Oil Supply and Demand in Canada's Energy Future: Current Context and Long Term Trends

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See footnotes at end of text.

INTRODUCTION

Canada is a large global producer of oil, and a relatively large user of oil products on a per capita or gross domestic product basis. Canadian crude oil production has increased significantly in recent years, inspired by technological change, investment, and high oil prices. This increase exists in a context of growing global oil demand, and expectations for significant growth in the near future.

While Canadian oil production has increased, Canada has also taken steps to reduce its own fossil fuel use, including oil products. This is reflected in various policies and regulations put in place at various levels of government over the past decade. Like other developed nations, demand for oil products has been flat during this time period. What sets Canada apart is the relative importance of energy production to its economy, as well as the fact that producing energy accounts for a relatively large share of Canada's own energy use (much of which is natural gas) and emissions.

This dynamic makes Canada an interesting case study for the paradox of fast growing global oil demand in the near-term, and expectations that global oil demand will be reduced in the long-term. Using recent projections from the Canadian National Energy Board's (NEB's) Energy Futures series of long-term supply and demand projections, this article contextualizes this paradox from a Canadian perspective.

CANADIAN HISTORICAL CONTEXT

In 2017, Canada produced an estimated 4.3 million barrels of oil per day (MMb/d), about 4% of total global production. Production also increased from 2.6 MMb/d in 2005, an increase of 67% over the 2005-2017 period. The recent increase in Canadian production has mainly come from the oil sands in Alberta. Driven largely by the sustained price signal of near $100 oil in the 2010-2014 period, oil sands production increased from 1 MMb/d in 2005, about 40% of Canadian production, to 3 MMb/d in 2017, nearly 70% of total Canadian production.

Canada consumes a lower share of global oil demand, approximately 2% in 2017. That said, Canada is a relatively intensive user of oil, with the third largest oil consumption per capita among OECD countries. Canadian demand for oil products, such as gasoline and diesel, has been relatively flat over the past few years, although the overall trend masks some interesting dynamics. The 2008-2009 recession reduced Canadian oil demand, and some larger provinces in Canada such as Ontario and Quebec, have not recovered to their pre-recession peaks. Various policy initiatives put downward pressure on oil demand in this time frame, including biofuel blending mandates for gasoline and diesel, new vehicle emission standards, and the introduction of carbon pricing systems in various provinces[1]. Some areas have experienced growth in oil consumption over this period, largely associated with industrial and economic growth related to resource industries. However, in recent years lower oil prices have reduced economic activity in those regions, which impacted oil consumption. For example, diesel used for transportation in Alberta increased by over 50% from 2005 to 2014, but declined nearly 30% from 2014 to 2016 (Statistics Canada, 2017).

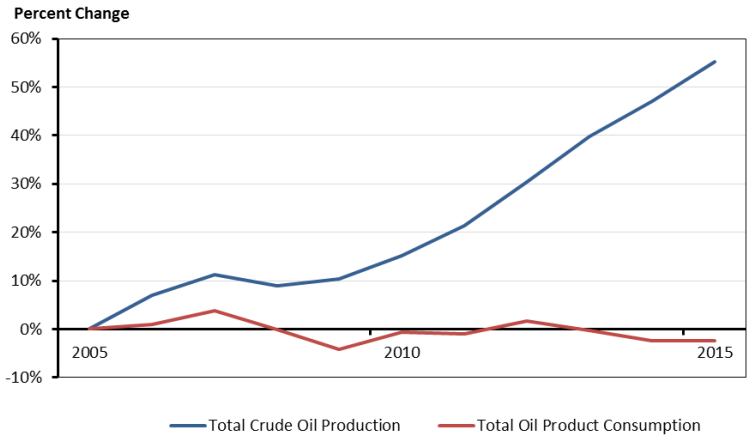

Figure 1: Growth in Canadian crude oil production vs oil product demand since 2005

Figure 1 demonstrates these differing trends. It compares the growth of crude oil production and oil product consumption relative to 2005. While oil production is an important part of the Canadian economy and influences oil consumption, overall Canadian production and consumption trends have clearly moved in different directions in recent history.

FUTURE EXPECTATIONS

Looking ahead, the divergence between production and consumption is likely to continue. The NEB provides outlooks for both Canadian production and consumption in its Energy Futures series of energy outlooks. These outlooks include baseline Reference Case projections, as well as several sensitivity cases to test key assumptions, similar to the U.S. Energy Information Administration Annual Energy Outlook series.

