WRONG SIDE OF THE TRACKS: WHY RAIL IS NOT THE ANSWER TO THE TAR SANDS MARKET ACCESS PROBLEM

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Cover image: A Canadian Pacific train transporting oil leaves Hardisty, Alberta, Canada, December 7, 2013. ©Brett Gundlock/Corbis/APImages

For more information on crude-by-rail please visit:
www.priceofoil.org/rail

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Glossary & Abbreviations:

Arbitrage: the simultaneous buying and selling of crude oil in different markets in order to take advantage of differing prices in those markets.

Bitumen-by-rail: the practice of transporting tar sands bitumen on trains through North America.

Bpd: barrels per day

Crude-by-rail: the practice of transporting crude oil on trains through North America.

Dilbit: a blend of bitumen and diluent that is suitable for transporting by pipeline. A typical dilbit blend is 72% bitumen to 28% diluent. The proportions can change according to seasonal requirements; often more diluent is needed during winter.

Diluent: a light hydrocarbon used to dilute bitumen to assist its flow through pipelines.

Diluent Penalty: the cost of buying and transporting diluent in order to get tar sands bitumen to market.

Feeder pipelines: short distance pipelines that bring dilbit from tar sands production areas to the major export pipeline hubs in Edmonton and Hardisty, Alberta.

Netback: the price per barrel received by oil producers minus the cost of transporting oil to market.

Price Differential: the price difference between crude oil of different qualities and of crude oil in different markets.

Railbit: a blend of bitumen and diluent that is suitable for transport in a rail car but not diluted enough to flow in a pipeline. A typical railbit blend is 85% bitumen to 15% diluent.

Rawbit: raw bitumen or bitumen that is not diluted.

Executive Summary

Tar sands pipelines face increasing resistance both in the United States and Canada. As existing pipelines reach capacity, the delay and possible cancellation of new pipelines is costing tar sands producers billions of dollars and reducing investment in the sector. The success of anti-pipeline campaigns has forced industry to look to rail in an attempt to address these losses and open new markets for their product.

The crude oil produced from the Albertan tar sands is a semi-solid substance called bitumen, rather than a liquid crude oil. Shipping bitumen by rail is more expensive than shipping it by pipeline and the added cost is a substantial challenge to the long-term viability of the tar sands industry. Despite significant evidence, market analysis, and real world experience to the contrary, some prominent institutions - including the U.S. Department of State - continue to assert that rail has the potential to replace tar sands pipeline capacity, and thus the rapid pace of tar sands development will continue regardless of whether new pipeline capacity is built or not.

This report details why this is not the case.

The report uses the best available data on actual bitumen-by-rail traffic and capacity and provides analysis of the Gulf Coast market for tar sands crude to demonstrate the realistic potential of bitumen-by-rail in the coming years. The conclusion is clear: bitumen-by-rail cannot replace tar sands pipelines.

While bitumen-by-rail will increase, it will not be the silver bullet that solves the tar sands industry's transportation woes. Most importantly, it will not send the price signal that tar sands producers need to expand production, and thus the growth of tar sands extraction is not, as industry and the Canadian and Albertan governments would have us believe, inevitable.

This report examines the development of bitumen-by-rail at a time when its growth is expected to take a substantial leap. How much bitumen is actually moving by rail in 2014? What is the capacity of loading and unloading terminals that are realistically positioned to handle tar sands bitumen? How profitable is bitumen-by-rail? What are the challenges it faces, and what can we realistically expect for the future? This report addresses these questions and more, and concludes the following:

- Bitumen-by-rail to the U.S. Gulf Coast currently provides less than 6 percent of the Keystone XL pipeline's proposed capacity and total bitumen-by-rail imports into the U.S. are around 3 percent of the total capacity required to accommodate future Canadian crude oil production growth. Even with planned expansions, it appears highly unlikely that rail could replace proposed pipeline capacity in the foreseeable future.

- The current capacity to load tar sands bitumen onto trains is 240,000 barrels per day (bpd). This is around 200,000 bpd lower than our previous estimates. While planned expansions could raise this capacity to 800,000 bpd by 2016, utilization of loading capacity has to date rarely exceeded 50 percent due to logistical and market factors that are expected to persist. If this utilization rate remains constant, this translates to a potential 400,000 bpd of bitumen-by-rail traffic by 2016. This falls far short of the 4 million bpd of total additional transportation capacity required by the tar sands industry to accommodate future growth to 2030 as estimated by the Canadian Association of Petroleum Producers (CAPP).

- Unit train terminals, which are needed to load large quantities of bitumen onto trains, currently only load pipeline-specified diluted bitumen (dilbit), because pipelines are the only means by which large quantities of bitumen can be delivered to the terminals. This means that unit train shippers cannot avoid the diluent penalty (the cost of expensive diluent that enables bitumen to flow in a pipeline) when shipping bitumen by unit train. Therefore, tar sands producers have yet to accomplish the optimum configuration of unit train shipments of undiluted bitumen that has been cited by the U.S. State Department and others as being cost competitive with pipeline transport. It is also far from clear that this can be achieved at a significant scale in the future.

- Shipping dilbit by rail triggers significant safety concerns given the volatile nature of diluent, which is made up of a blend of natural gas liquids similar to those that have caused dramatic explosions during the recent derailments of trains carrying Bakken oil from North Dakota. Proposals to recover and ship diluent back to Alberta by rail in the same tank cars used for shipping dilbit to refineries would result in trains loaded with pure natural gas liquids, posing additional serious safety concerns.

- Only small-scale shippers are currently able to avoid the cost of diluent by shipping undiluted tar sands crude, and they face the higher cost of heating bitumen during loading and offloading, more expensive tank cars, and the higher shipping costs and slower delivery of the small-scale rail freight system known as manifest freight. While shipping undiluted bitumen via manifest rail may be practical in some circumstances for smaller producers, it is not a large-scale solution to major tar sands transportation bottlenecks.

Smoke rises from railway cars that were carrying crude oil after derailing in downtown Lac Megantic, Quebec, Canada, Saturday, July 6, 2013. 47 people lost their lives in the tragedy.

- Crude-by-rail faces other significant challenges, many of which are particularly severe for bitumen because of its remote location. These include:

- Congestion of track capacity and the prospect of rate increases as the rail network must be shared with the other major commodities (e.g. grain, coal, autos etc.);

- Disruption due to weather – particularly during winter in the prairies – that impact loading and offloading as well as creating short- to long-term delays at rail hubs (e.g. Winnipeg, Chicago) and throughout the rail system;

- Increasing costs due to tighter crude-by-rail safety standards including the phasing out and retrofitting of the DOT-111 tank car and the imposition of speed restrictions.

The assertion that there can be a substantial increase in bitumen-by-rail also overlooks the fact that opposition to tar sands pipelines is about much more than the pipelines themselves.

At the core of the anti-pipeline campaigns is opposition to the tar sands expansion that pipelines – such as Keystone XL – will unlock. Emerging opposition to proposed rail terminals that would handle bitumen on the U.S. west coast and elsewhere is testimony to this broader opposition and represents another significant challenge to tar sands expansion.

The debate around pipeline versus rail is a red herring. The real choice that we are faced with is between climate damage resulting from the status quo and a modern, low-carbon energy future that can ensure a safe climate and environment for generations to come. One of the first steps towards that future is to stop extracting more tar sands crude that climate science clearly indicates we cannot afford to burn.

With new information and detailed analysis, this report confirms that rail cannot serve as a replacement for pipelines, and will remain a niche market for tar sands transportation. Rail simply does not have the capacity to unlock tar sands expansion.

1.0 Introduction

The growing campaigns to stop tar sands pipelines have enjoyed great success in recent years. Every major tar sands pipeline proposal in North America currently faces significant public opposition and legal challenges that have caused delays and, in some cases, doubts about whether they can ever be built. In response to the growing success of these campaigns, some oil industry leaders and government representatives assert that rail can replace pipelines for transporting tar sands crude to market, and therefore will enable tar sands production to expand as projected.

This report documents the current capacity to move bitumen by rail as well as documenting actual bitumen-by-rail traffic in 2014 to date, a period in which the trade was expected to grow significantly. It also exposes the constraints and challenges faced by the sector and concludes that although there is some growth potential for bitumen-by-rail, it is a long way from being able to replace the huge amount of pipeline capacity proposed by the industry.

This is essentially a common sense argument. If, as the industry would have us believe, rail and pipelines are interchangeable, then why is industry fighting so hard for approval of Keystone XL, Northern Gateway, and other proposed pipelines? The answer is clearly that rail simply cannot take the place of pipelines, as both proponents and opponents of tar sands extraction are acutely aware.

This report details the market factors and logistical challenges behind the fact that bitumen-by-rail shipments to the U.S. Gulf Coast have been unprofitable throughout 2014. It also details how a more profitable market for railed tar sands crude – the U.S. west coast – is substantially threatened by local opposition to both crude oil trains and tar sands production.

A BNSF Railway train hauls crude oil west of Wolf Point, Montana, November 2013. ©AP Photo/Matthew Brown

Our findings confirm what industry experts and tar sands companies themselves have stated on many occasions. Bitumen-by-rail is not a long-term solution to the tar sands transportation problem and pipelines are indeed imperative if tar sands expansion goals are to be met.

While bitumen-by-rail is a risk for our climate and communities, it is not poised to be the silver bullet that rescues the tar sands industry from its growing transportation constraints. Nonetheless, given the perpetuation of misinformation regarding the potential of bitumen-by-rail, the case for why rail cannot and will not replace pipelines must be made. This report does so using clear analysis, with the hope that we can move away from a false choice debate between pipelines and rail and towards real conversations about the safe, modern, and low-carbon energy future that our communities and climate need.

Efforts to expand tar sands shipments by rail also miss the bigger picture when it comes to the growing power and momentum of the anti-tar sands movement. These campaigns are not just about pipelines. They are about the expansion of tar sands production, an energy source that is extreme in terms of carbon intensity and local and regional impact, at a time when we should be urgently moving to safer, lower carbon alternatives for the sake of our communities and our climate.

2.0 The Tar Sands Transportation Challenge: The Role of Rail in Moving Tar Sands Crude to Market

2.1 PIPELINE PROBLEMS: WHY RAIL BECAME PART OF THE TAR SANDS TRANSPORTATION DEBATE

Tar sands crude is high-cost and high-carbon. It is costly to produce and requires intensive extraction and processing methods (see Section 2.2.), which can be over three times more carbon-intensive than conventional oil.[1] The tar sands are remotely located in Northern Alberta and the bitumen produced from them needs to travel great distances to reach major crude oil refining markets. While pipelines have historically served this purpose, the unprecedented anti-pipeline campaigns that have emerged in North America in recent years have the industry scrambling to calm shareholders and markets with alternative transportation solutions such as rail.

However, citing rail as an alternative to pipelines rests on the idea that rail transport can not only move a similar quantity of tar sands crude as pipelines, but that it can do it as profitably. The profitability of transporting bitumen by rail is crucial because the high cost of producing tar sands crude, together with the resource's remote location thousands of miles from refining centers, mean that profit margins are very tight. Anything that adds to cost and reduces profit makes it more difficult for tar sands producers to grow production.

Tar sands producers need to transport their product beyond the most proximate markets, in Western Canada and the U.S. Midwest, if they are to fully reach their ambitious expansion goals. The heavy crude refining markets in those regions are already saturated with tar sands bitumen, and as a result prices for Canadian heavy crude have been discounted for some time (see Section 4.3.2).

To address this transportation need, raise profits, and stimulate more investment in tar sands production, major new export pipelines have been proposed to take tar sands crude to the U.S. Gulf Coast and Canadian West and East Coasts. Two of these pipelines in particular, the Keystone XL and the Northern Gateway, have faced exceptional opposition and have been delayed by challenges from a growing coalition of environmental organizations, indigenous peoples, and concerned citizens across the continent.

Recent Canadian Federal government approval of the Northern Gateway Pipeline has been met by fierce opposition in British Columbia, which has included no fewer than nine constitutional legal challenges by local First Nations, as well as additional legal challenges from environmental organizations and Canada's largest private sector union. It is considered by many energy analysts and pundits to be an unbuildable pipeline.[2]

The Keystone XL pipeline has prompted diverse and powerful opposition in the U.S., and has become a litmus test of President Obama's commitment to serious action on climate change. President Obama stated in a June 2013 speech on climate change that "[t]he net effects of the pipeline's impact on our climate will be absolutely critical to determining whether this project is allowed to go forward".[3]

As a result of public pressure, the pipeline continues to face delays despite a controversial favorable environmental impact assessment from the U.S. Department of State. One of the most contentious claims in the final review, published in February 2014, asserted that "the proposed Project is unlikely to significantly affect the rate of extraction in oil sands areas".[4] This was primarily based on analysis in the State Department report that asserted that the tar sands crude the pipeline would deliver can get to market via rail if the pipeline is not built.

This analysis is shown to be flawed in subsequent chapters of this report, but its adoption by the U.S. Department of State has dangerously reinforced the political saliency of the industry's assertion that "it will get to market anyway". The State Department report failed to consider both actual market conditions and the many logistical challenges that bitumen-by-rail faces that pipelines do not.

Rail cannot make up for the loss of transportation capacity if the Keystone XL tar sands pipeline were to be rejected. A rejection of this (and other pipelines) would be a clear victory for our shared climate.

2.2 TAR SANDS TRANSPORT EXPLAINED

To understand the unique issues behind tar sands crude oil transportation it is important to understand the physical characteristics of the tar sands themselves.

Buried in the tar sands of Alberta is bitumen, a semi-solid hydrocarbon rather than a liquid crude oil. It has very high sulfur and heavy metal content and in many cases is highly acidic. The shallower deposits of this bitumen are mined using giant

1 Pembina Institute, Oil Sands Climate Impacts. http://www.pembina.org/oil-sands/os101/climate
2 Les Whittington and Bruce Campion-Smith, "Northern Gateway pipeline faces major hurdles" June 17, 2014 The Star. http://www.thestar.com/news/canada/2014/06/17/northern_gateway_pipeline_face_major_hurdles.html
3 Remarks by the President on Climate Change, Georgetown University Washington, D.C., June 25, 2014, http://www.whitehouse.gov/the-press-office/2013/06/25/remarks-president-climate-change
4 United States Department of State, "Keystone XL Pipeline Project Final Environmental Impact Statement. Volume 1, Chapter 1.4, Market Analysis" Page 1.4-1

mechanical shovels in vast open pit mines. The 'ore' from this mining is a mixture of sand, clay, water, and bitumen. The bitumen is then washed out from the mixture in processing plants at the mine.

Deeper bitumen deposits are extracted 'in situ' predominately using a method called Steam Assisted Gravity Drainage or SAGD (usually pronounced SAG-D). This highly energy intensive procedure pumps steam underground for weeks in order to heat the bitumen so that it will flow into a production well that brings it to the surface. While some projects are testing alternative methods of in situ production, SAGD is the most common method.

The initial product of both extraction methods is raw bitumen. Bitumen is carbon-rich and hydrogen-poor. The lack of hydrogen and abundance of carbon gives bitumen its thick consistency and is the key reason that it is much more difficult than conventional liquid crude oil to transport in pipelines. These attributes, together with its high acidity, high sulfur, and heavy metal content, also make it much more difficult to refine into gasoline, diesel, and other petroleum products.

From the 1960s until just a few years ago, the majority of tar sands bitumen was upgraded into a synthetic light crude oil before it was sent to refineries, either in Canada or the United States. This synthetic crude oil, also known as 'syncrude' or 'SCO', is produced at upgrading plants in Alberta and Saskatchewan. These upgraders are very similar to refineries and the process of upgrading can be described as a partial refining of the bitumen.

The upgrading process strips a lot of the sulfur, heavy metals, and excess carbon out of the bitumen and liquefies it using large quantities of hydrogen produced from natural gas. The stripped out carbon results in a waste product called petroleum coke that is sold into the power and cement industries as a substitute for coal.[5] The result of the upgrading process is a light, sweet (low-sulfur) synthetic crude oil that can be transported in pipelines and refined at most refineries without the need for specialized intensive refining processes.

However, constructing upgraders is very capital-intensive and the economics of building new upgraders in Alberta have been unfavorable since around the time of the Great Recession in 2008. Very little new upgrading capacity has been constructed since then and very little is planned for the future. Meanwhile tar sands bitumen production has been increasing and producers plan to increase it further (see Box 1A).

Most of the increasing quantity of tar sands bitumen that is not upgraded into synthetic crude oil is blended with very light hydrocarbons such as condensate, natural gas liquids (NGLs), or naphtha to be sent via pipelines to refineries, primarily in the United States.[6] This blend, known as diluted bitumen or 'dilbit', is essential for the bitumen to flow in a pipeline. A typical blending ratio for pipeline transport is 72 percent bitumen and 28 percent diluent. Some producers blend in synthetic crude oil to make a product dubbed 'synbit', but dilbit is the most common blended bitumen product. Diluent content can change at different times of year as temperature affects pipeline flow. The colder it is the more diluent may be needed.

To accommodate its ambitious plan for tar sands production growth (see Box 1A), the industry has for some time planned to expand its markets by shipping bitumen as dilbit through pipelines primarily to the U.S. Gulf Coast via the Keystone XL pipeline and to the Canadian west coast via the Enbridge Northern Gateway and/or Kinder Morgan TransMountain Pipeline expansion.

Intense public scrutiny and opposition has led to protracted delays to each of these projects. This opposition is concerned for the local impacts of tar sands production, the threat that transporting tar sands crude poses to land, water, and the communities it passes through, and the contradiction between developing tar sands crude and maintaining a stable climate (see Box 1B).

