



# FRACKED FUEL AND PETROCHEMICAL PROPOSALS IN THE NORTHWEST

COUSINS TO COAL AND OIL EXPORT PROJECTS GET THEIR FIRST REGIONWIDE REVIEW, REVEALING RISKS TO NORTHWEST WATER AND AIR.

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## Background

The Pacific Northwest states of Oregon and Washington are facing a raft of proposals to build large-scale fossil fuel energy facilities. Situated between vast carbon fuel deposits in the North American interior and fast-growing energy markets in Asia, the Northwest has become a major area of focus for the world's coal, oil, and gas industries. Although many of the proposals are intensely controversial, analysts and the media have for the most part overlooked or left unexplored one category of these projects: fracked fuel and petrochemical schemes that would transform the Northwest into a major international shipping hub for fossil fuels and their byproducts.

Fracked fuels and petrochemicals represent the third wave of interest in the region from the energy industry. The first wave began in 2010 when the US coal industry announced plans to build six coal export terminals in Oregon and Washington that would be capable of shipping up to 145 million metric tons of coal per year to markets abroad. The second wave began in 2012, with industry backers proposing 14 sites where crude oil transported by rail would be shipped overseas—as much as one million barrels a day.

This report provides the first regionwide inventory of the fracked fuel and petrochemical projects under consideration.

## Analysis

The proposed fracked fuel and petrochemical projects have gained much less attention than the coal export and oil-by-rail terminal projects that have become so controversial in the Northwest. The projects encompass an array of fuels and technologies, but they share some core features: they are made possible in large part by new oil and gas extraction techniques, especially fracking, and they either burn carbon-based fossil fuels or use them for manufacturing plastics and related products.

Stretching from Coos Bay, Oregon, in the south to Washington's Puget Sound in the north, the proposed fracked fuel and petrochemical projects pose a range of challenges. They would consume large quantities of fresh water, create potentially serious safety risks to local communities, release various forms of toxic contaminants into the Northwest's air and water, and increase the region's carbon pollution load.

Sightline's analysis of these proposed projects has found:

- Oregon and Washington are home to at least eight serious proposals to handle and export very large quantities of fracked fuel and petrochemicals. All of the projects would be located on the shorelines of ecologically sensitive water bodies, including four on the Columbia River, three on Puget Sound, and one on Coos Bay.



- Taken together, the proposed projects would export 16.7 million metric tons of liquefied natural gas and 27.4 million barrels of propane-like gases annually. Both natural gas and propane are gaseous at atmospheric pressure and are compressed into a liquid state for transport. Both products must be handled with extreme care because of the risks of severe fires and explosions.
- The proposed projects would also produce and export petrochemicals, including 14.5 million tons of methanol and 5.5 million barrels of xylene annually. If the projects are built, the Northwest would become the biggest methanol-producing region in North America and would have the world's largest methanol refinery.
- The methanol and xylene projects are designed to provide materials for manufacturers in China. These plants would receive relatively inexpensive raw fuels—shale oil and natural gas—that are commonly extracted with fracking technologies and would process them into the chemical precursors of plastics and other synthetic materials.
- The facilities analyzed in this report would receive their inputs from yet-to-be-built gas pipelines, mile-long “unit” trains, and tanker vessels. All of the projects would export their products using large oceangoing vessels.

## Findings

Product	Project name	Backer	Location	Annual capacity
LNG	Jordan Cove	Veresen	Coos Bay, OR	6.8 million metric tons
	Oregon LNG	Leucadia	Warrenton, OR	9.6 million metric tons
	Tacoma LNG	Puget Sound Energy	Tacoma, WA	0.3 million metric tons
LPGs	Washington Energy Storage & Transfer	Waterside Energy	Longview, WA	27.4 million barrels
Methanol	Port of Tacoma	NW Innovation Works	Tacoma, WA	7.3 million tons
	Port of Kalama	NW Innovation Works	Kalama, WA	3.6 million tons
	Port of St. Helens	NW Innovation Works	Clatskanie, OR	3.6 million tons
Xylene	Clean Products Upgrade Project	Tesoro	Anacortes, WA	5.5 million barrels

## Liquefied Natural Gas

Liquefied natural gas (LNG) projects are designed to convert natural gas, which today is often extracted by fracking, into a condensed form suitable for large-scale storage or transportation by ship. LNG facilities receive natural gas by pipeline, remove impurities such as water vapor, carbon dioxide, and sulfur, and then convert the gas into liquid form by cooling it to -260 degrees Fahrenheit. Because the liquid form of natural gas is just 1/600 the volume of its gaseous form, liquefaction allows companies to store and transport very large quantities of natural gas. Plant operators typically produce LNG either for export in specially designed oceangoing vessels or for storage at “peak-shaving” facilities that distribute the gas back into a local pipeline system during periods of high consumer demand.<sup>1</sup>

Three LNG projects are proposed for Oregon and Washington.

