CRUDE OIL BY RAIL: PART II
POTENTIAL FOR THE MOVEMENT OF ALBERTA OIL SANDS CRUDE OIL AND RELATED PRODUCTS BY CANADIAN RAILWAYS

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This is the second part of a two-part paper that follows on directly from Part I.

Opportunities for Canadian Rail

The movement of crude oil by rail is a relatively new but rapidly growing market for CP and CN. CP in [1] is anticipating moving 70,000 carloads of crude in 2013 and CN in [2] is expected to move approximately 60,000 carloads of crude. This is a significant level of growth given that CP only moved 500 carloads of crude in 2009 whereas CN didn't move any crude oil. CP and CN moved approximately 7.8 million total carloads in 2012 as reported in [3]. As such, crude carload volumes represent approximately 1-2% of total carload volumes for the two railways.

The growth in North American crude volumes moved by rail is primarily driven by three factors. One is the rapid development of non-conventional crude as is currently taking place in the Bakken formation located in southern Saskatchewan and North Dakota. The Bakken region does not have sufficient pipeline infrastructure in place to move crude from the wellhead to transmission pipelines. At the time of writing, 58% of oil produced in the Bakken is moved by rail, up from 22% a year ago according to [4]. Typically, oil produced in the Bakken is moved via truck to a rail transload facility for movement to market. Given the extensive rail infrastructure throughout the Bakken region, rail is well positioned to move the production of nonconventional crude. Figure 1 illustrates CP's market reach for the movement of crude oil. It should be noted that CP has direct access to the Alberta Industrial Heartland, Hardesty, the Bakken Formation and the Marcellus Shale. CN has access into the oil sands region and the Bakken Formation.

Figure 1. Canadian Pacific Network

Second, as is the case for Alberta, the transmission pipelines are operating at or near capacity and rail is being used as an option for moving crude. The lack of pipeline capacity is leading to extensive price differentials between Alberta grades of oil, namely Western Canadian Select (WCS), the Canadian heavy oil benchmark, relative to the North American benchmark West Texas Intermediate (WTI). WCS was trading at $57.84 per barrel in December 2012, or $34.41 a barrel less than WTI. The discount has widened to $36.94 a barrel in February 2013 and based on future contracts the discount is expected to be $36 a barrel in March 2013. The second discount is between WTI and the European benchmark Brent. The WTI discount to Brent has remained at approximately $15 per barrel since 2011 because of insufficient capacity between the Cushing, Oklahoma, hub and the refineries located on the US Gulf Coast. It should be noted that Mayan crude from Mexico, which is a heavy crude similar to that produced in Alberta is priced at approximately $100 per barrel because it is transported by tanker and shipped directly to the US Gulf coast refineries [5].

The third driver for the growth of crude oil by rail is the ability of rail to reach refineries that are not served or are underserved by pipelines. A majority of refineries are near tide water and are generally located on the east, south and west coasts of North America. They are primarily served by ocean tanker. Oil producers located in Alberta or the

Bakken are shipping oil by rail to coastal refiners where they can fetch the world price for their oil. For example, as reported in [6], Southern Pacific Resource Corp, a small Alberta producer, is moving oil to the US Gulf Coast where it is receiving the Brent price for its crude. Refiners are also sourcing crude from Alberta and the Bakken. For example, the Irving Oil refinery, located in Saint John, NB, refines approximately 300,000 barrels per day, and has built a train offloading site near its refinery able to receive about 70,000 barrels a day of Bakken and Western Canadian oil [7].

Moving crude by rail offers other advantages: the relatively low levels of capital investment to develop a crude transload facility; heavy oil does not require diluent to be transported; speed to market; flexibility of routing options; supply chain diversification; and the scalability of volumes. In addition, bitumen can be loaded into coiled tube cars that can be heated to ensure the bitumen flows, and therefore avoids the use of diluent [8]. Moreover, energy firms do not have to enter into long-term contracts for the movement of crude by rail. Typically, oil producers must enter into long-term contracts in order to access pipeline capacity. Rail also transports a number of inputs used for crude production, including: fracking sand; steel pipe; other oil field tubular products; aggregates; chemicals; fuel; condensate; construction materials; and dimensional cargo [9].

Evidence to date suggests that rail markets for the movement of Alberta oil are developing more slowly than in the Bakken. It is estimated that less than 20,000 carloads of crude moved out of Alberta in 2012 as compared to 180,000 carloads out of the Bakken. However, given that Alberta holds the world's third largest crude deposit and the pipeline capacity constraints to domestic, North American and international markets, Alberta is well positioned to be a significant crude-by-rail market.

