The Conference Board of Canada

# Canada's Propane Supply Chain

## Reliability and resilience

Presented to: The Canadian Propane Association and NRCan

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**Custom Report Prepared by:**
**The Conference Board of Canada**

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# Acknowledgements

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The findings in this report are entirely those of The Conference Board of Canada. Any errors or omissions in fact or interpretation remain the sole responsibility of The Conference Board. Final creation of this report has been completed to align with The Conference Board's policy regarding custom publications not released publicly by The Conference Board.

# Executive Summary

This report is a companion to the Conference Board of Canada's 2018 research output on propane supply and demand in Canada – *Fuelled Up: An Overview and Outlook of Canada's Propane Market and Industry (Fuelled Up).*[1] *Fuelled Up* was an assessment of the supply and disposition of propane in Canada at a moment in time using historical data from 2006-2016.

This report provides supply and demand for the period 2010-2019 using new data, updates to historic data, and new trends in the market as of data available at the end of March 2021. Due to the volume of updates to data, direct comparisons between the reports are not always feasible. To provide continuity between this and the previous report, we include brief analyses for each chapter outlining structural and editorial changes. Where possible substantive changes between the two reports are highlighted. Unless otherwise specified in this report, Western Canada refers to BC, Alberta, Saskatchewan, and Manitoba. Eastern Canada is defined as Ontario, Quebec, and the Atlantic provinces.

## Key Takeaways

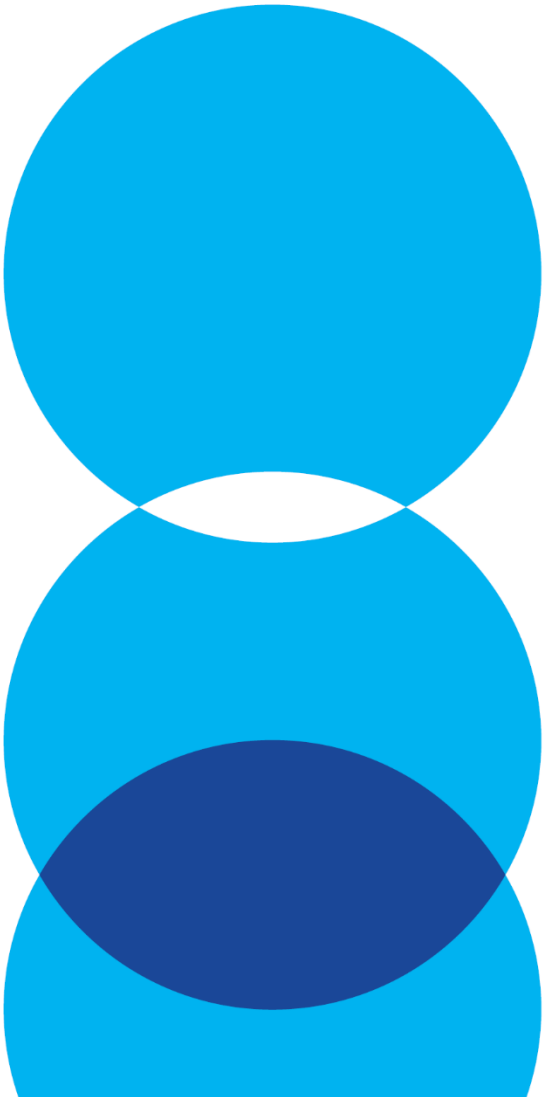
- Rapid growth in Western Canadian propane production dominates the past decade from 2010-2020. Production increased 115 thousand barrels per day (kb/d) from 2010-2019, just under half of this volume, 54 kb/d, added between 2017-2019.
- Growth is expected to continue even as the engine of growth shifts from Alberta to liquids-rich production fields in northeastern British Columbia.
- Storage patterns have been volatile in recent years. Inventory intentions and the impact of the pandemic remain unknown.
- Hub price dynamics since 2014 have incentivized new downstream and midstream investments.
- Exports are the most significant development impacting propane disposition in Canada. The Edmonton-to-tidewater export corridor supported by high-throughput terminals in BC and Edmonton will facilitate increased overseas exports.
- Petrochemical facilities and the potential for propane use in upstream oil and gas extraction are driving near and longer-term opportunities for propane. Rising wholesale end-user consumption may reduce surplus propane in Edmonton.
- While retail demand continues to increase, overall demand is shifting further towards the wholesale end-use segment, including non-energy demand.[2] Taken together with rising exports from BC, these trends could marginally move the Canadian market to less seasonality than in previous years.

[1] Murillo and others, *Fuelled Up*

[2] Wholesale end-users include firms in the Industrial, Non-energy and Producers' own-use demand sectors. Retail end-uses include firms and customers in the Residential, Commercial, Transportation and Agriculture sectors.

Section 1

# Canada’s propane market: overview and outlook



# Propane Supply in Canada

## New in this study

Two additions have been made to detail supply:

- Propane derived from off-gases are included in the supply analysis and forecast as a distinct category. Off-gases had previously been excluded.
- The volume, location, and inventory trends for Canada's bulk natural gas liquids (NGL) and propane storage infrastructure are included. With extremely long supply chains in Canada, storage is critical to balancing seasonal demand. Recent disruptions to propane supply demand a more substantial discussion of storage's role in the supply chain.

### Variances from previous forecast

*Fuelled Up* presented historical data for the period 2006-2016. Values for 2017 were estimated based on data available as of 2018. The forecast was from 2018-2025. This report is based on historical data for the period 2010-2019. Values for 2020 are estimates and the forecast horizon runs from 2021-2030.

Total supply of propane totaled 332 kb/d in 2019, 93 kb/d above forecast expectations in 2018. Based on public data, actual production reached 303 kb/d in 2019 (compared to the previous estimate of 238 kb/d). Cumulative production from 2017-2019 exceeded the previous forecast by around 115 kb/d. This increase is a dominant featuring shaping propane supply in the years since the previous report. Other factors include:

- Adjustments to historical data sets
- Inclusion of off-gas derived volumes in total supply
- Variances in methodology and macroeconomic assumptions
- Deployment of new capital infrastructure and the reversal of capital investment plans
- Global trade and macroeconomic trends including 2016's weak energy markets

These factors impact the forecast. Breaking down the composition of variances, however, highlights the important role growth one factor - gas processing - has had on the forecast.

### Monitoring Trends

- Growth in gas processing increases greatly relative to the 10 years from 2006-2016, covered in the previous report.
- Expanding production in BC demonstrates that propane and other liquids-oriented strategies have matured in recent years.[3] Since 2010, new production assets

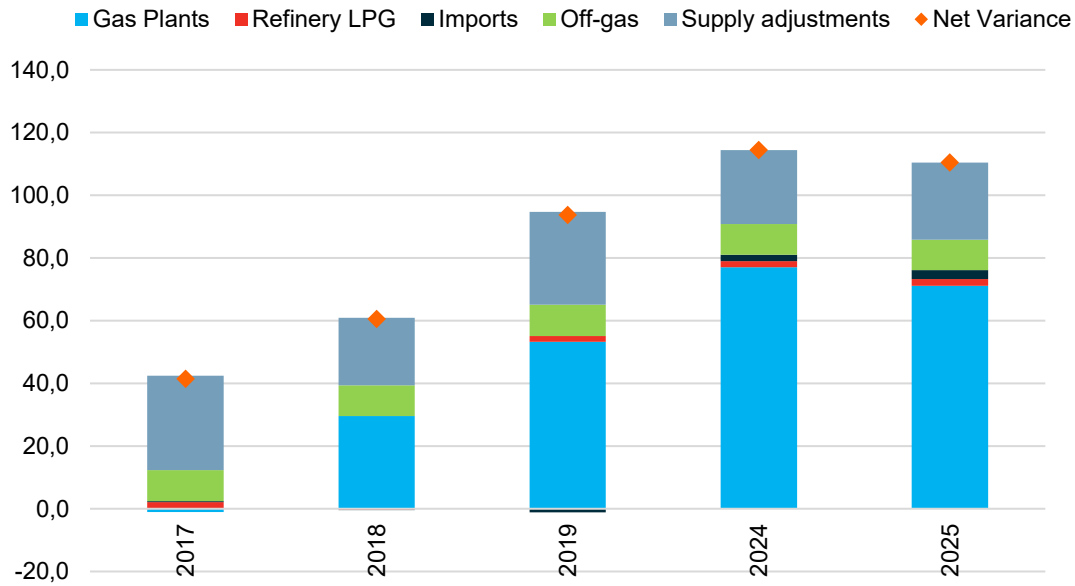
[3] British Columbia Oil & Gas Commission, Facility Inventory [BCOGC-41090].

account for 42 of the 54 kb/d or 78 per cent of the designed production capacity for propane in BC.

- Upstream assets and midstream processing plants deployed in BC over the last decade are designed to exploit the 'wet' gas of northeastern BC and Alberta's Montney formation. Exploiting these resources is increasing the availability of NGL and propane in the extracted gas stream. *Fuelled Up* estimated the average gas plant in BC yielded 4.7 barrels (bbl) of propane for every million cubic feet (MMcf) of gas processed in 2017, rising to just over 5 bbl/MMcf by 2019. Actual data for that period results in a yield exceeding 7 bbl/MMcf by 2019. Our forecast estimates yield to continue rising to 9 bbl/MMcf by 2030.

**Chart 1**

**Propane Supply - Variance from previous forecast in 2018 (kb/d)**




Source: The Conference Board of Canada

# Production

Natural gas production is the main source of natural gas liquids (NGLs) like ethane, propane, and butane. Recent demand for certain NGLs has added value and been a driver for increasing production especially for "wet" natural gas rich in NGLs.[4]

About 90 per cent of propane in Canada is produced/extracted at natural gas processing facilities along major gas pipeline and gathering systems. The rest is produced as liquid petroleum gases in Canadian refineries and from off-gases in upgraders in Alberta. Canada's total propane production reached just above 300 kb/d in 2019, increasing at a compound annual rate of 5 per cent since 2010 (see Table 1).

**Table 1**
**Propane Production**
**(kb/d; per cent)**

| | **2010** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | Δ (10-Yr) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Chg. | CAGR |
| Gas Processing | 156 | 155 | 168 | 170 | 172 | 172 | 196 | 216 | 251 | 272 | 115 | 6% |
| Refining | 26 | 27 | 25 | 26 | 21 | 18 | 18 | 21 | 19 | 21 | -5 | -2% |
| Off-gases | 6 | 9 | 9 | 9 | 7 | 9 | 10 | 10 | 10 | 10 | 4 | 5% |
| **Total** | **188** | **191** | **202** | **204** | **201** | **198** | **223** | **247** | **280** | **303** | **114** | **5%** |
| Western Canada | 107 | 114 | 124 | 128 | 130 | 128 | 150 | 178 | 212 | 233 | 126 | 8% |
| Eastern Canada | 82 | 77 | 78 | 76 | 71 | 69 | 73 | 69 | 67 | 70 | -11 | -2% |

CAGR = Compound Annual Growth Rate
Sources: The Conference Board of Canada; Canadian Association of Petroleum Producers (CAPP), Statistical Handbook; Government of British Columbia, "Natural Gas & Oil Statistics"; Government of Saskatchewan, "Gas Plant Report", Statistics Canada, Table 25-10-0026-01 (formerly CANSIM 128-0012).

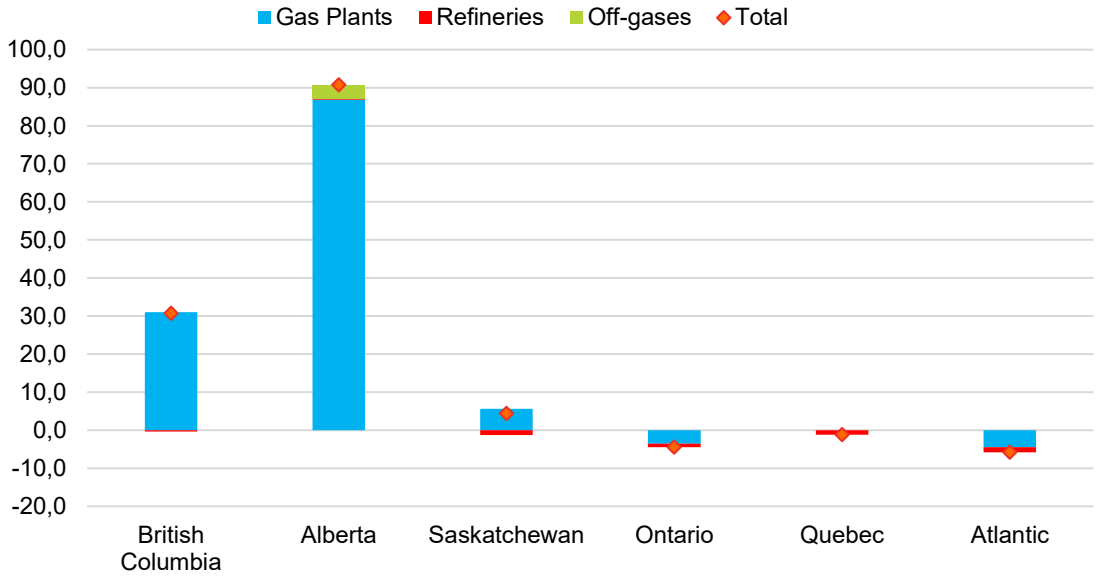
Total propane production in Canada grew over the past decade driven by increasing production from gas processing in Western Canada. While gas plant production volumes in the west increased, Eastern Canada's share of propane production declined. Production from refineries over the 10-year period dropped, however propane production from oil sands upgraders' off-gases more than made up for the decline.

The complex interplay between natural gas production, gas composition, NGLs extraction economics, and evolving processing and transportation infrastructure, have influenced regional propane production levels across Canada. These trends are anticipated to continue to impact the outlook for propane production in the coming years.

[4] Dry natural gas is at least 85 per cent methane, but often more. Wet natural gas contains methane, but also contains NGLs such as ethane, propane, butane, pentanes.

**Chart 2**

**Net Changes in Canadian Propane Production Between 2010 and 2019 (kb/d)**




Source: The Conference Board of Canada; CAPP, *Statistical Handbook*; Government of British Columbia, "Natural Gas & Oil Statistics"; Government of Saskatchewan, "Gas Plant Report", Statistics Canada, Table 25-10-0026-01 (formerly CANSIM 128-0012).

*Fuelled Up* reported the same trend during 2006-2016: an absolute decline in refinery production from eastern and western producers offset by a larger increase in propane production from expanding gas processing in Western Canada. Updated data indicates this trend remains although increases in production related to gas processing was greater in magnitude from 2010-2019 than in the previous decade.

# Imports

Canada imports relatively small volumes of propane primarily for Ontario and Quebec markets. These imports balance regional demand. Total imports grew from 2 kb/d in 2010 to 5 kb/d for 2019, peaking just above 8 kb/d in 2014. (See Chart 3).

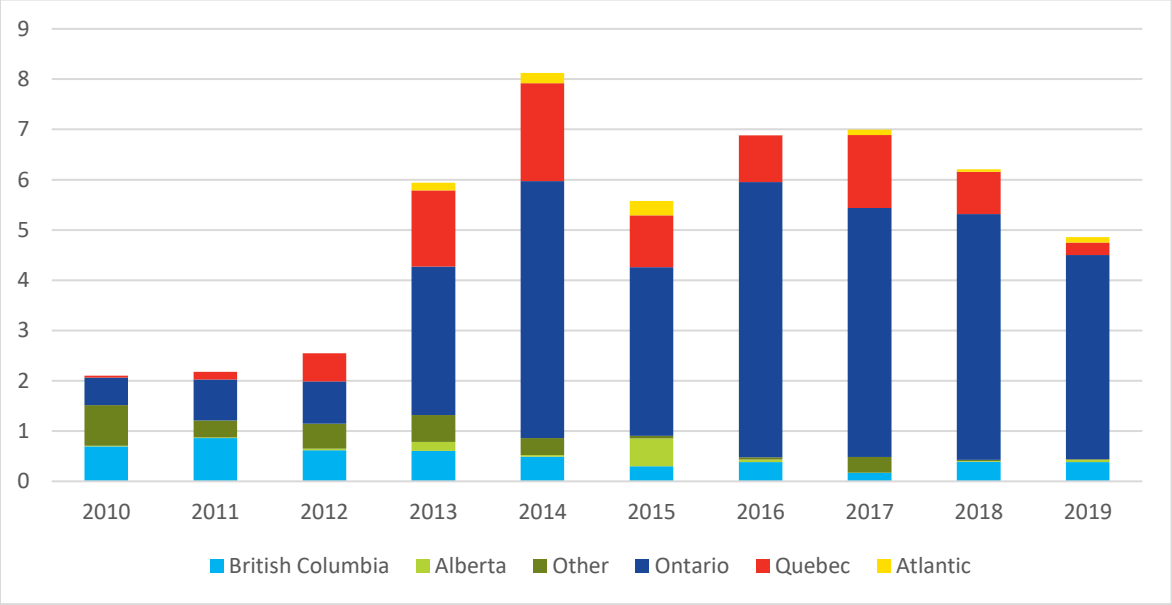
The record surge in imports during 2013-2014 was driven by an historic double-demand 'shock'.[5] The volatility was brought on by a large, wet corn harvest in the United States (US) followed by a severe cold snap impacting much of the Midwestern and Eastern US, and Canada.[6] Demand in some Canadian regions rose by more than 50 per cent in this period.[7] Wholesale and retail prices increased rapidly especially eastern Ontario, western Quebec

[5] 'Shock' in this context will refer to sudden and exogenous changes to demand-side factors impacting the level of propane demand relative to historical trends. Exogenous demand shocks can act to both increase or decrease domestic demand.
[6] Natural Resources Canada and Canada Energy Regulator, *Final Report to the Minister of Natural Resources and the Minister of Industry*.
[7] Ibid.

and Atlantic Canada. In some cases, prices rose more than 100 per cent.[8] As prices rose, volumes destined for export off the US Gulf Coast were pulled back into North American markets and record volumes made their way into Canada as imports.[9]

**Chart 3**

**Propane imports play important role in the Central and Atlantic Canada (kb/d)**




Source: The Conference Board of Canada; Statistics Canada, Table 25-10-0026-01 (formerly CANSIM 128-0012).

While the 2013-2014 was an extreme case, it does not explain sustained higher average rate of imports by Eastern Canada since 2015. (See Chart 3).

Analysis and assessment of data help identify several factors possibly contributing to elevated import rates. In no order of priority, they include:

- A reduction in supply from Atlantic provinces. Production in this region fell by 8 per cent annually from 6 kb/d in 2010 to a low of 4 kb/d by 2019. The decline may be due to lower gas processing in Nova Scotia and the shuttering of the Come-by-Chance oil refinery in Newfoundland.[10] These constraints forced an increase in propane-by-rail (PBR) shipments from Ontario and other US-based hubs which increased import volumes.
- Growing demand due to fuel switching from distillate oil and fuel oil.[11]
- Eastern Canadian retailers diversified suppliers over the last decade. Some retail distributors contracted annual supply with a wider range of wholesalers, looking

[8] Ibid.
[9] Milutinovic, Shelly, House of Commons Standing Committee on Natural Resources, "Evidence, December 9, 2014"
[10] CBC News, "North Atlantic oil refinery in Come By Chance could close permanently"
[11] Conference Board of Canada analysis.

beyond Sarnia and domestic refineries in response to recent and potential disruptive events, including both demand shocks and supply chain disruptions.[12]

- Weak hub prices following 2014, especially after the Cochin Pipeline reversal, added extra supply to North American markets. This contributed to a global decline in energy prices. As Edmonton spot prices for propane dipped into negative territory, a wider basis opened between hub prices in Sarnia, Ontario, and supply points accessible by rail like Conway, Kansas, and Edmonton, Alberta.

