The Conference Board of Canada

Supply Trains

Security and Resilience in Canada's Propane Market

Issue Briefing | October 7, 2021

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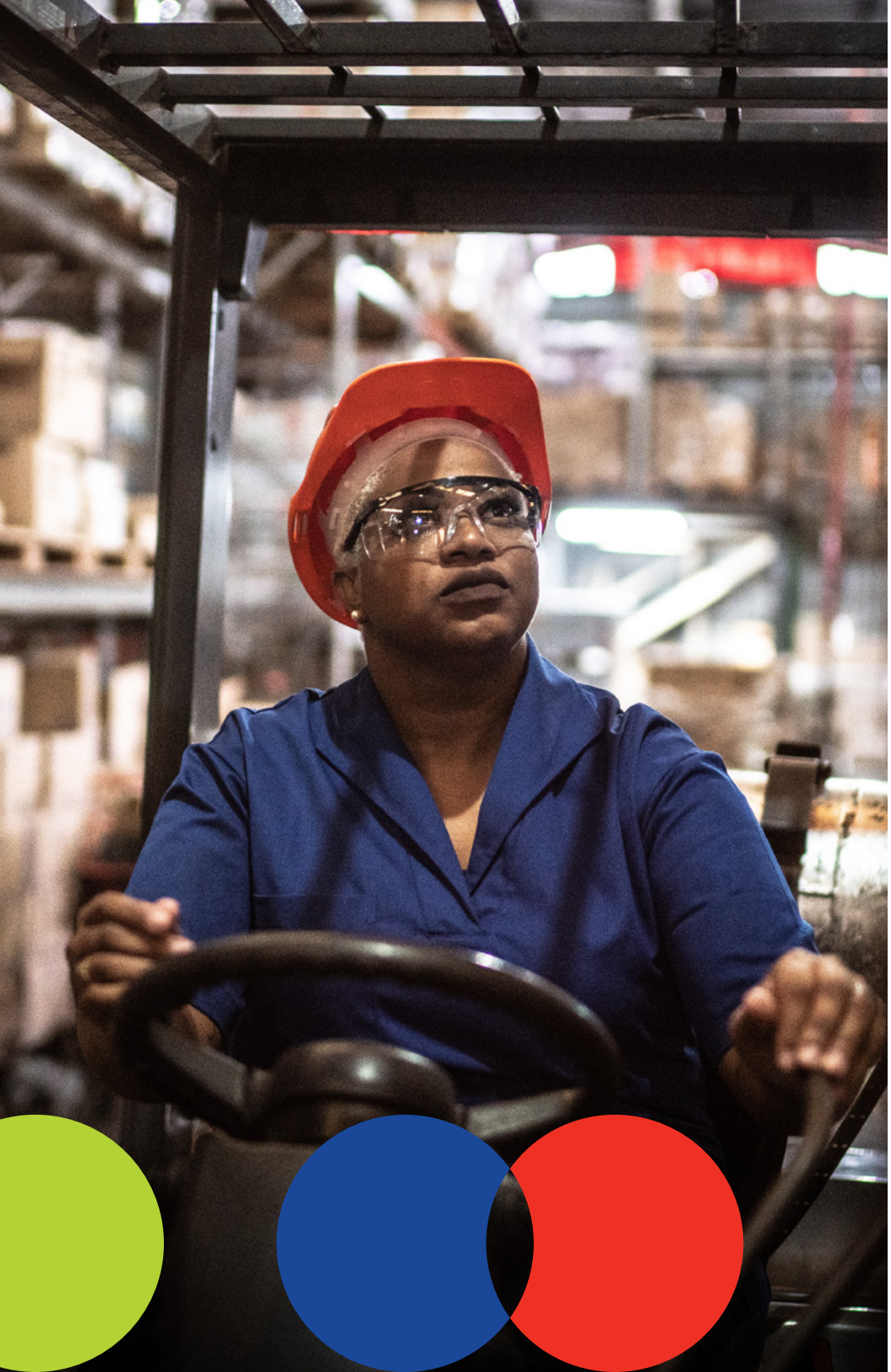


