RESPONSE TO BCUC PANEL QUESTION

Request Date: August 1, 2019

Requesting Document: Exhibit A-21

Witness: Dr. Kahwaty

Questions: 1. Are all six data series relating to Vancouver, Washington and California gasoline and diesel sourced from OPIS? If not, please clarify each data source. Please also define "Vancouver Gasoline", "Washington Gasoline", "California Gasoline", "Vancouver Diesel", "Washington Diesel" and "California Diesel."

2. Please expand all four charts to show the same data series from 2014 to present. Explain any significant or notable events from 2014 to present that may have caused notable price differential widening or tightening between wholesale prices and crude prices.

Response:

Response to Question 1

The data presented in slides 19 – 22 of my July 17, 2019, presentation, now marked as Exhibit C5-9, are derived from several different sources. The details regarding the sources of each of the data series are:

- Vancouver Gasoline
  - Source: Kent Group Ltd., Petroleum Pricing Data[1]
  - Data Description: Daily Wholesale Unleaded Gasoline Prices
  - Data Adjustments: N/A

- Vancouver Diesel
  - Source: Kent Group Ltd., Petroleum Pricing Data[2]
  - Data Description: Daily Wholesale Diesel Prices
  - Data Adjustments: N/A

- Washington Gasoline
  - Source: Oil Price Information Service (OPIS)
  - Data Description: Daily Wholesale Gasoline Prices, Anacortes and Seattle Racks

[1] Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/

[2] Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/

  - Data Adjustments: OPIS data include a wide variety of gasoline price series reported in USD cents per gallon. The data displayed in the chart are the average rack price for CBOB Ethanol 10% regular RVP 9.0 gasoline across branded and unbranded variants for the Anacortes and Seattle racks. USD cents are converted using historical exchange rates from the U.S. Federal Reserve Economic Data (FRED) website.[3] Gallons are converted to litres at a rate of 3.78541 litres per gallon.

- Washington Diesel
  - Source: Oil Price Information Service (OPIS)
  - Data Description: Daily Wholesale Diesel Prices, Anacortes and Seattle Racks
  - Data Adjustments: OPIS data include a wide variety of diesel price series reported in USD cents per gallon. The data displayed in the chart are the average rack price for Ultra-Low Diesel across branded and unbranded variants for the Anacortes and Seattle racks. USD cents are converted using historical exchange rates from the U.S. Federal Reserve Economic Data (FRED) website.[4] Gallons are converted to litres at a rate of 3.78541 litres per gallon.

- California Gasoline
  - Source: Oil Price Information Service (OPIS)
  - Data Description: Daily Wholesale Gasoline Prices, Los Angeles and San Francisco Racks
  - Data Adjustments: OPIS data include a wide variety of gasoline price series reported in USD cents per gallon. For the years 2015-present, the data displayed in the chart are the average rack price for CARFG Ethanol 10% Regular gasoline without Cap-at-the-Rack fees across branded and unbranded variants for the Los Angeles and San Francisco racks. In 2014, the same methodology was used, however the rack price did not specify whether it was with or without Cap-at-the-Rack fees. USD cents are converted using historical exchange rates from the U.S. Federal Reserve Economic Data (FRED) website.[5] Gallons are converted to litres at a rate of 3.78541 litres per gallon.

- California Diesel
  - Source: Oil Price Information Service (OPIS)
  - Data Description: Daily Wholesale Gasoline Prices, Los Angeles and San Francisco Racks

---

[3] Canada / U.S. Foreign Exchange Rate, Federal Reserve Economic Data (FRED), available at https://fred.stlouisfed.org/series/DEXCAUS.

[4] Canada / U.S. Foreign Exchange Rate, Federal Reserve Economic Data (FRED), available at https://fred.stlouisfed.org/series/DEXCAUS.

[5] Canada / U.S. Foreign Exchange Rate, Federal Reserve Economic Data (FRED), available at https://fred.stlouisfed.org/series/DEXCAUS.

