



The Economic Contribution of Washington State's Petroleum Refining Industry in 2017

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 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 2017.

In 2017, the refiners directly provided 2,171 full-time jobs, paying an annual average wage of \$129,132. In addition, the refiners employed, at high wages, 2,658 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 25,366 jobs and \$1.90 billion in personal income for Washington state in 2017. State and local governments received \$231.6 million in taxes directly from the refiners and \$74.4

million from the follow-on activities of other taxpayers.

Also, industries that distributed refined petroleum products, paid \$503 million in wages to 16,078 workers in 2017. Excise taxes collected by the state from these industries totaled \$97.3 million in 2017.

Because of Washington's unique tax structure, a Washington refinery's state and local tax burden in 2017 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 previously prepared by the Washington Research Council (WRC 2004, 2006, 2009, 2010, 2012, 2014 and 2016), drawing upon a survey of Washington refiners conducted by the Council in 2018 (Appendix A) and the WRC-REMI model of the Washington state economy (Appendix C).

Table 2: Summary of Multipliers and Economic Impacts

Refining Jobs	Multiplier	Indirect and Induced Economic Effect	Major Petroleum Refiners Total Economic Impact
2,171	11.68	23,171 jobs	25,366 jobs
	\$873,000	\$1,491,770,000 personal income	\$1,896,528,000 personal income
	\$41,600	\$60,856,000 sales and use taxes	\$63,656,000 sales and use taxes
	\$29,300	\$13,575,000 B&O taxes	\$101,075,000 B&O taxes

Source: 2018 Refiner Survey, DOR, WRC-REMI Model

2. Summary of Findings

Washington's five refineries provide 3.3 percent of the United States' refining capacity. In 2017 they processed 607,600 barrels of crude oil and other feedstocks per day. Gasoline, diesel oil, and jet fuel are the largest finished product categories, representing 45.8 percent, 17.5 percent, and 13.5 percent, respectively, of total production, with gasoline production averaging 280,000 barrels per day.

According to the refiners survey, the five major refineries employed 2,171 workers in 2017, paying them an average annual wage of \$129,132—more than twice the Washington state average.

As indicated in Table 2, these jobs have a total employment multiplier of 11.68, meaning that each direct refining job generates an additional 10.68 jobs in the state, for a total employment impact of 25,366 jobs resulting from the five refineries.

Petroleum refining's extraordinarily high capital intensity, high wages, extensive use of highly paid contract labor and high taxes are the major reasons for its high jobs multiplier. The WRC-REMI model, which is used here to determine the economic im-

act of the industry, calculates that each petroleum job adds \$873,000 to state personal income. Thus, the 2,171 refinery jobs ultimately contribute a total of \$1.90 billion to state personal income.

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

Refiners paid \$231.6 million in state and local taxes in 2017. This total included \$87.5 million in business and occupation (B&O) tax, \$101.2 million in hazardous substance tax, \$24.8 million in property tax and \$2.8 million in sales and use taxes (Table 7.2 on page 11).

In addition, the refiners paid \$16.6 million in regulatory fees in 2017 (Table 7.3 on page 11).

Including the indirect and induced effects, the refining industry generated \$63.7 million in sales and use and \$101.1 million in B&O taxes (Table 2).

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 was nearly triple that in California in 2017 (Table 8 on page 12).

Table 3: 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	236,000
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	110,500
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
Marathon Petroleum (formerly, Andeavor, Tesoro 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

Finally, refiners contribute generously to the communities in which they are located. The five refiners and their employees contributed \$2.1 million to various community causes in 2017. The firms themselves contributed about three-quarters of this, with the balance provided by firm-sponsored employee giving (Appendix A, Table A.11).

3. 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: In January 2019, Par Pacific Holdings acquired U.S. Oil and Refining Company. 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.)

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 3.3 percent of the nation's total refining capacity (EIA 2018a). With this state accounting for about 2.1 percent of national petroleum consumption, in-state refineries produce quantities more than sufficient for Washington's needs (EIA 2018b). In 2017, 54 percent of Washington production went to in-state customers, 38 percent was exported to other states, and 8 percent was exported to other countries.

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 135 at the beginning of 2018. Those refineries that remain, however, are more efficient, with 4 percent 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. During 2010–2012, margins for North American refineries rebounded as increased crude oil production in the U.S. lowered refinery costs, while

global product prices remained high. Subsequently, the profitability of North American refineries trended lower as global refining profits converged (EIA 2014, 2016c). During summer 2018, output of U.S. refineries exceeded 18 million barrels per day for the first time, although capacity utilization remained below the peak set in 1998 (EIA 2018c).

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 refinery 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 2017 the five refineries had 2,171 employees. With a multiplier of 11.48 the total impact of the refineries was 25,366 jobs. Similarly, the refinery activities resulted in \$1,280,000 of state personal income for every direct job, or a total statewide \$2.78 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 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 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

