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The Shape I'm In - Rising Canadian Production, Takeaway Constraints and WCS Price Discounts, Part 3

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Producers in the Western Canadian Sedimentary Basin (WCSB) are in a bind. Crude oil output in the WCSB has risen by more than 50% over the past seven years to about 4 MMb/d and is expected to increase to 5 MMb/d by the mid-2020s. But there has been only a modest expansion of refinery capacity within the region and pipeline capacity out of the WCSB, and lately takeaway constraints have had a devastating effect on the price relationship between benchmark Western Canadian Select (WCS) and West Texas Intermediate (WTI). What's ahead for WCSB producers and WCS prices? Today, we continue our series on Western Canadian crude and bitumen markets, this time focusing on WCSB refinery capacity and existing pipelines out of the region.

In [Part 1](#), we looked at the recent collapse in the price of WCS versus WTI and the 12-day shutdown of the Keystone Pipeline in November 2017, both of which put the spotlight on a major issue: Alberta production in particular is rising, pipeline takeaway capacity out of the province has not kept pace, and pipes are running so full that some owners have been forced to apportion access to them. We noted that while WCS had been selling at a steady \$10/bbl discount to WTI earlier in 2017, the pricing differential collapsed later in the year to as much as \$25/bbl. While the leak and subsequent shutdown of the Keystone Pipeline in November was the spark that ignited the most recent decline in WCS prices, the fundamentals behind the widening gap between WCS and WTI prices were already in place.

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In [Part 2](#), we examined the historical and projected growing volume of crude oil produced in the WCSB. In that supply assessment, we noted that crude oil volumes in the region had grown from around 2.5 MMbbl/d in 2010 to roughly 4.0 MMbbl/d in 2014. Although the crash in WCS crude oil prices in 2014 slowed the pace of investment in new oil sands projects, production volumes in Western Canada are still projected to reach 5.0 MMbbl/d by 2025. Where will all this growing crude oil supply go? Today, we'll dive into the current local demand for crude oil in the WCSB and the existing crude oil pipeline takeaway capacity.

In terms of local demand, there are a number of refineries in British Columbia, Alberta and Saskatchewan that are fed by crude oil supply from the WCSB. Figure 1 lists these refineries, and the numbers in the Map Label column to the far left correspond to the location of each refinery as shown on the map in Figure 2. While the nameplate capacity shown for these refineries represents potential local WCSB crude oil demand, refineries rarely operate at 100% utilization factor. Based on a review of historical operating performance from company websites and annual reports, the utilization factors of refineries listed below range from a low of 76% to a high of 96%. Factoring in the nameplate capacity and the historical utilization factor for each refinery, we end up with a total local refinery demand slightly above 550 Mb/d through 2017, growing to nearly 600 Mb/d once the 50-Mb/d first phase of North West Redwater Partnership's (NWRP) new Sturgeon Bitumen Refinery northeast of Edmonton, AB (#5 on our list), is fully operational. (NWRP is a 50-50 joint venture of North West Upgrading and Canadian Natural Upgrading, a subsidiary of Canadian Natural Resources.)

Map Label	Company	Refinery Location	Nameplate Capacity (Mb/d)	Status
1	Imperial	Edmonton, AB	191	Operating
2	Suncor	Edmonton, AB	142	Operating
3	Husky	Lloydminster, AB	29	Operating
4	Shell	Scotford, AB	100	Operating
5	North West Redwater Partnership	Sturgeon Co., AB	50	2018 Start Up
6	Federated Coop	Regina, SK	130	Operating
7	Gibson	Moose Jaw, SK	19	Operating
8	Husky	Prince George, BC	12	Operating

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Figure 1. Refineries in Western Canada. Source: Company Websites (Click to Enlarge)

There are also other refineries in Canada that are served by crude oil supply from the WCSB: refineries in eastern Canada and a refinery in British Columbia on Canada's West Coast. However, these other refineries are served by

the various crude oil takeaway pipelines that move crude oil out of the WCSB. For purposes of assessing the local demand and pipeline takeaway capacity, the WCSB volumes that might supply those other refineries are already accounted for in the pipeline takeaway capacity figures reviewed later in this blog.

Now that we have a sense for the crude oil demand from the local refineries in Western Canada, let's look at the existing WCSB crude oil takeaway pipelines. Figure 2 shows a map of the existing crude oil takeaway pipelines serving the WCSB (as well as the locations of those refineries).