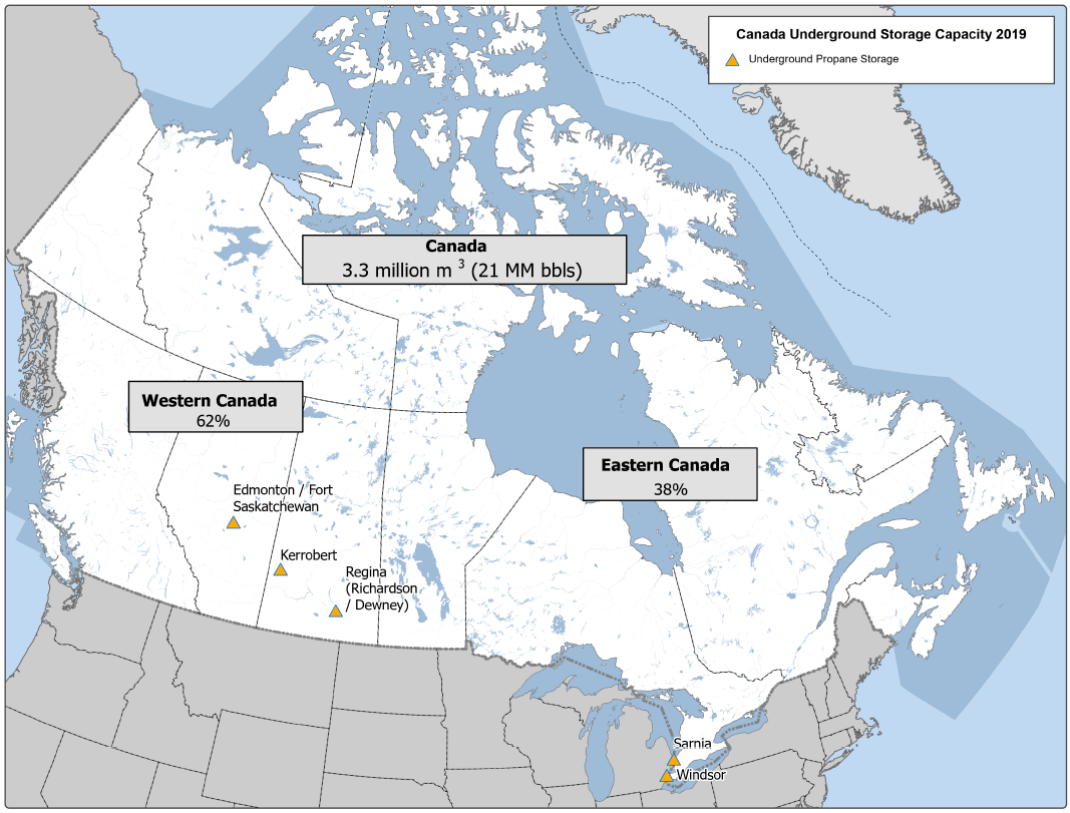
These factors help explain why imports rose as a share of total supply in the years since 2014 despite surging supplies of propane from Western Canada over the same period.

# Propane Storage

Propane demand is highest during Canada's cold winter months. Canadian farmers also rely on propane to dry crops during the fall of each year. These seasonal demands present logistical challenges. Producers are limited in their ability to increase propane production in response to seasonal price fluctuations.

**Figure 1**

**Underground Propane Storage in Canada (2019)**




Source: Canada Energy Regulator, "Market Snapshot: Where Are Canada's Propane Inventories for Winter Demand Stored?"

[12] Ibid.

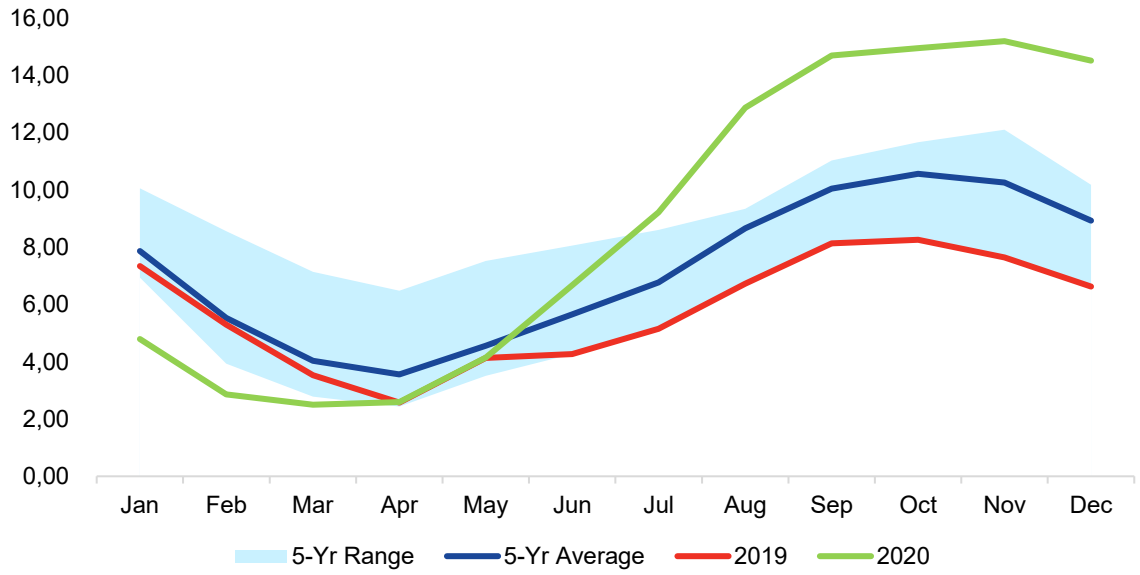
Propane is stored in bulk in large underground salt caverns. Canadian caverns have a total capacity of about 21 million barrels (MMbbl). Most is in Alberta (46 per cent), Ontario (38 per cent), and Saskatchewan (16 per cent).[13] Inventories fluctuate with seasonal demand. Stocks rising in April and continuing to grow through summer and early fall.

Peaking in October or November inventories then decline as harvest progresses and agricultural demand for crop drying drops off. Stocks recover slightly before the winter heating season begins, peaking again in January until inventories are drawn down as they meet heating demand across Canada and the US. (See Chart 4.)

The 2020 propane injection season (April to October) overlapped with the start of the COVID-19 pandemic. As a result, propane exports to major markets such as the US Midwest and Gulf Coast declined, and inventories increased. Low propane prices early in the season caused sellers to put propane into storage in the hopes of higher winter 2020/21 prices. This resulted in a build-up of propane stocks in Canada that reached a record high in October 2020 of 14.9 MMbbl, or roughly 70 per cent of the available storage. (See Chart 4.)

**Chart 4**

**Total Canadian underground propane inventories, 2015-2020 (MMbbl)**



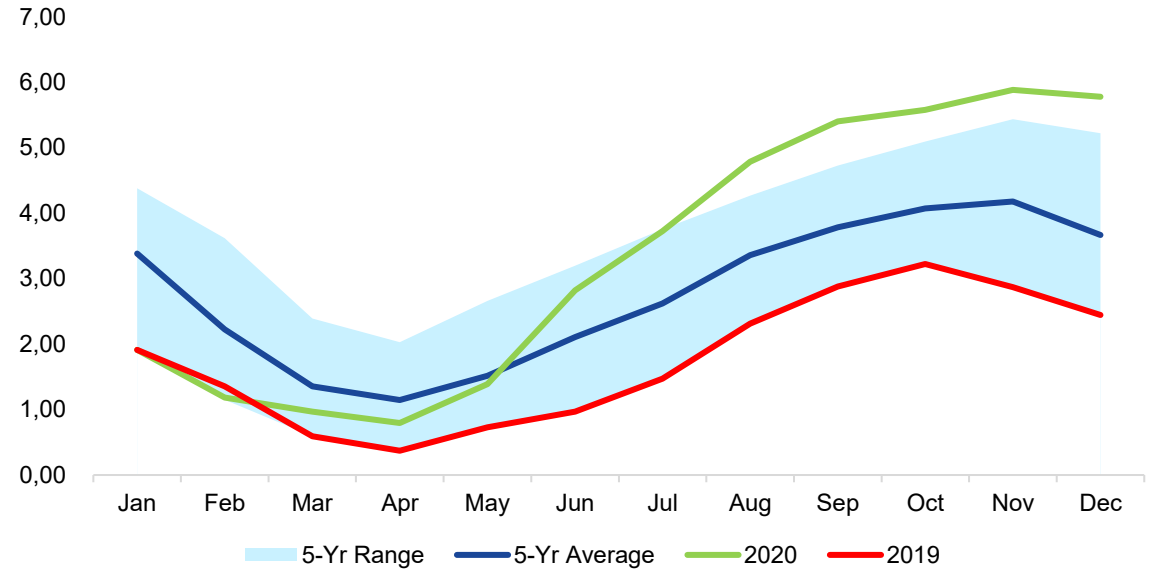

Source: Canada Energy Regulator; The Conference Board of Canada

Inventories in both Western Canada and Ontario were higher than levels reported in October 2019 when underground inventories were at their lowest levels in five years. (See Charts 5 and 6.)

[13] Canada Energy Regulator, "Market Snapshot: Where are Canada's propane inventories for winter demand stored?"

## Chart 5

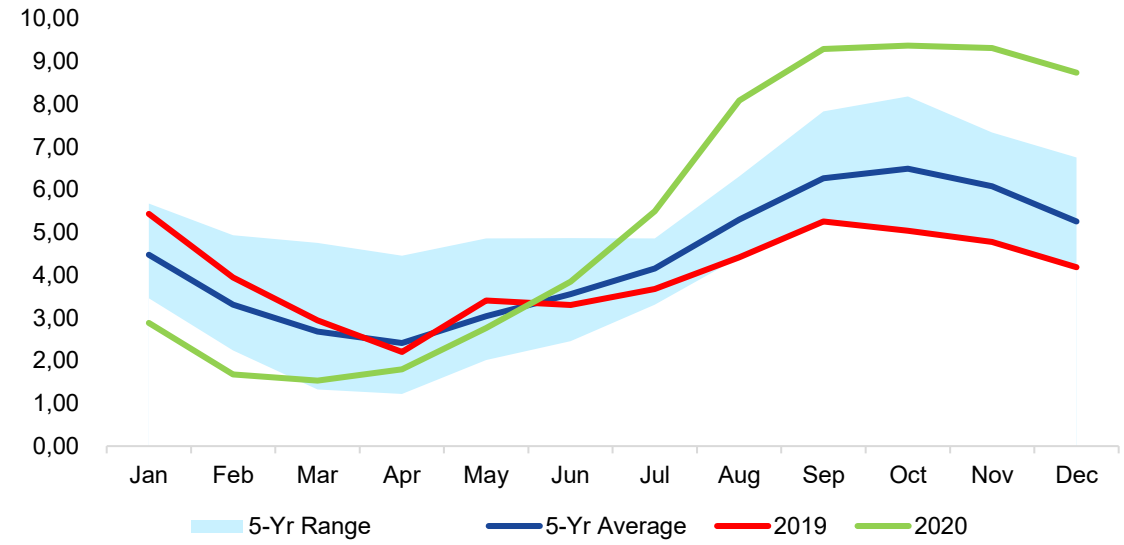
**Eastern Canadian underground propane inventories, 2015-2020 (MMbbl)**




Source: Canada Energy Regulator; The Conference Board of Canada

## Chart 6

**Western Canadian underground propane inventories, 2015-2020 (MMbbl)**




Source: Canada Energy Regulator; The Conference Board of Canada

# Total Supply

Propane supply reached 332 kb/d in 2019 growing by 5 per cent since 2010. Increasing domestic propane production from gas plants, refineries, and upgraders were the main drivers. (See Table 2.)

**Table 2**
**Canadian Propane Supply**
**(kb/d; per cent)**

| | 2010 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | Δ (10-Yr) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Chg. | CAGR |
| **Production** | 188 | 191 | 202 | 204 | 201 | 198 | 223 | 247 | 280 | 303 | 114 | 5% |
| Western Canada | 107 | 114 | 124 | 128 | 130 | 128 | 150 | 178 | 212 | 233 | 126 | 8% |
| Eastern Canada | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 0 | 0% |
| **Imports** | 2 | 2 | 3 | 6 | 8 | 6 | 7 | 7 | 6 | 5 | 3 | 9% |
| Western Canada | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | -1 | -12% |
| Eastern Canada | 1 | 1 | 1 | 5 | 7 | 5 | 6 | 7 | 6 | 4 | 4 | 22% |
| Supply Adjustments | 14 | 20 | 28 | 17 | 3 | 23 | 12 | 17 | 16 | 25 | 10 | 6% |
| **Total Supply** | **205** | **213** | **233** | **227** | **212** | **227** | **242** | **271** | **301** | **332** | **127** | 5% |

* supply adjustments include changes in inventories, inter-product transfers, and statistical adjustments
Sources: The Conference Board of Canada; CAPP, Statistical Handbook; Government of British Columbia, "Natural Gas & Oil Statistics"; Government of Saskatchewan, "Gas Plant Report", Statistics Canada, Table 25-10-0026-01 (formerly CANSIM 128-0012).

The COVID-19 pandemic has caused many disruptions. Domestically, Canada saw a decline in energy production and disposition in an already "dampened" energy sector.[14] In 2020 total propane supply in Canada declined an estimated 38 kb/d or 11 per cent from 2019 values. (See Table 2.)

# Supply Outlook (2020-2030)

From 2020 forward the COVID-related decline is expected to be offset by increased propane production. Supply is forecast to rise from 294 kb/d in 2020 to 387 kb/d by 2030, an increase of about 30 per cent. (See Chart 7.)

Liquids-rich natural gas production continues to be the main driver of NGL production growth in Canada. In addition, ongoing midstream infrastructure investments, like the expansion of the Empress Plant (completed in 2020) to add 30,000 b/d of propane-plus fractionation

[14] Refaei and others, *Economic Recovery Pathways for Canada's Energy Industry: Part 2 - Canadian Crude Oil and Natural Gas.*

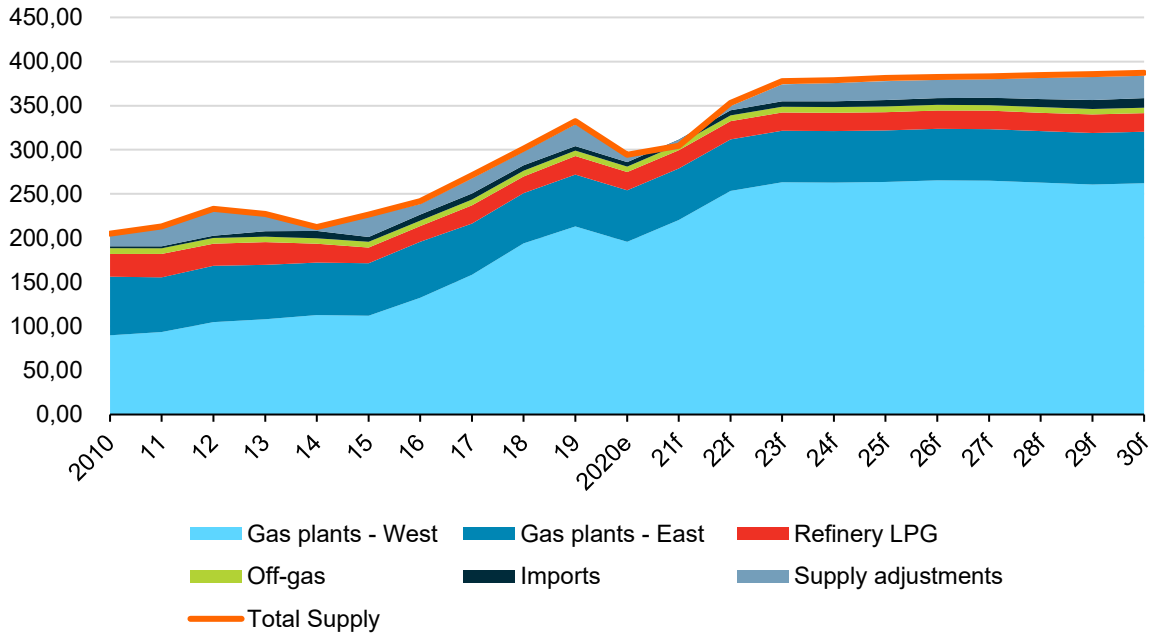
capacity to the company's Empress East NGL system, will likely prompt higher recovery of propane than the present.

After 2023 more than 90 per cent of the forecasted supply increase will be available to the market. Past 2030, the trajectory is essentially flat as demand and supply dynamics are driven by macroeconomic variables.

An important trend to monitor will be the shift from Alberta to BC as primary driver of supply growth over the outlook period. From 2024-2030 production in Alberta and Saskatchewan declines slightly, at rates of less than 2 per cent compound annual growth rate (CAGR). By contrast, total BC supply is forecast to expand by 4 per cent annually (see Chart 8).

**Chart 7**

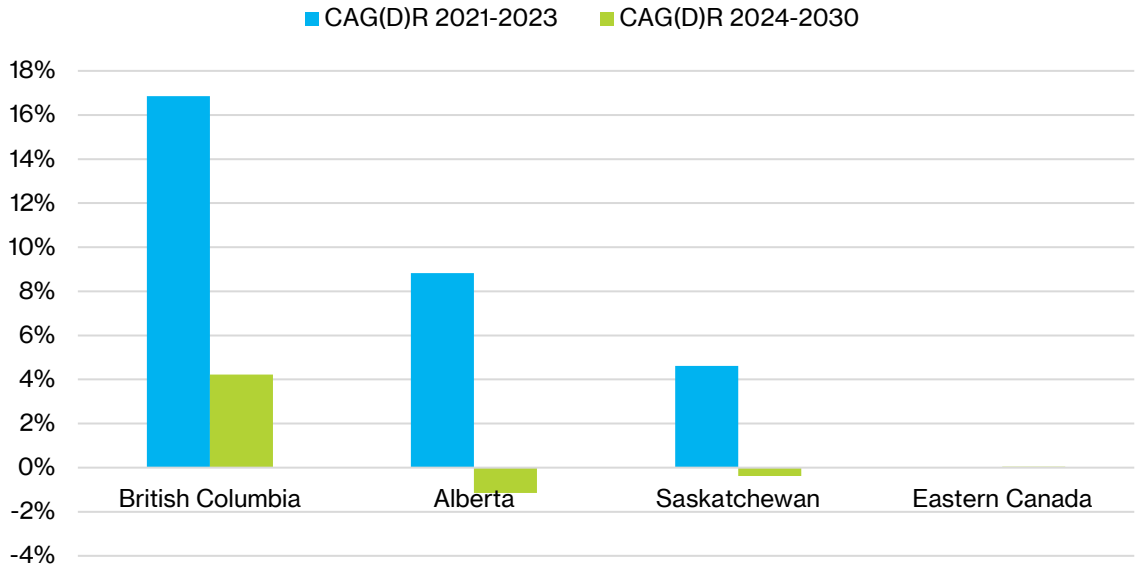
**Total Supply Outlook**
**(kb/d)**




Source: The Conference Board of Canada; CAPP, Statistical Handbook; Government of British Columbia, "Natural Gas & Oil Statistics"; Government of Saskatchewan, "Gas Plant Report", Statistics Canada, Table 25-10-0026-01 (formerly CANSIM 128-0012).