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

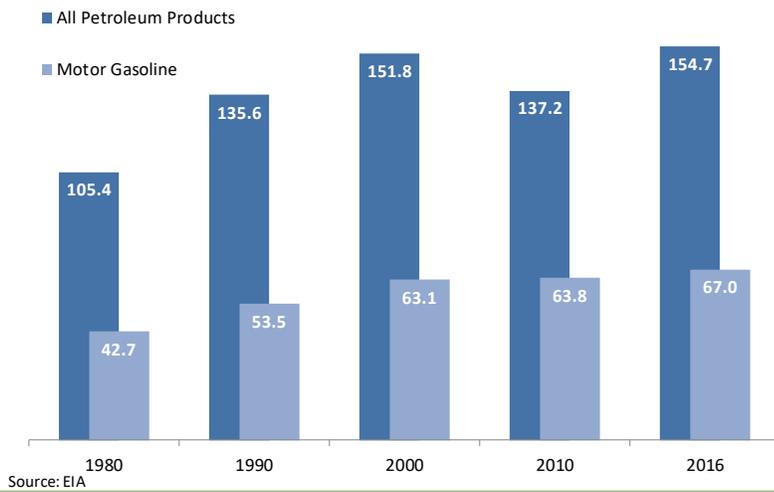


Figure 5.2: Washington Petroleum Consumption Trends

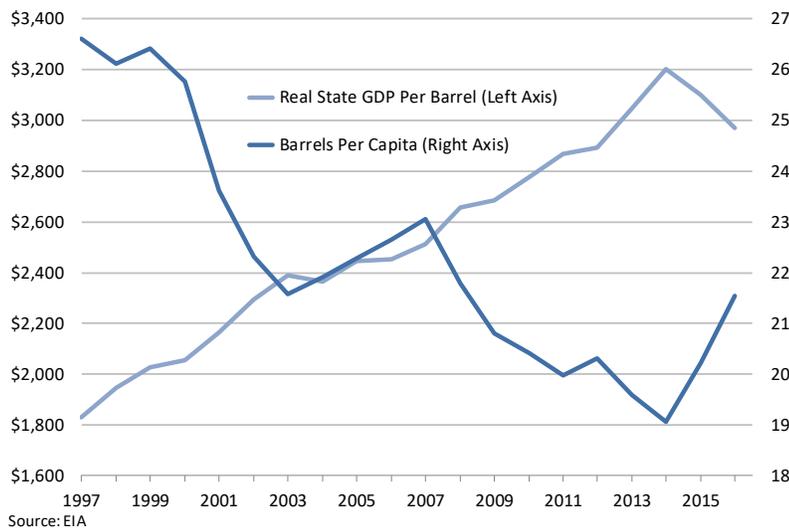
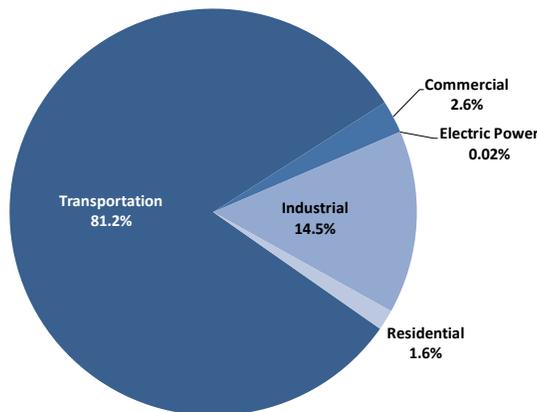


Figure 5.3: 2016 Consumption By Sector



Source: EIA

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.

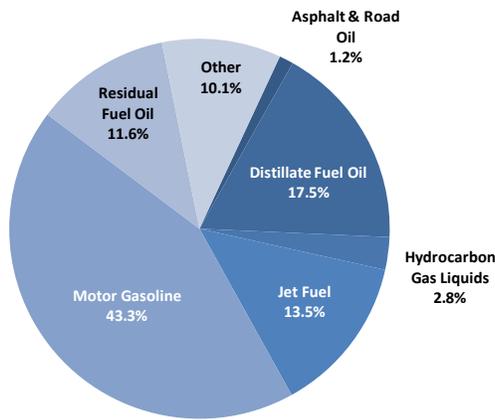
5. Petroleum Product Consumption in Washington

Washington households and businesses consumed a bit less than 155 million barrels of finished petroleum products in 2016, up 47 percent from 1980, according to the Energy Information Administration (EIA). (See Figure 5.1.) Washington’s 2016 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 2016 (EIA 2018b).

Petroleum product consumption in Washington increased by only 4 percent from 1997 to 2016. Over the period the state’s population grew by 29 percent and the output of the state economy (as measured by real gross state product) grew by 69 percent. As a result, per-capita consumption declined by 19 percent, while gross state product per barrel of petroleum increased by 62 percent. Residual fuel accounted for 52 percent of the gain from 2014 to 2016, while jet fuel accounted for 19 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 pe-

Figure 5.4: 2016 Consumption By Product (Volume in Barrels)



Source: EIA

roleum products from industrial and residential customers decreased over the 19-year period by 19 percent and 40 percent, respectively. Transportation and commercial customer demand increased by 10 percent and 122 percent (EIA 2016b).

As shown in Figure 5.3 on page 6, commercial customers accounted for less than 3 percent of Washington’s total petroleum product consumption; transportation and industrial customers together accounted for more than 85 percent.

By far, motor gasoline was the largest category of product consumed, at 43.3 percent of the total. (See Figure 5.4.)

6. Refinery Production in Washington

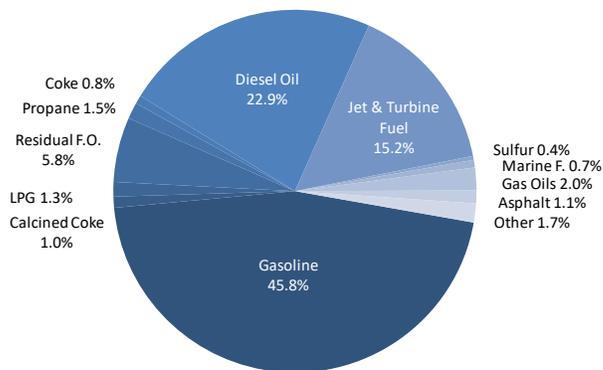
The data that follow in Sections 6, 7, and 8, unless otherwise indicated, are the aggregated results of our survey of Washington’s five major refiners (Appendix A).

