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Market Access – Oil Export Pipelines in Western Canada **By Nandha Karthik Suresh**

The quality characteristics of Canadian oil reserves, such as density and sulfur content, vary widely across the country. Around 64% of total Canadian oil production comes from oil sands regions in Alberta, approximately 3 million barrels per day (MMbbl/d). The remaining production comes from conventional, offshore, and tight oil resources. Crude oil produced in Alberta, Saskatchewan, and Newfoundland and Labrador accounts for 98% of the total oil produced in Canada ([NRCAN](#), 2020).

In this article, we examine Canadian crude oil exports markets for Canadian crude, accessibility, and the throughput capacity of existing major western Canadian pipelines, as well as several proposed pipeline projects.

Canada has the third-largest proven reserves (168.5 billion bbl) in the world, 96% of which are the reserves are in the oil sands regions of Alberta and Saskatchewan. In 2019, the country produces 4.9 MMbbl/d, making it the fourth-largest crude oil producer in the world.

At present, western Canada is producing more oil than it uses or stores. In CERI's latest production outlook (Studies 190 and 191), the Institute forecasted a gradual increase in crude oil production in the long term. With an increase in production and, assuming domestic demand remains at a historical level, an increase in exports can be predicted with possible access to global markets.

Exports & Imports

Canada is also the fourth-largest crude oil exporter, transporting 3.7 MMbbl/d ([NRCAN](#), 2020). The overwhelming majority (greater than 95%) is exported to the U.S. In fact, Canada is the largest exporter of crude to the U.S. ([CAPP](#), 2019). Despite increased U.S. shale oil production in recent years, the growing demand for Canadian heavy oil persists. An increase of 7% in crude oil exports was observed between 2018 and 2019, with exports valued at CAD\$87.1 billion in 2019 ([CER](#), 2020).

Despite being the fourth-largest crude oil producer, Canada imports oil from other countries. More than half of the oil used in eastern Canada is imported from countries such as Saudi Arabia, Azerbaijan, Nigeria, Norway, U.K., Columbia, and the U.S. via tankers and rail.

Market Access

Crude oil is not a final end-use product. It must be refined to produce valuable petroleum products such as gasoline, diesel, and jet fuel, to name a few. Refineries are designed and configured to

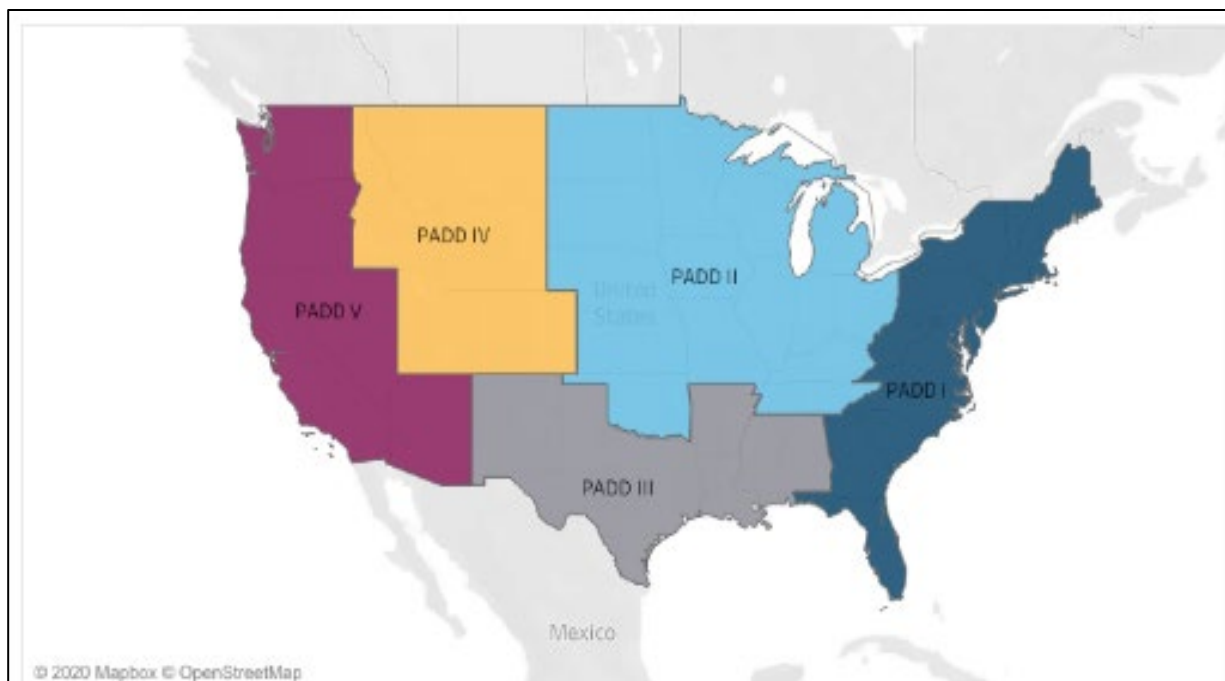
handle different types of crude; not all refineries can process heavy crude. In Canada, the Sturgeon Refinery in Alberta was primarily designed to process heavy crude¹.