### Jordan Cove Energy Project (Coos Bay, Oregon)

The proposed Jordan Cove Energy Project would build a large natural gas shipping hub on the North Spit of Coos Bay, Oregon.<sup>2</sup> Gas would arrive at the site via a proposed 36-inch-diameter, 230-mile pipeline that would connect to an interstate pipeline hub at Malin, Oregon.<sup>3</sup> The Pacific Connector Gas Pipeline would be capable of delivering 1 billion cubic feet of gas per day to the 400-acre site,<sup>4</sup> where it would be cooled into a liquid state and stored in two large tanks with a total storage capacity of 320,000 cubic meters.<sup>5</sup> The plant’s operations would be powered by a 420-megawatt natural-gas-fired power plant to be built adjacent to the export terminal. An average of two LNG marine carriers would call at the terminal weekly, each spending about 24 hours in port. In total, the facility would be capable of producing 6 million metric tons of LNG per year, but project backers have applied for permits to export up to 6.8 million metric tons annually.<sup>6</sup>

The project is backed by a partnership between two energy companies: Veresen would build and operate the LNG facility, while Williams Companies would build the pipeline.<sup>7</sup> The Federal Energy Regulatory Commission (FERC), the agency that oversees LNG facility approvals, issued a final environmental impact statement (EIS) in late September 2015. Follow-on approvals that were expected by the end of 2015 did not arrive by that date, but Veresen apparently still anticipates receiving these, along with the final “notice to proceed” that allows construction, in mid-2016.<sup>8</sup> In addition, multiple Oregon agencies, including the Department of State Lands and the Department of Environmental Quality, are reviewing applications for a range of state permits that are legally required before the project can begin construction.

### Oregon LNG (Warrenton, Oregon)

The backers of Oregon LNG are proposing to build a \$6 billion natural gas liquefaction and export facility at Warrenton, Oregon, at the mouth of the Columbia

River.<sup>9</sup> To supply the plant, Oregon LNG would construct a 36-inch-diameter, 87-mile pipeline connecting the proposed Warrenton terminal to the main Williams Northwest Pipeline at Woodland, Washington.<sup>10</sup>

The project also includes a proposal called the Washington Expansion Project, which would expand the capacity of 140 miles of existing pipeline along the Interstate 5 corridor between Woodland and Sumas, Washington, by constructing 10 noncontiguous 36-inch-diameter pipeline loops.<sup>11</sup> The new pipeline system would be able to deliver as much as 1.25 billion cubic feet of gas per day to the 96-acre site, where it would be liquefied and stored in two large storage tanks with a total capacity of 320,000 cubic meters.<sup>12</sup> Up to 125 LNG marine carriers would call at the terminal yearly, each spending about 24 hours in port.<sup>13</sup> The facility would be capable of producing 9 million metric tons of LNG per year, but the project backers have applied for permits to export up to 9.6 million metric tons annually.<sup>14</sup>

The project has been proposed by a diversified holding company, Leucadia National Corporation.<sup>15</sup> The company had hoped to start construction in 2016, completing work in early 2020, but most observers agree that this timeline is unrealistic. Although FERC issued a draft EIS in August 2015, with a final statement expected by spring 2016, the proposal has yet to receive key local, state, and federal permits. Among other problems, Clatsop County, where the facility would be located, has denied the company permission to build its pipeline, and the project backers are embroiled in a legal dispute with the US Army Corps of Engineers over the Corps' previously existing property rights at the proposed Oregon LNG site.<sup>16</sup>

### Tacoma LNG (Tacoma, Washington)

Puget Sound Energy, a heating and power utility that serves much of western Washington, plans to build a \$275 million LNG facility at the Port of Tacoma.<sup>17</sup> The proposal includes 5 miles of new pipelines, ranging from 12 to 16 inches in diameter, that would run through Tacoma, Fife, and unincorporated Pierce County to connect the facility to an existing pipeline. The facility would produce up to 293,881 metric tons of LNG annually and it would be capable of storing as much as 12,882 metric tons onsite in a single tank.<sup>18</sup> During periods of peak demand for natural gas, the utility company would regasify the LNG and supply it to homes and businesses in the region. It would also provide LNG as a fuel for marine vessels that have been converted from diesel-only power, and it could sell the fuel to various other third parties in the region.