Finished products. Washington’s refineries produced 611,900 barrels per day and more than a dozen different products in 2017. Gasoline, 280,000 barrels per day in 2017, is by far the largest product category, accounting for 45.8 percent of the total. Diesel oil and jet fuel are the next largest at 22.9 percent and 15.2 percent, respectively. (See Figure 6.1.)

Gasoline accounted for 49.4 percent of the refineries’ total \$15.3 billion in output value in 2017. Again, diesel oil and jet fuel are next, accounting for 24.3 percent and 13.1 percent, respectively.

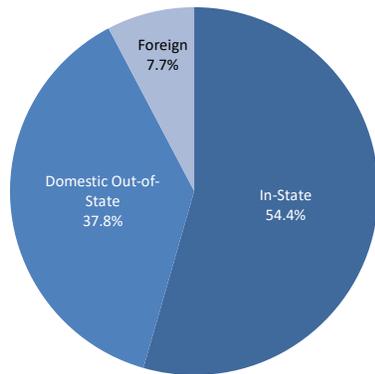
Markets. In 2017, 54.6 percent of Washington refined product was sold within the state; 37.8 percent of total product was sold domestically

Figure 6.1: 2017 Washington Production By Product (Volume in Barrels)



Source: 2018 Refiners Survey

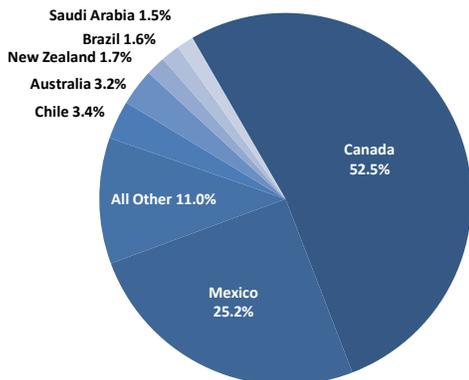
Figure 6.2: 2016 Washington Production By Destination (Volume in Barrels)



Source: 2018 Refiners Survey

Detail does not sum to 100% due to rounding

Figure 6.3: Top Export Markets in 2017



Source: WISER

Detail does not sum to 100% due to rounding

outside Washington; and the remaining 7.7 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 2017, the \$1.24 billion of petroleum products exported from the state amounted to 2.4 percent of Washington’s foreign exports. More than half of the dollar value of petroleum product exports went to Canada. Mexico was the second most important export market, followed by Chile, Australia, New Zealand, Brazil and Saudi Arabia. (See Figure 6.3; Appendix B provides more complete listings of export destinations for 2016 and 2017.)

Product transport. Finally, 47.3 percent of all products refined in Washington was shipped by pipeline in 2017, primarily to Seattle and Tacoma markets and on to Portland. Of the remaining product, 36.4 percent was shipped by water, to Portland and other destinations along the Columbia River as well as to foreign customers; 13.4 percent went by truck; and 3.0 percent went by rail.

Table 7.1: Quantity and Value of Feedstock Inputs

	2016	2017
Total Feedstock Inputs (thousands of barrels/day)	635.0	607.6
Crude Oil	609.9	572.3
Other	25.1	35.4
Total Value of Feedstock Inputs (millions of dollars)	9,920.2	11,671.0
Crude Oil	9,530.1	11,194.2
Other	390.1	476.8

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

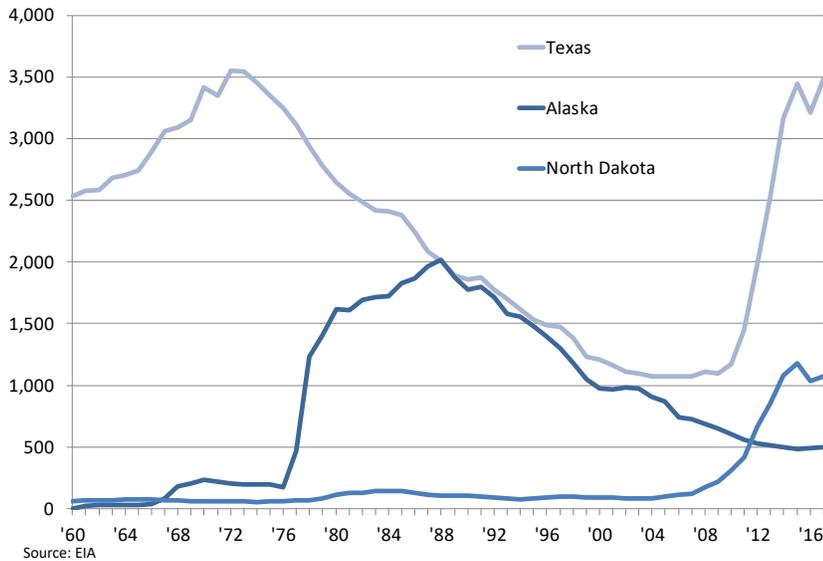
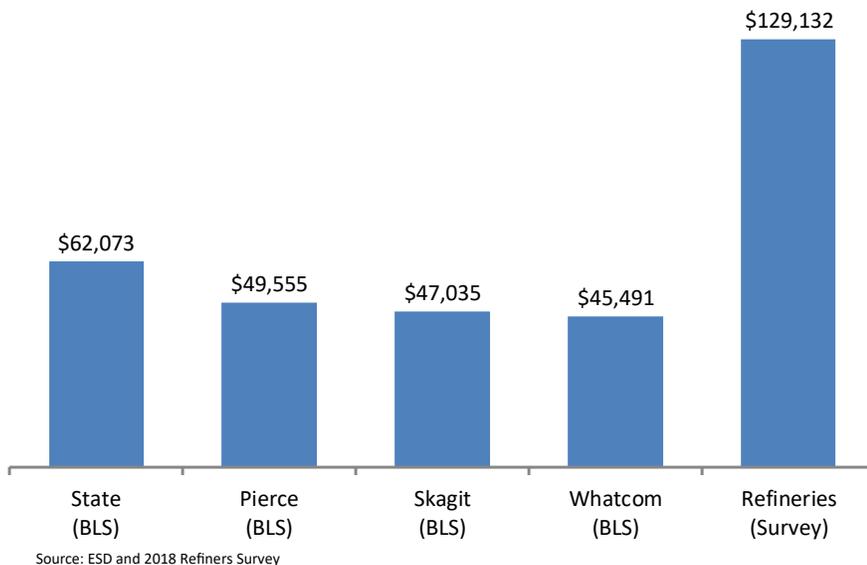


