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July 10, 2019

Sent via eFile

BCUC INQUIRY INTO GASOLINE AND DIESEL PRICES IN BC	**EXHIBIT A2-1-1**

Re: British Columbia Utilities Commission – An Inquiry into Gasoline and Diesel Prices in British Columbia – Project No. 1599007 – Deetken Group Independent Consultant Report

British Columbia Utilities Commission (BCUC) staff submit the following independent consultant report for the record in this proceeding:

Deetken Group
Phase 2: Analysis of Factors Contributing to BC's Gasoline and Diesel Price Behaviour

Sincerely,

Original signed by:

Patrick Wruck
Commission Secretary

/yl
Enclosure

2019

Phase 2

ANALYSIS OF FACTORS CONTRIBUTING TO BC’S GASOLINE AND DIESEL PRICE BEHAVIOUR

THE DEETKTEN GROUP

Contents

Executive Summary

On May 29th 2019, The Deetken Group, a Vancouver-based management consulting company, was engaged to complete a two-phase independent consultant report to support the BC Utilities Commission's inquiry into retail gasoline and diesel prices in British Columbia (BC).

Phase 1 of this report was released on June 20th, 2019. It provides an overview of BC's gasoline and diesel markets and describes the behaviour of gasoline and diesel prices in the province. The Phase 1 report makes the following observations:

1. Wholesale gasoline prices in BC have risen above historical price differentials with respect to comparator jurisdictions. Prices in the Vancouver area have experienced a more significant increase when compared to an average of prices found in other Western Canadian cities.

2. Gasoline retail margins in BC and to a greater extent in the Vancouver area have risen above the average found elsewhere in Western Canada.

3. When compared to other parts of Western Canada, diesel prices in BC have remained largely consistent with historical trends.

This Phase 2 report builds on the observations and supporting analysis found in Phase 1.[1] Specifically, this Phase 2 report analyzes factors contributing to the gasoline retail margin differential between Vancouver and other comparable jurisdictions as well as factors that may have an impact on the gasoline wholesale price differential between BC and comparable jurisdictions. The main findings of this report can be broken down into findings regarding the gasoline retail margin differential, those regarding the gasoline wholesale price differential, and those related to the compatibility of diesel price behaviour.

Retail margin differential

A number of factors were analyzed to explain the retail margin differential. These factors include:

- Average throughput by station;
- Costs of labour;
- Competitive environment;
- Rising land costs; and
- Credit card processing fees

The analysis reveals that rising land costs and credit card processing fees may account for nearly the entire differential observed between Vancouver and comparable areas, at least up to the end of 2018. Specifically:

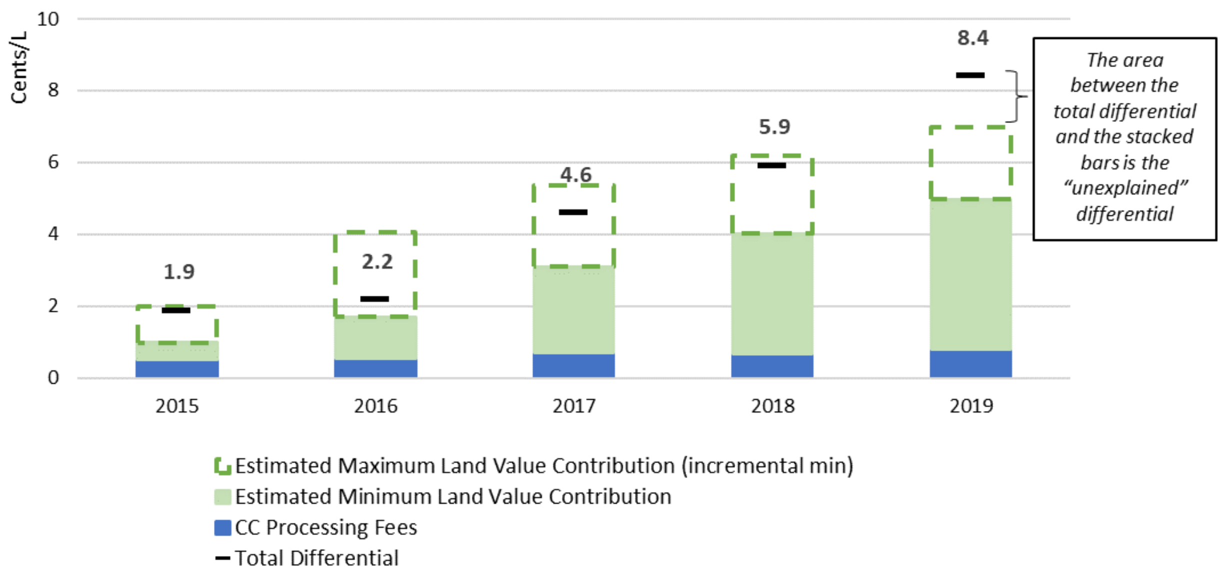
[1] In this regard, it is recommended that the Phase 1 report is reviewed prior to the Phase 2 report.

Finding 1: Vancouver's gasoline retail margins is highly correlated with local land values. Relatively high gasoline retail margins are likely to be a result, at least in part, of high land values in the Vancouver region.

Finding 2: Credit card processing fees also appear to have an impact on gasoline retail margin differentials. This is due to the fact that processing fees are applied as a percentage of a total transaction, meaning that fees will be higher in jurisdictions (like the Vancouver area) where retail prices are already higher than surrounding areas.

Finding 3: As illustrated in Chart 0.0, even after this range of factors is taken into account, a portion of the differential observed in 2019 remains unexplained.

Chart 0.0: Explained retail margin differential between Vancouver and the Western Region



Wholesale gasoline price differential

The wholesale gasoline price differential is analyzed as the differential between the BC cities for which consistent data exists (Vancouver and Kamloops) and the wholesale price in two nearby jurisdictions, which are also sources of supply for BC (Edmonton and Seattle, which serves as a proxy for the refining region of Washington State).

Four factors were assessed as potential explanatory variables. These include: the cost of inputs; the costs of the marginal unit of supply as determined by transport costs; the regulatory environment; and the competitive landscape. The transport costs of the marginal unit of supply and the costs associated with regulation in BC are likely contributing to the differential. Specifically:

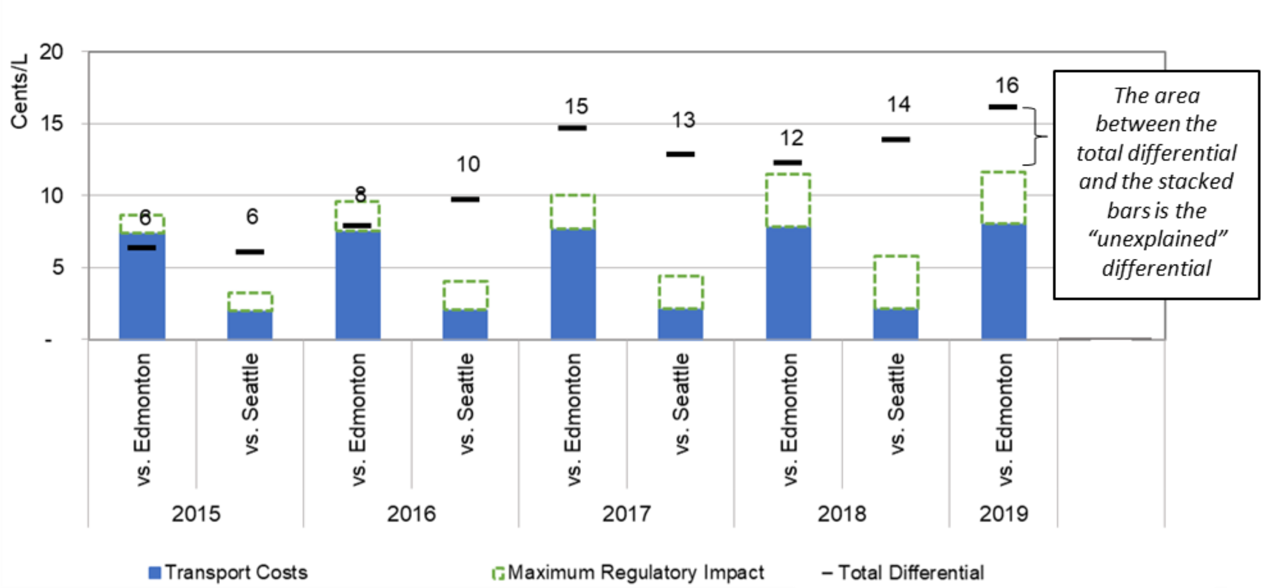
Finding 4: Transport costs may be contributing to the higher wholesale prices found in BC vis-à-vis Edmonton and Seattle.

Finding 5: There may be some costs associated with regulation in BC, but even the maximum estimated cost impact of regulation on wholesale prices is insufficient to explain wholesale price differentials.

Finding 6: In short, even the highest estimates of transport and regulatory costs combined do not sufficiently account for the differential in wholesale prices between the Vancouver market and the Edmonton and Seattle markets, particularly in 2019.

The charts below indicate the range of annual wholesale price differentials, the estimated portion explainable by transport costs, and the *maximum* regulatory impact.[2]

Chart 0.1: Explained wholesale price differential between Vancouver vis-à-vis Seattle and Edmonton[3]



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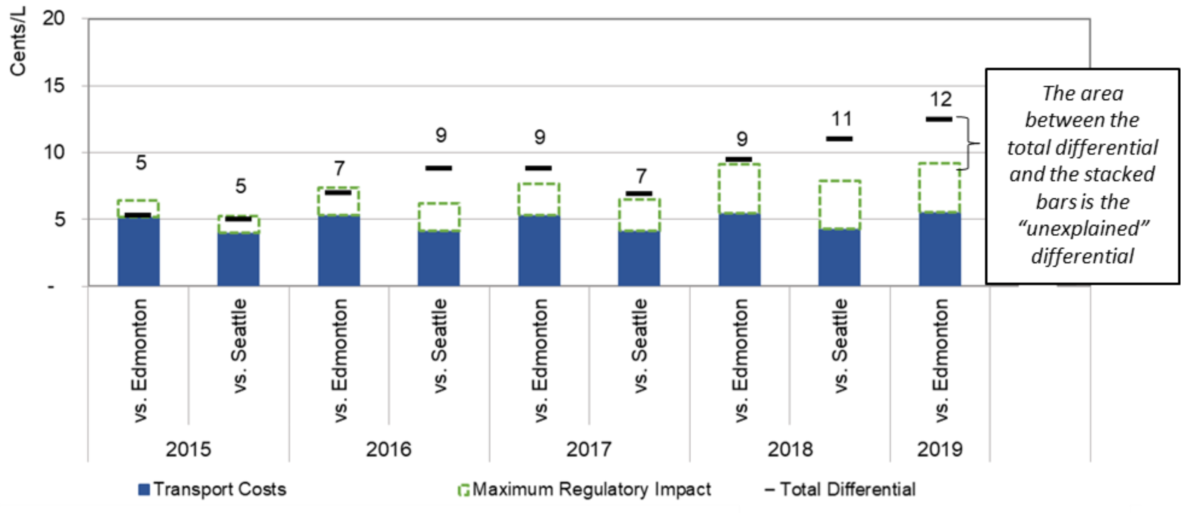
[2] As detailed in Section 4.4 of this report, the actual regulatory cost impact is expected to be lower than the estimated costs used in the analysis.

[3] Charts 0.1 and 0.3 include the following estimates:

- Transport costs were estimated using the highest marginal cost of transportation (tanker truck)
- The maximum regulatory impact of BC's Renewable and Low Carbon Fuel requirement regulation is estimated based on the maximum costs which would be incurred if fuel supplied had no lower cost abatement options and only purchased the maximum cost compliance costs.
- The total differential is the total annual difference is estimated by subtracting annual average wholesale prices in the comparable jurisdictions from the annual average in the BC jurisdictions.

Chart 0.2: Explained wholesale price differential between Kamloops vis-à-vis Seattle and Edmonton



Compatibility with diesel behaviour

> ***Finding 7***: The diesel market has not seen a material change in retail margin and whole price differentials in recent years, this may be in part due to different demand dynamics in the diesel market.

In order to complete the analysis and ensure all factors contributing to the retail margin differential, wholesale price differential, and diesel price behaviour are quantified, it is recommended that the following lines of inquiry are further explored:

1. Actual assessed land values and lease costs for the period under review
2. Barriers to trade with the US (and domestic, if applicable)
3. Actual transport costs of refined fuels (including pipeline, rail, marine, and tanker truck)
4. Production substitutability of gasoline and diesel
5. Likely regulatory impacts

1. Introduction

In May 2019, the BC Provincial Government directed the BC Utilities Commission (BCUC) to conduct an inquiry into retail gasoline and diesel prices in the province.[4] Results of the BCUC inquiry are to be provided to the Ministry of Jobs, Trade and Technology by August 30, 2019.

To inform the preparation of its report, BCUC requested the completion of a two-phase independent consultant report to evaluate the factors that influence the price of gasoline and diesel in BC. The Deetken Group was engaged in late May 2019 to complete the independent consultant report. This independent report considers both market factors (e.g. demand, competition and supply access) and non-market factors (e.g. regulation).

[4] BCUC Order in Council No. 254.

This report considers price behaviour in BC with a focus on pre-tax prices.[5] The report is not intended to make recommendations related to altering the price of gasoline or diesel in the province. Specifically, the Terms of Reference received from the BCUC requested that the independent consultant report examine, without limitation, the extent to which price changes in gasoline and diesel have been determined by market competition and the extent to which those changes have been determined by other factors.[6]

This report is delivered in two phases:

- Phase 1: Primer on BC's Market for Refined Petroleum Products (delivered June 20th, 2019); and
- Phase 2: Analysis of Factors Contributing to BC's Gasoline and Diesel Price Behaviour (delivered July 10th, 2019).

Phase 2 of the inquiry (herein) explores potential factors which could lead to the results described in Phase 1, which include the following:

1. Wholesale gasoline prices in BC have risen above historical price differentials with respect to comparator jurisdictions. Prices in the Vancouver area have experienced a more significant increase when compared to an average of prices found in other Western Canadian cities.
2. Gasoline retail margins in BC and to a greater extent in the Vancouver area have risen above the average found elsewhere in Western Canada.
3. When compared to other parts of Western Canada, diesel prices and margins in BC have remained largely consistent with historical trends.

2. Summary of Price Behaviour

Observations

1. A comparison of BC to other parts of Western Canada reveals that wholesale gasoline prices in BC have risen above historical price differentials.

2. Gasoline retail margins in BC and to a greater extent in the Vancouver area have risen above the average found elsewhere in Western Canada.

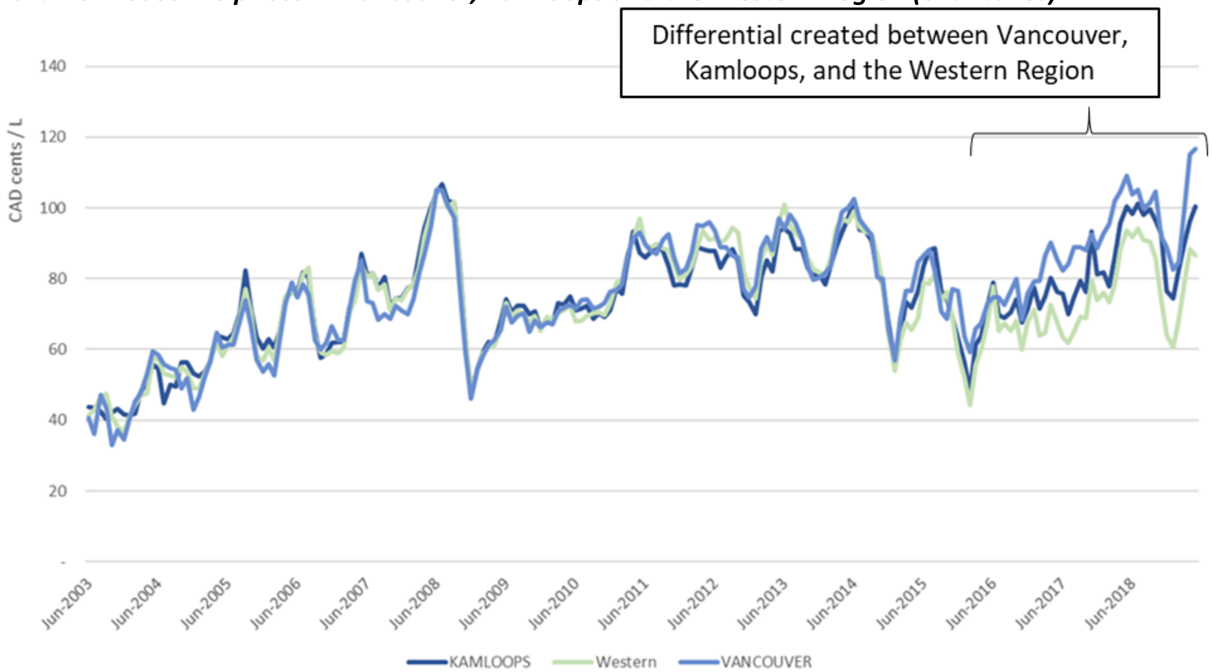
3. When compared to other parts of Western Canada, diesel prices in BC have remained largely consistent with historical trends.

[5] See Phase 1, Appendix 2 for a detailed explanation of BC's gasoline and diesel taxes.
[6] See Appendix 8 for Terms of Reference

As in Phase 1 of this report, gasoline and diesel prices in BC are considered in comparison to a composite measure of the Western Region in Canada. The Western Region is used as a comparison due to the relative similarity to BC in terms of crude and refined products access. When appropriate, this comparison is extended to include other regions of Canada and the United States. Specifically, these differentials are considered for Vancouver and Kamloops because these are the only two BC jurisdictions for which there are sufficient wholesale data to enable analysis. In this report, "Vancouver" refers to the Greater Vancouver Area.[7]

> ***Western Region***
>
> As in Phase 1 of this report, the Western Region is defined as a simple average across Edmonton, Calgary, Winnipeg, and Regina.

Chart 2.0.1 Gasoline prices in Vancouver, Kamloops and the Western Region (excl. taxes)



The differential observed for retail gasoline prices can be decomposed into two parts each of which are impacted by unique factors: **retail margins**, and **wholesale prices.**

Retail Margins

> ***Retail margin***
>
> The retail margin is the difference between the wholesale price for fuel and the retail price less taxes.
>
> **Retail margin = retail prices - wholesale price - taxes**

The Phase 1 report revealed that retail margins in Vancouver appear to have grown beyond the retail margins in other Western jurisdictions, while the retail margins in Kamloops appear to be more consistent with other locations. Chart 2.0.2, also found in section 4 of the Phase 1 report, illustrates these findings.

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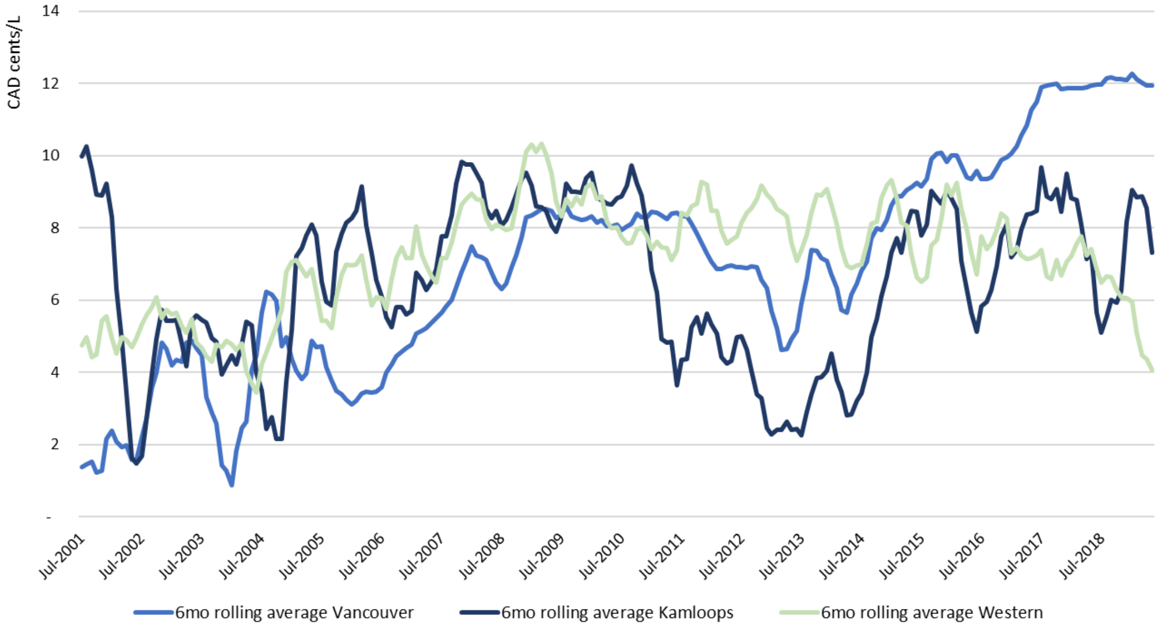
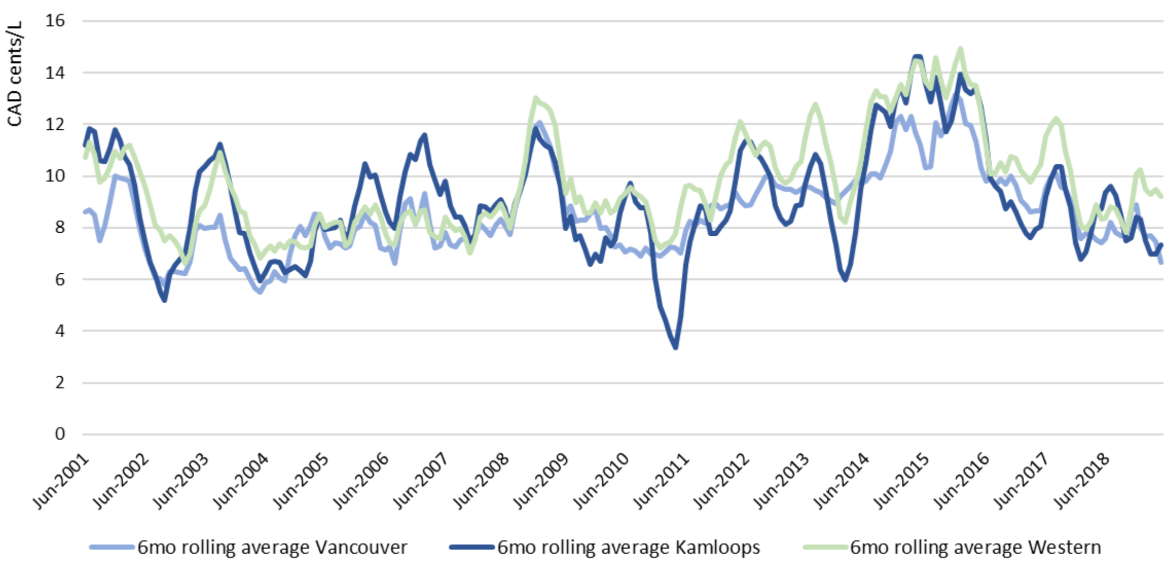
[7] Greater Vancouver includes Vancouver to the following boundaries: North to and including Lion's Bay, West to and including Bowen Island, South to the international border, East to and including the municipalities of Langley, Maple Ridge and Pitt Meadows. This area is consistent with e South Coast Transportation Service Area for taxation purposes.

***Chart 2.0.2 Six month rolling average gasoline retail margins in Vancouver, Kamloops and the Western Region*[8]**



In contrast, diesel retail margins have been consistent across regions for the period reviewed, as illustrated in Chart 2.0.3.

Chart 2.0.3 Diesel retail margins in Vancouver, Kamloops, and the Western Region



As a result, in what follows, this report assesses whether there are data-driven explanations consistent with a well-functioning competitive market that can account for the creation of a differential between retail margins in Vancouver and those found in the Western Region.

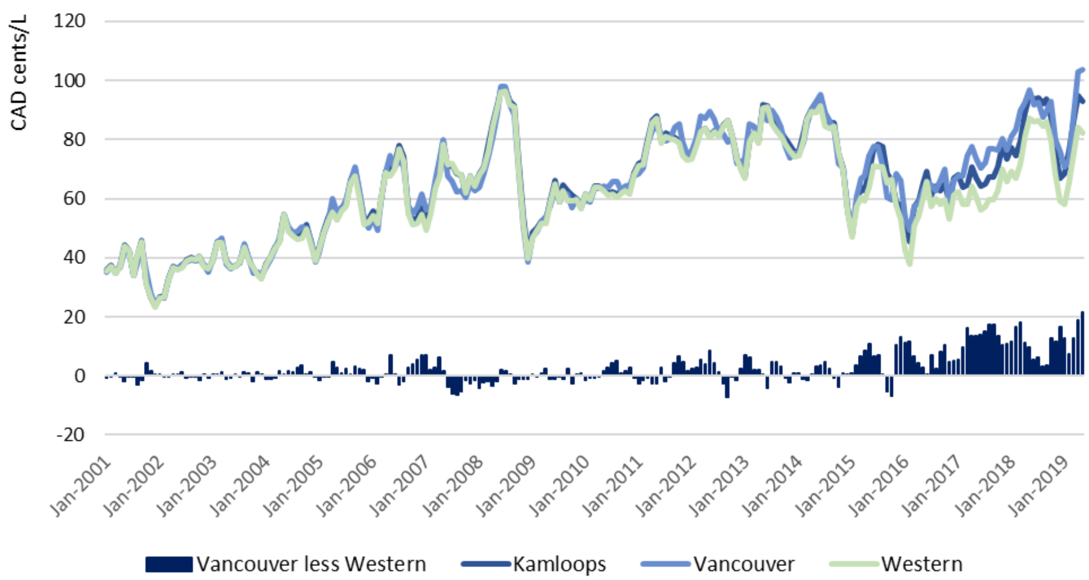
[8] As in Phase 1 of this report, a six-month rolling average is illustrated to clarify the long-term trends and smooth over day to day variability.

Wholesale Prices

> ***Wholesale Prices***
>
> Delivered price of refined products set by refiners for sale of fuel to retailers or other purchasers. Actual price paid is subject to commercial agreements.

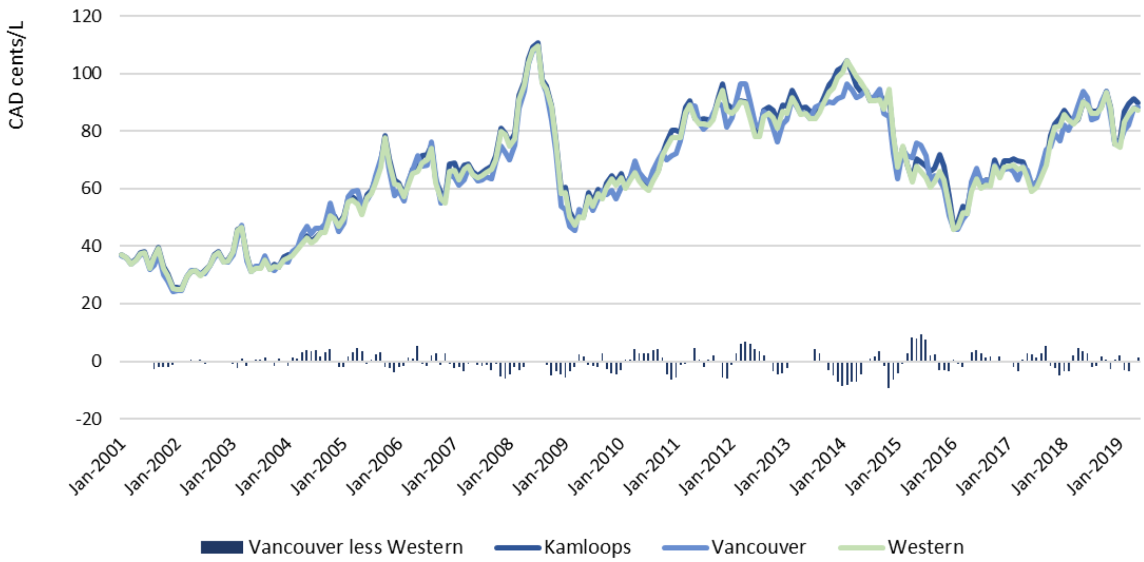
Wholesale gasoline prices in BC have experienced an escalation over the last few years. Phase 1 of this report illustrates how wholesale prices in BC (Vancouver and Kamloops) have grown beyond the wholesale prices observed in the Western Region. As illustrated in Chart 2.3, this differential emerged in 2015. The bars plotted below represent Vancouver prices less Western wholesale prices. The growth in the bars illustrates how Vancouver prices have climbed above those in the Western Region.

Chart 2.0.4 Wholesale gasoline prices in Vancouver, Kamloops, and the Western Region



As with retail margins, wholesale prices for diesel remain consistent across regions. Chart 2.0.5 compares wholesale diesel prices across BC and the Western Region.

Chart 2.0.5 Wholesale diesel prices in Vancouver, Kamloops, and the Western Region



The Phase 2 report seeks to identify the portion of the retail margin and wholesale gasoline price differentials which can be explained using available data. Specifically, it aims to address the following questions:

1. Why have gasoline retail margins in Vancouver risen above what is observed in Kamloops and the Western Region?
2. Why have wholesale gasoline prices in BC (Vancouver and Kamloops) risen above what is observed in the Western Region? (Note: This comparison is also extended to the Western United States.)

The report primarily considers gasoline prices as diesel prices have not been subject to the same variation in prices. Section 5 is devoted to linking gasoline retail margin and wholesale price behaviour to what is observed in the diesel market in order to reconcile the explanatory variables identified in the gasoline market with the pricing behaviour seen in the diesel market.

3. Retail Margins

Observations

4. Retail margins are influenced by several key factors, including operational costs, land costs and competition.

5. The competitive landscape and other operational cost components at the retail level do not appear to have changed substantially in the Vancouver area when compared to jurisdictions in the Western Region.

6. The most important factor that may be influencing retail margins in the Vancouver area is the rising cost of land.

Retail margins for gasoline in Vancouver have grown beyond what is observable in other Western Canadian cities. The total retail price is composed of the wholesale price, the applicable taxes, and the retail margin (or marketing margin). Specifically, and as noted in Section 2 above, the retail margin is calculated as:

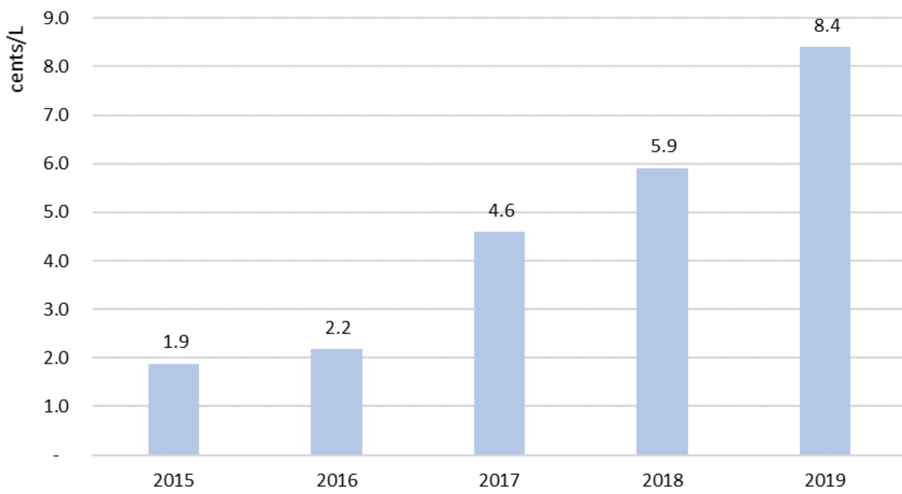
Retail Margin = Retail Price – Taxes – Wholesale price

The retail margin reflects several factors, including:

1. Operational costs: This includes the costs associated with staff, equipment, payment processing, meeting technical and safety requirements, etc.
2. Land costs: This includes the costs of a physical facility which requires retail space close to where people live. The high direct costs of land or opportunity costs of land could drive up the required margin.
3. Competition: A reduction in competition across retailers could result in market power, allowing retailers to raise prices and experience higher profits.

The chart below indicated the retail margin differential in Vancouver with respect to the average across the Western Region.

Chart 3.0.1 Retail margin differential in Vancouver relative to Western Region



In this section, the explanatory variables will be applied to the current retail margin differential in order to explain, where possible, reasons for the overall retail margin differential.

3.1 Operational Costs

If cost components which must be paid by all retail stations in the same jurisdiction rise then, given that demand for gasoline is relatively inelastic[9], economic theory indicates that the majority of these costs will be passed on to the consumer. These cost components are called operational costs and are required in order to provide the service of gasoline retail sales. Three aspects of operational costs were highlighted by interveners. These are summarized here and described in more detail in this section.

1. Throughput: If the amount of gasoline sold at each station decreases, then the retail margin on a cents/L basis would need to increase since the same costs (labour, land lease, etc.) must be recovered on a lower volume of fuel.
2. Credit card processing fees: Since credit card processing fees are charged on a percentage basis (e.g. 1% of the transaction) then the total amount paid on a cents/L basis rises with the total costs. This means that higher wholesale costs and higher taxes will result in greater credit card processing fees.
3. Labour costs: Most convenience store and gas station staff are paid close to minimum wage. If the minimum wage is higher in BC than in other locations, this will be passed on to the customer through increased retail margins.

Throughput

In this section, retail margins are assessed on a cents per litre (cents/L) basis. Since most gasoline stations are now self-serve (>75%),[10] the marginal cost of selling a litre of gasoline is quite low. That is, the same permits, storefront, staffing, etc. are required whether the retailer is selling 100 litres or 1,000

[9] Bureau of Labor Statistics, Using gasoline data to explain inelasticity, March 2016
[10] See Kent Group Ltd, Retail Census Report 2016

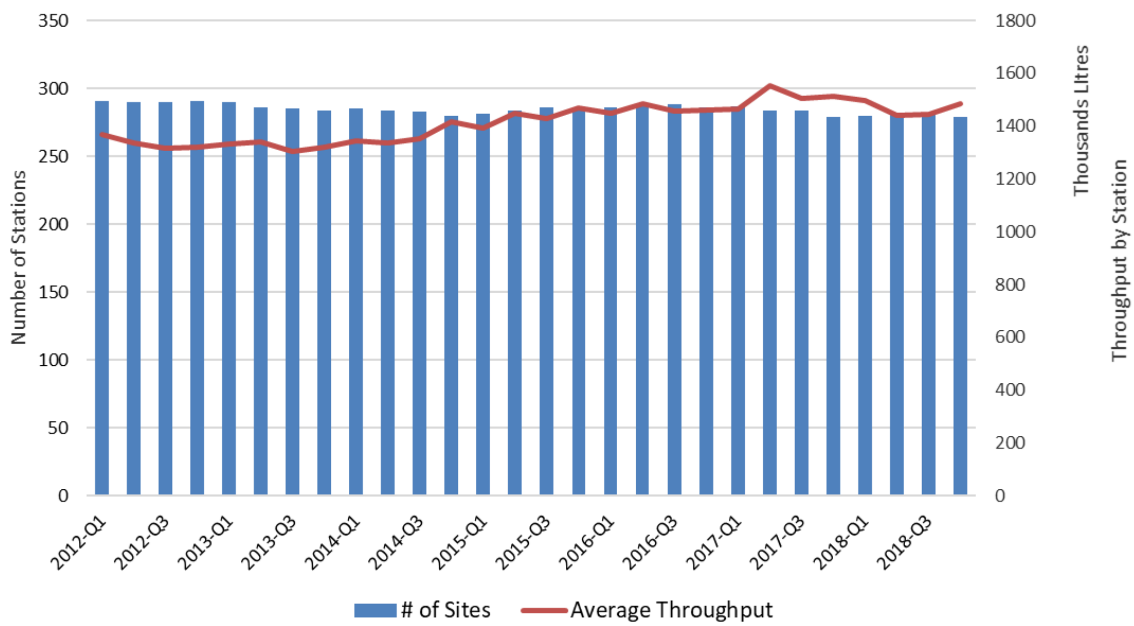
litres of gasoline. This means that high volume stations incur a lower operating cost per litre than similar, low volume stations.

Average throughput per station = Total throughput / Number of retail stations

If a region is experiencing a change in the average throughput by station (throughput is the number of litres sold at a station), then it is expected that a change in retail margins would be observed. For example, if more retailers are opening and if throughput per retailer is falling, then retail margins may need to increase on a cents/L basis in order to cover all of the fixed costs of operating the retail facility.

To test whether this has occurred in Vancouver, average throughput was calculated and compared across Vancouver and Kamloops. As illustrated in the charts below, there appears to have been a slight increase over time in average throughput per station in both Vancouver and Kamloops, with a quarterly average throughput of ~ 1.6 million litres/station in both locations. Therefore, if the throughput change resulted in a change to retail margins (cents/L), it would likely be downward.

Chart 3.1.1: Vancouver average throughput per station[11]



[11] This is chart is based on a custom report purchased from Kent Group Ltd. This report includes all grades of gasoline and diesel.

***Chart 3.1.2: Kamloops average throughput per station*[12]**

In Kamloops, throughput peaks in the summer months and decreases in the winter months. This is consistent with expectations for a relatively low population city that is also a popular tourist destination. As tourists drive to or through Kamloops for summer vacation and the number of stations remain constant, throughput rises.

Since average throughput has remained relatively constant over the time period considered, a reduction of throughput per station in Vancouver does not appear to be a valid cause of increased retail margins. Additionally, throughput in Vancouver and Kamloops are very close to one another, indicating that Vancouver, where retail margins have been higher, was not starting from a relatively low throughput value.

Credit Card Processing Fees

In general, retail margins will not scale with the price of gasoline. This is because the retail margin must cover the costs associated with items that are not directly accounted for in the wholesale price of gasoline. These items include the costs associated with profit, land costs, staff costs, machinery and equipment costs, etc. which do not necessarily change as the price of gasoline changes. This is why, thus far in the analysis, retail margin has been discussed on a cents/L basis, rather than a percentage basis. However, an exception to this is the credit card processing fees. These fees are applied as a percentage of the purchase and therefore scale with the absolute value of the transaction being made at the retail station.

In Canada, credit card processing fees for regular cards are estimated to be between 1.65% and 1.75% of the transaction made, while premium cards may charge between 1.75% and 2.71%.[13] As an example, charging 2% on a purchase means that all additional costs and taxes are further increased by 2%. The following table illustrates this point.

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[12] Ibid.

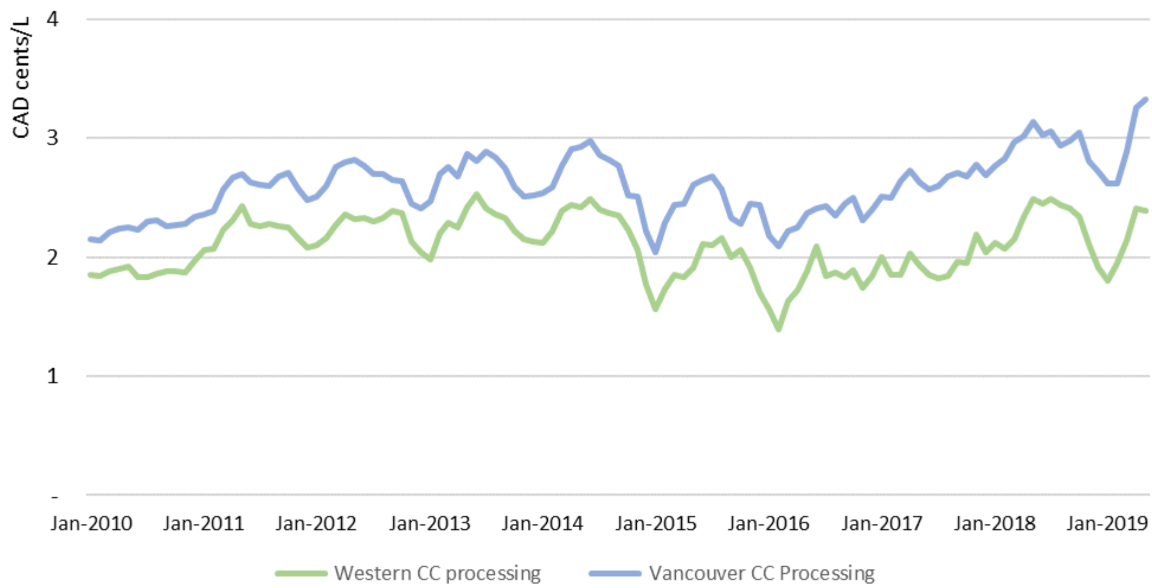
[13] Canadian Federation of Independent Business

Table 3.1.3: Illustrative example of incremental difference driven by credit card processing fees.