Key Findings

- Changes in Canada's propane supply chain—both real and potential—could have serious implications for thousands of Canadians who rely on propane. As supply and demand of propane takes new shape, policy-makers need to know where gaps exist so they can be prepared to address them quickly in the event of a disruption to the supply chain.
- Three knowledge gaps highlight the vulnerability of the propane supply chain: the expansion of propane by rail (PBR); pipeline disruptions; and the capacity and location of downstream storage.
- The flexibility of PBR's impact on strengthening or weakening security and resilience—especially during potential disruptions—remains largely unknown. A resource combining all datasets would provide a clearer illustration of how PBR both facilitates and shapes propane market dynamics in Canada.
- A shutdown of Enbridge's Line 5 places about 70 per cent of Eastern Canada's propane production at risk. Based on volume, approximately 150 rail cars would be needed to unload natural gas liquids (NGL) in Sarnia every day to replace Line 5 volume. If rail car availability, transit times, wait times, unloading, and other human factors are considered, the actual number may be 10 times higher.
- Additional storage strategically placed throughout Eastern Canada—Quebec and Atlantic Canada in particular—needs consideration. The storage gap would benefit from two efforts: a thorough understanding of inventory volumes and locations; and investment.

Toward Security and Resilience

Canada's propane supply chain is in good health. Production is up, exports are growing, and investment remains strong. But the supply chain is changing. Not only are new market dynamics poised to create impacts, but disruptions like blockades, strikes, and the increasing use of rail also loom large.

Recent external factors are creating concerns. Rail blockades, strikes, and current discussions on shutting down Enbridge's Line 5 are raising questions over security and the reliability of supply. Further upstream in Western Canada, infrastructure is being added to meet increasing wholesale and export demand.

Long-term policy aimed at ensuring energy security and reliability relies on improving our knowledge. The propane supply chain links infrastructure, pricing and contracting, exports, and supply and demand, but gaps in our knowledge remain.

Through our review of the industry, market literature, and economic data, the Board identified three cross-cutting issues that create the most vulnerability, have the greatest impact on security, expose the supply chain to disruption, and weaken its resilience:

- the growing importance of propane by rail (PBR) to downstream and midstream propane transportation;
- the impact of pipeline disruptions;
- storage capacity and locations in Eastern Canada.

Propane by Rail

Knowledge Gap: What Is Rail's Capacity to React to External Disruptions in Propane Supply?

Growth in the propane market has been made possible by rail. Constraints on building pipelines forced midstream investment into rail transport and larger rail terminals.[1] The demand side was just as critical: low-cost propane around market hubs in Edmonton and the United States over the last decade made it possible for customers in Eastern Canada to access supplies farther afield than Sarnia—as far as Kansas and the U.S. Gulf Coast.

As rail opened access out of Edmonton, shipping propane long distances by rail became an important way of balancing seasonal demand in North America. A simple logic developed: PBR exports from Canada rose when prices in the United States and Sarnia rose above the cost of Western Canadian propane plus the cost of transportation.[2] After 2014 and the Cochin Pipeline reversal, the incentive to ship propane east increased as Edmonton prices flattened. Rail shipment of propane from Western Canada increased over the same period as a consequence.[3] In high-demand periods, PBR acts like a pressure valve for the United States and Eastern Canada, pushing cheaper propane east to meet rising prices in the winter.[4] The availability of surplus western propane at a lower hub price makes this viable.

1 See, for example, the Pembina Redwater terminal, Keyera's Edmonton or Josephburg terminals, or the rail terminal facility for offloading cargo at the Ridley Island Propane Export Terminal in Prince Rupert, B.C.
2 Wilczewski, "Propane Market Fundamentals," 13.
3 Murillo and others, *Fuelled Up*, 8.
4 U.S. Energy Information Administration, "Movements of Crude Oil and Selected Products by Rail—Propane".