Figure 7.2: 2017 Average Annual wages



7. Washington Refiners: Inputs

Washington refiners spent \$13.1 billion on feedstocks and other inputs in 2017. This section describes their main areas of expenditure.

Feedstock. Washington's petroleum refineries received 607,600 barrels per day of crude oil and other feedstock inputs (e.g., butane, isobutene, and cat feed) in 2017. The total volume of feedstock in 2017 was 4.3 percent lower than 2016. The value of 2017 feedstocks was \$11.7 billion, up 17.6 percent from 2014. (See Table 7.1 on page 8.)

In 2017, 44.8 percent of crude oil came into the refineries by water, 29.0 percent came by pipeline; and 26.2 percent came by rail. Of the crude oil, 34.6 percent was Alaskan, 23.8 percent was Canadian from conventional sources, 10.4 percent was Canadian from oil sands and 23.3 percent was from North Dakota. The remaining 7.9 percent came from a number of other places.

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. The advances in drilling technology that triggered the North Dakota oil boom also enabled the resurgence of production in Texas.

Labor. Washington's five oil refiners employed 2,171 workers in 2017 and paid them extraordinarily well. The refiner survey puts the 2017 average annual refinery wage at \$129,132. According to the state Employment

Security Department (ESD), the overall statewide average wage was \$62,073 in 2017, less than half of the refinery average wage. (See Figure 7.2 on page 9.)

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 2017 was \$45,491 while in Skagit County it was \$47,035 (ESD 2018).

Refinery payrolls exceeded \$280 million in 2017. Worker benefits exceeded \$122 million, and average total compensation per employee was \$185,519.

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—1,745 in 2016 and 2,658 in 2017—and represents a significant part of the employment base, especially in Whatcom and Skagit counties.

In 2017 refiners paid \$289.5 million for contract workers, an average of \$108,900 per worker.

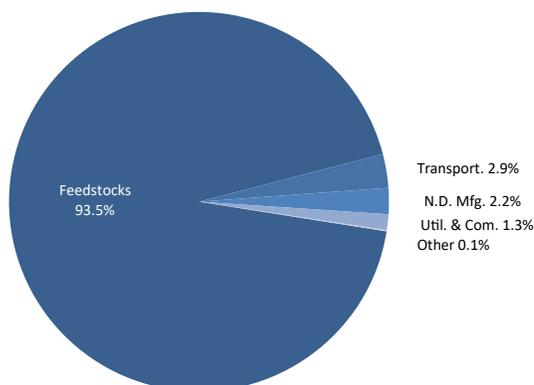
Thirty-three percent of contract workers in 2017 (869 workers) were engaged in capital repair and replacement, at a cost of \$95.6 million. In addition to this contract labor, the refiners made \$215.0 million in construction and other capital expenditures. Purposes included safety and environmental compliance, efficiency improvements and clean fuels.

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 93 percent of all non-labor operating expenditures.

Significant amounts are also spent on utilities and transportation, which together accounted for \$526.8 million in 2017. Utilities expenditures, including electricity, gas and communications, totaled \$167.46 million in 2017, and transportation totaled \$359.48 million. Transportation expenditures were primarily for waterborne transport of inbound and outbound product (Appendix A, Table A.7).

Taxes. Refiners paid \$231.6 million in state and local taxes in 2017 (See Table 7.2 on page 11.). The amount paid in 2016 was lower, \$197.0 million.

Figure 7.3: 2017 Non-Labor Operating Expenses



Source: 2018 Refiners Survey

Detail does not sum to 100% due to rounding

Table 7.2: Taxes Paid by Refiners in 2017

	(Millions)	% of Total
Retail sales and use tax	\$2.8	1.2%
Business and occupation tax	\$87.5	37.8%
Property tax	\$24.8	10.7%
Unemployment compensation tax (state only)	\$1.7	0.7%
Hazardous substance tax	\$102.2	44.1%
Oil spill tax	\$12.1	5.2%
Petroleum Products Tax	\$0.4	0.2%
Motor vehicle fuel tax	\$0.1	0.1%
Other	\$0.1	0.0%
Total	\$231.6	

Source: DOR, 2018 Refiners Survey

The state hazardous substance tax—\$102.2 million—contributed the largest share of total taxes paid in 2017, 44.1 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, \$87.5 million, 37.8 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, \$24.8 million and 10.7 percent of the total tax bill.