	Pre-processing fee cost	Including processing fees
Wholesale price	90 cents /L	91.8 cents/L
Retail margin	10 cents/L	10.2 cents/L
Taxes	40 cents/L	40.8 cents/L
Total	**140 cents/L**	**142.8 cents/L**

To estimate the impact of credit card processing fees, it is useful to consider the cost per litre of these fees in Vancouver compared to the Western Region using a *high* benchmark of 2%.[14] The highest reasonable estimate for credit card processing in Vancouver results in ~3.0 cents/L in 2019. Applying the same parameters to the Western Region results in ~ 2.4 cents/L in 2019.

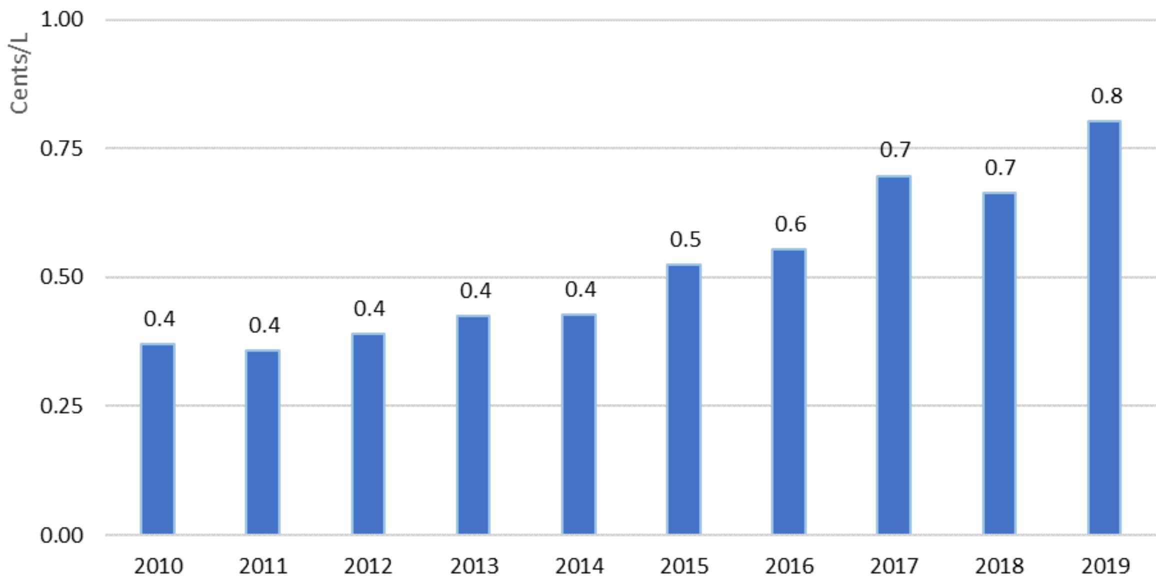
Chart 3.1.4 Estimated cents/L cost of credit card processing fees



A comparison of the credit card processing fee differentials between the Western Region and Vancouver in Chart 3.1.5 indicates that the impact of credit card processing is estimated to be ~ 0.4 cents /L higher in Vancouver than the Western Region from 2010-2014. The credit card processing fee differential steadily increased to 0.8 cents/L by 2019.

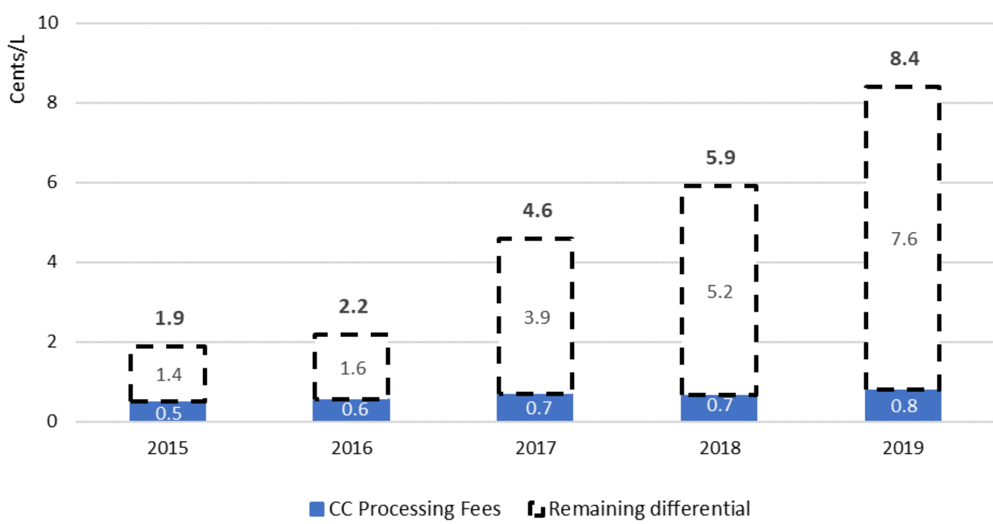
[14] Calculation uses the total cost including taxes of gasoline across the noted jurisdictions as follows: 2%*(total price/1.02) = processing fee.

Chart 3.1.5 Estimated credit card processing fee differential in Vancouver vs. Western Region



Even at a fee rate of 2% (a high benchmark) and assuming that all payments are made via credit card, removing the incremental credit card processing fees reduce the retail margin only slightly, as shown in the Chart 3.1.6 below.

Chart 3.1.6 Retail margin excluding incremental credit card processing fees



Labour Costs - Minimum Wage

Labour costs were highlighted by several interveners to the BCUC inquiry as a primary cost driver which has contributed to higher retail margins in BC. According to WorkBC the median wage rate for gas station attendants in 2017 was CAD 11.50/hr.[15] BC's minimum wage in 2017 grew from CAD 10.85/hr to CAD 11.35/hr, indicating that the minimum wage is likely the key factor for determining wages at retail

[15] Work BC, Labour Market Outlook: 2018 Edition

gasoline stations. In order to determine whether minimum wages have risen above other comparable jurisdictions in the 2015-2019 period, minimum wages in BC, and those provinces in the Western Region (Alberta, Saskatchewan, Manitoba) were assessed.

Chart 3.1.7 Provincial minimum wages[16]

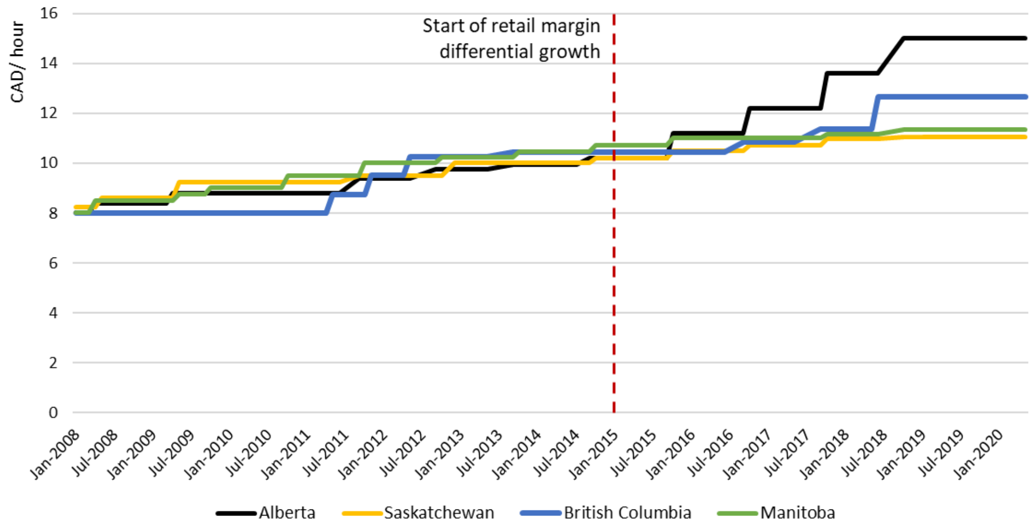


Chart 3.1.7 was created using Government of Canada historical data on minimum wages across the country. The chart illustrates that BC's minimum wage has been below the minimum wage in Alberta for nearly the entire observation period. Since the start of 2016, BC's minimum wage did not rise above those in Manitoba and Saskatchewan until 2018 and remains below the minimum wage in Alberta. Therefore, it is unlikely that the impact of a rising minimum wage in BC is the cause of growing retail margins in BC relative to the Western Region. If minimum wage had any impact, it would be expected that the lower minimum wage requirement in BC would result in lower retail margins in BC vis-à-vis Alberta.

3.2 Competition

Generally, if a firm selling an undifferentiated good raises its price in a competitive market, it will experience a loss in volume of sales and subsequent declines in overall profits. In other words, under competitive conditions, if one supplier raises its price vis-à-vis other suppliers, it will lose market share and its profits will fall. If a firm can raise prices and experience a rise in profits, that firm has market power.

> ***Market Power***
>
> The ability of a firm (or group of firms) to raise and maintain price above the level that would prevail under competition without losing profitability.

In the case of largely undifferentiated goods, market power may be present when one firm has a monopoly (only one supplier in the market) or several firms have an oligopoly (few suppliers).[17]

[16] Government of Canada, Open Data
[17] OECD Glossary of Statistical Terms

Since retail margins across jurisdictions appear to have been relatively well aligned until the post-2015 period, it is useful to examine the total number and the type of retailers in BC in order to determine if there has been a change in the competitiveness landscape in the post-2015 period.

In this regard, this section considers:

1. The number of retail stations in BC
2. Distribution of marketers in BC

Since retail margins have grown more in Vancouver than in Kamloops, it would be preferable to assess the level of retail competition in Vancouver and Kamloops separately. This level of data was identified for total number of retailers in each region, however only Provincial-level data was available for the marketers and their distribution in BC. Therefore, retail competition can only be assessed partially on a provincial and partially on a segmented basis for Vancouver and Kamloops.

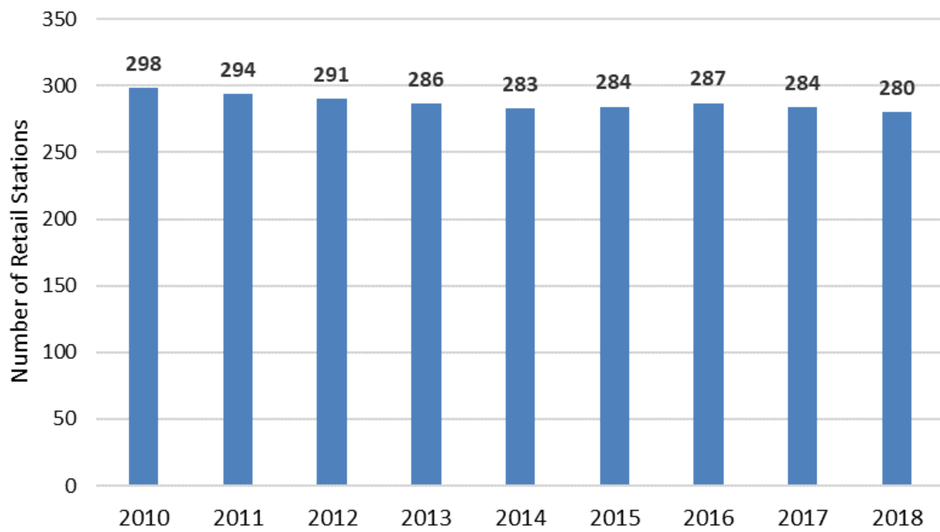
Number of Retailers

A decline in the number of retailers in Vancouver could cause increases in prices for two reasons: (1) reduced competition; or (2) increased "switching costs". Switching costs in this case refer to the costs in time, effort, and the direct cost (fuel consumed) that a driver must incur to travel to the cheapest station. As an illustrative example of switching costs, a driver may be willing to drive 1 km to save 3 cents/litre but may not be willing to drive 5 km to save 3 cents/litre. In the latter case, the switching costs would be too high and the driver would purchase more expensive gasoline rather than drive further for the cheaper gasoline. With fewer stations in any given geography, the switching costs will likely increase for at least some drivers, potentially allowing prices to trend higher.

However, the data (as illustrated in Chart 3.2.1) do not appear to indicate that the number of retail stations in Vancouver has been significantly declining over the 2012 to 2018 period.

Chart 3.2.1: Number of retailers in Vancouver[18]

[18] Kent Group Ltd, Unique report. Recall: Vancouver refers to the Greater Vancouver Area.



Since 2010, there has been a small decline in the number of retail stations in Vancouver (total of 6% decline from 2010 to 2018). However, with annual variation of 0.4% to -1.4 %, it is unlikely that a decline in the overall number of retailers in Vancouver has been a driver for reduced competitiveness in either the pre- or post-2015 periods.

Distribution of Marketers

As discussed in Phase 1 of this report, each retail station is associated with a marketer that supplies gasoline to the retail station. In some cases, the retail price is controlled by the marketer and, in others, it is uncontrolled with prices being set by the retailer. This section compares the distribution of marketers in BC to distribution in Alberta, as a nearby market and assesses the following:

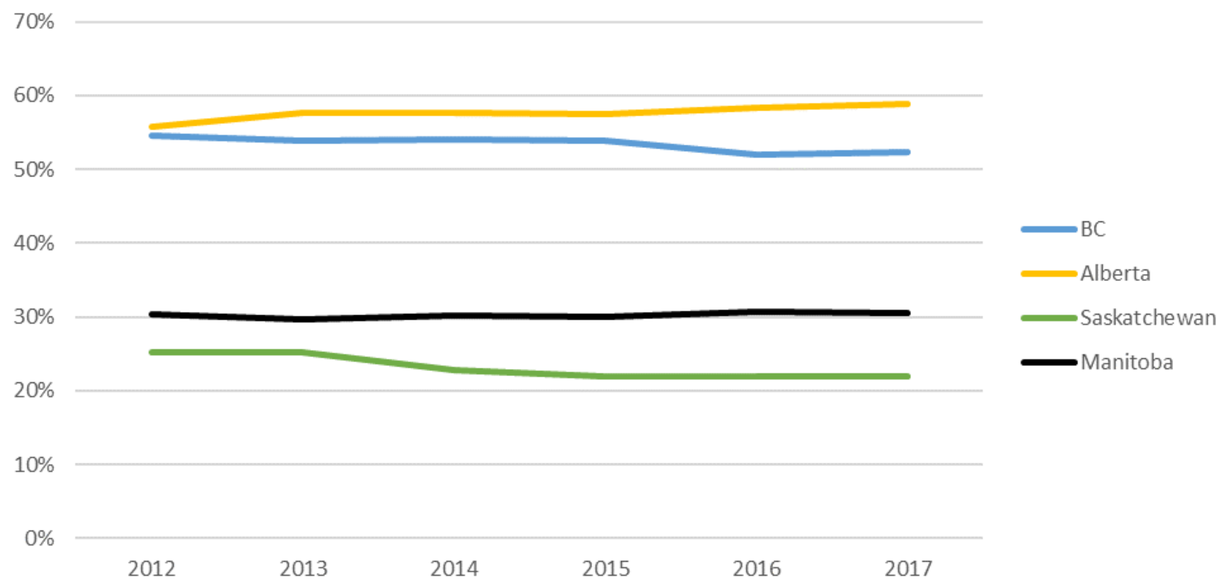
1. The share of retail stations which have marketer-controlled prices
2. The level of market concentration of both the marketers and the marketer-controlled retail stations

This comparison suggests that the distribution of marketers remained relatively consistent between 2012 and 2017. In other words, the analysis below does not reveal major changes in the competitive landscape that might account for retail margin differentials.

Share of Marketer-controlled stations

An area in which retail competition could be altered relates to the total number of retail stations which are "marketer-controlled", that is, the price is controlled by the marketer. These stations are contrasted with "uncontrolled" retail stations where the marketer sells the station gasoline and does not have a direct role in determining price. As illustrated in the chart below, the total share of *controlled* retail stations across BC and Alberta has remained fairly consistent between 2012 and 2017.

Chart 3.2.2: Share of marketer-controlled stations across Alberta and BC



Market Concentration

There are two common tests used to evaluate the level of concentration in a market. For consumers, low concentration is generally desired in a market because it is a signal of high levels of competition. For example, having hundreds of firms supplying coffee will result in lower prices for consumers than if coffee is only available from one firm, the latter being the extreme example of a monopoly. The two tests used are the **Four Firm Concentration Ratio**, and the **Herfindahl-Hirschman Index.**

The Four Firm Concentration Ratio (CR_4) measures the total market share of the four largest firms in an industry. The CR_4 measurement can be understood as follows:

Market Concentration Level	CR_4 Value
Low concentration	Between 0% and 40%
Moderate Concentration	Between 40% and 70%
High Concentration	Between 70% and 100%

The primary drawback of the CR_4 test is that is does not capture shifts in market concentration amongst the top four firms. A second measure of market concentration which can capture differences between concentration levels among top firms is called the Herfindahl-Hirschman Index (HHI). The HHI calculates a score based on the squared market share of each firm.

Market Concentration Level	HHI Value
Low concentration	Below 0.15
Moderate concentration	Between 0.15 and .25
High concentration	Above 0.25

Hefindahl-Hirschamann Index Calculation

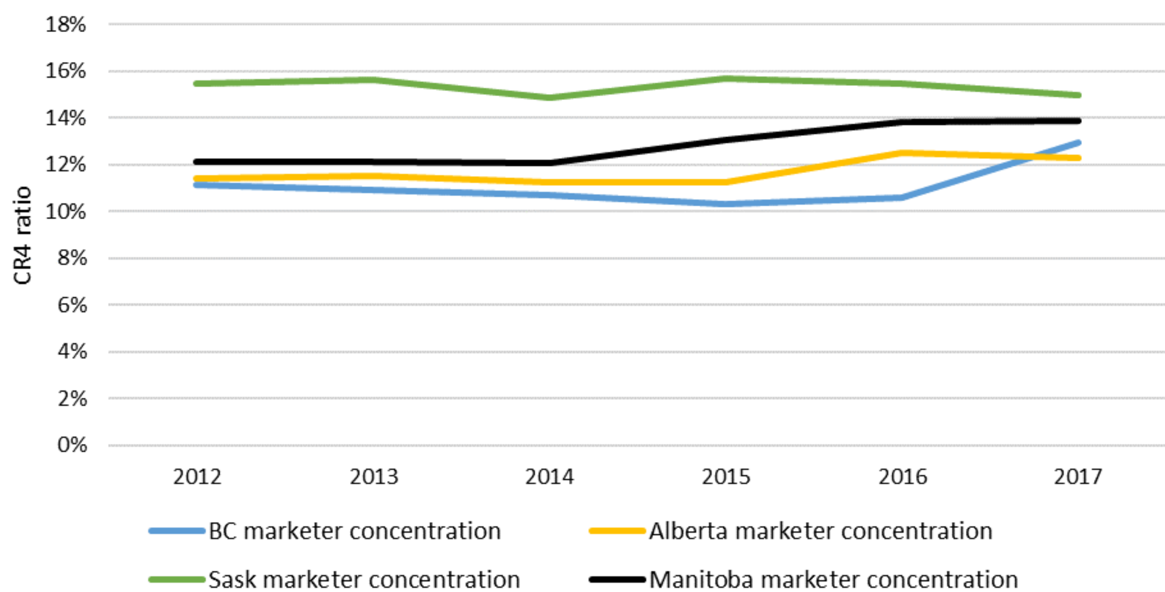
The HHI is calculated as follows where s= share of the market for firm i. As $HHI = \sum_{i=1}^{N} s_i{}^2$

Each of these measures of market concentration are applied to all marketers across BC and Alberta (i.e. marketer-controlled as well as uncontrolled retail stations). They are then applied more specifically to the concentration of marketer-controlled retail stations. Both measurements are based on the number of stations rather than total sales due to available data limitations.

All Marketers

Here the number of retail stations which each marketer supplies are compared across BC and the other Western Region Provinces using the CR_4 and the HHI measures.

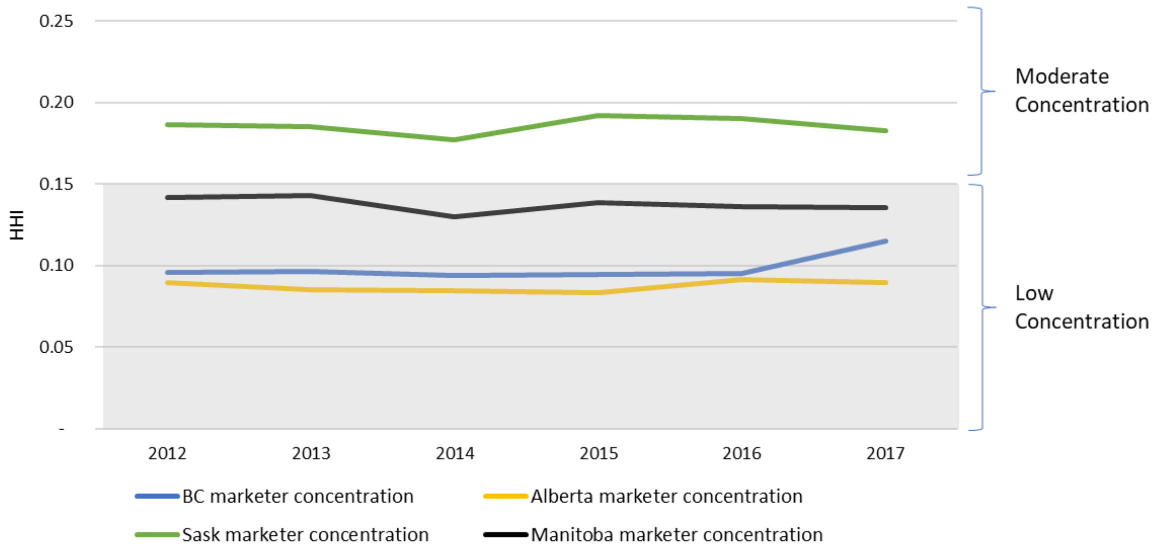
Chart 3.2.3: Four Firm Concentration Ratio, Marketers



In Chart 3.2.3 each line represents the share of retail stations in each Province which are supplied by the four marketers that supply the most retail stations in the relevant province. The Four Firm Concentration Ratio in Chart 3.2.3 illustrates that within each province the concentration of marketers has remained well within the "low concentration" category (0%-40%).

The HHI calculation in Chart 3.2.4 illustrates that the measure is quite consistent across time for each province and the only province not in the "low concentration" group is Saskatchewan. Each line indicates the percentage share of all retail stations supplied by each marketer in BC (squared and summed as per the HHI calculation).

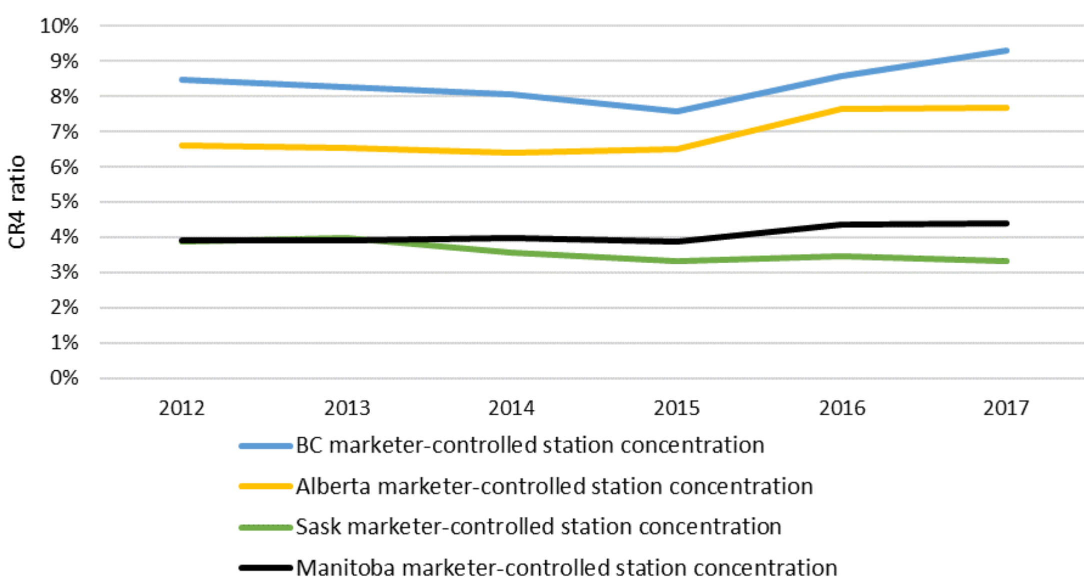
Chart 3.2.4: Herfindahl-Hirschman Index, Marketers



Marketer-Controlled Stations

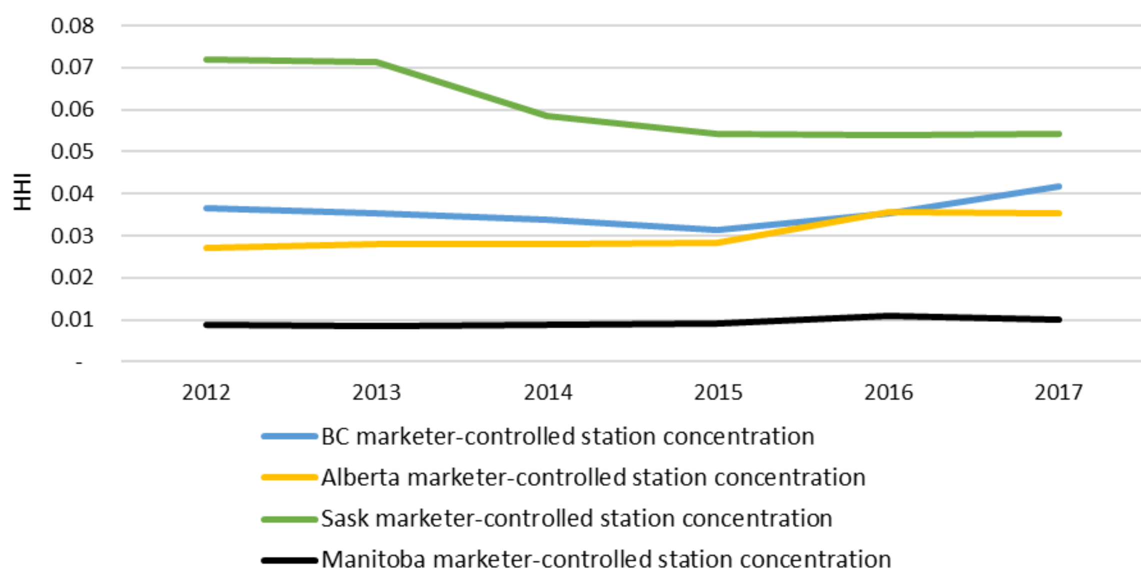
The market concentration of the marketer-controlled stations for all provinces assessed are within the "low concentration" group for the CR_4 and the HHI measures. In the CR_4 chart below each line represents the share of the retail stations in each province which are marketer-controlled by the four largest marketers.

Chart 3.2.5: Four Firm Concentration Ratio, marketer-controlled retail stations



The HHI Chart for marketer-controlled statiosn returns similar results, where all provinces are generally consistent over time and all provinces are within the "low concentration" group. Each line in the chart below is the relevant percentage share of all retail stations which are controlled by each marketer in BC (squared and summed as per the HHI calculation).

Chart 3.2.6: Herfindahl-Hirschman Index, marketer-controlled retail stations



Given these results, it does not appear that competition in the retail space has undergone substantial change in the pre- and post-2015 periods and therefore no evidence was found based on market composition and concentration to suggest that the competitive landscape in BC has changed over these periods.

In short, according to available data for BC and the Western Region, it does not appear that the competitive landscape significantly changed between the pre- and post-2015 periods. However, it is important to note both that provincial level data was used for this analysis and number of retailers was used rather than total volume of sales as a result of data limitations. As a result, the analysis does not necessarily imply the same conclusion apply at the municipal level. For example, it is possible, although not indicated by the available data, that the distribution of marketers in Vancouver has changed over the pre- and post-2015 period.

3.3 Land Costs

The costs to own or lease land for a bricks and mortar retail storefront will vary depending on the location of the storefront. For example, it would be expected that the costs of storefront ownership would be higher in cities with higher real estate costs (e.g. Vancouver, Toronto) and lower in cities with lower real estate costs (e.g. Ottawa, Montreal), all other factors being equal. In other words, it is expected that cities with similar cost structures would have similar retail margins.

With this in mind, it is useful to consider two scenarios to explore how increasing land costs could lead to higher retail margins on gasoline.

Illustrative Scenario 1: The retailer is renting the land from the property owner

In a competitive market, the cost of purchasing land should be equal to the discounted stream of revenues offered by that land. The discount rate is the purchaser's "time value of money" (i.e. the next best revenue-generating activity that the money could be used for) and is set at 8% for the purpose of this example. In finance, that stream is considered to be *in perpetuity* and results in the following equation:

Land value = annual rent / discount rate

If a renter (in this case a gasoline retailer) is paying CAD 20,000/month (CAD 240,000/year) to a landowner, and the landowner has an 8% discount rate, the land value would be valued by the landowner at no less than CAD 3,000,000. The rent will be set by competitive factors, however, the minimum acceptable rent to the landowner would be the opportunity cost of the land (i.e. the next best use of the land).

Consider a scenario where there is high growth in land values (for example, driven by an appreciating local housing market) and this growth compels a developer to offer the landowner CAD 4,000,000 for her property. Given this opportunity, and the landowner's time value of money, the landowner would be, economically speaking, just was well off if she sold the property for CAD 4,000,000 or if she rented the property for CAD 27,000/month (based on the calculation stated above where ***Monthly Rent= Land Value *discount rate/12*)**. In fact, in this illustrative example, the minimum rent that the landowner would accept would be CAD 27,000/month.

If the retailer wants to stay in business she must accepts this 33% increase in the rental payment (from CAD 20,000/month to CAD 27,000/month), and to prevent a decline in profitability the additional rental costs need to be covered by additional revenue. This can be done either by increasing throughput (number of litres sold) and/or increasing retail margins (on a cents per litre basis), both of which would increase revenues and help to preserve profitability (or at least allow the retailer to cover her costs). Since gasoline demand is fairly consistent in B.C., and the number of retailers is relatively stable, it is reasonable to conclude that the additional revenues would be primarily made up by increasing the retail margin (on a cents per litre basis).

Indeed, the principal components analysis (PCA) described in more detail below demonstrates that Vancouver's retail margins are clustered most closely with those found in Toronto. This may indicate that one of the most important factors determining retail margins relates to the relative costs of doing business in the location selected.

Illustrative Scenario 2: A retailer is the property owner

The retailer in this example owns the land and is looking for the next best use of the land and asking herself, "should I continue to operate or should I close and sell the land to a developer?" In this way, the retailer is making the same calculation as the landowner in Scenario 1.

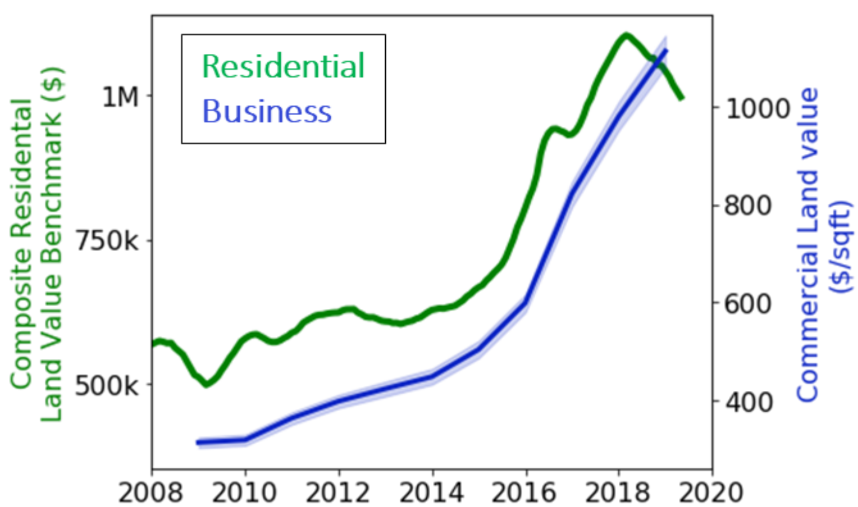
In Scenario 1, the landowner increases the rent, and thus the cost structure to the renter (the retailer) increases, requiring that the retailer sell more and/or increase prices. In Scenario 2 the retailer must consider that if the property increases in value then the retail margin must increase, or the station must sell more volume. If neither of these changes are implemented, it would be more profitable for the retailer to close the gas station and sell the land.

Anecdotally, these dynamics seem to be at play, at least in Vancouver's centre and west side, where numerous gas stations have been closed and the land repurposed. For example, Chevron sold its West Georgia Street location to a real estate developer for $72 million in April 2017. A Chevron spokesperson noted that the sale was a real estate decision and that the site was "… one of the highest performing sites in our network in B.C. but, given the vibrant real estate market in Vancouver, we made the decision last year to put the site on the market and now it is sold."[19]

Specifically, if this hypothesis is correct, it is expected that growth in Vancouver's retail margins would coincide with a rise in commercial real estate values. If the value of the *next best* use of the land rises, the return must rise or the land will be sold. For example, if the land used for the storefront location could be sold for a housing development (subject to zoning considerations), the property owner will require a higher return on either (i) lease/rent payments as in Scenario 1 above (i.e. the landowner rents the property to the retailer), or (ii) from the retailing business, as in Scenario 2 above (i.e. the retailer is also the landowner). Otherwise, the landowner will be better off selling the land.

Vancouver has had rapid growth in both commercial and residential real estate prices since 2015. In Chart 3.3.1 composite residential housing prices from the Canadian Real Estate Association[20] are plotted with commercial land values from BC Assessments for Vancouver. Specifically, the commercial values are those of the land use category *06-Business and Other.*[21] The correlation coefficient for these two series is very high at 0.97 (on a scale from -1 to 1, with 1 being perfectly correlated and -1 being perfectly inversely correlated).

Chart 3.3.1 Residential and commercial real estate values in Vancouver[22]



Since there has been a highly correlated relationship between commercial and residential values, and there is a lack of available commercial values for other Canadian jurisdictions, the remainder of this section uses residential values as a proxy for commercial values.

[19] Business in Vancouver, Anthem Buys West Georgia 2017

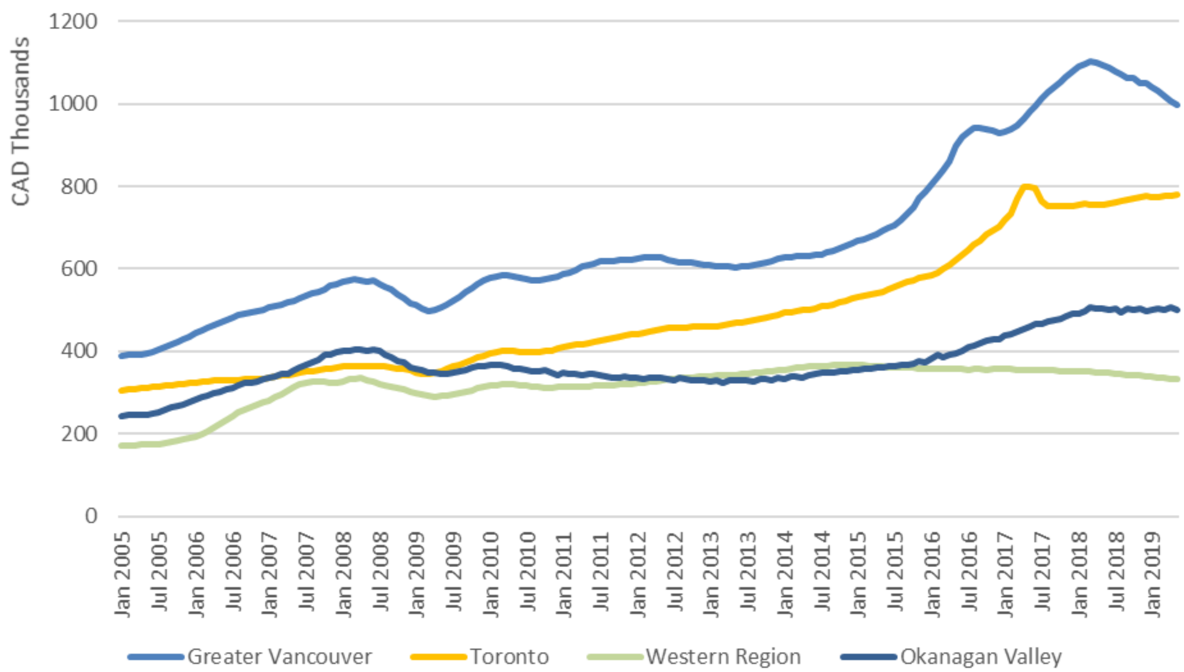
[20] CREA has provided written consent to use Benchmarked Composite Housing Price data for this report

[21] Business- Other includes property used for offices, retail, warehousing, hotels and motels all fall within this category. This class includes properties that do not fall into other classes. For more details see BC Assessment

[22] Permission from BC Assessment to use their data in this report

The only other Canadian city which has experienced land price growth nearing the same rate as Vancouver is Toronto. Chart 3.3.2, shows benchmarked composite housing prices from the Canadian Real Estate Association for Vancouver, the Okanagan valley (as an adjacent / neighbouring proxy for Kamloops), Toronto, and the Western Region.[23] It is clear that real estate growth in Vancouver and Toronto has outpaced other Canadian jurisdictions of interest.

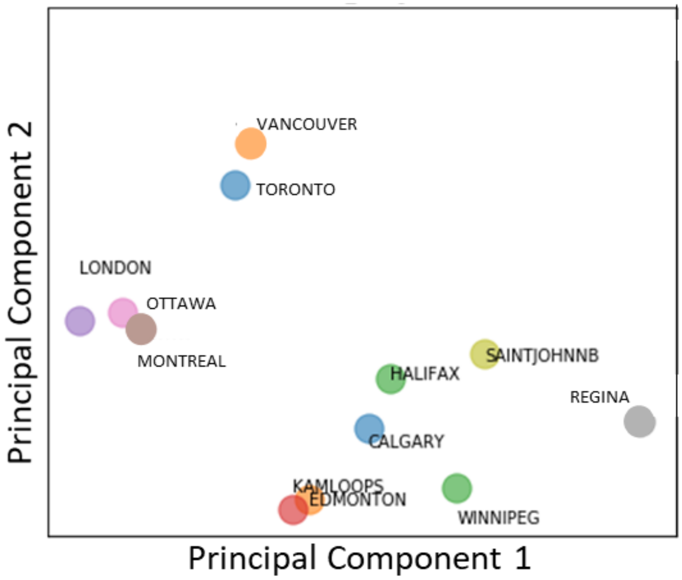
Chart 3.3.2 Benchmarked composite residential real estate prices[24]



A similar close relationship between the retail margins and real estate values exists in Toronto, as exists in Vancouver. This can first be visualized in a plot of the first two principal components from a Principal Components Analysis (PCA). In Chart 3.3.3 Vancouver and Toronto appear more closely related to one another than any other jurisdiction included in the analysis.

[23] Western Region here excludes Winnipeg due to data availability
[24] Residential data is seasonally adjusted by the CREA and available for download here

Chart 3.3.3: Principle Component Analysis: Retail margins across Canada [25]



> ***Principal Component Analysis***
>
> This analysis computes the time series (i.e. a series of values over time) that *best explains the variance* of retail margins in each city over time. It then finds the next best time series that explains the second most amount of variance. Chart 3.3.13shows the first two components which explain 50% of the variance in retail margins across cities. See Appendix 10 for more details.

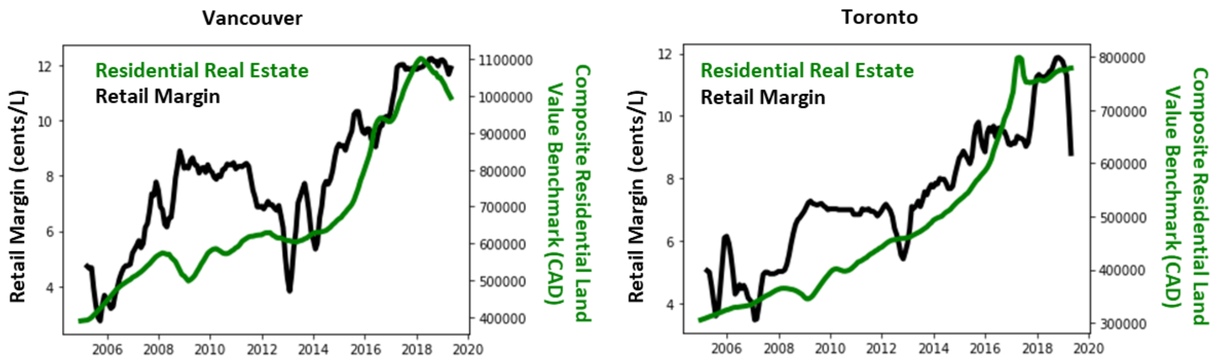
Plotting the retail margins in Vancouver and Toronto only, it is clear that these regions do appear to have closely aligned retail margins. (See Chart 3.3.4.)