  - Data Adjustments: OPIS data include a wide variety of diesel price series reported in USD cents per gallon. For the years 2015-present, the data displayed in the chart are the average rack price for Carb Ultra-Low diesel without Cap-at-the-Rack fees across branded and unbranded variants for the Los Angeles and San Francisco racks. In 2014, the same methodology was used, however the rack price did not specify whether it was with or without Cap-at-the-Rack fees. USD cents are converted using historical exchange rates from the U.S. Federal Reserve Economic Data (FRED) website.[6] Gallons are converted to litres at a rate of 3.78541 litres per gallon.

- Canadian Light Sweet Crude
  - Source: Natural Resources Canada (NRC)[7]
  - Data Description: Daily Crude Oil Prices for Canadian Light Sweet Crude
  - Data Adjustments: NRC began reporting the Edmonton par series as Canadian Light Sweet in May 2014, and Canadian Light Sweet was again replaced by Canadian Mixed Sweet in August 2018. The raw prices series are available in CAD per cubic metre, and are converted to litres at a rate of 6.29 barrels per cubic metre and 158.99 litres per barrel.

- West Texas Intermediate – Cushing Crude
  - Source: U.S. Energy Information Administration (EIA)[8]
  - Data Description: Daily Crude Oil Prices for Canadian Light Sweet Crude
  - Data Adjustments: EIA report these data in USD dollars per barrel. USD are converted using historical exchange rates from the U.S. Federal Reserve Economic Data (FRED) website.[9] Barrels are converted to litres at a rate of 158.99 litres per barrel.

Response to Question 2

Figures 1 and **2** show expanded versions of the price series previously included in my July 17, 2019, presentation. **Figure 1** provides gasoline and crude oil prices, and **Figure 2** provides diesel and crude oil prices. Both cover the period from 2014 to the present. Outlined in these charts are several events that likely had an impact on wholesale gasoline and/or diesel prices. **Table 1** provides a key to the events shown in **Figures 1** and **2** as vertical lines. **Figures 3 A/B – 15 A/B** that follow look at shorter time intervals during this period to allow for a closer review of the impact of individual events or groups of events on wholesale prices, and in particular on changes in the differential between wholesale fuel and crude prices**.**

---

[6] Canada / U.S. Foreign Exchange Rate, Federal Reserve Economic Data (FRED), available at https://fred.stlouisfed.org/series/DEXCAUS.

[7] Oil Pricing, Natural Resources Canada, available at https://www.nrcan.gc.ca/energy/energy-sources-distribution/crude-oil/oil-pricing/18087.

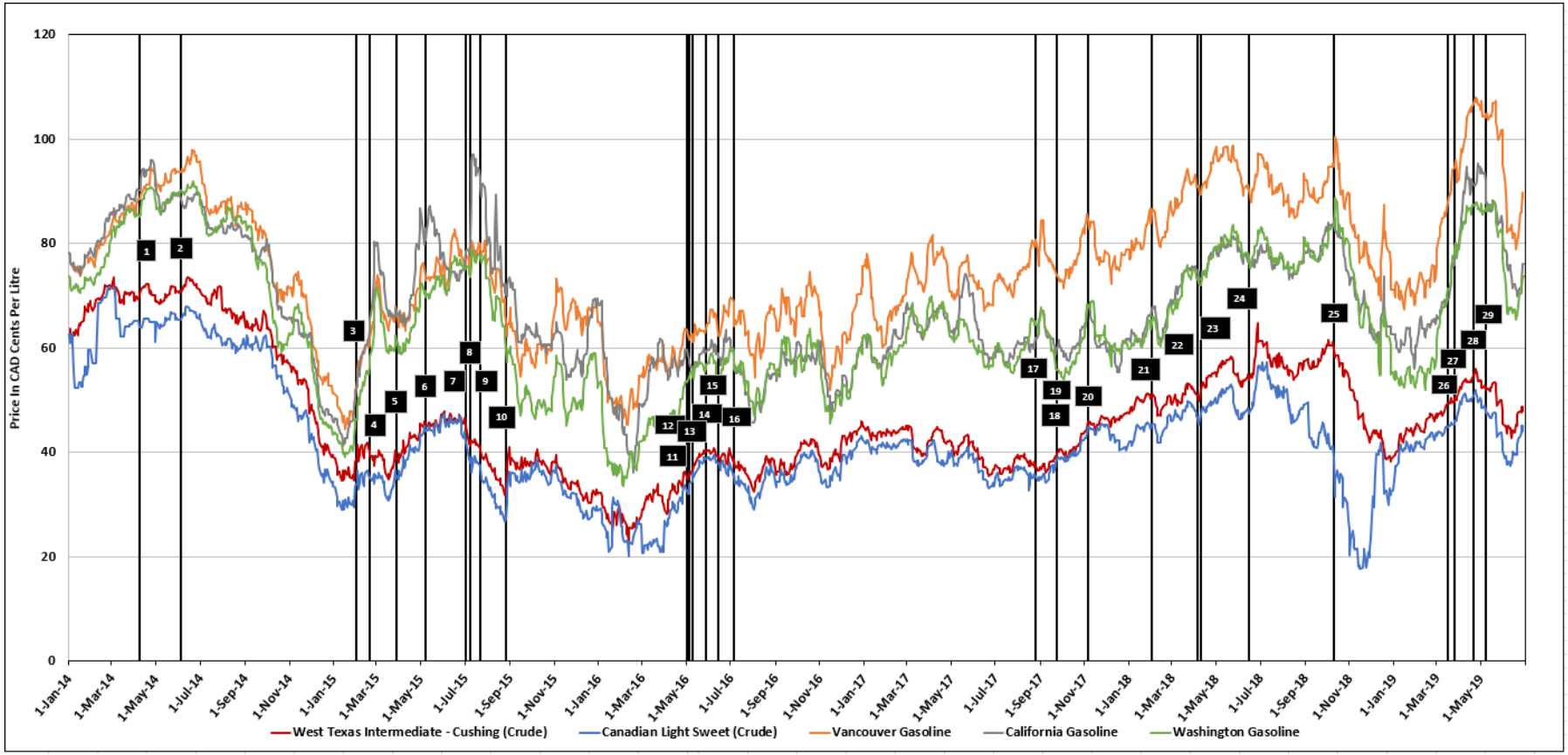
[8] "Petroleum & Other Liquids - Spot Prices," U.S. Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