The fourth most costly tax in 2017 was the oil spill tax, \$12.1 million. It is a tax of 5 cents per barrel on crude oil or petroleum products that are

transported by ship, barge, railroad or (beginning April 1, 2018) pipeline in Washington and delivered to an in-state terminal. Of the proceeds, 4 cents are paid into the oil spill administration account and 1 cent into the oil spill response account. When 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 suspended from April 1, 2013 to Dec. 31, 2015. 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 industry. The current rate on this tax is 0.3 percent of product value. Revenues from this tax are dedicated to the pollution liability insurance pro-

Table 7.3: Regulatory Fees Paid by Refiners in 2017 (Dollars)

	Amount	% of Total
Air operating registration and permit fees	\$2,477,552	14.9%
Waste disposal fees	\$2,489,145	15.0%
Wastewater discharge fees	\$916,568	5.5%
Building Inspection Fees	\$18,000	0.1%
Building permit fees	\$5,139,000	30.9%
Other	\$5,590,382	33.6%
Total	\$16,630,647	

Source: 2018 Refiners Survey

gram, 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 tax was most recently suspended from July 1, 2017 through March 31, 2018. Refiners paid \$0.4 million in 2017.

The refineries reported paying \$2.8 million in sales and use taxes in 2017. Currently the sales and use tax rate paid by four of the refineries is 8.5 percent, while the rate paid by the other refinery is 9.5 percent.

Fees. In addition, the refiners paid \$16.6 million in regulatory fees in 2017. These included building permit fees (\$5.1 million), air operating registration and permit fees (\$2.5 million), and waste disposal fees (\$2.5 million). (See Table 7.3 on page 11.)

8. Comparison with Taxation of a California Refinery

Table 8 compares the taxation of hypothetical refineries that processed 160,000 barrels of crude oil per-day in Washington and California in 2017.

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 2017 tax burden in Washington, \$48.8 million, was nearly three times the burden in California, \$16.9 million. This is largely due to the fact that the Washington refinery pays 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 filed with the U.S. Securities and Exchange Commission, we estimate the taxable income for a 160,000 barrels-per-day refinery to be \$82.6 million and the corporate income tax due to be \$7.3 million.

Table 8: Taxes on a 160,000 Barrels per Day Refinery, 2017 (Millions of Dollars)

	Washington	California
Corporate Profits Tax		\$ 7.3
Business & Occupation Tax	\$ 19.0	
Hazardous Substance Tax	\$ 21.5	
Property Tax	\$ 4.2	\$ 5.0
Sales & Use Tax	\$ 0.8	\$ 0.8
Oil Spill Tax	\$ 3.3	\$ 3.8
	<u>\$ 48.8</u>	<u>\$ 16.9</u>

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 \$3.93 billion. This results in a B&O tax obligation of \$19.0 million at the manufacturing/wholesaling rate of 0.484 percent.

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 as a percentage of revenue are particularly low when crude oil prices are high. In the long run, the prices refiners pay for crude oil passes directly through to the prices they receive for products, as Figure 8 illustrates. On the figure we have plotted the monthly average U.S. Gulf Coast spot price of conven-

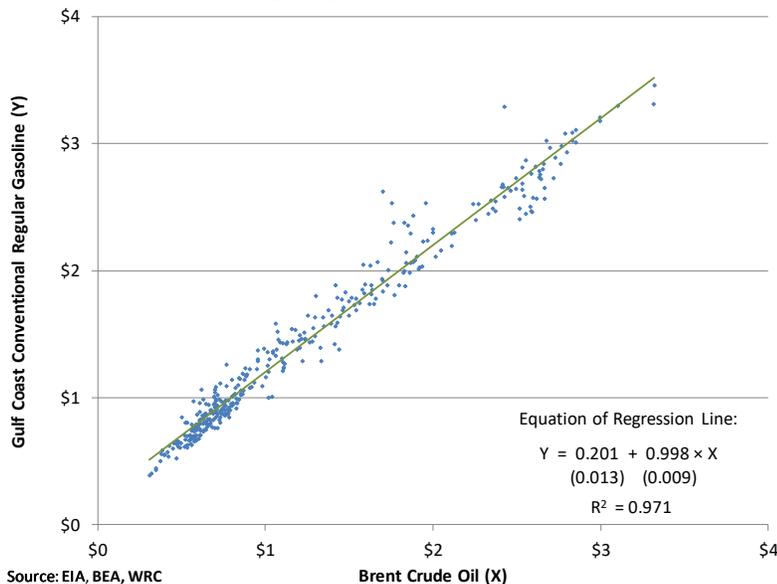
tional regular gasoline against the monthly average spot price of the benchmark European Brent crude oil (measured in dollars per gallon in both cases) from May 1987 to November 2018. The slope of the regression line through the data points is almost exactly equal to one.

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 0.6 percent to gross receipts of \$3.93 billion gives a \$21.5 million hazardous substance tax obligation for the 160,000 barrel per day Washington refinery. (Based on taxes actually paid by refineries in 2017, we use the 0.545 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 in Skagit County and that the California refinery is in the city of Martinez. We estimate that the taxes that would be paid by a 160,000 bbl/day refinery in Anacortes to be \$4.2 million. Based on the difference in property tax rates between Skagit County and Martinez, we estimate that such a refinery in Martinez would pay \$5.0 million in property taxes.

Sales and use tax. In 2017, the combined state and local sales tax rate was 8.5 percent in Skagit County and 8.75 percent in Martinez. Based on the survey of Washington refineries, we estimate transactions subject to the sales and use tax to be \$8.9 million and the amount paid to be 0.3 million.