While expanding its footprint in midstream transportation, rail plays a critical role in downstream delivery. This is especially true where rail lines connect midstream production and storage terminals in Sarnia to downstream distribution terminals in eastern provinces. Eighty to 85 per cent of propane in Quebec and Atlantic Canada is delivered by rail.[5] At this volume, any disruption to the railway weakens the supply chain.

Closing the Gap

The Conference Board of Canada's analysis of Statistics Canada supply and demand data indicates that 5 to 29 kb/d (thousands of barrels per day) of propane was railed directly from Western to Eastern Canada between 2010 and 2019: 9 kb/d was the average over the period.[6] Imports of PBR in Ontario ranged from 0.5 to 5.5 kb/d over the same period.[7]

New rail infrastructure has also changed market dynamics. Large rail-supplied terminals in British Columbia now export a growing share of Edmonton's propane supply each year. Energy Information Administration (EIA) analysis on propane imported and exported by rail indicate less propane was railed from Western to Eastern Canada and the United States in the 2019–20 heating season after offshore exports began in May 2019.[8] It's early days, but this suggests that lower volumes of surplus propane may limit the role that PBR plays in balancing seasonal demand in the long term.

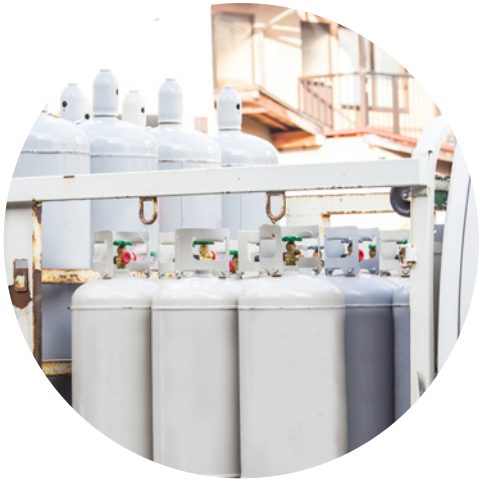
5 House of Commons Standing Committee on Natural Resources, "Evidence." Guy Marchand, around 1230.
6 Based on analysis of supply and demand data conducted by The Conference Board of Canada for the Canadian Propane Association in 2021. See Statistics Canada, Table 25-10-0026-01.
7 Ibid.
8 U.S. Energy Information Administration, *Final 2020/21 Winter Propane Market Update*, 11.

What's Needed

Given the variability in data and opinion, it is difficult to assess PBR's ability to deliver during periods of high demand and disruption.

Policy- and decision-makers working to strengthen supply chain security and resilience require monthly data that, at a minimum, identify what share of propane is originally sourced from Western Canada. The Alberta Energy Regulator updates that province's supply and disposition of propane monthly. But Canadian supply and demand data are only available annually from Statistics Canada, as are data on interprovincial transportation by rail, though fuel shipments are tracked in aggregate rather than by propane itself.

The flexibility of PBR's impact on strengthening or weakening security and resilience—especially during potential disruptions—remains largely unknown. A resource combining all datasets would provide a clearer illustration of how PBR both facilitates and shapes propane market dynamics in Canada.



Pipeline Transportation

Knowledge Gap: What Would Happen to the Propane Supply Chain if a Critical Pipeline Was Suspended or Closed?

Pipeline transportation is essential to supplying propane to Eastern Canada. But attitudes on energy and the environment are shifting. Regulatory and political pressure is mounting against existing pipeline rights-of-way carrying Western Canadian energy into the Great Lakes region.

Enbridge's Line 5 pipeline currently carries around 80 kb/d of natural gas liquids (NGL) and more than 400 kb/d of crude oil from the Superior terminal in Wisconsin to the refining and fractionation hub in Sarnia. NGL supplied on Line 5 makes up around 90 per cent of the feedstock used to produce specification propane at the Sarnia Fractionation Plant.[9] Losing access to NGL feedstock would jeopardize over 50 kb/d of production in Sarnia, at least 70 per cent of Eastern Canada's domestic production.