[9] Canada / U.S. Foreign Exchange Rate, Federal Reserve Economic Data (FRED), available at https://fred.stlouisfed.org/series/DEXCAUS.

Table 1
Summary of Significant Events
For Figures 1 and 2
2014 - 2019

Number	Date	Event
1	04/08/14	Suncor Edmonton Turnaround Begins
2	06/03/14	Suncor Edmonton Turnaround Ends
3	02/01/15	US Union Strike Begins
4	02/18/15	Fire at ExxonMobil Torrance, CA Refinery
5	03/27/15	US Union Strike Ends
6	05/06/15	Unplanned Shutdown at TrailStone Tacoma, WA Refinery
7	07/01/15	TrailStone Tacoma, WA Refinery Resumes Operations
8	07/07/15	Malfunction at Shell Scotford, AB Refinery
9	07/21/15	ExxonMobil Torrance, CA Refinery Resumes Operations
10	08/25/15	Shell Scotford, AB Refinery Resumes Operations
11	05/01/16	Wildfire Starts in Alberta
12	05/04/16	Multiple Upstream Operations in Oil Sands Shutdown or Reduce Production
13	05/09/16	Oil Sands Upstream Operations Begin to Restart
14	05/27/16	Unplanned Shutdown at Suncor Edmonton Refinery
15	06/13/16	Suncor Edmonton Refinery and Oil Sands Production Return to Normal Operations
16	07/05/16	Wildfire Under Control
17	08/25/17	PADD 3 Affected by Hurricane Harvey
18	09/22/17	Shell Puget Sound, WA Refinery Turnaround Begins
19	09/22/17	PADD 3 Returns to Near Normal Operations
20	11/05/17	Shell Puget Sound, WA Refinery Turnaround Ends
21	02/01/18	Parkland Burnaby Refinery Turnaround Begins
22	04/04/18	Imperial Strathcona Turnaround Begins
23	04/09/18	Parkland Burnaby Refinery Turnaround Ends
24	06/15/18	Imperial Strathcona Turnaround Ends
25	10/09/18	Prince George Pipeline Fire
26	03/15/19	Fire at Phillips 66 Carson, CA Refinery
27	03/24/19	Malfunction at Valero Benicia, CA Refinery
28	04/20/19	Phillips 66 Carson, CA Refinery Resumes Operations
29	05/07/19	Valero Benicia, CA Refinery Resumes Operations