Figure 8: Monthly Average Spot Prices May 1987 – November 2018
Gulf Coast Conventional Regular Gasoline vs. Brent Crude Oil
2009 Dollars Per Gallon



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. The full 5 cents was collected in 2017. Based on the amounts paid by Washington refineries in 2017, we estimate that the 160,000 barrel per day refinery would pay \$3.3 million in Washington. The oil spill tax rate in California is 6.5 cents per barrel, with no credit for exported product. The oil spill tax paid in California is then \$3.8 million.

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. The indirect economic effects also include the jobs, wages, and taxes of the supply chains of those suppliers.
- 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 11.68. Applying this multiplier to the 2,171 direct refinery jobs in 2017 gives a total state employment impact of 25,336 jobs.

This is large compared to employment multiplier typically seen in studies that use input-output models. For example, the 2007 Washington state Input-Output Study (2014) calculates that the employment multiplier for manufacturing/construction overall is 2.65. For the petroleum and coal products manufacturing sector (the “three-digit” sub-sector of manufacturing that contains the petroleum refining industry) the state study calculates an employment multiplier of 6.80.

The WRC-REMI model finds larger impacts because it is a more complete model of the state economy than the state Input-Output model. The REMI model incorporates many 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. Consumer purchases of specific goods and services respond to changes in relative prices and personal income. In addition, producers adjust production methods in response to changes in relative costs, market shares respond to

changes in regional production costs, and investment rises in response to increases in output.

Two channels of impact captured by the REMI model and absent from the Input-Output model are particularly important in explaining the high employment multiplier the WRC-REMI model finds for petroleum refining: government spending of the tax revenues paid by the refineries and investment spending by the refineries and their suppliers. When these two channels are turned off, the employment multiplier calculated for petroleum refining with the WRC-REMI model is 4.51. Government spending of the tax revenue generated by refining adds 2.29 to the multiplier, while investment spending adds 4.88. Of this 4.88, 1.45 is due to investment by the refineries and 3.43 is due to investments elsewhere in the economy.

Several additional factors contribute to the petroleum refining industry's large multiplier. First, petroleum refiners pay high wages. Thus, 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 (e.g. contract labor) pay unusually high wages.

The WRC-REMI model calculates that each refining job results in an additional \$873,000 of state personal income. At 2017 employment levels, the industry adds \$1.895 billion to state personal income.

In 2017 state and local sales and use taxes averaged \$0.0336 for each dollar of state personal income. With the income multiplier of \$873,000 each petroleum refining job results in \$29,300 in state and local sales taxes or a total of \$63.7 million.

The refiners directly paid \$87.5 million in B&O taxes in 2017. In 2017 state B&O taxes averaged \$0.0091 for each dollar of personal income. Multiplying this rate into \$1,429 million—the increase in state personal income we ascribe to the 2,171 refinery jobs net of the wages and benefits of the refinery workers—gives \$13.6 million additional induced and indirect B&O tax revenue, for a total of \$101.1 million, or \$46,600 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 2017, this refinery would have provided 568 jobs, and these workers would have re-

Table 9: Impact of a 160,000 Barrels Per Day Refinery

568 Direct Jobs
+6,069 Additional Jobs Elsewhere in the State Economy
\$105.3 Million Direct Compensation
+\$284.9 Million Additional Personal Income Elsewhere in the Economy
\$49.3 Million Direct Taxes
+\$20.2 Million Additional Sales, Use and B&O Taxes Elsewhere in the Economy

Source: WRC

ceived \$73.3 million in wages and salaries and \$32.0 million in benefits. In addition to the direct jobs and income, the refinery would generate 6,069 jobs and \$284.9 million in personal income elsewhere in the state's economy. The refinery itself would pay \$49.3 million in state and local taxes. In addition to these direct taxes, the indirect and induced activities generated by the refinery would provide \$20.2 million in sales, use and B&O tax revenue. (See Table 9 on page 15.)

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 due to 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, 50 percent leaves through pipeline to markets in Seattle and Tacoma and beyond. Another 36 percent goes by water to Seattle, Portland, or elsewhere with the remaining 14 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, Tables A.4 and A.5).

Jobs and wages. According to detailed data reported to the Bureau of Labor Statistics (BLS) for 2017, the most recent year for which such data are available, there were about 1,600 employers in these downstream industries. Together, they paid \$503 million in wages to 16,078 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

Table 10.1: Employment and Wages by Industry, 2017

Industry (NAICS Code)	Firms	Total Wages Paid	Average Employment	Average Annual Wage
Petroleum Bulk Stations and Terminals (424710)	25	\$52,764,882	791	\$66,707
Other Petroleum Merchant Wholesalers (424720)	81	\$69,513,304	991	\$70,145
Gasoline Stations With Convenience Store (447110)	1,371	\$258,561,320	11,827	\$21,862
Other Gasoline Stations (447190)	71	\$35,855,737	1,180	\$30,386
Fuel Dealers (45431)	56	\$54,870,574	1,021	\$53,742
Pipeline Transportation (486)	9	\$31,667,000	268	\$118,197

Source: BLS

Table 10.2: Taxable Income and Taxes Due by Industry, 2017 (Millions of Dollars)

Industry (NAICS Code)	Gross	Taxable	B&O Tax	Other Excise	Total
Petroleum Products Wholesaling (4247)	8,631.9	7,416.6	37.0	18.0	55.0
Gasoline Stations (447)	9,752.0	7,686.1	37.6	2.0	39.6
Fuel Dealers (45431)	458.0	419.6	2.1	0.5	2.6
Pipeline Transportation (486) 2016	43.8	41.1	0.2	D	D

Source: DOR

D: Value not disclosed by DOR

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:

- Pipeline Transportation Companies (crude oil, refined petroleum products and natural gas) employ a small number of highly paid workers—268 workers made \$118,197 (plus benefits) on average in 2017.
- Bulk stations and terminals, wholesalers, and fuel oil dealers employed about 2,800 workers who earned on average \$63,200 in 2017.
- Gasoline stations generate a large wage bill with a lot of lower-wage and part-time jobs. In 2017, this

industry's 1,442 employers paid total wages of \$294.4 million to 13,007 workers.