Chart 3.3.4: Six-month rolling average retail margins in Vancouver and Toronto

Combing the land value and retail margin plots, it is clear how tightly correlated land values and retail margins are in Vancouver and Toronto. The correlation coefficients for residential land values and retail margins in Vancouver and Toronto are 0.72 and 0.73 respectively.

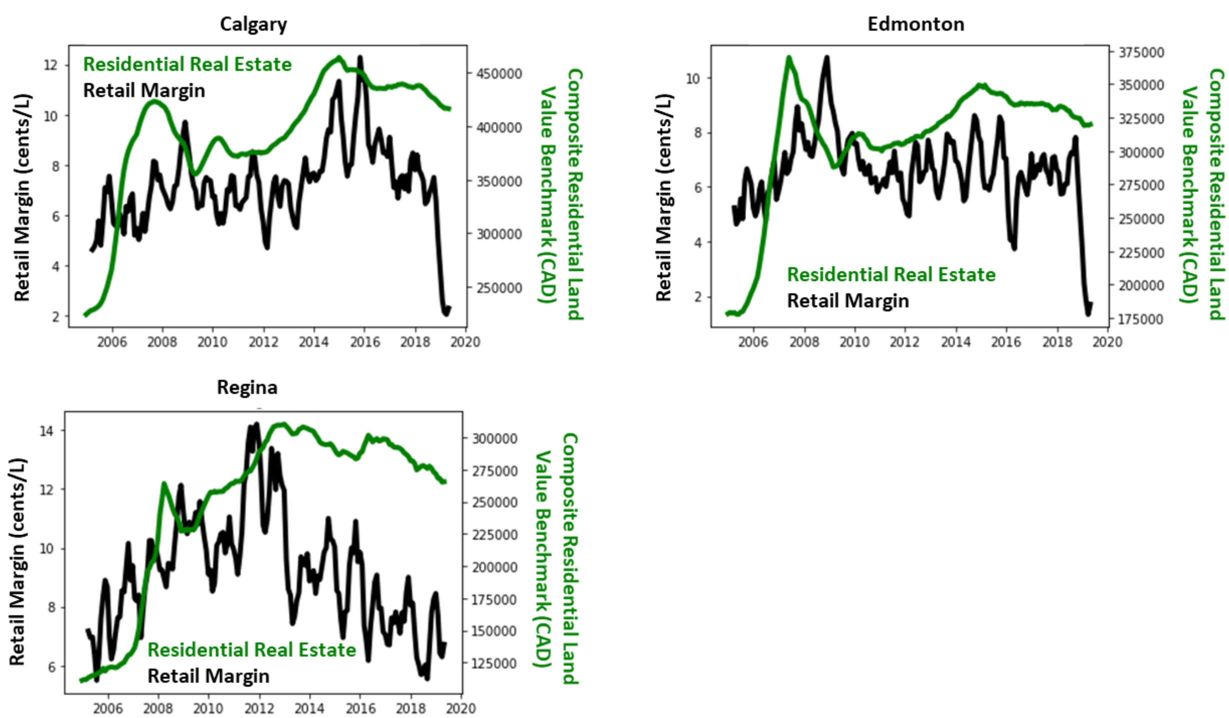
[25] See Appendix 10 for more details

Chart 3.3.5 Correlation between residential real estate and gasoline retail margins[26]



The correlation is evident in these cities with high real estate prices but is not evident when looking at data from cities which have experienced less dramatic growth. It is expected that since, as explored in Section 3, many factors affect retail margins, it is not until land values begin to outweigh all other factors that a clear relationship is evident. Chart 3.3.6 shows the lack of relationship between residential real estate values and retail margins in the available cities from the Western Region: Calgary, Edmonton, and Regina, with correlation coefficients of .13, .03 and .03 respectively.

Chart 3.3.6 Correlation between residential real estate and gasoline retail margins (Calgary, Edmonton, Regina)[27]



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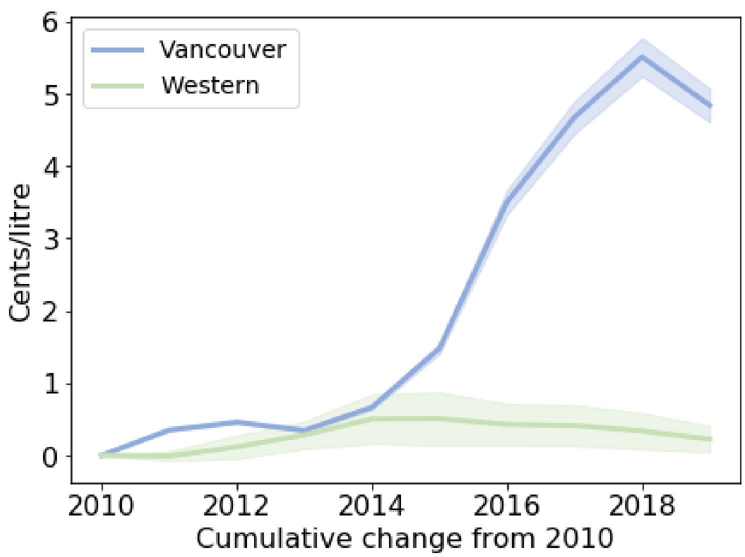
[26] Retail margins are a 4-month rolling average, residential data is seasonally adjusted by the CREA and available for download [here]

[27] *Ibid.*

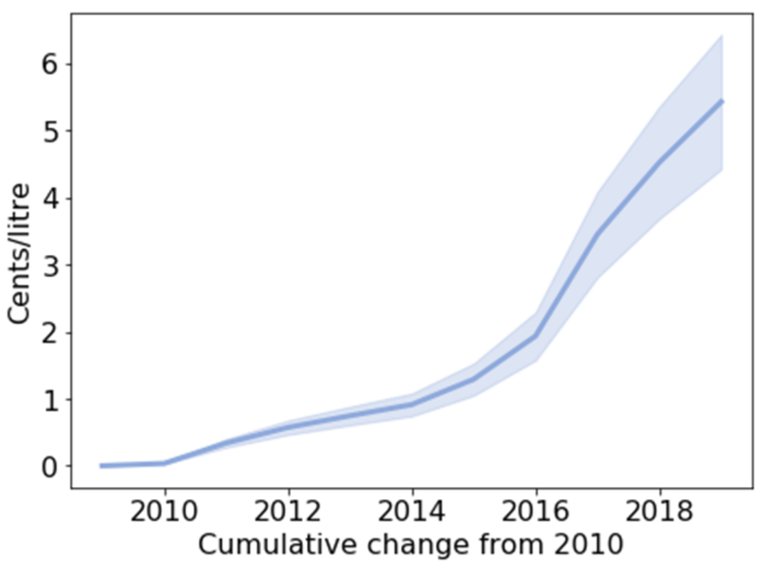
Chart 3.3.7 Estimated cumulative change in retail margin that could be attributed to real estate value (based on residential properties)



Using the data from Regina, Calgary, and Edmonton, a Western Region series is created. Comparing a regression analysis of retail prices against real estate values between Vancouver and this Western Region it is evident that real estate prices are strongly correlated, accounting for approximately 5.5 cents/L of retail margin in 2018 in Vancouver versus less than 1.0 cents/L in the Western Region. Note that the light area surrounding the Vancouver and Western lines indicate the error range.

Although the data is not available for the Western Region, a regression on Vancouver retail margins and commercial real estate values was also completed in order to capture any differences between commercial and residential real estate values in BC. This is of particular interest for the 2019 period when residential values appear to decline. [28]

Chart 3.3.8 Estimated cumulative change in retail margin that could be attributed to real estate value (Commercial properties)[29]

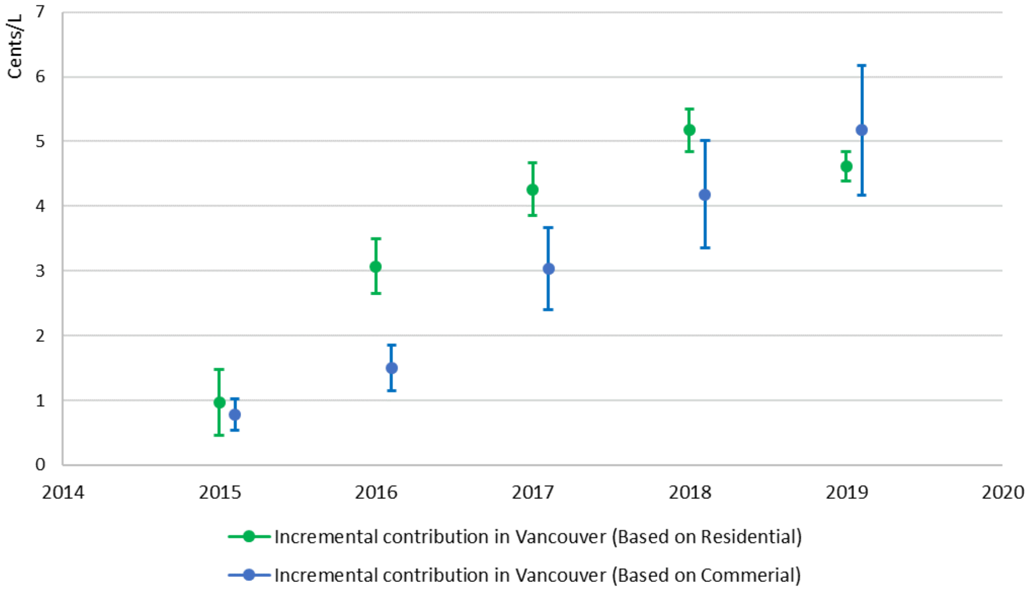


As expected, a similar degree of the differential can be explained using the commercial real estate values but the decline in 2019 is not observed. As a result, the differential in retail margins between Vancouver and the Western Region can be partially explained by land values, the estimated incremental difference is summarized in the chart below as a range between that can be explained using commercial and residential values.

[28] BC Assessment Data is only available on an annual basis and there's the correlation is expected to be slightly less robust than the correlation with residential prices. Regressing Vancouver retail margins on commercial land values results in an R-squared of 0.77

[29] '06– Business and Other' property class was used to defined commercial land. Retail margins used here are monthly retail margins averaged by year. Yearly commercial land value averages exclude properties < 100 sqft or > 10 acres.

Chart 3.3.8 Vancouver's retail margin differential explained by real estate values[30]



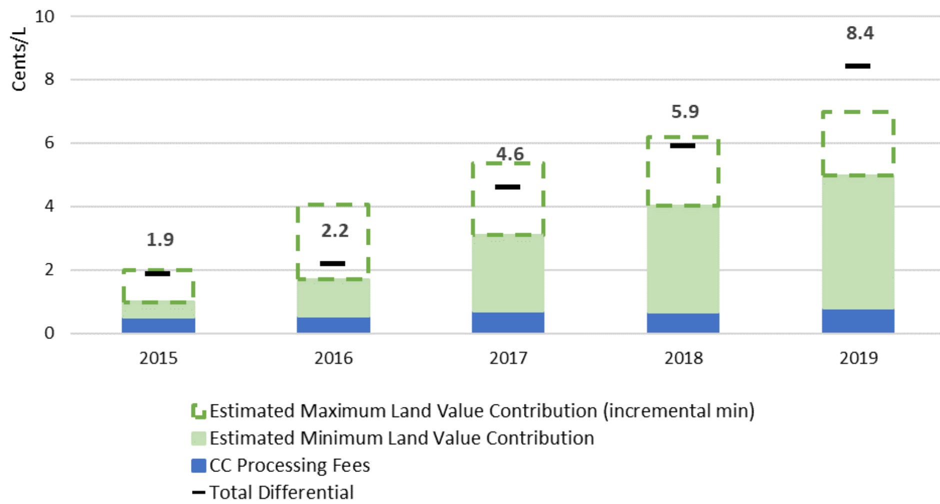
Therefore, given these correlations and the expected economic relationship between land costs and retail margins, it appears plausible that the rising land costs are increasing the retail margin in Vancouver. In 2019 land values in Vancouver are estimated to account for between 4.2-6.2 cents/L of the differential between Vancouver and Western Region retail margins.

3.4 Explainable Variance

Section 3 assessed several factors which could contribute to higher retail margins in Vancouver when compared to the Western Region. Several factors were not found to contribute to the differential in margins, including (i) changes in throughput, (ii) labour costs, and (iii) changes in competitive landscape. However, credit card fees and land costs were both found to have differential impacts in Vancouver in relation to the Western Region. Since credit card processing fees apply as a percentage on the total transaction, higher prices at the pump lead to incrementally higher credit card processing fees. This is estimated to account for less than 1 cent/ L of the retail margin differential. However, the steep rise in land values in Vancouver is estimated to potentially account for nearly 4.2-6.2 cents/L of the differential between Vancouver and other Western cities in 2019. The blue values in the chart below indicate the remaining differential which in most cases is close to zero, with the exception of 2019 where ~ 1.4 cents/L remain unexplained.

[30] The explained differential using commercial values for Vancouver and subtracting the incremental contribution of residential land prices to the retail margin in the Western Region

Chart 3.4.1 Explained retail margin differential and remaining retail margin differential



4. Wholesale

Observations

7. A comparison of wholesale gasoline prices between Vancouver, Kamloops, Seattle and Edmonton in the post-2015 period reveals that prices in Vancouver and Kamloops have been consistently higher than in Seattle and Edmonton. The differences in prices between BC jurisdictions (Vancouver and Kamloops) and those outside of BC (Edmonton and Seattle) is referred to as the wholesale price differential.

There are four main factors that may account for these differences:

- costs of inputs
- costs of the marginal unit of supply as determined by estimating transport costs
- the regulatory environment
- the competitive landscape

8. Changes to input costs are not expected to drive wholesale price differentials.

9. Although data is limited, the competitive landscape related to wholesale prices and refining does not appear to have significantly changed in BC over-time when compared to other jurisdictions.

10. Price differentials appear to be driven by three factors, albeit to varying degrees:

- Transport costs: Tanker truck delivery is likely the marginal transportation method for gasoline supply into BC, the costs of this form of transportation likely accounts for some of the differential between BC, Edmonton, and Seattle.
- Regulation: The Provincial Low Carbon Fuel Regulation may drive some additional costs in BC. However, the maximum impact is low in relation to the overall differential between BC, Seattle, and Edmonton.
- Import costs: Implicit barriers to trade may exist, which could add cost to the import of fuels from the United States.

The Phase 1 report indicated that BC's wholesale gasoline prices have risen above the historical differences with other Western regions. Comparing wholesale prices in BC to nearby jurisdictions is a simple check on the functioning of the gasoline production and distribution markets. This is because the market should adjust to take advantage of any *arbitrage* opportunity.

That is, if wholesale gasoline can be sold in Vancouver for a price that is higher than the price in a nearby jurisdiction plus the costs of transportation, then market participants should purchase gasoline and ship it to Vancouver to earn a profit.

At a macro-level, this allocation of a good to the market with the highest price is how short-run price differentials help allocate scarce resources and equalize long-run prices across jurisdictions.

Given BC's import profile and proximity to two refining hubs, this section compares Edmonton and Seattle prices with prices in Kamloops and Vancouver to estimate causal factors that may be contributing to the wholesale price differentials observed across these locations. Since the BC market's marginal unit of gasoline is imported and BC's closest sources of imported fuel supply are Alberta and Washington State, prices in Edmonton and Seattle provide useful comparisons. Chart 4.0.1 illustrates the gasoline wholesale price differentials between Vancouver versus Seattle, Vancouver versus Edmonton, Kamloops versus Seattle, and Kamloops versus Edmonton. Positive values indicate that the BC prices are *above* those found the other jurisdictions.[31] As illustrated in the chart below, gasoline wholesale prices in BC were consistently higher than those found in Seattle and Edmonton over the time period examined (where data is available).

Wholesale Price vs. Refining Margin:

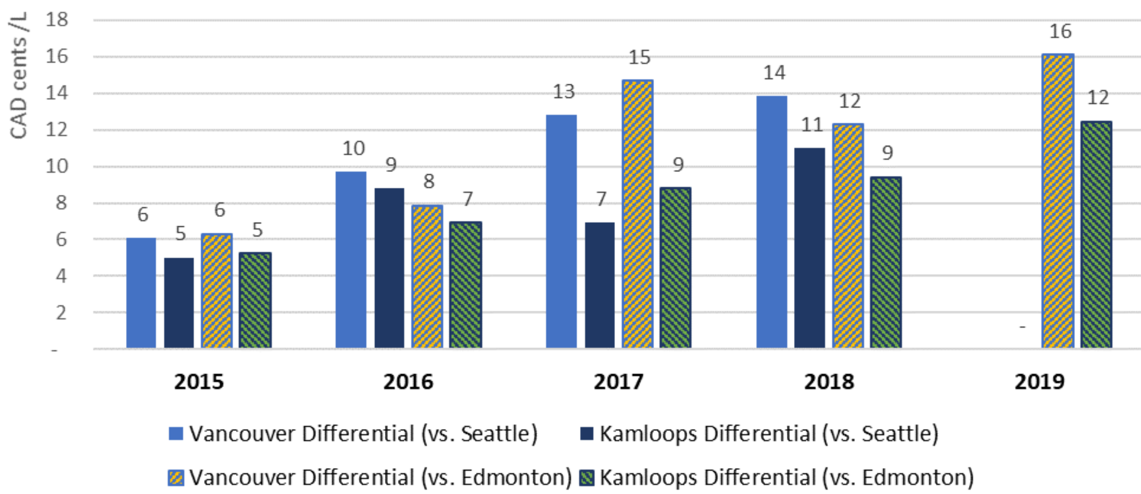
The report assessed wholesale price rather than refining margin because due to the estimating methodology, an analysis of wholesale prices provides the same information as an analysis of refining margins when focusing on a single supply region of Western Canada. See Appendix 4 for further details.

Arbitrage:

In economics and finance, arbitrage is the practice of taking advantage of a price difference between two or more markets by striking deals that capitalize upon the imbalance. The difference between the prices in different markets is the source of profit.

[31] See Appendix 12 for a detailed comparison of BC wholesale prices to those in Los Angeles.

Chart 4.0.1: Gasoline wholesale price differentials in BC compared to Seattle and Edmonton



This section explores potential explanations for the wholesale differentials illustrated in Chart 4.0.1. Although there are often short-term frictions[32] in the market that will result in short-term fluctuations, in the long-term the factors affecting wholesale prices can be divided into four categories:

i. Costs of inputs: If the cost of refining inputs has risen in BC but not in other jurisdictions, this may result in a pricing differential.
ii. Costs of the marginal unit of supply: If local production has been insufficient to supply demand, then BC fuel suppliers may have to look to more distant markets for supply. This may result in additional transport costs and, as a result, higher wholesale prices. This section therefore considers whether the differences between wholesale prices in BC and in nearby markets are greater than the differences in the costs of transportation.
iii. Regulatory environment: Regulatory costs are costs that apply to gasoline only once it has entered the market. For example, hypothetically if BC (but not other jurisdictions) required that all gasoline sold in the province meet a unique health and safety standard that did not exist in other jurisdictions, then the costs of meeting that standard would be applied specifically to the gasoline sold in BC. In other words, these costs would not apply to the gasoline sold in other jurisdictions.
iv. Competition: If there has been a reduction in competition or an increase in tacit coordination among wholesalers in BC, then wholesale prices would appear to be less connected to other surrounding markets.

4.2 Input Costs

Refiners require several inputs, the primary input being crude oil. Because this analysis is concerned with identifying causes for the differential that has been created in prices (wholesale and retail) between BC and other nearby jurisdictions, this section is focused on *changes* to input costs. In the

[32] Short-term friction in the gasoline market could be a result of rigid contracts, and time required to identify a new supply channel, among other factors.

context of this analysis, changes to input costs can generally be categorized in one of two ways: local shocks, and macro shocks.

Local Shocks

Local input price shocks affect local refined product producers. Examples of a local shock include an additional cost to comply with a standard in BC related to waste treatment, or additional costs for transporting or accessing appropriate crude supplies.

These would be costs uniquely experienced in BC and not in nearby locations (e.g. Alberta or Washington State). These additional costs will be borne by the producer and cannot necessarily be passed on to the consumer through the wholesale price.

> ***Marginal unit of supply***
>
> The price of gasoline will be set by the marginal unit, that is, the most expensive delivered source of supply that would be required in order to satisfy local demand. See Section 4.3 for further details.

The wholesale price is set by the marginal unit of supply. Therefore, if the marginal unit of gasoline is, for example, trucked in from Edmonton, then the increased costs to local producers may reduce local profit margins but would not be expected to impact price.

Chart 4.2.1 Example of local shock 1

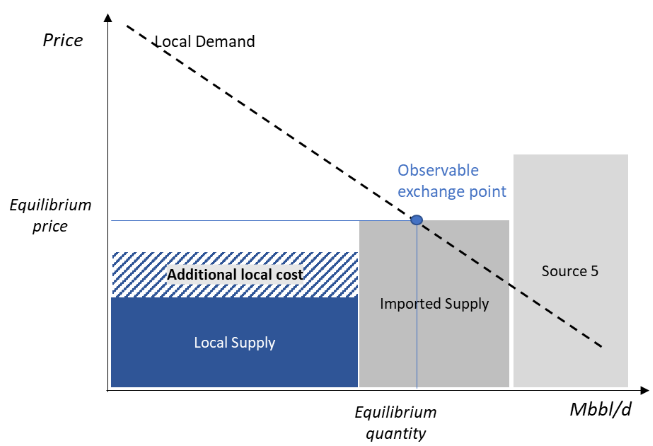


Chart 4.2.1 illustrates what happens when a local cost is added to the cost of local supply, in a competitive market. Since this change does not change the marginal unit of supply or push local production into becoming the marginal unit of supply, the equilibrium price and quantity are not affected. [33]

Therefore, these local input cost shocks are not assessed in the following analysis. For more detail on BC refineries' access to inputs see Appendix 5.

Macro Input Cost Shocks

The second cost shock category is macro shocks. These are shocks, such as changes in crude prices, that impact all producers. As illustrated in the Phase 1 report, crude indices across North America (Western Canadian Select, West Texas Intermediate) and Europe (Brent) all typically move closely together.

[33] An exception would be if these input costs push local producers into being the marginal (i.e. most costly) unit of supply. If this were to occur, it would be expected the local producer would reduce production or shut down.

[34]Therefore, if crude prices change, then it is expected that an equal cost impact will be felt across all refined product producers.

Since the impact is expected to be consistent across jurisdictions, changes in macro input factors are likely not causing the increasing differential between BC wholesale prices and those in surrounding jurisdictions.

Chart 4.2.2 Example of the impact of a macro shock

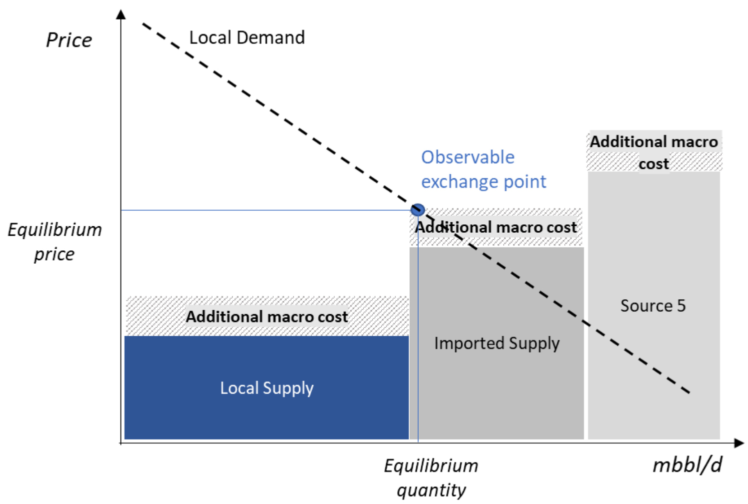


Chart 4.2.2 illustrates how a macro shock would add costs to all suppliers and, therefore, would not change the differential between the suppliers' cost structures. In this way, macro input cost shocks, like crude index price changes, are not expected to affect the differential in wholesale prices.

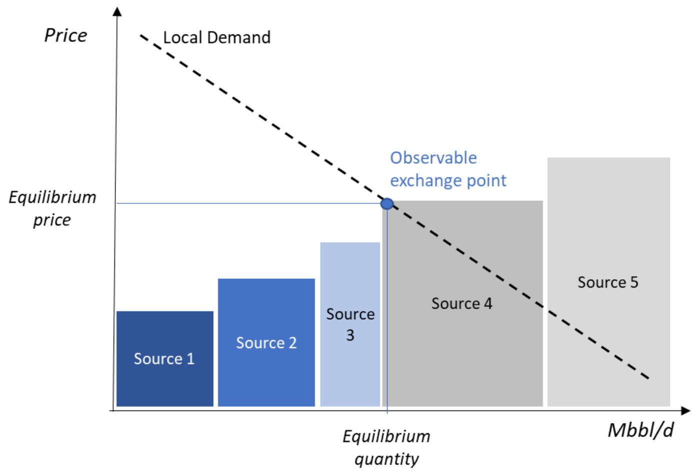
4.3 Marginal Wholesale Unit

The price of gasoline will be set by the marginal unit, that is, the most expensive delivered source of supply that would be required in order to satisfy local demand. BC has several supply channels to satisfy demand. As described in the Phase 1 report, the most expensive source required to satisfy local demand will set the marginal cost of supply.

The same rationale can be applied in considering the cost of transportation. The cheapest transportation method will be used first and, once capacity is exhausted, the cost of transportation for any unit (cents/L) will be based on the next cheapest method of transportation. Chart 4.3.1 illustrates this point.

[34] See section 4.2 in the Phase 1 report

Chart 4.3.1: Marginal unit of supply and equilibrium price



It is helpful to consider the example of a litre of gasoline travelling from Edmonton to Vancouver. If pipeline transportation is priced at 1 cent/L until capacity is reached and if the next best alternative is rail, then both forms of transport will be priced at the marginal cost of rail transport.

In order to assess whether prices across jurisdictions behave as would be expected in a well-functioning market, it is useful to test whether the marginal costs of transportation can explain the differential between wholesale prices in Vancouver, Kamloops, Seattle, and Edmonton.

All else being equal, prices in Seattle, Vancouver, and Edmonton should not diverge by more than the cost of transportation of fuel between the regions. If there is a broader divergence in price, then this would constitute an arbitrage opportunity (see call out box in Section 4.0) and market agents would capitalize on the opportunity to transport fuel to the jurisdiction with higher prices.

Cheaper methods of fuel transport are expected to be used up first. The market will then move on to the next most cost-effective method of transport. This transport method will continue to be used until additional capacity for a cheaper transport method is built. An example of this is currently underway at the Vancouver International Airport. The Vancouver Airport Fuel Delivery Project is focused on building a marine terminal to receive jet fuel. This investment is considered economical because the airport currently receives 25 to 35 tanker truck deliveries daily from Washington State, with trucking generally being the most expensive transport option over a given distance.[35]

Therefore, one hypothesis related to why higher wholesale gasoline prices are observed in BC is that the cheaper methods of import have reached capacity. This means that the market must use more costly forms of transport to receive the marginal unit of gasoline.

[35] Vancouver Airport Fuel Delivery Project, VAFFC

Illustration 4.3.2: Relative costs of transport

This section reviews transport capabilities in BC, including:

1. Pipeline
2. Marine
3. Railcar
4. Tanker truck

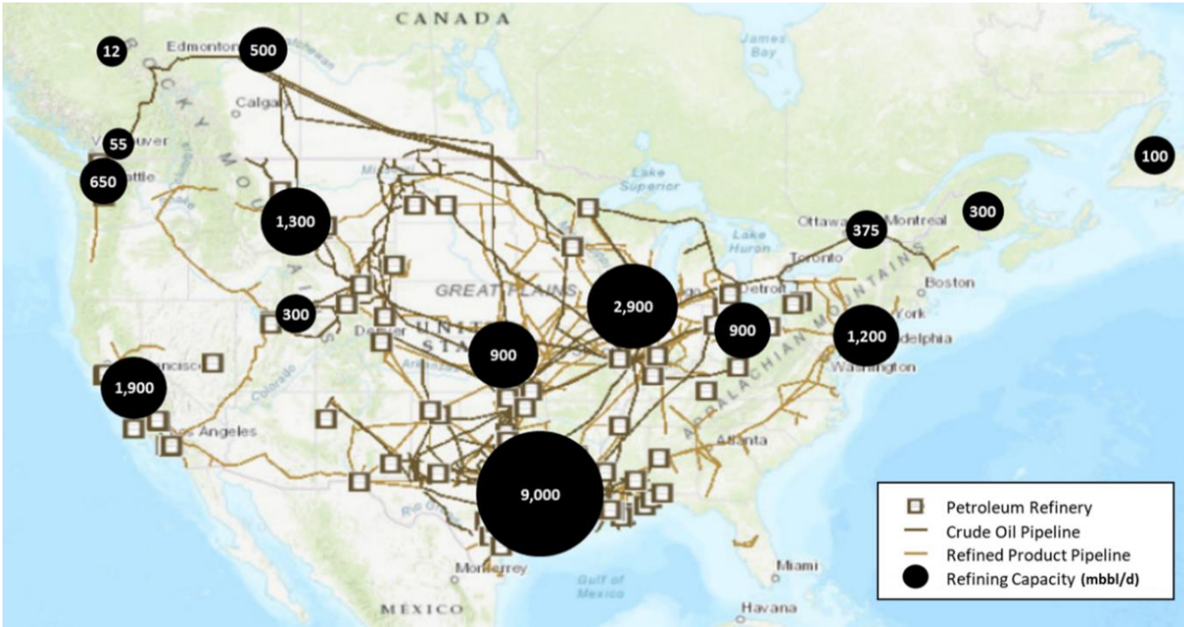
It then considers whether marginal travel costs can explain the differentials observed between BC and nearby jurisdictions.

Pipeline

> ***Pipeline Section Summary***
>
> In this section pipeline capacity and utilization is explored in the context of the substitution between crude and refined product transport into the BC market. The following are key findings:
>
> - The TMPL has been operating at capacity for the period assessed
> - In 2018 and 2019 the capacity for export of crude out of Alberta was fully utilized and unable to meet demand. Pipelines were full and the Province of Alberta announced a restriction in production of crude to address the situation.
> - These capacity constraints resulted in a growth of the arbitrage opportunity for crude product exported from Alberta, particularly in 2018.
> - This arbitrage opportunity created the market conditions for refined product traveling through the TMPL to be partially replaced with crude for export.
> - The pipeline tolls were not the highest marginal cost of transportation of refined product into the BC market either before nor after the refined product displacement that may have started as early as 2016 and became acute in 2018/2019.

The only pipeline that imports refined petroleum products to BC is the Trans Mountain Pipeline (TMPL). Overall, the entire western region of North America has only limited access to pipeline for moving volumes from refining hubs. This is illustrated in Map 4.3.1.

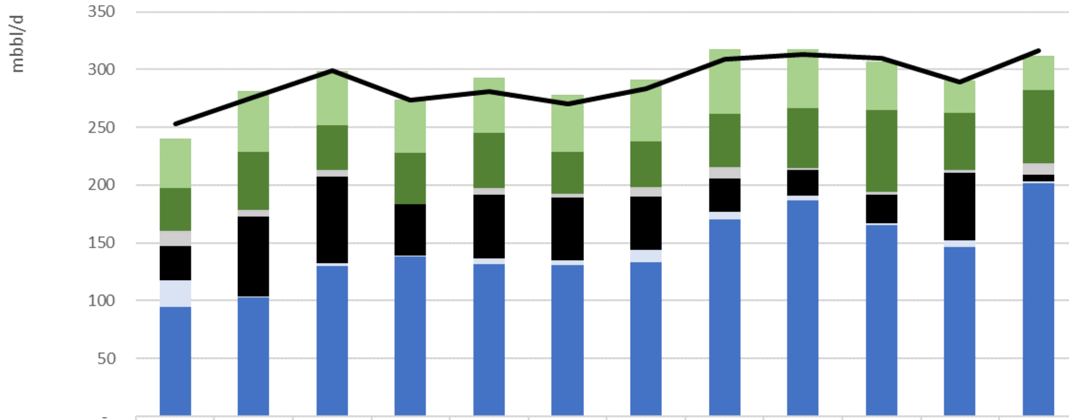
***Map 4.3.1: Canadian and American pipelines and refining capacity*[36]**



As explored in Phase 1 of this report, the TMPL has been at capacity for several years. In 2018, the volume of refined product transported through the TMPL declined. At this time, there was a shift in throughput away from refined products and towards crude. This appears to coincide with a crude supply glut experienced in Alberta in 2018. This glut likely resulted in some of the refined product in the pipeline being replaced by crude, which was facing storage and transportation capacity constraints in Alberta.[37]

[36] This map was constructed using data from the US Energy Information Administration (EIA) and the Canadian Association of Petroleum Producers (CAPP). Pipeline illustrations exclude pipelines that travel in Canada only and do not cross the American border.
[37] The allocation of product through the Trans Mountain Pipeline is based on equitable apportionment for the non-committed capacity by the NEB.

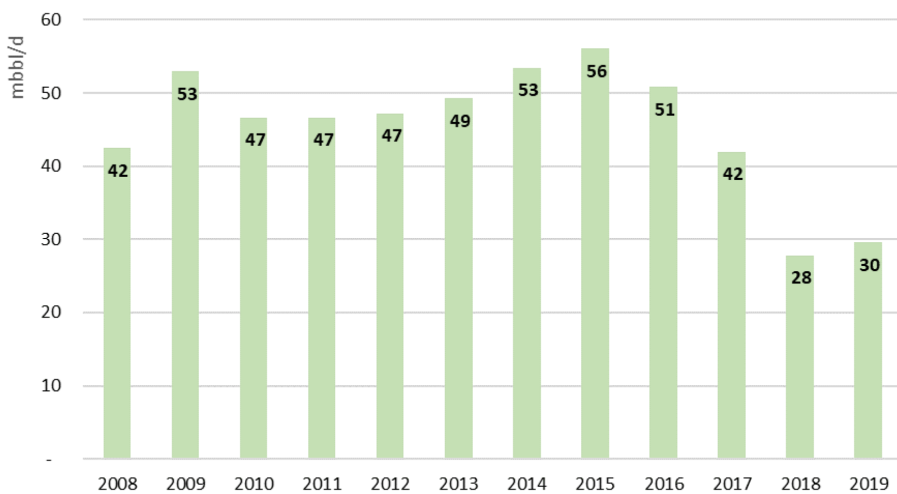
Chart 4.3.2: Trans Mountain Pipeline throughput (crude and all refined products)[38]



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Burnaby Refined	42	53	47	47	47	49	53	56	51	42	28	30
Burnaby Light crude	37	50	39	44	48	36	39	46	52	70	49	64
Westridge Light Crude	13	6	6	-	5	4	8	10	2	3	3	10
Westridge Heavy Crude	29	69	74	44	55	54	47	28	23	25	59	5
Sumas Heavy Crude	24	1	3	2	5	5	10	7	4	1	6	1
Sumas Light Crude	94	103	130	138	132	131	134	170	187	166	146	202
Capacity	253	276	299	274	281	270	283	309	313	310	289	317
Average Daily throughput	240	281	299	274	292	278	291	318	318	307	290	312

Examining refined volumes delivered to Burnaby through the TMPL specifically, it is evident that there is some variation year over year in throughput. In this regard, throughput ranged from 42 mbbl/d to 56 mbbl/d during the 2008-2017 period with a significant decline to 28 mbbl/d in 2018 and 30 mbbl/d in 2019. Although it is possible that declines began in 2016 and 2017, an unambiguous decline which is linked to the arbitrage opportunity for crude become acute in 2018.

Chart 4.3.3: All refined product -throughput received in Burnaby from the TMPL[39]



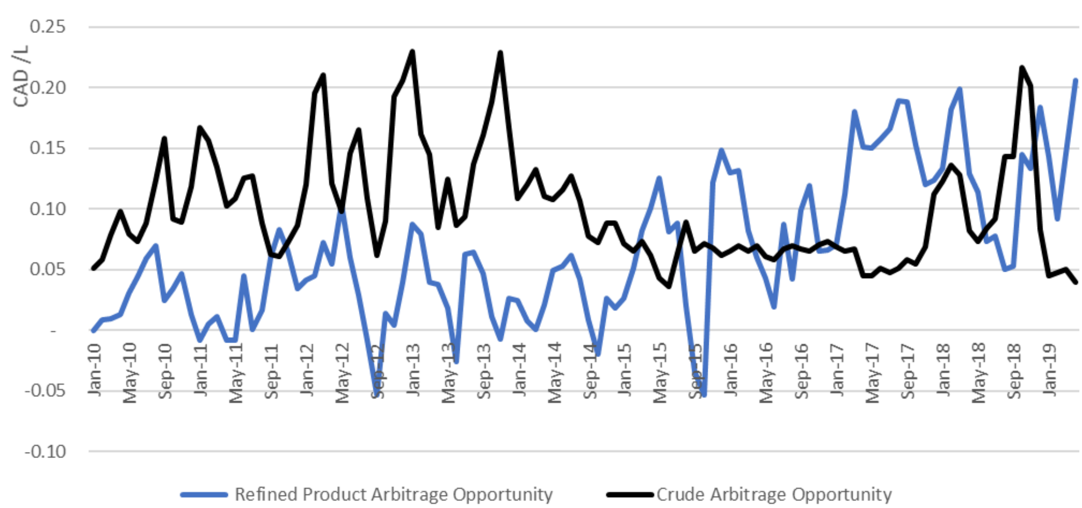
[38] NEB Pipeline Throughput and Capacity Data, 2019 figures are based on Q1 only.
[39] *Ibid.*

Suncor's intervener submission noted that the Suncor terminal has received a lower volume directly from the TMPL.[40] This has resulted in increased use of rail and truck, both of which are more costly transportation methods than the pipeline.

In 2018, the arbitrage opportunity for moving crude to tidewater grew to over 15 cents /L. The crude arbitrage opportunity is approximated by the difference between Western Canadian Select (evaluated in Edmonton) and West Texas Intermediate (WTI) (evaluated in Oklahoma) crude indices.[41]

As illustrated in the chart below, when the crude arbitrage opportunity rises above the refined product arbitrage opportunity, the benefit of transporting crude for export (i.e. outside of Alberta) becomes greater than the benefit of transporting refined products.

Chart 4.3.4: Arbitrage opportunity for crude and refined products (Edmonton to tidewater)



Although this comparison does not include transportation costs, it is evident that, in 2018, the spike in the crude arbitrage opportunity rose above the refined product arbitrage opportunity. It is expected that the interaction between these two arbitrage opportunities would result in more crude being transported. This is because the benefit of crude sale after transport to the BC coast is higher than the benefit of refined product sales after transport to the BC coast. Therefore, fuel shippers would be willing to pay a higher premium to ship crude than to ship refined product through the pipeline. This premium is expected to be used to purchase transport capacity (e.g. on the TMPL) and would need to be paid up to the point that the arbitrage opportunity across the products, including transport costs converge.

Although the crude arbitrage opportunity rises above that of the refined product arbitrage opportunity several times within the period assessed, crude transport only begins to displace refined product transport once the total export capacity from Alberta has been met, this export capacity constraint is shown in the National Energy Board chart below.

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[40] As noted in Suncor's submission, the facility receives approximately 30-36 million litres/month (~ 6-7.5 mbbl/day) less than 3-5 years ago. Submission can be reviewed on the BCUC site

[41] As described in Phase 1 WCS and WTI are not perfect substitutes, WCS is a heavier oil and more costly to refine.