## Chart 8

**British Columbia an engine of production by 2024**
**(Short/ medium-term growth rates; kb/d)**




Source: The Conference Board of Canada; *Statistical Handbook*; Government of British Columbia, "Natural Gas & Oil Statistics"; Government of Saskatchewan, "Gas Plant Report"; Statistics Canada, Table 25-10-0026-01 (formerly CANSIM 128-0012)

# Disposition of Propane in Canada

## New in this report

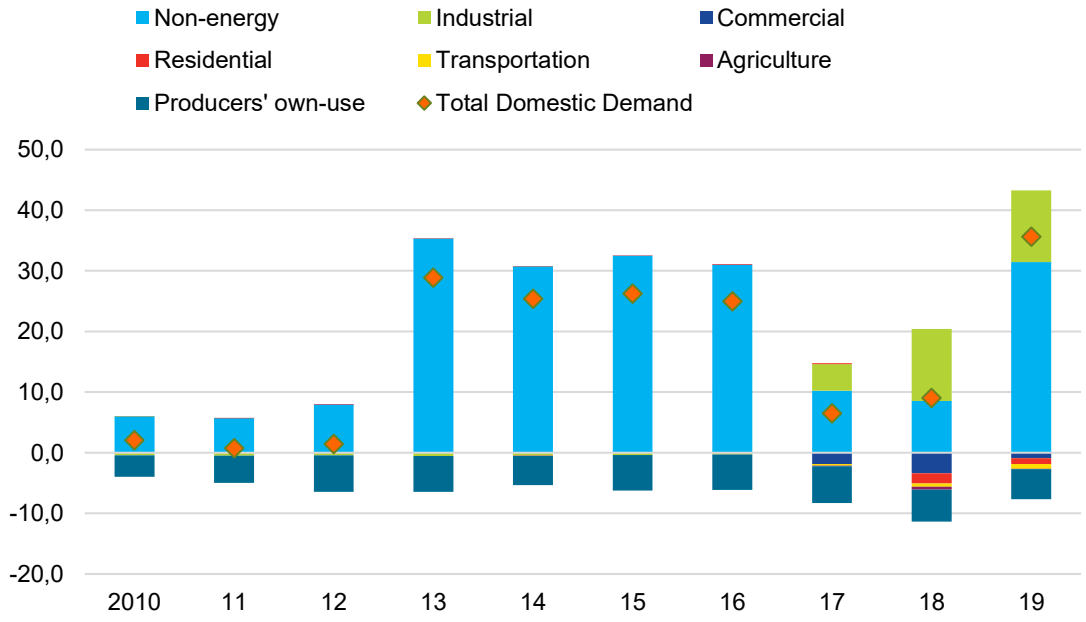
Disposition of propane in Canada is through seven economic sectors and through exports. Data is summarized by the wholesale and retail end-use segments and broken down between western, eastern, and overseas markets.

### Variances from previous forecast

Most significant is the growing share of Canada's overall propane supply used by exports and non-energy demand. Non-energy demand is an important theme in this report. Non-energy demand covers applications for propane that do not require combustion of propane as a fuel to produce secondary energy. Petrochemical manufacturing accounts for the largest share of non-energy demand, primarily for production of ethylene and propylene. Other examples include use as propellant in aerosol canisters, as a refrigerant, and as a solvent in a range of activities from food manufacturing to upstream oil and gas extraction.

**Chart 9**

**Variance from forecast: Propane disposition (kb/d)**




Source: The Conference Board of Canada

Exports grew by 8.3 per cent annually from 2010 to 2019. Non-energy demand increased by 6 per cent annually over the same period. That compares to an estimated average annual

decline in exports of 0.3 per cent in the 2006-2016 period of the previous report.[15] Non-energy demand grew faster over the decade 2010-2019 as well. These increases reflect significant adjustments and updates to Statistics Canada's data for non-energy demand in Ontario between 2013-2016 (see Chart 9).[16]

### Monitoring Trends

- Rapid growth in wholesale end-use segment and export demand is influencing long-term market dynamics.
- Crude oil producers are injecting increasing volumes of NGL and propane into unconventional oil sands deposits as solvent.

## Overview of Domestic Demand

In 2019, total domestic demand for propane was estimated at 146 kb/d, or 44 per cent of total propane supply (see Table 3). Propane demand increased over the 10-year period, growing at a compound annual growth rate of 3 per cent since 2010.

Growth in non-energy demand exceeded the previous forecast. Methodological and statistical adjustments are responsible for some historical variation; changes in the configuration of petrochemical plants in Ontario likely also contributed to the temporary rise in non-energy demand in Ontario between 2013-2017/18 (see Chart 19).[17] Anticipated growth in non-energy demand beyond 2020 is being driven by the petrochemical sector and upstream oil and gas sector in Alberta.

Industrial and non-energy demand sectors were two thirds of 2019 demand. Increase in non-energy results from propane being used in petrochemical processes such as ethylene and propylene manufacturing.[18] The increase in 2019 is not driven by new petrochemical projects that consume propane exclusively to produce polypropylene (PP), which are set to come online in early 2022. A smaller increase comes from the oil sands industry exploring solvent-based technologies to extract bitumen from in situ wells in Alberta.[19]

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[15] Murillo and others, *Fuelled Up*
[16] Statistics Canada, Table 25-10-0026-01
[17] See Nova Chemicals, *Second Quarter Earnings Report 2012; "*Update on Our Growth Projects: Manufacturing East." See also Oil and Gas Journal, "Nova nears 100% NGL feedstock conversion at Corunna ethylene plant"
[18] Note, the 2019 increase in non-energy demand is not the result of anticipated demand from Inter Pipeline's new PDH facility. No petrochemical facility is producing PP from a dedicated propane feedstock as of writing. Propane is consumed in small quantities by existing NOVA Chemicals ethylene-production facilities in Joffre, Alberta. See Murillo *Natural Gas Liquids (NGLs) in North America – An Update Part II*, p. 27; See also Nova Chemicals, "Joffre, AB, Canada"
[19] AER, ST3 – Supply and Disposition of Propane

**Table 3**
**Canadian Domestic Propane Demand**
**(kb/d; per cent)**

| | | | | | | | | | | | Δ (10-Yr) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2010** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | Chg. | CAGR |
| Industrial | 37 | 42 | 51 | 43 | 41 | 39 | 36 | 41 | 49 | 49 | 12 | 3% |
| Commercial | 25 | 27 | 31 | 26 | 25 | 24 | 26 | 25 | 23 | 26 | 1 | 0% |
| Residential | 11 | 12 | 14 | 11 | 10 | 10 | 12 | 12 | 10 | 11 | 0 | 0% |
| Non-energy Use | 25 | 30 | 40 | 54 | 40 | 42 | 42 | 22 | 20 | 43 | 18 | 6% |
| Transportation | 9 | 9 | 10 | 8 | 7 | 7 | 8 | 8 | 8 | 8 | -1 | -1% |
| Agriculture | 6 | 7 | 7 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 1 | 2% |
| Producers' Own-Use | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 2 | 1 | 17% |
| **Total Domestic Demand** | **113** | **127** | **153** | **148** | **129** | **129** | **132** | **115** | **118** | **146** | **33** | **3%** |
| Wholesale* | 62 | 72 | 91 | 97 | 82 | 81 | 79 | 63 | 70 | 94 | 31 | 4% |
| Retail | 50 | 55 | 62 | 51 | 48 | 48 | 53 | 52 | 48 | 52 | 2 | 0% |
| **By Region** | | | | | | | | | | | | |
| Alberta | 39 | 45 | 56 | 48 | 43 | 51 | 44 | 48 | 55 | 79 | 40 | 7.4% |
| Other Western Canada | 15 | 15 | 16 | 16 | 16 | 15 | 14 | 15 | 17 | 18 | 3 | 2.0% |
| **Western Canada** | **53** | **59** | **72** | **62** | **57** | **64** | **55** | **61** | **72** | **97** | **43** | **6.0%** |
| Ontario | 44 | 54 | 66 | 71 | 58 | 49 | 62 | 40 | 29 | 32 | -13 | -3.3% |
| Other Eastern Canada | 16 | 16 | 16 | 16 | 16 | 17 | 17 | 16 | 17 | 18 | 3 | 1.7% |
| **Eastern Canada** | **59** | **69** | **81** | **86** | **73** | **65** | **78** | **55** | **46** | **49** | **-10** | **-1.8%** |

CAGR = compound annual growth rate
*Industrial, non-energy, and producer own-use segments. Retail-level includes all other end-use segment Note: Totals may not be exact due to rounding.
Sources: The Conference Board of Canada; Statistics Canada, Table 25-10-0026-01 (formerly CANSIM 128-0012).

The commercial sector takes about 20 per cent of total demand, the remainder equally distributed between residential, agriculture and transportation sectors. The most common application for propane in these sectors is space heating. Significant changes from previous trends were not evident for these sectors.

## Technology Trend: solvent-based applications for propane in Canada

Pilot projects in Alberta are assessing the use of NGL-based solvents to reduce the energy intensity of in situ bitumen extraction.[20] Several variations are being looked but all share the idea that solvents introduced into subsurface deposits will reduce the bitumen viscosity and

[20] Umeozor, Zamzadeh and Millington, *In Situ Oilsands Technology Trends Study*.

improve in situ bitumen extraction performance.[21] Propane is one solvent under consideration.

Apart from extraction, other technologies such as Solvent Deashphalting (SDA) are also being explored. SDA plants treat and separate molecules within refinery residues in a process that produces deasphalted oil (DAO) product and pitch. These products are integrated into other refinery processes or fed into the production of higher-value commodities like asphalt.[22] SDA plants are considering propane for this process.[23]

Propane-as-solvent developments are driven by policy as much as technological and market reasons.[24] As climate regulation and carbon pricing mounts, there's rising pressure on upstream producers to reduce their energy and water-use intensity at unconventional oilsands projects. If propane is integrated into the upstream processes for unconventional crude oil and gas extraction, implications to long-term wholesale end-use demand in Alberta could be significant. Precisely what the impact on non-energy demand will be remains unknown.

## Exports

Canada relies on rail to get propane to domestic and export markets. After 2014 when the Cochin pipeline stopped shipping propane, rail's importance increased.[25] There are no pipelines moving consumer-grade propane out of Western Canada, so it is shipped by rail or truck to US and Eastern Canadian destinations.

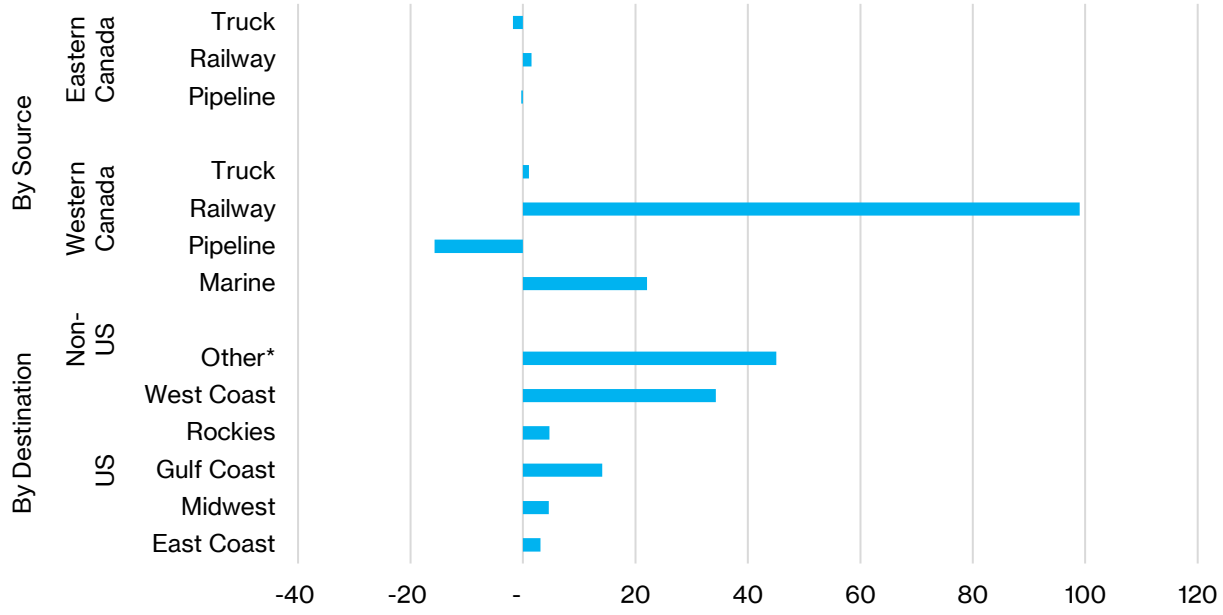
Sarnia has a fractionator and refineries producing propane. It also receives propane from the US and Western Canada by rail and pipeline. From Sarnia, propane is delivered by rail, truck, and pipeline to Eastern Canada and to export markets in the US, especially midwestern states.

Since May 2019 propane is also being railed to AltaGas' Ridley Island Propane Export Terminal (RIPET), in Prince Rupert, BC for export to overseas markets. In 2019, marine transport accounted for 12 per cent of the 187 Mb/d of Canadian propane exports, second only to rail (76 per cent), pipeline (7 per cent) and truck (5 per cent). (See Chart 10).

[21] Ibid.
[22] McDermott, "Solvent Deasphalting."
[23] Ibid.
[24] Ibid.
[25] Natural Resources Canada and Canada Energy Regulator *Final Report to the Minister of Natural Resources and the Minister of Industry*.

**Chart 10**

**Net Change in Propane Exports, 2010-19**
**(kb/d)**




Sources: The Conference Board of Canada; Canadian Energy Regulator, Commodity Tracking System—Natural Gas Liquids.

Prices for propane are higher in overseas markets than in existing export markets in the US. As more export capacity comes online on the West Coast, marine transport will play an even larger role relative to that of rail and trucks today.

# Total Disposition

Total disposition of propane grew over the last 10 years thanks to increasing domestic demand and increasing export volumes (see Table 4). In 2019, Western Canada disposed of 74 per cent of propane, Eastern Canada 26 per cent.

**Table 4**
**Total Canadian Propane Disposition**
**(kb/d)**

| | 2010 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | Δ (10-Yr) kb/d | Δ (10-Yr) CAGR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Domestic Demand | 113 | 127 | 153 | 148 | 129 | 129 | 132 | 115 | 118 | 146 | 33 | 3% |
| Exports | 81 | 81 | 99 | 100 | 90 | 112 | 115 | 138 | 152 | 187 | 106 | 9% |
| **Total Disposition** | **194** | **209** | **252** | **249** | **220** | **241** | **248** | **254** | **271** | **332** | **139** | **6%** |
| Western Canada | 97 | 106 | 126 | 116 | 109 | 136 | 142 | 162 | 183 | 247 | 150 | 10% |
| Eastern Canada | 97 | 103 | 126 | 133 | 111 | 105 | 106 | 91 | 87 | 86 | -11 | -1% |

CAGR = compound annual growth rate.
Note: totals may not be exact due to rounding.
Sources: The Conference Board of Canada; Statistics Canada, Table 25-10-0026-01 (formerly CANSIM 128-0012).

*Fuelled Up* forecasted non-energy demand to remain flat between 2017-2019 before increasing after 2020. With historical data now available, it shows non-energy demand is coming online much faster having expanded by 21 kb/d since 2017-2019.

This growth in non-energy demand is contributing to the shift from retail to wholesale end-use customers as a share of the overall disposition of propane among domestic sectors in Canada. Similarly, growth in exports from BC grew by around 18 per cent (CAGR) from 2010-2019, twice the rate estimated in the previous study.

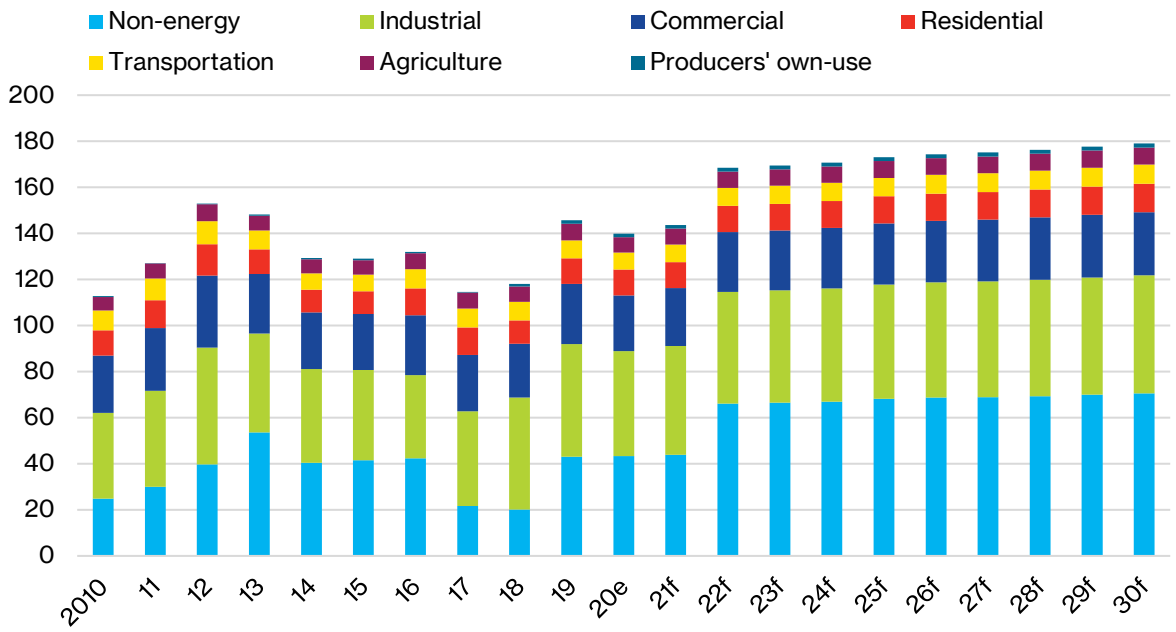
# Detailed Demand Outlook (2020-2030)

From 2020-2030 domestic propane demand is projected to mirror general economic and population growth for most end-use sectors. Total domestic demand is estimated to rise from 146 kb/d in 2019 to 179 kb/d in 2030, a 23 per cent increase (see Charts 11 and 12).

Western Canadian production coupled with location and price advantages will continue to increase domestic propane use in petrochemicals, oil sands, and West Coast exports.