Taxes. The state Department of Revenue (DOR) reports excise tax data on petroleum products wholesaling, gas stations and fuel dealers for 2017 (DOR 2018a, 2018b). Excise tax data for 2017 is not disclosed for pipelines.

As shown in Table 10.2, excise taxes due from wholesaling, gas stations and fuel dealers industries totaled \$97.3 million in 2017. Gasoline stations paid \$39.6 million in excise taxes; wholesalers paid \$55.0 million; fuel dealers, \$2.6 million.

In 2016 pipeline companies paid \$222,000 in B&O taxes. DOR has not disclosed their taxes for 2017.

Appendix A

A.1: Quantity and Value of Feedstock Inputs	2016	2017
Feedstock Quantity (KBBL/Day)		
Crude Oil	609.9	572.3
Other	25.1	35.4
Total	635.0	607.6
Feedstock Value (\$K)		
Crude Oil	9,530,067	11,194,202
Other	390,137	476,774
Total	9,920,205	11,670,975
A.2: Quantity and Value of Output	2016	2017
Output Quantity (KBBL/Day)		
Gasoline	293.0	280.0
Diesel Oil	150.1	140.0
Jet and Turbine Fuel	92.1	93.1
Calcined Coke	5.9	6.0
LPG	7.9	7.9
Residual Fuel Oil	36.2	35.3
Propane	9.2	8.9
Coke	5.9	4.6
Sulfur	1.2	2.1
Marine Fuels	3.2	4.1
Gas Oils	8.8	12.4
Emulsified and Road Asphalt	7.0	7.0
Other	13.3	10.3
Total	634.0	611.9
Output Value (\$K)		
Gasoline	6,482,800	7,570,294
Diesel Oil	3,088,417	3,724,487
Jet and Turbine Fuel	1,836,106	2,315,285
Calcined Coke	147,808	167,653
LPG	88,655	86,976
Residual Fuel Oil	457,582	624,229
Propane	60,553	109,159
Coke	49,968	47,448
Sulfur	2,512	1,086
Marine Fuels	51,927	100,957
Gas Oils	163,525	251,986
Emulsified and Road Asphalt	110,124	133,883
Other	175,625	182,077
Total	12,715,602	15,315,519

A.3: Origin of Inputs 2017 (KBBL/Day)	Crude Oil	Other
Alaska	197.8	6.0
Canada (Conventional)	135.9	-
Canada (Oil Sands)	59.5	-
Bakken	133.3	2.0
All Other Origins	45.1	27.6

A.4: Destination of Output 2017 (KBBL/Day)	Washington	Other U.S.	Foreign	Total
Gasoline	118.9	116.4	19.9	255.2
Diesel Oil	85.1	74.4	4.9	164.3
Jet and Turbine Fuel	72.5	12.4	7.8	92.8
Calcined Coke	6.0	-	-	6.0
LPG	7.8	-	-	7.8
Residual Fuel Oil	17.6	12.2	5.1	34.9
Propane	9.1	-	-	9.1
Coke	0.0	-	4.6	4.6
Sulfur	0.8	-	1.3	2.1
Marine Fuels	3.8	-	-	3.8
Gas Oils	4.0	5.9	2.5	12.4
Emulsified and Road Asphalt	3.0	4.0	-	7.0
Other	3.3	5.5	0.9	9.7

A.5: Mode of Transport 2017	Pipeline	Water	Truck	Rail
Feedstocks (KBBL/Day)				
Crude Oil	166.0	256.4	-	149.7
Other	1.6	21.2	-	12.3
Outputs (KBBL/Day)				
Gasoline	158.8	91.9	28.0	1.0
Diesel Oil	70.5	45.1	24.1	0.1
Jet and Turbine Fuel	48.8	30.9	13.6	-
Calcined Coke	-	-	0.0	6.0
LPG	5.8	-	-	2.0
Residual Fuel Oil	-	34.9	-	-
Propane	0.8	-	7.0	1.4
Coke	-	-	4.6	0.0
Sulfur	-	-	1.7	0.5
Marine Fuels	1.2	2.9	-	-
Gas Oils	-	12.4	-	-
Emulsified and Road Asphalt	-	-	2.0	5.0
Other	3.3	4.5	-	2.5

A.6: Employment and Contract Labor	2016	2017
On-Site Employment		
Number of FTE Employees	2,142	2,171
Total Payroll (\$K)	279,358	280,346
Total Employee Benefits (\$K)	111,551	122,416
Contract Labor		
Expenditure (\$K)		
Service and Maintenance	110,805	193,868
Capital Repair and Replacement	83,556	95,629
Total	194,361	289,497
Number of Contract Workers (FTE)		
Service and Maintenance	1,001	1,789
Capital Repair and Replacement	743	869
Total	1,745	2,658