Chart 4.3.5 NEB Chart – Alberta crude production and export capacity[42]

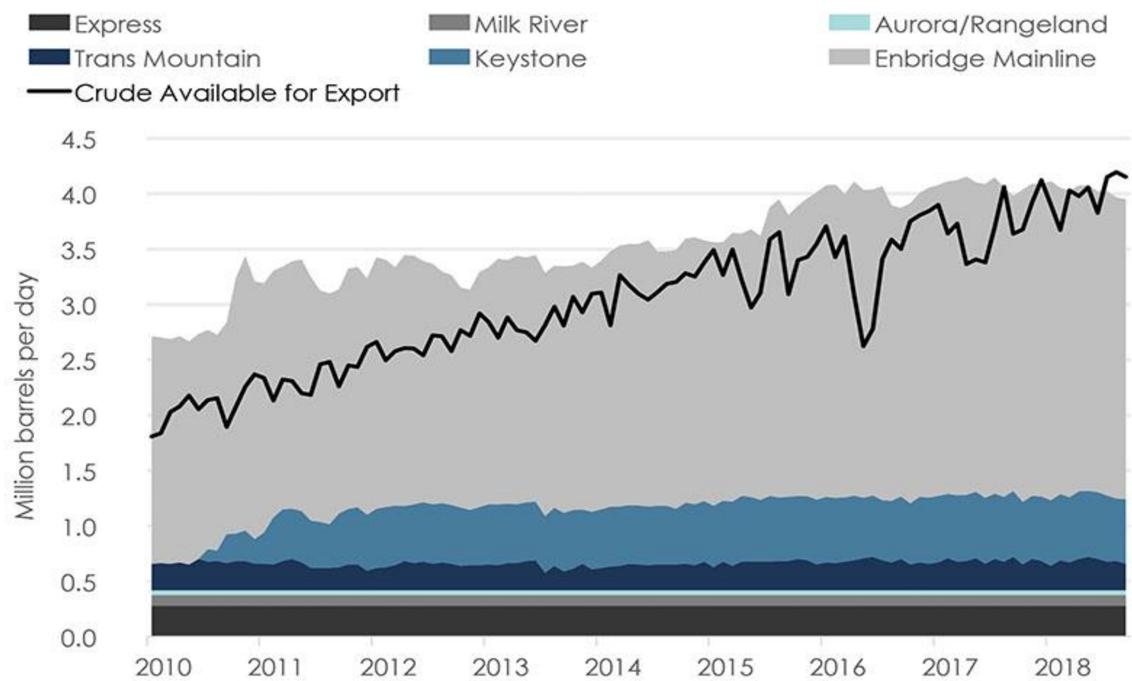
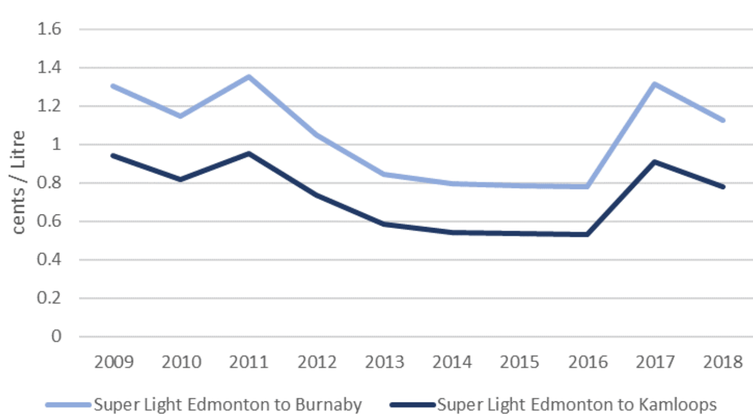


Chart 4.3.5 demonstrates that, in 2018, Alberta started producing more crude than it had the capacity to export by pipeline. This aligns with the spike observed in the arbitrage opportunity and the resulting fall in the volume of refined product moving through the Trans Mountain Pipeline in 2018 and 2019.

The TMPL tolls are regulated and therefore do not reflect the level of competition that exists for the limited pipeline capacity. The National Energy Board regulates the pipeline tolls and pipeline capacity is allocated based on a defined procedure (more details in Appendix 9) rather than willingness to pay. The resulting tolls are displayed in Chart 4.3.6.

Chart 4.3.6: Trans Mountain Pipeline costs per litre of transport[43]



Although the regulated tolls for transporting refined products on the TMPL are low (<2 cents/L), it is important to note that due to the regulated nature of the tariffs on the TMPL and the allocation method of volume on the pipeline, a post-allocation market exists. That is, following receipt of the allocated volumes, fuel shippers can purchase allocated capacity

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[42] NEB, Western Canadian Crude Oil Supply, Markets, and Pipeline Capacity [December 2018]

[43] Pipeline tolls include the Westridge Dock premium surcharge credit. More details can be found in a review of the NEB TMPL tariff.

from one another. Although not visible, it is expected that the after-allocation price for capacity would rise until the pipeline transportation price rises to the marginal cost of transportation (whether by rail or tanker truck). See Appendix 9 for details on TMPL apportionment.

The costs incurred to transport refined product through the TMPL in this after-market likely increased in 2018 and 2019 as refined product in the TMPL was displaced by crude exports which likely exacerbated price increases as additional supply channels were likely required in order to deliver supplies to BC.

In short, this analysis reveals that the TMPL is at capacity. This was additionally confirmed by interveners to the BCUC inquiry who indicated that they were receiving shipments of gasoline to BC from Edmonton via tanker truck. These findings therefore suggest that regulated tolls for the TMPL are not indicative of marginal costs of transport, and it is expected that the marginal cost of transport is represented by another more expensive method of transport.

Marine Imports

Since BC's most populated regions are coastal, marine transportation is a viable supply channel. There are five marine terminals that handle gasoline and diesel in the greater Vancouver Area:

1. Westridge, Burnaby: a petroleum terminal which imports and stores aviation turbine fuel for delivery to Vancouver International Airport via Kinder Morgan's jet fuel pipeline. It handles crude petroleum, petroleum products, and jet fuel.
2. Shellburn, Burnaby: a petroleum distribution terminal operated by Shell Canada Ltd.
3. Stanovan, Burnaby: a petroleum terminal operated by Chevron Canada Ltd.
4. Burrard Products Terminal, Port Moody: a petroleum terminal operated by Suncor, one of the largest integrated oil and gas companies in Canada.
5. IOCO, Port Moody: a petroleum terminal which handles heavy fuel oil, intermediate fuel oil, and marine gas oil.

Total marine receipts[44] of all refined products have been climbing over the last five years. However, as illustrated in Chart 4.3.7, the receipts of gasoline have been falling as a share of total receipts.

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[44] Marine receipts are received in BC's port but may not be logged as actual imports if the fuel is destined for a different market. As such, marine imports do not align with total import figures received from the Ministry of Finance.

Chart 4.3.7: Refined petroleum product marine receipts by product type

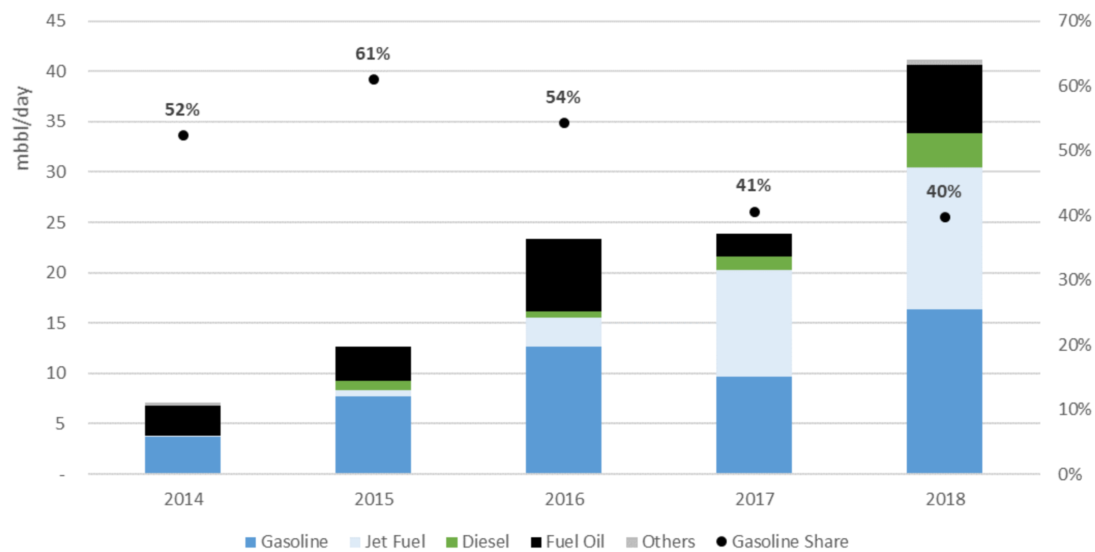
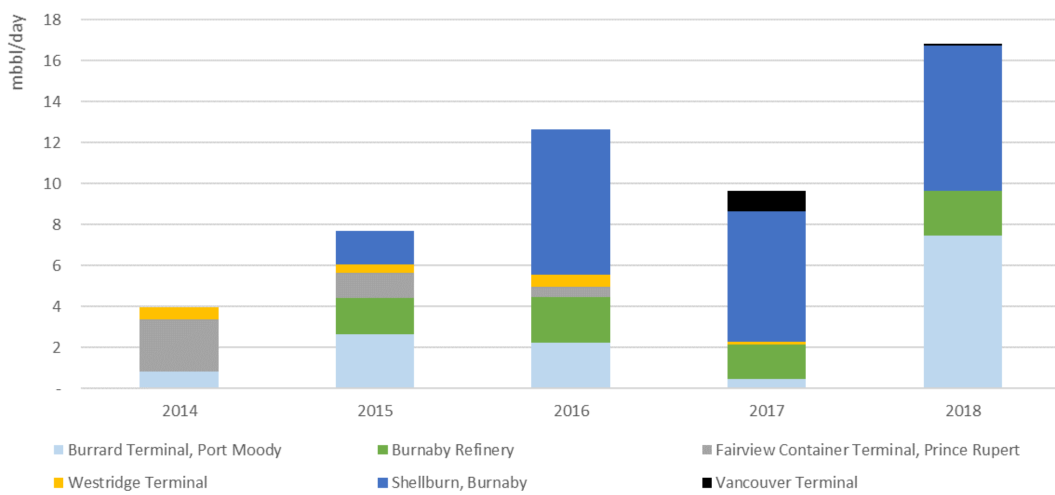


Chart 4.3.8: BC marine receipts of gasoline by terminal



Although information regarding receipt capacity for these terminals is not publicly available, by 2018, their total actual receipts of gasoline (as reported by a marine traffic report[45]) had grown to over 16 thousand barrels per day on average, as illustrated in Chart 4.3.8. While Parkland indicated in their interveners' submission that marine and wharf limitations are an issue for their supply access to crude supplies, it is not immediately clear whether marine receipt capacity was met throughout the 2015-2018 period.

In addition, marine transportation faces an additional challenge of volume-related requirements. In order for marine transport to be economical, the tankers or barges transporting the fuel are best used at full capacity. Due to the likely constraints on marine capacity and the "step-function of volumes" (i.e. large volumes must be committed in order to make trips economical), marine transport costs are not

[45] Unique report purchased from Clipper Data

considered as a likely marginal cost of transportation. Therefore, in what follows, land transport options (i.e. rail and tanker truck) are considered.

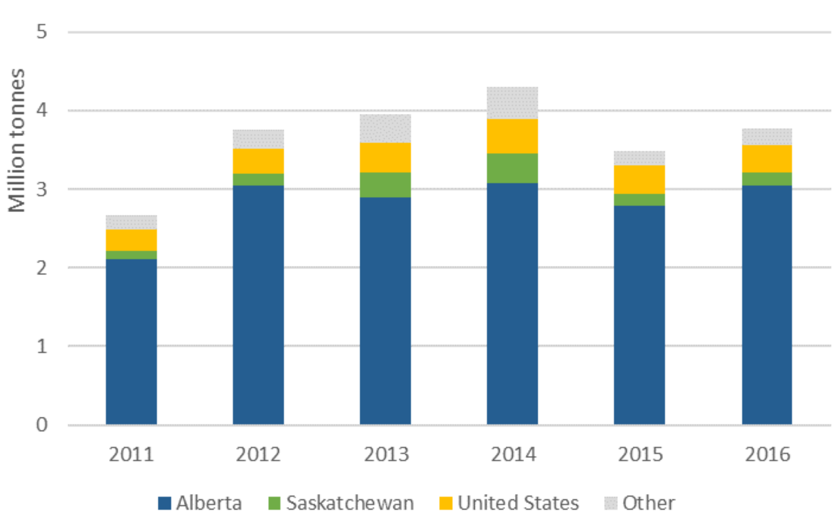
Rail

Several primary terminals in BC have the capability to receive refined product by rail and tanker truck. As rail transport is limited by rail capacity, the NEB has noted that rail transport is not a perfect substitute for pipeline transport. In addition, rail transport impacts the shipments of other goods since the same railway infrastructure is used for all rail transport and therefore is more complex than transport via tanker truck. [46]

Tanker truck is a more flexible and less complex shipping method but it is also more costly. In March 2018 (updated in March 2019), Statistics Canada published a Canadian Freight Analysis Framework (CFAF) for the 2011 to 2016 period.[47] The framework tracks the movement of fuels, the fuels tracked include the Standard Classification of Transported Goods (SCTG) of categories 16 (crude oil), 17 (gasoline), 18 (fuel oils, including diesel and bunker), and 19 (lubricating oils and greases, including kerosene (excluding type A).[48]

At the time of writing, available information had not been broken down by fuel type. This has limited the view to the sum of all products included in the “fuels” category.

Chart 4.3.9: BC’s Rail receipts of fuels (defined by CFAF)

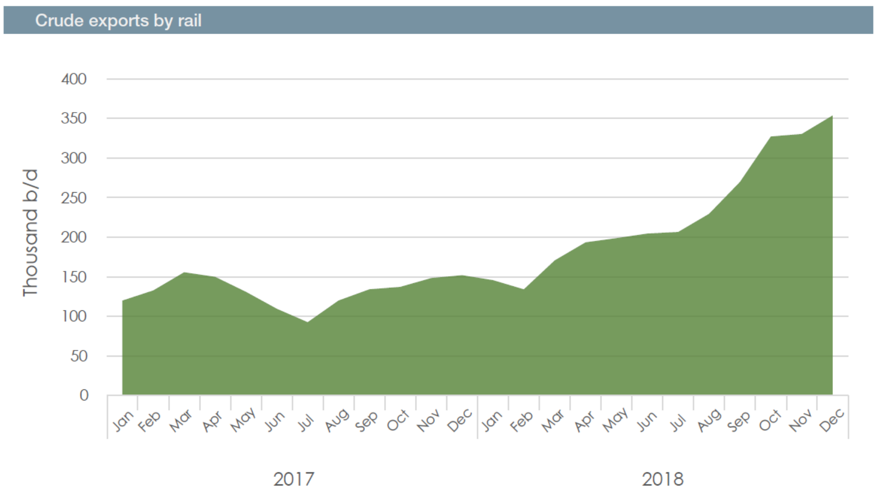


These limitations notwithstanding, this framework appears to indicate slight year over year changes in total fuels received by rail. However, the mix of fuels may have changed. In the NEB’s March 2019 publication, it was noted that crude transported by rail in Canada increased significantly in the 2019 period. Because rail infrastructure is used for movement of crude oil, refined product, as well as other goods, more

[46] NEB, Optimizing Oil Pipeline and Rail Capacity out of Western Canada, Advice to the Minister of Natural Resources, March 2019.
[47] Statistics Canada, Canadian Fright Analysis Framework, updated March 15, 2019
[48] Statistics Canada, Standard Classification of Transported Goods

movement of one good will necessarily reduce the capacity to transport other goods on the same infrastructure.

Chart 4.3.10: Crude exports by rail in Canada[49]



In one of its recent reports, the NEB notes that current rail infrastructure in Canada is operating at or near capacity. The capacity to ship petroleum resources by rail relies on many factors, including availability of tank cars, locomotives, crews, and tracks, as well as the demand on the system to ship other goods.[50]

Rail transport capacity depends on the capacity for rail cars to leave the loading location (e.g. Edmonton) and on the capacity of primary terminals to receive shipments. Although precise information on rail capacity and its utilization over the past 10 years was not available at the time of writing, the macro-view figures above, together with Parkland's intervener submission suggest that "there is very limited capacity to bring in crude via marine or rail." This indicates that rail transport infrastructure has been near capacity in recent years and is therefore not likely to be representative of the marginal cost of fuel transport in BC.

Tanker Truck

Marine, pipeline, and rail imports all require some degree of infrastructure. Although definitive figures on marine and rail receipt capacity in BC have not been identified, a public affidavit of the Director of the Low Carbon Fuel Branch of the BC Ministry of Energy, Mines, and Petroleum Resources stated that "there is inadequate infrastructure in place in British Columbia to transport, receive, store and then distribute large quantities of refined fuels acquired from a market other than Alberta."[51] This indicates that BC's marginal unit of supply may require delivery by tanker truck.

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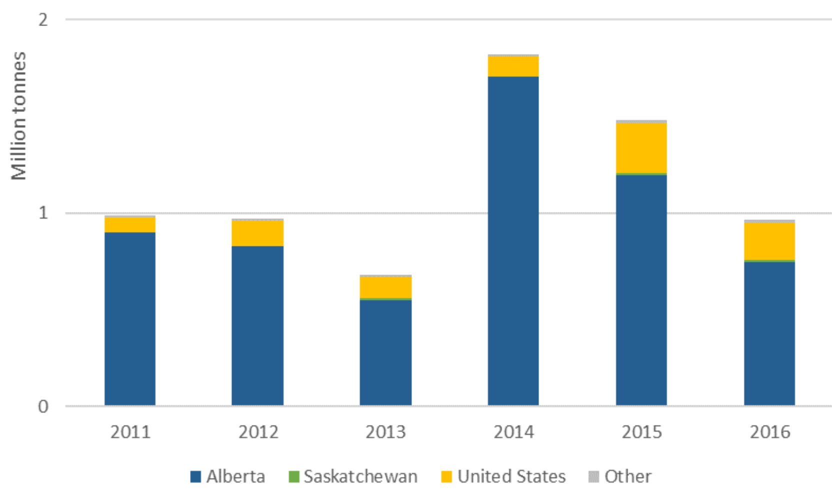
[49] NEB, Optimizing Oil Pipeline and Rail Capacity out of Western Canada, Advice to the Minister of Natural Resources, March 2019.
[50] *Ibid*
[51] April 2019 Affidavit of Michael Rensing

Chart 4.3.11: BC's receipt of fuels (defined by CFAF) by tanker truck[52]



Statistics Canada's Canadian Freight Analysis Framework indicates that, in 2014, BC experienced a large overall increase in receipts of fuel by tanker truck. Based on available data, it appears that 2014 and 2015 saw large increases in tanker truck imports from Alberta. In 2015, tanker truck imports from the United States also increased. Although volumes appear to have returned to normal levels in 2016 these data cannot be broken down by fuel type so the composition of the receipts are unknown.

Infrastructure constraints may also impact pricing. Tanker trucks all load at refineries but distribute to disperse locations therefore tanker truck transport constraints are primarily on the loading side. Therefore, capacity constraints on tanker truck loading would impact delivered cost of wholesale product in the receipt location as well as in the source location. As the costs incurred from constraints in loading infrastructure would apply to all jurisdictions receiving product from that loading location, they would not have an impact on the wholesale price differential. They are therefore not considered further.

In short, since it is expected that tanker truck transport is the marginal transport method, tanker truck transport costs are used to estimate the marginal transport costs between jurisdictions.

Cost Estimates

Net of taxes and regulatory effects, prices in two nearby locations should not be separated by more than the marginal transport costs. Therefore, this section takes a deep look at transport costs between a number of nearby regions in Western Canada and on the West Coast in order to understand whether the differences in wholesale prices have expanded beyond differences in transportation costs.

Building on information from a 2011 study by the Asia Pacific Economic Cooperation[53], the table below estimates the tanker truck transport costs from Edmonton to Vancouver and from Seattle to Vancouver.[54] Lower unit costs are provided for longer-distance trucking as the fixed costs of loading and unloading can be spread over more kilometres. This is used for Edmonton to Kamloops and Vancouver,

[52] Data excludes intra-BC transport

[53] APEC, Biofuel Transportation and Distribution Infrastructure, 2011

[54] Figures in the report appear to be reported in USD. However, in the year published (2011) the exchange rate was close to par so a simple 1 to 1 conversion is applied.

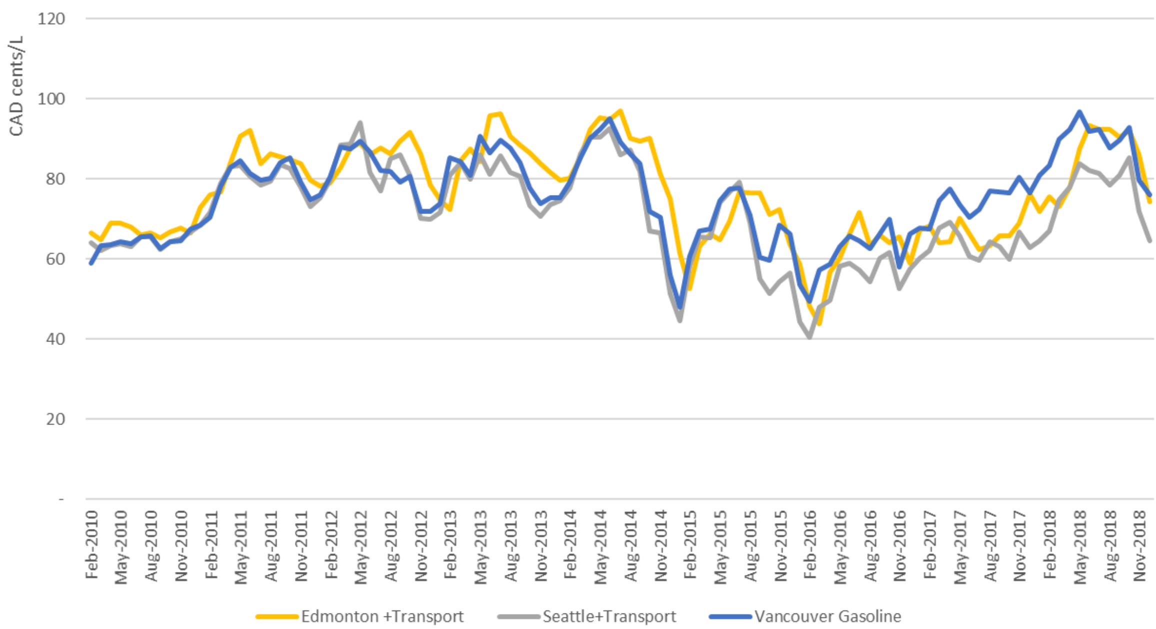
while the higher unit cost estimates are used for shorter distances, in this case for the transport from Seattle to Vancouver and Kamloops.

Estimated Tanker Truck Transport Costs (CAD/L), 2019[55]	
	Costs per litre
Edmonton to Vancouver	8.0 cents/L
Edmonton to Kamloops	5.6 cents/L
Seattle to Vancouver	2.2 cents/L
Seattle to Kamloops	4.4 cents/L

It is important to note that these cost estimates are estimates *only* and, although there will likely be rises and falls in pricing based on short term demand or supply shocks (i.e. a refinery losing production and a resulting surge in demand for tanker trucks), these estimated prices are considered representative.

Since tanker truck transport is more flexible than other forms of transport, it is expected that - if an arbitrage opportunity exists - tanker trucks will be able to transport the product without facing limitations on infrastructure requirements. Additionally, it is expected that tanker truck transport is the most expensive form of transportation for refined products. Therefore, price differentials across two regions are not expected to be greater than the cost of tanker transport.

Chart 4.3.12: Vancouver gasoline wholesale compared to tanker truck delivered wholesale from Seattle & Edmonton

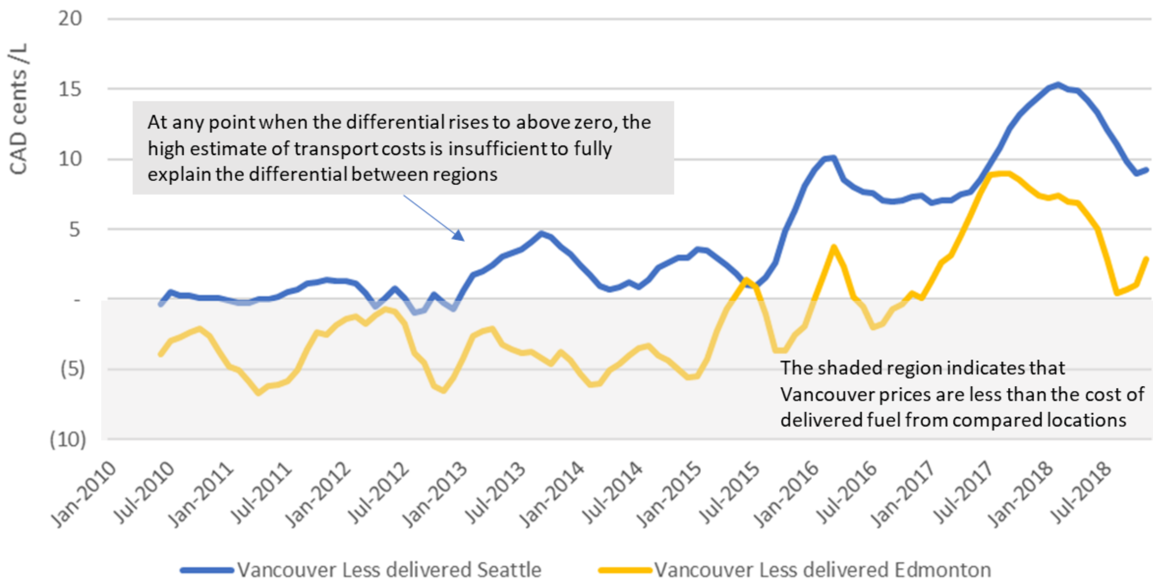


The total value somewhat masks the relative differentials between Vancouver and the delivered cost of wholesale product from Seattle and Edmonton. Chart 4.3.13 shows the 6-month rolling average of

[55] A second source, Truckers Report, cites the overall cost for tanker truck delivery at approximately 0.004 cents /L/km, which is lower than the low estimate used for the estimates provided here.

Vancouver less the estimated tanker truck delivered price from Edmonton and Seattle, and therefore provides a clearer picture of the results.

Chart 4.3.13: Six-month rolling average of Vancouver less the estimated tanker-truck delivered price



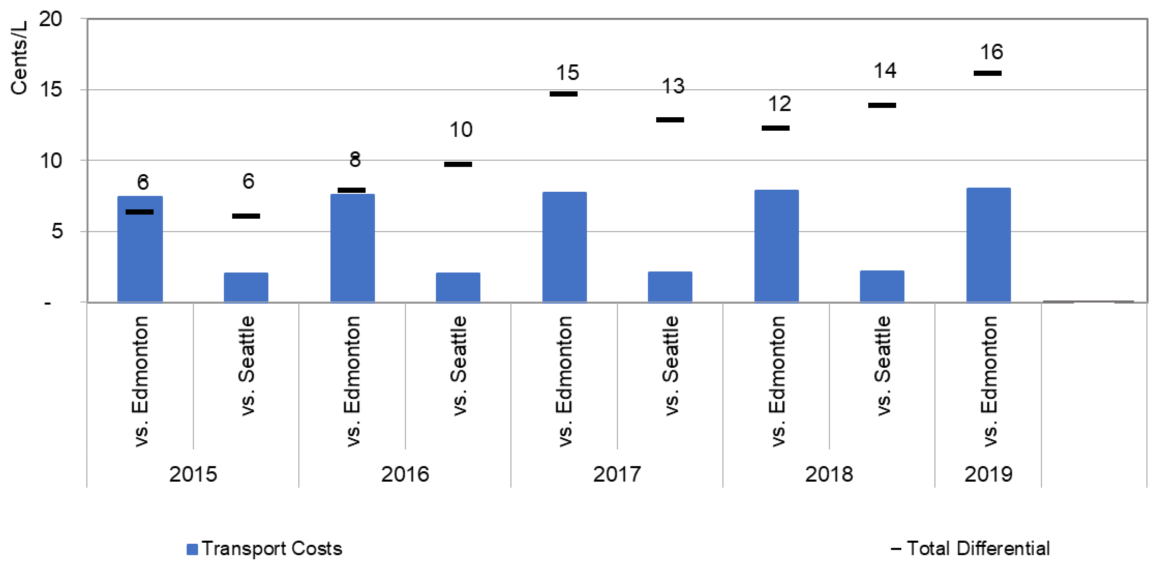
The delivered price from Seattle appears to be a useful variable for explaining the differential between Vancouver and Seattle's wholesale prices up until January 2016 when - even with the tanker truck transport accounted for - the differential rises to a high of 15 cents/L in 2018. In other words, as of 2016, tanker truck transportation costs fail to explain the full differential between Vancouver and Seattle.

The relationship with Edmonton prices follows a similar pattern with modeled tanker truck costs being ~5 cents/L too high to explain the differential up until mid-2015. From mid-2015 to the start of 2017, transportation by tanker truck appears to account for the differential quite well. However, by mid-2017, this differential grew past the cost of tanker truck transport only to once again fall around the end of 2018.

BCUC has heard from at least one intervener that tanker truck shipments are received from Edmonton. Additionally, YVR has stated that they received between 25-35 tanker truck deliveries of jet fuel daily from Washington State. Therefore, it is clear that these delivery channels are open, but it is not clear why wholesale price differentials would rise above this marginal cost of transportation for Vancouver.

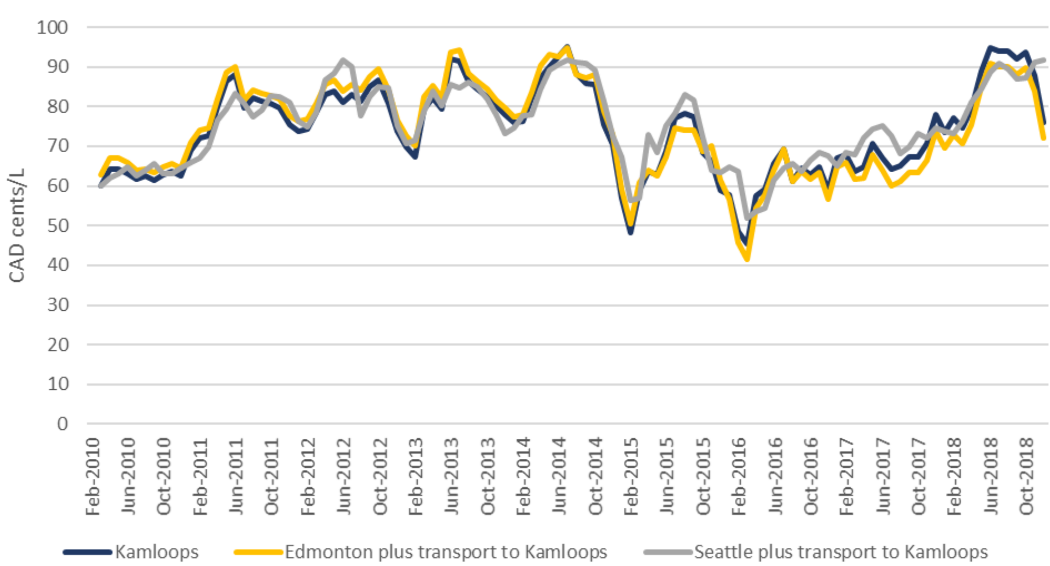
In short, in Vancouver, tanker truck transport costs are sufficient to explain some of the differential with Edmonton and to a lesser extent with Seattle. However, with transport costs removed, there was still a ~ 12 cents/L differential between Vancouver and Seattle in 2018 and a ~8 cents/L between differential between Vancouver and Edmonton in 2019 (includes up to June 2019).

Chart 4.3.14: Vancouver wholesale price differential net of tanker truck transport costs



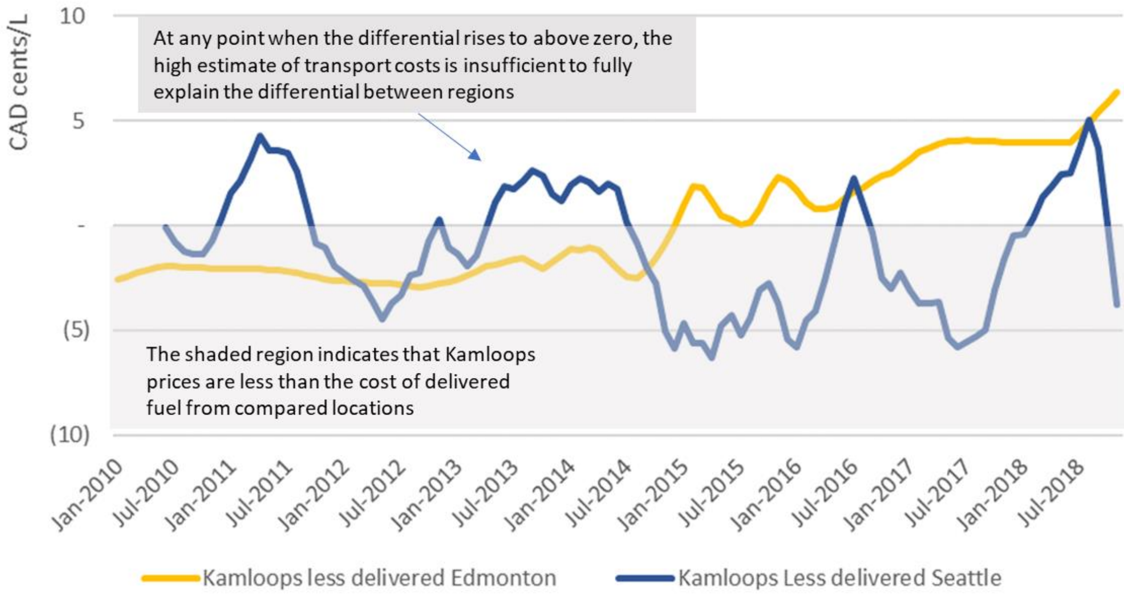
In Kamloops, tanker transportation costs from Edmonton and Seattle appear to close part of the differential. As illustrated in Chart 4.3.15, Kamloops and the modeled delivered wholesale prices from Edmonton and Seattle appear to align quite well.

Chart 4.3.15: Kamloops Wholesale and delivered gasoline from Edmonton and Seattle



Again, looking at the six-month rolling average of price differentials over time more clearly illustrates where the differential can be explained by transport costs and where transport costs do not provide a sufficient explanation of the differential.

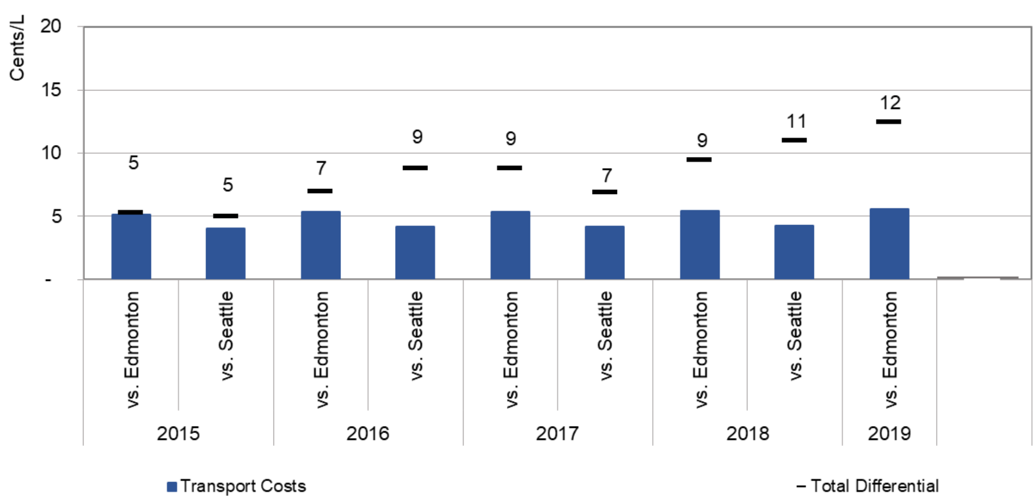
Chart 4.3.16: Six-month rolling average of Kamloops less the estimated tanker-truck delivered price



As this chart indicates, the "Kamloops less delivered Seattle" line is roughly centered around zero, indicating that there is some noise and friction but, in general, the differential does not appear to be consistently above zero. However, Kamloops wholesale prices appear to be ~ 2 cents/L less than delivered product from Edmonton up until mid-2015 when the differential closes to zero. The differential starts to rise again in 2018 to approximately 4 cents/L.

Overall, this explains about 4 cents/L of the differential between Kamloops and Seattle and ~5 cents/L of the differential with Edmonton in 2019 (up to June 2019). However, with transport costs removed, there was still a ~7 cents/L differential between Kamloops and Seattle in 2018 and a ~7 cents/L differential between Vancouver and Edmonton in 2019 (includes up to June 2019).

Chart 4.3.19: Kamloops wholesale price net of tanker truck transport costs



4.4 Regulation

In BC, as in other locations across North America, gasoline and diesel producers and importers have been required to mix renewable fuels with gasoline and diesel as a means of reducing the use of petroleum products. In addition to these minimum renewable fuel mixing requirements, several other additional measures have been put in place in BC and along the Pacific Coast of the United States. This section describes these measures and quantifies the estimated impact they have had on prices of gasoline and diesel in BC.

It is important to note that these regulations apply to fuel before it arrives at the retail station. In addition, the mixing of fuels generally occurs at the terminal level. For these reasons, any cost associated with regulatory requirements would be observed in the wholesale price.

In order to understand the sources of the regulation-related incremental costs that are specific to BC, it is important to focus on parts of the regulatory framework which are unique to BC. If there is a requirement that is the same across all regions, it is unlikely to have differential impacts.

Summary of Comparable Jurisdiction Regulation

Since 2010, Canada has required the mixing of renewable fuels with road use fuels. Specifically, the Federal Government requires 5% ethanol content in gasoline and 2% biodiesel in diesel by volume.[56]

Since these minimum fuel requirements apply across Canada, it is reasonable to assume that they would not impact the differences observed in wholesale prices between Vancouver, Kamloops and Edmonton, or more generally between BC and the Western Canadian region.

Additionally, the fuel mixing requirements have been in place since 2010, and both Alberta and BC have been compliant with the ethanol and biofuel mixing requirements. This is illustrated in Chart 4.4.1. During the 2010-2014 period BC's pricing behaviour remained consistent with Edmonton and Seattle, (Washington also requires 10% ethanol mixing with gasoline.)[57] Therefore, it is possible to conclude that these mixing requirements did not have a differential impact on BC's market.

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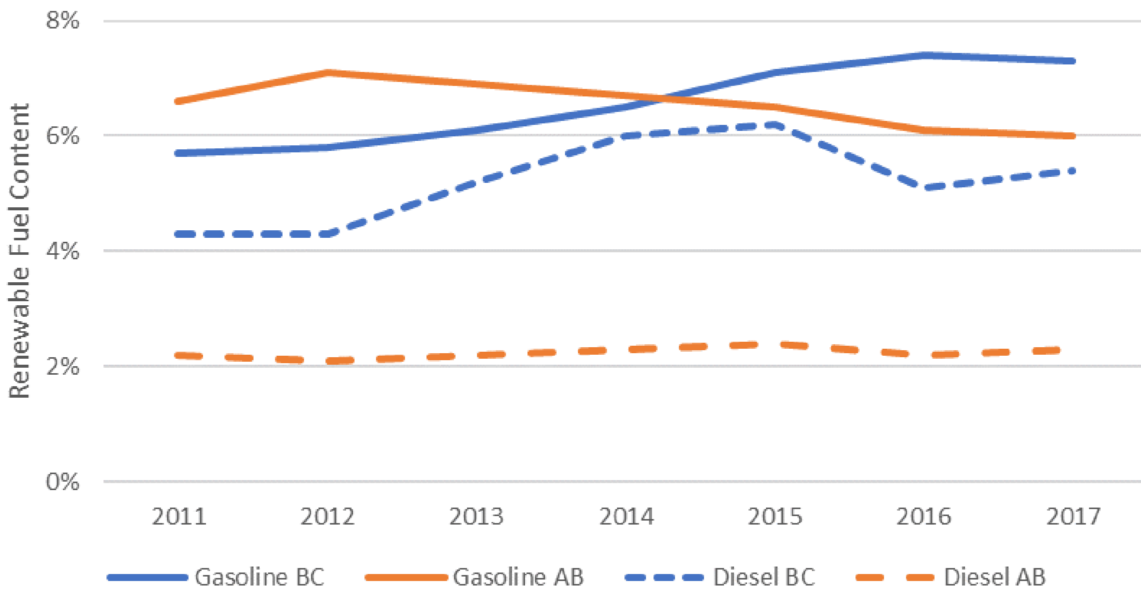
[56] Renewable and Low Carbon Fuel Requirement Regulation, 2010

[57] Based on conversations with OPIS.