Figure 2 shows the NEB's latest Reference Case crude oil production outlook, Canada's Energy Future 2017: Energy Supply and Demand Projections to 2040 (EF2017). EF2017 projects that Canadian crude oil production will increase 2.3 MMb/d to 6.3 MMb/d in 2040, an increase of 57%. Similar to recent trends, oil sands production dominates the growth. Within oil sands, growth is dominated by in situ production, where oil sands bitumen is generally extracted by injecting steam into reservoirs, and limited long-term increases in large-scale mining and upgrading facilities.

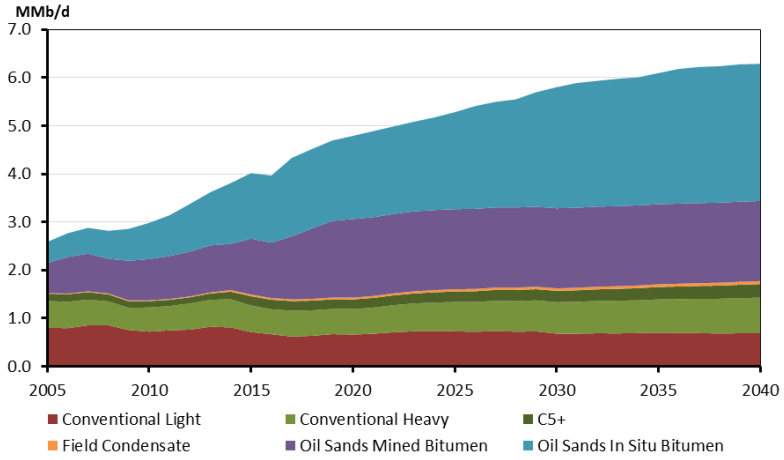

Figure 2: Canadian crude oil production by type

In the longer term, production continues to increase given that the prices assumed in the EF2017 Reference Case ($80 per barrel long term, based on a consensus review of various forecasters) are high enough to incent additional production. Incremental production growth is largely through expansions to existing projects (adding 1.2 MMb/d by 2040) as opposed to greenfield projects (adding 0.4 MMb/d).

In the EF2017 Reference Case, oil product demand remains below its 2007 peak due to numerous factors including macroeconomics, policy, and technology developments.

Perhaps the key policy impact is vehicle emission standards for passenger and freight vehicles, which are expected to increase efficiency across both passenger and freight fleets over the projection period. Another one of the important policy factors is carbon pricing. As noted earlier, some provinces have had some type of carbon pricing since 2008, and in 2016 the Federal government of Canada announced the Pan-Canadian Framework on Clean Growth and Climate Change[2]. One of the cornerstones of this framework is the Pan-Canadian Approach to Pricing Carbon Pollution[3]. EF2017 includes a simplified representation of Canadian carbon pricing where all jurisdictions converge to a $50/tonne price (nominal terms) in 2022 and beyond.

The Pan-Canadian Framework also includes several other initiatives that could have significant implications for oil demand but are still under development as of February 2018. These include a Clean Fuel Standard aiming to reduce the emission intensity of fuels, as well as a national zero emission vehicle strategy. Furthermore, if technology progresses and electric vehicles (EVs) become increasingly popular, increased adoption of EVs will impact oil demand. EF2017 EV adoption varies across the country, relatively higher in provinces with policy incentives, ranging between 5 and 25% of new sales by 2040.

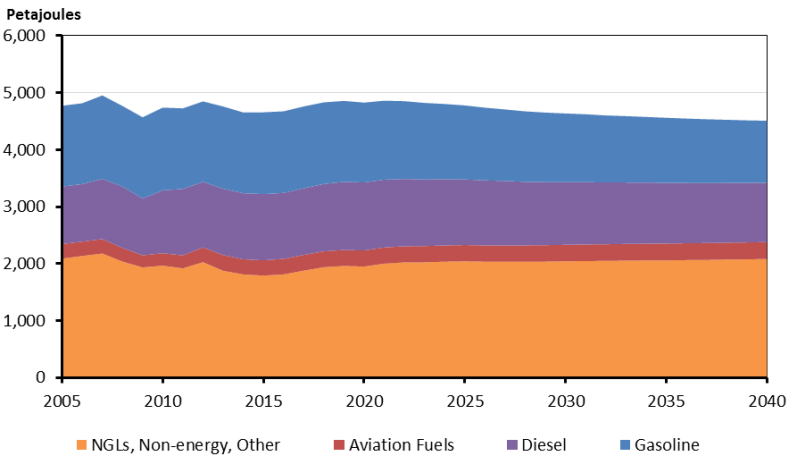

Figure 3: Canadian Oil Product Demand by Fuel

Figure 3 shows total Canadian oil product demand on an energy-equivalent basis. From 2016 to 2040 demand declines by 3.5%. Gasoline demand declines the most as emission standards and other policies reduce passenger transportation use. Aviation fuels and other oil products increase over the outlook, driven by increases in demand for air transport and as petrochemical feedstocks.