## Chart 11

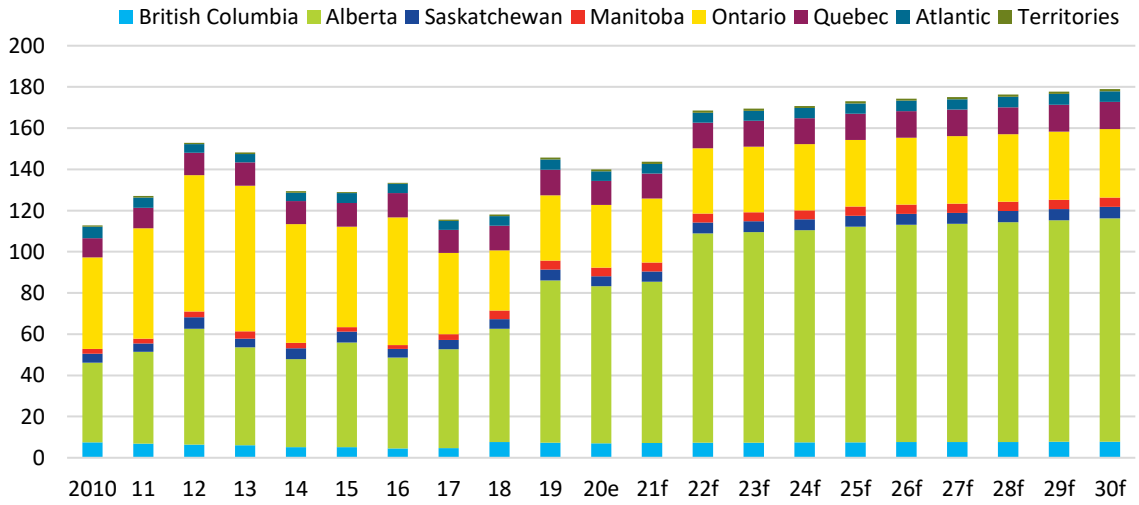
**Domestic Propane Demand Outlook, by sector**
**(kb/d)**




e = estimate; f = forecast
Source: The Conference Board of Canada

## Chart 12

**Domestic Propane Demand, by Province**
**(kb/d)**




e = estimate; f = forecast
Source: The Conference Board of Canada

Marine terminal capacity in BC will be a limiting factor in growing West Coast exports. Yet recent years have seen that capacity increase rapidly: expansions to RIPET doubled

capacity at the terminal to 80 kb/d in 2021. The terminal is exporting around 50 kb/d as of July 2021 and on target to increase further.[26] In addition, Pembina's Prince Rupert Terminal (PRT) commenced operation in April 2021. The forecast incorporates an additional 25 kb/d of export capacity to account for operations at PRT.

How will the rise in overseas exports and future growth in wholesale end-use demand driven by the petrochemical sector impact the commercial and logistical dynamics of Canada's propane supply chain? This remains unknown but is a key consideration for the propane industry.

As a growing share of supply is disposed towards overseas exports and domestic customers in the wholesale end-user segment propane demand in Canada will become, on average, less seasonal when compared to the sharply seasonal retail demand. This dynamic may generate unforeseen supply chain impacts and implications for the broader Canadian market.

The increasing size of wholesale end-use and overseas export (non-seasonal demand) demand would not have an impact on reliability. There remains ample production to service both wholesale offtakes and the stockpiling of propane in preparation for winter demand peaks. A shift to overseas exports and non-energy demand is not a serious concern for the reliability of the supply chain over the outlook period. There remains room for more slack to come out of the surplus propane supply around Edmonton.

Non-energy demand from petrochemical plants is not expected to compete for storage space with volumes required to maintain commercial, residential, and agricultural demand during harvest and the winter heating season. The outlook suggests that sufficient summer propane can be stockpiled to account for winter demand peaks and the trend towards wholesale and overseas export demand in Canada should not impact the overall reliability of the supply chain.

## Industrial Propane Demand Outlook

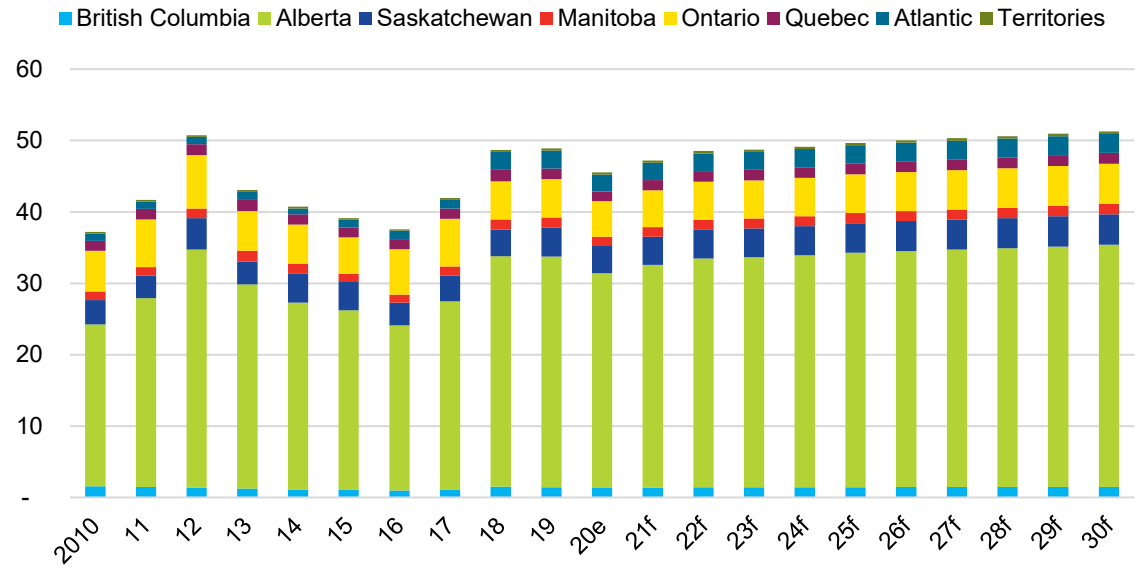
The industrial sector was the largest domestic user of propane in 2019. The oil and gas industry accounted for most of the sector's total use of propane, followed by mining, construction, and manufacturing.

Propane's high heating content is suited to many industrial processes requiring heat. Applications are varied and include metal manufacturing and manufacturing skim-milk powder. It's commonly employed for space heating applications like warehouses and at remote work camps. In addition to heating, facilities use propane to supply back-up power generation for critical infrastructure or remote installations not connected to the power grid. Forklifts and other specialized machinery also use propane for motive power.

[26] AltaGas Ltd., "Management's Discussion and Analysis, Q2 2021".

**Chart 13**

**Industrial Propane Demand Outlook, by province**
**(kb/d)**




e = estimate; f = forecast
Source: The Conference Board of Canada

The outlook for industrial demand has improved relative to the previous report. It is forecast to increase by a CAGR of 1.1 per cent over the outlook period, exceeding the prior forecast in 2025 by around 10 kb/d.

Looking to 2030, the industrial sector's share of total demand is projected to decrease from 34 per cent in 2019 to 29 cent in 2030. This is a relative decline, not an absolute one. Stronger growth in non-energy demand is forecast relative to industrial demand over the forecast horizon, resulting in the share of the total taken by the industrial segment declining over the same period.

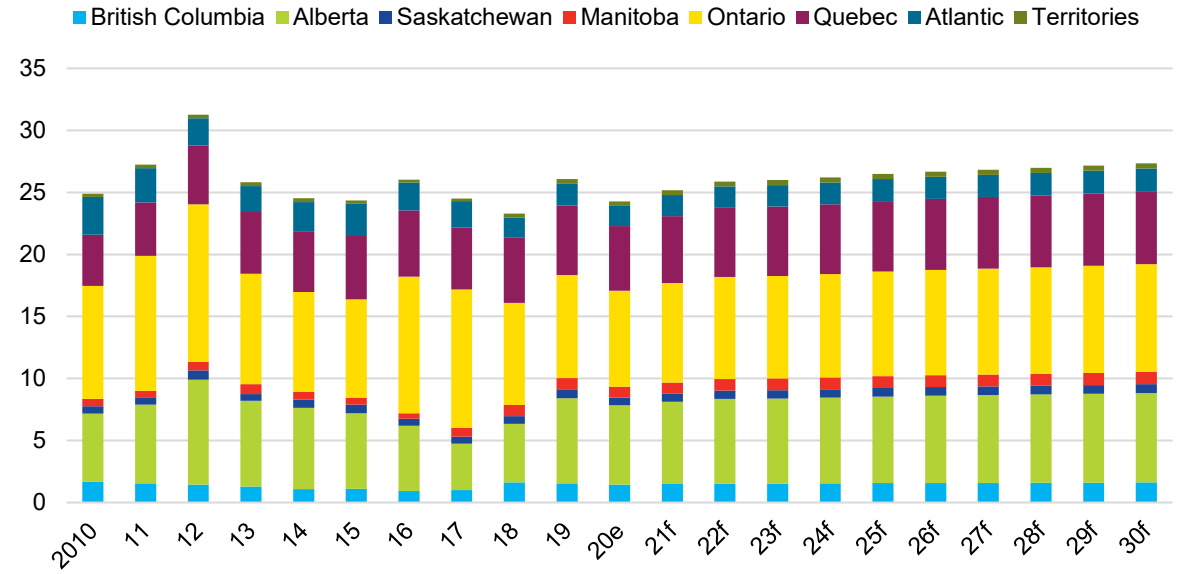
Depending on the stringency of policies like the Clean Fuel Standard (CFS) and the carbon price on greenhouse gas (GHG) emissions, some industrial demand for propane will shift to natural gas or electricity over the outlook. Where and at what rate this takes place remains dependent on location, incumbent fuel source, and available alternatives.

As environmental and regulatory policies push end-users to reduce energy intensity, however, a lower average emission intensity positions propane to displace some activities currently powered by more emission intensive fuels.

## Commercial Propane Demand Outlook

Propane is used in large urban centers and smaller communities. About 80 per cent of all demand comes from three provinces, Ontario, Quebec, and Alberta (see Chart 14).

**Chart 14**
**Commercial Propane Demand Outlook**
**(kb/d)**




e = estimate; f = forecast
Source: The Conference Board of Canada

Commercial consumers include wholesale and retail traders, warehouses, schools, hospitals, and office buildings. Commercial customers also account for the arts and entertainment sector, accommodation, and food services industries. These customers primarily use propane for space heating.

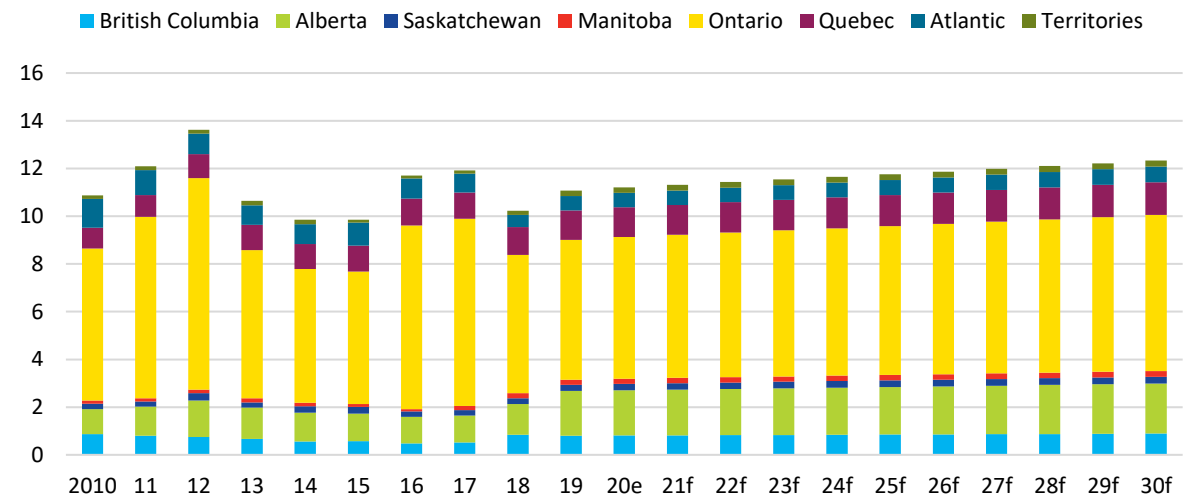
Over the outlook period this sector's demand is projected to remain flat. Various federal and national energy efficiency regulations related to improving building codes and energy use may limit demand growth (see Chart 14). This is consistent with the trajectory of the forecast in the previous report.

## Residential Propane Demand

Propane in the residential sector is primarily used for space and water heating. Ontario consumes 53 per cent and Alberta 20 per cent. Ontario's share of total residential propane demand fluctuated over the last decade rising as high as 66 per cent to as low as 56 per cent. The estimate for 2019 residential demand of 53 per cent was the lowest since 2010.

Again, this is not an absolute decline. Residential propane demand in Ontario rose from 2010-2019. The trend, however, suggests the composition of residential propane demand between provinces may be changing overtime. The overall volume of propane is forecast to grow slowly over the outlook period.

### Chart 15
**Residential Propane Demand (kb/d)**

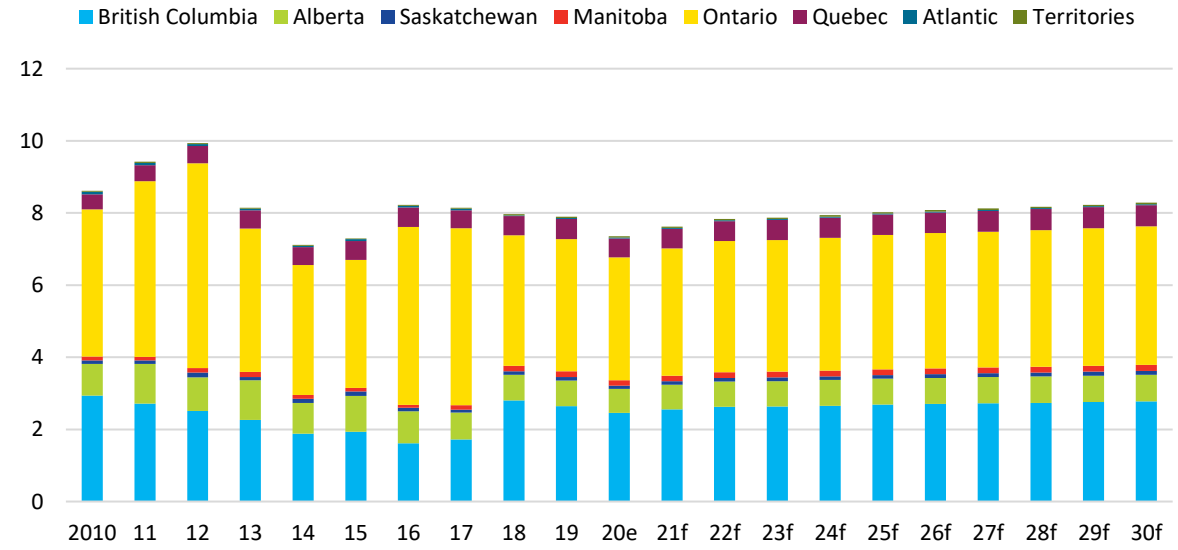



e = estimate; f = forecast  Source: The Conference Board of Canada

## Transportation Propane Demand

Automotive propane amounted to 0.4 per cent of transportation fuels used in Canada.[27] While road transportation is dominated by gasoline and diesel, propane is the third most used fuel in passenger and light duty cars and trucks.

### Chart 16
**Transportation Propane Demand (kb/d)**




e = estimate; f = forecast
Source: The Conference Board of Canada

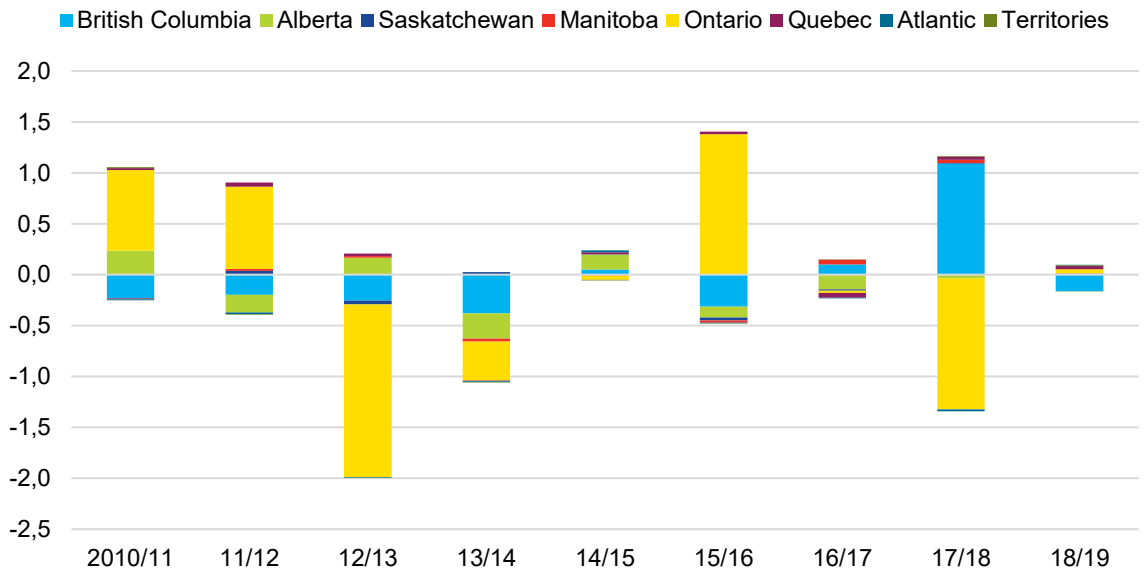
[27] Natural Resources Canada, Comprehensive Energy Use Database.

Propane has found purchase among fleet operators. School divisions, police departments, courier, and delivery companies have adopted propane partially in response to fuel standards impacting the use of diesel.

Canadians consumed 8.6 kb/d of auto-propane in 2010. The total declined to 7.9 kb/d by 2019, a 0.9 per cent compound annual decline over the decade (see Chart 16). The demand pattern over the last decade has been uneven, growth is fluctuating between positive and negative periods (see Chart 17). Over the outlook period, demand for auto-propane is projected to expand by 1.1 per cent annually to 2030 (see Chart 16).

**Chart 17**

**Transportation demand fluctuates over the decade.**
**(kb/d)**




Source: The Conference Board of Canada

The change observed for BC's transportation demand from 2017-2018 is significant. The increase is counter to the trend over the decade from 2007. Data for 2018 records a 67 per cent increase over the prior year compared to an average annual variation of 15 per cent in absolute terms (see Chart 17).

Statistics Canada has discontinued the Canadian Vehicle Survey. The previous report used that survey's data (2009) to extrapolate numbers for propane vehicles in different vehicle categories and by province. Estimating propane vehicles by category and province using this 12-year data is no longer valid and an up-to-date dataset would be required for accuracy.

## Clean energy policy and propane transportation demand

This analysis does not include an assessment of the impact of policies like the CFS on the future capital stock of vehicles in Canada. Wide-spread fuel switching to electricity and hydrogen in road transportation is not expected to have a great impact in this forecast

period. As alternative energy adoption increases beyond 2030, fossil fuel use is forecast to decline. The composition of fossil fuels still in use for transportation post 2030 remains unknown and speculative.

Auto-propane has lower emission intensities than gasoline and diesel, and LPG vehicles have a low pay-back period due to low fuel cost.[28] As operating costs for diesel vehicles rise, medium duty fleet operators will be incentivized to reduce costs by investing in lower emission vehicles. There is an opportunity for propane to displace diesel fuel for road freight transportation, a sector where diesel currently accounts for 66 per cent of total energy use in Canada.[29] Recent examples of this behavior include the conversion of around 140 school busses in Halifax to run on auto-propane.[30]

Seizing short- and medium-term opportunities will not be straight forward. Newly revised federal CFS policy identifies fuel switching to propane as one of the credit generation options under the Compliance Category 3 “End-use fuel switching in transportation”. However, the policy also states “this pathway on its own would not likely be sufficient to incentivize investment that supports measurable incremental natural gas/propane uptake in transportation.”[31] This guidance on the application and impact of the CFS is an important consideration. Fuel switching to auto-propane from gasoline or diesel will be highly dependent on federal and provincial policies to incentivize consumer behavior.[32]

## Agricultural Propane Outlook

Canada’s agricultural sector uses propane primarily as a source of heat and motive power. It’s used to power irrigation systems and on-farm generators, and heat livestock buildings, greenhouses, chicken coups, and other buildings.