There are 17 domestic refineries, nine in western Canada and the remaining eight in eastern and Atlantic Canada. Collectively, they have an operating capacity of 2 MMbbl/d ([CAPP](#), 2019). In western Canada, most of the refineries are connected to pipelines, while some volumes are moved by truck. The capacity of eastern refineries is larger than that of western refineries. However, the eastern refineries are not well connected to western Canadian crude output and are largely dependent on crude oil imports from other countries, such as the U.S. and other foreign imports, through tanker and rail.

Apart from domestic markets, a significant demand for western Canadian crude comes from U.S. refineries. According to the U.S. Energy Information Administration (EIA), since 1992, there has been a rise in oil consumption throughout the world, and the U.S. has become the largest consumer of oil. As of 2019, the U.S. consumed 20.5 MMbbl/d of petroleum products; approximately 20% of total world consumption ([EIA](#), 2020). More than half of U.S. crude oil imports come from Canada.

As seen in Figure 1, the U.S. Department of Energy has divided its states into five regions, called Petroleum Administration of Defense Districts (PADDs). These regions were established just before the second World War to help with rationing fuel coming from each region.

Figure 1: US PADDs



Source: CER 2020

¹ The bitumen upgraders that process bitumen and convert it to light synthetic oil in Alberta are not refineries.

In 2019, Canadian crude oil was exported to the five PADDs as follows (CER, 2020):

- U.S. East Coast (PADD I) – 6%
- U.S. Midwest (PADD II) – 59%
- U.S. Gulf Coast (PADD III) – 22%
- U.S. Rockies (PADD IV) – 7%
- U.S. West Coast (PADD V) – 6%

PADD II and PADD III alone consumed 81% of the exports. Of all the Canadian exports to the U.S., a significantly large portion of crude oil from Alberta, Saskatchewan, and Manitoba was exported to the PADD II region (Midwest). There are 27 refineries in these 16 states with a refining capacity of 4 MMbbl/d, which is twice that of the whole Canadian refinery capacity. PADD II region has invested significantly in its refineries lately to allow them to process more heavy crude oil from western Canada. According to the EIA, apart from PADD II's processing capacity, the region has approximately 77 MMbbl of storage capacity, allowing for efficient transport of crude to neighbouring PADD regions.