With respect to opportunities for the oil sands, both CP and CN could undertake to build new rail lines to provide direct rail service into the oil sands. Short build-ins are feasible: for CP into the Alberta Industrial Heartland; for CN into project sites along its line south of the Athabasca River; and for CN to connect using a 30 km build-in to

Hardesty. However, the construction of an extensive rail network is generally unlikely, due to the expense, and it would be in direct competition with the existing and extensive network of feeder pipelines that are owned and operated by pipeline companies closely associated with the oil companies that are extracting the oil sands product.

There are media reports of interest in building a new railway from the oil sands to Alaska, or upgrading the rail line to Churchill, but such projects have significant problems of their own – beyond the enormous capital costs. A railway to Alaska would require approval of the US federal government, crude oil through Churchill would see shipping oil in tankers in Arctic waters over a restricted summer period.

More promising immediate opportunities exist with the use of transload facilities to load crude oil into rail cars on existing rail lines. Figure 2 shows such a facility under construction on the CN line at Fort McMurray taken from [10] that is due to be operating in 2013. Also, Gibson Energy Inc. signed a letter of intent with CP in September 2012 to examine the construction of a unit train facility at Hardesty that would connect to CP's north main line for transporting crude oil by rail [11].

Figure 2

What volumes of oil sands crude oil might be handled by CP and CN from such future developments?

First, it should be pointed out that oil producers might prefer that rail handle increasing volumes of conventional crude oil from other locations to free up pipeline capacity for oil sands crude oil – see the quote from Cenovus reported in the *Calgary Herald* [12]

> For 2013 we're looking at about 10,000 b/d to help offset some of the congestion. And we'll look to potentially expand that because we see congestion being a continuing problem for the next couple of years. Cenovus is using the rail cars primarily to send its medium-light oil from conventional Alberta and Saskatchewan plays to the Irving refinery in New Brunswick or to the US Gulf Coast.

Returning now to the opportunities for moving crude oil southbound from the oil sands by Canadian rail, Figure 3 presents an order of magnitude approximation of the possibilities.

One barrel of crude oil - gallons	42	
One tank car - gallons	30,000	
Number of barrels per tank car	714	525 - 650
Number of tank cars per unit train		120
Number of barrels per train		63,000 - 78,000
Average train cycle time - days		15
Number of train sets required for one train-start per day		15
Volume moved in one train-start per day - b/d		**63,000 - 78,000**
Number of locomotives required - 2 per train		30
Number of tank cars required		1,800
Number of barrels in 10 train-starts per day - b/d		**630,000 - 780,000**
Number of locomotives required - 2 per train		300
Number of tank cars required		18,000

Figure 3. Potential Train capacity and Equipment Requirements

The following points may be noted:

- A simple calculation relating the gallons in a barrel with the gallons in a tank car suggest 714 barrels per tank car. CP has found that crude from the Bakken shale deposit is moved with 600 to 650 barrels per tank car. Elsewhere the tank car capacity for heavy crudes is approximately 525 barrels. Two of these figures are carried forward;
- Assuming a two-locomotive train hauls 120 tank cars, then one such train hauls between 63,000 and 78,000 barrels of crude oil;
- Assuming a rough average cycle time for a train from origin to destination and back is 15 days then 15 train sets are required to provide one train-start per day. This would need 30 locomotives and 1,800 tank cars;
- One train-start per day would handle 63,000 to 78,000 b/d of crude oil;
- By scaling up, 10 train-starts per day would handle 630,000 to 780,000 b/d of crude oil, and require 300 locomotives and 18,000 tank cars.[2]

To put this in perspective, the combined locomotive fleets of CP and CN operating in Canada numbered approximately 2,400 locomotives and 65,000 freight cars in 2011. Moreover, if each of CP and CN had a 50% share of the traffic, then each would be moving 5 train-starts per day – perhaps 2 west to the BC coast, 2 south to the US and 1 eastbound. For CP this would imply moving an additional 4 trains per day between Edmonton/Hardesty and Calgary, 2 trains per day to Vancouver, 2 trains per day through Portal to the US, and finally 1 train per day east bound from Edmonton/Hardesty east. A similar calculation pertains to CN.

To put this further in perspective, CP currently handles approximately 30-35 trains per day west to Vancouver, and, to give an idea of rail industry capabilities, UP and BNSF on their western corridors handle more than 100 trains per day.