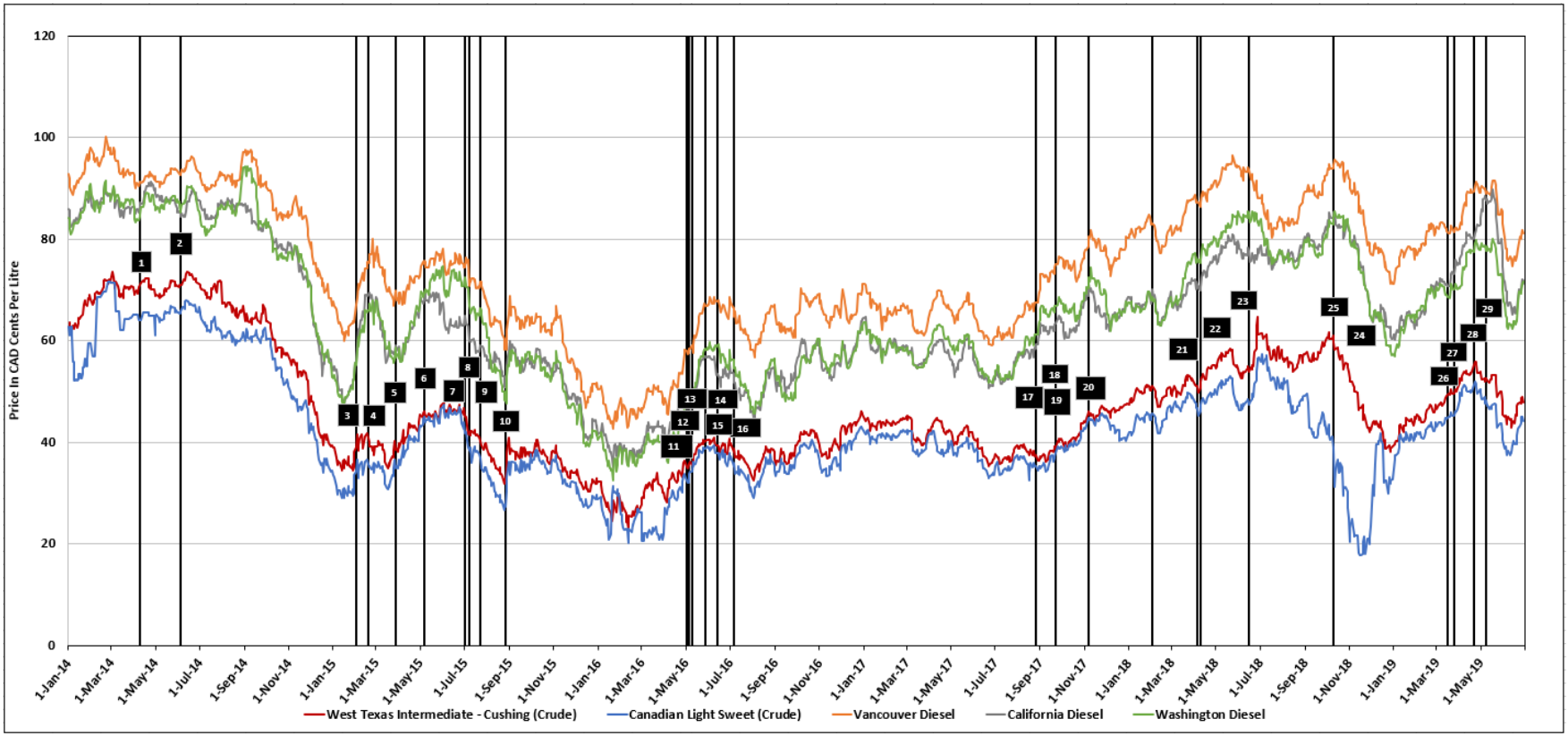
Figure 1
Daily Wholesale Regular Gasoline and Select Crude Prices
2014 - Present



Note: The California and Washington prices shown are based on OPIS rack prices. For 2014, OPIS does not clarify whether the California rack prices include Cap-at-the-Rack fees. From the start of 2014 through January 27, 2014, OPIS does not have rack data on regular gasoline for Anacortes. The Washington prices shown from the start of 2014 through January 27, 2014 are only based on Seattle.

Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 2
Daily Wholesale Regular Diesel and Select Crude Prices
2014 - Present



Note: The California and Washington prices shown are based on OPIS rack prices. For 2014, OPIS does not clarify whether the California rack prices include Cap-at-the-Rack fees. From the start of 2014 through January 27, 2014, OPIS does not have rack data on regular gasoline for Anacortes. The Washington prices shown from the start of 2014 through January 27, 2014 are only based on Seattle.

Sources: Same as Figure 1.

Several general patterns are apparent from **Figures 1** and **2** and from the discussions and graphs related to individual supply shocks and groups of supply shocks that follow:

- Vancouver, Washington, and California wholesale prices generally move together. These prices do not move in lock step with each other; price changes in one geography are not typically mirrored cent for cent by price changes in the other geographies. Nevertheless, wholesale prices do tend to increase or decrease together over time. The correlation between wholesale regular gasoline prices in Vancouver and wholesale regular gasoline prices in California is 0.83, while for diesel it is 0.97.[10] With correlations of 0.92 and 0.98, Vancouver wholesale prices are even more strongly correlated with Washington wholesale prices. These wholesale fuel prices are correlated because they not only move together with crude oil prices but also because they move together in response to shocks to supply, such as refinery outages.

- Vancouver, Washington, and California wholesale gasoline and diesel prices are positively correlated with crude oil prices, and indeed Vancouver retail prices are more strongly correlated with West Texas Intermediate – Cushing ("WTI") prices than with Canadian Light Sweet Crude prices. The correlation between Vancouver wholesale prices for regular gasoline and WTI crude oil prices is 0.74, and the correlation between Vancouver wholesale prices for regular gasoline and Canadian Light Sweet Crude prices is 0.65. For diesel, the correlation between Vancouver wholesale prices and WTI is 0.91, while for Vancouver wholesale prices and Canadian Light Sweet Crude it is 0.80.

- Refinery outages and other supply shocks in California, Washington, and Western Canada tend to impact all three wholesale markets – not just one of these markets – though the magnitude of the effects tend to be greater in markets that are closer to the supply shock (*e.g.*, the effects in Vancouver from outages in Edmonton tend to be larger than the effects in California).

- Individual outages or other supply shocks affect wholesale gasoline and diesel prices, but these prices and their differentials with crude prices change for reasons in addition to the supply shocks identified in **Table 1**. Wholesale gasoline and diesel markets in individual geographies are not static but instead are continually reacting and adjusting to supply and demand changes in their geography and in other areas.

- Though differentials between retail markets widen and narrow over time, in general, the gap between retail prices in Vancouver and other geographies has increased over time. In the first half of 2014, wholesale gasoline prices in Vancouver and Washington differed by an average of 3.5 cents and up to 6.9 cents per litre. By the first half of 2016, this spread had increased to between 10 and 15 cents per litre, though at times it was lower, and by the first half of 2018 it

[10] This correlation and those that follow are based on data from January 1, 2014, to June 30, 2019.

was generally between 15 and 20 cents, though at times it was either above or below this range. Differences between Vancouver wholesale gasoline prices and California wholesale gasoline prices also exhibit an upward trend over time, even though at times California prices have exceeded Vancouver prices substantially (*e.g.*, in mid-2015) and the difference has been near zero at other times (*e.g.*, early 2016, late 2016). California and Vancouver wholesale gasoline prices generally were within 5 cents of each other in the first half of 2014. The average difference between Vancouver wholesale gasoline prices and California wholesale gasoline prices during 2018 was 14.6 cents. There are also positive trends in the difference between Vancouver wholesale diesel prices and both Washington and California wholesale diesel prices, but these trends are less pronounced.