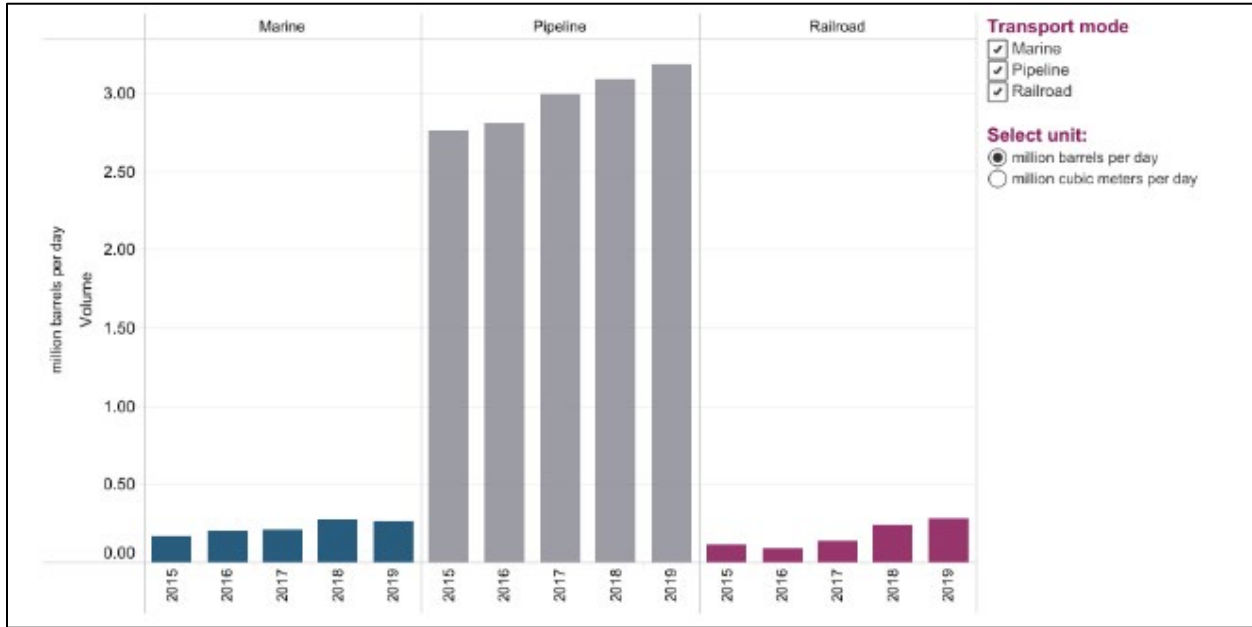
PADD III is the second-largest importer in the U.S., with 56 refineries and a processing capacity of 9.7 MMbbl/d, close to five times the total Canadian refinery capacity (CER, 2020). Most of this capacity comes from Texas and Louisiana.

In order to process heavy oil, refineries need specialized equipment like coking capacity and capability. PADD III has the largest coking capacity, followed by PADD II. Also, both markets are connected to western Canadian oil via pipelines and rail. Simultaneously, imports of heavy crude oil from Mexico and Venezuela to PADD III have been reduced over the recent years, creating more demand for Canadian heavy crude. Additional crude volumes to PADD III would depend on whether the Keystone XL pipeline project is completed.

Crude Export Pipelines and Throughput Capacity

As seen in Figure 2, most crude oil is exported through pipelines. For Canadian crude oil producers, PADD II and PADD III are the major markets. Canadian exports reach these markets primarily via the Enbridge Mainline, Keystone Pipeline, Express Pipeline, and a small portion by rail. The Trans Mountain pipeline transports crude to the west coast, where oil is shipped to BC, U.S., and a small portion to the Asian market.

