxes	+\$4.3 Million Additional Sales, Use and B&O Taxes Elsewhere in the Economy

Source: WRC

costs, and investment rises in response to increases in output. When we run the WRC-REMI model with these channels turned off so as to approximate an input-output model, the employment multiplier for petroleum refining is reduced to 4.84. When we run such a WRC-REMI simulation for the larger petroleum and coal products manufacturing sector (the “three-digit” sub-sector of manufacturing that contains the petroleum refining industry) the employment multiplier is 4.05. This is actually less than the 6.80 multiplier that the Washington Input-Output Model gives for petroleum and coal products manufacturing. (This 6.80 is the highest employment multiplier found by the 2007 Input-Output Study.)

Several additional factors contribute to the petroleum refining 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 \$880,142 of state personal income. At 2013 employment levels, the industry adds \$1.8 billion to state personal income.

In 2013 state and local sales and use taxes averaged \$0.0270 for each dollar of state personal income. With the income multiplier of \$880,142, each petroleum refining job results in

\$26,324 in state and local sales taxes or a total of \$53.4 million.

The refiners directly paid \$105.1 million in B&O taxes in 2013. In 2009 state B&O taxes averaged \$0.00106 for each dollar of personal income. Multiplying this rate into \$1,452.9 million—the increase in state personal income we ascribe to the 1,986 refinery jobs net of the wages and benefits of the refinery workers—gives \$15.4 million additional induced and indirect B&O tax revenue, for a total of \$120.5 million, or \$60,691 per direct job.

These impacts can be expressed in terms of the hypothetical Washington refinery producing 160,000 barrels of product a day that was analyzed in Section 8. In 2013, this refinery would have provided 565 jobs, and these workers would have received \$68.4 million in wages and salaries and \$25.3 million in benefits. In addition to the direct jobs and income, the refinery would generate 6,915 jobs and \$399.5 million in personal income elsewhere in the state's economy. The refinery itself would pay \$73.7 million in state and local taxes. In addition to these direct taxes, the indirect and induced activities generated by the refinery would provide \$4.3 million in sales, use and B&O tax revenue. (See Table 9.1.)

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

Table 10.1: Employment and Wages by Industry, 2013

Industry (NAICS Code)	Firms	Total Wages Paid	Average Employment	Average Annual Wage
Petroleum Bulk Stations and Terminals (424710)	38	\$45,169,000	716	\$63,092
Other Petroleum Merchant Wholesalers (424720)	94	\$63,632,000	1,085	\$58,661
Gasoline Stations With Convenience Store (447110)	1,730	\$230,081,000	12,109	\$19,001
Other Gasoline Stations (447190)	112	\$24,395,000	958	\$25,455
Fuel Dealers (45431)	120	\$49,627,000	1,038	\$47,799
Refined petroleum product pipelines (48691)	7	\$14,979,000	138	\$108,346
Crude Oil Pipelines (48611)	D	D	D	D

Source: BLS

D: Value not disclosed

(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, 48 percent leaves through pipeline to markets in Seattle and Tacoma and beyond. Another 39 percent goes by water to Seattle, Portland, or elsewhere with the remaining 13 percent of product shipped by rail or truck. About 50 percent of product is delivered to retailers for consumer sales within the state of Washington (Appendix A).

Jobs and wages. According to detailed data reported to the BLS for 2013, the most recent year for which such data are available, there were about 2,100 employers in these downstream industries. Together, they paid \$428 million in wages to 16,044 workers. These are all workers covered by unemployment insurance in these industries, so the number includes both full-time and part-time workers. Table 10.1 shows these data for each industrial classification with its corresponding North American Industrial Classification System (NAICS) code.

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

- Refined petroleum product pipelines employ a few highly paid workers—138 workers made \$108,346 (plus benefits) on average in 2013.
- Bulk stations and terminals, wholesalers, and fuel oil dealers employ about 2,839 workers who earned on average \$55,804 in 2013.
- Gasoline stations generate a large wage bill with a lot of lower-wage and part-time jobs. In 2013, this industry's 1,842 employers paid

total wages of \$254.6 million to 13,067 workers.

Taxes. The state Department of Revenue (DOR) reports excise tax data on these same industries (DOR 2014a, 2014b).

As shown in Table 10.2, total excise taxes due from the downstream industries equaled \$236.2 million in 2013. Gasoline stations paid \$156.7 million in excise taxes. Wholesalers paid \$59.9 million; fuel dealers, \$19.6 million.