Chart 4.4.1: Renewable fuel content compared across BC and Alberta[58]



Summary of BC-specific regulation

BC created additional carbon reduction regulation in 2010, the same year that the Federal renewable mixing regulation was put in place. BC's Renewable and Low Carbon Fuel requirement regulation (RLCF) established a Part 2 and Part 3 for fuel suppliers.[59]

Part 2 of the RLCF has the same fuel mixing requirement for gasoline as is required by the Federal Government (i.e. 5%). However, in the diesel pool, BC's renewable requirement was 3% in 2010 and 4% thereafter, compared to the Federal requirement of 2%.[60]

Part 3 of BC's RLCF is particularly unique when compared to the rest of Canada. It specifies a reduction in the lifecycle emissions of fuels based on a schedule of emissions intensity for both diesel and gasoline.

Specifically, this regulation allows fuel suppliers to submit compliance reports to demonstrate emissions reductions or to purchase compliance credits. If fuel suppliers do not submit information regarding the carbon intensity of their fuels, then the Provincial Government will calculate the suppliers' carbon intensity based on the precautionary high default carbon intensity for each fuel type as recognized by the regulation.[61] Compliance credits are also accumulated in periods when a particular fuel supplier's fuel carbon intensity is below the target.

[58] Alberta RFS, 2011-2017

[59] Note that BC has additional fuel standards, namely BC's Gasoline Vapour Control Regulation which has been in place since 1995 as well as the Cleaner Gasoline Regulation.

[60] See: Renewable and Low Carbon Fuel Requirements Regulation

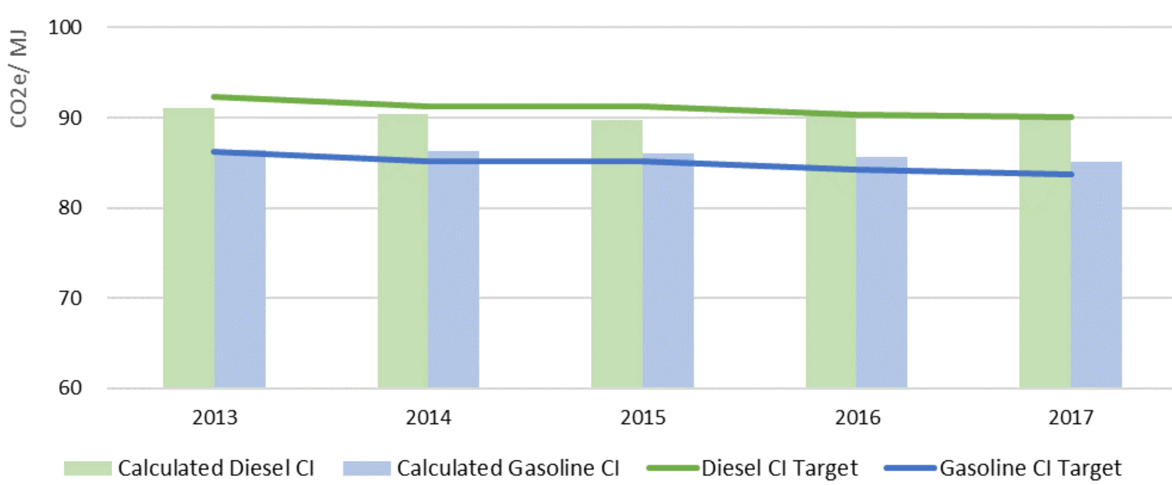
[61] BC's summary for 2010-2017

A baseline fuel intensity by fuel type was established by the Provincial Government for 2010 fuels[62] and was used to create a carbon-intensity reduction schedule. The schedule aims to reduce the greenhouse gas intensity of fuels sold in BC to 90% of 2010 levels by 2020.

Using the quantities of fuel reported by regulated fuel suppliers and the carbon intensity established by the RLCF requirement regulation, it is possible to calculate BC's average annual carbon intensity. This calculation does not account for credit acquisition and use in subsequent years or the actual carbon intensity reported by suppliers. The carbon intensity target was implemented in 2013. During the 2013-2017 period, regulated entities achieved compliance through several methods, including carrying forward credits which had begun to accrue in 2013, adding additional renewable fuel content to retail mixes, and purchasing compliance credits.

The chart below calculates the fuel intensity by year and by fuel based on the reported contents of gasoline and diesel sold and the carbon intensities posted by the Provincial Government. It is expected that the estimated carbon intensity for gasoline and diesel are over-stated in the chart as it does not account for the purchase or carry-forwards of compliance credits or the approved carbon intensities submitted by regulated suppliers.

Chart 4.4.2: Calculated carbon intensity (CI) based on fuel use[63]



During the 2013-2016 periods, more compliance credits were awarded than debits. In other words, it was not until 2017 that all regulated entities jointly began to require a draw-down of past year accumulated credits in order to become compliant. The table below details the net credits established on an annual basis and the average price these credits traded for in the compliance unit market.

[62] To model the carbon intensity of fuels sold in BC, the Provincial Government uses GHGenius, a lifecycle analysis model focused primary on transportation fuels in Canada.
[63] Calculation based on reported fuel quantities and the baseline carbon intensity for fuels reported in BC's summary for 2010-2017.

Table 4.4.3 Renewable and Low Carbon Fuel requirement regulation compliance market summary

Compliance Period	Surplus Credits/(Debits)[64]	Cumulative	Number of compliance unit transfers	Average Price of compliance units
2013	352,096	352,096		
2014	704,191	1,056,287		
2015	525,238	1,581,525	14,354	$169.95
2016	314,947	1,896,472	198,705	$170.93
2017	-55,797	1,840,675	240,164	$164.30
2018	*Not available*	*Not available*	435,221	$193.44

Compliance units are purchased per tonne of carbon emissions above the carbon intensity target and therefore are a function of volume as well as carbon intensity.

Estimated impact of the regulation in BC

The BC regulation is stricter than the regulation applicable across Canada (i.e. the Federal regulation) or the regulation applied in Washington State. For this reason, this section focuses on the difference in the costs of compliance resulting from BC's stricter regulation.

The RLCF could potentially drive costs and therefore could cause increases in price in BC that are not experienced elsewhere in Western Canada. This could occur through two mechanisms:

1. Access to Renewable Fuels: If BC has constrained access to ethanol and biodiesel when compared to other regions in Western Canada. This could drive up the costs of road use fuel.
2. Costs of Reducing Carbon Intensity: If the reduction in carbon intensity of fuel is driving additional costs in BC that are not exhibited elsewhere.

These two mechanisms are described in more detail below.

Access to Ethanol

In order to comply with BC's regulations, gasoline must include at least 5% ethanol content and diesel must include at least 4% biodiesel content. Since biofuels (i.e. ethanol and biodiesel) are distributed separately from refined petroleum products and are blended at terminals often while being mixed into fuel trucks for delivery, the dynamics around access to these fuels cannot be determined by looking exclusively at the distribution of petroleum fuels. A separate analysis is therefore required.

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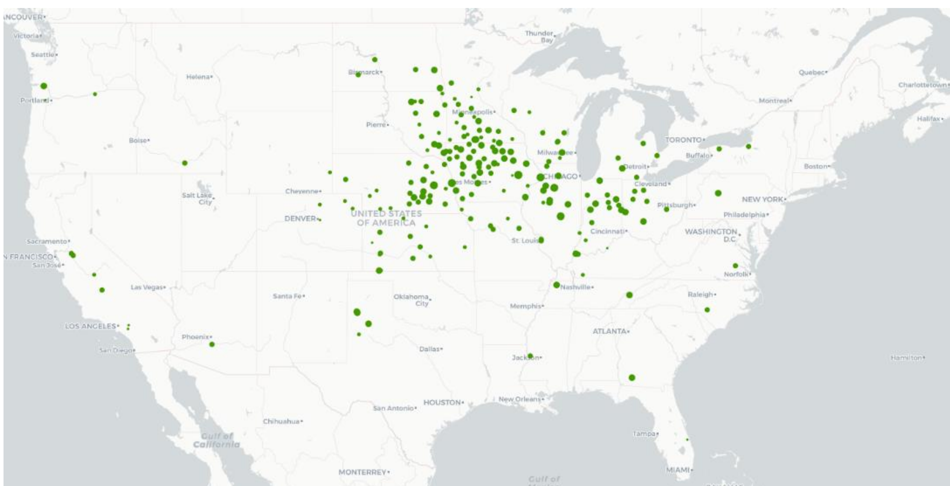
[64] Includes Part 3 Agreements: A Part 3 Agreement is an agreement between a Part 3 fuel supplier and the Director under the Greenhouse Gas Reduction (Renewable and Low Carbon Fuel Requirement Regulation) Act to take actions that would have a reasonable possibility of reducing GHG emissions through the use of Part 3 fuels sooner than would occur without the agreed-upon action. Part 3 Agreements provide a mechanism for Part 3 fuel suppliers to generate credits in order to comply with B.C.'s low carbon fuel requirements under the Renewable and Low Carbon Fuel Requirements Regulation (Regulation). Part 3 Agreement credits are indistinguishable from other credits under the Regulation and, as such, may be used to meet compliance obligations or may be transferred to other Part 3 fuel suppliers. For more information and a list of the Part 3 fuel suppliers currently recognized by the Ministry. See Information Bulletin RLCF-013 – Validation and Transfer of Part 3 (Low Carbon Fuel) Credits(Information Bulletin RLCF-014).

BC's 5% ethanol requirement is identical to all other Canadian jurisdictions. However, the Pacific Northwest is rather isolated from existing transportation networks. Therefore, BC may experience additional costs when accessing ethanol from the neighbouring province of Alberta. BC's southern neighbour, (Washington State) is geographically quite similar to BC, with a large port and a major mountain range that isolates the area from the rest of the continent.

In Washington, gasoline is mixed with 10% ethanol.[65] Compared to the corn-growing Midwest, ethanol production in the Pacific Northwest is low. The total capacity of active production facilities is 102 million gallons per year, approximately 20% of current ethanol demand in the region. [66] Washington State has not commercially produced ethanol fuel since 2006.[67] According to the U.S. Department of Energy,[68],90% of the ethanol in the United States is transported by train or truck. The remaining 10% is mainly transported by barge, with minimal amounts transported by pipeline.

Map 4.4.3: Ethanol production plants in the United States[69]

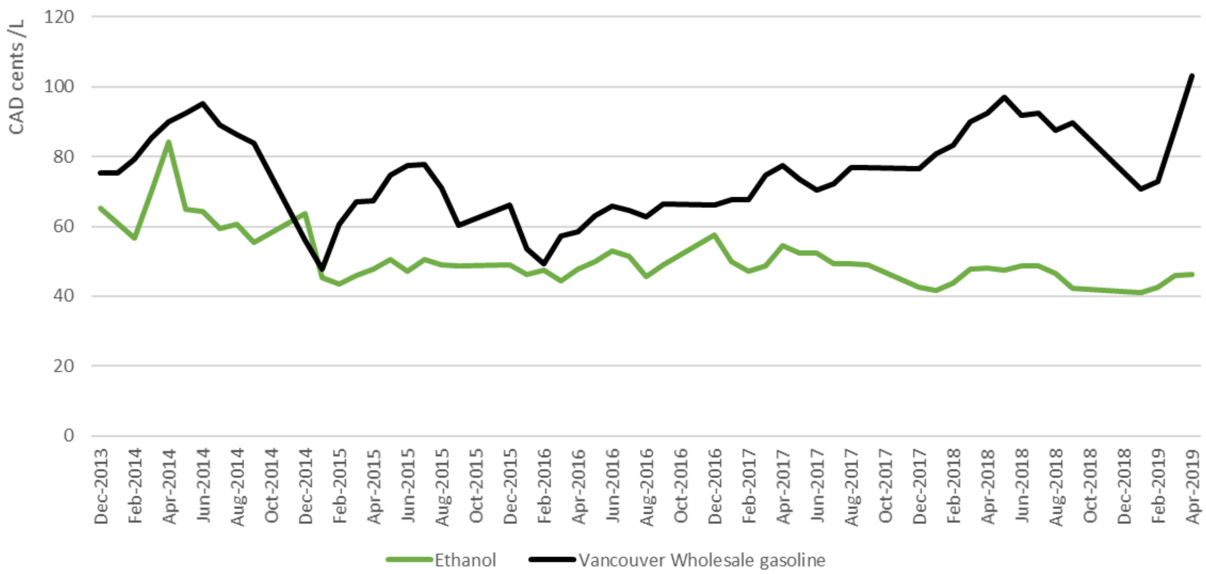


The majority of ethanol in the United States is produced in the Midwest region. The major pricing hub for ethanol in the United States is at Kinder Morgan's Argo Illinois Terminal.

In the chart below, it is clear that the overall cost of ethanol has been lower than wholesale gasoline for some time. However, Argo Illinois is approximately 3,500 km from Vancouver, BC and the ethanol must be transported. This means that ethanol costs in Vancouver, as in other locations in Western Canada and Western United States, must account for the transport of ethanol. This is discussed in more detail below.

[65] Based on conversations with OPIS.
[66] US Department of Energy, Alternative Fuels Data Centre, Ethanol Laws and Incentives in Washington
[67] Pacific Northwest Extension Publication: Ethanol in the Pacific Northwest, Hart, Lesnik, and Townsend
[68] US Department of Energy, Alternative Fuels Data Centre, Ethanol Production and Distribution
[69] The Biofuels Atlas

***Chart 4.4.4: Ethanol versus gasoline wholesale prices*[70]**



Transport of biofuels by pipeline is not considered feasible because biofuels would require a dedicated pipeline.[71] Since the quantities of biofuels consumed are not generally large enough to warrant a dedicated pipeline, biofuels are usually transported by rail, tanker truck, or marine.

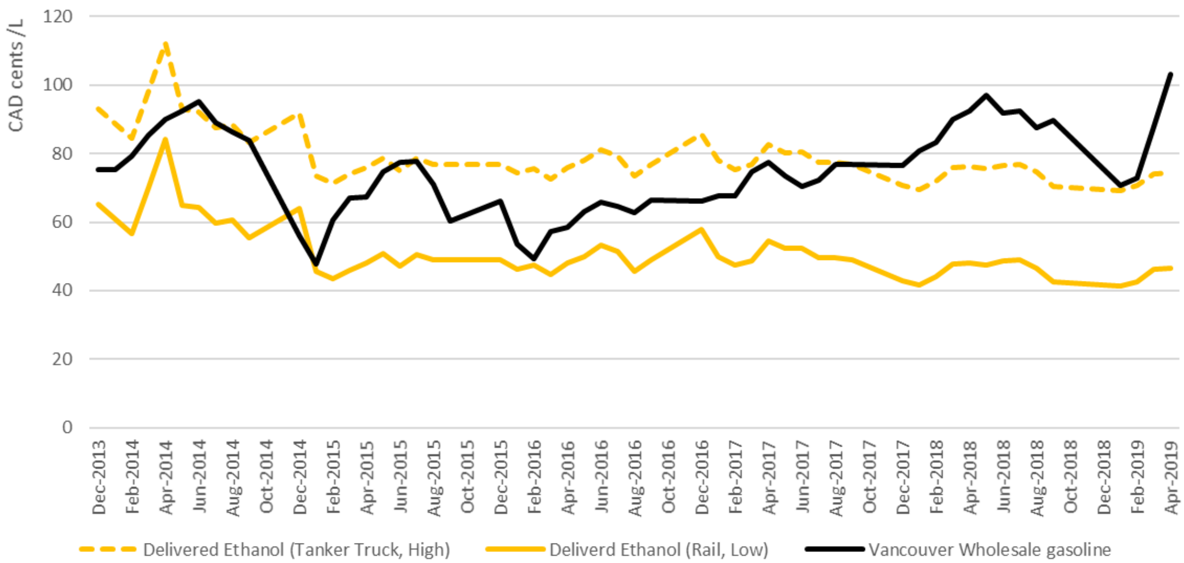
Kent Group found that nearly all Canadian ethanol imported in 2016 originated from the Midwest of the United States via rail into Central and Western Canada. Data submitted by terminal operators indicated that most ethanol is in fact delivered to primary distribution terminals by tanker truck.[72]

In the Asia-Pacific Economic Cooperation's 2011 publication, Biofuel Transportation and Distribution Options for APEC Economies, [73] it is estimated that the cost to transport biofuels could be between 0.2 cents/L per km to 0.6 cents/L per km by rail, between 0.6 cents/L per km and 0.8 cents/L per km by tanker truck, and between 0.3 cents/L per km and 0.7 cents/L per km by barge.

The chart below demonstrates the impact of transport costs on the costs of ethanol. The analysis used to create this chart used the most expensive form of transport and considered ethanol that is transported from Argo Illinois by tanker truck. Under this scenario, the delivered cost of ethanol rises above the observed price of gasoline.

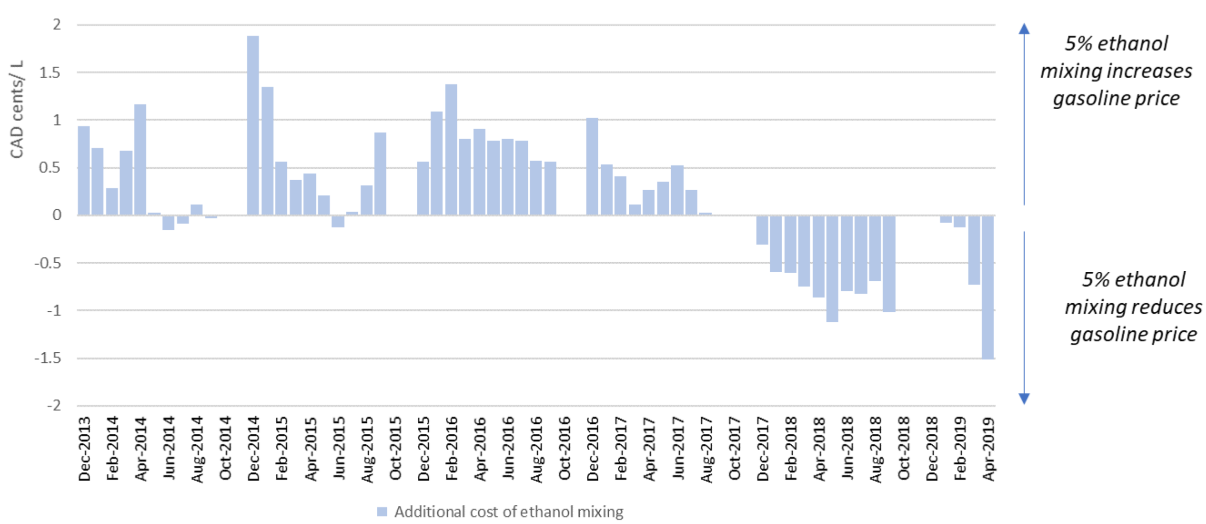
[70] Ethanol process are the Illinois average spot price as listed by the USDA Agricultural Marketing Resource Centre
[71] A dedicated pipeline is required due to the condensation in the pipeline caused by biofuels.
[72] Kent Group logistics overview - 2017
[73] APEC, Biofuel Transportation and Distribution Options for APEC Economies, 2011

Chart 4.4.5: Delivered cost of ethanol to Vancouver compared to Vancouver wholesale gasoline price



A consideration of the differential between gasoline and the highest estimated cost of delivered ethanol in Vancouver reveals that, at most, the ethanol requirement could have added ~ 1 cent/L from mid-2015 to the end of 2017. Due to the pricing differential, this relationship inverted in 2018 and 2019. Therefore, as illustrated in Chart 4.4.6 below, the requirement for a 5% ethanol blend with gasoline is estimated to have reduced the wholesale price of gasoline by ~1 cent /L since 2018. Because the benefit of low ethanol costs would be experienced across all jurisdictions that require ethanol mixing, this differential is not carried through the cost analysis.

Chart 4.4.6: Cost of 5% ethanol mixing requirement



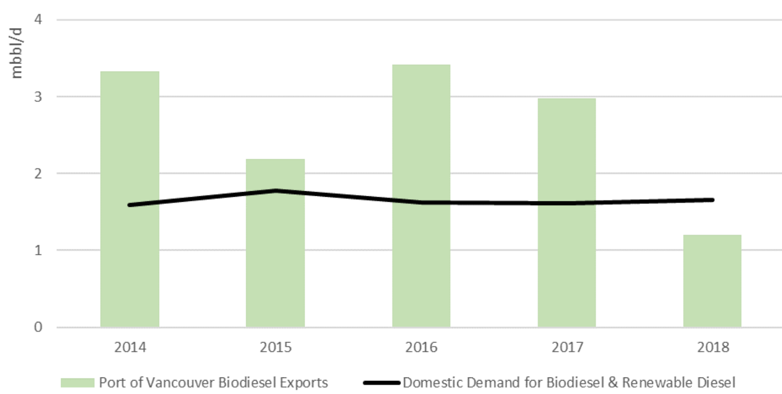
Costs associated with storage capacity, and the capital and operating costs associated with mixing ethanol do not explain the growing differential between wholesale prices in BC and those in Edmonton, or Seattle. This is because suppliers in BC, Alberta and Washington State would be required to incur these costs, as a 5% and 10% ethanol mixing requirement applies across the three jurisdictions.

In short, this analysis did not find any evidence that a lack of access to ethanol or that ethanol transport costs have caused an increase in BC's wholesale gasoline prices.

Access to Biodielsel

BC requires 4% biodiesel to be mixed with diesel sold and consumed in the province. Currently, there are 22 commercial biodiesel production facilities in Canada, two of which are in Delta, BC (City-Farm Biofuel Ltd and Consolidated Biofuels Ltd). However, much of the biodiesel used in BC is imported from the United States.[74]

Chart 4.4.7: Biofuel Exports, Port of Vancouver[75]



Despite BC's imports of biodiesel, the province has also been exporting product. Based on records from the Port Authority, BC has been exporting biodiesel and renewable diesel from marine ports in amounts that often exceed the annual demand resulting from the 4% biodiesel requirement. This likely indicates that access to biodiesel in BC is not a major challenge for local diesel suppliers. Therefore, it is unlikely that BC faces higher transport costs than Edmonton and Seattle.

Cost impacts of reduced carbon intensity

Suppliers have several options for ensuring compliance with the schedule of carbon intensity for the fuels they supply. The most expensive source of compliance is direct purchase of compliance credits. Comparatively, the least expensive sources of compliance may include change of transport, mixing or storing technology, or the increasing use of renewable fuels, among others. Economic theory suggest that suppliers will first turn to the least expensive compliance option.

This understanding can be used to estimate the maximum impact of the regulation by modeling the following scenario:

- Use carbon intensity of fuels supplied in 2010.
- Assume that carbon intensity is determined solely by the regulation, that is, the precautionarily high carbon intensity by fuel type which is intended to incentivize suppliers to submit their own carbon intensity.

[74] BC Sustainable Energy Association, Biodiesel information.
[75] Port of Vancouver Export data.

- Assume that all carbon reductions come exclusively from the purchase of compliance units at the maximum compliance unit cost observed in the market.

Even with these assumptions, the maximum cost of this section of the regulation is 2 cents/L in 2016, climbing to 4 cents/L for gasoline and 3 cents/L for diesel in 2018.

Modeled Maximum Impact of Part 3 of the RLCFS for Gasoline						
	2013	**2014**	**2015**	**2016**	**2017**	**2018**
Target Emissions Intensity	86.20	85.11	85.11	84.23	83.74	82.41
2010 Baseline Intensity	87.08	87.08	87.08	87.08	87.08	87.08
PJs Supplied	159	165	170	178	178	178
CO_2e Tonnes above target (MTs)[76]	140,568	325,284	334,769	508,564	594,407	830,796
Maximum Cost / compliance unit (CAD$)	170*	170*	170	190	185	210.5
Maximum Total Cost (CAD$ Millions)	23.90	55.30	56.91	96.63	109.97	174.88
Quantities reported (Million Litres)	4,343	4,497	4,600	4,828	4,817	4,817
Cost per Litre ($/L)[77]	0.01	0.01	0.01	0.02	0.02	0.04

** Maximum trade price from 2015 used for modeling*

Modeled Maximum Impact of Part 3 of the RLCFS for Diesel						
	2013	**2014**	**2015**	**2016**	**2017**	**2018**
Target Emissions Intensity	92.38	91.21	91.21	90.28	90.02	88.60
2010 Baseline Intensity	92.60	92.60	92.60	92.60	92.60	92.60
PJs supplied	149	152	143	141	157	157
CO_2e Tonnes above target (MTs)[78]	33,298	212,299	199,891	326,523	405,009	627,614
Maximum Cost / compliance unit (CAD$)	170*	170*	170	190	185	210.50
Maximum Total Cost (CAD$ Millions)	6	36	34	62	75	116
Quantities Reported (Million Litres)	3,643	3,695	3,460	3,423	3,804	3,804
Cost per Litre ($/L)[79]	0.00	0.01	0.01	0.02	0.02	0.03

** Maximum trade price from 2015 used for modeling*

---

[76] Calculated as (baseline intensity- target intensity)*output (MJ)*(1 tonne/1000000 grams)= total tonnes above target.
[77] Calculated as total compliance cost divided by litres reported.
[78] Calculated as (baseline intensity- target intensity)*output (MJ)*(1 tonne/1000000 grams)= total tonnes above target
[79] Calculated as total compliance cost divided by litres reported.

For example, in 2017 the regulation could explain up to a maximum of 2 cents/L of a total differential of 9-12 cents/L between Kamloops and the comparable jurisdictions and 13-15 cents/L between Vancouver and the comparable jurisdictions (which are not subject to this regulation).

As indicated, the estimate for the regulatory impact in this section is the *maximum* plausible. Given this, it is important to note several factors which indicate that the likely true impact is far less than what has been modeled here. These factors include the following:

1. The average trade price for compliance credit has been below the maximum observed in the market.

	2013	2014	2015	2016	2017	2018
Maximums Cost / compliance unit (CAD$)	170*	170*	170	190	185	210.5
Average cost/ compliance unit (CAD$)			170	171	164	193

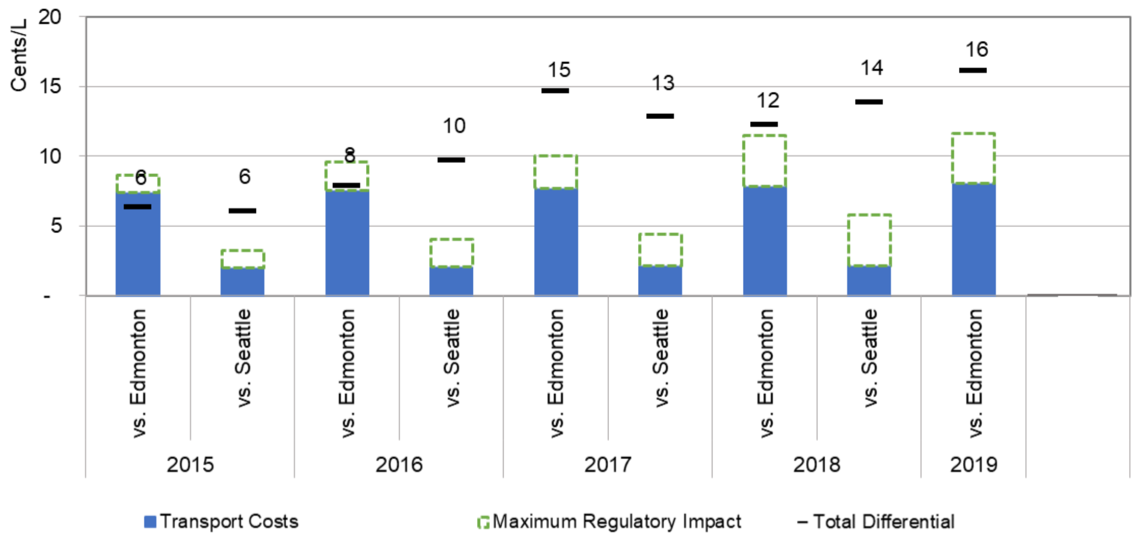
** Maximum trade price from 2015 used for modeling*

2. California has a very similar regulatory environment and has lower cost wholesale gasoline. (See Appendix 12 for details.)
3. A similarly sized differential is not observed for diesel prices in BC when compared to other jurisdictions, despite the fact that the regulation applies for diesel as well as gasoline.
4. Only a small share of compliance units are actually transferred, indicating that most compliance credits can be achieved more cost effectively than purchasing compliance credits from the market at the average price. 0.9% of the cumulative credits available were transferred in 2015, and 10.5%, and 13.0% in 2016 and 2017 respectively.

Therefore, in the following charts the regulatory impact is shown as a range between zero and the maximum impact modeled.

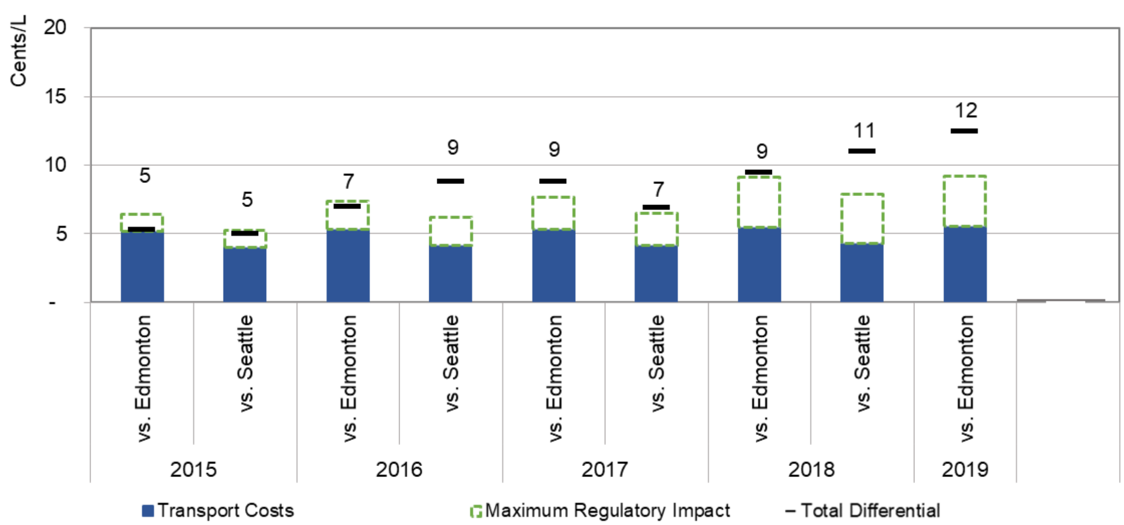
Adding the maximum regulation to estimated marginal transport costs, the differential between Vancouver and Edmonton is reduced to ~ 4 cents/L. The modeled impact of the regulation is the absolute *maximum* cost of the regulation and therefore should be understood as the upper bound of the regulatory impact, not necessarily the actual impact in any given year. With this in mind, the differential between Seattle and Vancouver of ~ 8 cents/L remains.

Chart 4.4.8 Vancouver wholesale differential less tanker truck transport and maximum regulatory impact



As illustrated in Chart 4.4.9, the differentials between Kamloops and Edmonton, and Kamloops and Seattle also appear to be largely explainable when the maximum impact of the regulation is considered. However, ~3 cents/L of a differential continued to exist between Kamloops and Seattle in 2018 and between Kamloops and Edmonton in 2019.

Chart 4.4.9 Kamloops wholesale differential less tanker truck transport and maximum regulatory impacts



Barriers to Trade

Another regulatory item that could add to the cost differential relates to the indirect barriers to trade, for example if an expensive permit is required to transport fuel across borders (provincial or national).

Although research at the time of writing did not reveal any changes to the fuel transportation and trade regulatory environment in the pre-and post-2015 periods, it is possible that there are some barriers to trade which add additional costs. These may include, for example:

1. Border waits: Paying drivers, or owner-operators for additional wait time at the border may add some additional costs to the transport of fuel from the United States.
2. Permits: Additional permits may be costly to acquire, either due to limited availability, wait time, or direct costs. These may add cost to imports from the United States or from elsewhere in Canada.
3. Official Procedures: There may be additional official procedures, which may add additional costs to international or inter-provincial imports.

There was insufficient data at the time of writing to draw conclusions regarding the existence of or costs associated with indirect barriers to trade for fuels into BC.

4.5 Wholesale Competition

Wholesale prices are generally set by refiners in different jurisdictions. Based on reports received by OPIS, current wholesale prices are primarily set by Esso, Shell, Suncor, and Parkland. This is detailed on a city-by-city basis in the table below.

Table 4.5.1 Companies with OPIS quoted wholesale prices

City	Esso	Suncor	Shell	Parkland
Edmonton	✓	✓	✓	
Calgary	✓	✓	✓	
Winnipeg	✓	✓	✓	
Saskatoon	✓	✓	✓	
Kamloops	✓	✓	✓	✓
Prince George	✓	✓	✓	
Vancouver	✓	✓	✓	✓

Posted wholesale prices throughout Western Canada are determined by a small and consistent set of refiners. Since they are similar across Western Canada, any impact that a small number of market players would have on market competition (and, therefore, on prices) would apply across Western Canada. In other words, any market competition dynamics that impact pricing in BC would also impact pricing in the rest of Western Canada and, accordingly, would not account for wholesale price differentials.

It is important to note that at the refinery level, there was some movement in the ownership of refineries in BC, Alberta, and Washington State between 2000 and 2019. As detailed in Table 4.5.2, these ownership changes do not appear to result in a change in the concentration of ownership across the region in either the pre- or post-2015 periods.

Table 4.5.2 Refinery Ownership in BC, Alberta, and Washington State

<table>
<tr><th colspan="2">Location</th><th>Capacity (mbbl/d)</th><th>2000</th><th>2001</th><th>2002</th><th>2003</th><th>2004</th><th>2005</th><th>2006</th><th>2007</th><th>2008</th><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th></tr>
<tr><th rowspan="2">BC</th><th>Burnaby</th><td>55</td><td colspan="18">Chevron</td><td colspan="2">Parkland</td></tr>
<tr><th>Prince George</th><td>12</td><td colspan="20">Husky</td></tr>
<tr><th rowspan="3">Alberta</th><th>Strathcona</th><td>191</td><td colspan="20">Imperial Oil</td></tr>
<tr><th>Edmonton Refinery</th><td>142</td><td colspan="10">Petro-Canada</td><td colspan="10">Suncor (Purchased Petro-Canada)</td></tr>
<tr><th>Scotford Refining</th><td>114</td><td colspan="20">Shell</td></tr>
<tr><th rowspan="5">Washington</th><th>Anacortes</th><td>145</td><td colspan="20">Shelll</td></tr>
<tr><th>Tacoma</th><td>41</td><td colspan="7">US Oil</td><td colspan="7">Astra Oil Trading</td><td colspan="6">TrailStone</td></tr>
<tr><th>Anacortes</th><td>120</td><td colspan="17">Texaco</td><td colspan="2">Andeavor (Aug'17-Oct'18)</td><td>Marathon</td></tr>
<tr><th>Cherry Point</th><td>225</td><td colspan="3">ARCO</td><td colspan="17">British Petroleum</td></tr>
<tr><th>Ferndale</th><td>101</td><td colspan="2">Tosco</td><td colspan="11">Phillips / Conoco Phillips</td><td colspan="7">Phillips 66</td></tr>
</table>

Overall, this report has not found evidence to indicate that refining ownership concentration has changed in the Western Canadian and Washington State region between the pre- and post-2015 time periods. Therefore, this report has not found evidence that changes to the competitive landscape account for wholesale gasoline price differentials.

4.6 Explainable Variance

In summary, it appears that some of the wholesale price differential between Vancouver and Edmonton and Seattle, and between Kamloops and Edmonton and Seattle can be explained by (1) transport costs, and (2) possibly regulatory compliance.

There is evidence that gasoline is being imported from Alberta by tanker truck and perhaps from Seattle., given YVR's high level of tanker truck imports of jet fuel. This high marginal cost of transport has likely increased the cost of the marginal unit of supply. If alternative transport networks are at capacity, then all fuel will be priced based on this marginal cost of transport from a neighbouring market. As summarized in the Table 4.6.1, this explains between 2 and 8 cents/L of the differentials reviewed in this section.

Table 4.6.1 Estimated tanker truck transport costs

Trip	Transport Costs
Edmonton to Vancouver	**$0.080/L**
Edmonton to Kamloops	**$0.056/L**
Seattle to Vancouver	**$0.022/L**
Seattle to Kamloops	**$0.044/L**

In addition, the Renewable Fuel and Low Carbon Fuel requirement regulation may add some costs to the wholesale price in BC. However, this does not fully explain the differential. To estimate the cost implications of the regulation, this report analyzed the impact of the absolute upper bound of the cost associated with the regulation, as the lower bound is a negligible cost impact. Even with the most expensive form of transport and the highest possible cost estimate for the incremental cost of BC's regulatory environment, the differential is not fully explained. A comparison of the remaining differential between BC and Seattle reveals that a ~ 8 cents/L differential remains between Vancouver and Seattle, and a 0 to 3 cents/L differential remains between Kamloops and Seattle. (See Chart 4.6.2.) Finally, if there are barriers to trade, it is expected that these would apply equally to Vancouver, Kamloops and Seattle. Therefore, barriers to trade do not appear to explain the entire remaining differential between Vancouver and Seattle.

Chart 4.6.2 Remaining wholesale price differential between BC and Seattle

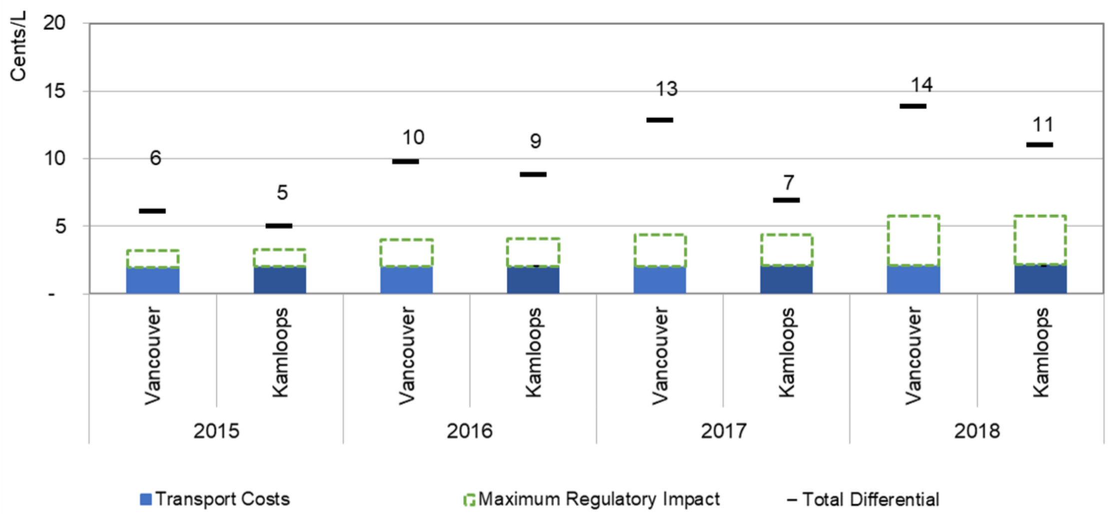
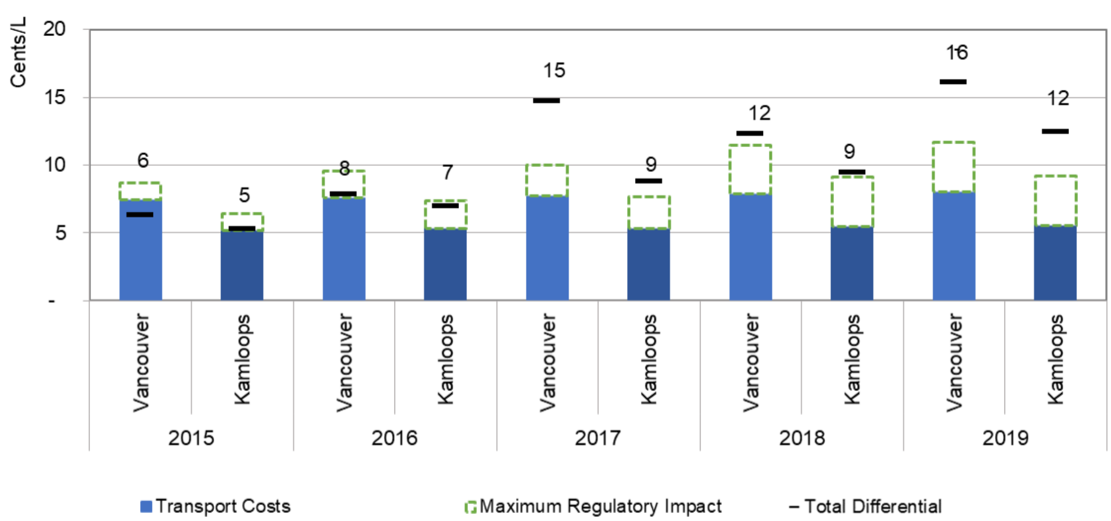


Chart 4.6.3 displays the remaining differential in wholesale gasoline prices between BC and Edmonton. (Note that this comparison includes 2019 which is excluded in the comparison to Seattle due to data availability). With respect to Edmonton, it may be that in years prior to 2017, the marginal unit was imported using rail infrastructure. This is indicated by the negative differentials presented in the chart below. In this regard, it is possible that during this time rail and pipeline capacity was more available for transportation of refined products. However, in 2017 and again in 2019 a substantial differential is created between Vancouver and Edmonton, and to a lesser extent between Kamloops and Edmonton.