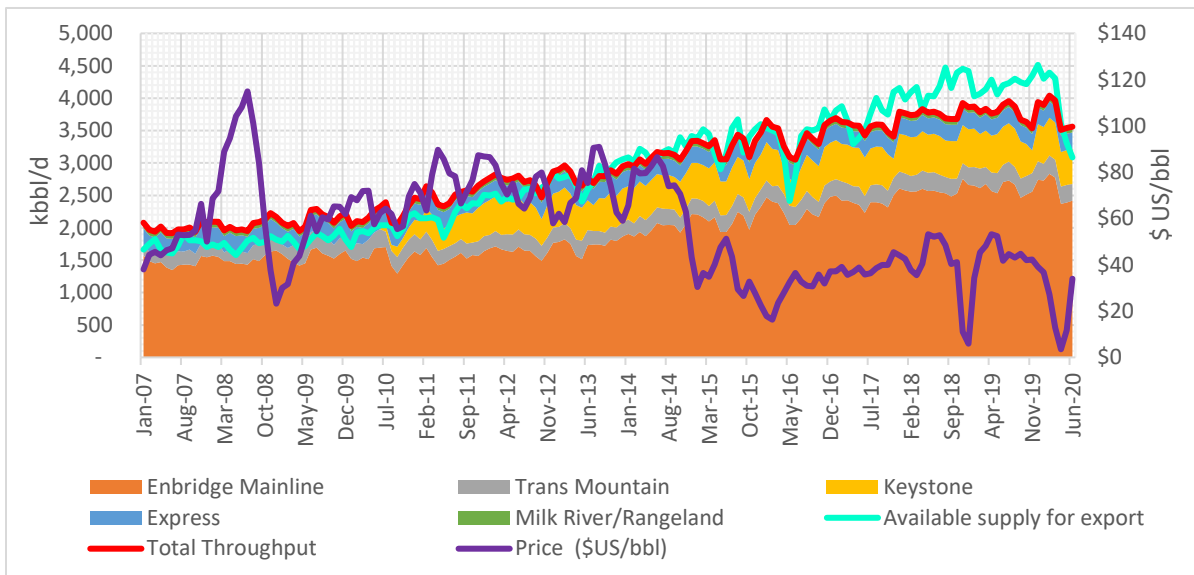
Figure 2: Crude Oil – Transport Mode



Source: CER 2020.

Figure 3 is an integrated pipeline throughput graph showing all major pipelines that flow from the Western Canadian Sedimentary Basin (WCSB) from 2007 to present. The volume of oil available for export was calculated by subtracting domestic refining capacity from total production volumes. The throughput volumes for all major pipelines were obtained at their respective international terminals and tallied to obtain the total throughput volume. There has been a significant rise in the production of crude oil, which explains the rise in the volume of crude oil available for export.

Figure 3: Pipeline Throughput and Crude Available for Export



Data Source: CER, Government of Canada, Baytex Energy

Of all the pipelines that carry crude oil, only a portion of the Trans Mountain pipeline throughput reaches the Asian market. There is not enough pipeline capacity to support the additional export of oil to markets around the world. The only major market that Canada has access to is the U.S., which is constrained by limited transportation capacity out of Western Canada. While there is significant potential to increase production, limited egress and domestic demand create challenges for crude producers and impacts the price of Canadian crudes (Figure 3 displays WCS price², the benchmark for Canadian heavy oil (purple line).

In 2008, the fall in the price of WCS was due to the consequences of the financial crash in the U.S. real estate market. In late 2014, the price drop was due to an excess supply environment, with increasing production in the U.S. Reacting to falling crude prices, OPEC and other global producers reduced production and exports to correct falling prices. An agreement was reached between OPEC and Russia in particular to curb their respective production volumes. The deteriorating demand levels further reduced oil prices in mid-2015 and this demand reduction persisted until early 2016. The worst drop in prices came in late 2018. Continued global oversupply and a lack of regional export pipeline capacity necessitated the transport of more crude by rail and associated higher transportation fees. In 2020, the fall in WCS prices was due to the outbreak of the pandemic disease COVID-19.