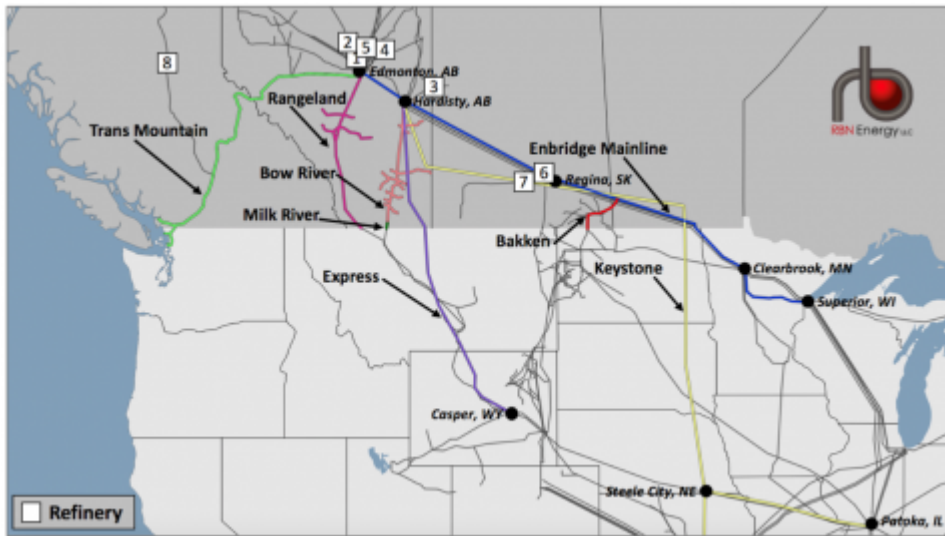


Figure 2. WCSB Refineries and Crude Oil Takeaway Pipelines. Sources: Company Websites, RBN (Click to Enlarge)

Kinder Morgan's existing Trans Mountain Pipeline (bright green line in Figure 2) is the only crude oil takeaway pipeline from Alberta that serves the West Coast of Canada (and exports crude oil to the Pacific Northwest region of the U.S.) The pipeline was originally

commissioned in 1953 with an initial capacity of 150 Mb/d. Over the years, the pipeline has been expanded several times and currently has a nameplate capacity of 300 Mb/d. Trans Mountain originates in Edmonton, AB, and transports crude oil and refined products to refineries and terminals in British Columbia and Washington state. Key Trans Mountain delivery points include refineries and terminals in the Burnaby, BC, area, the Westridge marine terminal (also near Burnaby), and exports to the U.S. at Sumas, WA, which then flow into Kinder Morgan's Puget Sound Pipeline for delivery to four refineries along the Washington coast. Although Trans Mountain's nameplate capacity is 300 Mb/d, there are a variety of factors that influence the actual physical capacity at any one time, including the mix of products being shipped (e.g., light crude, heavy crude, refined products). Operating statistics from the Canadian government reveal that over the past few years, Trans Mountain has shipped an average of about 50 Mb/d of refined products, and that the total volume flowing through the pipe has been very close to the nameplate capacity of 300 Mb/d. In terms of crude oil takeaway capacity from Alberta, this leaves 250 Mb/d of operating capacity available to move the growing supply of crude oil from Alberta. Kinder Morgan is also working on the Trans Mountain Expansion (TMX) project; TMX will be discussed in detail in the next blog in this series.

The Enbridge Express Pipeline System (purple line) originates in Hardisty, AB, and delivers to refining markets in the Rockies and to a Casper, WY, interconnect with the Platte Pipeline System, which transports crude oil to markets in Kansas and Illinois. The Platte Pipeline System was owned by Spectra Energy, but in 2017 Enbridge acquired Spectra. The Enbridge Express system has a nameplate capacity of 280 Mb/d, but historically operated at closer to 225 Mb/d. In October 2016, Spectra completed the Express Enhancement Project, which augmented capacity on its system and increased contractual transportation commitments as

well. Based on Federal Energy Regulatory Commission (FERC) Form 6 data through the third quarter of 2017, flows on the combined Express-Platte system averaged 245 Mb/d in the January-through-September period last year. For the purposes of our crude oil takeaway capacity analysis out of Alberta, we've used this recent operating flow level of 245 Mb/d.