As with pipelines, it is possible to load both synthetic crude and dilbit onto rail cars. However, unlike pipelines, it is also possible to load rail cars with raw bitumen (rawbit) or a bitumen blend with less diluent than dilbit known as 'railbit', depending on the tank cars and loading and unloading equipment used.

While shipping railbit or rawbit saves on diluent costs, known as the 'diluent penalty', it adds cost and time during loading and unloading as railbit and rawbit must be heated before being transferred to and from rail cars. Additionally, because bitumen is heavier than diluent a barrel of raw bitumen weighs more than a barrel of diluted bitumen. Strict weight limits on tank car carrying capacity therefore mean that tank cars carrying rawbit or railbit carry less volume.

The different logistics of pipeline and rail transportation shape the profitability of each method. While shipping by rail costs more than pipelines, there are advantages and disadvantages to both methods as outlined in Box 3.

Ultimately, transportation costs need to be adequately covered by the price received at the destination market. If the difference between the price of bitumen in Alberta and its price at the destination (the price differential) is small, only the least expensive transportation method will be profitable enough to support ongoing tar sands development.

5 Lorne Stockman, "Petroleum Coke: The coal hiding in the tar sands" January 2013, Oil Change International. http://priceofoil.org/content/uploads/2013/01/OCI.Petcoke.FINALSCREEN.pdf
6 For an explanation of these light hydrocarbons search each term at: http://www.eia.gov/tools/glossary/

Box 1A: Tar Sands Growth Plans and Transportation Capacity

In June 2014, the Canadian Association of Petroleum Producers (CAPP) estimated that Canadian oil production could almost double from 3.25 million barrels per day (bpd) in 2013 to 6.35 million bpd by 2030.[7] Much of this growth would come from the tar sands, which is estimated to grow from just under 2 million bpd in 2013 to 4.8 million bpd in 2030. The tar sands production forecast was reduced by 400,000 bpd compared to CAPP's 2013 report because of what it described as "cost competitiveness and availability of financing". These obstacles are due in great part to the ongoing transportation bottlenecks and resultant price discounts and concerns about market access for tar sands crude described elsewhere in this report.

Beyond 2030, tar sands producers have even greater ambition for growth, with some 9 million bpd of total production capacity identified in projects that are operating, under construction, approved or proposed.[8]

However, for the vast majority of this production growth to take place, additional transportation capacity must be built. In fact, every single pipeline project that is being proposed today, plus all the rail capacity that is currently being developed, would still not be enough to accommodate the full potential of tar sands production growth in addition to the conventional oil being developed in Canada.

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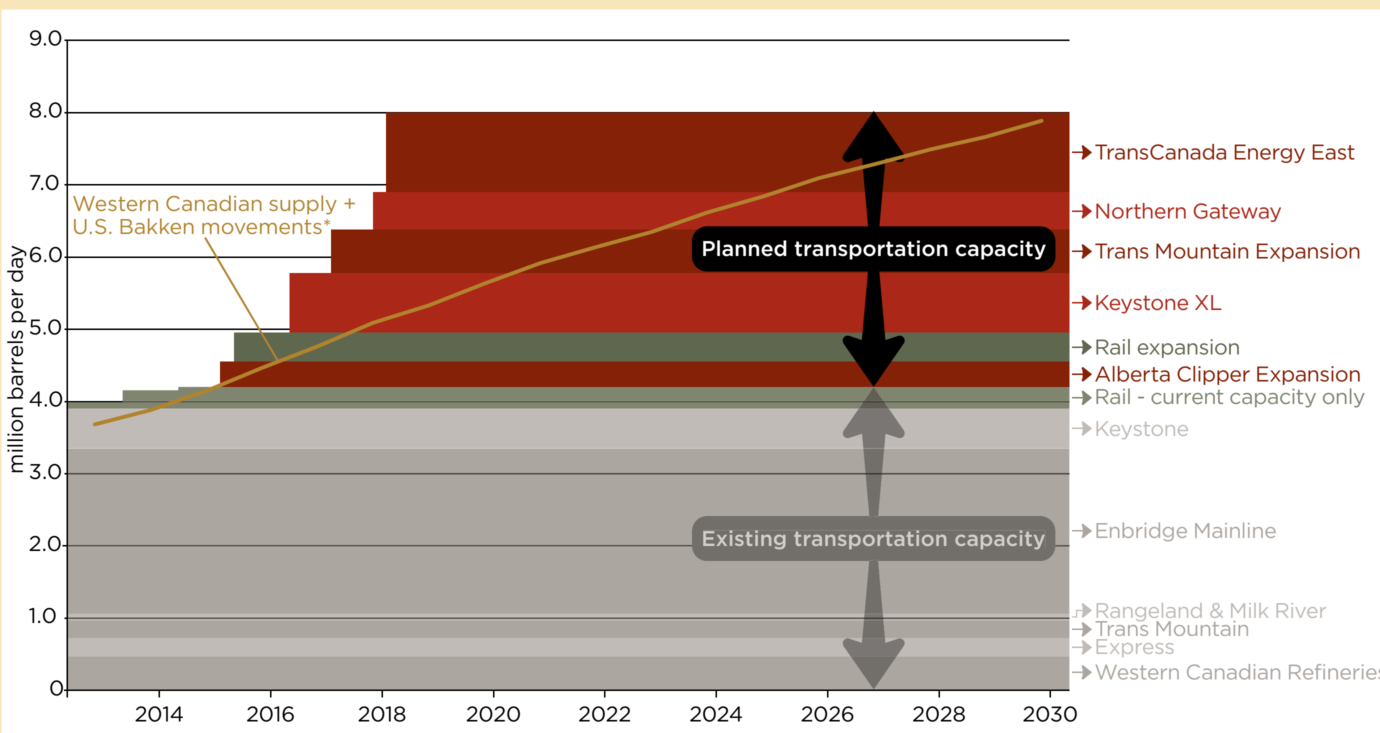
Figure 1, which is based on a chart in the CAPP report, shows not only the need for all proposed pipeline projects, but also the vast gap between potential rail capacity and the proposed pipeline projects. Given the challenges faced by bitumen-by-rail described in this report, and the vast need for additional transportation capacity outlined in Figure 1, the important role of any single pipeline in enabling incremental tar sands production is very clear.

Figure 1: Canadian Oil Supply Forecast vs. Transportation Capacity



*Refers to the portion of U.S. Bakken production that is also transported on the Canadian pipeline network.

7 Canadian Association of Petroleum Producers, "Crude Oil: Forecast, Markets & Transportation" June 2014. http://www.capp.ca/getdoc.aspx?DocId=247759&DT=NTV
8 Lorne Stockman "Tar sands planned growth is 3X climate limit" November 1, 2012 , Oil Change International http://priceofoil.org/2012/11/01/tar-sands-planned-growth-is-3x-climate-limit/

Box 1B: Tar Sands Production Potential vs. Climate Limits

In 2013 tar sands production was a little over 2 million bpd[9], while production capacity was over 2.5 million bpd.[10] Over 1 million bpd of production capacity is under construction today, raising production capacity beyond 3.5 million bpd by 2017.[11]

The Alberta Energy Regulator (AER) has estimated that "established reserves" of tar sands bitumen were 167 billion barrels at the end of 2013. It also estimates that the "ultimate potential" of the tar sands reserve is around 314 billion barrels.[12] However, the amount of tar sands bitumen that is technically considered a "proved" reserve is likely much lower than the 167 billion barrels that the Alberta regulator considers "established". This is because proved reserves under the most commonly used definition, which is the definition established by the U.S. Securities and Exchange Commission (SEC), are those that can be extracted under "existing economic conditions", meaning the average oil price in the year preceding the booking of those reserves as 'proved'.[13]

A large proportion of the reserves estimated to be 'established' by the AER are not producible at current oil prices, as is clearly reflected in data on tar sands project costs from Rystad Energy (see Figure 3 below). In fact, the AER's latest assessment of supply costs for the tar sands notes a $5 per barrel average rise in cost in 2013 over 2012 for in-situ projects (SAGD) and an increase of up to $20 per barrel for mining projects. The AER comments that "some higher cost projects may be delayed or cancelled."[14]

The misinterpretation of Canada's 'established' reserves as 'proved' is discussed in more detail in a study by researchers at University College London.[15] The distinction is important because climate science clearly shows that only a small portion of existing proved fossil fuel reserves can be consumed if climate change is to be constrained within reasonably safe limits.

In November 2013, the Intergovernmental Panel on Climate Change (IPCC) delivered its Fifth Assessment Report.[16] This report confirmed the scientific consensus on human caused climate change and put a figure on the quantity of climate changing gases, such as CO_2, that can be emitted into the atmosphere before reaching the internationally-agreed limit of 2 degrees (Celsius) of average global warming.[17] These permissible emissions are essentially a carbon budget that the world must remain within to prevent the worst impacts of climate change. At current emission rates, that budget will be used up within only three decades.[18]

The carbon budget has serious implications for the fossil fuel industry, which will deeply affect tar sands producers. In order to stay within the carbon budget, around two-thirds of existing proved reserves must be left in the ground unburned.[19] We simply cannot afford to emit the carbon pollution from these reserves as doing so risks irrevocably destroying the planet's climate system.

The International Energy Agency (IEA), an organization with a mandate to enhance energy security that has generally been an advocate of increased oil production, concurs with this assessment of how much of the world's fossil fuel reserve can be exploited. In the IEA's 2012 World Energy Outlook the agency stated that, "(n)o more than one-third of proven reserves of fossil fuels can be consumed prior to 2050 if the world is to achieve the 2°C goal".[20]

This emerging consensus on the imperative to leave the majority of proven fossil fuel reserves in the ground shows that the tar sands industry's plans to both expand production and build pipelines to take that production to market are grossly irresponsible. Replacing even a proportion of that pipeline capacity with rail is just as irresponsible.

9 Canadian Association of Petroleum Producers, "Crude Oil: Forecast, Markets & Transportation" June 2014. http://www.capp.ca/getdoc.aspx?DocId=247759&DT=NTV Appendix B.1.
10 OilSands Review, Canadian Oilsands Navigator, Updated July 14, 2014. http://navigator.oilsandsreview.com/listing
11 OilSands Review, Canadian Oilsands Navigator, Updated July 14, 2014. http://navigator.oilsandsreview.com/listing
12 Alberta Energy Regulator "ST98-2014: Alberta's Energy Reserves 2013 and Supply/Demand Outlook 2014–2023" May 2014. http://www.aer.ca/documents/sts/ST98/ST98-2014.pdf
13 Securities and Exchange Commission, "Modernization of Oil and Gas Reporting" January 1, 2010. http://www.sec.gov/rules/final/2008/33-8995.pdf
14 Alberta Energy Regulator "ST98-2014: Alberta's Energy Reserves 2013 and Supply/Demand Outlook 2014–2023" May 2014. http://www.aer.ca/documents/sts/ST98/ST98-2014.pdf Page: 3-26
15 Christophe McGlade and Paul Ekins "Un-burnable oil: An examination of oil resource utilization in a decarbonized energy system" January 2014, in "Energy Policy" Volume 64, January 2014, Pages 102–112. http://dx.doi.org/10.1016/j.enpol.2013.09.042
16 http://www.ipcc.ch/report/ar5/index.shtml
17 For an explanation of this aspect of the Fifth Assessment Report see: Kelley Levin "World's Carbon Budget to Be Spent in Three Decades" September 27, 2013, World Resources Institute. http://www.wri.org/blog/2013/09/world%E2%80%99s-carbon-budget-be-spent-three-decades#fnref:5
18 Kelley Levin "World's Carbon Budget to Be Spent in Three Decades" September 27, 2013, World Resources Institute. http://www.wri.org/blog/2013/09/world%E2%80%99s-carbon-budget-be-spent-three-decades#fnref:5
19 David Turnbull, "IPCC says we must stop digging" September 27, 2013. Oil Change International. http://priceofoil.org/2013/09/27/ipcc-says-must-stop-digging/
20 OECD/IEA World Energy Outlook 2012. http://www.worldenergyoutlook.org/publications/weo-2012/

3.0 Bitumen-by-Rail Today: Trickling Along

The Canadian Association of Petroleum Producers (CAPP) estimated in a June 2014 report that total crude oil movements by rail from Western Canada reached about 200,000 bpd in late 2013.[21] The Canadian National Energy Board (NEB) monitors crude oil exports by rail and published a figure of just less than 150,000 bpd for the fourth quarter of 2013, which rose to just over 160,000 bpd for the first quarter of 2014.[22] The intra-Canadian shipments of Western Canadian crude being railed to refineries in Eastern Canada makes up the difference between these figures.

Determining exactly how much tar sands crude is being shipped by rail is complicated by a number of factors including: transportation of a variety of Western Canadian crudes, terminal capacity as an inadequate indicator of actual volumes or content, as well as other challenges to determining the transportation methods for dilbit blends.

However, we are confident that our methodology presents a reasonable estimate. For example, we could be overestimating as some conventional heavy crude oils have a similar density to tar sands bitumen. Likewise, we could be underestimating as some ports in the data may be used by both rail and pipeline. We believe that our estimate is the best possible given the available information.[23]

Table 1 shows the results of this bitumen-by-rail estimate for the most recent period for which data is available. From January to May 2014 an average of just less than 128,000 bpd of tar sands bitumen was imported into the U.S. by rail. A little over 47,000 bpd of this was processed in the Gulf Coast region (PADD3). This volume of rail imports into the Gulf Coast region represents just 5.7 percent of the full capacity of the Keystone XL pipeline.

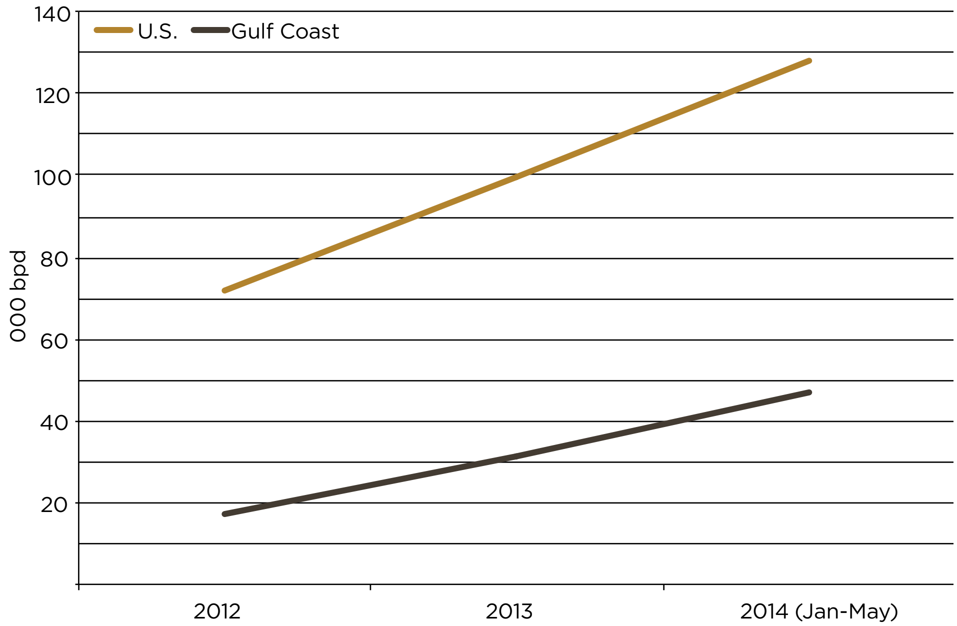
The quantity of tar sands bitumen imported into the U.S. by rail has been growing. Figure 2 shows this growth since 2012, when imports by rail were around 72,000 bpd for the U.S. and 17,000 bpd for the Gulf Coast region.

Table 1: Estimated Average Bitumen-by-Rail Imports (bpd) – January to May 2014

	Railbit/Rawbit	Dilbit	Total
U.S.	113,477	14,397	127,874
Gulf Coast	37,272	9,993	47,265

Source: Data from EIA Company Level Imports.[24] Calculation by Oil Change International.

Figure 2: Estimated Average Bitumen-by-Rail Imports (bpd) – 2012 to 2014 (Jan-May)



Source: Data from EIA Company Level Imports.[25] Calculation by Oil Change International.

21 Canadian Association of Petroleum Producers, "Crude Oil Forecasts, Markets & Transportation" June 2014. http://www.capp.ca/getdoc.aspx?DocId=224970&dt=NTV
22 http://www.neb-one.gc.ca/clf-nsi/rnrgynfmtn/sttstc/crdlndptrlmprdct/2014/cndncrdlxprtsrl-eng.html
23 We used U.S. Department of Energy data located at: http://www.eia.gov/petroleum/imports/companylevel/ to estimate how much tar sands crude enters the U.S. by rail. The data includes details on the density of the crude oil imported in the U.S. (API Gravity) and the sulfur content. This helps us identify some tar sands crudes. However, it is difficult to pinpoint with precision dilbit that is imported by rail as opposed to dilbit that is imported by pipeline. It is also difficult to identify synthetic crude, although we do not expect to see much synthetic crude shipped by rail. We estimated railbit and rawbit shipments based on the density (API Gravity) of the crude oil. It is very difficult to move crude that is denser or heavier than 18 API Gravity in a pipeline. Therefore, we have assumed that all crude oil entering the U.S. from Canada that is 17.9 API Gravity or less is railbit or rawbit imported by rail. The transport mode for dilbit blends is more difficult to pinpoint. Most dilbit enters via pipeline but some is going by rail. We have ascertained that certain ports listed in the import data can only be rail so we have counted crude oil with density in the dilbit range (18-22.9 API Gravity) that entered through these ports to be dilbit entering by rail.
24 EIA, Company Level Imports http://www.eia.gov/petroleum/imports/companylevel/ Accessed August 11, 2014.
25 EIA, Company Level Imports http://www.eia.gov/petroleum/imports/companylevel/ Accessed August 11, 2014.