Chart 4.6.3 Remaining wholesale price differential between BC and Edmonton



The reason for the remaining differential is unclear. Additional analysis and further cooperation with market participants is recommended in order to identify actual (rather than estimated) marginal transport costs and other potential market frictions, which may be contributing to the remaining differential in gasoline wholesale prices between BC and Edmonton and Seattle.

5. Compatibility with Diesel Behaviour

Observations

11. The diesel market exhibits more stable prices than the gasoline market. This may be a result of more elastic demand at both the retail and wholesale levels.

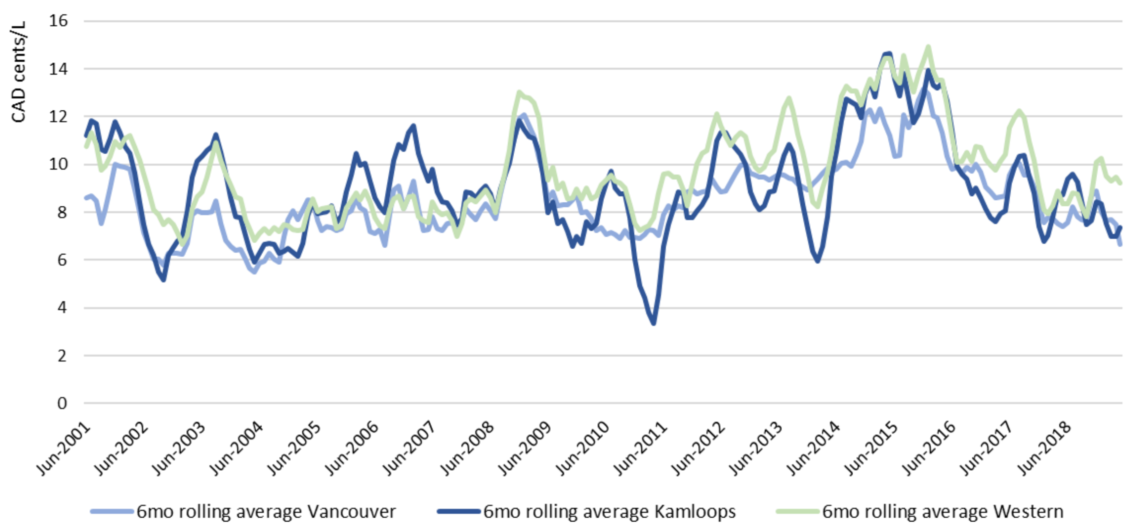
12. A comparison of the behaviour of diesel wholesale prices between Vancouver, Kamloops and Seattle may indicate that barriers to trade could be contributing to the price differential that has been observed since 2013. However, the costs of trade require more investigation.

As detailed in Section 2 of this report, the behaviour of diesel retail margins and wholesale prices has been different than the behaviour of gasoline retail margins and wholesale prices over the period under review. This section explores how gasoline and diesel may be subject to different market conditions and supply and demand dynamics, which may explain the differences in behaviour of retail margins and wholesale prices.

5.1 Diesel Retail Margins

As indicated in the Phase 1 report and in contrast to gasoline margins, diesel retail margins in Vancouver, Kamloops and the Western Region have remained fairly consistent over the period under review. This is illustrated in Chart 5.1.1.

Chart 5.1.1 Six month rolling average of diesel retail margins in Vancouver, Kamloops and the Western Region



Although consumers can switch between gasoline and diesel in the long-term, in the short-term, consumers' ties to one fuel source are relatively rigid due to the high switching costs of purchasing a new vehicle. Since the fuels are not easily substituted in the short-run, the demand profiles of these markets are likely subject to independent forces. However, the supply of these fuels is highly interconnected, as they are refined at the same facilities using the same crude product and they are sold to end customers by the same retailers.

In what follows, this report examines two possible factors that may be driving the relative stability observed in diesel margins:

1. Competition: more competitive markets place downwards pressure on margins.
2. Price elasticity: if consumers are highly sensitive to price increases, retailers risk a greater loss of sales volume if they increase margins by raising price.

Competition

As outlined in section 3 there have been no major changes in the competitive landscape for retail gasoline and therefore competition is not likely a cause of changes to the gasoline retail margins. Competition in the diesel market is expected to be similar or slightly lower as diesel-only stations are not know in BC,[80] therefore any retailer that sells diesel will most likely also sell gasoline. As a result, the number of retailers selling gasoline is at least as high as the number of retailers selling diesel. Although simple counts of retail stations offering diesel in Vancouver over time is not available, in their 2017 retail site report, the Kent Group indicates that diesel fuel was available at 72.5% of their reporting retail petroleum outlets.[81]

Adding to this evidence, no major changes to the retail margins for diesel have been observed. Therefore, differences in the competitive landscape for retail diesel (lower levels of retail competition than gasoline) do not explain the relative stability of diesel retail margins vis-a-vis gasoline retail margins. Marketer information for diesel specific transactions was not available at the time of writing.

In short, none of the available information indicates that the competitive landscape has developed differently for diesel and gasoline markets in BC, and this is not likely a contributor to the relative stability of diesel retail margins.

[80] Note: Cardlocks (i.e. automated, unattended fuelling sites designed for commercial fleet vehicles) are not included in this price analysis.
[81] Kent Group Ltd, Retail Census Report, 2017

Price Elasticity

If retailers are forced to increase prices for products as their costs rise, they may choose to apply the additional cost to the goods which are least sensitive to prices changes (i.e. are less elastic). This would allow the price increase to be absorbed with minimal impact to total volume purchased.

If diesel demand is more elastic than gasoline demand, then an increase in retail margin may be applied to gasoline rather than diesel prices.

> ***Price Elasticity of Demand***
>
> The price elasticity of demand measures how much consumers adjust their demand based on prices. The measurement is the percentage change in demand based on a 1% change in price.
>
> If demand decreases by 1% following a 1% increase in price then the price elasticity is, 1%/-1% = -1
>
> The closer the elasticity score is to zero, the less sensitive consumers are to price changes.

Chart 5.1.2 Yearly Price Point Elasticities across BC (Diesel and Gasoline)

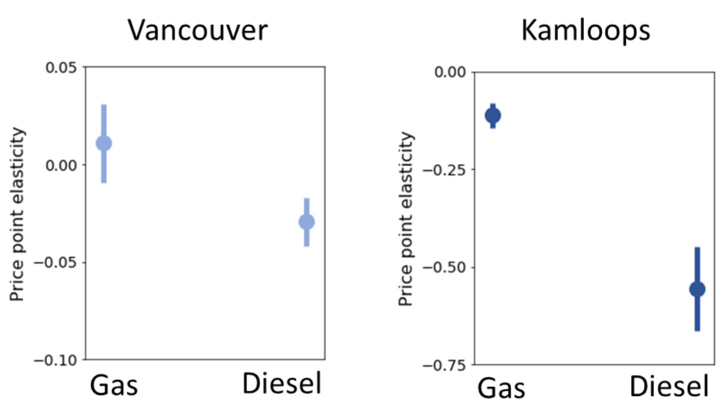


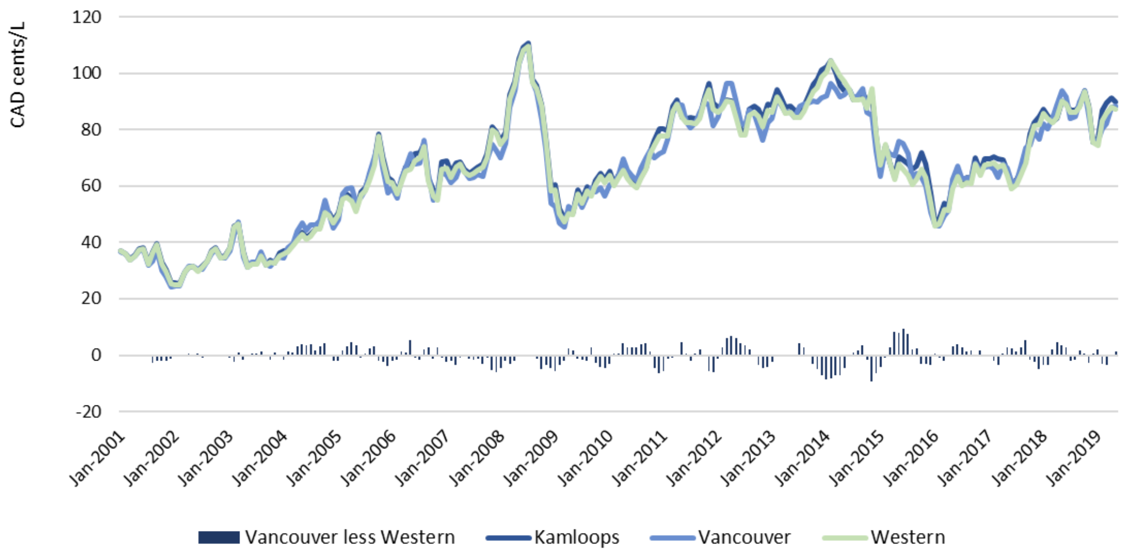
Chart 5.1.2 illustrate that Vancouver's diesel price elasticity is somewhat more elastic than gasoline price elasticity. In Kamloops, diesel price elasticity was significantly more elastic than gasoline price elasticity. (See Appendix 7 for the methodology used to make these estimates.)

Therefore, it may be the case that retailers pass higher margins on to the product with the lower elasticity of demand (gasoline, in this case) in order to minimize volume suppression due to price increases.

5.2 Diesel Wholesale Prices

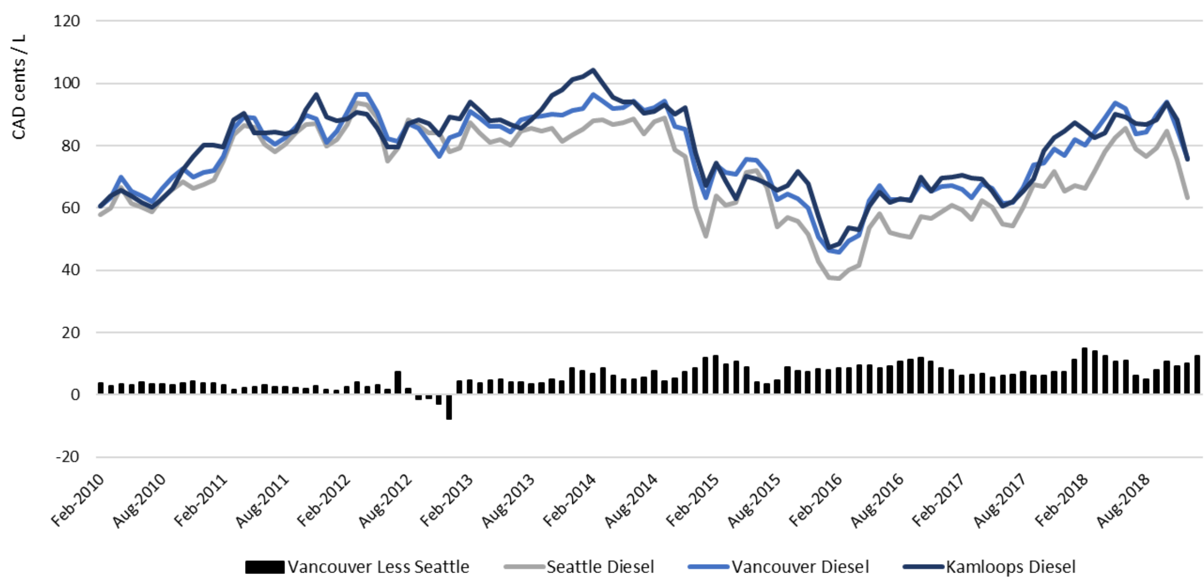
As noted in Section 2 of this report, diesel wholesale prices across Vancouver, Kamloops and the Western Region have been quite consistent.

Chart 5.2.1 Diesel wholesale prices for Vancouver, Kamloops and the Western Region



As with the gasoline wholesale price analysis, this comparison is expanded to include a comparison to Seattle's wholesale prices. See Chart 5.2.2.

Chart 5.2.2 Wholesale diesel price in Vancouver, Kamloops, and Seattle



Adding Seattle wholesale prices adds a new layer to this analysis. It reveals a clear divergence starting in early 2013, as BC prices outgrew Seattle prices and remained that way throughout the remainder of the period. Both the divergence of Seattle and Vancouver's wholesale prices as well as the consistency observed amongst diesel wholesale prices within Western Canada are considered in the analysis below.

Similar to retail margins, the behaviour of wholesale prices may be a result of both supply and demand factors. In addition to these factors, as in the gasoline wholesale section, this section considers regulatory factors.

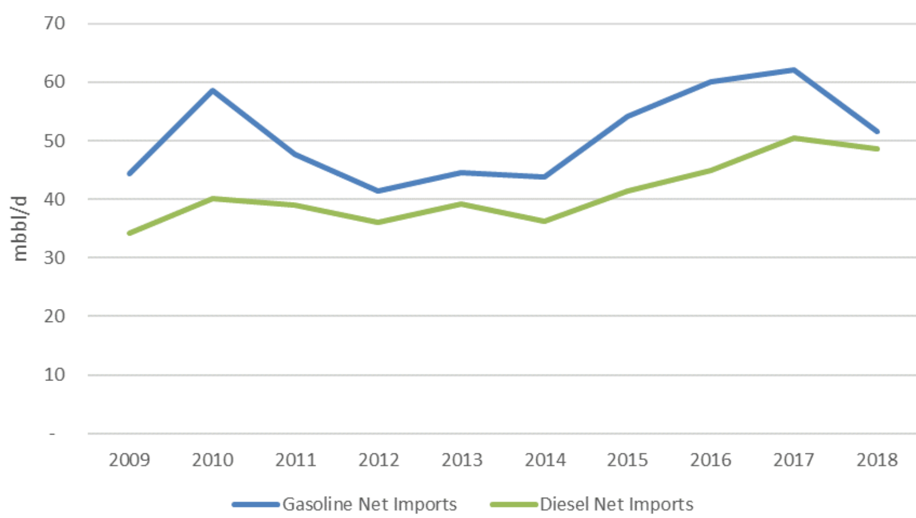
Supply Side

Section 4 detailed how gasoline demand in BC may have exhausted some of the more cost-effective modes of transportation. This has led to the use of a more expensive form of transportation (i.e. tanker truck) to import fuel. Theoretically, it would be expected that because diesel and gasoline use the same transportation networks, the same marginal transport costs would apply to both.

However, production of diesel and gasoline are not perfect substitutes; a refiner cannot simply choose to produce a barrel of gasoline rather than diesel without impacting its ability to produce other products. Additionally, it is expected that some switching costs are incurred when deciding to produce either diesel or gasoline and therefore refiners cannot react immediately or perfectly to market price signals. As a result, despite there being higher prices for gasoline, suppliers may be restricted in the mix of products that they can produce and may not have the flexibility to switch from production of diesel to the production of gasoline. Therefore, it may be that there is a greater supply of diesel in BC than would be the case if producers could respond to demand without constraints.

In absolute terms, BC's net imports for clear diesel (including blended diesel) and gasoline (including ethanol) appear to be quite close, with gasoline net imports ranging from 46% higher to 6% higher than diesel in 2010 and 2018, respectively.

Chart 5.2.3 Net imports of gasoline and diesel to BC (includes inter-provincial trade)



The understanding at the time of writing was that gasoline and diesel would utilize the same transportation infrastructure and, therefore, a rise in transport prices for gasoline would also be expected to result in an increase in transport prices for diesel.

In relation to competition on the supply side, no differences are expected in level of competition are expected at the wholesale level. This is due to the fact that refiners produce both gasoline and diesel. Therefore, it is not expected that changes in refiner competition would drive differences in the competitiveness of the diesel versus gasoline markets.

Demand Side Elasticity

The wholesale diesel market is expected to be considerably different than the retail diesel market due to the diesel demand of the long-haul trucking industry. The long-haul trucking industry is likely to have a higher sensitivity to prices because:

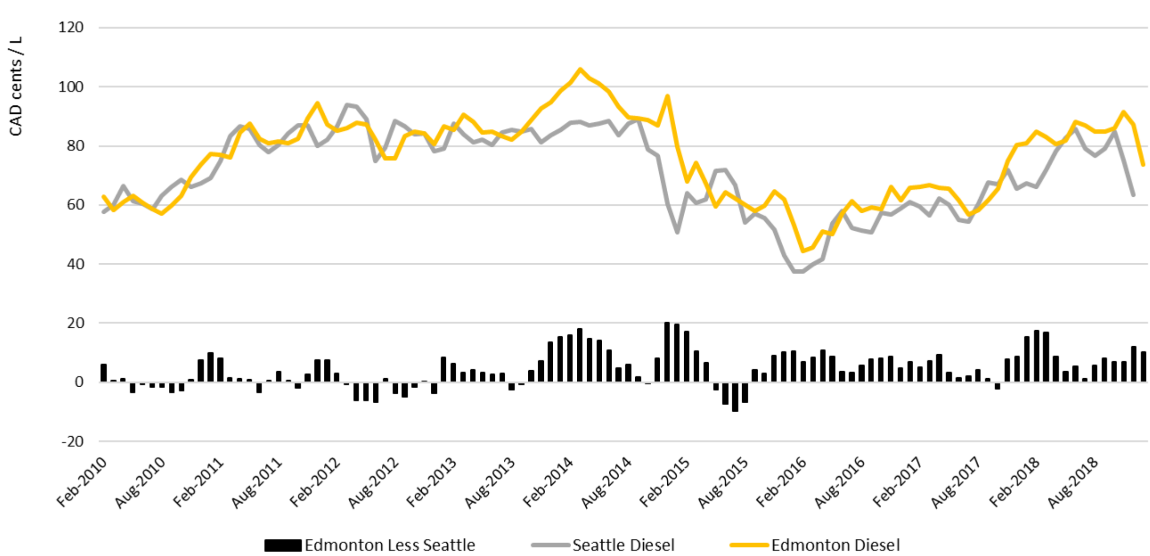
1. Purchasers are larger and have the ability to enter into long-term agreements
2. Companies invest in fleet optimization, minimizing refueling costs
3. Longer distances are travelled on a regular basis, allowing for potentially more geographic substitutability in fuel. For example, a truck may decide to purchase fuel in Hope, BC or Vancouver, whereas a retail consumer may be limited to locations within the same neighbourhood in Vancouver.

It is expected that the higher price elasticity of demand of the wholesale diesel market would explain the consistency in wholesale diesel prices across BC and the Western Region. However, direct consumption data from cardlocks and prices on those transactions are not available to directly compute price elasticities in the wholesale market.

Regulation

The differential between BC and Seattle related to diesel wholesale prices appears to indicate that barriers to trade may be in effect. In order to test this theory, Edmonton wholesale diesel prices are compared to Seattle prices.

Chart 5.2.4 Comparison of wholesale diesel prices between Edmonton and Vancouver



A similar relationship in wholesale diesel prices between Edmonton and Seattle has been visible since 2013. Although the trend has slightly more variation, this indicates that there may have been a barrier to trade introduced in the 2013 period, adding an additional cost to importing fuel from the United States.

6.0 Conclusions

Observations

13.The gasoline retail margin differential between the Vancouver region and other comparable jurisdictions is correlated with the appreciation Vancouver's land costs. Relatively high gasoline retail margins are likely to be a result, at least in part, of high land values in the Vancouver region.

14. With respect to the gasoline wholesale market, transport costs may be contributing to the higher wholesale prices found in BC vis-à-vis Edmonton and Seattle. In addition, there may be some costs associated with regulation in BC, but even the maximum cost estimate of regulation on wholesale prices is insufficient to explain wholesale price differentials. Furthermore, even the highest estimates of transport and regulatory costs combined do not sufficiently account for the differential in wholesale prices between the Vancouver market and the Edmonton and Seattle markets, particularly in 2019.

15. The competitive landscape has not changed in a material way over the period assessed in the report, and therefore is not expected to be a likely cause of higher retail margin and wholesale price differentials.

16. The diesel market has not seen a material change in retail margin and whole price differentials in recent years, this may be in part due to different demand dynamics in the diesel market.

This report sought to evaluate the factors that may explain the differential between BC prices of gasoline and diesel and those in comparable jurisdictions. In this regard, the report explored a number of factors that might explain the gasoline retail margin differential between the Vancouver region and other regions, as well as the gasoline wholesale price differential between BC regions and comparable jurisdictions. These factors were also considered with respect to the diesel retail margin and diesel wholesale price behaviour.

Retail Margins

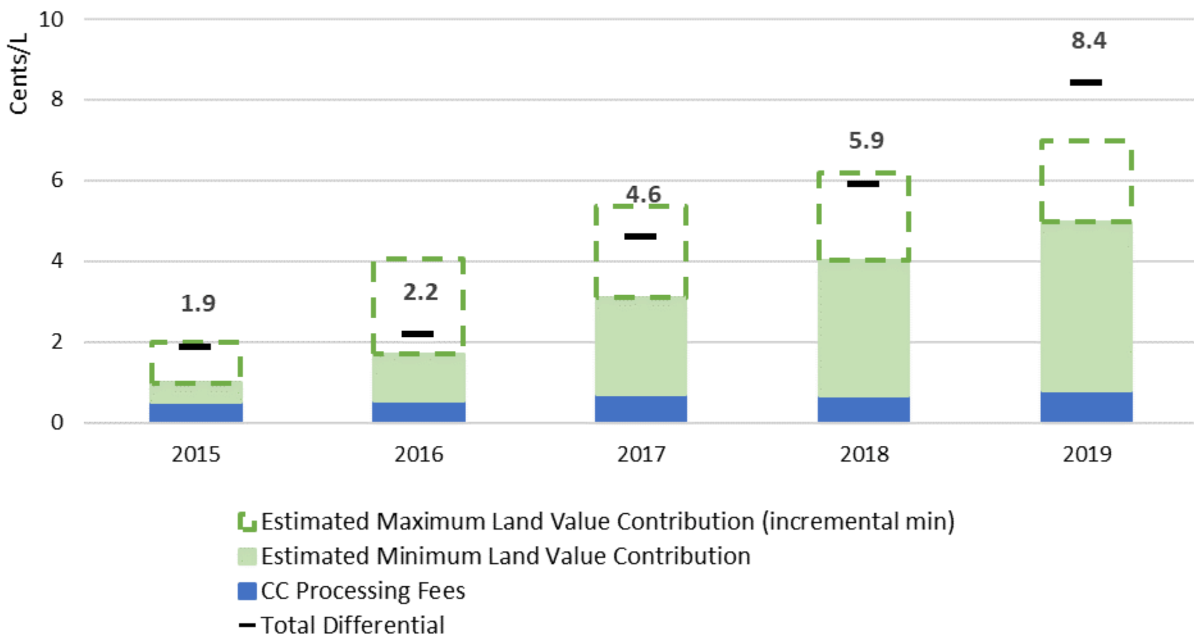
Starting in 2015, Vancouver exhibited higher retail margins than Kamloops and other locations in the Western Region. A number of factors were tested to determine their impact on this differential. These include the following:

- Average throughput by station
- Costs of labour
- Competitive environment
- Rising land costs
- Credit card processing fees

The analysis revealed that throughput, labour costs and the competitive landscape do not appear to contribute to the differential identified. Instead, it was found that land costs are correlated with and could drive a portion of the Vancouver gasoline retail margin growth. This is consistent with findings from Toronto, where land values and gasoline retail margins have also increased significantly since 2015.

Credit card processing fees also appear to have an impact on gasoline retail margin differentials. This is due to the fact that processing fees are applied as a percentage of a total transaction, meaning that fees will be higher in jurisdictions (like Vancouver) where retail prices are already higher than surrounding areas. Chart 6.0.1 illustrates how much of the gasoline retail margin differential can be explained by land costs and credit card processing fees, and how much of the differential remains unexplained.

Chart 6.0.1 Explained and unexplained retail margin differential between Vancouver and Western Regions



As this chart demonstrates, the explanatory variables identified (i.e. Credit card processing fees and land values) could explain the total differential well until 2019. However, in 2019, 1.4 cent/L of the differential remains unexplained.

In order to complete the retail margin assessment, it is recommended that the Commission:

1. **Assess actual land values and lease costs for the period under review:** Assess the actual assessed values of the land occupied by the retail gas stations as well as year over year lease costs for those retailers that do not own the land. This approach could test the conclusion that land values are a contributing factor to retail gasoline margins and this data could identify whether commercial values in 2019 are sufficient to explain the remaining "unexplained" differential in 2019.

Gasoline Wholesale Prices

Both Kamloops and Vancouver experienced higher wholesale prices than the Western regions of Canada and the United States. In order to assess the factors contributing to this differential, Vancouver and Kamloops were compared to Edmonton and Seattle specifically. These comparator jurisdictions were selected based on their proximity to BC and their access to nearby refinery capacity.

Four main factors were assessed as potential explanatory variables. These include the following:

- Costs of inputs
- Costs of the marginal unit of supply as determined by transport costs
- The regulatory environment
- The competitive landscape

The analysis revealed that input costs and competition in the wholesale market in the pre- to post-2015 period likely did not contribute to the differential in wholesale gasoline prices between BC and comparable jurisdictions. Instead, the transport costs of the marginal unit of supply, is identified as a likely contributor to the differential. Transportation is an important issue in the BC market because BC is a net importer of gasoline. Therefore, the marginal source of supply is imported and the marginal costs of transport will determine the total cost this supply. Specifically, it appears that BC's marginal transportation capacity is tanker truck delivery. The (comparatively high) costs of tanker truck delivery may account for some of the observed differential. In addition, the Renewable and Low Carbon Fuel requirement regulation could be driving some additional costs in BC. This report estimates the maximum impact of the regulation, but the actual impacts are likely significantly lower and is therefore depicted as a range from 0 to the maximum impact.

As with the retail margin differential, a larger differential appears to remain unexplained in 2019 than in previous years (see Chart 6.0.2). This is particularly true with respect to comparisons with Edmonton. Additionally, transport costs and the maximum costs associated with regulation only offer a partial explanation of Vancouver's differential with Seattle.

Chart 6.0.2 Explained and unexplained wholesale price differential between Kamloops with Seattle and Edmonton[82]

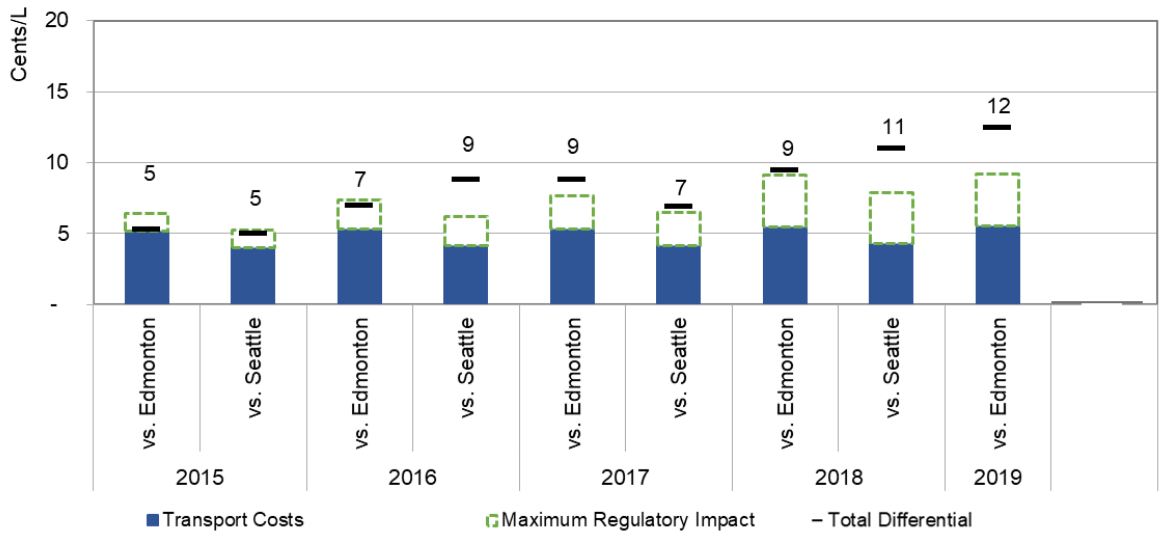
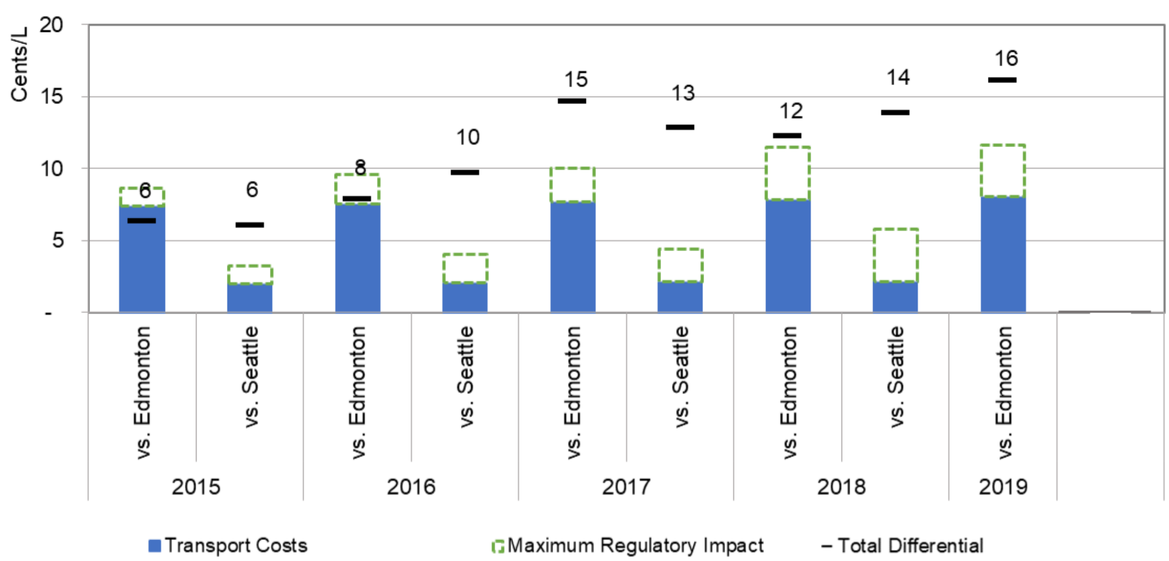


Chart 6.0.3 Explained and unexplained wholesale price differential between Vancouver with Seattle and Edmonton



[82] Chart 6.0.2 and 6.0.3 include:

- Transport costs were estimated using the highest marginal cost of transportation (tanker truck)
- The maximum regulatory impact of BC's Renewable and Low Carbon Fuel requirement regulation is estimated based on the maximum costs which would be incurred if fuel supplied had no lower cost abatement options and only purchased the maximum cost compliance costs.
- The total differential is the total annual difference is estimated by subtracting annual average wholesale prices in the comparable jurisdictions from the annual average in the BC jurisdictions.

Further research may be required. In this respect, it is recommended that BCUC inquire into the following:

1. **Barriers to trade with the United States (and domestic, if applicable):** The BCUC may want to ask the interveners to provide information related to any indirect barriers to trade which may increase the cost of imports.
2. **Actual transport costs of refined fuels**: The BCUC may benefit from reviewing actual transportation costs rather than the estimated values which are leveraged in this report. This may require sourcing information related to the transport costs for refined fuel imported by all possible transport methods (i.e. pipeline, rail, marine, and tanker truck).
3. **Likely regulatory impacts**: The maximum regulatory impact was used in the analysis presented in this report. It would be useful to establish more "likely" regulatory impact, potentially by leveraging insights from interveners.

Compatibility with Diesel Behaviour

Diesel retail margins in BC were found to be consistent with those in the Western Region for the full period reviewed. This behaviour may be explained by that the fact that diesel demand appears to be more price elastic in BC than demand for gasoline.

Wholesale diesel prices in BC were also found to be quite consistent with those in the Western Region for the full period reviewed. This result may be explained by the different demand profile for wholesale gasoline (i.e. demand at Cardlock stations for long-haul trucking).

Conversely, when assessed against diesel wholesale prices in Washington State (Seattle), a divergence in wholesale prices beginning in 2013 with BC's wholesale prices climbing above those in Seattle. This observation may indicate the indirect barriers to trade began to add costs to imports around 2013.

In order to reconcile the inconsistent wholesale price behaviour of diesel in relation to gasoline, it is recommended that BCUC further explore:

1. **Barriers to trade with the US (and domestic, if applicable):** Inquire into implicit barriers to trade. These barriers may add costs to imported wholesale fuel from Washington State.
2. **Production substitutability of gasoline and diesel:** Inquire into the flexibility of refineries to shift from production of diesel to production of gasoline. This may include costs, technical constraints, or other production considerations.

Summary

This report outlined several factors which are consistent with a well-functioning market and which may be contributing to both the gasoline retail and the wholesale pricing differentials experienced in Vancouver and in BC more generally. It was found that a significant portion of the differential can be explained through the factors identified in this report. However, a portion of the differentials remains unexplained.

In order to complete the analysis and ensure all factors contributing to the retail margin differential, wholesale price differential, and diesel price behaviour are quantified, it is recommended that the following lines of inquiry are further explored:

1. Actual assessed land values and lease costs for the period under review.
2. Barriers to trade with the US (and domestic, if applicable)
3. Actual transport costs of refined fuels (including pipeline, rail, marine, and tanker truck)
4. Production substitutability of gasoline and diesel
5. Likely regulatory impacts

In summary, a number of factors have been explored as explanatory factors for both the retail margin observed between BC regions and other neighbouring jurisdictions outside of the province, as well as for wholesale prices between BC and comparable jurisdictions. The compatibility of these explanatory variables with diesel retail margins and wholesale price behaviour has also been assessed.

Appendix 1: Methods of distribution of gasoline or diesel to retailer

At a high-level distribution was covered in Phase 1. Some additional information was submitted by interveners on June 27th, 2019 by Parkland Industries Ltd. and Shell. [83]

Appendix 2: Seasonal Variations

In this section we review the seasonal variance in prices, demand and supply of gasoline and diesel in British Columbia.

Seasonal factors affecting gasoline prices and demand

Historically, retail gasoline prices tend to gradually rise in the spring and peak in late summer when people drive more frequently and decline in winter months. In addition to demand changes, gasoline specifications and formulations also change seasonally. Environmental regulations require that gasoline sold in the summer be less prone to evaporate during warm weather. This requirement means that refiners must replace cheaper but more evaporative gasoline components with less evaporative but more expensive components.[84]

Before the start of the summer months many refineries briefly shut down for maintenance while transitioning from winter-blend to summer-blend gasoline. This usually involves switching from a more volatile gasoline (higher Reid Vapor Pressure (RVP)) to a lower volatility fuel.

The higher the volatility of the fuel, the more easily it evaporates. Winter-blend fuel has a higher RVP because the fuel must be able to evaporate at low temperatures for the engine to operate properly, especially when the engine is cold.

Summer-blend gasoline has a lower RVP to prevent excessive evaporation when outside temperatures rise. Reducing the volatility of summer gas decreases emissions that can contribute to unhealthy ozone and smog levels. A lower RVP also helps prevent drivability problems such as vapor lock on hot days, especially in older vehicles.

The Government of Canada sets out the standards for RVP based on region of Canada which are indicated on the map below.[85]

[83] Intervener document, C5-2

[84] US Energy Information Administration (EIA), Gasoline Price Fluctuations

[85] National Standard of Canada, Automotive Gasoline.

Map A.2.0: Automobile gasoline regulatory regions

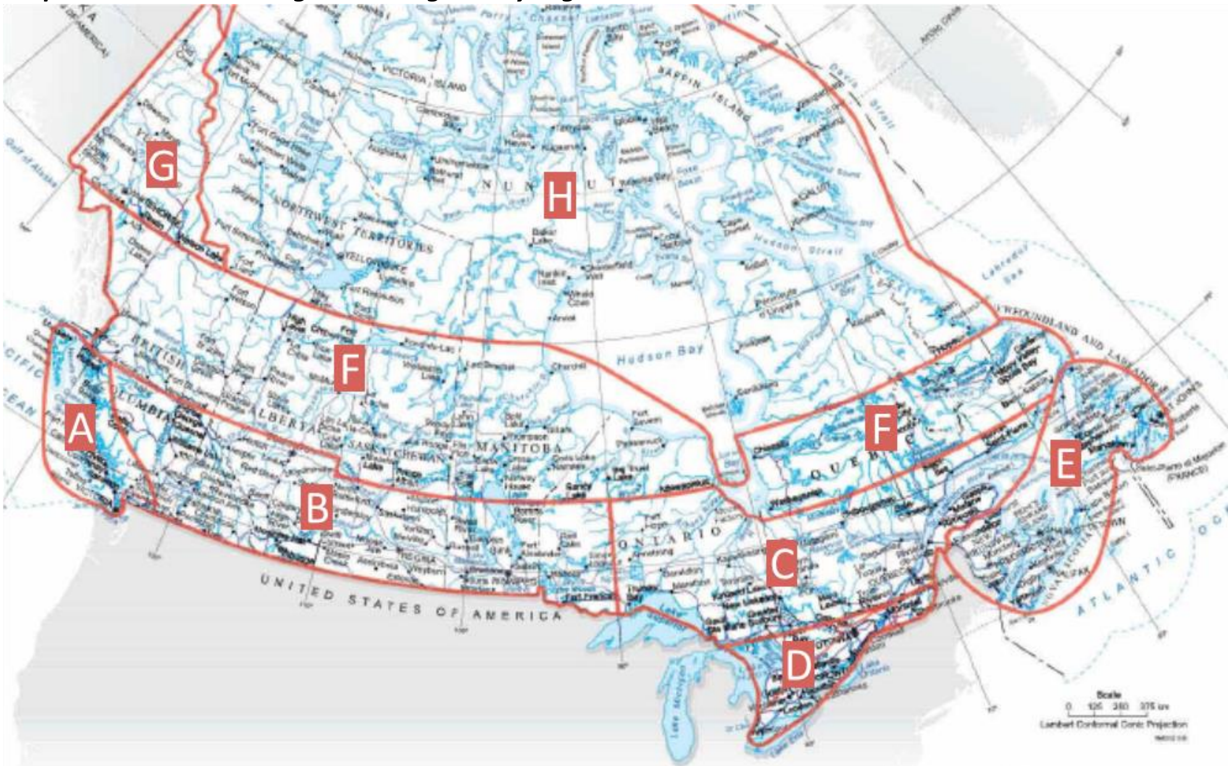
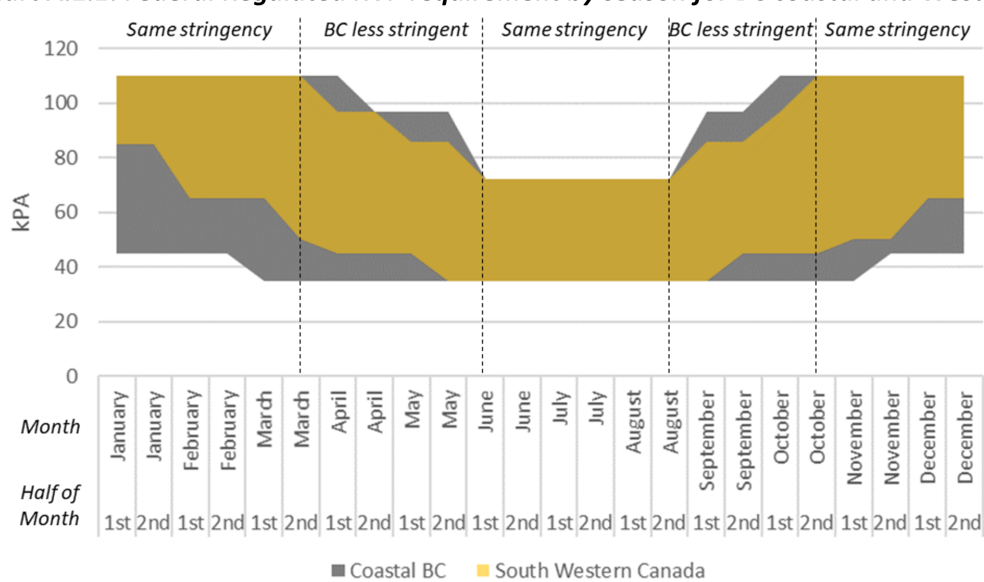


Chart A.2.1 illustrates the overlapping RVP ranges in the BC Coastal (A) and the South Western Canada (B) regions. The required ranges throughout the year for BC Coastal straddles the pressure range for South Western Canada (B), making the BC Coastal requirement less stringent for much of the year. Because is it more expensive to reduce the pressure, the stringency of the regulation is based on the upper bound of the ranges shown in Chart A.2.1. The South Western Canada region includes both Kamloops and Edmonton.