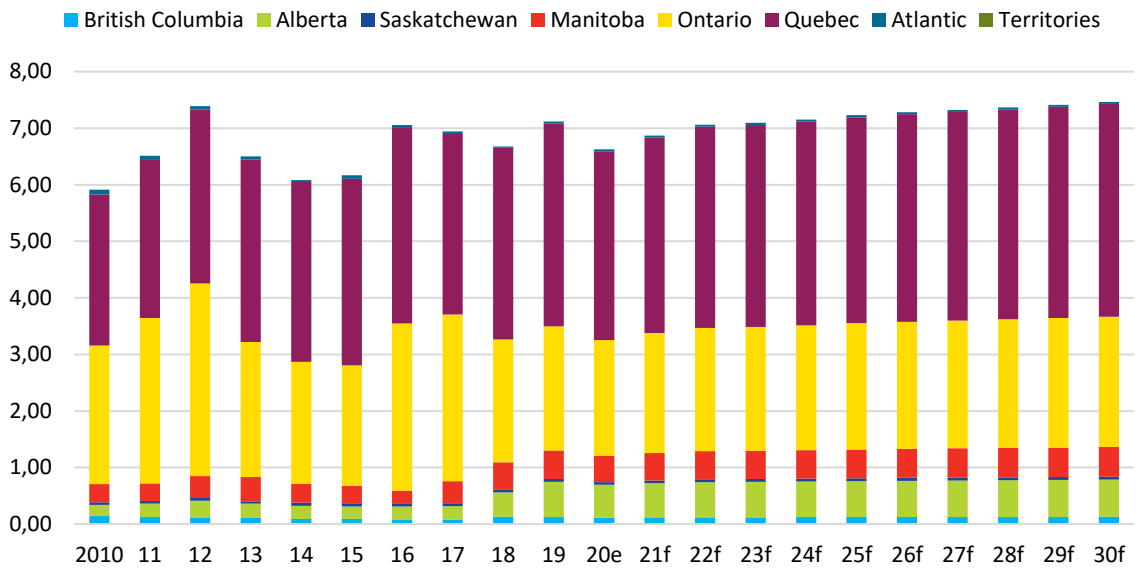
Farmers rely on propane to dry crops before being delivered to elevators for transit to market. Undried crops cause farmers financial loss due to penalties or, if left too wet for too long, product loss. While only accounting for 2.3 per cent of total agricultural demand propane has an outsized importance for farmers across the country. This is especially true in Quebec and Ontario where more propane is needed kilo-for-kilo, to dry the same volume of crop due to higher moisture conditions than Western Canada.[33]

Agriculture’s share of total propane demand was estimated at 5 per cent in 2019. Ontario and Quebec account for more than 80 per cent of total Canadian agricultural propane demand. Demand is forecast to expand at a compound annual rate of 1.1 per cent, 0.4 per cent higher than the forecast in the previous report (see Chart 18).

[28] The Conference Board of Canada; Canadian Propane Association, “Auto-Propane.”
[29] Natural Resources Canada, Comprehensive Energy Use Database.
[30] Canadian Propane Association, “Auto-Propane.”
[31] Canada Gazette, "Part I, Volume 154, Number 51: Clean Fuel Regulations."
[32] Ibid.
[33] Natural Resources Canada, Comprehensive Energy Use Database.; Interview feedback

**Chart 18**

**Agricultural Propane Demand Outlook, by province (kb/d)**




e = estimate; f = forecast
Source: The Conference Board of Canada

Growth rates and the composition of agricultural demand among provinces is similar to the previous report. Ontario and Quebec's share declined from 86 to 82 per cent of total demand from 2010-2019. Alberta and Manitoba accounted for most of the offsetting increase.

## Producer Consumption and Non-Energy Propane Demand

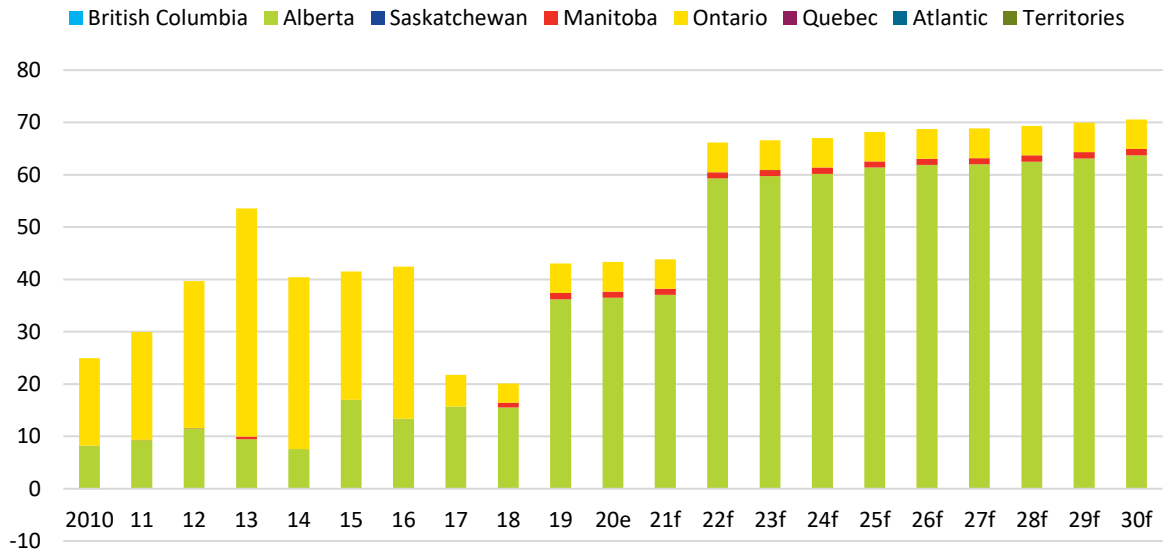
Traditionally propane consumed in the process of fractionating NGL mixes to produce specification products and the propane consumed at refineries to produce specification propane, are considered producer consumption. This is the smallest share of total propane demand. Over the forecast period, producer consumption is projected to remain flat.

Provincial investment into Alberta's petrochemical sector has the potential to increase the use of propane to make plastics. Inter Pipeline's Heartland Petrochemical Complex (HPC) is expected to commence production of PP from propane in the second quarter of 2022.[34] [35] This plant would consume 22 kb/d of propane annually and while the suspension Pembina and Kuwait Petrochemical Industries (KPI) planned PDH facility did reduce our estimate for non-energy demand over the outlook period, additional investments in the petrochemical

[34] AER, ST3: Supply and Disposition of Propane.
[35] Inter Pipeline, "Inter Pipeline issues Notice of Change recommending Brookfield offer and provides update o Heartland Petrochemical Complex."

industry in Alberta are under review by industry – expansion of the existing PDH/PP opportunities remains a distinct possibility over coming years. (see Chart 19).

**Chart 19**
**Non-Energy Propane Demand**
**(kb/d)**




e = estimate; f = forecast
Source: The Conference Board of Canada

Additional demand for propane is coming from the oil sands sector, specifically in situ technologies utilizing propane and/or butane as a solvent.[36] Solvent-aided extraction reduces the emission intensity of produced bitumen, therefore, demand for propane is projected to increase in line with sector's adoption of these technologies.

Growth in non-energy demand in updated historical data is the most significant development relative to the previous report. The expansion was not unanticipated. Updated data for the period 2017-2019 indicates an acceleration of the timeline set out in *Fuelled Up* and is not a deviation from that trend.

## Exports

Canada is expected to remain a net exporter. Traditionally, propane exports were directed to markets in the US. Since 2019 when propane started to be shipped to international markets in Asia, the distribution of export volumes started to shift between new and existing markets for Canadian propane.[37]

[36] Umeozor and others. *In Situ Oilsands Technology Trends*
[37] The US market has historically been the primary export market for Canadian propane. In recent years, a small volume of propane was exported through the United States to Mexico. The size of these shipments is increasing

The forecast projects propane exports to non-US destinations to increase. Currently there are two operating export terminals on the West Coast, RIPET and PRT. In addition, three new facilities and facility expansions are proposed and awaiting regulatory approval and (or) a final investment decision (FID):[38]

- Pembina is examining the opportunity to expand capacity at the PRT. The company confirmed that engineering work on an expansion project to increase capacity to 45 kb/d is "well advanced", however, the project is currently listed as deferred according to July 2021 filings by Pembina – FID is expected by the first quarter of 2022.[39] [40]
- Vopak Pacific Canada (VPC) is a bulk liquids storage terminal proposed by Royal Vopak. The project would add 40 kb/d storage and export capacity built in the vicinity of the RIPET and using the same rail infrastructure. LPG could be stored and exported at this facility.[41]
- Finally, Pacific Traverse Energy (PTE) has submitted a proposal to build a LPG export terminal with a design capacity of 46 kb/d constructed near Kitimat, BC.[42] This project is currently under review by the proponent.[43] The project design includes a new rail terminal for offloading LPG connected to a 15 km pipeline which extends to the export terminal. In a first for the Canadian supply chain, PTE is plans to utilize a Floating Storage and Offloading Vessel (FSO) to facilitate loading to the transport vessel.[44]

If all projects receive regulatory approvals and a positive FID, the incremental export capacity for propane on the West Coast could rise by around 130 kb/d.[45]

As more export terminal capacity comes online the destination for exports is shifting away from the US and toward new overseas markets. Based on the projects with regulatory approvals and an FID in place, overseas exports will account for 25 per cent of the overall export market over the outlook period compared to virtually zero as of January 2018 (see Chart 20).[46]

in recent years however the total trade remains small compared to the increasing export volumes to overseas markets. Mexico-Canada exports of propane-by-rail are not a subject of the analysis in this report.

[38] "Market Snapshot: New Propane Export Terminal in British Columbia Allows Canadian Propane Direct Access to Asian Markets."

[39] Pembina Pipeline Corporation, "Management's Discussion and Analysis, Q2 2021".

[40] Pembina Pipeline Corporation, "Pembina Highlights Growing Momentum with Business Update and Extensive Opportunity Portfolio"

[41] Royal Vopak, "Vopak Pacific Canada".

[42] Pacific Traverse Energy, "Northwestern BC Kitimat LPG Export Project".

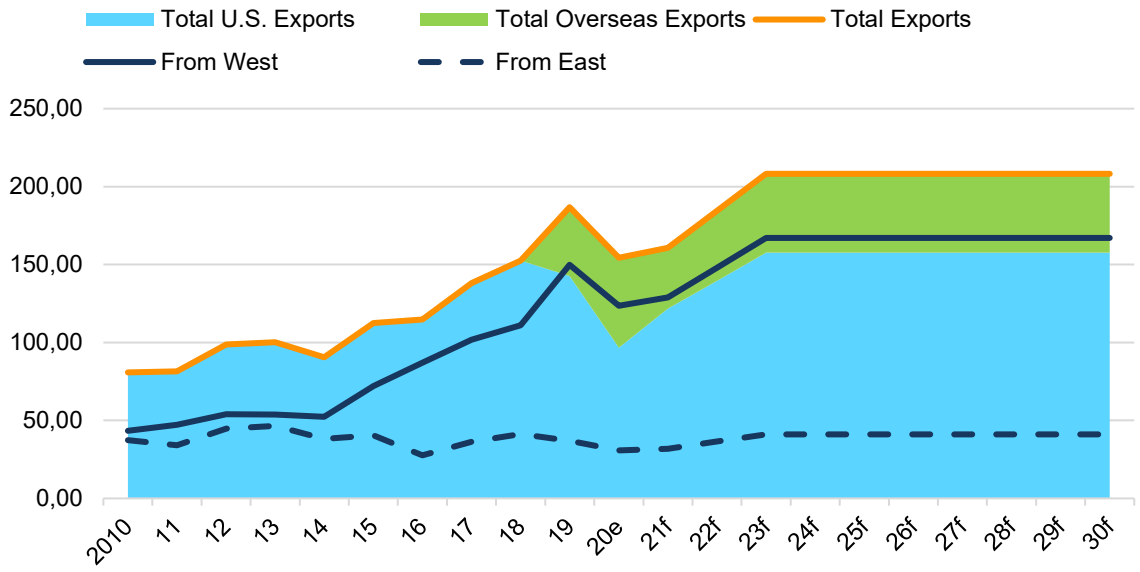
[43] Lubberts, "PTE propane project put on hold".

[44] Pacific Traverse Energy. 2021. Northwestern BC Kitimat LPG Export Project.

[45] Based on design capacities for VPC, PTE-Kitimat, and the expansion of Pembina's PRT.

[46] Canada Energy Regulator. Commodity Statistics, Natural Gas Liquids

**Chart 20**
**Canadian Propane Exports, by Regional Source and Destination (kb/d)**




e = estimate; f = forecast
Source: The Conference Board of Canada

# Total Demand

Canadian propane demand is expected to increase considerably over the outlook—growing by 55 kb/d by 2030 — relative to 2019 levels (see Chart 21).

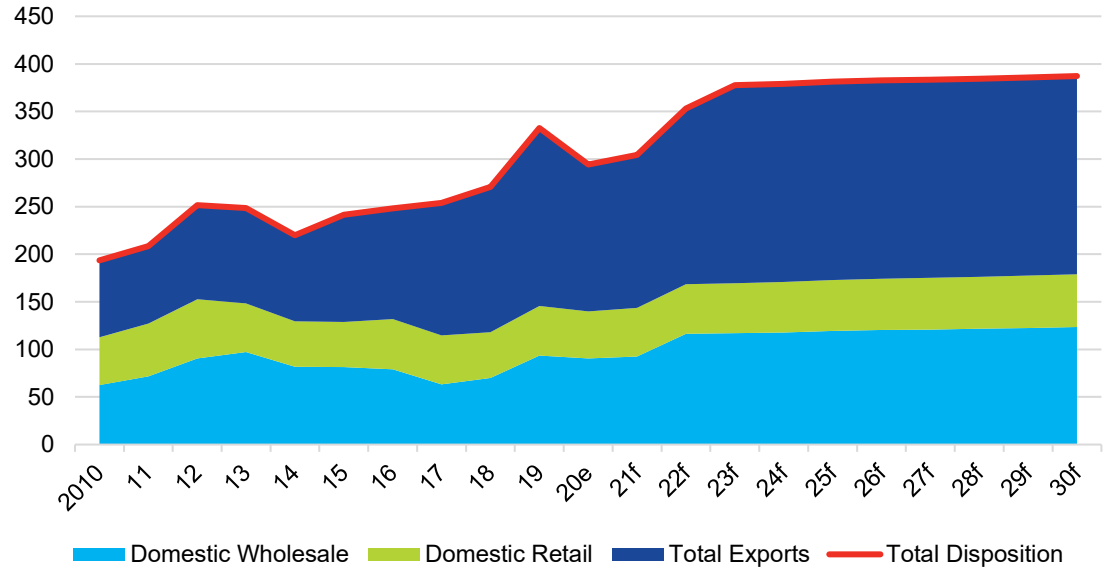
Domestic demand and exports will account for nearly equal shares of total propane disposition by 2030. As domestic demand is projected to increase due to petrochemical and oil sands sector developments, the completion of LPG terminals in BC will ensure exports to overseas markets grow and play a more significant role in the outlook.

Non-energy demand will eclipse the share of domestic industrial demand for propane sooner than anticipated in the previous report. *Fuelled Up* estimated non-energy demand to exceed industrial demand after 2023. Updated data for 2017-2019 indicates non-energy demand will now surpass industrial demand as the largest category by 2022. That year non-energy applications will account for 39 per cent of total demand, compared to 29 per cent for industrial demand (see Chart 21).

Exports are also growing rapidly, shifting away from the US towards overseas demand. From virtually zero shipments in April 2019, marine terminals are expected to export 25 per cent of total exports forecast for that year. This is a substantial shift in the composition Canada's external market for propane. This share will expand as the capacity of West Coast marine export terminals increases, provided there is midstream capacity to carry propane to the coast.

## Chart 21

**Total Canadian Disposition by domestic end use and export destination (kb/d)**

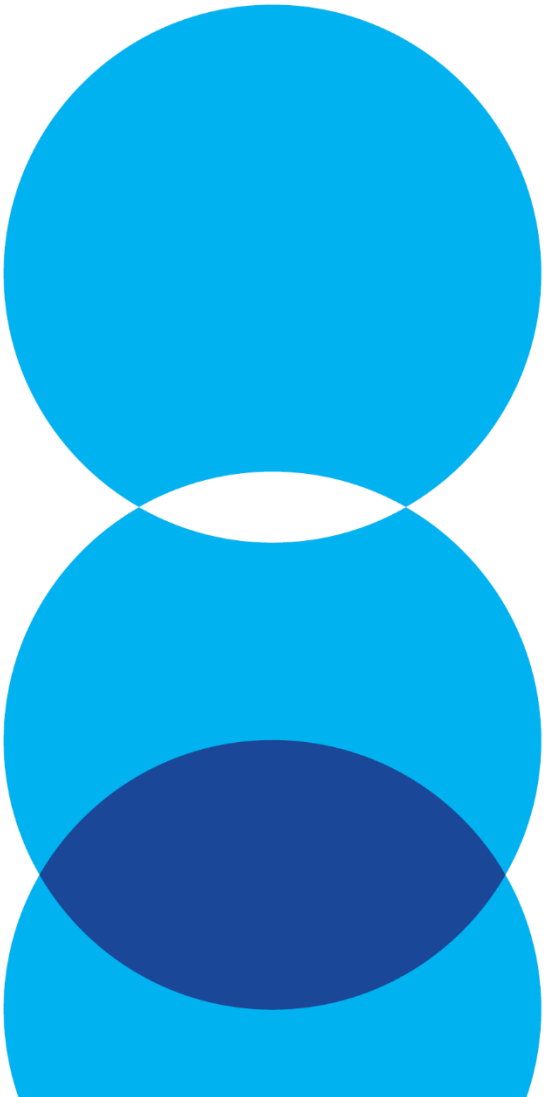



e = estimate; f = forecast
Source: The Conference Board of Canada

Demand for propane in the energy-use segment continues to grow across industrial, commercial, agriculture and transportation sectors at a compound annual rate just over 1 per cent from 2020-2030. Residential demand is expected to grow at just under one per cent growth annual over the same period. This reflects slower growth, between 0.1 and 0.2 per cent, for each of these demand sectors compared to the previous forecast in *Fuelled Up*.

Section 2

# Propane Pricing and Market Dynamics in Canada



# Prices and the Propane Supply Chain in Canada

Propane prices vary between different regions of the country, times of the year and level of the supply chain. The cost of propane at any point along the supply chain reflects product cost plus margin for the seller. When the price of fuel in one market falls above or below the price in another over time, the differential reflects an imbalance, an arbitrage opportunity for the owners of propane in the surplus market to sell fuel at a higher price into the – so long as they can secure the midstream transportation in time and at the right price.