With rail to the U.S. Gulf Coast currently providing less than 6 percent of Keystone XL's proposed capacity and total bitumen-by-rail into the U.S. at around 3 percent of the total additional capacity required to accommodate future Canadian crude oil production growth, it appears highly unlikely that rail could replace proposed pipeline capacity in the foreseeable future.

A train carrying crude oil burns after derailing outside Aliceville, Alabama in November 2013. ©AP Photo/Alabama Emergency Management Agency

The growth in bitumen-by-rail since 2012 is significant, but the volume remains a trickle compared to the capacity of proposed pipelines and the need for additional transportation capacity that the forecasted growth in tar sands production will create (see Figure 1). With rail to the U.S. Gulf Coast currently providing less than 6 percent of Keystone XL's proposed capacity and total bitumen-by-rail into the U.S. at around 3 percent of the total additional capacity required to accommodate future Canadian crude oil production growth[26], it appears highly unlikely that rail could replace proposed pipeline capacity in the foreseeable future.

26 Based on the 4 million bpd of transportation capacity in the CAPP forecast in Figure 1 that would be provided by all pipeline proposals plus current and forecast rail capacity.

3.1 RAILING BITUMEN TO THE GULF COAST IS LOSING MONEY

For rail to compete with pipelines for tar sands bitumen transport to the Gulf Coast, certain conditions need to be firmly in place. So far in 2014, these conditions have not been met and railing tar sands crude to the Gulf continues to be a loss leader for many producers.

One of the main factors is that the price of tar sands bitumen on the Gulf Coast has to be high enough to pay for the additional cost of rail over pipe. For traders to engage in buying tar sands crude in Alberta and then pay for it to be delivered to the Gulf Coast by rail, the difference in price between those markets has to more than make up for the cost of transport.

The other factor is that to reduce rail costs down to a level close to pipeline transport, an optimum configuration of unit trains filled with raw bitumen needs to be arranged. To date, that optimum configuration has not been achieved and will not even be tested until late 2015. Until it has been tested over time, it is far from clear that bitumen-by-rail can be as profitable as some have claimed.

The factors behind the lack of raw bitumen unit train infrastructure are explained in detail in Section 4. Comments from traders about the lack of profitability in the Gulf Coast trade are presented in Box 2.

Although railing tar sands bitumen to the Gulf Coast has not been profitable for traders, long-term contracts and price hedging mean that some shipments continue even while they make a loss. However, there is no incentive for traders to exploit 'arbitrage' – the difference in price between the source and destination of the crude – when the cost of rail shipments was factored in. This unprofitability means that price signals are not driving forward the business of railing crude oil to the Gulf Coast, and there has been little growth in bitumen-by-rail to the region outside of the fulfillment of long-term contracts.

While the first half of 2014 is a small window of time for the tar sands industry, it is a period in which new bitumen-by-rail loading capacity came online and many expected the trade to flourish. While the pricing conditions discussed below may change, as market price dynamics often do, the vulnerability of the bitumen-by-rail trade to volatile pricing is a negative indicator for the long-term sustainability of the industry. The dynamic has been negative for the first part of 2014. If this situation continues, it is very hard to see how railing tar sands crude to the Gulf Coast can possibly send the price signals necessary for tar sands production to grow.

Box 2: A Trader's Perspective: No Incentive to Rail Tar Sands Crude to the U.S. Gulf Coast in 2014

At the end of February 2014, oil traders began reporting that railing tar sands to the Gulf Coast was barely breaking even. Genscape, a commodities information service, reported that the price differential between Mexican heavy oil (Maya) over tar sands dilbit (WCS) had widened to $13-14 per barrel in Gulf Coast refining markets. In reference to Canadian heavy crude, Genscape quoted a crude oil trader saying, "It's not that viable to breakeven railing to the Gulf."[27]

By the first week of April, the situation had further deteriorated. Genscape quoted traders as saying that the prevailing price differentials meant that rail movements for May production were looking significantly less economical than pipeline. "'It's going to be very difficult to move by rail,' one crude trader said, with pipeline transportation set to predominate further for Canadian crude."[28]

In mid-April, Genscape's weekly report continued its theme. "The economics of railing out spot Canadian crude have continued to remain broadly uneconomical, trader sources said. 'The volumes moving are the same but they're just not making money,' one source commented."[29]

By mid-June, it became clear that rail to the Gulf Coast had not been profitable for much of 2014. Genscape reported a trader commenting, "[t]here's been no incentive to rail to the Gulf for about six months".[30] Genscape further explained that, "Canadian crude market sources reported that the pricing arbitrage for railing Canadian crude profitably into the U.S. Gulf remained closed last week. While some crude-by-rail shippers have secured longer term rail contracts in preparation of limited pipeline capacity, other players railed their crude because of a lack of pipeline commitments. But 'anyone who is railing is probably losing money on it' as price differentials between Western Canadian Select and coastal crudes remained narrow, one trader said."[31]

Later in June, Genscape reported that railing Bakken crude to the Gulf Coast was not making money either. "But, some market participants still railed the barrels southward, "just because they don't want to park loaded trains," one source said."

27 Genscape Petrorail Report, March 4, 2014, Volume: 2, Issue: 9 (Subscription Only)
28 Genscape Petrorail Report, April 8, 2014, Volume: 2, Issue: 14 (Subscription Only)
29 Genscape Petrorail Report, April 15, 2014, Volume: 2, Issue: 15 (Subscription Only)
30 Genscape Petrorail Report, June 3, 2014, Volume: 2, Issue: 22 (Subscription Only)
31 Ibid.

4.0 Why Rail Won't Solve The Problem: Rail's Biggest Challenges

4.1 DILUENT DILEMMAS AND DIFFERENTIALS: WHY RAILING BITUMEN IS NOT LIVING UP TO THE HYPE

Bitumen-by-rail has so far remained a niche activity that is serving a small proportion of tar sands crude transportation. It is not living up to the expectations of the U.S. State Department report on Keystone XL and is not ensuring the profit margins that tar sands producers need to keep expanding.

In this section, we explain why rail has failed to meet expectations, examining in particular why the optimum configuration for bitumen-by-rail has not been achieved yet and why prices for tar sands bitumen on the Gulf Coast are not supporting profitable rail transport.

4.1.1 Enigmatic Optimum: Why Tar Sands Shippers have yet to Achieve the State Department's Hypothetical Optimum Configuration for Shipping Bitumen by Rail

In order to optimize the economics of shipping bitumen by rail, a combination of unit trains and reduced diluent is necessary. However, achieving this combination is not as straightforward as the State Department assumed.

The State Department's assessment of bitumen-by-rail economics concluded that bitumen could be delivered to the Gulf Coast by rail at a similar cost to pipelines, if it was transported by unit train as either railbit or rawbit. But this optimum scenario has yet to materialize and there so far remains a lack of commitment from the industry to achieve it. This throws into question whether rail can really deliver tar sands bitumen to the Gulf Coast at a similar price or scale to pipeline.

The State Department presented figures, summarized in Table 2 below, that gave a range of costs based on different blends and transport modes for transporting tar sands bitumen to the Gulf Coast. For pipeline transport the range reflects varying tariffs for different routes, as well as the difference between committed and uncommitted tariffs. Committed tariffs involve long term take-or-pay contracts that only large scale producers can afford. Smaller scale producers who are unable to commit to these contracts are forced to pay the uncommitted rate and also usually have to wait for space on the pipeline to move their product. So as smaller producers generally have to settle for unfavorable terms for pipeline transport, they may find rail a favorable option for getting their product to market.

The State Department rail cost estimates also reflect different routes, but the lower end of the range generally refers to unit train costs while the higher end of the range reflects manifest train costs (see Box 4).

The general conclusion drawn from the State Department estimates is that unit train shipment of railbit can be done at a similar price to pipeline, while a unit train of rawbit may actually be cheaper. This raises the question of why tar sands producers are not rushing to send unit trains of raw bitumen to the Gulf Coast. The answer to that question is that the logistics and costs of loading a unit train with railbit or rawbit are much more complex and expensive than the State Department assumed.

Table 2: Summary of State Department Cost Estimates for transporting tar sands bitumen to the U.S. Gulf Coast

Blend	Dilbit	Dilbit	Dilbit	Railbit	Rawbit
Transport Mode	Pipeline (Committed)	Pipeline (Uncommitted)	Rail	Rail	Rail
Landed cost at Gulf Coast	\$70.64-\$73.05	\$77.06-\$79.47	\$77.54-\$83.54	\$73.89-\$80.89	\$67.66-\$74.66

Source: U.S. Department of State, Keystone XL Pipeline Market Analysis, P. 1.4-129[32]

32 Available at http://keystonepipeline-xl.state.gov/documents/organization/221147.pdf

Box 3: Pipelines vs. Rail: Advantages & Disadvantages

Pipeline Advantages

- Lower per barrel carriage rates
- Simple logistics from source to destination (no need to change diluent levels or change mode of transport)
- Not vulnerable to extreme weather disruptions
- Not competing with other commodities (grain, coal etc.) for access to route
- Long-term commitment gives large producers market security

Pipeline Disadvantages

- Diluent costs add to overall transport costs
- High capital costs for pipeline construction make long-term contracts necessary, make entry costs high for smaller producers
- Single destination, no market flexibility
- A major pipeline malfunction can take a long time to fix and can result in severe market disruption
- Long lead in time for new projects (permitting and construction)
- Exposure to public opposition during application, construction, and operation
- A pipeline spill can cause significant damage to local environments and communities

Rail Advantages

- Can reduce and possibly eliminate diluent
- Can reach multiple markets
- Scalable, can start small and expand
- Low entry costs
- No need for long-term contracts, suits smaller producers.
- Low capital costs for infrastructure (terminals)
- Relatively low capital risk (try it and see)
- Lower permitting hurdles (terminals)
- Relatively fast construction (terminals)

Rail Disadvantages

- High per barrel carriage rates
- High logistical complexity (loading, unloading, transloading, diluent recovery, heating, etc.)
- Unit train loading terminals require connection to source via pipeline. Diluent removal adds cost
- Heating bitumen for loading and unloading adds capital and operational cost to terminals and time to the process
- Reduced diluent requires insulated and coiled tank cars, which are more expensive to buy or lease and are currently in short supply.
- Reducing diluent increases weight, reduces number of barrels per tank car/train
- High vulnerability to extreme weather
- Competition for access to track (grain, coal, etc.)
- Exposure to cost inflation risk (fuel, tank car leasing, track access, etc.)
- Exposure to public backlash over safety and associated increased regulatory costs
- Public opposition to terminals, particularly on the west coast, may shut down major market

4.1.2 How Is Tar Sands Bitumen Being Railed Today and Why Is It Not Making Money in the Gulf?

Currently the only unit trains carrying tar sands crude are carrying dilbit, while shipments of railbit or rawbit are only going by manifest freight (see Box 4 for an explanation of unit trains and manifest freight).

In general, the manifest shipment of reduced diluent blends is only benefiting small producers while large producers, who require the larger scale of unit train operations, are only able to ship dilbit.

The reason unit train terminals are not shipping railbit or rawbit today has to do with the scale of their operations. Unit train terminals by definition require a large steady flow of product if they are to operate at high capacity. A typical unit train carries between 60,000 to 65,000 barrels, and most unit train terminals plan to have the capacity to load two to three trains per day (see Tables 4 & 5).

In general, the larger tar sands operations, as well as some of the smaller ones, are connected by pipeline to trading hubs at Edmonton and Hardisty. These pipelines are called 'feeder pipelines'. Edmonton and Hardisty are starting points for the main export pipelines out of Alberta and feeder pipelines generally terminate at the loading points for these export pipelines. All but one of the planned and currently operating unit train terminals are located close to these two trading centers (see Section 7). The bitumen delivered to unit train terminals is transported by feeder pipelines, and therefore must be dilbit to flow through these pipelines. The dilbit is then loaded directly onto trains; no diluent is removed and therefore the cost savings of shipping a purer blend of bitumen are not realized.

Diluent can be removed via a diluent recovery unit (DRU) and the estimated cost and benefit for doing this were factored into the railbit and rawbit cost estimates in the State Department analysis (see Table 2). However, there is to-date no DRU operating at any unit train terminal so this technology has not yet been tested at scale.

At the time of writing only one rail terminal connected DRU is under construction. It is being built by MEG Energy, which is a major customer for the Canexus Bruderheim unit train terminal near Edmonton, Alberta. The 30,000 bpd DRU is scheduled to begin operation in late 2015 and is estimated to cost CAD75 million (USD68 million) to construct. It could be expanded to 90,000 bpd "depending on market demand".[33]

Other unit train terminals currently under construction in Alberta have so far not announced DRUs as part of their plans, although an executive at Gibson Energy recently stated that his company is "actively working on it". However, he was unable to answer investor questions on the economics of DRUs or confirm that Gibson would actually build a DRU.[34]

At an industry conference in December 2013, Randy Meyer, VP for Corporate Development and Logistics at Altex Energy, which operates six small scale loading terminals in Alberta and Saskatchewan, told attendees that using DRUs to recover diluent and send it back to the field was "not economic in our view".[35]

While MEG may disagree with Meyer, the facts on the ground are that currently only one rail-connected DRU is under construction and there are currently no concrete plans to install a DRU at most unit train loading terminals operating or being planned in Alberta today. This suggests that the economics of DRUs have yet to be proven, and both terminal operators and tar sands producers are currently unwilling to commit capital to this part of the bitumen-by-rail conundrum.

This means that until the DRU at the Canexus terminal comes on line in late 2015, all unit trains carrying tar sands crude will carry dilbit. Railbit or raw bitumen can only be shipped in more expensive manifest shipments.

The optimal configuration for bitumen-by-rail – in which unit trains move railbit or rawbit – that in theory equals or beats the cost of moving a barrel of bitumen by pipeline is yet to be realized. While one terminal may be equipped to do this by the end of 2015, no other unit train terminals are currently committed to diluent recovery. This raises questions about whether diluent recovery is as universally economic as the State Department assumed and certainly challenges the idea that tar sands can be railed at a similar cost to pipeline transport at a meaningful scale.

33 Ashok Dutta and Travis Whelan, "Alberta bitumen producers to rely more on condensate imports." June 10, 2014. Platts Commodity News. Subscription Only.
34 Remarks by Stewart Hanlon, President and CEO of Gibson Energy at RBC Capital Markets Global Energy and Power Conference, New York, New York, June 2, 2014. Transcript available from CQ FD Disclosure by subscription only. In response to a question from Mark Friesen, analyst at RBC, in which Friesen asked whether Gibson Energy was looking at DRUs and whether they make sense, Hanlon answered, "Well, I was hoping there wasn't a second part to that question because the first part was easy," implying that Gibson is looking into it but was as yet unclear whether it makes sense. In the rest of his response he did not comment on the economics of DRUs.
35 Randy Meyer, VP for Corporate Development and Logistics of Altex Energy at the Condensate Marketing Congress 2013, Houston, Texas, December 10, 2013. Presentations and slides available from American Business Conferences. http://www.condensate-markets-2013.com/

Box 4: Unit Trains, Manifest Trains and Crude Oil Carrying Capacity

Unit trains are trains which are loaded as a single train with one product to be transported from source to destination, without being broken up or mixed with carriages from other trains. They are usually between 100 and 120 cars long.

Manifest freight refers to a train with cars carrying different products from multiple sources. With manifest freight, a small number of cars are loaded with crude oil and these are joined with railcars carrying other commodities to make up the full train. Cars that are part of a manifest or mixed train take longer to reach their destination as they are switched between different trains along their journey and can spend several days in switching yards. Shipping oil (and in fact any product) is cheaper, faster, and more efficient by unit train.

Tank cars come in two sizes and the amount of oil they can carry depends on the weight of the oil. For example, Bakken oil is light oil whereas tar sands crude is heavy. The amount of oil being carried by any one train depends on the tank car size, the weight of the oil and the number of tank cars. The table below is indicative.

Tank Car and Train Crude Oil Carrying Capacity Estimate Note: Gallons are U.S. Gallons, 42 in a barrel. All figures have been rounded.

	Tank Car Capacity	Manifest Train (e.g. 20 Cars)	Unit Train (e.g. 120 Cars)
Light Crude	600 – 700 barrels 25,000 – 29,000 gallons	12,000 – 14,000 barrels 500,000 – 600,000 gallons	72,000 – 84,000 barrels 3 million – 3.5 million gallons
Heavy Crude	500 – 550 barrels 21,000 – 23,000 gallons	10,000 – 11,000 barrels 420,000 – 460,000 gallons	60,000 – 66,000 barrels 2.5 million – 2.77 million gallons

Additionally, the fact that unit train terminals can only load dilbit means that trains with around 100 cars full of a blend of energy-dense bitumen and volatile natural gas liquids are increasingly barreling through North American communities with no clear measures to guarantee their safety. In the meantime, smaller terminals, generally with capacities under 20,000 bpd (see Table 4), are the only facilities able to load trains with railbit or rawbit. These generally receive the bitumen by truck from the field. Trucking bitumen is a laborious and time consuming endeavor but producers who have no access to pipeline capacity are forced to do it. They may load a dozen or so tank cars at a time and these cars are joined with cars shipping other commodities to form a full train. In general, this can take two to three times longer to reach the destination compared to unit trains that go directly from source to destination.

This may be a workable option for small producers but it is not viable for large producers. If large producers cannot make rail to the Gulf work profitably over the long term, rail cannot support their ambitious long-term production growth plans.

4.2 REAL TRANSPORT COSTS & NETBACKS: WHERE THE RUBBER HITS THE ROAD FOR TAR SANDS PROFITABILITY

We have explained above that sending tar sands bitumen to market by pipeline is complicated by the need to dilute the bitumen so that it will flow as a liquid. The diluent is expensive in Alberta but cheap on the Gulf Coast where it is subsequently sold, essentially at a loss, as part of the bitumen blend.