FERC issued a final EIS in October 2015, paving the way for local permitting and construction. Although developers expect that the project will be operational by 2018, the nearby Puyallup Tribe filed suit in December 2015 asking local authorities to rescind some initial permits and conduct further evaluations of the project.<sup>19</sup>

## Liquid Petroleum Gases

Liquid petroleum gases (LPGs) are hydrocarbon-based gases that are often byproducts of natural gas processing or petroleum refining. LPGs are gases at atmospheric pressure, but they are often compressed slightly to create a liquid suitable for transport or storage. Most people are familiar with the LPGs propane and butane, which fuel backyard grills and camping stoves, but LPG fuels are also used in much larger quantities for industrial purposes. In addition, they are commonly used to create the petrochemicals used in the production of plastics, alcohol, fibers, cosmetics, and other products. LPGs can also be used as transportation fuels for motor vehicles; although uncommon in North America, LPG-based “autogas” is widely used in Korea, Russia, Turkey, and other parts of Asia and Europe.

Two LPG-by-rail project proposals have recently failed in the Northwest. In March 2015, the Port of Longview, Washington, rejected a 47,000-barrel-per-day propane export terminal proposed by Haven Energy.<sup>20</sup> A few days later, a 37,500-barrel-per-day project backed by the Pembina Pipeline Corporation at the Port of Portland was effectively killed when the mayor, formerly a backer of the project, abruptly reversed course and opposed it.<sup>21</sup> As of early 2016, only one LPG export proposal was active in the Northwest.

### Washington Energy Storage and Transfer LPG Export Terminal (Longview, Washington)

Waterside Energy, a company with virtually no corporate history, is backing a proposed venture at Longview that appears to have changed over time.<sup>22</sup> The project, dubbed Washington Energy Storage and Transfer (WEST), would build a \$450 million propane storage facility capable of receiving an average of one train per day, each bearing 75,000 barrels of propane and other LPGs delivered from Canada and North Dakota.<sup>23</sup> Once onsite, the fuel would be pumped from rail tank cars into the terminal’s refrigerated storage tanks, which together could store up to 1.1 million barrels.<sup>24</sup> The facility would export four shiploads per month to Asia.

The Port of Longview has jurisdiction over the underground pipeline, rail corridor, and wharf needed for the project’s development and operations.<sup>25</sup> The terminal would also need approval from Washington’s Energy Facility Site Evaluation Council, the permitting body that governs large energy projects in the state. Waterside has said that it anticipates submitting an application in early 2016 and publishing a draft EIS in May 2016, but the project backers appear to have made very little progress toward advancing the plan. The firm hopes for a final EIS by January 2017, with a final decision from the governor in March 2017.<sup>26</sup>

At an adjacent property, the same project backers are promoting a separate proposal under the name Riverside Refining: an \$800 million, 45,000-barrel-per-day oil refinery. The refinery would process 15,000 barrels per day of internationally sourced biofuels that would arrive in two or three tanker vessels per month; these fuels would be blended with 30,000 barrels per day of oil arriving on roughly three unit trains per week from the Bakken shale formation in North Dakota. There is no known timeline for permitting on the Riverside Refining project.<sup>27</sup>

## Methanol

Methanol is a liquid petrochemical that can be put to a range of uses. It can be blended into gasoline or diesel, used as an element in biodiesel production, combusted for home heating and cooking, or used to make portable fuel cells. Methanol is also used in wastewater treatment. Most frequently, however, it is used for manufacturing products such as formaldehyde, paints, resins, insulation, and plastics. A simple alcohol—light, colorless, and flammable at room temperature—it is typically synthesized from fossil fuels such as coal and oil, or from biomass such as wood and plant material. A recent development in refining technology allows producers to derive methanol from natural gas, a process that is billed as an improvement over costlier and dirtier feedstocks such as naphtha or coal.<sup>28</sup>

All three of the proposed methanol projects in the Northwest are backed by Northwest Innovation Works, a subsidiary of the Chinese Academy of Sciences Holdings, which is itself the investment arm of the Chinese Academy of Sciences, a China state-owned institution that develops and markets new technologies. These sites would receive natural gas by pipeline, refine it into a distilled and purified manufacturing-grade methanol, and then load it onto Panamax-sized tanker ships bound for China where yet-to-be-built chemical plants would convert the methanol into olefins. Although the project backers insist that Northwest-produced methanol would be used to manufacture plastics, there is evidence that China aims to use methanol as a significant source of fuel for the growing number of cars and trucks in the country.<sup>29</sup>