Table 10.2: Taxable Income and Taxes Due by Industry, 2013 (millions of dollars)

Industry (NAICS Code)	Gross	Taxable	B&O Tax	Other Excise	Total
Petroleum Products Wholesaling (4247)	7,667.4	6,079.4	29.9	30.0	59.9
Gasoline Stations (4471)	12,015.1	9,907.2	47.9	108.8	156.7
Fuel Dealers (45431)	540.5	510.3	2.5	17.1	19.6
Refined petroleum product pipelines (48691)	D	D	D	D	D
Crude Oil Pipelines (48611)	D	D	D	D	D

Source: DOR

D: Value not disclosed by DOR

Appendix A

A.1: Quantity and Value of Feedstock Inputs	2012	2013
Feedstock Quantity (KBLS/Day)		
Crude Oil	528.4	572.3
Other	14.5	19.0
Total	542.9	591.3
Feedstock Value (\$K)		
Crude Oil	20,296,503	22,012,122
Other	376,451	482,324
Total	20,672,954	22,494,447
A.2: Quantity and Value of Output	2012	2013
Output Quantity (KBLS/Day)		
Gasoline	244.0	257.1
Diesel Oil	123.0	156.8
Jet and Turbine Fuel	77.6	83.7
Calcined Coke	5.0	6.5
LPG	6.2	9.0
Residual Fuel Oil	25.6	23.7
Propane	8.7	9.8
Coke	5.5	4.9
Sulfur	0.9	1.1
Marine Fuels	18.7	13.9
Gas Oils	17.0	13.0
Emulsified and Road Asphalt	3.0	3.0
Other	19.6	23.8
Total	554.8	606.2
Output Value (\$K)		
Gasoline	11,131,333	11,283,582
Diesel Oil	5,925,518	7,180,577
Jet and Turbine Fuel	3,607,739	3,776,891
Calcined Coke	240,571	274,427
LPG	147,581	186,164
Residual Fuel Oil	954,440	761,980
Propane	110,292	143,743
Coke	46,945	46,263
Sulfur	10,802	7,245
Marine Fuels	732,733	486,125
Gas Oils	492,609	369,691
Emulsified and Road Asphalt	108,848	88,554
Other	404,719	460,997
Total	23,914,129	25,066,238

A.3: Origin of Inputs 2013 (KBBLs/Day)	Crude Oil	Other
Alaska	264.4	2.9
Canada (Conventional)	105.4	-
Canada (Oil Sands)	49.6	-
Bakken	79.3	-
All Other Origins	73.7	16.1

A.4: Destination of Output 2013 (KBBLs/Day)	Washington	Other U.S.	Foreign	Total
Gasoline	118.7	116.6	21.8	257.1
Diesel Oil	77.2	57.8	21.8	156.8
Jet and Turbine Fuel	47.6	15.4	20.8	83.7
Calcined Coke	-	-	6.5	6.5
LPG	8.6	0.3	-	9.0
Residual Fuel Oil	12.9	3.2	7.6	23.7
Propane	8.3	1.5	-	9.8
Coke	3.0	2.0	-	4.9
Sulfur	1.0	0.0	-	1.1
Marine Fuels	12.1	1.8	-	13.9
Gas Oils	2.0	11.0	-	13.0
Emulsified and Road Asphalt	2.0	1.0	-	3.0
Other	3.8	20.0	-	23.8

A.5: Mode of Transport 2013	Pipeline	Water	Truck	Rail
Feedstocks (KBBLs/Day)				
Crude Oil	155.7	346.1	0.1	70.4
Other	1.8	8.0	0.2	9.1
Outputs (KBBLs/Day)				
Gasoline	159.2	77.6	20.3	-
Diesel Oil	77.4	63.7	15.6	0.1
Jet and Turbine Fuel	37.6	33.0	13.2	-
Calcined Coke	-	-	0.2	6.3
LPG	5.7	-	-	3.3
Residual Fuel Oil	-	23.7	-	-
Propane	0.1	-	7.2	2.4
Coke	-	2.0	-	3.0
Sulfur	-	-	1.1	-
Marine Fuels	-	13.9	-	-
Gas Oils	-	13.0	-	-
Emulsified and Road Asphalt	-	-	2.0	1.0
Other	-	16.7	-	7.1

A.6: Employment and Contract Labor	2012	2013
On-Site Employment		
Number of FTE Employees	1,996	2,024
Total Payroll (\$K)	248,408	245,134
Total Employee Benefits (\$K)	91,579	90,586
Contract Labor		
Expenditure (\$K)		
Service and Maintenance	517,015	321,197
Capital Repair and Replacement	80,889	91,709
Total	597,903	412,906
Number of Contract Workers (FTE)		
Service and Maintenance	1,790	1,599
Capital Repair and Replacement	1,053	1,128
Total	2,843	2,727
% of Contract Labor from Outside WA State		
Service and Maintenance	19%	10%
Capital Repair and Replacement	25%	50%

A.7: Operating Expenditures Other than Labor or Feedstock (\$K)	2012	2013
Non-Durable Manufactured Goods		
Petroleum Products	240,056	234,633
Other Non-Durable Goods	42,544	40,235
Total	282,600	274,868
Durable Manufacturing	-	-
Construction	178,368	75,900
Transportation		
Rail	27,188	61,653
Trucking	8,557	4,956
Automobiles	9,479	5,360
Waterborne	216,837	223,115
Air	-	-
Other	17,123	19,419
Total Transportation	279,185	314,503
Utilities and Communications		
Electricity	48,745	64,952
Gas	140,716	211,872
Other	14,450	17,824
Total U&C	203,911	294,647
Finance, Insurance and Real Estate	8,029	45,858
Business Services	6,213	6,109
Other Services	37,067	40,076