This price-as-signal dynamic is at play in each of the major trends identified in Section 1 of this report: exports to overseas markets are surging because high propane prices in Asia and low propane prices in Edmonton signalled to midstream investors that there was a significant opportunity building to move propane from Edmonton to the West Coast. Similarly, low prices for propane in Edmonton signalled to the Government of Alberta and to private industry the opportunity to take low-cost, surplus propane in Edmonton and convert it into high-value PP plastic by backing the construction of PDH facilities..

In short, prices and supply chain dynamics are intricately linked. Market dynamics shape the supply chain infrastructure just as emerging market opportunities along the supply chain, send signals back to the market over time.

This section is not an in-depth discussion on pricing. Pricing and pricing mechanisms are not within the public realm. This was to be expected. The contractual environment that “prices” the supply chain limits releasing details. Therefore, this section aims to provide an overview only of the complexity and challenges pricing can exert on the propane supply chain.

## Propane prices

Propane prices vary depending upon whether fuel is purchased from production plant terminal hubs, a wholesaler, or a retail distributor. The price paid at any level of the market reflects the accumulated cost and profit of the propane supply chain. Propane prices are typically determined using a cost-plus model that sets the price for fuel equal to the cost of the product, plus cost of transportation and storage, plus the margin taken by the seller.[47]

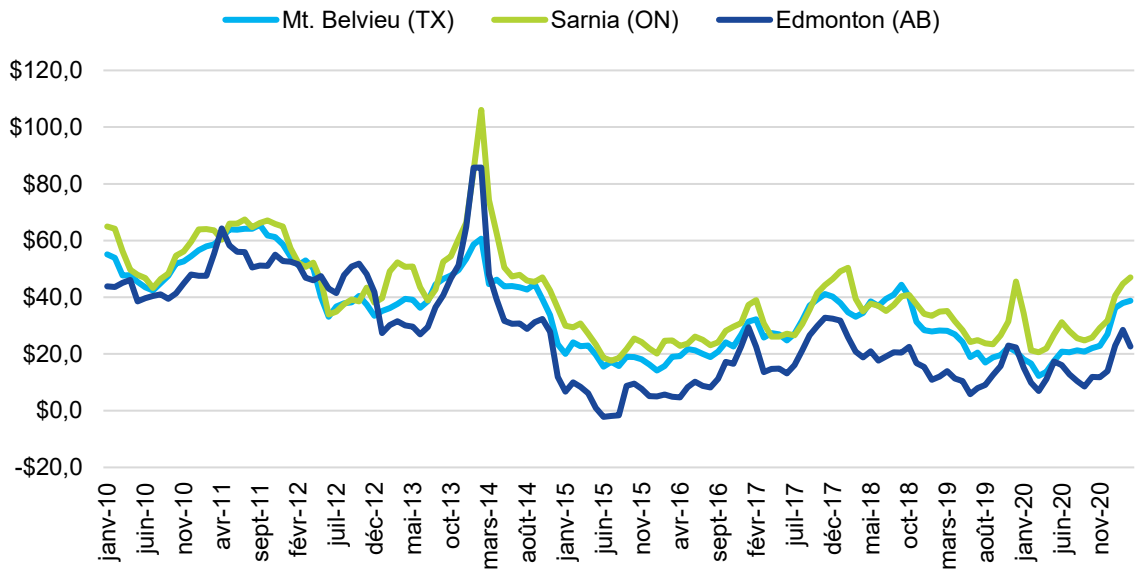
### Spot Prices

The spot price is the basic unit of the cost-plus model for propane in North America. Spot prices reflect the upstream cost of extracting NGL and crude, midstream transportation costs, and the cost of producing the propane via fractionation or refinery processing. The

[47] OPIS, Glossary Terms, “Cost-plus”.

‘spot’ aspect of a spot price indicates the price quoted is current, i.e. the price you would pay if you purchased propane directly from the terminal at a production plant and took possession immediately.

**Chart 22**
**Select Spot Prices for North American Propane**
**(C$ per bbl)**




Source: Energy Information Administration “Mont Belvieu, TX Spot Price”; Sproule “Escalated forecast March 2021; New Brunswick Energy and Utilities Board “Past Petroleum Prices”; The Conference Board of Canada

Propane spot prices are set on the integrated North American energy market and respond dynamically to domestic and external factors. Spot propane is priced at four major hubs in North America: Mont Belvieu, Texas; Conway, Kansas; Edmonton, Alberta and Sarnia, Ontario. Mont Belvieu is generally taken as the North American reference price.[48] Spot prices track each other throughout the year, fluctuating up and down in line with seasonal demand and external demand shocks (see Chart 22).

All things being equal, the greater the supply relative to accessible demand in a regional market, the lower the hub price in that region. From these initial conditions arise the average spread or basis between one market hub and another. The basis between the spot price at one production hub and another will tend to persist to the extent underlying conditions remain the same i.e. there are no major changes in the overall level of production, local demand and the external market demand accessible through midstream infrastructure. Hub prices adjust relative to each other as demand increases or decreases, as supply patterns change, or supply chain infrastructure adds or subtracts accessible demand to different markets via midstream transportation links.

[48] Canada Energy Regulator, *Propane Market Review: 2016 Update*.

This dynamic is on display in Chart 21, especially during 2014-2015. Production of natural gas and crude oil surged in this period pushing up supply relative to accessible demand from Edmonton. Already dealing with a lack of pipeline egress capacity, the Cochin Pipeline reversal exacerbated the already constrained transportation infrastructure for propane. Production mounted, storage filled, and by June 2015, Edmonton's abundant propane supply led to prices dropping into negative territory. Lacking additional storage capacity, producers paid customers to take product off their hands.

## Wholesale Prices

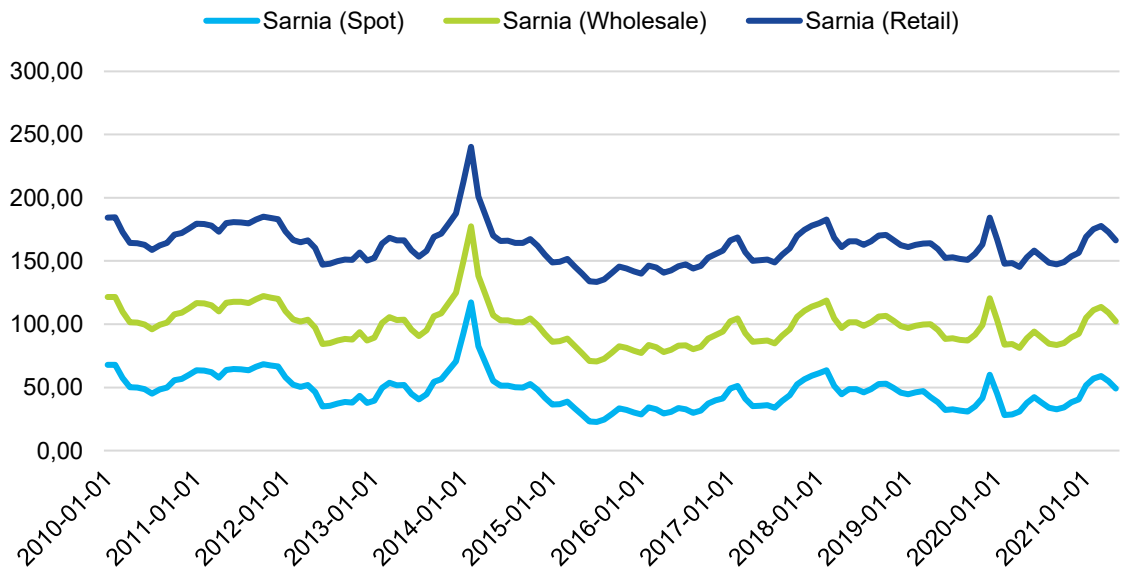
Wholesale prices reflect the cost of the product (the spot price offered at a terminal), the cost of transporting the product from storage or production terminals, and the wholesale margin. Wholesalers purchase propane in advance of a heating season, contracting with suppliers and transporters to secure the necessary volumes at the right time of the year to meet the demand of their customers.

The prices agreed in supply contracts at the wholesale level are not subject to systematic analysis since they are private transactions and part of commercial strategies.

Local competition for space heating, transportation, and other energy use demand impacts wholesale prices in a market as well as supply-side factors. The price of crude oil, for example, is a key factor in determining the local price at which propane must compete against fuel oil to supply heating and motive power for farms, hospitals, factories, and schools.[49]

### Chart 22

**Propane prices 'stack' under the cost-plus model (C$/bbl)**




Source: New Brunswick Energy and Utilities Board "Past Petroleum Prices"; The Conference Board of Canada

[49] Canada Propane Association, "Propane Prices"

The wholesale price varies depending on a set of factors besides the spot price, among them the size of the contracted volume, customer relationships, risk mitigation, etc. However, transportation is usually the most significant variable cost included in wholesale prices.

Wholesale price dynamics around Sarnia are of key interest for Canada's propane market. The Sarnia spot price is a benchmark against which wholesalers in Ontario, Quebec, and Atlantic Canada measure the relative value of sourcing propane from more distant supply points such as Conway, Kansas or Edmonton, Alberta. When Sarnia-based wholesale costs exceed the sum of another hub's posted spot price and transportation costs, an opportunity exists to source propane more cheaply than from the terminal in Sarnia, Ontario.[50]

### Retail Prices

Retail prices reflect the cost of fuel at the wholesale cost plus the retailer's margin and any applicable taxes (see Chart 22). The retail price of propane is set on a contractual basis between the retailer and customer. The details of these contracts are private and not open to systematic evaluation.

## Propane Pricing and Storage Dynamics

Storage is critical for Canada's propane supply chain because it allows the industry to stockpile product during the summer when demand and price are lower. Storage is used to smooth the availability of propane between low-demand summers and high-demand winters.

In theory seasonal demand could be balanced by expanding production. The challenge, and what makes storage crucial to the supply chain, is that propane production does not respond to seasonal fluctuations in heating or agricultural market demand. Rather, propane production is linked to natural gas production which is not sensitive to propane demand over the short term.

A second reason storage is valuable is that having access to storage capacity provides propane owners with an opportunity to maximize value by timing sales to take advantage of price differences between markets.

Underground storage hubs tend to cluster around production hubs and midstream transport nodes to ensure they can maximize the potential for arbitrage by positioning their storage at a terminus between energy markets. Storage facilities in Saskatchewan are positioned along Enbridge's mainline system access, connecting the stored fuel to several potential end-markets across Canada and the US.

[50] U.S. Energy Information Administration, "Propane Market Fundamentals."

# Contracting Propane Supplies

## General

Contracts are important commercial and legal instruments used to secure supplies in advance of a season. They ensure enough propane can be sold throughout the year to maintain production levels along the supply chain.

During disruptions and unexpected events impacting supply, contracts protect parties to a transaction by outlining contingencies in the event of non-performance. Force majeure clauses address a range of scenarios that may impact the ability of either party to perform obligations. Events contemplated by existing force majeure language include pandemics, labor action, adverse weather, physical attack, and blockades.

## Producers

Producers balance many variables when making commercial decisions about how to contract future purchases. Decisions are informed by commercial strategy, experience, market information, and a host of other considerations specific to the individual, the firm, the market, etc. A top of mind concern all producers share is managing throughput: making sure enough product is going out to balance what is coming in.

Producers may structure contracts to incent more efficient behaviour from their customers. For example, adding a performance incentive for customers that take 100 per cent of volumes on the specified date, or applying a discount to secure a larger volume sale. There are variations and this aspect of the commercial supply chain is subject to firm-level goals, capacity, and strategy.

Cost is specific to the contract and a range of factors impact the price agreed, however, the producer's cost is the base value around which the contract price will gravitate.

Contracting sales in advance of production helps producers manage risk in the event of adverse movements in price over the year or a sudden change in demand. Not all production is secured by future contract. Uncontracted propane is traded on a spot market.

Maintaining a portion of annual production on the spot market can be beneficial for producers. This strategy allows a producer (or their marketing agent) to take advantage of short-term fluctuations in spot price between markets. If an opportunity to earn a higher margin emerges in the short term, perhaps due to a derailment or a blockade, a producer with uncontracted volumes at their disposal can sell into the higher priced market for a value greater than if the volume had been contracted for sale a year in advance.

The resilience of the propane supply chain during a disruption is directly impacted by the commercial arrangements that structure ownership of propane produced throughout the year. Resilience is also impacted by how much information is known among market participants and by public authorities. When a disruption physically obstructs the supply chain, particularly along a critical rail line, time is the limiting factor in averting serious

impacts on customers. That faster potential buyers can be connected to parties with an existing contract, the faster new contracts can be arranged, and ownership transfer and supplies can be redirected to the disrupted region.

### Wholesalers

Wholesale companies buy propane in bulk from producers. Wholesalers arrange contracts covering a year of anticipated demand and may contract with one or a wide range of suppliers depending on the level of competition and suppliers available. The primary customer base for wholesalers is the network of retailers that purchase fuel supply from wholesale providers. Larger wholesalers may operate both marketing and retail arms.

Wholesale contracts are based on forecasted demand for the current season (April-March) and wholesalers typically base that value on a three-year historical average of customer demand.

Wholesale companies may tailor contractual terms to further specific ends, for example, reducing the price paid by a retail distributor to reflect a longer-term commitment, a larger offtake, agreement to invest in propane tanks at the site of end-use, etc.

### Retail Distributors

Retail distributors have similar incentives as wholesalers when negotiating fuel supply agreements but in general the retail cost is higher, reflecting the wholesale margin and transport costs. Retailers will be in the best position when they are in a market with more than one wholesale supplier. Beyond that, reliable offtakes, large volumes under contract and other characteristics that reduce the wholesaler’s risk or costs can be leveraged in contracting fuel supplies.

Section 3

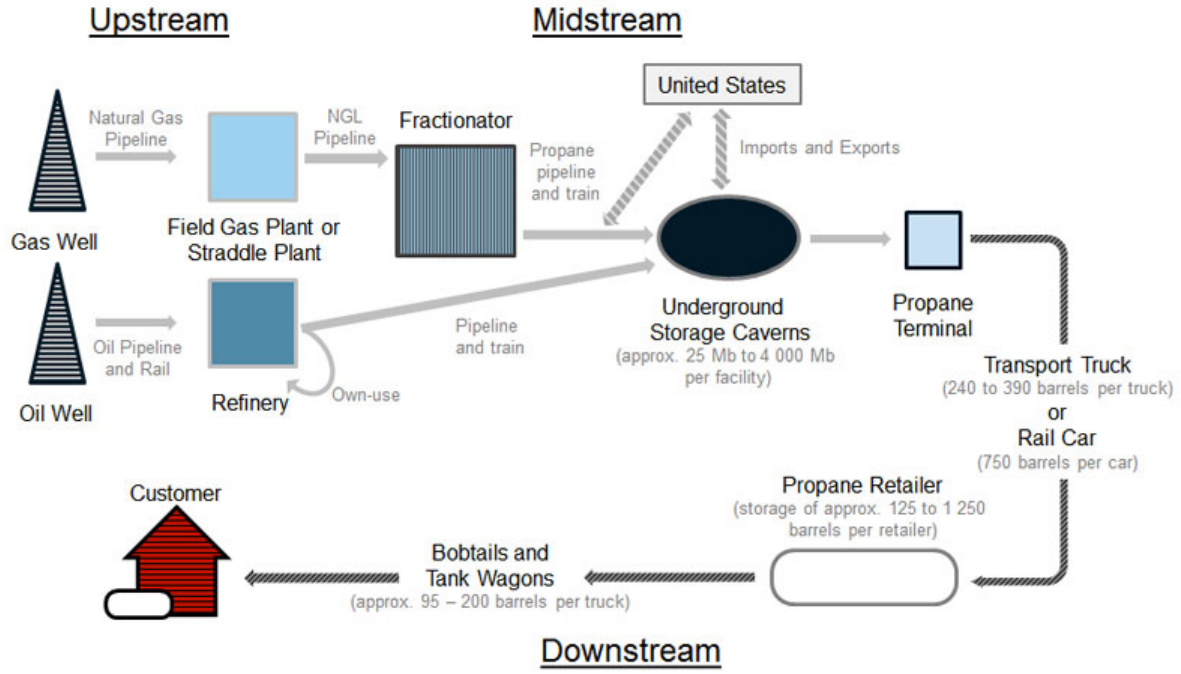
# Supply Chain Infrastructure for Propane in Canada

# Introduction

Canada's propane supply chain extends across the continent weaving its way through Canada and the US. It is part of an integrated energy market built up over many decades in North America. Distance and integration are two features that define the propane market in Canada, both have had tangible effects on how the propane supply chain has developed into the complex just-in-time operation we have today.

**Figure 2**

**Canada's Propane Supply Chain at a High Level**




Source: Canada Energy Regulator and Natural Resources Canada (2014)

"Just-in-time" is a term not used lightly. The phrase reflects the infrastructure and data collection related to the distribution and inventory of downstream supply terminals in Eastern Canada.

Aboveground tanks at wholesale and retail terminals are not storage assets, as such, and only maintain a limited inventory that must be regularly replenished through rail or truck resupply. The Conference Board's analysis of downstream terminal infrastructure in Eastern Canada found that aboveground inventory tanks hold, when full, the equivalent just over five days of average annual demand in Eastern Canada[51] This does not account for other inventories including the volume of fuel moving in railcars and trucks, as well as the 'tertiary' reserve made up of fuel sitting in customers tanks at any one time.

[51] This is an approximate figure based on our estimate for aggregate inventories in Eastern Canada compared to the annual average demand for Eastern Canada. The Conference Board found average annual demand of 49 kb/d in Eastern Canada compared to terminal inventories of 251,643 barrels.

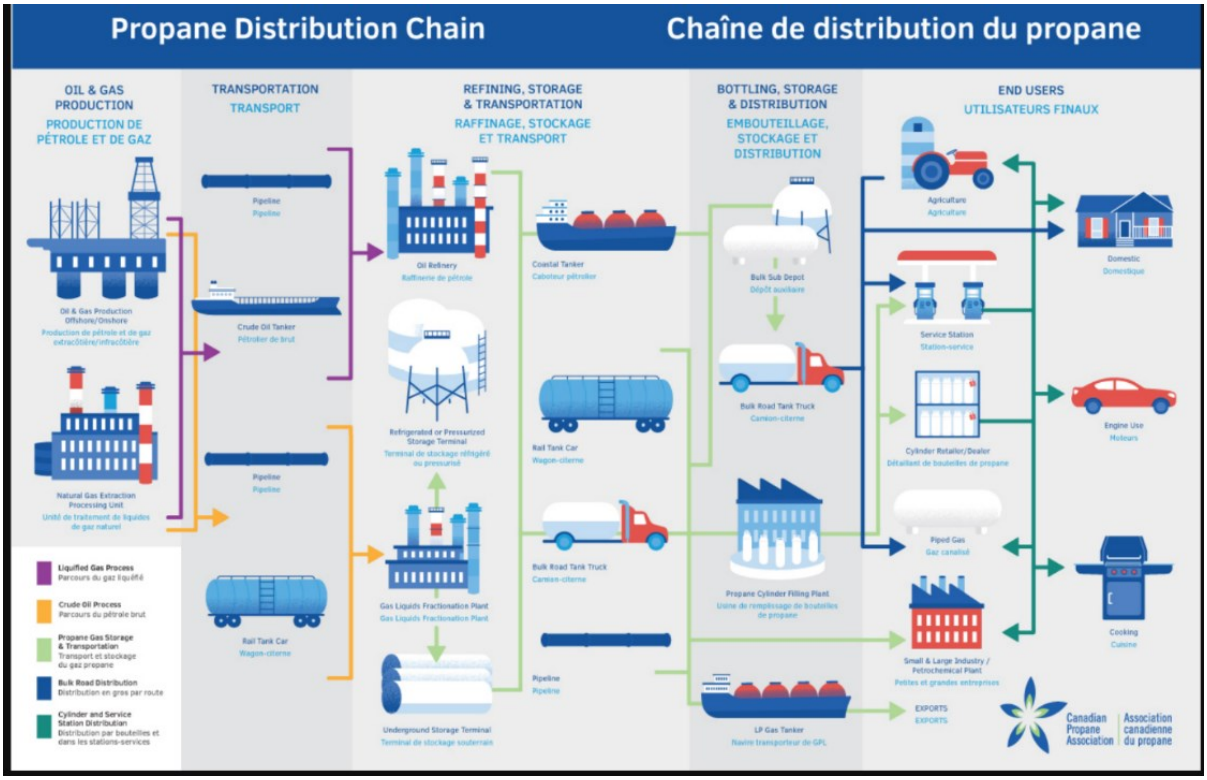
This thin margin means that just-in-time deliveries from production hubs are essential to maintaining a reliable supply of propane to customers heating their homes, schools and businesses, powering vehicles, drying crops and sustaining local economies.