Suncor Edmonton Refinery Turnaround

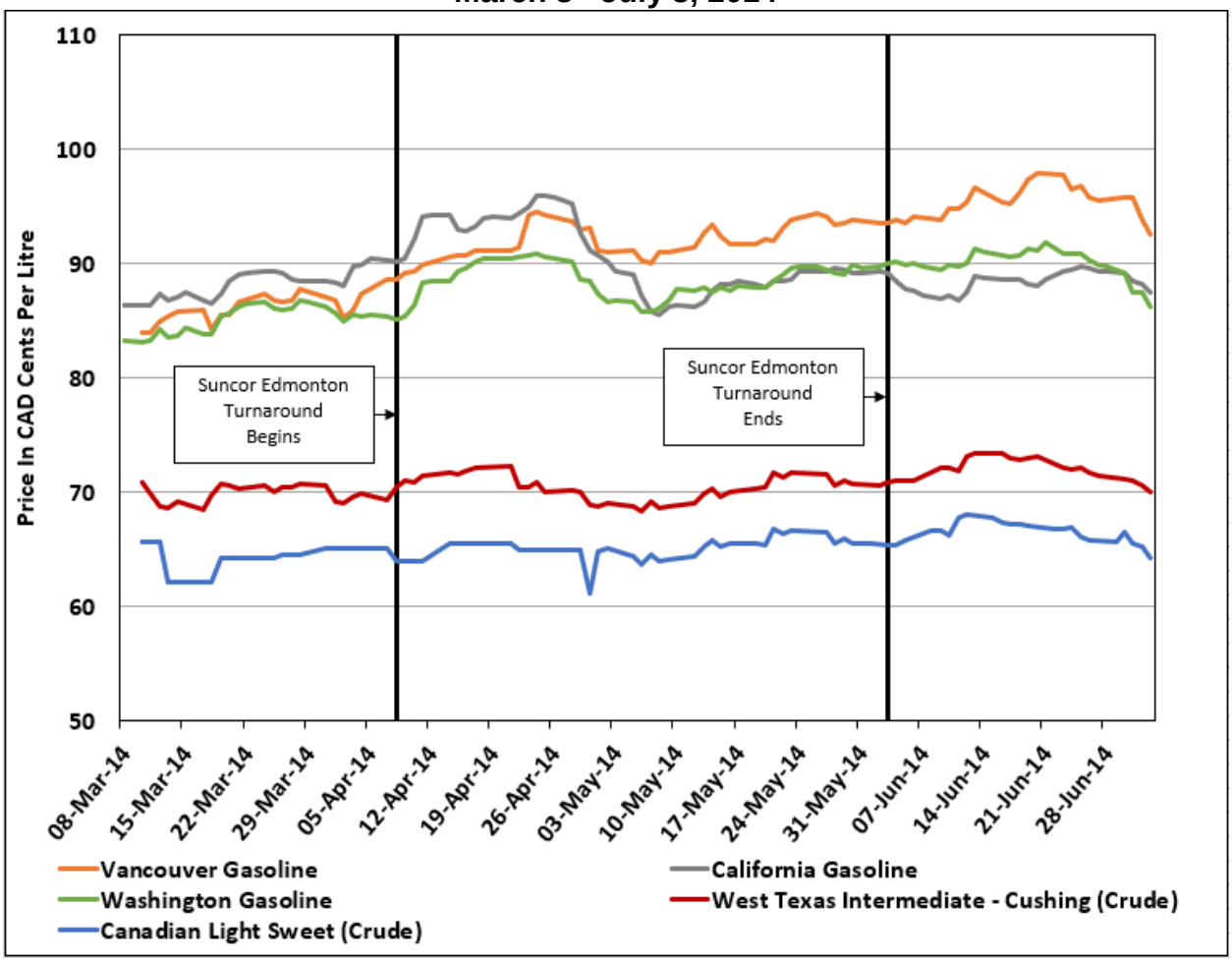
Figure 3A shows wholesale gasoline prices for Vancouver, Washington, and California from March 8 to July 3, 2014. Also included are prices series for WTI crude oil and Canadian Light Sweet crude oil. During this time, Suncor's refinery in Alberta underwent extensive maintenance as part of a planned turnaround. Suncor began the turnaround on April 8, 2014, and the maintenance itself lasted approximately eight weeks.[11]

Figure 3B builds on **Figure 3A** by providing the differences between the gasoline prices and the WTI price.[12] As shown in **Figure 3B**, the differential between crude and gasoline increased during the time of the turnaround and decreased immediately thereafter, though the Vancouver differential subsequently increased later in July 2014. The average difference between daily gasoline wholesale prices and WTI for the month prior to the turnaround was 16.3 cents in Vancouver, 18.3 cents in California, and 15.3 cents in Washington. During the turnaround, the average difference between gasoline wholesale prices and WTI was 21.6 cents in Vancouver, 19.9 cents in California, and 18.0 cents in Washington. For the month after the turnaround, the average difference between gasoline wholesale prices and WTI was 23.5 cents in Vancouver, 16.4 cents in California, and 18.0 cents in Washington.