A.7: Operating Expenditures Other than Labor or Feedstock (\$K)	2016	2017
Non-Durable Manufactured Goods		
Petroleum Products	172,446	237,140
Other Non-Durable Goods	33,185	40,220
Total	205,631	277,360
Durable Manufacturing	13,713	24,258
Construction	3,030	3,177
Transportation		
Rail	132,011	129,155
Trucking	3,334	3,665
Automobiles	2,700	3,275
Waterborne	197,138	209,131
Air	-	-
Other	14,194	14,161
Total Transportation	349,377	359,386
Utilities and Communications		
Electricity	53,687	50,547
Gas	93,606	102,979
Other	11,580	13,892
Total U&C	158,873	167,417
Finance, Insurance and Real Estate	7,760	7,574
Business Services	4,788	3,801
Other Services	1,800	1,473

A.8: Non-Labor Capital Expenditures	2016	2017
Equipment (\$K)	105,426	124,206
Materials and Supplies (\$K)	87,841	85,280
Construction (\$K)	11,658	5,525
Other (\$K)	-	-
Total	234,362	282,872
A.9: Taxes and Fees (State and Local)	2016	2017
Taxes (\$K)		
Retail Sales and Use tax		
Business and Occupation Tax	2,283	2,791
Property Tax	71,320	87,473
Unemployment Insurance Tax	24,622	24,766
Industrial Insurance Premium	2,063	1,662
Hazardous Substance Tax	5,553	5,205
Oil Spill Tax	84,691	102,160
Petroleum Products Tax	10,916	12,110
Motor Vehicle Fuel Tax	729	360
Special Fuel Tax	139	138
Other	7,321	4,991
Regulatory Fees (\$K)	244	113
Air Operating Registration and Permit Fees		
Waste Disposal Fees	2,353	2,478
Wastewater Discharge Fees	1,725	2,489
Building Inspection Fees	1,122	917
Building Permit Fees	21	18
Other	5,289	5,139
	5,891	5,590
A.10: Estimated Services and Retail Trade	2016	2017
Food Services (\$K)		
Associated with Contract Labor		
Associated with Business Visitors	1,040	2,032
Total	747	809
Hotel and Motels (\$K)	1,787	2,841
Associated with Contract Labor		
Associated with Business Visitors	589	2,414
Total	972	1,245
Other Trade and Services (\$K)	1,561	3,659
Associated with Contract Labor		
Associated with Business Visitors	514	26
Total	562	65
	1076	91
A.11: Contributions	2016	2017
Corporate		
Firm-Sponsored Employee Giving	1,554	1,583
	449	475

Appendix B: Petroleum Product Exports from Washington State

	2017		2016	
Canada	\$968,073,339	1	\$1,018,623,622	1
Mexico	\$465,013,620	2	\$453,596,117	2
Chile	\$61,916,443	3	\$150,595,029	3
Australia	\$58,608,748	4	\$74,784,981	6
New Zealand	\$31,276,949	5	\$28,360,668	7
Brazil	\$30,180,000	6	\$28,308,302	8
Saudi Arabia	\$27,300,000	7	\$14,986,407	14
India	\$24,167,931	8	\$6,037,792	17
Japan	\$22,170,345	9	\$7,846,461	16
Oman	\$21,297,430	10	\$27,050,602	9
Singapore	\$20,617,092	11	\$83,878,377	4
Peru	\$19,894,298	12	\$82,683,429	5
United Arab Emirates	\$19,728,868	13	\$4,329	42
Panama	\$19,386,192	14	\$35,418	32
Korea, Republic Of	\$14,317,784	15	\$44,110	31
Malaysia	\$10,261,272	16	\$15,415,359	13
Taiwan	\$8,171,323	17	\$17,957,338	12
Belgium	\$6,467,074	18	\$22,159,986	11
Qatar	\$5,400,000	19	\$0	44
China	\$4,916,871	20	\$26,863,615	10
Mozambique	\$2,850,000	21	\$0	44
Thailand	\$359,855	22	\$459,776	19
Guatemala	\$343,256	23	\$271,390	22
Indonesia	\$299,486	24	\$353,631	20
Colombia	\$287,549	25	\$127,450	25
Dominican Republic	\$267,400	26	\$60,091	29
Costa Rica	\$208,018	27	\$63,644	27
Russia	\$195,922	28	\$155,308	24
Philippines	\$133,299	29	\$301,307	21
Mali	\$84,166	30	\$61,227	28
Germany	\$67,970	31	\$4,558	41
Palau	\$62,923	32	\$0	44
Nicaragua	\$49,953	33	\$101,309	26
Solomon Islands	\$38,400	34	\$0	44
Afghanistan	\$21,036	35	\$0	44
Ecuador	\$12,934	36	\$2,981	43
Kuwait	\$12,933	37	\$0	44
Netherlands	\$9,843	38	\$12,247,094	15
Federated States Of Mic	\$9,348	39	\$0	44
Paraguay	\$9,321	40	\$0	44
Marshall Islands	\$8,619	41	\$5,441	38
Sri Lanka	\$5,400	42	\$0	44
Bolivia	\$4,014	43	\$0	44
Italy	\$3,828	44	\$0	44
Barbados	\$3,135	45	\$0	44
Other	\$0		\$4,698,926	
Total	\$1,844,514,187		\$2,078,146,075	

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+ 1.7.2 of the WRC-REMI model. We use a custom regional control with the standard responses of government spending to changes in economic activity turned off. We increase government spending via the state and local government spending policy variables based on taxes refiners report paying. Additionally we increase investment using the nonresidential investment policy variable, based on the amount refiner reported investment exceeds that predicted by the REMI model's investment equation.

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