Collectively, the three refineries could increase natural gas use in the Pacific Northwest by 40 percent—more than triple the entire US methanol industry's current output—with much of it likely produced through fracking.<sup>30</sup>

### Northwest Innovation Works at the Port of Kalama (Kalama, Washington)

The Port of Kalama awarded a lease agreement for a methanol refinery to Northwest Innovation Works in April 2014, along with a separate agreement for the company to locate its corporate headquarters in Kalama.<sup>31</sup> At full buildout, the \$1.8 billion facility would be able to produce 3.6 million metric tons of methanol per year, which would be exported to China in three to six tankers per month.<sup>32</sup>

The company had originally hoped to obtain permits in 2015 and complete the first phase of construction by 2017, but the project is already somewhat delayed. A draft EIS is slated for publication and review in March 2016.<sup>33</sup> Northwest Innovation Works will also need to secure an air permit, a water quality permit, and a stormwater discharge permit from the Washington Department of Ecology. Project backers say they hope to complete construction in early 2018, with a second phase operational by early 2019.<sup>34</sup>

In August 2014, Northwest Innovation Works signed an agreement with Williams Partners to construct a 3.1-mile, 24-inch pipeline called Kalama Lateral that would deliver 320 million cubic feet of natural gas per day to the site.<sup>35</sup> The pipeline received a favorable environmental assessment report from FERC in July 2015,<sup>36</sup> and the project backers anticipate having the pipeline in service by late 2017.<sup>37</sup>

### **Northwest Innovation Works at the Port of Tacoma (Tacoma, Washington)**

Northwest Innovation Works has obtained a 30-year lease agreement with the Port of Tacoma for a \$3.4 billion refinery that would be able to produce 7.3 million metric tons of methanol per year—more than double the capacity of the facility planned for Kalama. It would be the largest methanol production facility in the world. Natural gas would arrive at the plant via a newly constructed 11-mile underground pipeline lateral to the existing Williams natural gas pipeline east of Interstate 5. Project backers say the plant will consume about 7,200 gallons of water per minute to cool chemical reactions, nearly as much as Tacoma's total residential water use.<sup>38</sup>

The project is currently in the “scoping” phase of its EIS process, during which officials will determine the breadth of their review. Northwest Innovation Works hopes to break ground on phase one of the plant in the fourth quarter of 2017, with operations commencing by the end of 2020. A second phase would start construction in late 2018 and begin operations in 2021.<sup>39</sup>

### **Northwest Innovation Works at the Port of St. Helens (Clatskanie, Oregon)**

A third methanol facility is planned for Port Westward, a publicly owned industrial park near Clatskanie, Oregon. In February 2014, the Port of St. Helens and Northwest Innovation Works signed an Option to Lease agreement for the site.<sup>40</sup> Like the one at Kalama, the \$1.8 billion facility would produce 3.6 million metric tons of methanol per year from natural gas delivered by pipeline.

Project backers are still negotiating a lease agreement with the Port of St. Helens. They anticipate a 12- to 18-month permitting phase starting in 2016, which will include local land use approvals as well as air quality, water quality, and stormwater permits from the Oregon Department of Environmental Quality. No project schedule for construction and operations has yet been published.<sup>41</sup>

## Xylene

Xylene is a lesser-known liquid petrochemical that is the principal chemical precursor in the production of polyethylene terephthalate (PET), which is used for making plastic bottles, polyester fibers, food packaging, paint, rubber, solvents, and other products.<sup>42</sup> Xylene is created from a partially refined crude oil product called “reformate” that is often produced from light oil, such as Bakken shale oil, which yields particularly high levels of petroleum naphtha.<sup>43</sup>

Currently, the Northwest is home to one proposal to produce and export xylene.