[11] Begg, Rehana, "Planned maintenance begins at Edmonton refinery, Suncor Energy," Resource Engineering and Maintenance, April 8, 2014, available at https://www.rem-mag.com/shutdowns/planned-maintenance-begins-at-edmonton-refinery-suncor-energy; Suncor – Maintenance turnarounds, available at https://connections.suncor.com/edmonton-alberta/november-2014/maintenance-turnarounds.

[12] Throughout the rest of this response, figures are labeled either "A" or "B". As is shown in this example, figures labeled "B" show the difference between daily gasoline or diesel wholesale prices and WTI. I also analyzed the difference between daily gasoline and diesel wholesale prices and Canadian Light Sweet crude prices. For most of the period studied, WTI and Canadian Light Sweet crude track each other closely, and there is no substantive difference if Canadian Light Sweet crude is used as a benchmark instead of WTI.

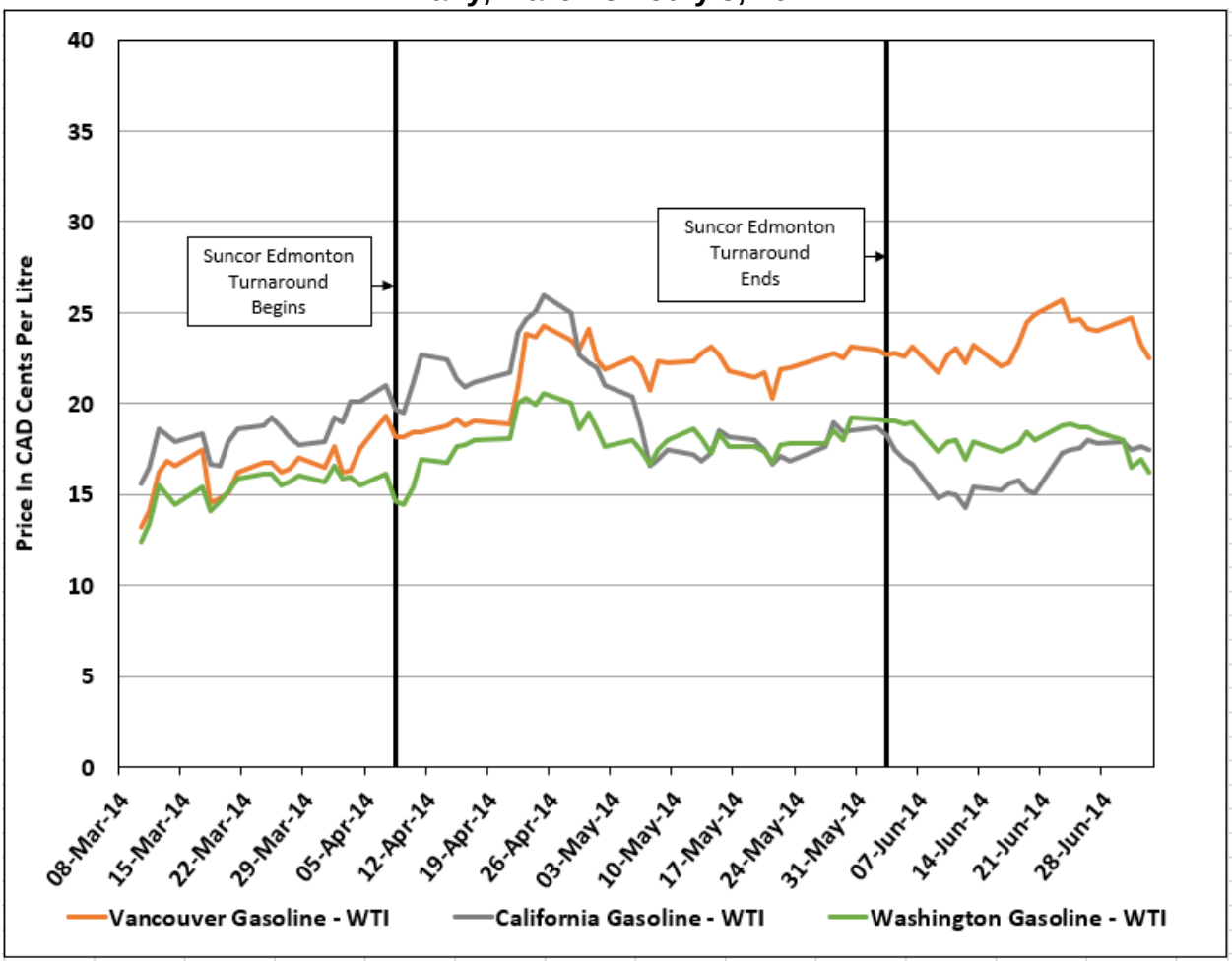
Figure 3A
Daily Wholesale Regular Gasoline and Select Crude Prices
March 8 - July 3, 2014