Rail operators point to this 'diluent penalty' as the key reason that rail can compete with pipeline transport, despite the fact that per barrel freight costs of rail are roughly double those for pipelines. However, as explained above, actually avoiding the 'diluent penalty' at a meaningful scale that involves unit trains is not currently happening, and it is unclear if it will ever take off.

Despite the claims of rail and terminal operators selling their wares, the facts on the ground show that pipeline transport delivers higher 'netbacks' (the price received by producers minus the cost of getting the product to market) to tar sands producers than rail does.

A recent analysis of current market conditions by RBN Energy demonstrated the preferable economics of pipeline compared to rail very clearly. Table 3 shows the estimates for netback on a barrel of bitumen via different transport options. Note that in the case of bitumen blends, netback for producers is different to the price received on a barrel of dilbit or railbit minus transportation costs. Diluent is a cost and therefore delivering a barrel of bitumen requires delivering between 1.2 and 1.4 barrels of bitumen blend, depending on the diluent level. The netback on a barrel of actual bitumen is what really matters to tar sands producers and this is what is shown in Table 3.

Table 3: RBN Energy Analysis of Current Tar Sands Netbacks on the Gulf Coast

Summary	Bitumen $/Bdl	Dilbit $/Bdl	Railbit $/Bdl
Crude sale price (less diluent)	90	90.56	88.27
Netback Rail Manifest	65	56.24	58.02
Netback Rail Unit		59.10	61.65
Netback Pipeline		74.11	

Source: RBN Energy LLC 2014, Go Your Own Way: Moving Western Canadian Bitumen to Market[37]

It is clear from RBN's analysis that the highest netback is for dilbit delivered by pipeline, which is listed here as $74.11.[36] The netback on manifest rail of raw bitumen is the next highest at $65. No analysis was done for unit train delivery of raw bitumen as it is not currently technically possible for reasons outlined above. RBN did do an analysis of unit train delivery of railbit even though that is also not yet achievable. As railbit still contains between 15 and 20 percent diluent, netback remains far below pipeline dilbit because of the extra cost of rail logistics and the still considerable cost of diluent.

For dilbit and railbit, unit train transport improves netback by about $3 over manifest rail. This would suggest that should unit train delivery of rawbit be achieved, netbacks would still be below that of pipeline dilbit, possibly by some $7 per barrel (See Table 3).

The fact is that while using less diluent saves some cost, transporting railbit and rawbit involves the additional cost of heating the product during loading and unloading, as well as additional time, using more expensive insulated and coiled tank cars, in addition to lowering the amount of product that can be carried in each car due to weight limits. If the bitumen is delivered to the rail terminal as dilbit, requiring diluent recovery to create railbit or rawbit, this can only add to these costs.

In summary, despite the 'diluent penalty' pipeline transport of tar sands bitumen to the Gulf Coast is the most cost-effective method. For large-scale tar sands producers, pipelines are essential for moving hundreds of thousands of barrels per day to trading hubs in Alberta. The most efficient and cost-effective way to then move that dilbit to distant markets is for it to continue its journey on a pipeline network, rather than being forced to undergo the complex logistics of removing diluent and loading and unloading onto and off of the cumbersome rail network.

Small-scale tar sands producers may continue to benefit from manifest rail shipment of bitumen. But these producers do not hold the key to unlocking the billions of barrels of tar sands bitumen that represent the largest potential contributions to greenhouse gas pollution and upstream environmental damages.

The transport of bitumen by rail may be growing, but it will never fill the roughly 4 million barrels per day gap between future Canadian oil production and export pipeline capacity (see Figure 1). The quotes from industry leaders in Box 5 clearly show that the tar sands industry agrees with this conclusion.

4.3 ALL ABOUT PRICE

We have explained above how the State Department underestimated the logistical complexity and cost of shipping unit trains full of raw bitumen, which it claimed would enable tar sands producers to get bitumen to market at a similar cost to pipeline transport.

Keeping transport costs as low as possible is crucial for tar sands producers because margins are already tight due to high capital and operational costs for production, the distance to market, and the low price the product fetches due to its low quality (see Section 2.2).

36 It should be noted that all of these prices fluctuate and RBN's figures should be considered indicative mostly of the difference between different transport options. RBN assumed that raw bitumen fetches $90 per barrel on the Gulf Coast. Our research has not been able to confirm that either way as raw bitumen prices are not tracked or published. According t Bloomberg data, in the same week that the RBN report was released (June 23, 2014), the price of Maya averaged $99.60 and WCS averaged $85.46.
37 Available at www.rbnenergy.com via subscription.

4.3.1 Rising Costs

Rising costs are a perpetual concern for tar sands producers. The remote location of the resource means that everything required for construction and operations comes at a cost premium, from labor to steel and cement. The Alberta Energy Regulator reported in May 2014 that average costs for tar sands production in 2013 were up $5 per barrel for in-situ and up to $20 per barrel for mining over 2012.[38]

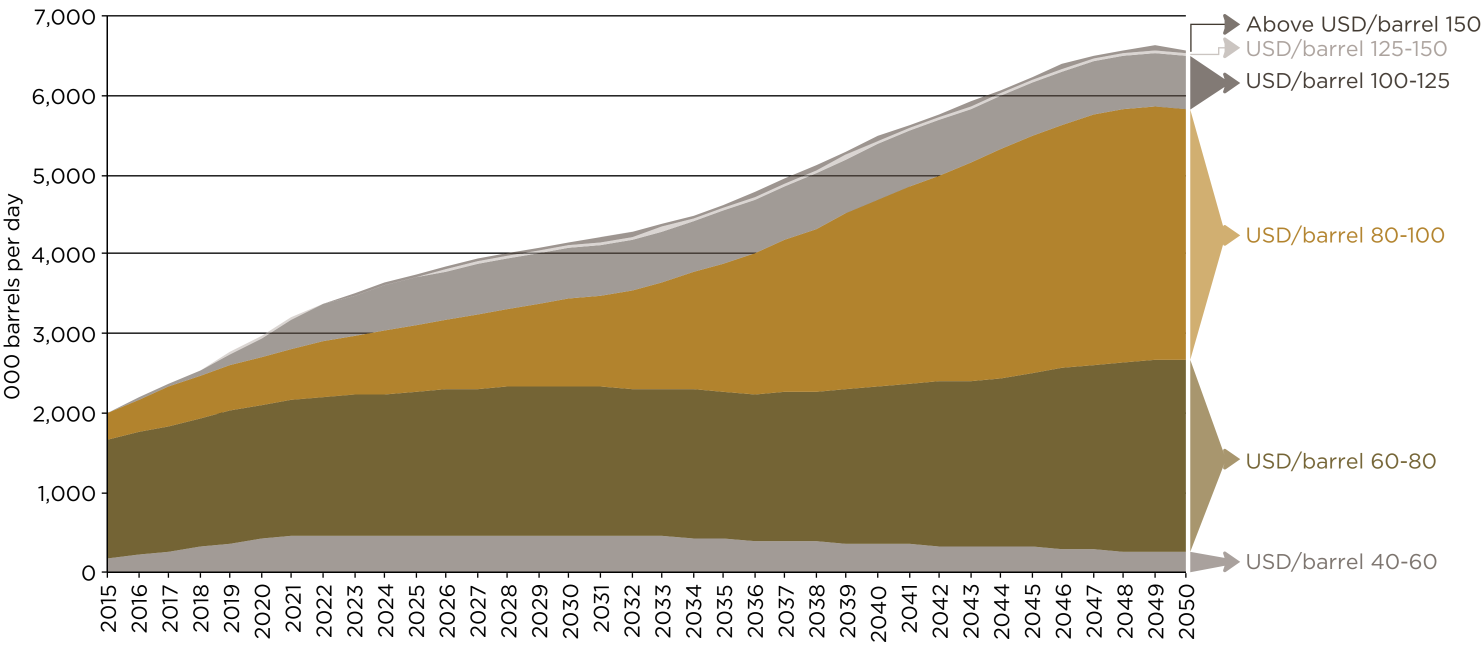
In April 2014, Grant Ukrainetz, vice president and treasurer at tar sands producer Harvest Operations Corp., told an industry conference, "[c]apital cost pressures in the oil sands have tripled, operating costs in the oil sands at least doubled, we had a change in the oil sands royalty regime, we had greater environmental regulations, costs of compliance have increased, we had continued delays in pipelines that allow us to move products out to maximize revenue, [there is] negative public sentiment toward the oil sands, plus you have the emergence of other opportunities in the U.S. and elsewhere".[39] It is exactly this long list of cost pressures and headwinds that makes the tar sands industry so vulnerable to any additional cost pressures.

This highlights yet another issue overlooked by the State Department's analysis of bitumen-by-rail. The figures presented in the analysis of the profitability of bitumen-by-rail, part of which are summarized in Table 2 above, used a low bitumen production cost figure of $45 per barrel across the board. This figure does not reflect the real, higher cost of producing bitumen for some existing tar sands projects, and crucially, does not reflect the rising costs faced by future projects.[40]

Many planned tar sands projects are poised to face higher operational costs than existing projects as producers move into ever more marginal resources. This reality is clearly indicated in tar sands reserves and production data compiled by Rystad Energy (see Figure 3). The data shows that over the next few decades, an increasing proportion of tar sands production will require a WTI oil price, of at least $80 to $100 per barrel, to break even. While oil may currently be trading at around $100 per barrel, tar sands producers receive significantly less than this due to transport costs and price discounts based on supply bottlenecks and the poor quality of tar sands crude (see Section 4.3.2).

This combination of rising costs and increasingly marginal resources seriously calls into question the viability of future tar sands production growth unless the most cost effective transport solution can be secured. Major export pipelines are that solution. Rail is not.

Figure 3: Breakeven (WTI) Oil Price for Tar Sands Production



Source: Rystad Energy UCube, August 2014.

38 Alberta Energy Regulator "ST98-2014: Alberta's Energy Reserves 2013 and Supply/Demand Outlook 2014–2023" May 2014. http://www.aer.ca/documents/sts/ST98/ST98-2014.pdf Page: 3-26
39 Claudia Cattaneo, "Oil sands investment slowing because of tough market, not new SOE rules, execs say" April 4, 2014. Financial Post, Canwest News Service. http://business.financialpost.com/2014/04/04/oil-sands-investment-slowing-because-of-tough-market-not-new-soe-rules-execs-say/?__lsa=6798-9b33
40 For a detailed critique of this aspect of the State Department analysis see: Carbon Tracker Initiative, "March 2014, Keystone XL (KXL) Pipeline: The Significance Trap." http://www.carbontracker.org/site/kxl

4.3.2 Volatile Oil Prices

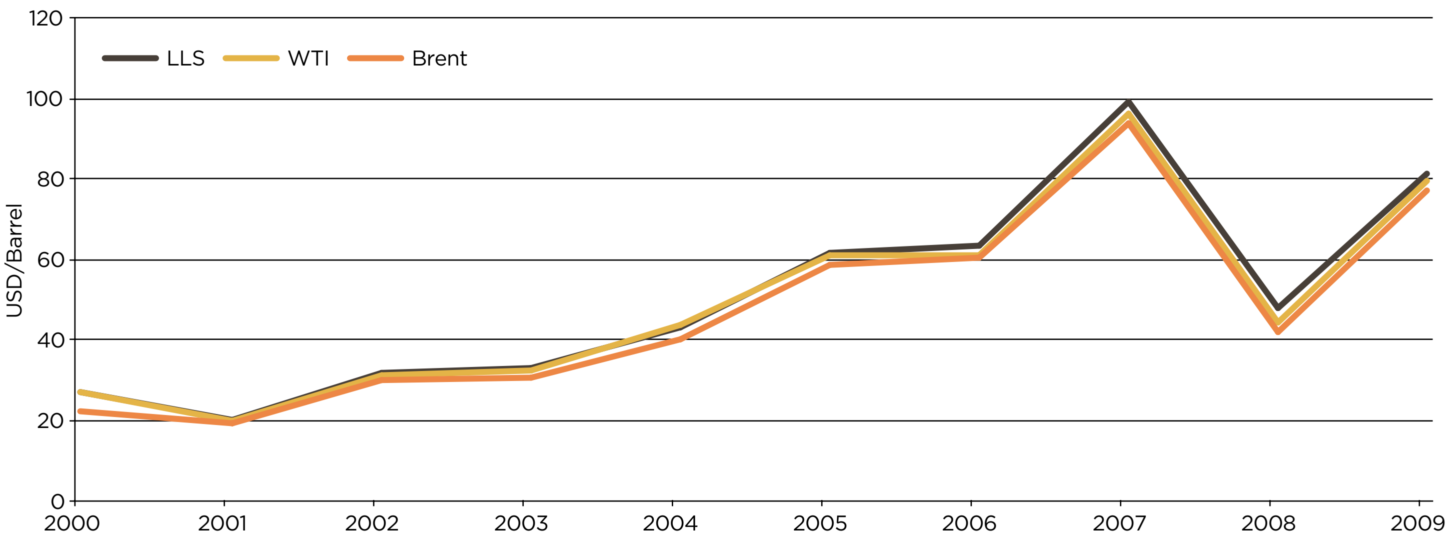
The evidence revealed in this report shows that even for existing production, where capital costs have already been sunk, producers are struggling to make a return on railing tar sands bitumen to the Gulf Coast. Further, the more proximate and therefore cheaper to access markets, such as the east and west coasts of the United States, do not currently have sufficient unloading capacity to offer tar sands producers an alternative to the proposed major export pipelines. While there are a number of planned capacity expansions in those regions, they are seriously threatened by local dissent (See Section 5 below).

For much of 2014, railing tar sands bitumen to the Gulf Coast has not been a profitable business. However, this is not only because shippers have not been able to optimize bitumen-by-rail by using unit trains to ship raw bitumen, as explained in Section 4.1.1. It is also because the price of bitumen in the Gulf Coast market is not significantly higher than it is in Edmonton, the pricing hub in Alberta. In order for traders to make a profit on buying bitumen in Edmonton and then transporting and selling it on the Gulf Coast, the difference in these prices needs to more than cover the cost of transport. This pricing indicator is known as the price 'differential'.

The unfavorable price differential affecting bitumen prices on the Gulf Coast is a symptom of the ongoing U.S. oil boom. For much of the last few decades, the Gulf Coast has been a market in which oil producers could get a higher price for their crude than in some other markets. As the world's largest refining center, the region requires a lot of crude oil, between 10 and 12 percent of global supply. U.S. crude oil production declined from the early 1970s until 2009, and this meant refiners often had to pay a premium to get enough supply imported from overseas.

The historical U.S. price premium is illustrated in Figure 4, which shows the price for Brent crude, an international crude oil benchmark that is generally used as a proxy for the global oil price, against the price of West Texas Intermediate (WTI) and Light Louisiana Sweet (LLS), which are both benchmarks for U.S. crude oil. From 2000 to 2009, the price of U.S. crude was consistently higher than that of Brent. This meant that the cost of shipping crude to the U.S., especially the Gulf Coast, was covered by the premium price the crude fetched in that market.