Proposed Pipeline Programs

Line 3 Replacement Program (Line 3)

Line 3 is one of the primary pipelines of the Enbridge Mainline. This program will replace the existing 1,660 kilometer pipeline with the latest pipeline technology ([Enbridge](#), 2020). Since 2008, the operating capacity of the pipeline has been reduced by approximately half of its total capacity, due to pressure restrictions. The replacement is due to safety, ageing, and to make use of the full capacity of the pipeline. In December 2019, commercial services for the Canadian segment of the line began, whereas the U.S. segment is expected to begin in the second half of 2020. Line 3 will be a mixed service line, meaning it will transport a variety of crude oils, including sweet, light, and high sours and light synthetics ([Enbridge](#), 2020).

Keystone XL (KXL)

The KXL proposed pipeline, with a capacity of 830,000 bbl/d, is a new line that will run 1947 kilometres from Hardisty, Alberta to Steele City, Nebraska ([Keystone-xl](#), 2020). At Nebraska, it will connect with the existing facility and supply products to the U.S. Gulf Coast. The commercial service of this pipeline is expected to begin in 2023. Six scientific reviews in the last decade have been carried out on this project by both federal and provincial agencies. All of them concluded that this pipeline could be built with safety and care for the environment ([Keystone-xl](#), 2020). It plans to use Horizontal Directional Drilling (HDD) to cross waterways such as the Yellowstone and Missouri rivers. The fate of this line rests with the upcoming U.S. elections in November.

² WCS is a Canadian benchmark for heavy crude oil supply. Heavy crudes like WCS will always trade at a discount because of its poor quality relative to light sweet crudes like Brent or WTI. Here we are referring to price discounting due to transportation bottlenecks.

Trans Mountain Expansion Project (TMX)

The TMX expansion project is a twinning of the existing Trans Mountain pipeline. This 1,150-kilometer pipeline will run from Edmonton, Alberta to Burnaby, British Columbia, with a capacity of 590,000 bbl/d. The project utilizes 73% of the existing right of way. The pipeline is expected to commence operation in December 2022. To support the increase in pipeline capacity, the expansion includes the construction of three new berths at Westridge Marine Terminal, Burnaby. The berths will provide additional loading capacity of 34 Aframax tankers (245m vessel size) per month. This pipeline is designed to carry heavy oil, with a capacity to transport light crude as well. With a larger pipeline capacity, Canadian producers will be able to access markets outside of North America.

Conclusion

The pipeline programs noted above would provide an opportunity to export an additional 1.8 MMbbl/d of western Canadian crude. This is approximately 50% of the current total crude oil exports. With the added export capacity, an increase in oil production would be expected, but not guaranteed, in the coming years.

Apart from delivering energy safely to markets, pipelines create jobs, attract investments, and provide tax revenues. Canadian Energy Pipeline Association (CEPA) members have invested around CAD\$17 million to develop new technologies that lower corrosion on pipelines, provide a better inspection of pipelines, and determine leaks in pipes (CEPA, 2020). Both KXL and TMX follow Horizontal Directional Drilling (HDD) to cross major waterways in their respective routes and as stated above, six reviews on the KXL, with all of them favouring its construction. All this would imply that pipeline projects are carried out with utmost care and are made sure that they have minimal impact on the environment.

With Canadian oil companies focusing on Environmental, Social, and Governance (ESG) criteria, oil is being produced with an intention to have less impact on the environment and to continue to provide economic benefits to society. If Canada can transport its oil across the country through a Transnational pipeline, it could reduce Canada's carbon footprint in the world by having little to no oil imported from countries that have a minimal concern about ESG criteria. Additional pipeline and crude production could substantially increase government tax revenues and reduce import expenditures. Also, having access to both coasts via pipelines will provide Canada with an opportunity to reach global markets, raising its market share, exports, and potentially, prices of Canadian crudes, making Canada less reliant on one market.

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Additional Background Information

- <https://memberprojects.aboutpipelines.com/?show=liquids#pipemap1>
- [CER imports and exports graph](#)
- <https://www.oilsandsmagazine.com/projects/crude-oil-liquids-pipelines>
- <https://www.oilsandsmagazine.com/energy-statistics/canada#CrudeExports>

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