### Tesoro Refinery Clean Products Upgrade Project (Anacortes, Washington)

In July 2014, Tesoro announced plans to build a xylene extraction facility at its Anacortes oil refinery.<sup>44</sup> The \$400 million facility would be capable of producing 15,000 barrels per day for export in oceangoing tankers, primarily to Asia. When fully operational, the Anacortes facility would represent a 9 percent increase in total US xylene production.<sup>45</sup>

The refinery would “recover” xylene from the refinery’s crude oil production processes. To do so, Tesoro would direct about half of the 32,000 barrels of reformate produced per day onsite at the Anacortes refinery, along with additional reformate shipped by vessel from the company’s Golden Eagle Refinery in California, toward the production of xylene. Tesoro’s Anacortes refinery was the first site in the Northwest to begin receiving large-scale rail deliveries of crude oil from the Bakken shale formation.<sup>46</sup>

Skagit County is in the process of determining the project’s requirements under the State Environmental Policy Act, which will determine what permits are required. Tesoro says it aims to begin construction in 2016 and start producing xylene by 2017 or 2018.<sup>47</sup>

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## Endnotes

1. US Department of Energy, "Liquefied Natural Gas: Understanding the Basic Facts," August 2005, [http://energy.gov/sites/prod/files/2013/04/f0/LNG\\_primerupd.pdf](http://energy.gov/sites/prod/files/2013/04/f0/LNG_primerupd.pdf); and US Department of Energy, "Liquefied Natural Gas," <http://energy.gov/fe/science-innovation/oil-gas/liquefied-natural-gas>.
2. Pacific Connector Gas Pipeline, "Overview," <http://pacificconnectorgp.com/about-the-project/overview>.
3. US Federal Energy Regulatory Commission, "FERC Staff Issues the Final Environmental Impact Statement for the Jordan Cove Liquefaction and Pacific Connector Pipeline Projects (CP13-483-000 and CP13-492-000)," [www.ferc.gov/industries/gas/enviro/eis/2015/09-30-15-eis.asp](http://www.ferc.gov/industries/gas/enviro/eis/2015/09-30-15-eis.asp).
4. Oregon Department of Environmental Quality, "Jordan Cove Energy Project," [www.oregon.gov/deq/wr/pages/jordancove.aspx](http://www.oregon.gov/deq/wr/pages/jordancove.aspx).
5. Jordan Cove LNG, "Project," <http://jordancovelng.com/project>.
6. Jordan Cove LNG, "Frequently Asked Questions," <http://jordancovelng.com/project/faqs>.
7. Ted Sickinger, "Jordan Cove LNG terminal offers economic windfall, but creates big divisions in Coos Bay," May 27, 2014, [www.oregonlive.com/business/index.ssf/2014/05/jordan\\_cove\\_lng\\_terminal\\_in\\_co.html](http://www.oregonlive.com/business/index.ssf/2014/05/jordan_cove_lng_terminal_in_co.html).
8. Jordan Cove LNG, "Jordan Cove LNG and Pacific Connector Gas Pipeline Receive Final Environmental Impact Statement," <http://jordancovelng.com/wp-content/uploads/2015/09/NR-JCLNG-Receives-FEIS-FINAL-30-SEPT-15.pdf>; and US Federal Energy Regulatory Commission, "FERC Staff Issues the Final Environmental Impact Statement for the Jordan Cove Liquefaction and Pacific Connector Pipeline Projects (CP13-483-000 and CP13-492-000)," [www.ferc.gov/industries/gas/enviro/eis/2015/09-30-15-eis.asp](http://www.ferc.gov/industries/gas/enviro/eis/2015/09-30-15-eis.asp).
9. Oregon LNG, "Welcome," [www.oregonlng.com](http://www.oregonlng.com).
10. Oregon LNG, "Welcome to Oregon Pipeline," [www.oregonlng.com/pipeline](http://www.oregonlng.com/pipeline).
11. US Federal Energy Regulatory Commission, "Oregon LNG and Washington Expansion Projects," August 2015, [http://www.oregonlng.com/static/media/uploads/deis/OLNG\\_WEP\\_DEIS\\_Vol\\_1\\_August\\_2015.PDF](http://www.oregonlng.com/static/media/uploads/deis/OLNG_WEP_DEIS_Vol_1_August_2015.PDF).