Based on available information, the Sarnia plant produced around 52 kb/d of propane from the 80 kb/d available from Line 5. This implies that the Sarnia Fractionation Plant sourced an additional 6 to 8 kb/d from alternative sources in 2019.[10]

9 Public Sector Consultants, *Analysis of Propane Supply Alternatives for Michigan*.

10 Based on a propane content of 65 per cent in the NGL entering Sarnia. See Public Sector Consultants, *Analysis*.

A shutdown of Line 5 would halt shipments and force the plant to find alternative supplies equivalent to that 80 kb/d of NGL. This would be the total required to replace the plant's production. Since no other pipelines carry NGL into Sarnia from the United States, the plant would need to source additional NGL volumes from one of the U.S. hubs or from Edmonton.[11] Rail would be the most likely option. Moving a similar volume that distance by truck from Alberta would not be economical.

Closing the Gap

Based on a standard rail car size used to carry bulk petroleum, replacing the 80 kb/d from Line 5 would require about 150 rail cars to unload an NGL mix at the fractionation plant every day.[12] While this figure does represent the volume required, it does not account for the realities of rail car availability, transit time, unloading, and other human factors. We found no verified information that captures these factors. If these pragmatic aspects of the rail industry are considered, the real number of rail cars required could be 10 times higher. This is additional traffic on area rail lines over and above current rail volumes.

The impact of this shift should not be underestimated. In the mid- to long term, the supply chain would need time to adjust to losing western NGL deliveries. Investments need to be made in terminal infrastructure to accept additional rail cars, increase throughput, and store propane, especially if accommodating a shift in supply patterns becomes an option.

Alternative sources of NGL or propane are determined by distance, transportation costs, and hub price.[13] An analysis by Public Sector Consultants found that the supply cost for replacement propane to Sarnia would be around US$0.65/bbl, provided the consumer agreed to take two shipments in the low-demand period for each shipment received in the peak-demand period.[14,15]

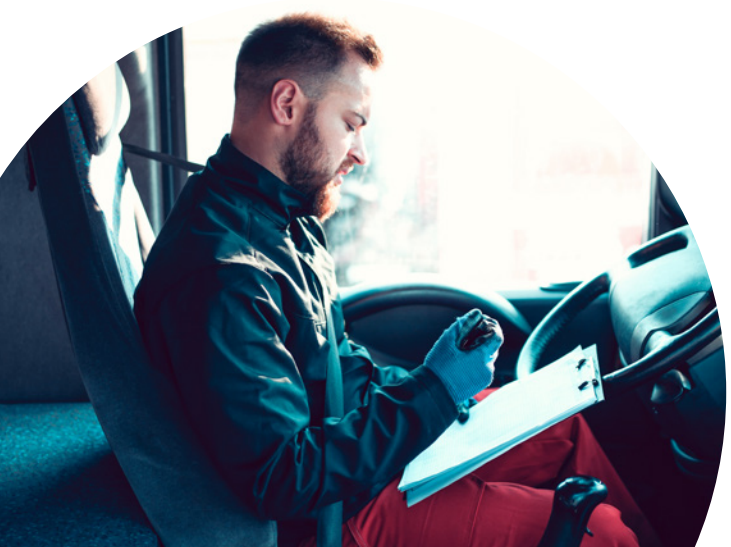
This kind of adjustment to the supply pattern for Eastern Canadian customers could provide one solution. Shippers prefer moving product during summer months, which potentially reduces the amounts needed to ship in winter during peak demand. An adjustment in supply to summer delivery has already been identified as the cheapest option to replace specification propane in Marysville, Michigan, near Sarnia.

11 Public Sector Consultants, *Analysis of Propane Supply Alternatives for Michigan*.
12 Note that we have used the factor of 714 bbl of propane or NGL per rail car, the nameplate capacity typically listed for bulk liquids with rail cars of this kind. Our literature review indicates that the actual volume of propane loaded in a given rail car can vary significantly below that total.
13 Public Sector Consultants, *Analysis of Propane Supply Alternatives for Michigan*.
14 Ibid.
15 London Economics International LLC, *Assessment of Alternative Methods of Supplying Propane to Michigan in the Absence of Line 5*, 44.