Figure 4: Crude Oil Prices from 2000 to 2009



Source: Bloomberg

Figure 5: Crude Oil Prices 2009 to 2013

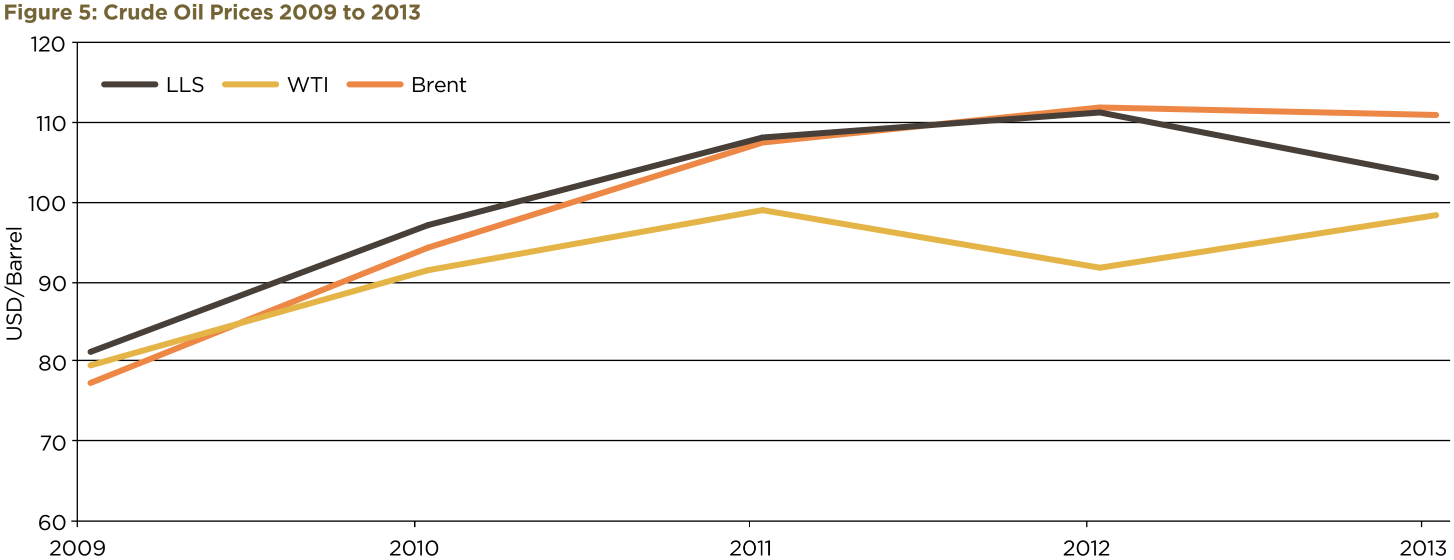
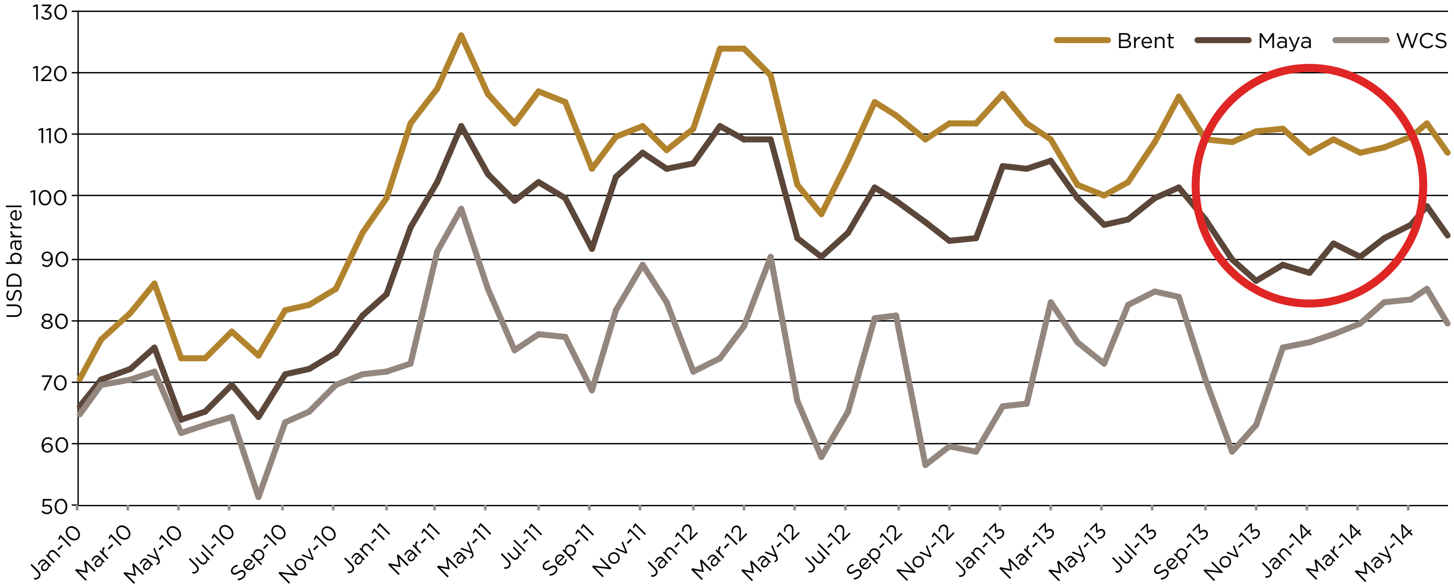


Figure 6: Heavy Oil Prices and the Brent Benchmark – 2010 to July 2014



As oil produced from horizontal drilling and hydraulic fracturing (fracking) started to increase in North Dakota and other parts of the U.S., this started to change. The WTI price is set at Cushing, Oklahoma, which is a major pipeline hub from where oil is redistributed around the center of the country and to the northern Midwest. For decades, crude oil travelled north to Cushing from oil fields in Texas, the Gulf of Mexico and from imported oil that would arrive by tanker at the Gulf Coast. But the U.S. oil boom has literally reversed this flow.

From 2009 onwards, an increasing amount of oil primarily produced in North Dakota and Canada needed to reach refineries south of Cushing on the Gulf Coast. But there were no pipelines to take it there. This glut of U.S. crude oil is what caused the WTI discount to Brent that continues today. Figure 5 shows the same crude oil benchmarks between 2009 and 2013.

In 2010, WTI became substantially discounted to both Brent and LLS. LLS is priced in Louisiana and is essentially a proxy for Gulf Coast oil prices. So from 2010 on, WTI was not only discounted to imported crude oil (Brent), but was also substantially discounted to domestic crude sold in the Gulf Coast market (LLS).

As the chart shows, LLS was at a premium to Brent from 2010 and throughout much of 2011. But in 2012 LLS started to fall compared to Brent. This was the result of increasing flows of domestic oil reaching the Gulf Coast from the Eagle Ford and Permian basins in west and north Texas respectively, through new and expanded pipelines such as the Longhorn Pipeline and West Texas Express.

In 2013, new pipeline capacity flowed south from Cushing to the Texas Gulf Coast for the first time, reducing crude oil stocks at Cushing and raising the price of WTI closer to Brent; although it currently still trades at a small discount.

By April 2014 crude oil stocks on the Gulf Coast hit record levels, putting more downward pressure on the LLS benchmark price.[41] In effect, the flood of domestic U.S. crude oil coming into the Gulf Coast via new pipelines from Texas and Cushing, Oklahoma has shifted the WTI discount to the Gulf Coast.

WTI and LLS are light oil benchmarks, while the tar sands crudes that seek to access the Gulf Coast via rail (or pipeline for that matter) are heavy bitumen blends. Nevertheless, tar sands producers feel the impact of these price discounts very strongly because the light oil benchmarks set a ceiling for oil prices in the Gulf Coast market.

Tar sands bitumen is the lowest quality crude on the market. Its high density and high sulfur and acid content make it difficult to refine and lower its value. All heavy oil is priced at a discount to the light oil benchmarks but tar sands bitumen generally sells at an even further discount to other heavy crudes.

The heavy oil benchmark that tar sands bitumen is generally priced against in the Gulf Coast market is called Mexican Maya. Maya is a conventionally produced heavy crude that has been produced in Mexico for many years. As heavy oil is in demand on the Gulf Coast, Maya has at some times sold for just a few dollars less than Brent. But since the third quarter of 2013, Maya's discount to Brent has widened. The tar sands bitumen benchmark WCS is consistently below Maya, and although it has narrowed recently compared to the extraordinary discounts seen between 2011 through most of 2013, it is still over 12 dollars below Maya (see Figure 6).

The widening discount for Gulf Coast crudes, whether light crudes such as LLS or heavy crudes such as Maya, is symptomatic

41 http://www.eia.gov/todayinenergy/detail.cfm?id=15891

of the flood of crude oil entering the region. This is a situation forecast to continue for years to come as U.S. oil production continues to rise through to at least 2019.[42]

In addition, while there is demand for tar sands bitumen on the Gulf Coast, it is limited by the amount of heavy oil refining capacity that is available to Canadian suppliers. While there is roughly 2 million bpd of heavy oil refining capacity on the Gulf Coast, around 1 million bpd is owned by national oil companies from Saudi Arabia, Mexico, Venezuela, and Brazil, which generally prefer to refine their own heavy crude at these plants.[43] This limits the demand for Canadian bitumen on the Gulf Coast and makes it difficult for Canadian suppliers to raise their prices. The result of this surplus is that Canadian producers cannot expect higher prices for their product on the Gulf Coast for at least the rest of this decade and possibly longer.

The increasingly competitive pricing environment in the Gulf Coast oil market means that producers need to transport their bitumen the 3,000 miles from northern Alberta to the coast as cheaply as possible. As we have seen in Section 4.2, rail is simply not the cheapest way to do that.

Box 5: Oil Industry Leaders Confirm That Rail Cannot Replace Pipelines for the Tar Sands

"Crude by rail is not a panacea. It's not going to replace pipe." Stewart Hanlon, President & CEO, Gibson Energy Inc. (a tar sands rail terminal operator). June 2, 2014.[44]

"[Rail] is the stop-gap measure" for Canadian crude oil, Dave Collyer, President of the Canadian Association of Petroleum Producers, May 22, 2014.[45]

"[A] rail-only plan would likely put a dent in future oil sands development." [...] "I don't think anybody feels that it could be a substitute for pipelines." Joe Oliver, Canadian Natural Resources Minister, April 24, 2013.[46]

"Lingering questions remain about pipeline vs. rail economics." [...] Pipeline constraints this year may leave producers little alternative but to turn to rail even though the economics are less favorable." RBN Energy LLC, June 23, 2014.[47]

"Pipelines are the most efficient means of connecting large supply basins to large markets areas." Canadian Association of Petroleum Producers, June 2014.[48]

"I think, all-in, you will see pipelines being more economical." Paul Miller, EVP & President, Liquids Pipelines, TransCanada Corporation. June 2, 2014.[49]

"This is a market inefficiency created by regulatory impediments. [Shipping crude by rail] wouldn't have been on our radar screen because it's not logical." Russ Girling, CEO, TransCanada Corporation. May 22, 2014.[50]

42 See EIA's Reference Case in the Annual Energy Outlook 2014. http://www.eia.gov/oiaf/aeo/tablebrowser/#release=AEO2014&subject=0-AEO2014&table=11-AEO2014&region=0-0&cases=ref2014-d102413a
43 Lorne Stockman, "The Keystone XL pipeline will lead to a surplus of heavy crude oil on the Gulf Coast that will be exported." July 2013, Oil Change International. http://priceofoil.org/content/uploads/2013/07/OCI_KXL-Crude-Exports_07-11-13.pdf
44 Baytex Energy Corp (& Gibson Energy) at RBC Capital Markets Global Energy – Final, 2 June 2014. CQ FD Disclosure
45 Jim Efstathiou Jr. and Rebecca Penty "TransCanada Explores Oil by Rail on Keystone Permit Wait" May 22, 2014 Bloomberg News. http://www.bloomberg.com/news/2014-05-22/transcanada-explores-oil-by-rail-on-keystone-permit-wait.html
46 Patrick Rucker "Crude-by-rail no substitute for Keystone XL –energy minister" April 24, 2013. Reuters http://www.reuters.com/article/2013/04/24/usa-keystone-rail-idUSL2N0DB23P20130424
47 RBN Energy LLC, "Go Your Own Way: Moving Western Canadian Bitumen to Market" A RBN Drill Down Report. June 23, 2014.
48 Canadian Association of Petroleum Producers, "Crude Oil Forecasts, Markets & Transportation" June 2014. http://www.capp.ca/getdoc.aspx?DocId=224970&dt=NTV
49 Cenovus Energy Inc (and TransCanada) at RBC Capital Markets Global Energy – Final 2 June 2014 CQ FD Disclosure
50 Jim Efstathiou Jr. and Rebecca Penty "TransCanada Explores Oil by Rail on Keystone Permit Wait" May 22, 2014 Bloomberg News. http://www.bloomberg.com/news/2014-05-22/transcanada-explores-oil-by-rail-on-keystone-permit-wait.html

5.0 California Dreaming: The West Coast Offers Better Prospects but Local Opposition is a Serious Challenge

While the Gulf Coast represents the biggest single refining market for tar sands bitumen, it is 3,000 miles from Fort McMurray, the center of large-scale tar sands production. A more proximate market exists on the U.S. West Coast, primarily in California and Washington. Refineries there have some heavy oil capacity, although not as much as the Gulf Coast. However, another big attraction of accessing the West Coast is its potential role as a gateway to the world's fastest growing oil market: Asia.

A number of unit train terminals have been proposed in southern Washington State that are designed to transfer crude oil, including tar sands bitumen, from trains to ocean-going tankers. The crude would then either travel to Californian refineries, which are already equipped to receive waterborne crude oil, or it could cross the Pacific to Asian markets.

The U.S. crude oil export ban currently prohibits exports of American crude except to Canada. However, export licenses can be issued for exports of Canadian crude through the United States. The main regulatory condition for such exports is that the foreign crude must not be comingled with U.S. crude. Shipping tar sands bitumen by rail is uniquely suited for this because crude oil loaded into a rail tank car is not in danger of being mingled with other crude oil in the same way that it might in a pipeline. More importantly though, the potential to ship rawbit, which can only be done by train, means that there is no possibility that the bitumen is blended with diluent that was sourced from the U.S., as much of it currently is.

The emergence of the Washington State and California terminals is a major opportunity for tar sands producers as they would gain access to some 450,000 bpd of heavy oil refining capacity in those states as well as the Asian export market.[51] The shorter distance, particularly to Washington State, means that the cost of shipping by rail would be lower than to the Gulf Coast, with shorter cycle times for tank cars and lower fuel costs, all helping to widen the profit margins (see Figure 7). In addition, the West Coast crude market is not currently flooded with domestic crude the way the Gulf Coast is, so tar sands producers should be able to fetch a higher price for their product.

However, growing public awareness of the risks of crude-by-rail and the upstream impacts of the tar sands is generating local concern and opposition to new large-scale unloading terminals, in similar ways seen in the pipeline campaigns. Coastal communities are also concerned about an increase in oil tanker traffic. There remains a moratorium on oil tanker traffic along some parts of the British Columbian coast,[52] and campaigns spanning both Washington State and British Columbia aim to ban tankers carrying tar sands crude.[53]

To date, several key rail terminal projects have been delayed along the U.S. West Coast. If these projects are cancelled, the tar sands industry will have yet another major route to market denied. In November 2013, the Washington Shorelines Hearings Board revoked permits for two crude-by-rail terminals that plan to handle tar sands crude in Grays Harbor, Washington.[54] The Board ruled in favor of a coalition of opposing groups challenging the permits, which had been issued by the City of Hoquiam and the Washington Department of Ecology, to Westway Terminal Company and Imperium Terminal Services, without full environmental reviews. The Board found that the permitting process had violated the State Environmental Policy Act (SEPA), and raised skepticism of the City and Department of Ecology's conclusion that the major increase in crude-by-rail and tanker traffic that would result from the proposed terminals would not have a significant environmental impact. The Board went on to identify "troubling questions of the adequacy of the analysis done regarding the potential for individual and cumulative impacts from oil spills, seismic events, greenhouse gas emissions, and impacts to cultural resources."[55]

The largest of the proposed terminals in Washington, Tesoro's 380,000 bpd project in the Port of Vancouver, has also faced stiff opposition. In a June meeting attended by hundreds of citizens, the city council passed a non-binding resolution to oppose the project.[56] The project remains under review by the state's Energy Facility Site Evaluation Council and a decision is ultimately in the hands of Democratic governor Jay Inslee.

Citizen groups are also challenging crude-by-rail terminals in California. Valero's plan

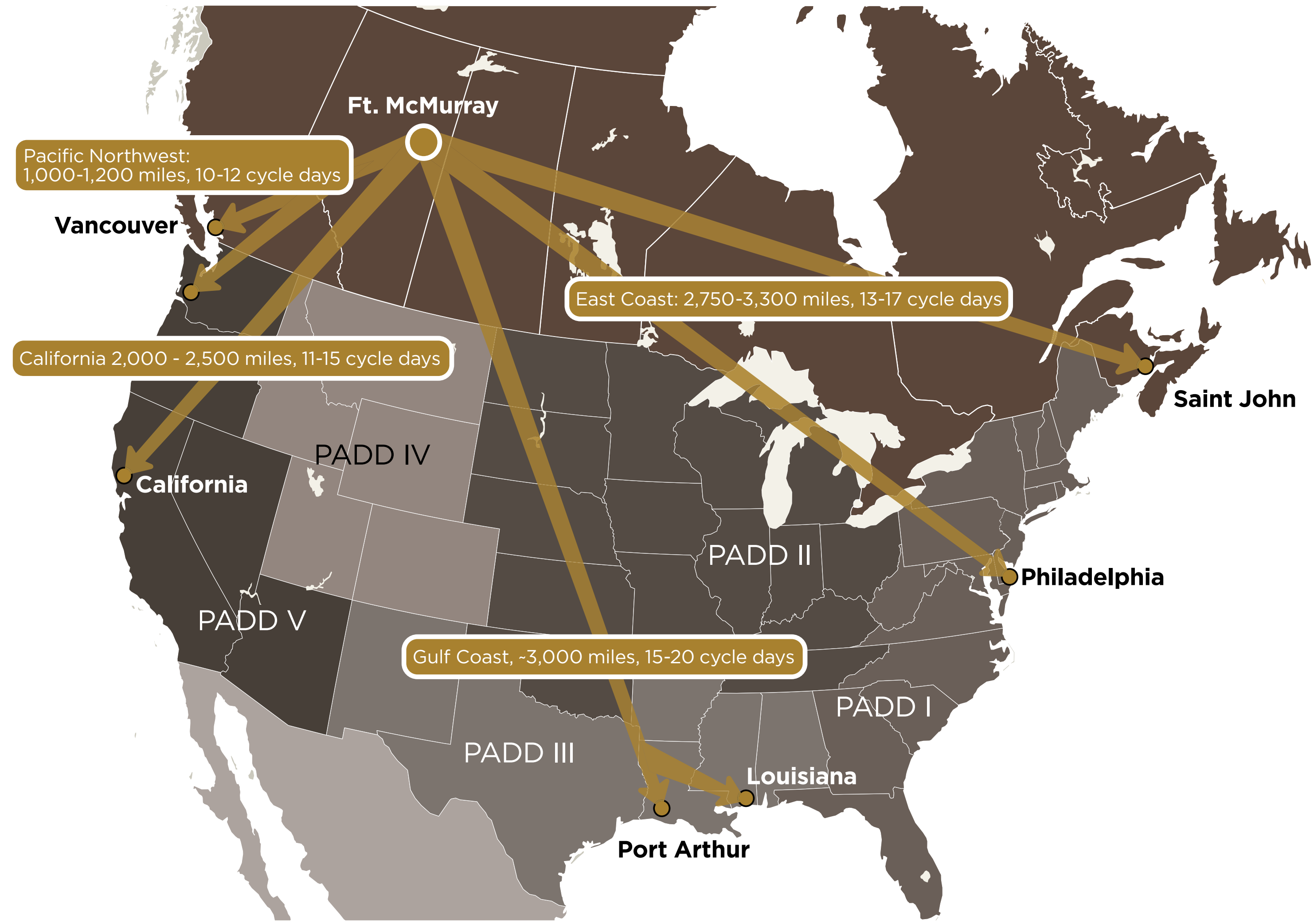
51 Canadian Association of Petroleum Producers, "Crude Oil Forecasts, Markets & Transportation" June 2014.
52 http://www.sierraclub.bc.ca/our-work/seafood-oceans/solutions/maintaining-the-moratorium-on-inland-tanker-traffic
53 http://tarsandssos.org/
54 Earthjustice, "Grays Harbor Crude Oil Terminals Blocked," November 13, 2013, http://earthjustice.org/news/press/2013/grays-harbor-crude-oil-terminals-blocked
55 Washington Shorelines Hearing Board, Order on Summary Judgment and the Partial Concurrence and Dissent of the Shorelines Hearing Board for Quinault Indian Nation and Friends of Grays Harbor, Sierra Club, Surfrider Foundation, Grays Harbor Audubon, and Citizens for a Clean Harbor v. City of Hoquiam, Ecology and Westway Terminal Co. LLC and Imperial Terminal Services LLC, November 12, 2013, http://earthjustice.org/sites/default/files/files/Crudebyrail.orderonsummaryjudgment.pdf
56 Cassandra Profita, "Vancouver City Council opposes Tesoro oil terminal" June 03, 2014, The Portland Tribune http://portlandtribune.com/sl/222919-84476-vancouver-city-council-opposes-tesoro-oil-terminal-

to build an unloading terminal at its Benicia refinery, near San-Francisco, is on hold after the city decided that a full environmental impact study was required.[57] Valero has already cancelled plans to build a terminal at its refinery in Wilmington, near Los Angeles.