Recent disruptions to Canada's propane supply chain (rail strikes and blockades) drew the attention of the industry and governments to the just-in-time nature of Canada's propane supply chain. Those episodes highlighted how distance and supply chain integration can be impacted by events throughout Canada. Supply chain concerns have now extended and intensified to include US jurisdictions with the government of Michigan ordering a shutdown of Enbridge's Line 5 pipeline.

# Supply Chain Framework

Physical infrastructure forms Canada's propane supply chain. Loosely, physical assets can be organized into upstream, midstream, and downstream segments. To ensure clarity, this report makes the following assumptions about the boundary of upstream, midstream, and downstream activities.

**Figure 3**
**Canada's Propane Supply Chain**



Source: Canadian Propane Association (2016)

**Upstream** includes the balance of facilities and other capital required to extract crude oil, natural gas, and bitumen. The upstream segment ends when products are channeled into transportation infrastructure at the production site.

**Midstream** includes pipelines and rail lines transporting crude oil, bitumen, and natural gas from upstream production to processing plants and refineries. Midstream includes bulk storage caverns and large aboveground storage tanks located at production sites. In general, the boundary of midstream infrastructure can be placed at the bulk product terminals. To avoid confusion, export terminals on the West Coast are included in the midstream segment because propane moves onto another midstream supply channel (an LPG tanker) and only reaches downstream customers when it arrives at unloading terminals.[52]

**Downstream** begins when propane volumes are transferred from a producer's terminal into trucks and railcars for onward movement, either to the end-user or to a wholesaler's terminal**.** This includes rail lines and highways connecting production terminals to the network of wholesale and retail distribution terminals.

# Upstream Supply Chain

Upstream infrastructure required to produce the inputs for propane can be differentiated by the type of energy products extracted and the infrastructure required for that extraction. Six types of extraction processes are involved in producing inputs for propane:

- Conventional natural gas extraction
- Unconventional natural gas extraction
- Conventional oil extraction
- Unconventional oil extraction
- Surface mining of bitumen deposits (oil sands mining)
- In situ bitumen extraction

## Upstream Natural Gas

Upstream natural gas assets are concentrated in Alberta and BC. Natural gas extraction is typically separated into two types of activity differentiated by the characteristic of the geological formation being exploited. Conventional natural gas extraction is the older of the two methods. Conventional extraction proceeds by positioning a drilling rig directly above the target formation and drilling down until reaching porous natural gas bearing formations from which gas volumes pumped up and extracted.[53] Conventional gas extraction may be done by onshore or offshore rigs.

[52] The propane supply chain has evolved over the last decade and rail is increasingly moving more propane and other NGL over longer distances, traditionally the preserve of pipeline infrastructure. To account for this dynamic, we include Class I railways and railcars in our review of midstream infrastructure. We also discuss the role of railways and propane trucks in the context of facilitating downstream distribution of propane.
[53] Canadian Association of Petroleum Producers, "Natural Gas Extraction."

Unconventional natural gas extraction is produced from non-porous geological formations which only began to be exploited around 2011-2012 following the development of horizontal drilling technology and new methods of liberating gas from non-porous formations. There are three types of unconventional gas deposits targeted by unconventional extraction: shale gas, coalbed methane, and 'tight' gas.

## Upstream crude oil and oil sands extraction

Canada's upstream oil and gas sector is also differentiated into three categories each requiring distinct infrastructure assets.

Conventional oil extraction, like conventional gas extraction, uses traditional methods of vertically drilling into large reservoirs of light and medium oil which is pumped to the surface without the need for further intervention via injection or other methods. Conventional crude oil extraction may be performed by onshore or offshore rigs.

Unconventional oil extraction covers distinct extraction activities:

- Surface mining of bitumen deposits have been a defining feature of the energy sector in Alberta. These are exceptionally large and expensive operations operating where bitumen deposits have been thrust upward over geological time allowing for surface mining. Surface mining tends to be limited to deposits accessible at around 75 meters below the surface.[54] Raw bitumen is extracted using specialized mining equipment include heavy haulers and hydraulic shovels for extracting the bitumen and hauling the raw material back to the bitumen production facilities.[55]

  Mined product is put through a four-stage process that treats and separates bitumen from non-bitumen materials and produces a mixture of 98 per cent bitumen. The bitumen on its own is too viscous to move along pipelines. The final stage in the upstream processes is converting bitumen into diluted bitumen (dilbit) with the addition of a solvent such as condensate.

- In situ extraction is a more recent development that permits bitumen deposits too deep below the surface to be exploited using a combination of extraction processes and new drilling configurations. In situ extraction projects commonly use a process called Steam Assisted Gravity Drainage (SAGD).

  SAGD projects work by drilling two parallel wells down into a geological formation. Once in place, operators inject steam into one of the two wells called the 'injection well'. The combination of heat and steam under pressure separates bitumen from sand and other components within the formation hence the 'in situ' moniker. This emulsion is then pumped to the second 'production well' and recovered at the surface.[56]

[54] Oil Sands Magazine, "Surface Mining Techniques used in the Oil Sands"
[55] Oil Sands Magazine, "Evolution of Mining Equipment in the Oil Sands"
[56] Oil Sands Magazine, "In Situ Bitumen Extraction."

The two-well configuration is a significant difference in the infrastructure required for SAGD operations compared to similar activities involved in unconventional gas extraction or the extraction of oil from tight or shale formations. Moreover, the directional drilling techniques used in SAGD projects allows many wells to be drilled from a single location.[57]

# Midstream Supply Chain

Midstream supply chain components encompass the infrastructure and facilities required to gather intermediate products, transport them to processing sites for manufacture of the specification propane, storage volumes, and finally the terminals required to load propane fuel onto trucks, railcars, and other transportation modalities for movement to downstream wholesale and retail distributors. To accommodate an appropriate view of the role of long-distance PBR in Canada supply chain, we include elements of the rail network in our analysis of the midstream supply chain infrastructure.

## Transportation infrastructure

### Pipelines

Pipelines are the most efficient midstream option to move large volumes of gas and liquid product over thousands of kilometres at great speed. Pipelines are used at various points along the supply chain for propane, however since the reversal of the Cochin Pipeline in 2014 there are no pipelines currently carrying propane out of Western Canada. Limited pipeline capacity remains a dominant feature of the Western Canadian energy sector.

### Class 1 Railways

Class 1 Railways are operators of Canada's main railways. Railway classes are determined according to gross annual revenue with Class I carriers have more than $250,000,000 in two consecutive years.[58] Propane and NGL volumes are transported in standardized DOT-117 railcars.

Rail has emerged as the midstream option of choice for Western Canadian producers of crude oil and NGL unable to move their product to market on a pipeline. [59] Crude oil rail terminals proliferated rapidly in the early 2010's, followed by a subsequent wave of investment in NGL infrastructure.[60] Midstream firms consolidated and expanded their liquids assets during this period, integrating field-level facilities and centralized fractionation plants

[57] Canadian Association of Petroleum Producers, "Natural Gas Extraction."
[58] Class II railways are those earning revenues under the threshold and Cass II are operators of tollbooths and other support infrastructure. See Ministry of Transport, *Transportation Information Regulations (SOR/96-334)*
[59] Millington and others, *Market Review of Natural Gas Liquids in Western Canada, p. 21-23.*
[60] US Department of Energy, *Quadrennial Energy Review, Chapter* 5, p. 3-3.

with pipeline infrastructure, expanding the size and number of fractionation facilities in Alberta.[61] [62] Rail terminal capacity for NGLs in Canada more than doubled between 2013-2018 to support growing NGL volumes being produced in Alberta.[63]

The large carousel-like rail infrastructure and steadily climbing throughput of the export facility at RIPET is similarly illustrative of the scale and sophistication that PBR operations have attained over the last decade.[64]

Rail infrastructure also expanded in the downstream sector, particularly the wholesale terminal infrastructure used to distribute propane into local markets. Our analysis of terminals in Eastern Canada finds that at least 7 rail-connected facilities were constructed between 2010-2020, with additional efforts undertaken to expand terminal infrastructure and inventories at least two other sites.[65]

**Figure 4**

**Key Midstream flows**


Source: The Conference Board of Canada

[61] Millington and others, *Market Review of Natural Gas Liquids in Western Canada*
[62] Pembina, "Pembina Pipeline Corporation Reaches Major Milestone by Placing Approximately $2.8 Billion of Integrated Assets into Service"; Keyera, "Josephburg Fact Sheet"; Keyera, "Gathering and Processing"
[63] The Canadian Energy Research Institute (CERI) estimated Canadian NGL rail terminal loading capacity to be 225 kb/d in 2013 (*see Murillo, Natural Gas Liquids (NGLs) in North America – An Update Part* I, p. 23). In 2018 CERI estimated of 545 kb/d for NGL rail terminal loading capacity, an increase of 140% over the period (see Millington and others, *Market Review of Natural Gas Liquids in Western Canada,* p. 49. Rail infrastructure was incremental increased in many terminals, new facilities include the South Cheecham, AB and the Josephburg, AB terminals (Keyera, 2013/17 and 2014, respectively). The size and capacity of the NGL terminal at Pembina's Redwater Fort Saskatchewan plant also doubled over the period to support expanded fractionation capacity in Fort Saskatchewan. Again, see estimates in Murillo (2014) and Millington and others (2018).
[64] AltaGas, *Management's Discussion and Analysis – July 28, 2021*; AltaGas, "Ridley Island Export Terminal"
[65] Conference Board review of data on downstream terminal infrastructure, this may not include all active retail sites. See NRCan CER, *Final Report to the Minister of Natural Resources and the Minister of Industry.*

As investment in the rail network increased, low propane prices at market hubs in Conway, Kansas and Edmonton, Alberta also made it more feasible for downstream customers to purchase supplies from these more distant markets. The result has been an increasingly dominant role for PBR shipments across distances normally associated with midstream transportation (Edmonton, AB to Moncton, NB for example).

## Intermediate inputs

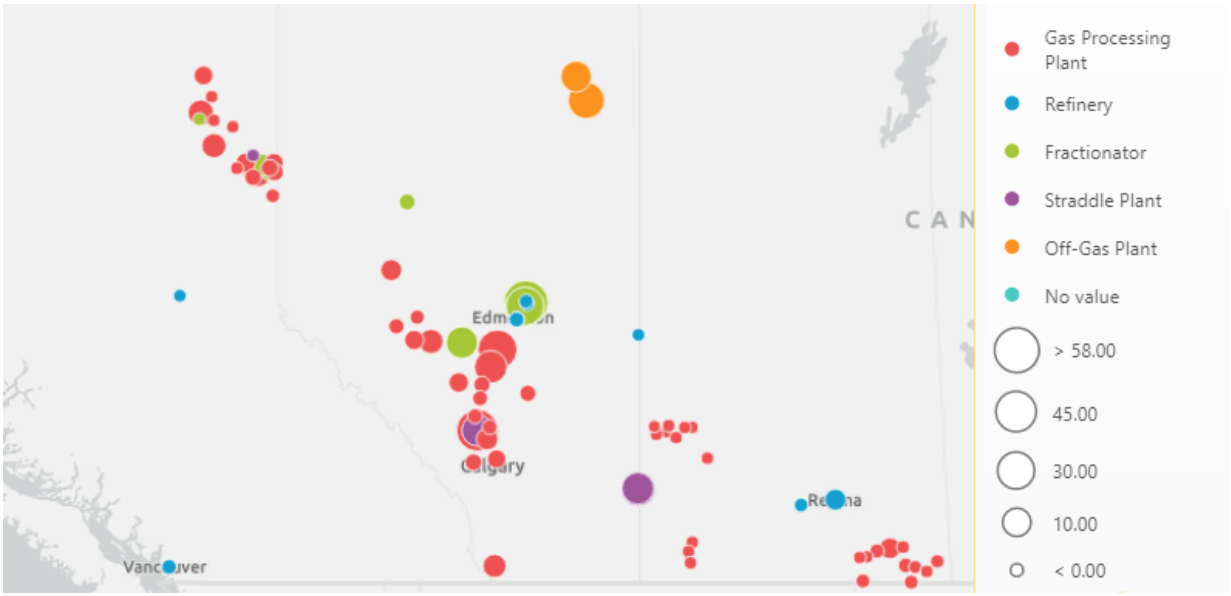
### NGL production

Gas processing plants receive volumes of raw natural gas gathered from upstream extraction facilities via pipelines. Gas plants process and remove other components such as water, sulphur, and carbon dioxide, from the natural gas stream before moving product (sales gas) onto the distribution network for customers, or in some cases with gas produced in Alberta or BC, a straddle plant. Gas processing also removes NGL compounds from the gas stream and separates sales gas from unfractionated NGL which contains ethane, propane, butane, and other compounds.[66] All raw gas is processed at a field level gas plant prior to moving downstream to natural gas distribution.

### Synthetic Gas Liquids Production

Diluted bitumen can be upgraded into synthetic crude oil (SCO), a higher value product requiring less intensive refining downstream. Upgrading bitumen produces gases which can be captured and processed in an off-gas plant.

**Figure 5**
**Propane Production in Western Canada (bubble size = est. 2020 production, kb/d*)**




*BC facilities report design capacity as opposed to production estimates.
Source: BC Oil & Gas Commission (2021); Alberta Energy Regulator (2021); Government of Saskatchewan, "Gas Plant Report".

[66] Millington and others, *Market Review of Natural Gas Liquids in Western Canada*

Off-gas plants capture the exhaust gas produced during bitumen upgrading and process it into synthetic gas liquids (SGL) a compound similar to NGL. Two off-gas plants, now operated by Inter Pipeline, have combined SGL production capacity of around 40 kb/d. These plants are currently producing around 35 kb/d of SGL which is shipped to Edmonton and processed in a centralized fractionation plant.[67] SGL fractionated at these facilities results in around 10 kb/d of specification propane for the market.

**Figure 6**
**Propane Production in Eastern Canada (bubble size = est. 2020 production, kb/d*)**


Source: The Conference Board of Canada

## Final production

Fractionation plants are large propane production centers that take in NGL feedstock and process the mixture to separate out different components into specification propane and other final goods.

Straddle plants are specialized extraction plants that sit alongside main transmission pipelines carrying natural gas towards sales markets. Straddle plants extract mainly ethane as well as additional volumes of propane-plus that are not extracted by field gas plants.[68]

Crude oil refineries process a range of heavy, medium, light, and synthetic light crude oils. The gases produced are processed into LPG and can be marketed from the refinery terminal (see Figures 5 and 6).

[67] Inter Pipeline, “Facilities Infrastructure”
[68] Canada Energy Regulator, “Market Snapshot: Where are Canada's propane inventories for winter demand stored?”

# Midstream terminal and storage infrastructure

## Midstream Storage

Canada's propane inventories are held in large underground salt caverns in Alberta, Saskatchewan, and Ontario. Facilities near Edmonton, Alberta, Kerrobert and Richardson, Saskatchewan, and Sarnia, Ontario hold a combined 21.0 million bbl (3.3 million $m^3$). Western provinces account for 62 per cent of total storage capacity while Sarnia has 38 per cent or around 8 million bbl.

Storage allows the propane market to balance seasonal demand by stockpiling during the summer when demand is low and drawing down inventories in during the harvest period and over the winter heating season.[69]

## Midstream Terminals

### Production Terminals

Terminals attached to production hubs are the primary distribution point for the downstream sector. Plants may have a combination of pipeline, railway, or truck terminals depending on access to midstream infrastructure. The production sites around Edmonton host the largest terminal capacity in Western Canada. Sarnia's rail and truck terminals are the most important distribution terminals in Eastern Canada.

### Marine export terminals

Marine terminals receive shipments of propane from a rail or pipeline offload terminal. Propane is fed into pressurized storage at the terminal. From there propane is fed through a refrigeration unit and into refrigerated storage where it eventually gets transferred into an LPG tanker vessel for shipment to overseas markets.[70]

Some export terminals, such as the proposed PTE's Kitimat LPG Export Project, may include a Floating Storage and Offload (FSO) vessel which is a water-borne platform that manages both the offload to an export vessel and storage for the project.

# Downstream Supply Chain

Downstream infrastructure includes the balance of facilities, transportation vessels and other infrastructure required to move propane from production terminals, through wholesale distribution, and into the retail distribution network before propane is finally sold to end-users.

[69] Natural Resources Canada and Canada Energy Regulator *Final Report to the Minister of Natural Resources and the Minister of Industry.*
[70] AltaGas, "Ridley Island Export Terminal"

# Distribution Terminals

Our classification of the supply chain segments makes a distinction between the loading terminals abutting production and storage, and the network of distribution terminals that manage the final delivery to the end-user.

**Rail terminals**

Rail terminals are the main regional nodes in the downstream distribution network. While critical to all of Canada, for downstream markets in Quebec and Atlantic Canada they have added importance by delivering production from Sarnia, rail hubs in the US, and from Western Canada. Rail terminals include tracks to bring railcars into the terminal, as well as a set of integrated pumps or racks where railcars line up to be emptied. The larger the rail rack, the faster the throughput provided the fuel can be pumped into inventory tanks at the terminal or into waiting trucks.

Rail terminals are important elements of the just-in-time supply operations serving the retail market in Canada especially for wholesalers and retailers in Quebec and Atlantic Canada. The production terminal in Sarnia is beyond an economical distance that can be served by trucks to resupply the distribution network. The majority of regional demand must be moved first along the rail line to rail terminals to allow fuel to be diffused throughout the regional supply network by truck and bobtail wagon.

**Figure 7**
**Eastern Canada's Network of Distribution Terminals**

Note: Red dots denote production terminals; blue dots are rail terminals; green dots are truck-in terminals.
Source: The Conference Board of Canada

Eastern rail networks can create bottlenecks. The rail network connecting Quebec and Atlantic Canada is not extensive. In addition, and of more concern, is the segment of mainline between Montreal and Toronto which lacks any easy rail alternative. During the 2020 blockades, the lack of alternate routes made the distribution network vulnerable to disruption along a single segment of track. Western provinces fare better. Geography, history of infrastructure development, and availability of supply has resulted in the ability to circumvent an issue any one rail line or highway by using an alternate route.