A.8.: Non-Labor Capital Expenditures	2012	2013
Equipment (\$K)	95,261	139,241
Materials and Supplies (\$K)	53,451	121,808
Total	148,712	261,050
A.9: Taxes and Fees		
Taxes (\$K)		
Retail Sales and Use tax	3,182	5,919
Business and Occupation Tax	101,517	110,028
Property Tax	23,371	24,270
Unemployment Compensation Tax	934	1,067
Hazardous Substance Tax	109,339	116,746
Oil Spill Tax	7,943	8,343
Petroleum Products Tax	-	-
Motor Vehicle Fuel Tax	530	514
Special Fuel Tax	52	33
Other	1,586	1,662
Regulatory Fees (\$K)		
Air Operating Registration and Permit Fees	1,957	2,061
Waste Disposal Fees	2,126	1,330
Wastewater Discharge Fees	794	821
Building Inspection Fees	3,879	8,345
Building Permit Fees	30	35
Other	40	109
Industrial Insurance Premium (\$K)	9,210	6,966
A.10: Estimated Services and Retail Trade		
Food Services (\$K)		
Associated with Contract Labor	372	415
Associated with Business Visitors	505	579
Total	877	994
Hotel and Motels (\$K)		
Associated with Contract Labor	634	653
Associated with Business Visitors	695	665
Total	1,329	1,318
Other Trade and Services (\$K)		
Associated with Contract Labor	25	25
Associated with Business Visitors	61	70
Total	86	95
A.11: Contributions (\$K)		
Corporate	755	807
Firm-Sponsored Employee Giving	860	908
A.12.: Other (\$K)		
Estimated Business visitors from outside Washington	3,050	2,450

Appendix B

Petroleum Product Exports from Washington State

	2013		2012	
Canada	\$2,177,833,636	1	\$1,781,345,720	1
Mexico	\$829,871,226	2	\$1,082,484,856	2
Chile	\$799,600,716	3	\$321,653,747	3
Singapore	\$246,697,826	4	\$244,062,973	4
Peru	\$151,040,493	5	\$439,895	19
Panama	\$101,230,413	6	\$497,533	18
Australia	\$96,604,700	7	\$138,680,487	5
Guatemala	\$95,946,791	8	\$38,177,596	9
China	\$71,483,403	9	\$67,575,139	6
Brazil	\$64,440,635	10	\$64,750,640	7
New Zealand	\$40,964,163	11	\$52,736,383	8
Thailand	\$17,846,188	12	\$233,353	21
United Arab Emirates	\$14,671,853	13	\$7,409,777	13
Ecuador	\$9,773,181	14	\$34,457,684	10
Colombia	\$9,348,212	15	\$213,812	22
Indonesia	\$8,461,078	16	\$8,180,664	12
India	\$8,244,201	17	\$2,023,767	16
Belgium	\$8,000,000	18	\$16,142	32
Japan	\$7,325,684	19	\$5,377,778	14
Taiwan	\$3,650,060	20	\$3,471,180	15
Russia	\$3,484,204	21	\$621,938	17
Malaysia	\$549,305	22	\$10,705,014	11
Philippines	\$394,911	23	\$364,487	20
Dominican Republic	\$167,947	24	\$172,401	23
Costa Rica	\$137,888	25	\$125,102	24
Germany	\$110,370	26	\$49,032	27
Nicaragua	\$96,226	27	\$19,487	31
Kazakhstan	\$94,789	28	\$14,120	34
Vietnam	\$40,451	29	\$116,818	25
Guadeloupe	\$31,109	30	\$0	-
Saudi Arabia	\$25,242	31	\$0	-
Uruguay	\$21,101	32	\$0	-
Trinidad And Tobago	\$17,531	33	\$11,195	37
French Polynesia	\$16,802	34	\$8,401	39
Fiji	\$9,444	35	\$0	-
Barbados	\$8,483	36	\$4,448	42
United Kingdom	\$5,535	37	\$26,097	28
Czech Republic	\$5,440	38	\$7,400	40
New Caledonia	\$5,260	39	\$0	-
Korea, Republic Of	\$4,607	40	\$26,033	29
Switzerland	\$3,996	41	\$0	-
Hong Kong	\$3,561	42	\$88,040	26
Netherlands	\$3,480	43	\$0	-
Norway	\$2,886	44	\$0	-
Spain	\$2,613	45	\$5,280	41
Haiti	\$2,580	46	\$13,960	35
Jamaica	\$0	-	\$23,234	30
Maldiv Islands	\$0	-	\$15,196	33
Denmark	\$0	-	\$12,000	36
Austria	\$0	-	\$8,799	38
France	\$0	-	\$2,559	43
Total All Countries	\$4,768,280,220		\$3,866,230,167	

Source: WISERTrade

Appendix C

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 standard input-output model 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 sub-regions: The Seattle Metropolitan District (King and Snohomish Counties) and the balance of the state. There are 66 private industrial sectors within each sub-region, as well as four governmental sectors. Within each sub-region the model tracks inter-industry 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 PI+ 1.5.2 of the WRC-REMI model.

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