12. US Federal Energy Regulatory Commission, “Oregon LNG and Washington Expansion Projects,” August 2015, [http://www.oregonlng.com/static/media/uploads/deis/OLNG\\_WEP\\_DEIS\\_Vol\\_1\\_August\\_2015.PDF](http://www.oregonlng.com/static/media/uploads/deis/OLNG_WEP_DEIS_Vol_1_August_2015.PDF).
13. US Federal Energy Regulatory Commission, “Oregon LNG and Washington Expansion Projects,” August 2015, [http://www.oregonlng.com/static/media/uploads/deis/OLNG\\_WEP\\_DEIS\\_Vol\\_1\\_August\\_2015.PDF](http://www.oregonlng.com/static/media/uploads/deis/OLNG_WEP_DEIS_Vol_1_August_2015.PDF).
14. Oregon LNG, “Terminal,” [www.oregonlng.com/terminal](http://www.oregonlng.com/terminal); and US Federal Energy Regulatory Commission, “Oregon LNG and Washington Expansion Projects,” August 2015, [http://www.oregonlng.com/static/media/uploads/deis/OLNG\\_WEP\\_DEIS\\_Vol\\_1\\_August\\_2015.PDF](http://www.oregonlng.com/static/media/uploads/deis/OLNG_WEP_DEIS_Vol_1_August_2015.PDF).
15. Oregon LNG, “About Leucadia National Corporation,” <http://www.oregonlng.com/about/ownership>.
16. Oregon LNG, “Draft Environmental Impact Statement,” [www.oregonlng.com/draft-environmental-impact-statement](http://www.oregonlng.com/draft-environmental-impact-statement); Oil Online, “Midstream,” [www.oilonline.com/news/midstream/ferc-timeline-oregon-lng-facility-final-approval](http://www.oilonline.com/news/midstream/ferc-timeline-oregon-lng-facility-final-approval); Erick Bengel, “New dredge spoil site could change Army Corps, Oregon LNG dispute,” Daily Astorian, December 21, 2015, [www.dailyastorian.com/LocalNews/20151221/new-dredge-spoil-site-could-change-army-corps-oregon-lng-dispute](http://www.dailyastorian.com/LocalNews/20151221/new-dredge-spoil-site-could-change-army-corps-oregon-lng-dispute); and January 2016 communications with Dan Serres, conservation director, Columbia Riverkeeper.
17. Tacoma LNG, “Project Summary,” <http://tacomacleanlng.com/project-summary>.
18. City of Tacoma, “PSE LNG FEIS Executive Summary,” <http://cms.cityoftacoma.org/planning/pse/PSE%20LNG%20FEIS%20Executive%20Summary.pdf>; City of Tacoma, “Resolution No. 39302,” <https://cityoftacoma.legistar.com/Legislation.aspx>; and City of Tacoma, “PSE LNG FEIS Executive Summary,” <http://cms.cityoftacoma.org/planning/pse/PSE%20LNG%20FEIS%20Executive%20Summary.pdf>. To report the capacity at Tacoma LNG in units consistent with other LNG projects in the region, Sightline converts the figures in the project documents from volume to weight using a factor of 621 US gallons per metric ton, a typical industry standard.
19. City of Tacoma, “PSE Proposed Tideflats LNG Facility,” [www.cityoftacoma.org/government/city\\_departments/planning\\_and\\_development\\_services/planning\\_services/pse\\_proposed\\_tideflats\\_lng\\_facility](http://www.cityoftacoma.org/government/city_departments/planning_and_development_services/planning_services/pse_proposed_tideflats_lng_facility); Adam Lynn, “Puyallup tribe asks court to halt permits for Tacoma gas plant,” Tacoma News Tribune, December 20, 2015, [www.thenewstribune.com/news/local/article50986020.html](http://www.thenewstribune.com/news/local/article50986020.html).
20. Marissa Luck and Bruce Johnson, “Port of Longview commissioners reject Haven Energy lease on 3-0 vote,” Longview Daily News, March 10, 2015, [http://tdn.com/news/local/port-of-longview-commissioners-reject-haven-energy-lease-on-article\\_f7e284cc-c73f-11e4-bc68-5f5ac32ce6b8.html](http://tdn.com/news/local/port-of-longview-commissioners-reject-haven-energy-lease-on-article_f7e284cc-c73f-11e4-bc68-5f5ac32ce6b8.html).
21. Nigel Jaquiss, “Mayor Charlie Hales Withdraws Support for Pembina Propane Terminal,” Willamette Week, May 7, 2015, <http://www.wweek.com/portland/blog-33181-mayor-charlie-hales-withdraws-support-for-pembina-propane-terminal-updated.html>.
22. Eric de Place and Maoulay Adjorlolo, “The Proposed Longview Refinery: Understanding the Basics,” Sightline Institute, July 9, 2015, [www.sightline.org/2015/07/09/the-proposed-longview-refinery-understanding-the-basics](http://www.sightline.org/2015/07/09/the-proposed-longview-refinery-understanding-the-basics).
23. Waterside Energy, “Longview Energy Center,” summer 2015, <http://www.portoflongview.com/Portals/0/Documents/Waterside%20Energy/09022015%20WatersideRiversideWEST.pdf>.
24. TankTerminals.com, “Port of Longview Refinery Proposal Now Includes LPG Export Terminal,” September 4, 2015, [www.tankterminals.com/news\\_detail.php?id=3334](http://www.tankterminals.com/news_detail.php?id=3334).
25. Marissa Luck, “More than oil: Texas firm pitches propane export at Port of Longview,” Longview Daily News, September 3, 2015, [http://tdn.com/news/more-than-oil-texas-firm-pitches-propane-export-at-port/article\\_17db827d-0260-59be-9750-6c4b00e1e2d5.html](http://tdn.com/news/more-than-oil-texas-firm-pitches-propane-export-at-port/article_17db827d-0260-59be-9750-6c4b00e1e2d5.html).
26. TankTerminals.com, “Port of Longview Refinery Proposal Now Includes LPG Export Terminal,” September 4, 2015, [www.tankterminals.com/news\\_detail.php?id=3334](http://www.tankterminals.com/news_detail.php?id=3334).
27. “Riverside Refining Presentation,” Longview Daily News, [http://tdn.com/pdf/riverside-refining-presentation/pdf\\_857200a4-c07c-5acd-8d6b-86f61064b646.html](http://tdn.com/pdf/riverside-refining-presentation/pdf_857200a4-c07c-5acd-8d6b-86f61064b646.html).
28. Mike Nash, “The changing face of methanol demand,” IHS Chemical Week, July 20, 2015, [www.chemweek.com/lab/The-changing-face-of-methanol-demand\\_72206.html](http://www.chemweek.com/lab/The-changing-face-of-methanol-demand_72206.html); and Eric de Place and Maoulay Adjorlolo, “What Methanol Means for the