Chart A.2.1: Federal Regulated RVP requirement by season for BC coastal and Western Canada



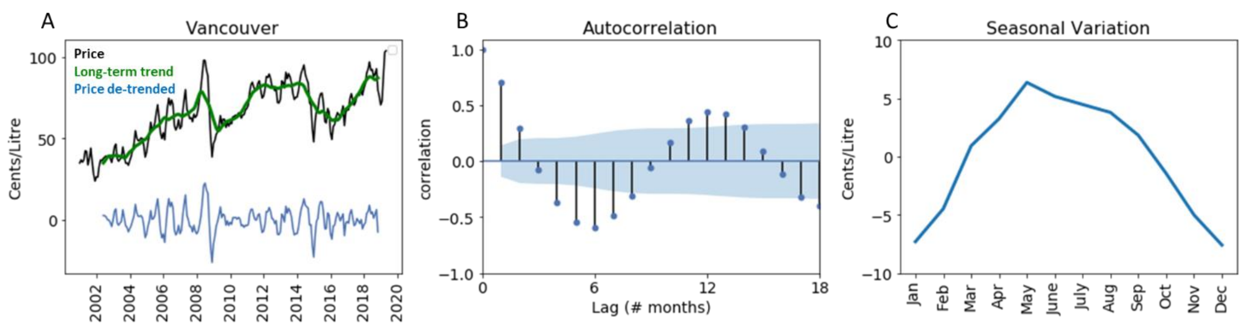
Methodology for Estimating Seasonal Effects

Chart A.2.2 illustrates in figures A, B, and C, the method for estimating seasonal effects based on Steps 1 and 2 detailed below.

<u>**Step 1**: determine whether a significant seasonal effect exists in the data:</u>

Potential seasonal effects (**A; blue line**) were isolated by subtracting a rolling 12-month average of the wholesale price data (**A; green line**) from the raw wholesale price data (**A; black line**). To test whether any significant seasonal effects exist in the de-trended data, we looked at its autocorrelation with varying lags (**B; blue dots**). The detrended data was randomly shuffled and autocorrelated to estimate how much correlation is expected due to random variance in the data (**B: blue shaded region represents 95% confidence interval**). Blue dots protruding past the shaded region represent periods where the de-trended data is significantly correlated — here we can see it is maximally anti-correlated at 6 months and maximally correlated at 0 and 12 months, corresponding with a significant seasonal variation corresponding to winter & summer months.

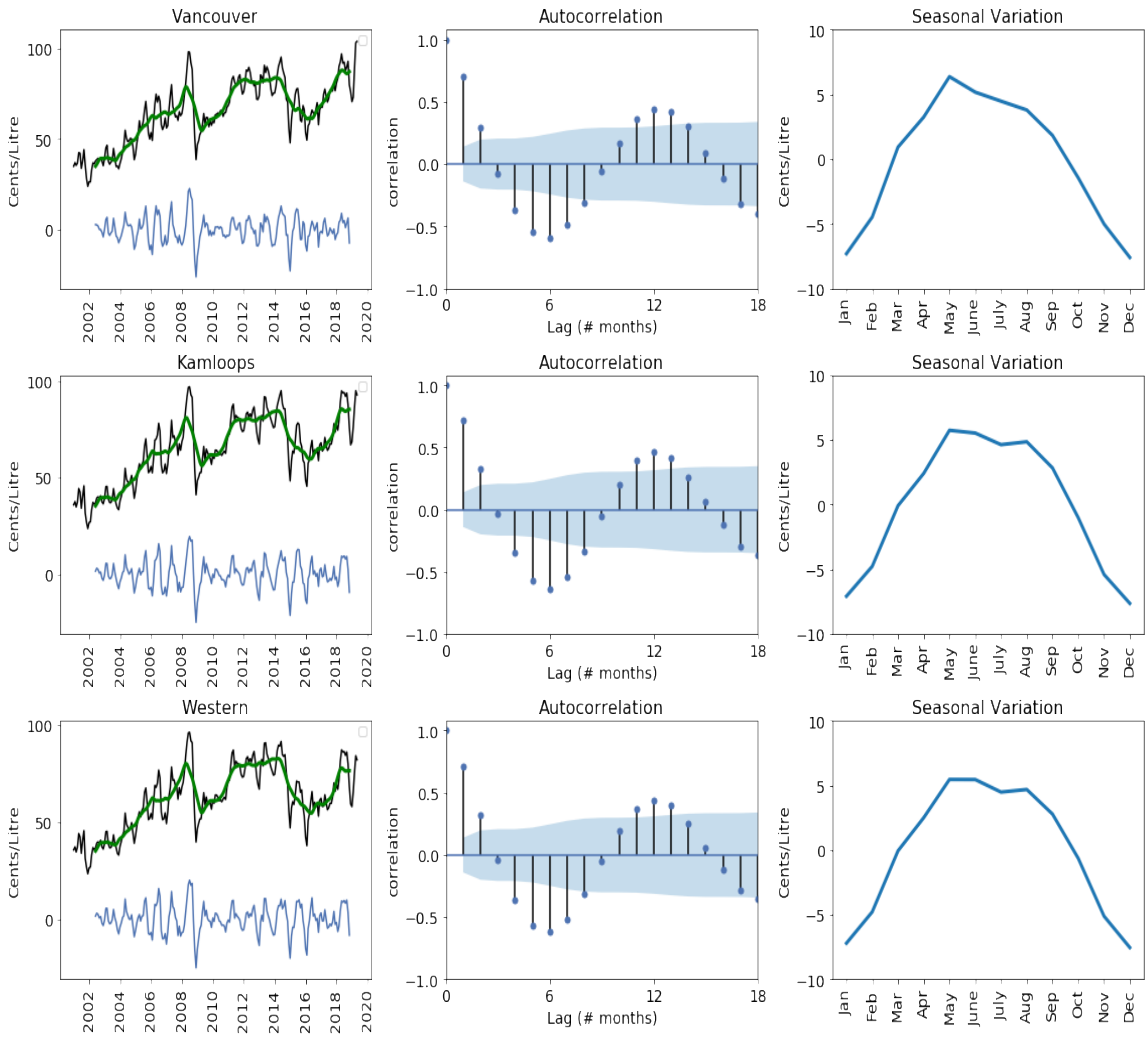
Chart A.2.2 Method for Estimating Seasonal Effects

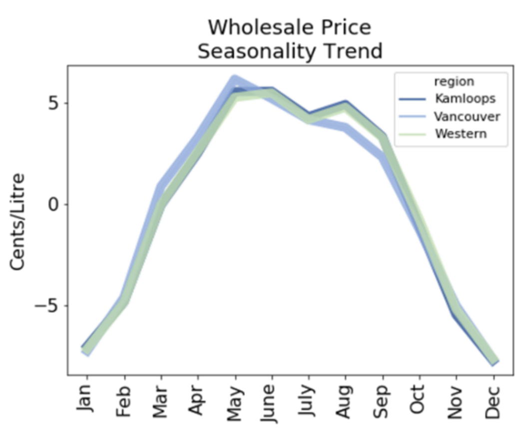


<u>**Step 2:** if a significant seasonal effect exists, estimate its size:</u>

The magnitude of the seasonal trend was estimated by decomposing the data into 3 components: long-term trend, seasonal trend, and random noise (or the residual) using a convolutional filter to isolate the seasonal component **(C).**

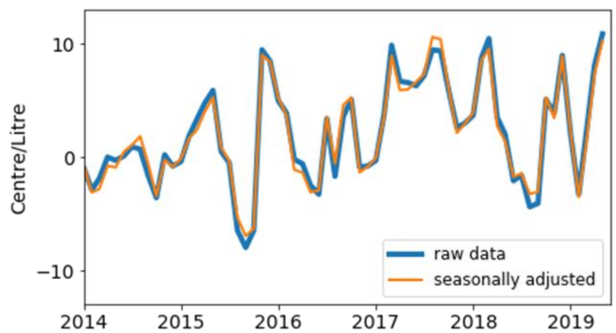
These seasonal effects can be compared for wholesale gas prices for Vancouver, Kamloops, and the Western Region.



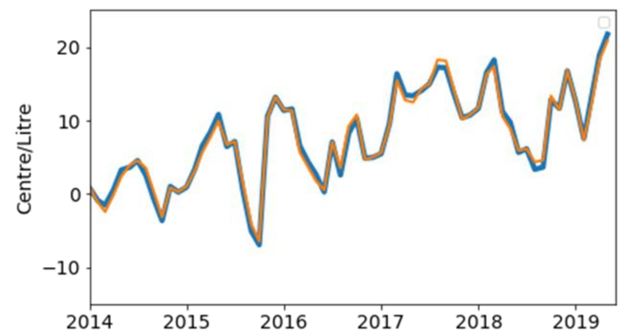


Since the seasonal variation is so similar between Vancouver, Kamloops, and Western Regions, adjusting for seasonality has very little effect (+/- 1 cent maximum) on estimating the wholesale price differences between the regions over the past few years.

Vancouver less **Kamloops**



Vancouver less **Western**

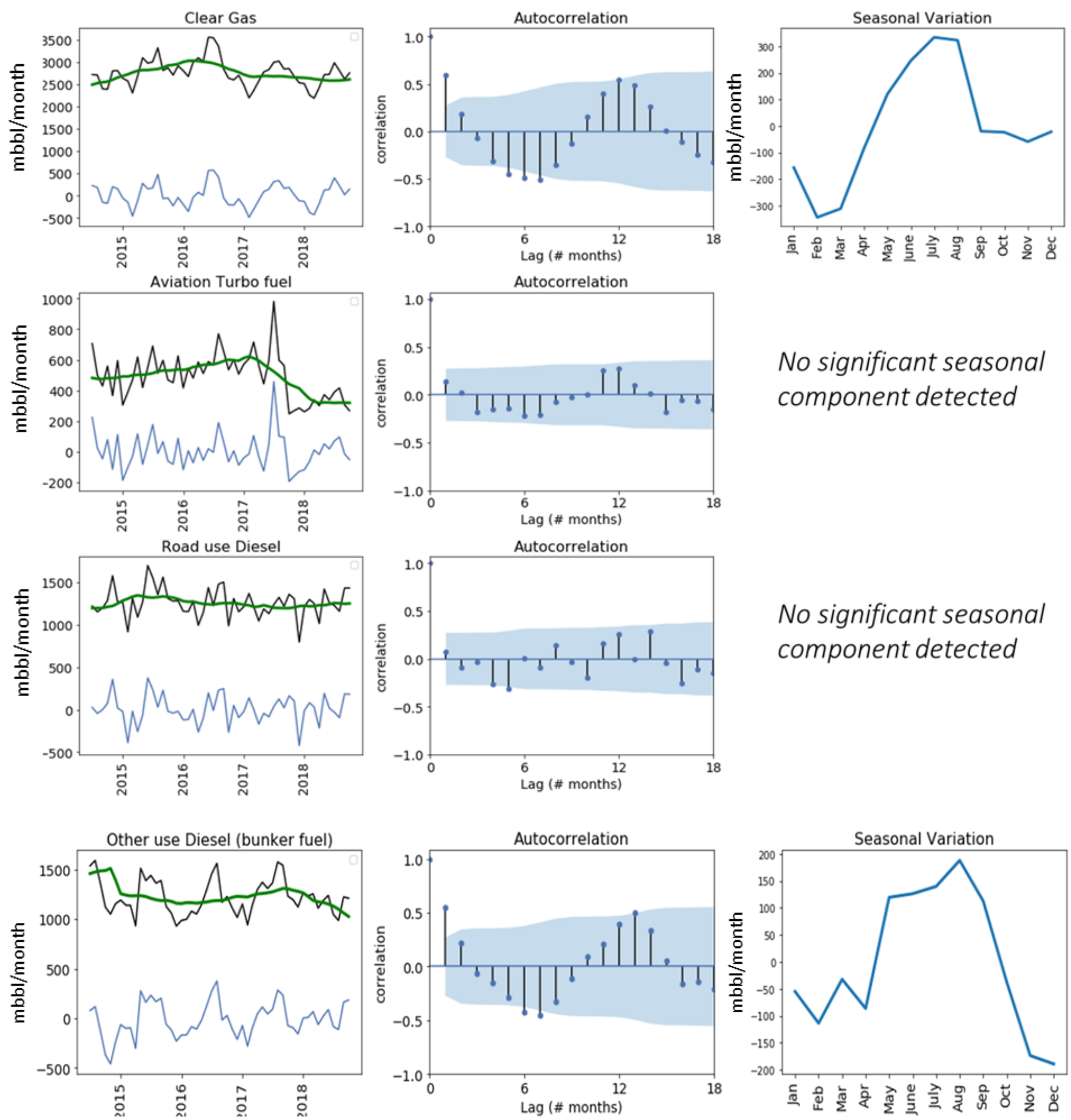


Seasonality in Supply & Demand

The same method is used to assess the presence of seasonality in demand and supply of refined petroleum products in BC.

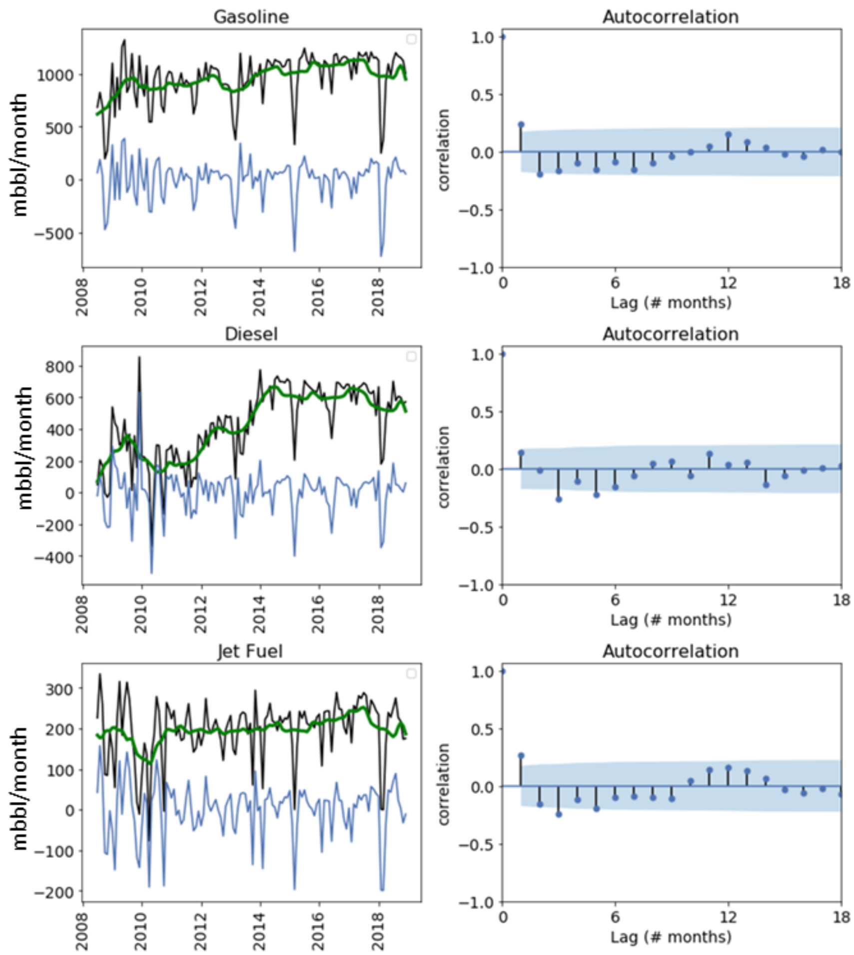
Demand Seasonality

As expected, a rise in demand for clear, road use gasoline is observed in the summer months with demand declining throughout the winter. Marine fuel also reaches a seasonal high for demand in the summer months.



Supply Seasonality

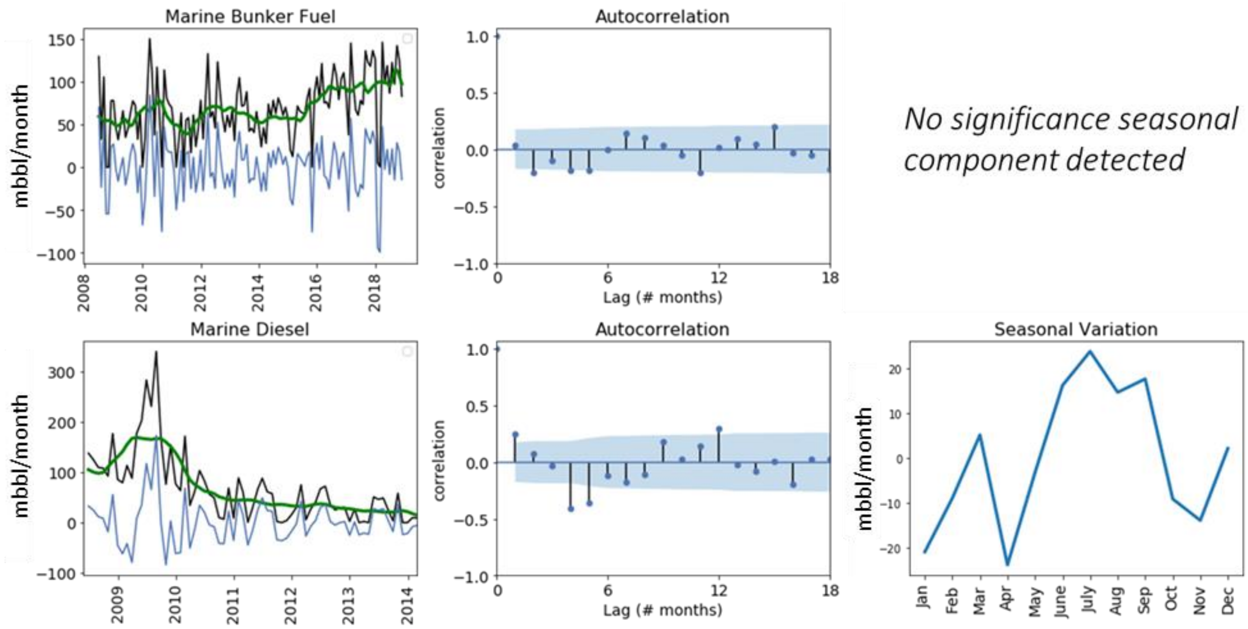
The supply data from different sources was difficult to match with demand data. Therefore, seasonality of supply is included as it was requested in the terms of reference, but the results are not relied upon to draw conclusions. Significant seasonal effects are only observable in the supply of marine diesel.



No significant seasonal component detected

No significant seasonal component detected

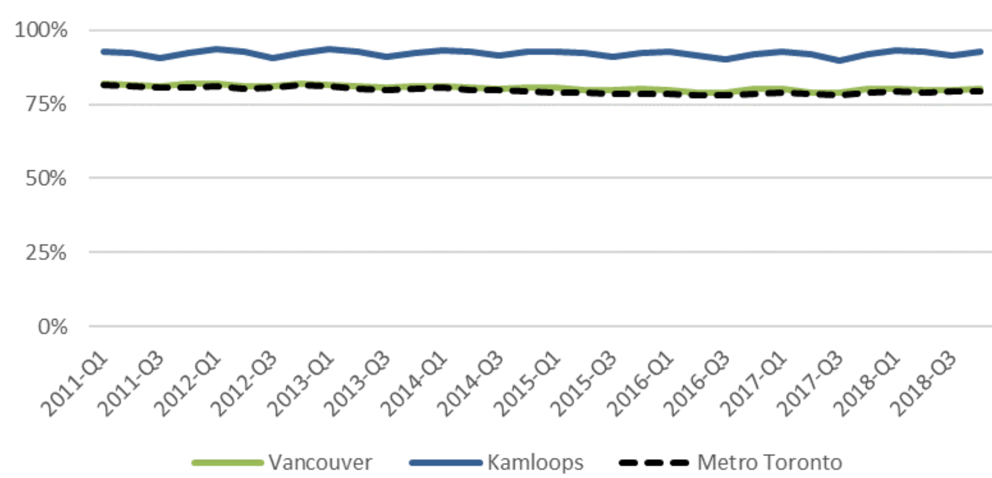
No significant seasonal component detected



Appendix 3: Regular vs. Premium Gasoline Consumption

In addition to the high-level statement regarding the shares of regular versus premium gasoline consumption across Canada, detailed consumption data has been accessed through a purchase from Kent Group Ltd. This data indicated precisely the share of regular gasoline consumed across three areas: Vancouver, Kamloops and Toronto. This data confirms that the majority of gasoline consumed in each jurisdiction is regular grade while the minority are mid and premium grades.

Chart A.3.0: Regular Gasoline as a Share of Total Gasoline Consumed

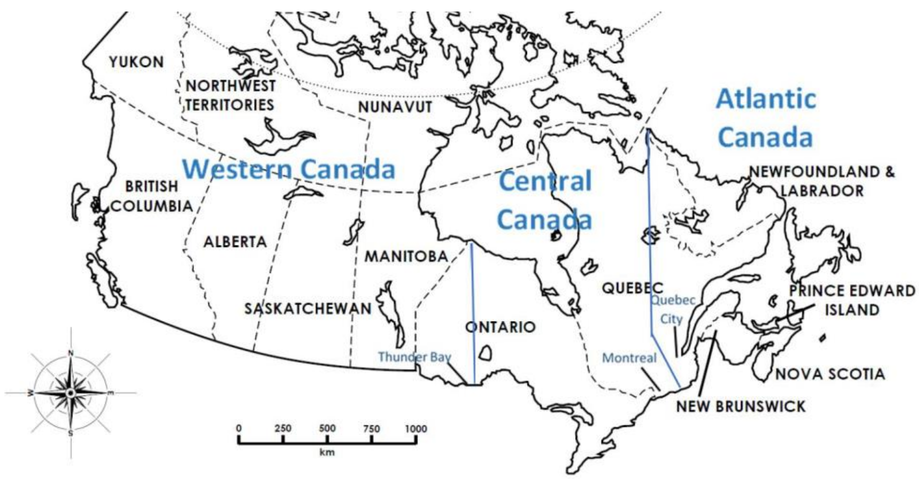


Appendix 4: Refining Margin

Refining margin is defined as the difference between the acquisition cost of crude and the wholesale price of refined products. In practice, the cost of acquiring crude is unobservable and so a crude index price is used as a proxy. Therefore, the calculated refining margin picks up several factors. (See section 4 of Phase 1 for details). Due to the estimating methodology, an analysis of wholesale prices provides the same information as an analysis of refining margins when focusing on a single supply region of Western Canada.

In the data collected by Kent Group, Ltd., three crude prices are used for three different regions of Canada: Western: Western Crude Average; Central: Ontario Crude Average; and Atlantic: Eastern Crude Average. Kent Group uses these indices for crude costs across these regions are an approximation of crude acquisition costs since crude acquisition costs are not directly observable. The indices used have evolved over time as detailed in figure A.4.1 below.

Map A.4.1: Kent Marketing Crude Price Regions[86]

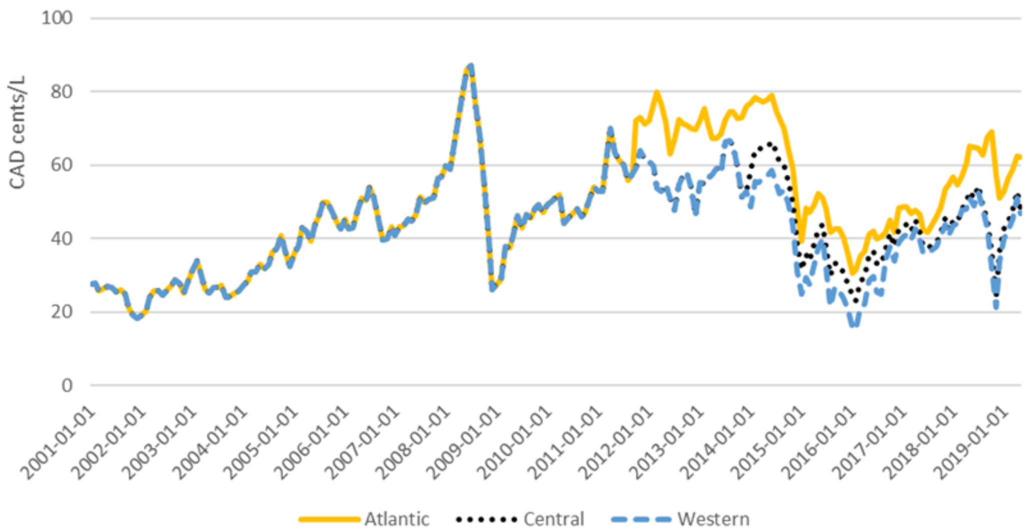


KENT Group Ltd. Crude prices selected to calculate refining margins				
	October '11 & prior	**Oct'11-Dec'13**	**Jan'14- Sept '16**	**Sept '16 & onwards**
Western	Monthly average for Edmonton Par		Western Canadian Select (WCS)	Blend of Synthetic Crude (SCO) and WCS
Central	Monthly average for Edmonton Par		Blend of WTI and WCS	Blend of Canadian Light Sweet and WCS
Atlantic	Monthly average for Edmonton Par	Monthly average Brent crude		

An estimate for crude contribution to refined product (gasoline and diesel) cost per litre is published by Kent Group Ltd. and shown below in Chart A.4.2.

[86] Kent Group Ltd.

Chart A.4.2: Crude Contribution to Gasoline and Diesel Prices across Three Regions[87]



Since we are comparing the Western Region to BC for wholesale prices, regions which have identical crude indices, then the refining margin differentials for BC versus western regions look identical to wholesale differentials.

Refining margin = crude price – wholesale price

The refining margin differential between Vancouver and the Western Region can be calculated as:

Refining Margin Differential =
(Vancouver Wholesale – Western Crude) – (Western Wholesale – Western Crude)

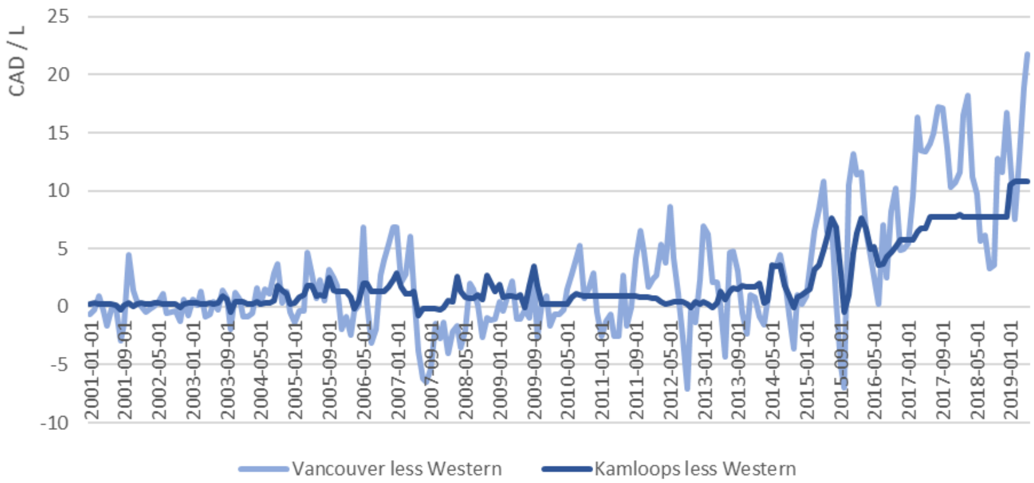
Which simplifies to

Refining Margin Differential =
Vancouver Wholesale – Western Crude – Western Wholesale + Western Crude= Vancouver Wholesale – Western Wholesale

Which is equivalent to the wholesale price differential.

[87] Kent Group, Ltd. Crude Prices

Chart A.4.3: Refining margins in BC compared to monthly average of other Western cities



A similar result is achieved when considering diesel prices. This is because the same crude input indices are used to calculate diesel refining margins as the crude indices that are used to calculate gasoline refining margins.

Appendix 5: BC Refinery Access to crude oil supply and other components

Crude oil is the most important input into the refining process, it is the primary material processed at the refinery. In addition, catalysts – chemicals which cause the desired carbon link changes are an important input.

Crude Oil Inputs

The two refineries in BC are in quite different regions and as a result receive their crude supply through different means. The Husky refinery in Prince George is nearby to BC's light crude production and is understood to receive crude via a pipeline from the Taylor, BC region. As noted in Phase 1 of this report, BC continues to produce ~ 20 mbbl/day of crude oil which is sufficient to supply Husky's capacity of 12 mbbl/day and has been operating at approximately 90% capacity since 2014.[88] In Husky's intervener submission to the BCUC it was stated that Husky primarily transports crude oil to the Refinery via Pembina West Pipeline, and that the refiner also occasionally transports crude oil to the Refinery by truck, primarily when the Pembina West Pipeline is not available. However, no data is available at the refinery-level for inputs into production and crude sources.

The Parkland refinery in Burnaby was acquired from Chevron in 2018 and has been producing at ~90% capacity.[89] Its utilization has since increased slightly to 92% over the Q1 2018 to Q1 2019 period.[90] The Parkland refinery is equipped to receive light crude from the Trans Mountain pipeline (TMPL). Because the total capacity of the refinery is 55 mbbl/day, this utilization rate implies that the Parkland Refinery

[88] Husky Interim Supplemental Information Quarterly Reports from Q1 2014 to Q1 2019
[89] Parkland June 2018 Investor Presentation
[90] Parkland MD&A Quarterly Reports

would need ~ 50 mbbl/day of light crude. Parkland's intervener report stated that over 90% of the light crude refined at its Refinery is sourced by the TMPL. Before September 2016, Parkland received some crude shipments through the TMPL which originated from the Plateau pipeline (which connects to the TMPL in Kamloops). Since September 2016, the Plateau pipeline no longer injects BC-based crude into the TMPL at Kamloops where space was created by product offtakes in Kamloops, so Parkland can no longer secure BC crude via the Pembina and Trans Mountain pipeline.

Currently, the TMPL is considered by Parkland as the only viable mechanism to access crude at the scale required by the Parkland Refinery. Because of capacity constraints on the TMPL and the method used to allocate capacity on the pipeline, the refinery is often forced to purchase space (if possible) from other shippers, which comes at a significant premium over tariff rates. In response, in Q4 2018 the Parkland Refinery began receiving rail shipments of crude.

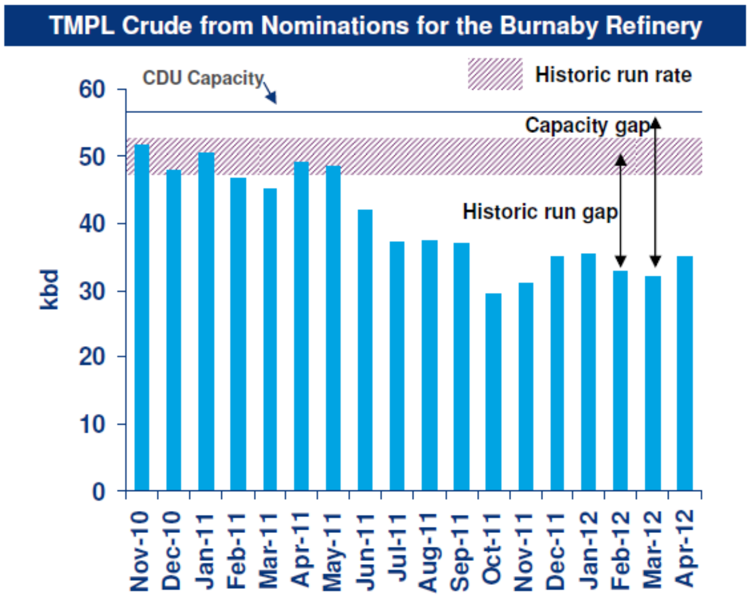
Although NEB tracks light crude delivered to the Parkland Refinery, some of this light crude may be destined for export markets. The first three rows as provided by Statscan[91] do not precisely align with the averages reported in the NEB data, as detailed in the table below.

	2014	2015	2016	2017
Receipts of Western Canada crude	43.64	56.15	55.11	45.58
Total domestic crude receipts	43.64	56.15	55.11	45.58
Crude received by pipeline	43.64	56.15	55.11	45.58
NEB tracked deliveries of light crude to Burnaby	39	46	52	70

In 2013, the Parkland Refinery failed to be secured as a "priority destination" for crude oil from the TMPL (Financial Post 2013). As a result, they must continue to rely on alternative modes of transportation to maintain fuel supply. Alternative transportation modes like rail are more expensive than pipelines, an option the refinery was trying to avoid (Frittelli et al. 2014). In 2013, of petroleum products received at the Parkland Refinery, over 85% of crude oil was delivered by pipeline, with 6,500 barrels by rail, and a further 1,000 barrels by truck.[92]

Additional crude imports may be received by rail from Alberta or other sources but is likely not received via marine supply as the Port of Vancouver has no records of crude imports into the Port. No direct tracking of light crude imports for refining purposes has been identified in this study however a report by Wood Mackenzie prepared for Chevron in 2011[93] made clear that crude supply access for the refiner was considered an issue as receipts via the TMPL had dropped off in 2012.

[91] StatsCan, Refinery supply of crude oil and equivalent, monthly
[92] CBC, Oil brought by rail, truck to Burnaby refinery, July 2013
[93] Burnaby Refinery Crude Supply, May 2012



The presentation from Wood Mackenzie suggested that the most favourable alternative sources of crude would be a combination of railcar deliveries and the addition of a truck/rail terminal to add additional capacity. Railcar deliveries appear to offer capacity for 7-8 mbbl/day and cost ~ $7-12/ bbl while an additional rail/truck terminal would offer an additional ~ 6mbbl/day in receipt capacity and cost ~ $10-15 / bbl.

The report noted that the potential marine source for suitable crude may be difficult to precisely locate, and suggested sources such as Russia, Saudi Arabia, and Oman. The report also noted that the Parkland Refinery is not suitable to receive efficiently sized deliveries of crude and therefore would require the refinery to share a tanker with other facilities. These notes are consistent with our observation of no marine-imports.

Catalysts

Catalytic cracking refers to the process of breaking down hydrocarbon "fractions" (that are produced from crude oil in the preceding distillation process) into lighter molecular chains required to produce fuel products. While refineries once used high temperatures to break down the molecules in a process referred to as "thermal cracking", this has now been almost universally replaced by catalytic cracking. Catalytic cracking is done at both the Prince George (Husky) and Burnaby (Parkland) refineries in British Columbia, with a catalytic cracking capacity of approximately 3.4 mbbl/day and 17.6 mbbl/day, respectively.[94]

Using catalysts allows refineries to create more fuel at higher octane levels at greater production efficiency. Further, the process also provides greater flexibility and control in outputs, allowing refineries to meet evolving fuel regulations more easily. Increases in demand for refined products, requirements for cleaner fuels, and the need to meet more stringent environmental regulations have all contributed to the historical increases in demand for refining catalysts.[95] It is anticipated that demand for these catalysts could continue to grow in the future due to the role they can play in meeting evolving environmental regulations.

Catalytic cracking largely comes in two forms: "Fluid Catalytic Cracking" (used mainly for producing motor gasoline products), and "Hydrocracking" (used mainly for producing Kerosene and Diesel products). Using data for the U.S./PADD 5 region as a proxy (due to insufficient public data in British

[94] NEB, North American Crude oil Refinery and Upgrader Capacity
[95] Oil and Gas Journal, Special Report Oct. 2007

Columbia), we can observe the input volumes processed by catalytic cracking units over time.[96] While longer-term trends in increased demand for catalytic cracking have been reported, this has remained consistent during the period of time pertinent to this investigation; demand for refining catalysts is not likely a large driver of the increase in wholesale prices since 2015.

Chart A.5.1 U.S. refinery processing of fresh feed input by catalytic cracking units (mbbl/d)

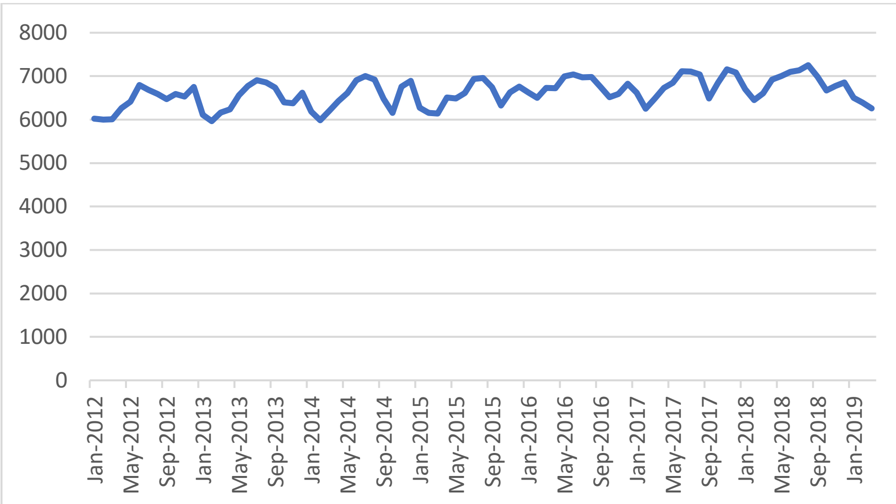
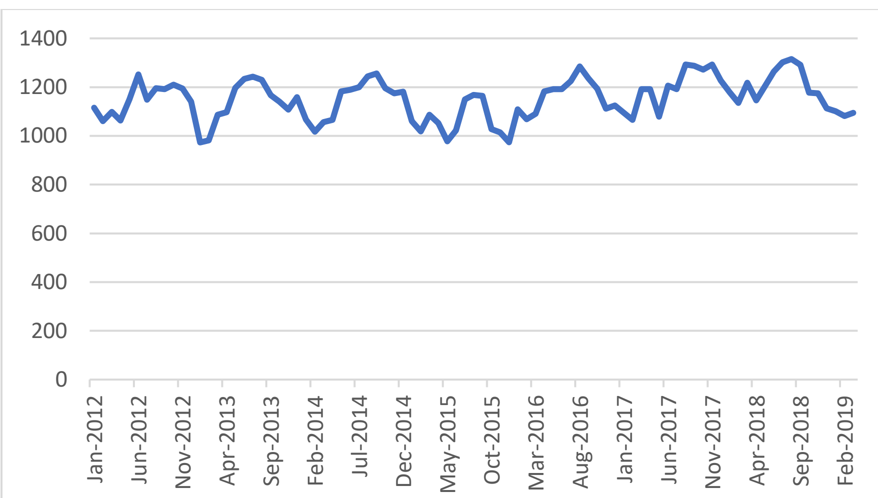


Chart A.5.2: PADD5 refinery processing of fresh feed input by catalytic cracking units (mbbl/d)



"Catalytic Reforming" is another common refining process which requires the use of chemical catalysts. This is a process that uses the chemical catalysts to reform lower-octane products into higher-octane liquid reformates, which are then used for blending high-octane gasoline. This process also produces significant amounts of hydrogen gas, which is used as an input for hydrocracking (among other processes), so some of the refining catalysts demanded for catalytic reforming are also used towards catalytic cracking processes. Similar to catalytic cracking, the overall demand for catalytic reforming has

[96] EIA Downstream Processing of Fresh Feed Input

remained consistent during the period of time pertinent to this inquiry; the overall consistency in catalytic reforming process indicates that demand for refining catalysts is not likely a large driver of the increase in wholesale prices since 2015.