**Truck and Transload terminals**

The majority of distribution terminals are supplied by truck. In some cases, truck-in terminals are located along or near Class 1 rail infrastructure to easily permit transload operations. This involves purchasing or renting a transloader unit (essentially a pump mounted on a truck or other mobile platform) and maneuvering it and the railcar next to each other to transfer volumes from the rail car into a waiting inventory tank.

Transloading is slower and less efficient that constructing a fixed rail rack. It does, however, afford more flexibility to the supply chain, especially when obtaining necessary permits and suitable real estate is a challenge for propane distributors.

# Emerging Trends and Uncertainties

Canada's propane industry is changing as North America's energy market evolves and responds to global pressures. Market participants in Canada are reacting to these trends and the supply chain is changing as a result.

Western propane infrastructure has undergone an evolution in size and scale since 2010. Additions to centralized fractionation capacity throughout the decade have expanded production capacity. In addition, new investments in high-throughput terminal infrastructure has facilitated efficient midstream transportation of NGL and propane throughout the North American market.

Export terminals on the West Coast with rail-operations equivalent to the size and scale of large producers in Edmonton allow unit trains of propane – carrying upwards of 60,000 bbl per train – to shuttle back and forth between production and export terminals in a highly efficient supply chain.[71]

The industry in Ontario, Quebec, and Atlantic Canada have also responded to changes in the market. Wholesalers have added more rail terminals east of Sarnia and the inventory of

[71] Unit trains are a mode of transportation service on Class I railways. A unit train must have at least 80 'physically consecutive and connected' railcars, all carrying the same product and moving as a group. An 80-car unit train can carry around 60 kb in a single shipment. See Canadian Pacific Railway, *Tariff 5 - Unit Train Service*

rail terminals has expanded. These additions increase the overall reliability of the supply chain, permitting easier throughout and circulating of propane into the distribution network. The increased network of rail terminals should enhance the resiliency of the system over time, spreading capacity to weather temporary disruptions along the railway to Sarnia across a larger number of terminals.

Section 4

# Case Studies

# Case 1: United Parcel Service Canada (UPS Canada)

UPS Canada is a courier and delivery service and the Canadian subsidiary of UPS Global Inc. UPS Canada was incorporated and began deliveries in Canada in 1975.[72] Since then, it has grown to operate a nation-wide service with hundreds of delivery and receipt locations across the country.

The company operates a fleet of around 3,000 vehicles, approximately 2,000 of which are delivery trucks[73], and employs approximately 12,000 people in Canada.[74] As the operator of one of the largest fleets of delivery and other vehicles in the country, UPS Canada has a strong interest in managing the sustainable performance of their fleet. Propane has been a part of UPS Canada's alternative vehicle fleet since 1985. UPS has expanded the role of propane since then and today 41 per cent of their vehicle fleet are propane vehicles.[75]

## UPS Canada's facilities and operations

UPS Canada ships, sorts, and delivers packages and other non-freight items. It directly operates at least 62 sortation, distribution, pick-up, and drop-off locations.[76] Many more affiliated drop-off and pick-up locations not directly operated by UPS extend their reach into rural areas and the north. UPS Canada's distribution network is centered around three classes of UPS facility: Customer Centers, UPS store locations, and affiliated and other authorized UPS locations

Customer Centers are large sorting and distribution centers. These facilities tend to be in proximity to entry and arrival points for freight and other goods, especially international airports, rail terminals, and port facilities. Customer Centers are sited in proximity to freight shipping nodes and may or may not be connected to Class 1 railways.

These centers act as central nodes for a regional distribution network. Packages are received, sorted, and distributed into delivery vehicles for further distribution to either a regional UPS Store, affiliated drop-off point, or the customer.

## Propane in UPS Canada's operations

UPS Canada has used propane vehicles since at least 1985.[77] Approximately 600 vehicles were converted from conventional internal combustion engines to engines designed for propane at that time. Since then, there have been at least two large expansions of the propane fleet. Procurement of new propane vehicles in 2008 and 2009 was approximately

[72] UPS Canada, "About UPS"
[73] Truck News, "UPS Canada goes from brown to green with propane trucks"
[74] UPS Global Inc. "UPS Canada Fact Sheet."
[75] Ibid.
[76] Ibid.
[77] Truck News, "UPS Canada goes from brown to green with propane trucks"

140 and 170 vehicles respectively. Expansion of on-site infrastructure for propane refueling was carried out at on at least one UPS Customer Center during this period.[78]

**Estimated Propane Vehicles in UPS Canada's Fleet: 1990-2020**

- 1990: ~600
- 2000: ~600
- 2008: ~730
- 2010: ~890[79]
- 2018: ~1,150[80]
- 2020: ~1,200[81]

Delivery vans are the most common vehicle in the UPS Canada fleet, however, the company notes that propane is also used to power a portion of other vehicle classes, including the 'shifters' that operate around Customer Centers.[82]

UPS Canada's alternative vehicle fleet has become more varied in its composition and energy mixture since propane vehicles were first introduced in 1985. The company has continued the expansion of its propane fleet since then and propane now powers as many as 1,200 vehicles, approximately 40 per cent of UPS Canada's fleet. The commitment to propane is also reflected in the infrastructure on-site. Propane tanks have been added to existing Customer Centers as recently as 2017-2018 and included in the design of new Customer Centers as recently as 2018.[83]

### UPS Canada's propane supply chain

UPS Canada's fleet of propane vehicles are refilled using on-site propane refilling infrastructure in at least 11 of 22 Customer Centers in Canada (Figure 9). It is not clear if propane vehicles are operated only where on-site propane infrastructure is installed at the Customer Center or if local refueling stations are utilized in some cases.

The standard propane tank at one of UPS Canada's Customer Centers is 2,000 USWG, or approximately 7,570 liters.[84] An exception to the size of on-site inventory is the larger tank installed in 2010 to manage the operations at the Customer Center in Vaughan, ON. This location's tank was exchanged for a larger 15,000 USWG tank around 2010.[85]

[78] A $72 million dollar capital expansion of the flagship UPS Customer Center in Vaughn, ON in 2010 included a significant expansion of on-site propane refueling infrastructure. See
[79] World Liquid Petroluem Gas Association, "UPS Canada Fleet,"
[80] EDI, "UPS Canada implementing 50 per cent alternative fuels in fleet by 2018"
[81] UPS Global Inc. "UPS Canada Fact Sheet."
[82] Ibid.
[83] See the UPS Customer Center in Kanata, ON, for example.
[84] The volume of tanks in USWG terms is estimated by estimating the dimensions of the tank and assessing the dimensions relative to standard USWG vessels.
[85] The Conference Board of Canada

UPS Canada's propane tanks are supplied by trucks hauling propane trailers. Trucks draw their fuel from wholesaler's terminals or production terminals in their operating area. Pumping infrastructure on-site is used for refilling delivery vans and other propane vehicles.

**Figure 8**
**UPS Canada's Onsite Propane Refueling Infrastructure (2021)**


Note: Blue dots denote facilities with propane tanks on-site.
Source: The Conference Board of Canada

The supply chain for each of UPS Canada's propane refilling stations at Customer Centers is the same if not substantially similar. However, the geographic location of UPS Canada's Customer Centers provides an opportunity to gauge how Canada's supply chain infrastructure impacts the relative reliability and resilience of propane supply for a given Customer Center.

For example, the Customer Center in Calgary, AB enjoys a robust supply chain, being in proximity to nearby wholesale terminals as well as a pipe-in, truck-out terminal. If one transporter is disrupted, several other channels can still deliver to the Calgary facility.

Eastern Canada by contrast, depends first on the diffusion of propane from the Sarnia hub into Quebec and Atlantic Canada. A serious disruption along the railway leading to Sarnia puts the fuel supply for propane tanks at four Customer Centers in jeopardy unless service is restored, or alternative supplies accessed to circumvent a blockade. Beyond rail, the supply of propane to Customer Centers in Eastern Canada would also be disrupted due to a shutdown on Enbridge Line 5 which supplies the NGL for fractionation at Sarnia.

# Case 2: Agropur Dairy Cooperative

Agropur Dairy Cooperative (Agropur) is a dairy farming co-operative comprised of more than 2,974 Canadian farmers and other associated producers around the world.[86] Agropur's farmers feed their dairy products into a global dairy processing business with domestic processing facilities in five provinces and several US states.

Agropur is the largest dairy cooperative in Canada and the only major dairy processor with production and processing interests held directly by members. Agropur, Saputo Inc., and Parmalat Inc. together account for 82 per cent of milk processing in Canada.[87] Including fluid milk plants operated by subsidiaries, Agropur's processing plants employed around 2,750 people as of 2017.[88]

Between farmers and manufacturing, Agropur and its farmer-owners rely on supply chains rooted in both the dairy producing and processing industries. The farms and facilities in Agropur's broader supply chain consume propane as heating fuel for both space heating and industrial processes.

**Figure 9**
**Agropur-owned dairy processing plants (2021)**


Note: Blue dots denote facilities with external propane tanks.
Source: The Conference Board of Canada

Agropur's member-owned farms constitute the upstream segment of the dairy supply chain and produce inputs to Agropur's larger processing business.

Fully 80 per cent of active dairy farms in Canada are in Ontario (33 per cent) or Quebec (47 per cent).[89] In Ontario, dairy farms cluster in the south of the province centered around

[86] Agropur Dairy Cooperative. *We are a cooperative*.
[87] Ibid.
[88] Environment and Climate Change Canada, "National Pollutant Release Inventory, 2017."
[89] Canadian Dairy Information Center. "Number of farms, dairy cows and dairy heifers."

Oxford County and the southern lakeshore. In Quebec, dairy farming is concentrated in an agricultural band extending up the St. Lawrence River between Cornwall, ON and Quebec City, QC, and up into the Gaspe Peninsula. Seventy-five per cent of dairy farms in Quebec are located between the south bank of the St. Lawrence and the US border.[9091]

Agropur has at least 19 dairy processing facilities across Canada including plants controlled through subsidiaries.[92] These facilities are co-located in large dairy farming regions in BC, Alberta, Ontario, Quebec, New Brunswick, and Nova Scotia (see Figure 10).

There are two types of facilities operated by Agropur. Four of the 19 processing plants produce fluid milk for the Canadian market (North America Industry Classification System (NAICS) 311511). The other 14 are classified as 'butter, cheese, and dry and condensed dairy product manufacturing' plants (NAICS 311515). Both types of facilities fall into the light manufacturing category in Canada's industrial classifications. These facilities do not for the most part include infrastructure connected to Class 1 rail lines.

## Propane Use in Agropur's operations

Propane is used at two points along Agropur's broader supply chain including both upstream milk production and in processing activities.

### On the Farm

Propane is used by some of Agropur's dairy farmers as fuel for space heating. Propane is used most intensively in rural areas of Ontario, Quebec, and Atlantic Canada where natural gas distribution is scattered, absent, or too expensive to build. In these regions, heating oil and propane are commonly used for space and other heating applications.

Propane accounts for 14 per cent of secondary energy in the agricultural sector in Quebec and 5 per cent in Ontario. By contrast, propane provides only 1 per cent of secondary energy for agriculture in Alberta and 3 per cent nationally.

Some of the variation is attributable to the availability of natural gas, however, a major factor is the agricultural conditions that prevail across Ontario and Quebec compared to the Prairie provinces. Farmers in Ontario and Quebec must remove more moisture from their crops in any given year than farmers in Alberta or Saskatchewan. That means more propane must be used kilo-for-kilo to dry crops.

### In Processing

The application of heat is central to the preparation of raw milk and processing into fluid milk or other dairy products like butter and cheese. Processing facilities use large steam boilers to heat raw milk and divide it into heavier cream elements and separated milk, the elements of which go on for further processing into fluid milk, cheese, butter, and other products. In

[90] Assuming a 1:1 identify between members and operating dairy farms; Agropur's membership represents around one-third of all dairy farmers in Canada. See: The Canadian Dairy Information Center.
[91] Les Producteurs de lait du Quebec. *Profile of Quebec Dairy Production.*
[92] The Northumberland Dairy fluid milk plant in Miramichi, NB is an example of an Agropur subsidiary plant.

addition to heating steam boilers, propane may also be used by a dairy processing plant to provide heat for spray drying processes used in the manufacture of skim-milk powder.[93]

Milk separation and other manufacturing processes account for most energy use in a dairy processing facility, however, propane is also used for minor uses such as fueling forklifts.[94]

## Agropur's propane supply chain

Propane is used by a portion of Agropur's farmers and by some of its processing factories as a fuel to provide heat for manufacturing processes and buildings. Given the size of the propane tank in use, farms and processing facilities exist along distinct supply chains for propane and require different transport methods to make the last mile.

Farms are typically supplied by a local retail distributor operating a bobtail truck. The retailer will draw fuel either from a wholesale terminal or production terminal, depending on location, and then deliver volumes directly to the customer.

Processing plants have much larger tanks than the average farm and are resupplied by wholesale distributors that dispatch tractor-trailers with propane. Smaller volumes are carried by non-articulated bobtail trucks which are the mainstay of the retail distribution network.

Propane is utilized along Agropur's full supply chain to produce milk and dairy products. Dairy farms and processing plants using propane rely on fuel delivered either by rail or by truck from Sarnia and the smaller volumes produced by refineries in the region. Disruptions to propane supply to this region have become more common in recent years with the loss of production in Atlantic Canada (end of fractionation at Point Tupper, NS and the more recent shutdown of the North Atlantic refinery in Come-by-Chance, NL). Disruptions would be critical where plants utilize propane for heat because a loss of heat supply during processing will cause large production losses at the plant – more likely a shutdown in operation until supplies are restored.

[93] Agropur Dairy Cooperative. Together To Secure Our Sustainability
[94] Murillo and others, *Fuelled Up*.

Section 5

# Canada’s Propane Supply Chain

Key takeaways

# Reliability and Resiliency

Canada's propane supply chain has had a dynamic decade.

Historical growth in production due to new extraction techniques and a favorable resource base contributed to the development of novel types of supply chain assets. New markets previously inaccessible to Edmonton's surplus production have opened up. At the same time the market has weathered disruptions like a national rail strike, several minor port strikes, and blockades of national rail infrastructure.

Despite these challenges, the propane supply chain has remained reliable and resilient. Research points to some themes that will continue to contribute to the propane supply chain's reliability and resilience. They include:

- Rapid growth in the production of propane in Western Canada is the dominant feature of the last decade in Canada's propane market. Production increased 115 kb/d from 2010-2019, just under half of this volume, 54 kb/d, was added between 2017-2019 alone. Going forward, the growth is expected to continue even if the engine of that growth shifts from Alberta to liquids-rich production fields in northeastern BC.

- Storage patterns have been volatile in recent years and the pattern for inventories going forward remains obscured by the impacts of COVID-19. A key question going forward is how inventory patterns will settle once the distortions due to COVID-19 have fallen out of the market.

- Hub price dynamics over the last decade and especially since 2014 incentivized a wave of investment in new downstream and midstream enterprises, eager to take advantage of the low prices caused by shut-in production volumes around Edmonton.

- Exports are the most important development in terms of the disposition of propane in Canada in recent years. Steadily rising exports to overseas markets reflect the Edmonton-to-tidewater export corridor now facilitated by high-throughput rail loading terminals in Edmonton and offloading and export terminals near Prince Rupert, BC.

- Petrochemical facilities coming online in 2022 will bolster non-energy demand in the near term. Over the longer-term, demand from solvent-assisted extraction in upstream oil and gas may intensify the non-energy demand for propane – potentially reducing surplus propane in Edmonton.

- The overall result is that Canadian demand for propane is shifting further towards wholesale end-users. As this shift continues, the Canadian market will reflect marginally less seasonality than in previous years.

The market is facing an open question as to how surplus western propane will impact historic relationships going forward. Export capacity will continue to grow over time and surplus propane in Edmonton will find its way to the coast provided there is export capacity and the right price. If enough surplus comes out of the Edmonton market, upward pressure on hub prices could develop. This would restrict the ability of Eastern Canadians to pull on Edmonton's propane inventory as an option to balance higher seasonal demand during winter.

Reliability and security of supply remains a core consideration. The rail blockade of 2020 and strike of 2019 raised alarms because they were disruptive, but they also highlighted the circumstances that led up to the disruptions and raised the prospects of future potential incidents. Serious consideration should be given to the resiliency of propane supply chains and the rail network.

Overall Canada's propane supply chain is reliable and resilient. Investments downstream to increase and expand the number and size of rail terminals east of Sarnia are and will enhance the reliability of the supply chain over time. Going forward, new investments are needed to increase the number of rail terminals and rail yards in Eastern Canada. Expanding terminal inventories would allow the industry to better leverage the value of high-capacity infrastructure in Western Canada and create further resiliency to disruption.

# Appendices

# Appendix A

## Methodology

This report examines the supply and disposition of propane in Canada. It includes a breakdown of propane supply and demand by sector and by province. The report also provides a 10-year forecast.

A review of the infrastructure that make up Canada's propane supply chain is included. This analysis was conducted based reviewing public records and data collection. Key insights and feedback were gathered through a round of semi-structured interviews with representatives of firms from across the supply chain. Eleven individuals participated in interviews conducted between February and April 2021.

# Appendix B

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# Appendix C

## Abbreviations and Acronyms

**AER**—Alberta Energy Regulator

**CAPP**—Canadian Association of Petroleum Producers

**CERI**—Canada Energy Research Institute

**CER**—Canada Energy Regulator

**CANSIM**—Canadian Socio-Economic Information Management System (Statistics Canada database)

**CAGR**—compound annual growth rate

**CFS** – Clean Fuel Standard

**DAO**—deasphalted oil

**FID** – final investment decision

**FSO** – floating storage and offloading vessel

**GHG**—greenhouse gas

**HPC**—Heartland Petrochemical Complex

**LPG**—liquefied petroleum gas

**NGL**—natural gas liquids

**NAICS**—North American Industry Classification System (Canada – Version 3.0)

**RIPET**—Ridley Island Propane Export Terminal (Royal Vopak)

**SAGD**—Steam Assisted Gravity Drainage

**SCO** – synthetic crude oil

**SDA**—solvent deasphalting plant

**SGL**—synthetic gas liquids

**PTE**—Pacific Traverse Energy

**PBR**—propane-by-rail

**PDH**—propane dehydrogenation

**PP**—Polypropylene

**PRT**—Prince Rupert Terminal (Pembina)

**VPC**—Vopak Pacific Canada

# Units

**Bbl**—barrels

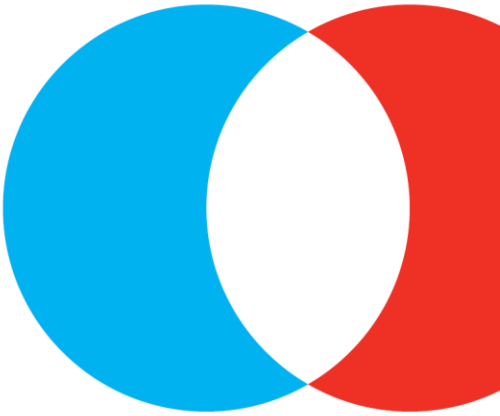
**kb/d**—thousands of barrels per day

$m^3$—cubic meters

**MMbbl**—millions of barrels per day

**MMcf** – million cubic feet

# Where insights meet impact



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