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TransCanada's Keystone Pipeline (yellow line) also originates in Hardisty, AB, and delivers to Steele City, NE, where it then splits into two legs. The eastern leg transports crude oil to the Wood River and Patoka, IL, area, while the southern leg of the system transports crude to Cushing, OK (and ultimately to Gulf Coast markets through other pipeline links at Cushing). The Keystone Pipeline system began operation in 2010, and the current nameplate capacity of the pipeline is 591 Mb/d. Based on flow data from the Canadian government and FERC Form 6 submissions, Keystone operated at very close to its nameplate capacity in the second half of 2016 and the first three quarters of 2017. As noted in Part 1 of this series, however, the Keystone system was shut down for 12 days during November 2017 after TransCanada detected a leak on a portion of the system near Amherst, SD. Flows on Keystone resumed on November 28, 2017, but at an operating pressure 20% below what was previously authorized — a reduced operating level dictated by the Pipeline and Hazardous Materials Safety Administration (PHMSA). Flow data from our friends at Genscape indicates that during December 2017, average flows on the Keystone system were around 517 Mb/d — that's 74 Mb/d less than the nameplate capacity. It is not known when PHMSA will allow TransCanada to resume normal operations on Keystone. For our crude oil takeaway capacity analysis out of Alberta, we've assumed that the Keystone pressure limitations will be lifted, and that the pipeline will operate at around 95% of its 591-Mb/d nameplate capacity, or 561 Mb/d. TransCanada is also working on the Keystone XL Pipeline project, and that proposed new crude oil takeaway pipeline will be discussed in detail in the next blog of this series.

The Enbridge Mainline System (blue line) is the largest of the crude oil takeaway pipelines serving the WCSB. The Mainline transports crude oil to markets in the U.S. Midwest and eastern Canada, transports refined products to Saskatchewan and Manitoba and transports natural gas liquids (NGLs) to Sarnia, ON. The system originates in Edmonton and Hardisty, AB, and is comprised of several pipeline segments as noted in the table in Figure 3.

Mainline Segment	Origin	Destination	Nameplate Capacity (Mb/d)	Products
Line 1	Edmonton, AB	Superior, WI	237	Light crude, refined products, NGLs
Line 2	Edmonton, AB	Superior, WI	442	Light crude
Line 3	Edmonton, AB	Superior, WI	390 ¹	Light crude
Line 4	Edmonton, AB	Superior, WI	796	Light, medium & heavy crude
Line 65	Cromer, MB	Clearbrook, MN	186	Light & medium crude
Line 67	Edmonton, AB	Superior, WI	800	Heavy crude
		Total	2,851	

¹ The current capacity of Line 3 has been de-rated to 390 Mb/d, based on a variety of maintenance and operational issues.

Figure 3. Enbridge Mainline Line Segments. Sources: Enbridge and RBN Energy (Click to Enlarge)

In addition to crude oil that originates in the WCSB, the Enbridge Mainline receives

crude oil from the Bakken Shale in western North Dakota. Enbridge's Bakken Pipeline [red line in Figure 2; not to be confused with the Dakota Access Pipeline (DAPL), which is also known as the Bakken Pipeline System] receives crude oil in North Dakota and delivers that volume to the Enbridge Mainline near Cromer, MB. Based on FERC Form 6 and NEB volume data, the volume of crude from the Bakken hitting the Mainline via the Bakken Pipeline has averaged around 130 Mb/d over the past year. This Bakken volume then reduces the amount of Mainline capacity that is available to move WCSB crude. In addition to the Bakken volumes, there is an estimated volume of 270 Mb/d of other products (refined products and NGLs) moving on Enbridge's Mainline system that also reduce the available Mainline capacity for moving WCSB crude oil. For purposes of our crude oil takeaway capacity analysis out of Alberta, we've assumed that the Mainline will operate at 95% of its nameplate capacity (based on typical operational downtime and downstream constraints), that 130 Mb/d of capacity will be used to flow Bakken volumes and that 270 Mb/d will be used to flow other products (refined products and NGLs). That leaves around 2.3 MMB/d of capacity available to move WCSB crude (2,851 Mb/d x 95%) - 130 Mb/d - 270 Mb/d = 2,300 Mb/d). Enbridge is also working on the Line 3 Replacement Project, and that project and its potential incremental crude oil takeaway capacity will be discussed in detail in the next blog in this series.