- Northwest,” Sightline Institute, August 17, 2015, [www.sightline.org/2015/08/17/what-methanol-means-for-the-northwest](http://www.sightline.org/2015/08/17/what-methanol-means-for-the-northwest).
29. Honeywell UOP, “A different game plan: Gregory A. Funk, David Myers, and Bipin Vora, UOP, USA, discuss new technology for the production of ethylene and propylene from methanol,” December 2013, [www.uop.com/wp-content/uploads/2013/12/Methanol-to-Olefins-Technology-Hydrocarbon-Engineering-Dec-2013.pdf](http://www.uop.com/wp-content/uploads/2013/12/Methanol-to-Olefins-Technology-Hydrocarbon-Engineering-Dec-2013.pdf); and Methanol Institute, “China: The Leader in Methanol Transportation,” Methanol Facts, July 2011, <http://methanol.org/Methanol-Basics/Resources/China-Methanol.aspx>; Zana Nesheiwat, “China’s Growing Methanol Economy,” <http://cleantechnica.com/2013/04/15/chinas-growing-methanol-economy>; and Eric de Place and Maoulay Adjorlolo, “Why China Wants Methanol from the Northwest,” Sightline Institute, September 22, 2015, [www.sightline.org/2015/09/22/why-china-wants-methanol-from-the-northwest](http://www.sightline.org/2015/09/22/why-china-wants-methanol-from-the-northwest).
  30. David Ferris, “Enormous Northwest refineries would feed China exclusively,” E&E EnergyWire, November 17, 2015, [www.eenews.net/stories/1060028071](http://www.eenews.net/stories/1060028071).
  31. Cowlitz Economic Development Council, “NW Innovation International Headquarters Chooses Kalama!” January 30, 2015, <http://cowlitzedc.com/news/nw-innovation-international-headquarters-chooses-kalama>.
  32. Kalama Manufacturing and Marine Export Facility SEPA, [http://kalamamfgfacilitysepa.com/wp-content/uploads/2014/11/Boards\\_11-21-14\\_lo-res.pdf](http://kalamamfgfacilitysepa.com/wp-content/uploads/2014/11/Boards_11-21-14_lo-res.pdf).
  33. Kalama Manufacturing & Marine Export Facility SEPA website, <http://kalamamfgfacilitysepa.com>.
  34. Eric de Place and Maoulay Adjorlolo, “What Methanol Means for the Northwest,” Sightline Institute, August 17, 2015, [www.sightline.org/2015/08/17/what-methanol-means-for-the-northwest](http://www.sightline.org/2015/08/17/what-methanol-means-for-the-northwest).
  35. Shari Phiel, “Northwest Innovation Works reaches deal on gas pipeline to Kalama,” Longview Daily News, August 13, 2014, [http://tdn.com/news/local/northwest-innovation-works-reaches-deal-on-gas-pipeline-to-kalama/article\\_250189aa-235b-11e4-ba4d-0019bb2963f4.html](http://tdn.com/news/local/northwest-innovation-works-reaches-deal-on-gas-pipeline-to-kalama/article_250189aa-235b-11e4-ba4d-0019bb2963f4.html).
  36. Richard Nemec, “FERC Finishes Environmental Review of Gas Lateral to NW Port Site,” Natural Gas Intelligence, July 14, 2015, [www.naturalgasintel.com/articles/102977-ferc-finishes-environmental-review-of-gas-lateral-to-nw-port-site](http://www.naturalgasintel.com/articles/102977-ferc-finishes-environmental-review-of-gas-lateral-to-nw-port-site).
  37. Williams, “Kalama Lateral Project,” <http://kalamapipeline.com>.