A massive terminal planned near the East Bay town of Pittsburg, California is also facing vociferous opposition from the local community.[58] The Berkeley City Council unanimously passed a resolution to oppose plans by Phillips 66 to transport crude oil by train through the city to reach its refinery in Los Angeles.[59]

If some of these bigger projects do not go ahead, particularly the port terminals in Washington State, tar sands producers will not be able to take advantage of one of the most viable rail routes for their product. As a result, the main rail route out for the tar sands will continue to be the Gulf Coast, which as noted elsewhere in this report, offers slim margins in a highly competitive market.

Figure 7: Distances from the Tar Sands to Key Markets



57 Tony Burchyns "Benicia calls for more review of Valero's plan to ship crude oil by railcar" August 8, 2013. Times-Herald. http://www.timesheraldonline.com/ci_23823107/benicia-callsmore-review-valeros-plan-ship-crude

58 Eve Mitchell, "WesPac crude oil storage and transfer project faces scrutiny at community forum" November 20, 2013. Contra Costa Times. http://www.contracostatimes.com/contra-costa-times/ci_24565499/wespac-crude-oil-storage-and-transfer-project-faces

59 Angel Grace Jennings, "City Council votes to oppose rail transport of crude oil through Berkeley" April 1, 2014. The Daily Californian. http://www.dailycal.org/2014/03/30/city-councilvotes-oppose-rail-transport-crude-oil-berkeley/

6.0 A Long List of Obstacles

While the viability of bitumen-by-rail primarily rests on avoiding the diluent penalty and an adequate price differential between source and destination, as described above, there are some other factors that make rail transport a less reliable option compared to pipelines.

These factors include weather, route congestion, and the prospect of tighter safety regulations that could raise costs.

6.1 WEATHER AND ROUTE CONGESTION

Extreme weather events are clearly more of a factor for rail than pipeline simply because rail is an above-ground activity whereas pipelines primarily run underground. Winter weather is a particular hazard for tar sands shippers because bitumen must be heated for loading. Extreme cold in winter raises the time required and cost of this part of the process. Extreme snowfall can also lead to track closures and delays that can disrupt the system and result in reduced deliveries.

The winter of 2013-2014 was particularly severe and caused major disruption in the Midwest, Great Lakes region, and in the Canadian prairies. At a hearing in the Minnesota state House in February, a BNSF spokesman told a panel of the House Transportation Finance committee concerned with recent delays to the Northstar commuter line in St. Paul, MN, that harsh winter weather affects the brakes on trains, "creates snow and ice buildups on the rail lines, and limits how long rail employees can work outside to make repairs".[60] He told the panel that winter weather had caused similar delays around Chicago as those experienced around St Paul.[61]

Tar sands producers shipping by rail are at a particular disadvantage as they have to use routes that are exposed to some of the harshest winter weather in the region as well as some of the most congested rail routes. The level of rail traffic is particularly high in North Dakota and the Chicago area due to the amount of crude oil being shipped by rail out of North Dakota. The state is at the center of the crude-by-rail boom and is the source of some 70 to 80 percent of North American crude-by-rail traffic. Some 600,000 to 800,000 bpd of crude oil moved out of North Dakota by rail in 2013 and winter weather disrupted traffic for much of the first three months of 2014, with Canadian rail traffic often backed up behind. The increase in crude-by-rail in both countries was also blamed by shippers of other commodities, particularly grain, for exacerbating the problem, as well as by Amtrak for disruptions to its passenger services.

At a hearing of the U.S. Surface Transportation Board (STF) in April, representatives from industries ranging from ethanol and coal to cat litter lined up to complain that increased crude-by-rail traffic had come at the detriment of their industries' capacity to deliver. Ed Hubbard, general counsel of the Renewable Fuels Association told the hearing that "[t]he growth in crude oil shipments has reshuffled the existing fleet of railcars and locomotives, pressured lease rates, changed normal rail traffic patterns, and generally exerted significant stress on the rail system, [...] and with this congestion crisis, it is becoming more and more apparent that surging crude oil shipments are coming at the expense of other goods and commodities, like ethanol."[62]

The congestion was particularly sorely felt by Canadian and U.S. Midwest grain suppliers. A bumper harvest of wheat and canola on the Canadian prairies in 2013 led to grain suppliers struggling to get their product to market as they played second fiddle to crude oil on North America's rail network. In January 2014, Bloomberg reported that Canadian grain shipments to export terminals in Vancouver, British Columbia were two months behind schedule.[63] Keith Bruch, vice president of operations for Paterson GlobalFoods Inc., told the news agency that "it's looking more and more that grain is becoming second choice to oil".[64] He described how grain ships have been left waiting in the Port of Vancouver for as much as six weeks at a cost of up to C$20,000 (more than US$18,000) per day.

The problem has also affected U.S. grain suppliers. "Moving crude by rail has definitely impacted our ability to supply our facilities," said Sam Snyder, director of corporate development for Minneapolis-based Grain Millers Inc.[65] In an effort to relieve the situation, Canadian regulators moved in March 2014 to force rail operators to double the amount of grain they transport.[66]

Crude oil trains have also caused eight-to ten-hour delays to Amtrak's Empire Builder passenger train service, which runs through North Dakota on its way to and from Chicago, Portland, and Seattle. According to Ross Capon, president of the National Rail Passengers Association, "[t]he train acts as a vital transportation link for hundreds of rural communities to essential services in urban population centers" and is Amtrak's most popular overnight service.[67]

60 Mark Sommerhauser, "BNSF official says weather, not oil trains, caused Northstar woes" February 28, 2014, St. Cloud Times.
61 Ibid.
62 Herman Wang "US rail traffic to ease, no need to prioritize shipments" April 11, 2014 Platts Oilgram News
63 Jen Skerritt, "Record Grain Crop Stuck on Prairie as Railways Tap Oil" January 23, 2014, Bloomberg News. http://www.bloomberg.com/news/2014-01-23/recrod-grain-crop-stuck-onprairie-as-railways-tap-oil.html
64 Ibid.
65 Ibid.
66 Progressive Railroading "Canadian government adopts measures to get more export grain moving by rail" March 10, 2014. http://www.progressiverailroading.com/federal_legislation_regulation/article/Canadian-government-adopts-measures-to-get-more-export-grain-moving-by-rail--39708
67 Keith Laing, "Oil shipments blocking Amtrak trains" January 29, 2014. The Hill. http://thehill.com/blogs/transportation-report/railroads/196894-oil-shipments-blocking-amtrakpassenger-trains#ixzz2yUkXsTgW

Oil train protestors sit on the tracks at the Texas Road crossing on March's Point to block a train from leaving the Tesoro Refinery railroad yard, in Anacortes, Washington, July 28, 2014.
©AP Photo/The Skagit Valley Herald, Scott Terrell

The route, which in North Dakota relies on track owned by BNSF, was forced to skip three stops in an effort to regain lost time on the journey due to the delays caused by crude oil trains. Passengers wishing to travel to those locations in North Dakota had to disembark the train at 3 a.m. and board buses to get to their destinations.[68]

BNSF denied that crude oil trains are given priority and instead blamed a rise in rail freight across different commodities including corn and container traffic (intermodal) as well as the severe winter weather. Chicago, which is a major regional hub for the Midwest, was hit by nine severe winter storms. BNSF vice president Robert Lease said, "[g]rains surged, coal jumped, crude oil spiked and velocity slowed down. We operated shorter trains due to the temperatures. We had to redeploy manpower throughout our network. The resulting congestion in and around Chicago had a ripple effect in each of our three corridors."[69]

Congestion is not only confined to the Chicago area. Bottlenecks also exist in the Canadian system. Geoff Darcy, Senior Vice President of Marketing at Baytex Energy, a tar sands producer and shipper of bitumen-by-rail, told an investor conference in June, "In Winnipeg, this system gets clumpy, and the railcars all gather off at a pinch point, and they kind of stop. And so your nice treadmill gets much more lumpy. So that's a challenge, and [...] (w)e've seen it with difficult winters. [...] So, there is some issues [sic.] with congestion.[70]

Competing with everything from grain and corn, to autos and containers full of just about any product manufactured or imported into North America, can only mean that as rail demand goes up, so will cost.

Some rail operators raised tariffs on April 1, 2014, triggering Chris Bliley, director of regulatory affairs for ethanol trade group Growth Energy, to state that, "[n]ot only did one railroad give our producers very little notice of the increases, but I dare say, few, if any industries would have the audacity or ability to increase shipping rates while their service has been so poor."[71]

The dynamics of weather and capacity demand will vary, but what is certain is that pipelines do not suffer from these issues. Winter weather is rarely a problem for pipelines and crude oil shippers do not have to share a pipeline with other commodities.

There exists today the capacity to load around 3.5 million bpd of crude oil onto trains in North America. This is over three times higher than current traffic levels of around 1 million bpd and could rise further to reach some 5 million barrels per day.[72] A proportion of future loading capacity growth is located in western Canada, some of it positioned to load tar sands bitumen. But a huge question remains as to whether the rail network can reliably deliver that much additional crude-by-rail year round, particularly during winter when rail networks are strained by severe weather and agricultural freight.

It is abundantly clear that pipelines offer a more reliable year round service that does not face disruption from competing commodities and weather. With long-term contracts that fix pricing for decades ahead, they also do not face the potential for cost increases that the railroads may need to implement in order to make the investments necessary to upgrade and expand the system to accommodate demand growth.

68 Ibid.
69 Herman Wang "US rail traffic to ease, no need to prioritize shipments" April 11, 2014 Platts Oilgram News
70 Baytex Energy Corp (& Gibson Energy) at RBC Capital Markets Global Energy – Final, 2 June 2014. CQ FD Disclosure
71 Herman Wang "US rail traffic to ease, no need to prioritize shipments" April 11, 2014 Platts Oilgram News
72 Lorne Stockman, "Runaway Train: The Reckless Expansion of Crude-by-Rail in North America" May 2014. Oil Change International. http://priceofoil.org/content/uploads/2014/05/OCI_Runaway_Train_Single_reduce.pdf

6.2 SAFETY, NEW REGULATIONS, AND INCREASING COSTS

As crude-by-rail traffic levels approached one million barrels per day in 2013 – a 70-fold increase in crude oil trains compared to just three years before, the number of accidents involving crude oil trains reached unprecedented proportions. The explosion of an unattended train full of Bakken crude oil in Lac-Megantic, Quebec in July 2013 was an unimaginable tragedy, costing 47 lives and destroying the downtown of a small community. This event catapulted the risks of crude-by-rail to the forefront of public and political concern, with decision makers rightfully assuring the public that stronger regulations and monitoring of crude-by-rail would become a priority.

Subsequent incidents that did not claim lives but did result in dramatic explosions and fires have further added pressure for improved safety standards and increased scrutiny on the crude-by-rail business (see Table 4).

Over a year later, communities threatened by these "bomb trains" are still waiting for regulators to issue a final rule on improving the safety of crude-by-rail in the United States, although the proposed rule was finally published in late July.[73] In Canada, regulators moved more quickly, ordering the replacement of thousands of dangerous 'DOT-111' tank cars within three years, as well as issuing new standards that appear tougher than those proposed by the United States.[74]

Several recommendations have been raised in light of these accidents including speed restrictions, rerouting around urban areas, more accurate labelling and information-sharing with emergency services, and fitting trains with electronically controlled pneumatic (ECP) brakes. But the issue that has gained the most attention has been the inadequacy of the tank cars that carry the crude oil across North America.

The DOT-111 tank cars in service today vary according to when they were built. The oldest cars have the least protection, with thinner steel, no reinforcements at the front and back of the car, and inferior valves at the top and bottom of the car that easily open in a derailment. The vulnerably of these tank cars to rupture and spillage during a derailment was noted by the National Transportation Safety Board (NTSB) in a study dating back to 1991.[75] But nothing was done to improve the cars and there was little attention on the issue until an incident in 2009 in which a woman died when DOT-111s carrying ethanol derailed and exploded at a rail crossing in Illinois.[76]

Table 4: Major Crude-by-Rail Accidents 2013-2014

Date	Location	Railroad	Crude Source	Fire?	Spill Volume (U.S. Gallons)	Type of Incident
Mar. 27, 2013	Parkers Prairie, Minnesota	Canadian Pacific	Canada, possibly tar sands	No	10,000-15,000	Derailment
Jul. 5, 2013	Lac-Mégantic, Quebec, Canada	Montreal, Maine & Atlantic Railway	Bakken, North Dakota	Yes	>26,500	Derailment
Oct. 19, 2013	Gainford, Alberta, Canada	Canadian National	Unknown	Yes	Unknown	Derailment
Nov. 8, 2013	Aliceville, Alabama	Genesee & Wyoming	Bakken, North Dakota	Yes	<748,400	Derailment
Dec. 30, 2013	Casselton, North Dakota	BNSF	Bakken, North Dakota	Yes	>400,000	Derailment
Jan. 7, 2014	Plaster Rock, New Brunswick, Canada	Canadian National	Unknown, Western Canada	Yes	Unknown	Derailment
Feb. 3, 2014	Wisconsin/Minnesota	Canadian Pacific	Unknown	No	<12,000	Leak from tank car over 70 miles of track
Feb. 13, 2014	Vandergrift, Pennsylvania	Norfolk Southern	Tar Sands Bitumen, Alberta, Canada	No	4,550	Derailment
Apr. 30, 2014	Lynchburg, Virginia	CSX	Bakken, North Dakota	Yes	<50,000	Derailment
May 9, 2014	LaSalle, Colorado	Union Pacific	Niobrara, Colorado	No	6,500	Derailment

73 U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration. Notice of Proposed Rulemaking. http://www.phmsa.dot.gov/pv_obj_cache/pv_obj_id_75F600DC57D81471F96C328EB5DF9177527E1000/filename/Proposed_Rulemaking_Enhanced_Tank_Car_Standards_and_Operational_Controls_for_High_Hazard_Flammable_Trains_PHMSA_2012_0082_%28HM_251%29_RIN_2137_AE91.pdf
74 Solarina Ho and Randall Palmer, "Canada's rail safety measures: earlier and tougher than U.S." July 23, 2014. Reuters. http://www.reuters.com/article/2014/07/23/usa-oil-railways-canada-idUSL2N0PY33P20140723
75 Jason Keyser, "Common Type of Rail Car Has Dangerous Design Flaw" September 12, 2012. Associated Press. http://bigstory.ap.org/article/common-type-rail-car-has-dangerous-design-flaw
76 Vikki Ortiz, "Rockford woman killed in train derailment" June 21, 2009, The Chicago Tribune. http://articles.chicagotribune.com/2009-06-21/news/0906200180_1_train-cars-derailment-rockford

However, this incident did not lead to a change in regulations. Instead tank car manufactures started to produce higher quality tank cars following recommendations from the Association of American Railroads (AAR). But as there were no new regulations, older DOT-111s were not removed from service. The crude-by-rail boom has greatly increased the demand for these tank cars, pressing thousands of outdated cars back onto the rails, alongside new, safer cars coming off the factory floor. According to the AAR, around 92,000 DOT-111s are being used for flammable liquid service in North America today, mostly for crude oil and ethanol. Around 78,000 of these would require retrofitting to meet higher standards proposed by the AAR.[77]

Since the Lac-Mégantic incident some of the oldest DOT-111 cars have been removed from service, but thousands of inferior quality tank cars remain in service. Additionally, the newest cars being used today, known as the DOT-111-CPC-1232 tank car, are not immune to rupture. One of the cars that ruptured and spilled crude oil into the James River in Lynchburg, Virginia in April 2014 was a '1232' and it ruptured at relatively low speed. U.S. Transport Secretary Anthony Foxx told Rachel Maddow shortly after the Lynchburg accident that he did not think the CPC-1232 was the solution to the crude-by-rail safety problem, and that a new tank car standard will need to be established.[78]

On July 23, the U.S. DOT issued its proposed rulemaking laying out three options for improving train car safety. A 60-day public consultation period is underway during which industry and the public may comment on the proposals. The final rule should be issued before the end of the year and become effective in early 2015.[79]

The proposals include raising tank thickness to 9/16ths of an inch, installing ECP brakes, and slowing down trains in some areas, as well as additional speed restrictions for trains that do not have tank cars with the recommended specifications. The industry is likely to resist these measures and it remains to be seen which standards will make it into the final rule.