There are two additional pipeline segments that provide crude oil takeaway capacity out of Alberta. The Rangeland and Bow River pipeline systems move crude oil from Alberta into Montana. The Rangeland system (hot pink line in Figure 2) is owned by Plains Midstream Canada (PMC; a subsidiary of Plains All American) and moves crude from the Edmonton, AB, area to the U.S.-Canadian border near Cut Bank, MT. The Bow River system (pink line) is owned by Inter Pipeline and originates at Hardisty, AB. Bow River flows crude oil south to PMC's Milk River Pipeline (short dark green line), which provides a link to the U.S.-Canadian border, also near Cut Bank, MT. Both Rangeland and Bow River/Milk River connect to Phillips 66's Glacier Pipeline system at the border, which then delivers crude oil to markets in the Rocky Mountain region. For purposes of our crude oil takeaway capacity analysis out of Alberta, we've assumed that the combined crude oil takeaway capacity available on these pipeline systems is 107 Mb/d, which represents the maximum level of throughput on these lines over the past few years.

By combining the local refinery demand with the available capacity from the crude oil takeaway pipelines discussed above, we can get a better sense of what's included in the

existing “stack” to consume or transport the growing supply of crude oil in the WCSB. Figure 4 provides a consolidated view of the refinery demand (bottom, blue shaded layer), and the takeaway capacity from each pipeline in the stack. A similar chart was used in Part 1, and we’ve included for reference the same historical WCSB crude oil supply curve (solid black line), as well as the incremental crude-by-rail capacity (red dashed line).

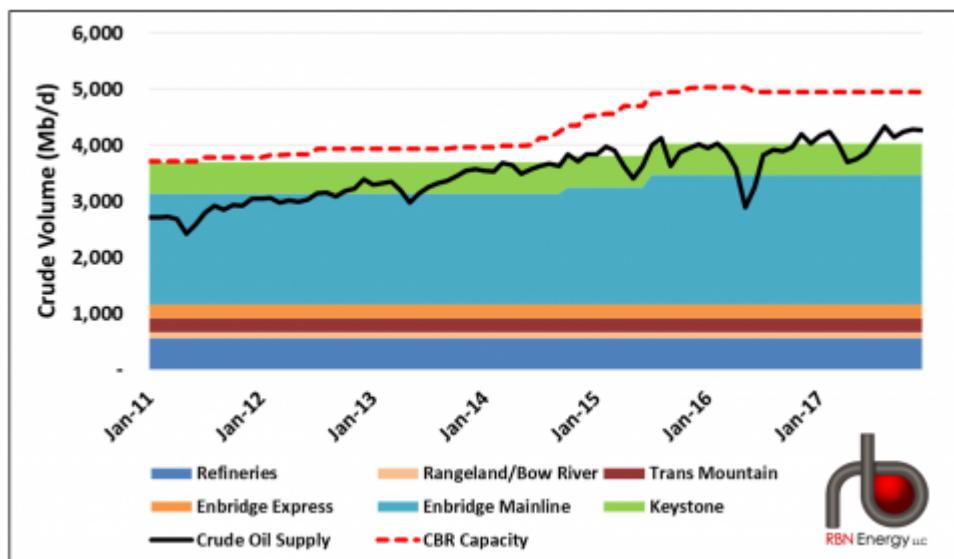



Figure 4. WCSB Crude Oil Supply, Refinery & Pipeline Takeaway Capacity. (Click to Enlarge)

Sources: Company Websites and RBN Energy

The problem we identified in Part 1 is still evident in Figure 4, namely that WCSB crude oil supply is growing faster than the available refinery and pipeline takeaway capacity. As noted previously, this led to periods of time in

2017 when WCSB supply exceeded demand and WCS prices crashed as a result. The next blog in this series will dive into what the market is doing about this. What new pipelines are proposed to fill this gap? What hurdles do they face? Can they successfully navigate the regulatory, environmental and political minefields? And if so, how soon could they come online, and how do those timelines align with the incremental need for takeaway capacity?



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“The Shape I’m In” is among the most popular songs by The Band, the Canadian-American roots rock group that was formed in Toronto in 1968. The song, written by Robbie Robertson, is from The Band's 1970 third album, entitled *Stage Fright*. Richard Manuel sings lead vocals and plays the unique Clavinet keyboard part of the song. “The Shape I’m In” was a featured song in many of The Band's live performances, and also appears on their live albums *Rock of Ages*, *Before the Flood* and *The Last Waltz*.

The Band ended its touring career in 1976 in a performance filmed for Martin Scorsese’s highly praised documentary, “The Last Waltz.” The Band entered the Canadian Music Hall of Fame in 1989, and the Rock and Roll Hall of Fame in 1994. Rolling Stone Magazine ranked them #50 on its 100 Greatest Artists of All Time list in 2004. In 2008, they received a Grammy Lifetime Achievement Award.

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