LONG-TERM UNCERTAINTIES

The outlooks discussed earlier show a country where, at assumed price levels, production looks to increase significantly in the near and long term. Alternatively, oil product demand looks to increase slightly in the very near term, although remaining below its 2007 peak, and bend downward in the longer term.

This outlook therefore assumes that the excess production will be absorbed by a global market. Specifically, it assumes that "over the long term, all energy production will find markets and infrastructure will be built as needed" (NEB 2017). However, the paradox of near-term growth globally and the possibility for declining longer-term trends pose several key uncertainties for Canadian supply and demand dynamics, and is driving some of the notable recent developments.

First, recent increases in crude oil production in Canada and the U.S. have led to situations where capacity to move oil is challenged, and the gap between regional and global benchmark prices has increased at various times[4]. This notably occurred between Brent and WTI benchmarks in the early part of the decade. For Canadian heavy crude oil prices, discounts to Brent were large in that period as well, and have once again increased rapidly in late 2017 and early 2018 (Leach 2017).

Second, increasing global climate action over the long term also creates several uncertainties for Canadian oil supply and demand, including domestic and global technology and policy trends. The alternate cases in EF2017 look at how these uncertainties might compare to the Reference Case. The Higher Carbon Price Case involves an increasing carbon price over time, while the Technology Case has the same increasing carbon price along with greater penetration of select technologies such as electric vehicles and improved oil sands recovery using steam-solvent methods[5]. These cases also assume progressively stronger global climate action, which will put downward pressure on global oil demand, and therefore these cases have progressively lower crude oil price assumptions. Figure 4 illustrates the crude oil price assumptions, as well as 2040 production and consumption in all three cases.

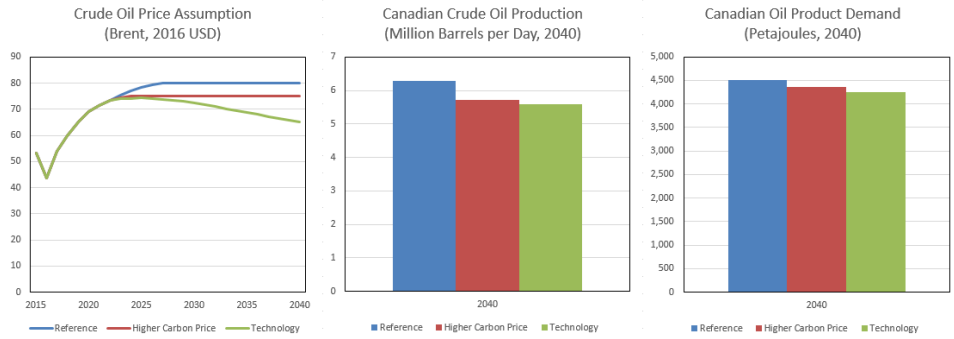

Figure 4: EF 2017 Crude Oil Price Assumptions and 2040 Crude Oil Production and Oil Product Demand Projections

The long-term decline in global demand for oil is likely to be driven by aims to reduce emissions and increasing costs of carbon pollution, which implies that reducing the emission intensity of a barrel produced will be important for future production to be competitive[6]. Because three of the fifteen global crudes with the highest life-cycle carbon intensities currently measured[7] are Canadian oil sand crudes, using energy more efficiently will be more essential to its future competitiveness than the average global benchmark crude.

One promising emerging oil sands technology to reduce emissions is by injecting solvents along with the steam into bitumen reservoirs. This will reduce the natural gas use requirements, reduce the emissions intensity, and improve the longer-term economics of in situ production. The EF2017 Technology Case assumes a greater penetration of this technology, which is the key reason why crude oil production remains at levels similar to the Higher Carbon Price Case despite a significantly lower crude oil price (see Figure 4)[8].