In general, the oil industry is looking for less stringent tank car standards as it is mostly responsible for buying or leasing tank cars. Meanwhile, the rail industry is resistant to speed limits, as they will affect capacity across the network, and has long resisted the introduction of ECP brakes. Both are striving to protect profits over public safety.

Shippers of rawbit and railbit may have little to worry about with the tank car standards as these products must be carried in insulated and coiled tank cars in order to stop the bitumen from solidifying and to enable it to be loaded and unloaded. These cars are generally quite new and already have some of the features being proposed, though some minor modifications might have to be made. Rawbit has none of the volatile natural gas liquids that are so easily combustible in an accident and tank cars carrying rawbit may be exempt from some of the requirements, while railbit does contain up to 20 percent of these volatile hydrocarbons.

However, as more unit train terminals come online in Alberta, an increasing number of unit trains will be crossing North America carrying pipeline-specification diluted bitumen (dilbit). Dilbit contains up to 30 percent natural gas liquids, and this bitumen blend does not require insulated cars as it is not in danger of solidifying. Therefore, tar sands shippers will be affected by new tank car standards, which will inevitably raise costs.

Reducing speed limits on crude trains would be an effective way to reduce both the chance of derailment and the chances of rupture during derailment. However, reducing speed would cost the industry severely depending on the level and extent of the speed limits set. For tar sands producers that must ship their crude great distances to reach markets, particularly the Gulf Coast, reducing speed limits could be very costly.

A big part of the cost implications of speed reductions is the increase in cycle times for tank cars. Tank cars are often leased on a monthly basis, so the longer it takes to get a tank car to its destination and then back for another run the more expensive tank car leasing becomes. Cycle times from Alberta to the Gulf Coast are currently between 17 and 20 days. So a tank car can do roughly 1.5 cycles per month. Insulated and coiled tank cars, for rawbit and railbit use, lease at between $2,000 to $2,500 per month, while uninsulated cars cost between $1,800 and $2,000 per month.[80] Keeping a unit train operation going requires around two thousand tank cars in circulation at any one time.[81] It is easy to see that speed reductions that increase cycle times will raise costs for tar sands shippers.

The cost implications of tighter regulations are a big issue for all crude-by-rail shippers and both the oil and rail industries have been lobbying hard against them.[82] It remains to be seen whether the U.S. and Canadian authorities will have the courage to put public safety ahead of the profits of the oil and rail industries and implement a combination of tighter tank cars standards and reduced speeds that will actually ensure that crude oil trains do not derail, rupture, spill, and explode.

What is clear is that reform is happening and will raise costs. With margins as tight as they are for shipping tar sands bitumen by rail to the Gulf Coast, any additional costs will be unwelcome.

77 Association of American Railroads, "Railroad Tank Cars" https://www.aar.org/safety/Documents/Railroad%20Tank%20Cars.pdf
78 http://on.msnbc.com/1mtl3qc
79 U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration. Notice of Proposed Rulemaking. http://www.phmsa.dot.gov/pv_obj_cache/pv_obj_id_75F600DC57D81471F96C328EB5DF9177527E1000/filename/Proposed_Rulemaking_Enhanced_Tank_Car_Standards_and_Operational_Controls_for_High_Hazard_Flammable_Trains_PHMSA_2012_0082_%28HM_251%29_RIN_2137_AE91.pdf
80 Figures from Genscape Petrorail Report July 1, 2014.
81 To load one 100-car unit train per day and send each train on a 20-day round trip to the Gulf Coast requires at least 2,000 cars in circulation. Additional cars are often needed to allow for maintenance and possible delays. If reduced speeds add 1 day to the cycle time that could raise monthly lease costs by $133,000 for 2,000 uninsulated cars at $2,000 per month.
82 Kathryn A. Wolfe, "Documents: Railroads want to hit brakes on some oil train safeguards" June 13, 2014 Politico http://politi.co/1itavD7

Box 6: Condensate Backhaul: A Helping Hand for Bitumen-by-Rail or a Major Safety Oversight?

Tar sands shippers often point to an additional advantage they have over pipelines that can help them gain back some of the high costs of shipping their product by rail. With the price of the condensate (the diluent in dilbit) lower on the Gulf Coast than it is back in Edmonton, hauling condensate back in the tank cars that would otherwise head back to Edmonton empty can boost profits in the bitumen-by-rail business.

It is unclear how much condensate is backhauled today as most companies are tight-lipped about it. However some companies have touted this service.

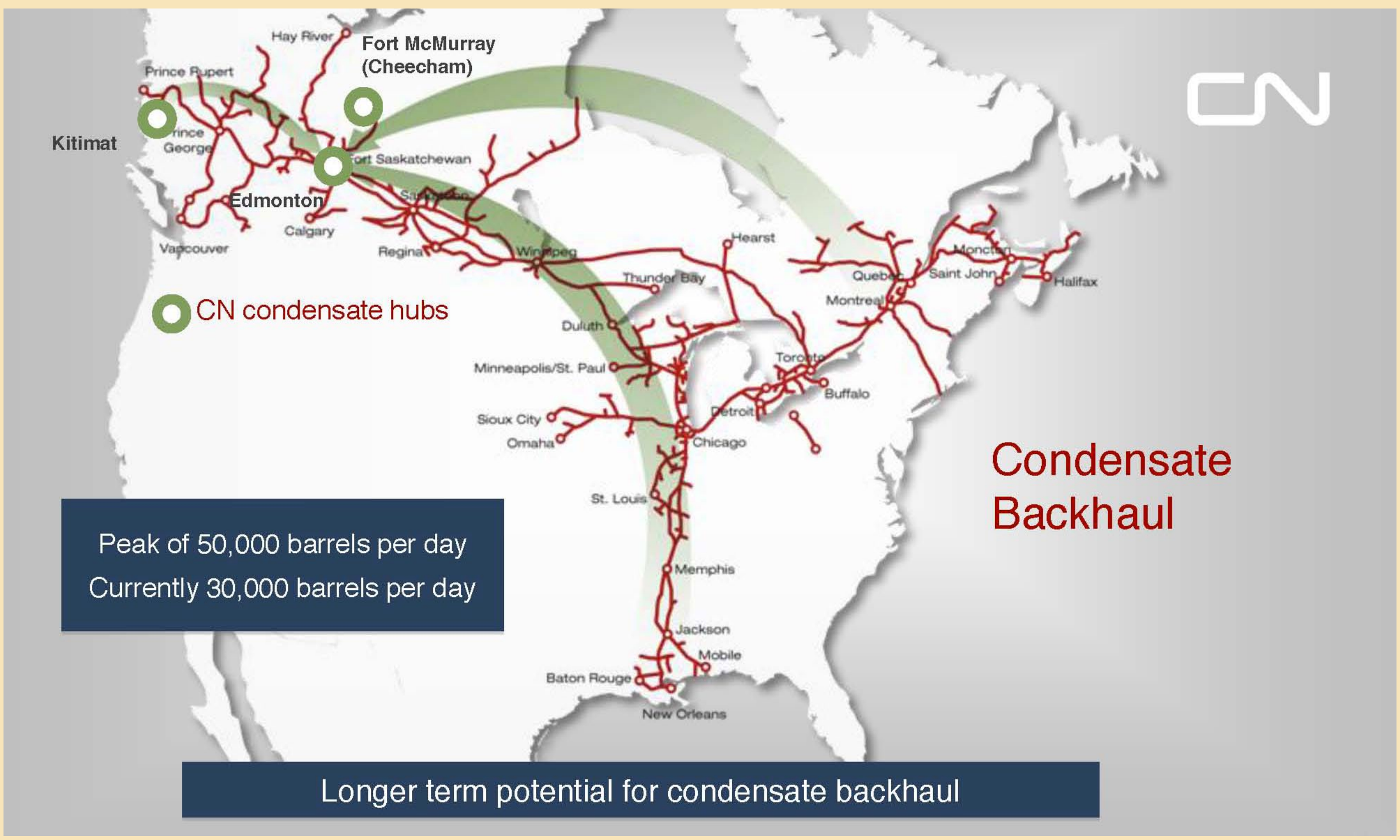
Canadian National (CN) has mentioned condensate backhaul in several recent presentations and provides a map shown in Figure 8 that suggests that they haul condensate back to Edmonton from at least three parts of the continent. The slide, which is from a 2013 presentation, claims that CN was moving about 30,000 bpd of condensate in 2013 but has capacity for at least 50,000 bpd.

Managers at Kansas City Southern railroad, which mostly operates south of Missouri into Texas and Louisiana, told investors that they plan to haul condensate north from the Gulf Coast in 2014.[83] It is possible that the railroad will transfer these condensate cars to CN or another railroad north of its network.

A Canadian rail terminal operator called Altex Energy is handling condensate backhaul at its terminals, some of which may be the same condensate that is backhauled on CN's lines. The company's vice president of corporate development and logistics, Randy Meyer, told a condensate conference in December 2013 that his company loads condensate at Gulf Coast terminals to bring back to Alberta. He explained that the condensate is loaded into the same tank cars that deliver bitumen and that the only safety precaution is that the tank cars are given time to cool before the condensate is loaded.[84]

Condensate is a natural gas liquid with a much lower flashpoint than crude oil or bitumen. This means the temperature at which the product gives off enough vapor to ignite in air is low. When investigators examined the crude oil that was left in tanks after the Lac-Mégantic disaster, they found that it had characteristics similar to gasoline and condensate and suspected that this had a role in the particularly explosive nature of the incident.[85] In the case of condensate backhaul, the tank car is filled with volatile condensate and nothing else. The transport of condensate by rail is a highly risky business that will invariably face growing scrutiny, regulations, and cost.

Figure 8: Canadian National's Condensate Backhaul Map



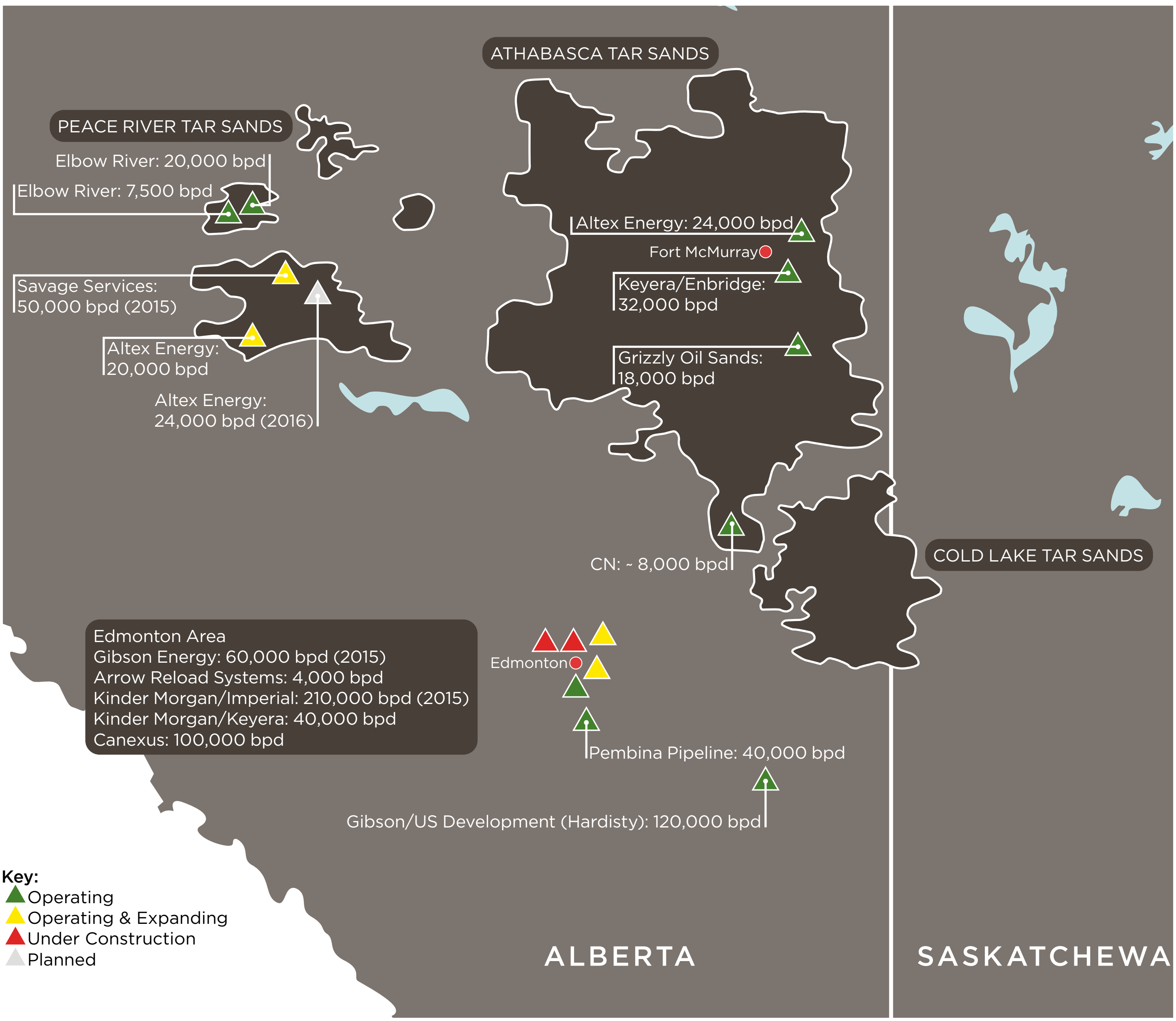
83 Bridget Hunsucker "KCS to rebound crudebyrail movements in 2014 with Canadian heavy: managers" January 24, 2014 Platts Commodity News.
84 Remarks made at the Condensate Marketing Congress 2013, Houston, Texas, December 10, 2013. Presentations and slides available from American Business Conferences. http://www.condensate-markets-2013.com
85 Charmaine Noronha "Volatile oil tied to crash" March 6, 2014, The Chronicle Herald, http://thechronicleherald.ca/business/1191763-volatile-oil-tied-to-crash

7.0 Terminals, Capacity, Traffic

7.1 REVISING OUR EARLIER ESTIMATE

In our first report on crude-by-rail, we overestimated the number and capacity of terminals that load tar sands crude.[86] This is primarily because we included terminals in western Saskatchewan and central Alberta that we now believe only load conventional crude rather that tar sands bitumen. As terminal operators generally do not disclose many details on what oil they are shipping or where the crude is from, it required a detailed examination of the locations of these terminals and the kind of oil production in the areas surrounding the terminals to get a more accurate picture of what kinds of crude these terminals handle.

Figure 9: Tar Sands Loading Terminals in Alberta



Source: Company information compiled by Oil Change International. For more details go to: www.priceofoil.org/rail-map

86 "Runaway Train: The Reckless Expansion of Crude-by-rail in North America" May 2014. http://priceofoil.org/content/uploads/2014/05/OCI_Runaway_Train_Single_reduce.pdf

7.1.2 Saskatchewan

Terminals in western Saskatchewan are generally located within a corridor between Lloydminster and Kerrobert, which is the source of significant conventional heavy oil production but no tar sands production. Conventional heavy oil production in this area is estimated to reach around 165,000 bpd in 2014.[87] There is also some conventional light oil production in the area and total oil production in Saskatchewan is projected to reach 385,000 bpd in 2014.[88]

Kerrobert, where Saskatchewan's biggest crude-by-rail terminal is currently under construction, is a pipeline hub for western Saskatchewan's conventional oil production. Feeder pipelines run from oil projects in the region to this town where the oil has traditionally been fed into the Enbridge mainline system, which originates in Edmonton, Alberta and carries oil into the United States. As the Enbridge system reaches full capacity, Saskatchewan's conventional oil producers are increasingly putting their production onto trains. The 168,000 bpd Torq Transloading terminal that is under construction in Kerrobert today will transfer conventional heavy and light crude oil from Saskatchewan's pipeline system onto rail cars for distribution both within Canada and the United States.[89]

We have found no evidence that tar sands bitumen is, or would be in the future, transported into Saskatchewan for loading onto trains at any of the other eight terminals in the western part of the province. The only possible exception would be the Altex terminal in Lloydminster, which is located close to tar sands production in the Cold Lake area of Alberta. However, there is also significant conventional heavy oil production in the Lloydminster area and it is unlikely that this 3,000 bpd rail terminal will handle any significant quantity of tar sands bitumen.

We therefore have removed all Saskatchewan terminals from our list of tar sands loading terminals and this affords a more accurate and reliable estimate of actual tar sands loading capacity at Canadian crude-by-rail terminals.

We have also removed nine terminals in Alberta from our list as we have ascertained that these terminals are far from tar sands production and are not located at major tar sands pipeline hubs such as Edmonton and Hardisty. We found that these nine terminals were in fact close to conventional Albertan oil production and therefore are likely to only load conventional oil.[90] The next section describes the terminals in Alberta that are loading tar sands bitumen.

7.1.3 Alberta

In the first half of 2014, there were 11 terminals in Alberta loading tar sands crude onto trains. At the time of writing one additional terminal had just completed construction and was preparing to send its first shipment, while five others were under construction and one facility had a permit application in process. When all of these terminals are completed, there will be a total of 18 rail terminals loading tar sands crude in Alberta.

The total capacity of tar sands loading terminals in Alberta that were operating in the first half of 2014 was around 240,000 bpd. For various reasons, including weather and technical issues, only about half of this capacity was utilized as we estimate total tar sands shipments out of Alberta to have been around 128,000 bpd (see Table 1). The Gibson Energy terminal in Hardisty recently completed construction and will add 120,000 bpd of capacity to load dilbit. It was scheduled to begin operations in August 2014.