  38. Port of Tacoma, “Northwest Innovation Works,” <http://portoftacoma.com/northwest-innovation-works>; Natasha Alperowicz, “Northwest Innovation Works to invest \$7 billion in eight methanol plants in US,” IHS Chemical Week, October 12, 2015, [www.chemweek.com/lab/Northwest-Innovation-Works-to-invest-\\$7-billion-in-eight-methanol-plants-in-US\\_74339.html](http://www.chemweek.com/lab/Northwest-Innovation-Works-to-invest-$7-billion-in-eight-methanol-plants-in-US_74339.html); and Citizens for a Healthy Bay, “Proposed Methanol Plant in Tacoma,” [http://www.healthybay.org/index.php?option=com\\_content&view=article&id=212:proposed-methanol-plant-in-tacoma&catid=42:news-and-events&Itemid=74](http://www.healthybay.org/index.php?option=com_content&view=article&id=212:proposed-methanol-plant-in-tacoma&catid=42:news-and-events&Itemid=74).
  39. Port of Tacoma, “Northwest Innovation Works,” <http://portoftacoma.com/northwest-innovation-works>.
  40. Port of St. Helens, “Resolution No. 2014-13,” [www.portsh.org/resolutions/Resolution\\_2014-13.pdf](http://www.portsh.org/resolutions/Resolution_2014-13.pdf).
  41. Northwest Innovation Works, “Port of St. Helens,” <http://nwinnovationworks.com/projects/port-of-st-helens>.
  42. Technically, “xylene” refers to a group of three petrochemicals: orthoxylene, metaxylene, and paraxylene.
  43. Mary Jo Wier et al., “Optimizing Naptha Complexes in the Tight Oil Boom,” Honeywell UOP, 2014, [www.uop.com/?document=optimizing-naptha-complexes-in-the-tight-oil-boom&download=1](http://www.uop.com/?document=optimizing-naptha-complexes-in-the-tight-oil-boom&download=1).
  44. Reuters, “Tesoro Corporation Announces New Petrochemical Feedstock Project,” July 21, 2014, [www.reuters.com/article/2014/07/21/idUSnHUGW4GCqa+1ec+ONE20140721](http://www.reuters.com/article/2014/07/21/idUSnHUGW4GCqa+1ec+ONE20140721).
  45. Eric de Place and Ahren Stroming, “What is Xylene and What Does it Mean for Puget Sound?,” Sightline Institute, December 15, 2014, [www.sightline.org/2014/12/15/what-is-xylene-and-what-does-it-mean-for-puget-sound](http://www.sightline.org/2014/12/15/what-is-xylene-and-what-does-it-mean-for-puget-sound).
  46. Eric de Place, “The Northwest’s Pipeline on Rails,” Sightline Institute, July 2015, [www.sightline.org/research\\_item/the-northwests-pipeline-on-rails](http://www.sightline.org/research_item/the-northwests-pipeline-on-rails); and Eric de Place and Ahren Stroming, “What is Xylene and What Does it Mean for Puget Sound?,” Sightline Institute, December 15, 2014, [www.sightline.org/2014/12/15/what-is-xylene-and-what-does-it-mean-for-puget-sound](http://www.sightline.org/2014/12/15/what-is-xylene-and-what-does-it-mean-for-puget-sound).
  47. Shelby Rowe, “Tesoro to enter chemical business with new project,” Skagit Valley Herald, July 28, 2015, [http://www.goskagit.com/all\\_access/tesoro-to-enter-chemical-business-with-new-project/article\\_335aadac-36f9-5453-b109-ea31f5010ae9.html](http://www.goskagit.com/all_access/tesoro-to-enter-chemical-business-with-new-project/article_335aadac-36f9-5453-b109-ea31f5010ae9.html).