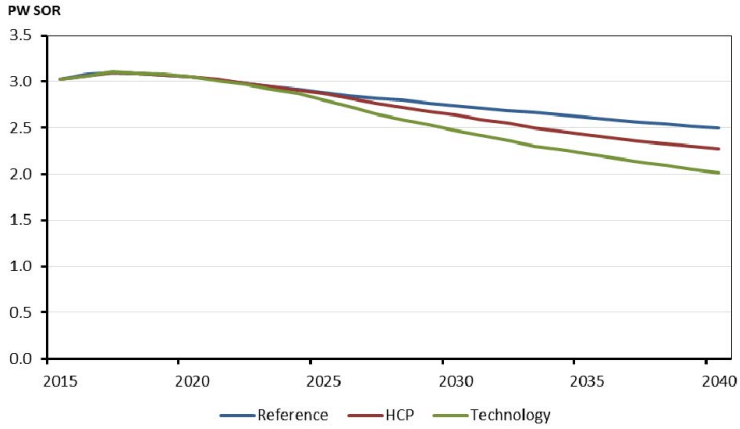

Figure 5: Average Annual Production-Weighted Steam Oil Ratio of Thermal Oil Sands Production, All Cases, EF2017

The goal of improving competitiveness in a world of reduced emissions and oil demand is central to many of the key policy initiatives that affect the oil producing sector in Canada. In particular, Alberta recently adopted its Carbon Competitiveness Incentive regulation[9], which provides an incentive to reduce emissions while reducing average carbon costs for emission-intensive, trade-exposed indus-

tries, such as the oil sands. Alberta is also implementing a 100 mega tonne cap on emissions from the oil sands[10], which further incentivizes reducing emissions intensity. Figure 5 shows the steam oil ratio trends in the EF2017 scenarios, which captures the ratio of steam needed to produce a barrel of oil; a key measure of oil sands energy efficiency and productivity. These trends are integral to both reducing Canada's fossil fuel demand trends and increasing production by improving oil sands economics.

CONCLUSION

In reviewing the supply and demand dynamics for Canadian oil, it is clear that the global oil market paradox of increasing supply and demand in the near term, and possibilities for declining demand in the longer term, has been very influential in current Canadian developments, and will likely continue to be so in future trends. Despite strong recent growth in production and demand worldwide, the possibility for longer-term declines in oil use poses additional questions. For Canada, declining domestic oil demand is a result of some of the new policy developments which have occurred over the past few years. If the world acts similarly, a key question for Canada's energy system is if its oil production can adapt through technological developments to maintain competitiveness in a demand-constrained world. Since the oil sands are also an expected demand growth area for natural gas in Canada, this question is also important for that commodity. As natural gas faces a similar paradox, the Canadian context shows the questions on the future of oil supply and demand go far beyond a single commodity.

Footnotes

[1] Alberta introduced its Specified Gas Emitters Regulation, an intensity based approach, in 2007 (this was replaced by the Carbon Competitiveness Incentive Regulation in 2018) B.C.'s carbon tax was put in place in 2008, and Quebec joined the Western Climate Initiative cap-and-trade system in 2013. For a review of how B.C.'s carbon tax has impacted GHG emissions see Murray and Rivers (2015), while Rivers and Shaufele (2015) focus specifically on the carbon tax's impact on gasoline demand.

[2] Pan-Canadian Framework on Clean Growth and Climate Change

[3] Pan-Canadian Approach to Pricing Carbon Pollution

[4] Canada's Energy Future 2016: Energy Supply and Demand Projections to 2040 includes a scenario where crude oil export pipeline capacity is constrained in the long-term. Excess production is then carried by rail, which is more costly, and reduced net back prices paid to producers. This in turn leads to a production outlook that is approximately 10% lower than the Reference Case in the long-term.

[5] Further details can be found in EF2017.

[6] The International Energy Agency's most recent World Energy Outlook includes the Sustainable Development Scenario, which although oil demand does decline long-term, still shows a global demand of over 70 MMb/d to 2040 (IEA, 2017).

[7] ARC Energy Institute

[8] Because natural gas is used to create the steam that is injected into oil sand reservoirs, further inspection of these scenarios begins to hint at another twin paradox that we will not touch on here: the twin paradox surrounding the near and long-term supply and demand balances of Canadian natural gas. If Canadian oil sand producers are successful at achieving SOR reductions and thus reductions in natural gas use, there could be increased pressure to find global markets for the surplus natural gas.

[9] Carbon Competitiveness Incentive Regulation

[10] Oil sands emissions in 2015 were 71 Mt (ECCC, 2017)

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