Another six tar sands terminals that are currently either under construction or planned would create an additional 380,000 bpd of new capacity. In addition to these new terminals, there are expansions underway at two of the existing terminals that will add another 55,000 bpd. The capacity at all existing and planned terminals would therefore amount to a maximum of 795,000 bpd (see Tables 4 & 5).

There are two terminals of the total 18 for which we do not have any capacity figures as companies have not disclosed any information about these operations. We believe that these are small facilities and are unlikely to have a capacity greater than 8,000 bpd each. We therefore add a total of 16,000 bpd to account for these terminals for a total potential capacity to load tar sands crude of 811,000 bpd by 2016. This is around 300,000 bpd less than the estimate in our first report.

Until recently, all the tar sands crude loaded onto trains in Alberta was loaded at small terminals close to the site of production, with the crude delivered to the terminal by truck or by local feeder pipelines. The capacity of these terminals ranged from as little as 4,000 bpd to around 25,000 bpd for the larger ones. These terminals load tank cars that are hauled away to rail yards where they join with other cars to form a manifest rail shipment (see Box 4).

One of these terminals, the Savage Services terminal in Reno, Alberta, which is close to the Peace River tar sands region, is doubling its capacity to 50,000 bpd and will move from loading manifest freight to unit trains.

The first unit train terminal in Alberta was the Canexus Bruderheim terminal near Edmonton, which began operations in December 2013. This terminal has a maximum capacity of 70,000 bpd, although loading has only averaged around 20,000 bpd up to mid-June when it was shut down for maintenance. Canexus plans to add another 30,000 bpd of capacity in 2015.[91]

Canexus ran into a lot of problems building and operating this terminal and there has been speculation about whether it may have to be sold to ease pressure on the company's balance sheet.[92] Construction is 60 percent over budget caused by severe weather last winter and problems with an incinerator designed to flare vapors during tank car loading.[93] The terminal was expected to be back online following maintenance by the end of August 2014.

87 Estimate from Rystad Energy UCube Database. http://www.rystadenergy.com/Databases/UCube
88 Estimate from Rystad Energy UCube Database. http://www.rystadenergy.com/Databases/UCube
89 Reuters, "TORQ to build 168,000 bpd Western Canada crude-by-rail terminal" August 14, 2013. http://www.reuters.com/article/2013/08/14/canada-crude-rail-idUSL2N0GF0Z520130814
90 See http://priceofoil.org/rail-map/ for a map of crude-by-rail terminals in North America, the data behind the map can be downloaded from a link on this page: http://priceofoil.org/rail/
91 "Canexus Corporation Announces First Quarter Results, May 7, 2014. http://canexus.ca/investors/news-releases#/press-releases/canexus-corporation-announces-first-quarter-result-tsx-cus-201405070944477001
92 Nia Williams, "Canexus pays high price for wining Canadian crude-by-rail race" August 5, 2014. Reuters http://uk.reuters.com/article/2014/08/05/canexus-railway-crude-idUKL2N0Q72BB20140805
93 Ibid.

The next unit train terminal to being operations in Alberta will be the Gibson Energy terminal in Hardisty, which at the time of writing was undergoing commissioning. Both of these terminals are connected to tar sands production via feeder pipelines from multiple tar sands projects. Edmonton and Hardisty are the two main pipeline hubs for tar sands production, where feeder pipelines deliver crude from tar sands fields across Alberta to be fed into the Enbridge, KinderMorgan, and TransCanada export pipeline systems. This means that dilbit will be loaded at these terminals as that is what is delivered by the pipeline system. A diluent recovery unit is being built at the Canexus Bruderheim terminal that is scheduled to come on stream in December 2015. This will enable shippers to reduce the amount of diluent they ship by rail, essentially enabling them to convert dilbit to railbit.

One more unit train terminal is under construction in Alberta. Kinder Morgan is building a terminal in Edmonton in partnership with Imperial Oil. This terminal will also load dilbit and will have a capacity of 210,000 bpd, and is scheduled to begin operation in 2015.

Other sections of this report show that while terminal capacity is on the rise in Alberta, the economics of shipping tar sands bitumen by rail are marginal. Future terminal capacity should not be used as an indicator of how much tar sands will be shipped by rail in the future. Since the beginning of 2014, only about 50 percent of loading terminal capacity has actually been utilized for loading tar sands onto trains. The underutilization of capacity is due to a number of factors including severe winter weather, operational challenges at terminals, and the lack of pricing incentives to stimulate increased use of rail.

Table 4: Alberta Tar Sands Loading Terminals Operating in January to June 2014

Operator	Railroad	Location	Capacity/(Future) 000 bpd	Producers
Altex Energy	CN	Falher	20	N/A
Altex Energy	CN	Lynton, Fort McMurray	20	Southern Pacific
Arrow	CP	Lambton Park	4	N/A
Canexus	CN / CP	Bruderheim (nr Edmonton)	70 / (100)	MEG, Cenovus & others
CN	CN	Athabasca	N/A	Suncor/Nexen
CP	CP	Edmonton	N/A	N/A
Elbow River	CN	Roma	7.5	N/A
Elbow River	CN	Peace River Nampa	20	N/A
Keyera / Enbridge	CN	South Cheecham	32	Statoil, JACOS
Pembina Pipeline	CN	Edmonton	40	N/A
Savage Services	CN	Reno, Alberta	25 / (50)	N/A
Total			238.5 (293.5)	

Source: Company information compiled by Oil Change International

Table 5: Alberta Tar Sands Loading Terminals Under Construction

Operator	Railroad	Location	Capacity 000 bpd	Start Up	Producer
Altex Energy	CN	Reno	24	2016 (Awaiting Permit)	N/A
Gibson Energy	CP	Hardisty	120	Q2-2014	N/A
Gibson Energy	CN / CP	Edmonton	60	2015	Statoil
Grizzly Oil Sands / Gulfport	CN	Windell	18	Q3-2014	Grizzly
Kinder Morgan / Keyera	CN / CP	Edmonton	40	Q3-2014	N/A
Kinder Morgan / Imperial	CN / CP	Edmonton	210	2015	Imperial
Plains Midstream	CN	Mitsue	30	2015	N/A
Total			502		

Source: Company information compiled by Oil Change International

If these challenges continue, tar sands rail shipments may grow to some 400,000 bpd by 2016. If the logistical challenges at terminals are resolved, there still remain weather and market challenges. It seems unlikely that these terminals could run at full capacity year round.

7.2 UNLOADING TERMINALS: OVERCAPACITY THAT WILL NEVER BE FILLED

There are 38 terminals in our North American crude-by-rail database that are listed as currently having some capacity to unload tar sands crude from trains.[94] All but two of these are in the U.S. with the Canadian terminals located at the Chevron refinery in Burnaby, near Vancouver, British Columbia and at the Suncor refinery near Montreal, Quebec.

In practice, only a handful of these terminals actually regularly handled tar sands crude in the first half of 2014. Most unloading terminals can handle dilbit crude if they have a customer for it, as dilbit does not require any special handling. For this reason it is possible that some terminals have listed tar sands crude (usually described as Canadian heavy crude) as something they handle simply because they are located close to potential customers.

Terminals that have installed equipment to generate steam to heat tank cars full of railbit and heated storage tanks to store the product have made a concrete commitment to handle tar sands crude. We can confirm only 16 terminals that currently have steam heating facilities for unloading tar sands crude (see Table 6). In addition there is one terminal under construction and one in the process of obtaining permits (see Table 6). There is also a proposal to build a heated terminal at Prince Rupert, British Columbia that would load tankers for export. This has been proposed by Canadian National Railway (CN) and tar sands producer Nexen. There is currently no information about the proposed capacity of the terminal or when it might be built.

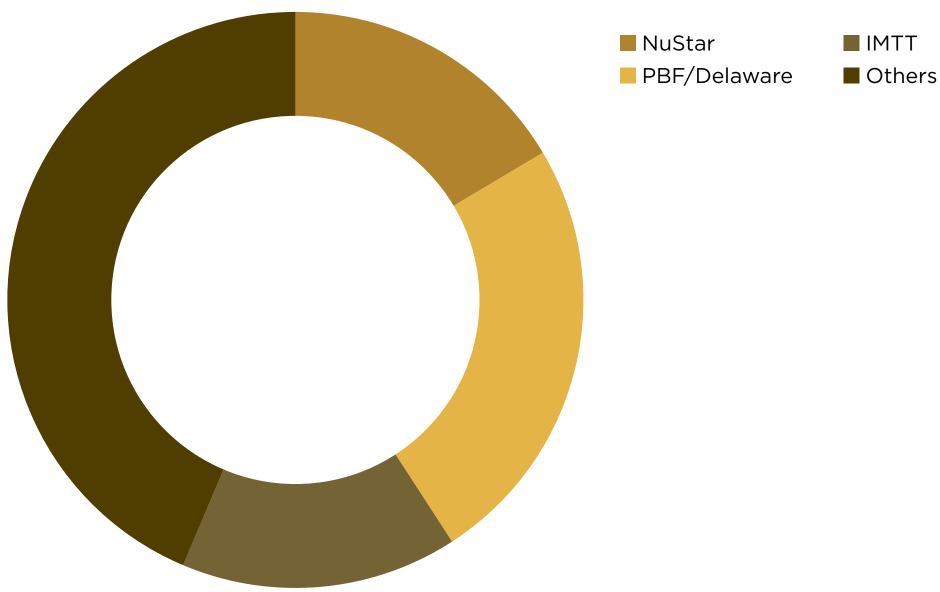
Fourteen of these 16 terminals currently have capacity to unload at least 619,000 bpd and they have plans to expand to just over 1.1 million bpd. We do not have capacity figures for the other two terminals, so actual current and future capacity is likely higher. However, not all of this capacity is necessarily dedicated to unloading tar sands railbit. The capacity of steaming equipment may be less than the total capacity to unload tank cars. Some terminals also handle light tight oil (LTO) from the Bakken oil field and elsewhere, as well as conventional heavy and light crudes. An example is the terminal at the Delek refinery in El Dorado, AK. This has a total capacity of 45,000 bpd for heavy and light crudes but can only unload 12,000 bpd of heavy crude such as railbit.

Four of these terminals are at refineries. The PBF refinery in Delaware City refines railbit and the terminal there also transfers it onto barges to head up the Delaware River to the PBF refinery in Paulsboro, New Jersey. Also in Paulsboro is NuStar's asphalt refinery, which has capacity to unload 12,000 bpd of railbit. Valero's refinery in St. Charles, LA is also a regular receiver of railbit and is expanding its capacity to handle more.

The other terminals all transfer railbit onto other delivery systems for delivery to refineries further afield or potentially for export. Many of these terminals are located along the Mississippi River and load crude oil and railbit onto barges which can then access dozens of Gulf Coast refineries that have ample facilities for unloading tankers and barges rather than rail cars.

There is one terminal with planned steam heating capacity under construction, the Petroplex terminal in St. James, Louisiana. This terminal will have a capacity of 70,000 bpd and is scheduled to come online in 2015. There are also two terminals currently going through permitting processes that plan steaming capacity. Global Partners and Kansas City Southern announced they had submitted applications for a new terminal in Port Arthur, Texas that would potentially handle up to 120,000 bpd of railbit.[98] The other is the massive 360,000 bpd terminal proposed by Tesoro and Savage in the Port of Vancouver, Washington. This proposal faces severe opposition from the community and city council and it is far from certain that it will go ahead (see Section 5.0).

Figure 10: Railbit Imports in 2014 are Dominated by Three Terminals



94 See http://priceofoil.org/rail/
95 CN = Canadian National, UP = Union Pacfiic, CP= Canadian Pacific, KCS = Kansas City and Southern.
96 Petroleum Administration Defense District, these are Department of Energy designated regions for organizing national petroleum infrastructure. These correspond to 1: East Coast, 2: MidWest, 3: Gulf Coast, 4: Rocky Mountain States, 5: West Coast
97 TS = Tar Sands - LTO – Light Tight Oil (e.g. Bakken)
98 "Global Partners and Kansas City Southern Announce Agreement to Develop Unit Train Crude Oil Terminal in Port Arthur, Texas" July 8, 2014. http://www.globalp.com/news/article.cfm?articleID=301
99 See http://priceofoil.org/rail/
100 Lorne Stockman "Runaway Train: The Reckless Expansion of Crude-by-rail in North America" May 2014. Oil Change International http://priceofoil.org/content/uploads/2014/05/OCI_Runaway_Train_Single_reduce.pdf

Table 6: Currently Operating U.S. Unloading Terminals with Steam Heat Capacity

Operator	Railroad[95]	Location	PADD[96]	Crude Type[97]	Facility Type	Total Capacity/(Future) Thousand bpd
NuStar Energy	CSX	Paulsboro, NJ	1	TS	Refinery	12
PBF Refining	Norfolk Southern	Delaware City, DE	1	TS & LTO	Refinery + Rail to barge	145 – (210)
Gateway Terminals (Seacorp)	BNSF	Sauget, Ill.	2	TS & LTO	Rail to barge	50
Arc Logistics Partners	CN	Mobile, AL.	3	TS	Rail to barge and pipeline	17 (70)
Crosstex Energy	CN	Geismar, LA.	3	TS	Rail to barge and pipeline	15
Delek	BNSF & UP	El Dorado, AK.	3	TS & LTO	Refinery	45 (of which steam = 12)
Genesis Energy	CN via Natchez Railway	Natchez, MS.	3	TS	Rail to barge	50
GT Logistics LLC	UP & BNSF	Port Arthur, TX.	3	TS & LTO	Rail to barge	100
International Matex Tank Terminals (IMTT)	CN	St. Rose, LA.	3	TS & LTO	Rail to barge	N/A
Jefferson Refining	KCS, UP & BNSF	Beaumont, TX.	3	TS	Rail to barge	70 (300)
JW Stone Oil Distributors	CN	Port Manchac, LA.	3	TS	Rail to barge	15
Kinder Morgan-Watco	BNSF, UP & KCS	Greensport, TX.	3	TS	Rail to barge and pipeline	50 (210)
LBC Tank Terminals	CN	Geismar, LA.	3	TS	Rail to barge	10
LBC Tank Terminals	UP	Seabrook, TX	3	TS	Rail to Barge	N/A
Valero	CN	St. Charles, LA.	3	TS	Refinery	20 (35)
Wolverine Terminals	CN	St. James, LA.	3	TS	Rail to barge	10 (40)
Total						619 (1,162)

Source: Company information compiled by Oil Change International

The amount of railbit currently being loaded in Alberta is far below the capacity of these unloading terminals. An average of 113,000 bpd was loaded in the first five months of 2014 compared to the roughly half-million bpd of capacity available to unload it. EIA data shows that most of the railbit coming into the United States was handled by a small number of these terminals.

For the first five months of 2014, 56 percent of all railbit was imported into just three terminals: the PBF terminal in Delaware City, the NuStar terminal in Paulsboro, New Jersey, and the IMTT terminal in St. James, Louisiana (see Figure 10).

In addition to these facilities that are designed specifically to unload railbit using steam heat, there are at least 21 terminals that claim to be handling some kind of Canadian heavy crude.[99] Many of these are located in the Gulf Coast region. Our research on the development of crude-by-rail loading and unloading capacity and traffic volumes revealed that on the continental level, only about one-third of capacity is being utilized.[100] While there is certainly scope to increase the utilization rates, there are also significant barriers to any rapid or substantial increase in traffic in the near future (See Sections 4, 5 and 6).

It appears that throughout the North American crude-by-rail system there is significant overcapacity at terminals, particularly for unloading crude in the Gulf Coast. It remains to be seen whether there will be a rationalization of this capacity over time as terminals compete with each other for business and some fall by the wayside. For now, it appears that the existence of a large amount of unloading capacity is not a reliable indicator of how much crude actually moves by rail.

8.0 Conclusion

Crude-by-rail is no doubt growing across the continent, but it cannot practically or profitably replace the capacity of major tar sands pipelines. The ambitious expansion goals of the tar sands industry rely on approval and construction of large pipelines in order to profitably move product to market. Bitumen-by-rail will grow and ease some marginal transportation constraints, but it is not poised to be a substitute for pipelines, and thus cannot be expected to facilitate rapid tar sands expansion in the same way as pipelines.

In order for tar sands bitumen to reach markets by rail it must overcome significant market and logistical constraints. While a limited amount of bitumen may overcome these hurdles and be profitably shipped by rail, data and practical experience show that a large scaling up of bitumen-by-rail faces substantial challenges. The amount of tar sands reaching the Gulf Coast by rail in early 2014 represents just 5.7 percent of what the Keystone XL is proposed to carry.

For tar sands bitumen to reach markets by rail it must travel thousands of miles while negotiating congested rail systems in both Canada and the United States. It must overcome frequent severe weather in the winter. The logistics involved in overcoming the 'diluent penalty' are more complicated than tar sands proponents would have us believe, making the suggestion that rail can compete on costs with pipelines for large scale tar sands producers a theory that has yet to be proven. Access to West Coast markets is threatened by opposition to crude-by-rail generally, and tar sands specifically, as well as to the increased tanker traffic that it would enable.

Another major threat to the idea that rail can replace tar sands pipelines, especially the Keystone XL pipeline to the Gulf Coast, is the fact that Gulf Coast oil market is flooded with crude oil, which is suppressing prices and undermining the economics of railing bitumen to the world's biggest refining center. Very little profit has been made railing bitumen to the Gulf in 2014, and future prospects are not any rosier.

Railing bitumen may provide a transport solution for small-time tar sands producers, but it will never support the growth that large-scale producers are planning for. Stopping pipeline projects will reduce tar sands production as the economics of increasingly marginal tar sands projects crumble under the strain of increased transport costs and cheaper alternatives.

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