Chart A.5.3: U.S. Refinery Processing of Fresh Feed Input by Catalytic Reforming Units (mbbl/d)

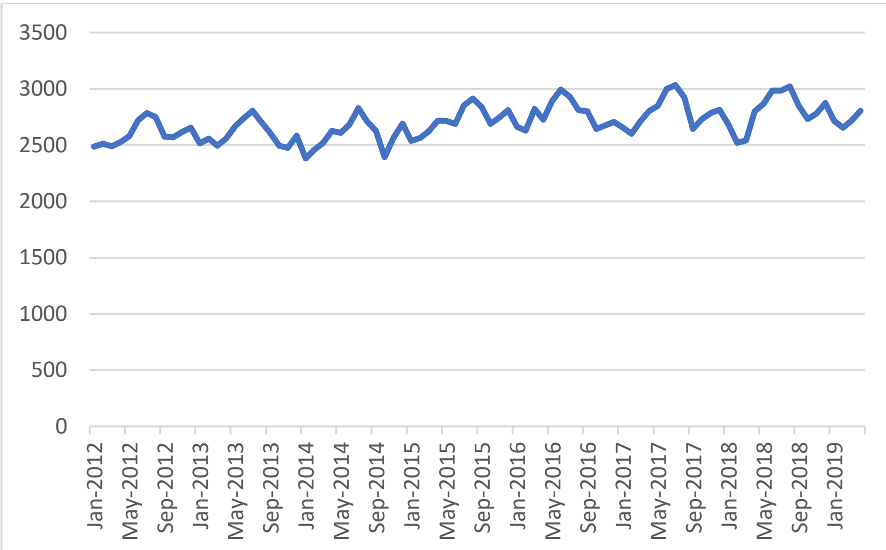
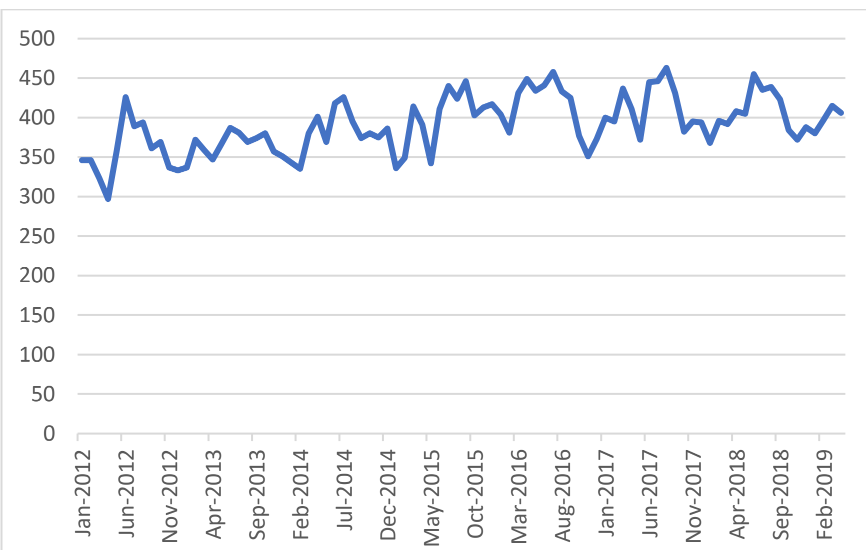


Chart A.5.4: PADD5 Refinery Processing of Fresh Feed Input by Catalytic Reforming Units (mbbl/d)



Appendix 6: Amount of gasoline and diesel stored in BC for sale in BC

No public data was identified which indicates the total amount of gasoline and diesel stored in BC, nor what purpose it was stored for. However, some interveners did submit total storage capacity in their June 27th, 2019 submissions. The table below includes only information from Husky, Parkland, Shell and Suncor, other facilities exist in BC but are not indicated below due to presently unavailable information.

Company	Location	Product	Storage Capacity
Husky	BC	Gasoline	43 million litres
Husky	BC	Diesel	70 million litres
Shell	Chemainus	Gasoline	12,000 m3
Shell	Chemainus	Diesel	3,248 m3
Shell	Burmount	Gasoline	17,973 m3
Shell	Burmount	Diesel	38,604 m3
Shell	Shellburn	Gasoline	10,515.4 m3
Shell	Shellburn	Diesel	24,100.4 m3
Suncor	Burrard	Gasoline / Ethanol	61 million litres
Suncor	Kamloops	Gasoline / Ethanol	21.6 million litres
Suncor	Nanaimo	Gasoline / Ethanol	1 million litres
Suncor	Terrace	Gasoline / Ethanol	2 million litres
Suncor	Burrard	Diesel/Biodiesel/ Renewable diesel	66 million litres
Suncor	Kamloops	Diesel/Biodiesel/ Renewable diesel	9.7 million litres
Suncor	Nanaimo	Diesel/Biodiesel/ Renewable diesel	1.7 million litres
Suncor	Terrace	Diesel/Biodiesel/ Renewable diesel	1.5 million litres
Parkland	BC	All Fuels	950,000 bbl

Shell also indicated that storage costs in BC are similar to storage costs in other facilities in Canada.

Appendix 7: Price-point Elasticity Estimation Methodology and Results

Retail prices (excluding tax) & quarterly demand data were obtained from Kent **(A)**. Population data for Kamloops and Vancouver (2011-2018) were obtained from the BC Census.[97] Quarterly gas & diesel demands (barrels per month) were normalized by population (i.e. barrels per month per capita) in order to fairly compare price point elasticities between Vancouver & Kamloops **(A)**. Seasonal & long-term trends were subtracted from the retail & demand data to isolate the demand-price relationship elasticity in the short-run **(B)**. The demand-price curve was estimated by regressing demand on retail price, assuming a constant linear relationship from 2011-2018 **(C)**. We estimated the price point elasticity of demand **(D)** for each year by taking the average yearly price & demand, using the following formula:

$$E = \frac{\delta Q}{\delta P} \cdot \frac{P}{Q}$$

Where **E** is the price point elasticity of demand, **dQ/dP** is the first derivative of the quantity with respect to price, **P** is the yearly average retail price, and **Q** is the quantity (i.e. yearly average demand). The

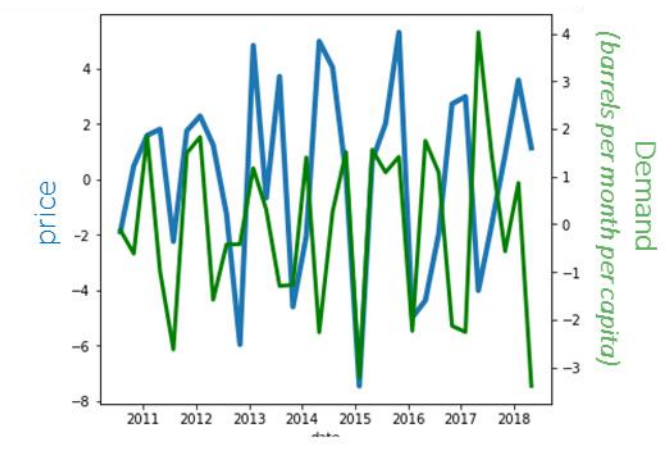
[97] BC Population Estimates, updated June 2019

uncertainty in **E** was estimated by propagating the 95% confidence intervals of **dQ/dP** (from regressing Q on P).

Chart A.7.1 Vancouver Gasoline Price and Per Capita Demand

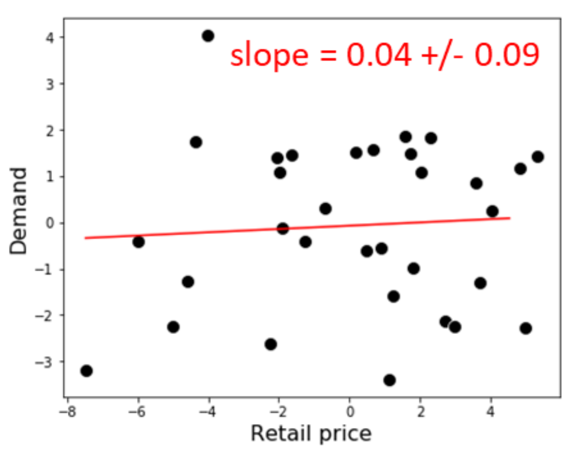
Raw price and demand per capita for the Greater Vancouver Area is plotted in the Chart A.7.1. In Chart A.7.2 these figures are de-trended and de-seasonalized (as described in Appendix 2). This adjustment corrects for the confounding factors of high summer demand, and long-term price increases, allowing for the isolation of the short-term price elasticity of demand.

Chart A.7.2 De-Trended & De-Seasonalized Vancouver Gasoline Prices and per capita Demand



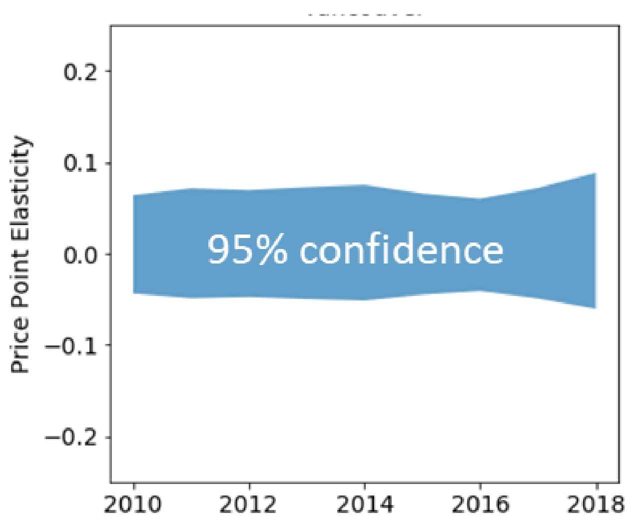
The data in Chart A.7.2 is then used to estimate a linear demand-price curve, assuming a constant linear relationship from 2011 to 2018. This regression is shown in Chart A.7.3.

Chart A.7.3 Vancouver Gasoline Adjusted Demand-Price curve



This slope (**dQ/dP**) is estimated for every year from 2011 to 2018 and is then used to calculate the yearly price point elasticity which is shown in Chart A.7.4.

Chart A.7.4 Vancouver Yearly price point Elasticity for Gasoline

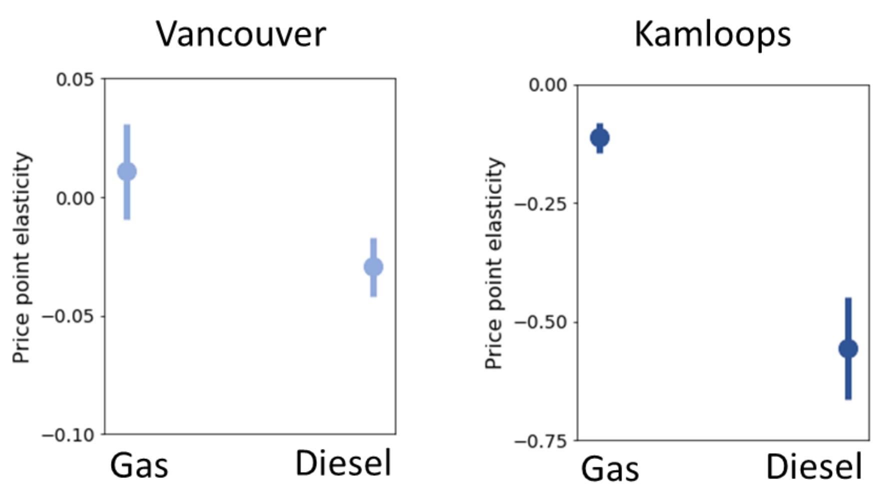


The range indicated a 95% confidence interval propagated from uncertainty in the dQ/dP share of the elasticity equation:

$$E = \frac{\delta Q}{\delta P} \cdot \frac{P}{Q}$$

The same method is used for estimating the yearly price point elasticity for both gasoline and diesel in Vancouver and Kamloops in Chart A.7.5 below:

Chart A.7.5 Gas and Diesel Price elasticities across Vancouver and Kamloops[98]



The charts in A.7.5 illustrate that diesel price elasticity was consistently but non-significantly lower than gas price elasticity. However, in Kamloops diesel price elasticity was significantly larger negative price elasticity of demand than gasoline.

Appendix 8: Terms of Reference

According to the terms of reference, the independent investigation commissioned by the BCUC must examine the following for the period since 2015:[99]

1. the differences in refining margins among British Columbia and other jurisdictions in Canada and the reasons for any differences.

[98] Whereas Kamloops has significant retail price elasticities for both gas and diesel, Vancouver's elasticities were not significantly different from 0. Kamloops has more price elasticity than Vancouver for diesel.
[99] Full terms of references are available from BCUC

2. the differences in retail margins among British Columbia and other jurisdictions in Canada, and among different regions in British Columbia.
3. the reasons for any differences factors that have contributed to the increases in gasoline and diesel prices, both retail and wholesale, including, without limitation
    a. the access of refineries in British Columbia to crude oil supply and other components
    b. the amount of gasoline and diesel stored in British Columbia for sale in British Columbia
    c. usage of refinery and pipeline capacity
    d. wholesale and retail market sizes and demand
    e. methods of distribution of gasoline or diesel to retailer
    f. seasonal variations in supply and demand
4. the extent to which price changes in gasoline and diesel have been determined by market competition and the extent to which those changes have been determined by other factors.

Appendix 9: Trans Mountain Pipeline Apportionment Rules

As noted in the phase one report, the daily throughput capacity of the TMPL varies based on the amount heavy crude passing through the pipeline, typically operating at a capacity of approximately 300 mbbl/d each month. Shippers use the pipeline to transport crude and refined petroleum products either on a contracted basis (referred to as “Term Shippers”) or on an un-contracted basis (referred to as “Uncommitted Shippers”).

While Term Shippers can access the same committed capacity every month they must *nominate* barrels (including receipt points) to be transported on the TMPL. The nomination must then be “verified” by the TMPL operator in order to confirm the transport of the fuel. Subject to pipeline rules and regulations, nomination verifications for uncommitted shippers can be accepted, refused, or accepted on a reduced basis to the volumes originally nominated.

The TMPL is a regulated pipeline and has several rules to ensure equity amongst shippers and to prevent preferential treatment (reference). At a high-level, pipeline capacity is allocated based on the following five steps:

1) **Term Shippers:** Term shippers are first offered the opportunity to use their monthly volume (as specified in their contract). Presently, approximately 18% of the pipeline capacity (54 mbbl/d) is allocated to term shippers each month.[100]
2) **Marine Capacity:** Set volumes are made available for marine transportation from the Westridge Marine Terminal. These include tanker and barge volumes set as follows:
    A) 8% (~20 mbbld/d) of the capacity remaining after terms shippers is allocated among nominations for tankers.
    B) 850 m^3/day (~ 5.3 mbbl/d) is allocated to nominations for barges.

[100] NEB, Western Canadian Crude Oil Supply, Markets, and Pipeline Capacity, December 2018

3) **Uncommitted Shippers:** The remaining available capacity is then made available for uncommitted shippers to nominate barrels to land destinations (i.e. refineries or terminals connected at Burnaby, Kamloops, and Sumas to export destinations.) Both the substance and the locations are important in establishing whether the nomination will fit within pipeline capacity.
4) **Remaining Capacity:** It may be that after steps 1-3 there is still available capacity. This could be because the nominations didn't utilize the full capacity or the destinations of the nominations were not compatible. If there is any remaining available capacity, it would be allocated as follows:
    A) among term shippers nominating volumes to alternate delivery points based on one or both the availability of capacity to the requested alternative delivery point and priority ranking according to Contracts;
    B) among term shippers nominating make-up volumes.

Steps two and three are the most involved processes and have undergone some change in recent years, these changes are detailed below.

Marine Capacity

Although the actual tariff on the pipeline are set by the NEB, the capacity allocated by the pipeline to shipper nominations to the Westridge Marine Terminal is determined based on a bidding process. Shippers nominate volumes as well as a bid price ($/bbl) for tanker and barge shipments. The total *Bid Premium* for that shipment is the volume (bbl) multiplied by the bid price ($). Allocation of the available capacity is ranked by the pipeline from the highest to lowest priority based on the *Bid Premium*.

This process was defined in a 2006 revision to the tariff, prior to 2006 the marine terminal nominations were allocated on a "pro-rata" basis (i.e. If all requests summed to 120% of the capacity then every shipper had only 80% of their nomination approved). However, because marine transport is most cost effective when the vessel (tanker or barge) is full, the pro-rata basis was ultimately deemed unsuitable for these shippers.

Following the "pro-rata" allocation for marine capacity, the allocation shifted to an "all or nothing" basis (i.e: shippers were either awarded their full request, or awarded zero capacity) to ensure shippers awarded with the pipeline capacity were provided a feasible volume of products. The all or nothing method originally involved drawing lots (i.e. randomly choosing nominations to grant). However, this method was deemed to be "unjust to true shippers"[101] as it enabled those who received the allocation to profit off of their allocation through secondary "aftermarket" activity, rather than honour their nominations through actual marine shipments. As a result, the Westridge marine capacity is now allocated using a formal bidding process in order to curb secondary "aftermarket" activity.

Currently, the bid premiums collected by the TMPL operator is allocated to reducing the cost of service for all users of the TMPL pipeline.[102] In this way, tolls for the TMPL are reduced further than would otherwise be the case.

[101] NEB, Reason for Decision, Trans Mountain Pipeline Inc. Capacity Allocation Procedures March 2006-2007
[102] Based on conversations with Trans Mountain Pipeline staff

Uncommitted Shippers

As of April 2015, some limitations were placed on volume that could be nominated by uncommitted land shippers. Volumes nominated can be up to the greater of the following:

a) Three percent
b) The rolling average of monthly nominations filled by each shipper, taking the average of the 18 highest nominations for that shipper within the past 24 months preceding the nomination date.[103]

In the event where the aggregate nominations exceed the available pipeline capacity at this point, each of these nominations are reduced on a pro rata basis, so that each nomination is reduced by the same percentage until the aggregate nominations are within pipeline available capacity. This process is commonly referred to as "apportionment"

Prior to April 2015, there were no verification limits for land destinations set for the Trans Mountain Pipeline.

Market participants have indicated that the limits placed on their nomination volumes to land destinations have led to a heightened competition in a secondary "aftermarket" in which shippers pay to purchase the allocated capacity awarded to other shippers.[104]

Appendix 10: Principle Component Analysis

A principal component analysis was used to develop insights from the trends in the price data gathered from Kent Group Ltd.

Principal Component Analysis

Principal component analysis is a statistical tool used in exploratory data analysis and for making predictive models. It uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. Essentially, it takes a set of possibly related variables (i.e. retail margins in major Canadian cities) and identifies a number of different and unrelated 'components' that together capture the total variation in the original variables. Principal component analysis can be useful if the resulting 'components' can be affixed to 'real-life' explanatory variables (e.g. on a longer-term time series, a primary principal component may mirror the variation in crude price).

This transformation is defined in such a way that the first principal component has the largest possible variance (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it is orthogonal to the preceding components. The resulting vectors (each being a linear combination of the variables and containing n observations) are an uncorrelated orthogonal basis set. In other word, the algorithm

[103] Rule 6.3 in the Trans Mountain Pipeline ULC Petroleum Tariff no.105

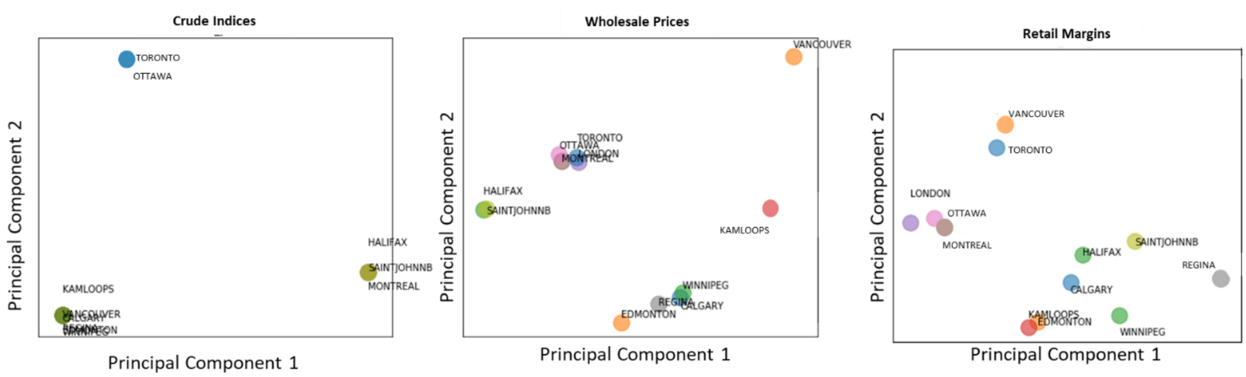
[104] Intervener Submissions to Inquiry into Gasoline and Diesel Prices in British Columbia- "Parkland Fuel Corporation"

computes the time series that accounts for as much of the variability in the data as possible (**Principal Component 1**). Then, each succeeding component in turn accounts for the highest variance possible under the constraint that it is orthogonal (i.e. independent) to the preceding components (**Principal Component 2**, **Principal Component 3**, etc). This can be repeated until you have the same number of time series that you started with (i.e. number of cities = number of Principal Components estimated).

Each time series analyzed (i.e. prices over time by city) can then be explained by a linear combination of the components (i.e. Winnipeg retail margins = (Principal Component 1)* β_1 + (Principal Component 2)*β_2). For each variable (crude prices, wholesale prices, and retail margins), each city is plotted according to its coefficient associated with each component (refer to graphs below).

Cities may form into 'clusters' based on the above plotting. This indicates similarities in the way the clustered variables are explained by each component.

Chart A.10.1 Principal Component Analysis for Crude Price Indices, Wholesale Prices, and Retail Margins



Note that the principal components for each analysis are different. For example principle component 1 in the crude price is not equivalent to principal component 1 in the retail margin. Also a point in the top right corner *does not* necessarily indicate a higher price.

Appendix 11: Correction to Phase 1

Information in Phase 1 from Kent Group, Ltd. was corrected by Imperial Oil in their intervener submission:

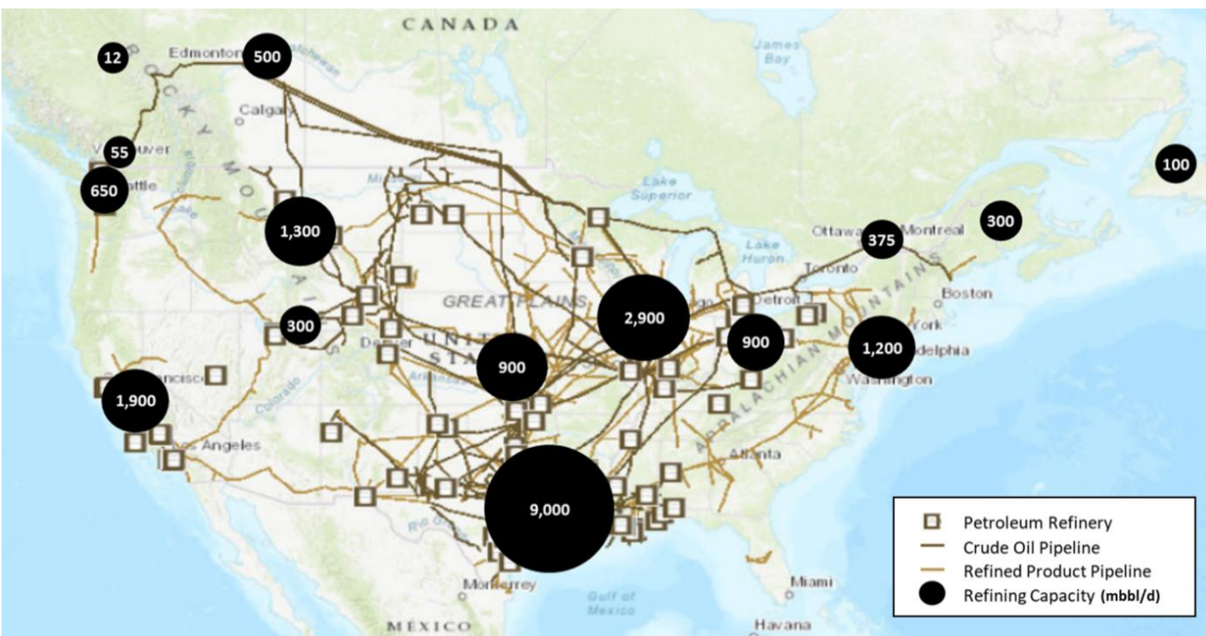
- This report incorrectly states that Imperial Oil owns 8 bulk plants in British Columbia. Imperial has access to these 8 bulk plants through its Esso-branded reseller network but does not own them.
- This report lists Imperial owning three primary terminals in British Columbia with biofuels blending capability, however one of those terminals, Imperial's IOCO Terminal, is used exclusively for marine fuels and does not have biofuels blending capability.

Appendix 12: Wholesale Price comparison to Los Angeles

It is expected that jurisdictions that have similar access to supply channels (both crude and refined products) would also experience wholesale gasoline prices that follow one another quite closely. Although it may be possible that there are short-term fluctuation in certain locations related to local shocks (e.g. a local refinery unplanned outage), in the longer-term, these markets should recalibrate and equalize.

Although Alberta is a key supplier to BC, the entire west coast is quite isolated from a supply perspective, as illustrated in Map A.12.1, the west coast is served by three refined pipelines in the United States and only one crude pipeline which is the Trans Mountain Pipeline.

Map A.12.1: Canadian and American Pipelines and Refining Capacity[105]



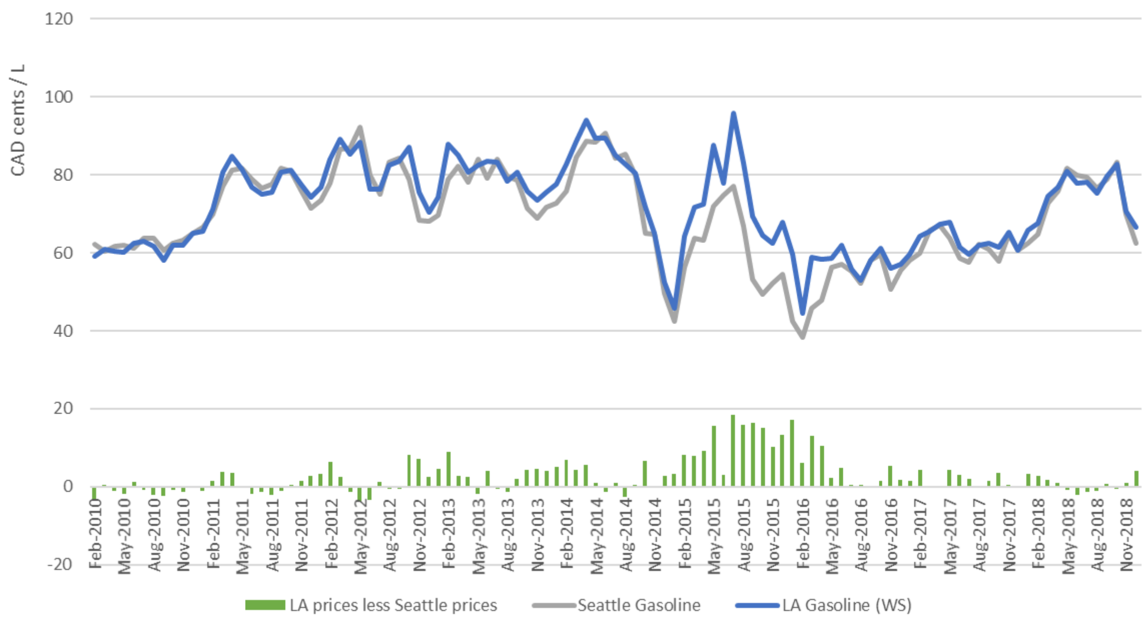
BC is compared to Seattle in the body of this document but comparisons between Vancouver and LA are also frequently made as result of the geographic similarity and similar regulatory environment. Therefore, this appendix is devoted to the comparison of the Vancouver and LA markets.

[105] Map constructed using data from EIA and CAPP. Canadian pipeline which do not cross the US border are excluded from the map.

Gasoline Wholesale

The wholesale prices used for LA is the contract average prices, excluding taxes.[106] Wholesale prices in California are commonly reported as including CAR, a carbon tax. In order to ensure consistency when comparing wholesale prices excluding tax, the LA wholesale prices used in this analysis are net of CAR (i.e. they do not include CAR).

Chart A.12.2: LA & Seattle Gasoline Wholesale Prices



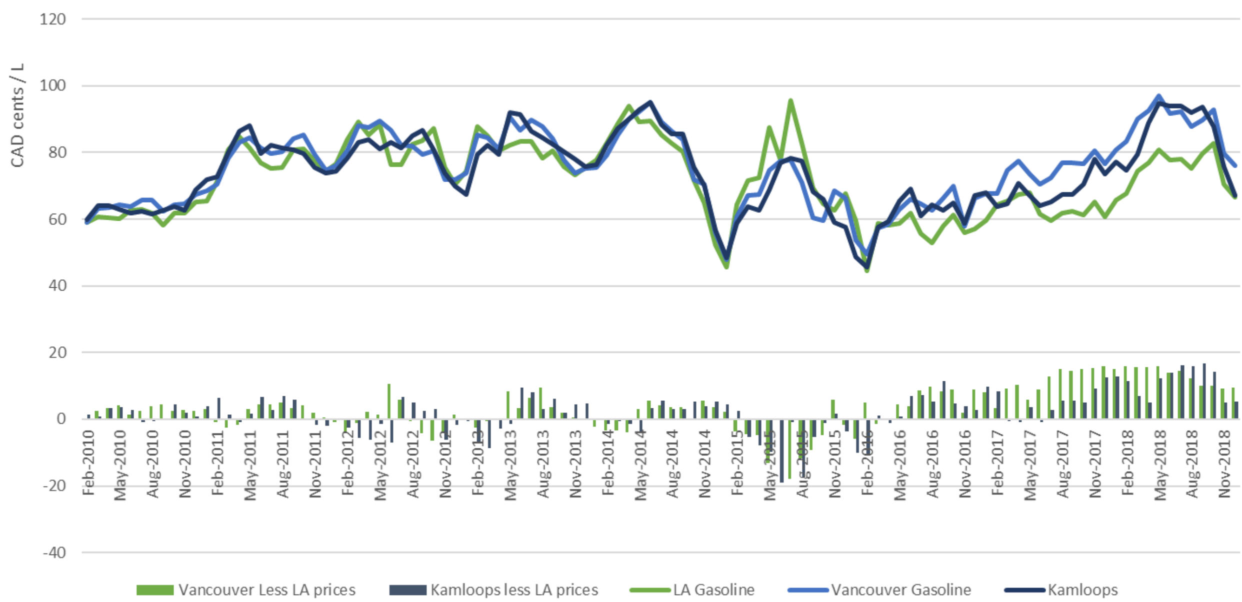
LA and Seattle have historically experienced wholesale gasoline prices that generally move closely together. In 2015, LA's prices briefly surged above the wholesale prices observed in Seattle. This price surge coincided with the timing of the Exxon refinery fire, which created a large supply shock in this relatively supply-isolated market.[107]

A comparison of Vancouver and Kamloops wholesale prices to prices in LA reveals a divergence around mid-2016, although it is possible that the California refinery fire is masking what could have been an earlier divergence.

[106] Seattle gasoline price is CBOB ethanol 10%, regular RVP 9.0, Gross, Contract Average, as per OPIS' recommendation and as is consistent with Washington regulation regarding fuel mixing and RVP. LA gasoline price is CARFG Ethanol 10%, Regular, Gross, Contract Average, Without CAR. Wholesale figures were purchased from OPIS.

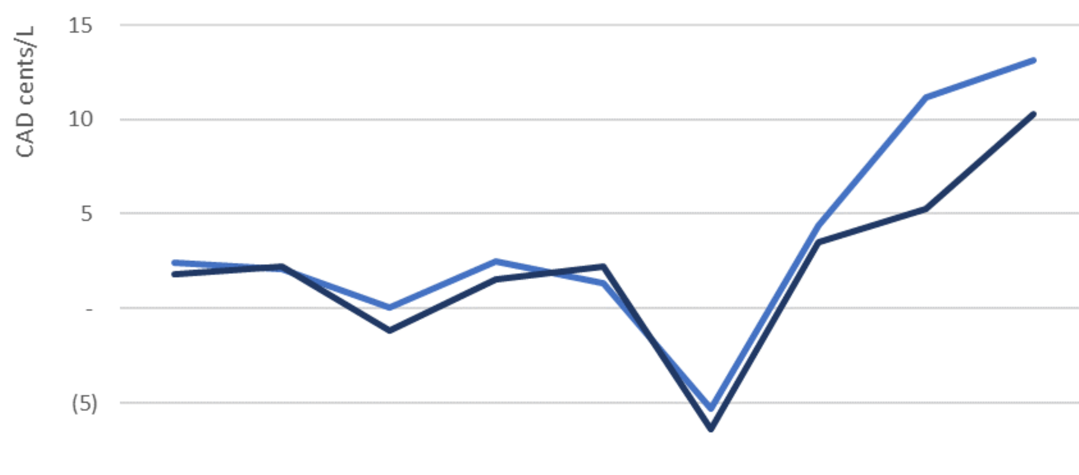
[107] California's gasoline imports increase 10-fold after major refinery outage, EIA October 2015

Chart A.12.3: West coast wholesale gasoline prices



Historical differentials appear to be less than or equal to ~ 2 cents/L. In 2018, the differential between grew to 13 cents between Vancouver and LA and 10 cents with Kamloops and LA.

Chart A.12.4: Average annual wholesale price differentials

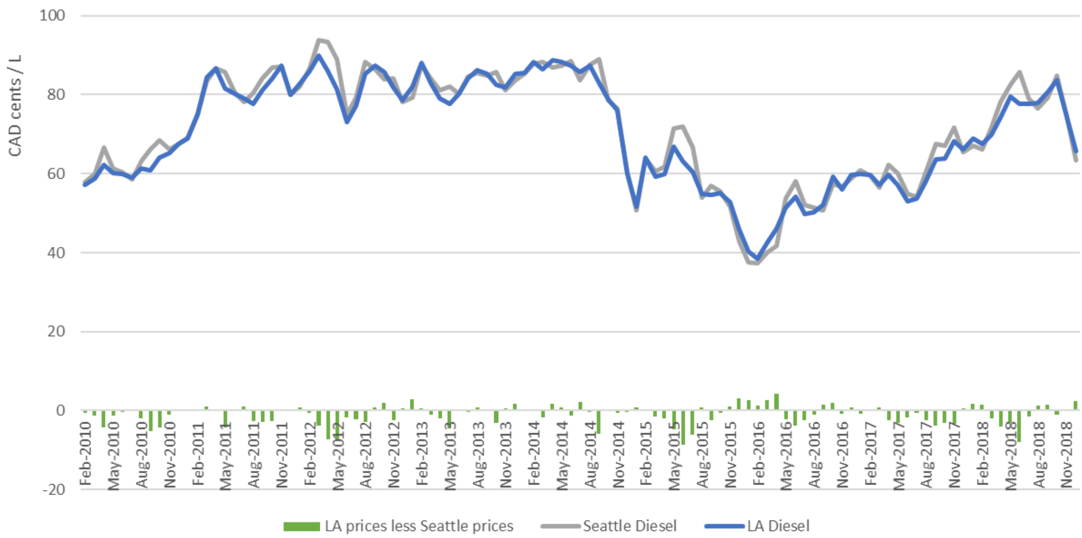


	2010	2011	2012	2013	2014	2015	2016	2017	2018
Vancouver Less LA	2	2	0	2	1	-5	4	11	13
Kamloops Less LA	2	2	-1	2	2	-6	3	5	10

Diesel Wholesale

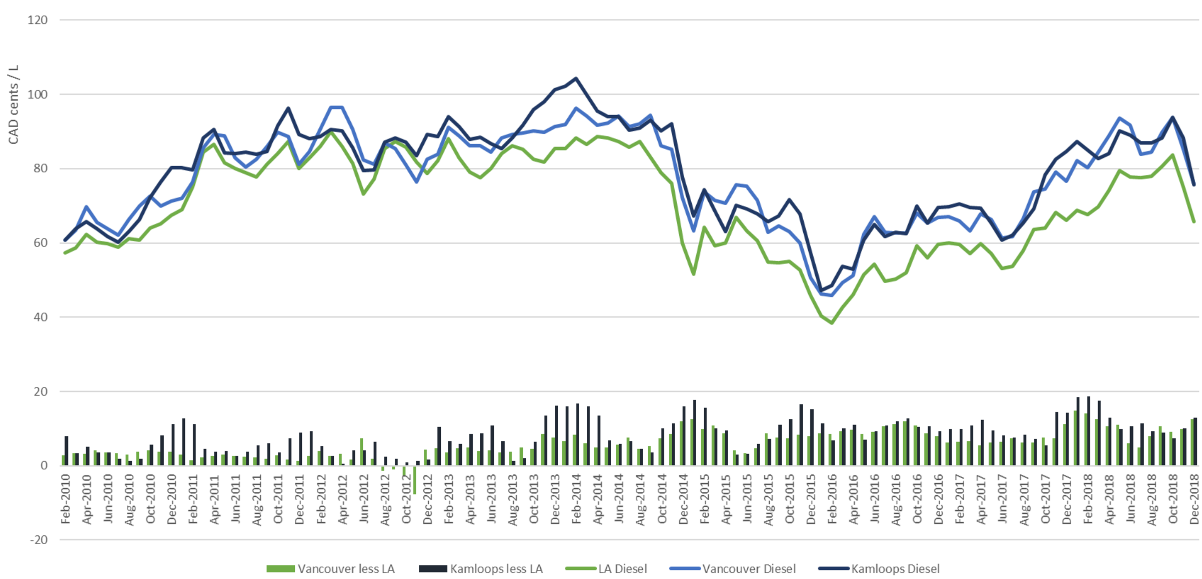
As was reviewed in Phase 1 of this report, wholesale prices in Vancouver in Kamloops have moved closely together, and with the Western Canadian region over the last decade. The data illustrates that wholesale prices in Seattle and LA are also tightly linked to one another.

Chart A.12.5: LA & Seattle diesel wholesale prices



However, it appears that in comparing the diesel prices across the border to BC's diesel wholesale prices, it is clear that in the late 2012 / early 2013 period, a differential began to open between LA diesel wholesale prices and those in BC. These trends mirror the trends assessed in section 5.2 of this document.

Chart A .12.6: Wholesale diesel prices in Seattle, LA, Kamloops, and Vancouver.



These price differentials are also in the context of California and BC having a similar regulatory environment. California also requires 10% ethanol mixing with gasoline although does not require biofuel mixing.[108] In addition to the ethanol mixing requirements, California also has a low carbon fuel

[108] Based on conversations with OPIS

standard (LCFS) which functions similarly to BC's.[109] California's LCFS was adopted in 2009, amended in 2011, re-adopted in 2015, and amended in 2018 with the goal of reducing the carbon intensity of transportation fuels pool by at least 20% by 2030.[110] Similarly to BC, credits and debits are calculated based on carbon intensity of the fuel supplied by the regulated entity and trading of credits of purchase of compliance units is allowed.

California's Carbon Intensity Benchmarks for Gasoline and Diesel Fuel and their substitutes		
Year	Gasoline Average CI (gCO_2e / MJ)	Diesel Average CI (gCO_2e / MJ)
2019	93.23	94.17
2020	91.98	92.92
2021	90.74	91.66
2022	89.50	90.41
2023	88.25	89.15
2024	87.01	87.89
2025	85.77	86.64

In nominal values, these targets are less stringent than the BC targets but California uses different lifecycle analysis tools than BC making the actual target difficult to compare. In addition to its RLCF regulation, California has had more stringent regulations surrounding fuel sold in the state. These regulations were rolled out in three phases creating phase, 1, 2, and 3 California reformulated gasoline (CaRFG):

- Phase 1: Implemented in 1992, CaRFG1 eliminated lead from gasoline and set regulations for deposit control additives and reid vapor pressure (RVP).
- Phase 2: Implemented in 1996, CaRFG2 set specifications for sulfur, aromatics, oxygen, benzene, T50, T90, Olefins, and RVP and established a Predictive Model.
- Phase 3: Implemented in 1999, CaRFG3 eliminated methyl-tertiary-butyl-ether from California gasoline.[111]

Since these regulations have been in place since the 1990s, and Canada has established similar regulations, they are unlikely to be a cause for a discontinuity in California's prices in the past several years.

Appendix 13: Exchange Rates

In the comparison of wholesale prices between locations in the United States and In Canada, all US dollar figures were converted to Canadian. In this section we test sensitivity to exchange rates used.

[109] "Pacific coast collaborative" includes California, Oregon, Washington, and BC. However, Washington does not have a low carbon fuel standard in place
[110] LCFS Basics, California Air Resource Board
[111] California Reformulated Gasoline Program, edited May 2018

The figures in the body of the document are converted using the US federal exchange rate. The number published by the Federals Reserve is the noon buy rates in New York for cable transfers payable in foreign currencies.[112]

On large transactions differentials in the exchange rate are thought of in "pips" which are variances at the fourth decimal place. So typical spread might be 5 pips which is the difference between 1.3305 and 1.3300, differences at this level are negligible to the result of the analysis in this document.

[112] Federal Reserve Exchange Rates