It would appear that handling between 600,000 and 800,000 b/d by rail is manageable, although handling the additional 3 million b/d that is projected to be produced by 2035 might be a stretch too far.

CP and CN do not disclose the rates they charge for moving oil as this is confidential to the railway and the customer. It is generally acknowledged that moving oil by rail is more expensive than transporting it via pipeline. The question is how much more expensive? The answer depends on a number of factors. Figure 4 provides estimates of the cost of shipping western Canadian crude by pipeline to various North American markets.

Destination	Costs in $ per barrel
US Gulf Coast	$7.00
West Coast of British Columbia	$3.00
Montreal, Quebec	$3.00
Quebec City, Quebec	$6.50
Saint John, New brunswick	$8.00

Source: TD Economics

Figure 4. Potential Train capacity and Equipment Requirements

In the case of rail, the cost of moving oil is dependent on volume and distance. The greater the distance the more it will cost to move the oil via rail tank car. If a shipper is moving large volumes then there may be opportunities to move the crude via a unit train thus lowering the cost of moving oil on a per unit basis (i.e. per barrel). One of the factors that narrows the cost difference between rail and pipeline is that heavy oil that requires expensive thinner called diluent to be transported by pipeline. Heavy oil can be moved by rail without the use of diluent as indicated earlier.

With regard to the cost differentials of moving oil by pipeline versus rail, the public estimates vary greatly. According to Scott Saxberg, CEO, Crescent Point Energy Corp. in [13] “The cost of rail versus pipe isn’t hugely significant these days, especially now with the

increased regulations and delays on pipelining. We see it being is the $2 a barrel range". Crescent Point produces light oil that does not require the use of diluent to ship via pipeline. It has built its own facility to load rail cars and is moving 15,000-16,000 barrels a day, or a fifth of its production via rail. The markets that Crescent Point are accessing for its oil are paying so much more for the oil that the company expects to pay off the loading facility within a year [14]. It is clearly economical for Crescent Point to use rail to transport oil.

It has been reported elsewhere that it can cost nearly four times as much to ship oil by rail versus pipelines. Southern Pacific Resource Corp, a small Alberta producer, estimates that it costs $31 a barrel to moves its Canadian oil sands–mined heavy crude by rail to the US Gulf Coast, with the comparable pipeline cost of $8 per barrel [15]. However, as mentioned earlier Southern Pacific Resource Corp receives the Brent price for its oil in the US Gulf, thus it makes economic sense to move its oil to that market.

The publicly available evidence suggests that the additional total cost of moving oil by rail as compared to pipelines is in the $2 to $20 per barrel range.

Conclusions

The analysis presented in this two-part paper suggest the following preliminary conclusions:

- The current feeder pipeline network serving the Alberta oil sands has the capacity to handle some 2 million b/d of outbound crude oil, and this capacity can likely be expanded relatively easily given that licensing is regulated by a provincial authority;
- The feeder network connects with the trans-continental transmission pipeline network at two locations: the Alberta Industrial Heartland just northeast of Edmonton, and Hardesty, Alberta;
- Both of these locations have direct rail service and very significant existing storage capacity;

- The transmission pipeline network from these two locations – keeping in mind that it handles not just Alberta oil sands crude, but also conventional crude and other related products – is some 3.5 million b/d;
- Current expansion plans would see additional transmission pipeline capacity of some 2 million b/d;
- Official projections indicate that Alberta oil sands production could increase from 2 million b/d to 5 million b/d by 2035, and possibly 8 million b/d at a later date;
- Pipeline capacity constraints are a factor in the current discounting of the price of Alberta oil sands crude oil from world prices by anywhere in the range $10 to $30 per barrel;
- The additional total costs of moving crude oil by railway over transmission pipeline is likely in the range from $2 to $20 per barrel depending upon the markets being served. It would therefore appear that with the current discounting, the movement of Alberta crude oil by rail would be economic;
- An order of magnitude estimation suggests that CP and CN combined could move 600,000 to 800,000 b/d with a manageable increase in equipment and infrastructure.

It therefore appears that the railways could provide a significant capacity to move Alberta oil sands crude oil, during any transitional period while transmission pipeline capacity is expanded, and as a long-term source of flexibility. However, the handling of the full 3 million b/d anticipated by 2035 is probably a stretch too far.

References

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Endnotes

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[2] It should be noted that tank cars are usually provided by the shipper rather than the railway.