What's Needed

Long-term resilience requires supply transportation options and/or markets. With little current appetite in Canada and the United States for pipelines, long-term alternatives for NGL and propane supply should be explored. Alternatives like additional rail and/or truck capacity require more research.

For example, there's no public answer to the question: How many rail cars would be required to move the propane displaced by a shutdown in Enbridge's Line 5? Every rail car needs to travel to its destination, potentially park while awaiting unloading (dwell), unload, dwell again, load again, and then move to its destination where the cycle repeats itself. Estimates of the average time for unloading and dwelling on each end of the individual rail car's journey, combined with average travel time (inclusive of weather disruption), need to be made available to create a formula that better calculates the size of the fleet required to circulate for the consistent delivery of propane. Including relevant data for propane supply by truck would also enhance understanding of the future resupply alternatives in the vicinity of Sarnia.



Storage Capacity and Locations

Knowledge Gap: What Is the Optimal Amount of Storage Required for Eastern Canada to Weather Disruption?

Storage is critical to managing seasonal demand, but storage comes with many considerations. Securing new land and approvals is difficult and capital costs are imposing. In response to the supply disruptions of the past few years, inventory at distribution terminals is expanding. Using what they can where they can, some terminal operators continue to expand above-ground inventories.

Storage locations can be problematic. They are often along parallel main lines also subject to disruption or blockade. The only bulk storage caverns are in Sarnia. In the event of a rail line blockade or any other disruption, they offer little help to consumers in Quebec's and Atlantic Canada's propane markets.

The Conference Board of Canada derived some estimates of the aggregate inventory after surveying all downstream terminals in Eastern Canada through a search of public records. We found 171 downstream terminals in Eastern Canada, of which 33 are equipped with terminal infrastructure accessible to Class I rail lines. (A Class 1 rail carrier is defined as a company with gross revenues exceeding $250 million per year for two consecutive years.) Assuming full tanks, the average volume of a rail terminal is just under 2,800 barrels. The remainder (138) are supplied by truck, with some sites being along Class I rail lines to permit transloading from rail cars. The average storage at truck-in

terminals is 1,200 barrels. Using these estimates, above-ground storage tank volume at distribution terminals in Eastern Canada is about 250,000 barrels.

Existing terminal inventories play a critical role. Many terminals in Ontario are supplied by truck because they are close to Sarnia. These terminals have a lower risk of disruption partly because they have easy access to storage volumes in Sarnia and alternative supply points by rail like Edmonton.

By contrast, distribution terminals in Quebec and Atlantic Canada are beyond the economical distance for truck deliveries from Sarnia. Distributors in these areas do not have access to alternative rail networks to circumvent bottlenecks between Ontario and Quebec. In the event of a disruption, the downstream terminal infrastructure forms an important part in maintaining inventory before a disruption becomes serious.

Closing the Gap

The Conference Board identified 67 downstream terminals located in Quebec and Atlantic Canada that contain around 116,000 barrels of inventory combined. These are the terminals most at risk in the event of a disruption to the rail network. Around 60 per cent of this inventory is located at 26 rail-connected terminals. The remainder is located at 41 truck terminals.

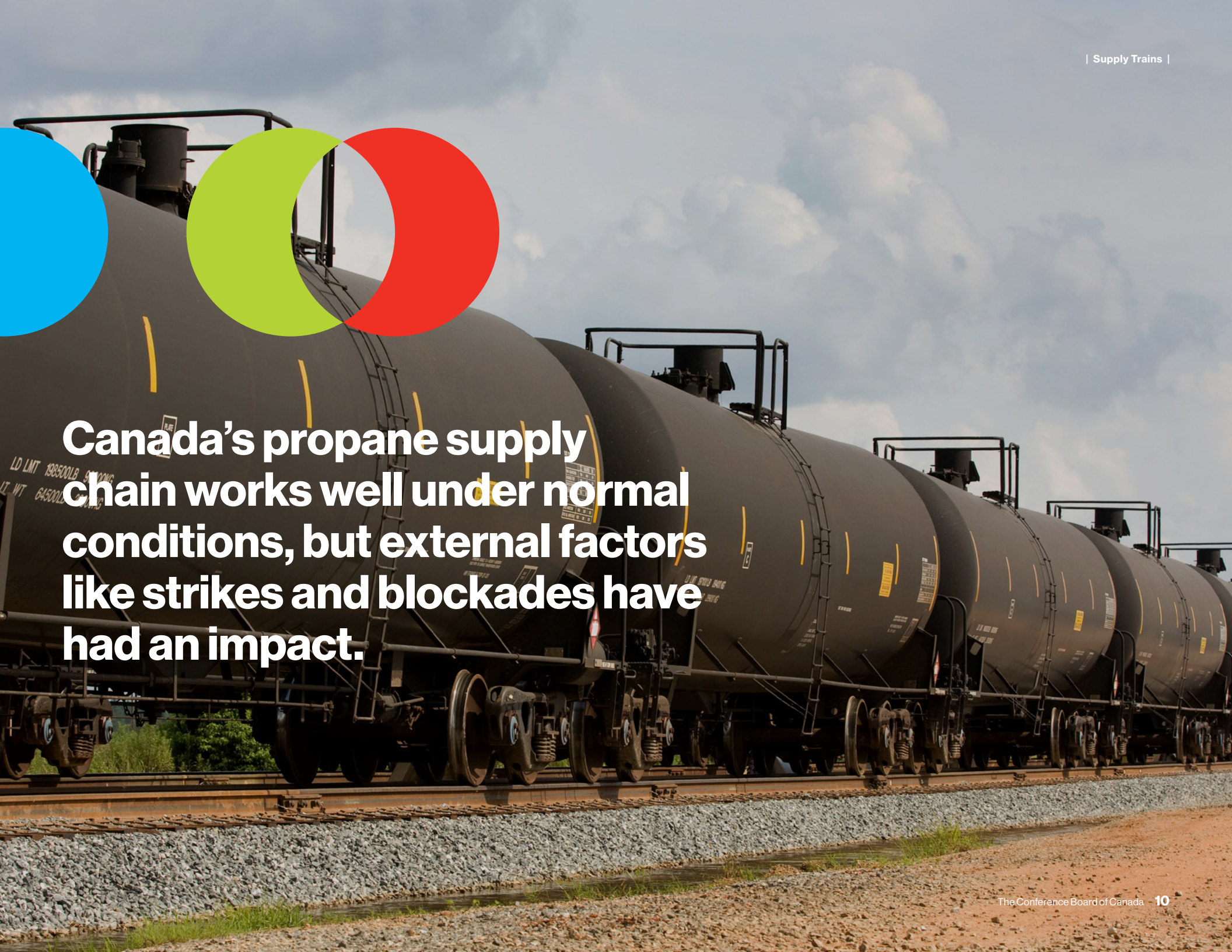
Approximately 14 kb/d of propane was railed into Quebec and Atlantic Canada in 2019. At 116,000 barrels, inventories are minimal. Higher inventories or inventories more widely stored may improve supply chain operation during a crisis.[16]

What's Needed

Is a week or 10 days of inventory, at best, optimal for the supply chain? Analysis suggests not. Additional storage strategically placed throughout Eastern Canada—Quebec and Atlantic Canada in particular—needs consideration in ensuring security of supply and increased resilience. The storage gap would benefit from two efforts: a thorough understanding of inventory volumes and locations; and investment.

A complete storage evaluation includes geographic placement, transportation connectivity, and seasonal inventory. Decision-makers need data to help understand how long the supply chain can operate before the situation becomes critical. Changes in the timing of supply deliveries to accommodate shipping availability also benefit from this evaluation. As well, the review should address new solutions. For example, in addition to expanding above-ground terminals, Ontario may assess salt caverns previously considered for compressed air storage for underground propane storage.

16 MacDonald, "Shutdown of CN Rail lines Leads to Propane Shortages in the Maritimes."



Canada's propane supply chain works well under normal conditions, but external factors like strikes and blockades have had an impact.

Secondly, the availability of propane to end users is critical to the economy of Eastern Canada. As it is critical infrastructure, all levels of government should consider providing financial support for additional storage to maintain security and resilience of the supply chain.

Challenging Gaps

Canada's propane supply chain works well under normal conditions, but external factors like strikes and blockades have had an impact. Internal sector factors like exports, rail capacity, and increased uses for NGL are also being felt. These factors combined raise questions, and there remain gaps in knowledge related to the security and resilience of Canada's propane supply chain. An overarching insight is the connectivity of the supply chain. Upstream changes impact downstream deliveries. Changes in policy, regulation, and investment at any point in the supply chain can have a cascading effect.

We isolated three gaps for discussion, and there remain key opportunities to resolve:

1. The flexibility of PBR's impact on strengthening or weakening security and resilience—especially during potential disruptions—remains largely unknown. A resource combining all datasets would provide a clearer illustration of how PBR both facilitates and shapes propane market dynamics in Canada.
2. A shutdown of Enbridge's Line 5 places about 70 per cent of Eastern Canada's propane production at risk. Based on volume, approximately 150 rail cars would be needed to unload natural gas liquids (NGL) in Sarnia every day to replace Line 5 volume. If rail car availability, transit times, wait times, unloading, and other human factors are considered, the actual number may be 10 times higher.
3. Additional storage strategically placed throughout Eastern Canada—Quebec and Atlantic Canada in particular—needs to be considered. The storage gap would benefit from two efforts: a thorough understanding of inventory volumes and locations; and investment.

Propane is a healthy sector. But as economic and external pressures have demonstrated, work needs to continue to strengthen the propane supply chain's security and resilience.

Appendix A

Methodology

This Conference Board of Canada impact paper builds on unpublished custom research related to propane supply and demand and provided to the Canada Energy Regulator, the Canadian Propane Association, Natural Resources Canada, and Transport Canada. New data and additions/changes to Statistics Canada datasets were used in the preparation of supply and demand information and forecasts for this report. The Conference Board also collected data on propane supply chain infrastructure through a desktop search of public material. Additionally, the funders of the study supplied information both formally and informally.

Our analysis uncovered areas that required additional consideration. They are framed as questions and grouped by segment of the supply chain: upstream, where production primarily occurs; midstream, which significantly covers the transportation segment; and downstream, which loosely covers all distribution activities.

Based on this feedback and our review of the propane supply chain, the Conference Board identified three cross-cutting issues as the focus of this report.

Upstream

- What are the implications for non-energy propane demand in Canada?

Midstream

- How has a lack of pipeline capacity for crude oil exports impacted available capacity to ship specification propane across Canada?
- What is the capacity of propane by rail (PBR) during demand peaks?
- Will recent labour and blockade actions cause governments to ensure freight main lines are free to operate?
- What investments need to be made in rail yard infrastructure to increase efficiency and resilience of PBR in the existing supply chain?
- What is the ability of the existing system to cope with disruptions (i.e., Line 5 shutdown) and compensate for lost volumes over time?

Downstream

- How much risk is acceptable to terminal operators and other supply chain partners before investing in new strategies to mitigate risk?
- Who should bear the risks when the causes are external to the actual normal supply chain?
- Are regulations and public perception having an impact on the cost and availability of land for new propane distribution terminals?
- Are load-shifting strategies, such as increasing shipments during off-demand seasons to ease the system in on-demand times, feasible given the current stock of terminal infrastructure and inventory?
- Will new wholesale markets in the petrochemical sector have any impact on the prices paid during peak demand periods in Eastern Canada?

Appendix B

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Disclaimer
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