Note: The California prices shown are based on OPIS rack prices. For 2014, OPIS does not clarify whether the rack prices include Cap-at-the-Rack fees.

Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 3B
Difference Between Wholesale Regular Gasoline and WTI Crude Prices
Daily, March 8 - July 3, 2014



Note: The California prices shown are based on OPIS rack prices. For 2014, OPIS does not clarify whether the rack prices include Cap-at-the-Rack fees.

Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Strikes at U.S. Refineries and the Torrance Refinery Outage

Figures 4A and **5A** show wholesale fuel and crude prices from January 1 to April 27, 2015, for gasoline and diesel. In the first half of 2015, two events occurred that impacted U.S. refineries and in particular several refineries in California. On February 1, 2015, the United Steelworkers Union announced strikes at nine oil refineries in several

states.[13] This included two refineries in California: Tesoro's Carson and Martinez refineries. The strike eventually expanded to include an additional three refineries, which in total accounted for nearly one-fifth of U.S. refining capacity.[14] As a result of the strike, Tesoro shut down its Martinez refinery and did not restart operations until late March, around when the strike ended.[15] Concurrent to the strike, the Torrance refinery in California experienced a fire on February 18, 2015.[16] This fire initially caused a total shutdown of the refinery, and it was only able to operate at 20% of capacity as of July 21, 2015.[17] Both the strike and the fire were noted by trade press as resulting in reduced supply and higher fuel prices.[18]

Figures 4B and **5B** show significant increases in the price differentials for gasoline and diesel relative to WTI, including Vancouver. The average difference between wholesale gasoline prices and WTI for the month prior to the strike was 11.8 cents in Vancouver, 9.0 cents in California, and 5.4 cents in Washington. During the strike the average difference between gasoline wholesale prices and WTI was 25.2 cents in Vancouver, 28.0 cents in California, and 20.7 cents in Washington. For the month after the strike, the average difference between gasoline wholesale prices and WTI was 25.1 cents in Vancouver, 27.4 cents in California, and 20.6 cents in Washington.

The average difference between wholesale diesel prices and WTI for the month prior to the strike was 27.2 cents in Vancouver, 14.9 cents in California, and 14.1 cents in Washington. During the strike the average difference between diesel wholesale prices and WTI was 33.9 cents in Vancouver, 24.0 cents in California, and 23.1 cents in Washington. For the month after the strike, the average difference between diesel wholesale prices and WTI was 28.8 cents in Vancouver, 19.1 cents in California, and 19.2 cents in Washington.

---

[13] Smith, Allen, "Steelworkers Strike at Oil Refineries, Slow Down at Ports," Society For Human Resource Management, February 6, 2015, available at https://web.archive.org/web/20180121071250/https://www.shrm.org/ResourcesAndTools/hr-topics/labor-relations/Pages/USW-refineries-strike.aspx.

[14] Seba, Erwin, "U.S. refinery strike spreads to one-fifth of national capacity," February 21, 2015, available at https://www.reuters.com/article/us-refineries-labor-strike/u-s-refinery-strike-spreads-to-one-fifth-of-national-capacity-idUSKBN0LP06420150222.

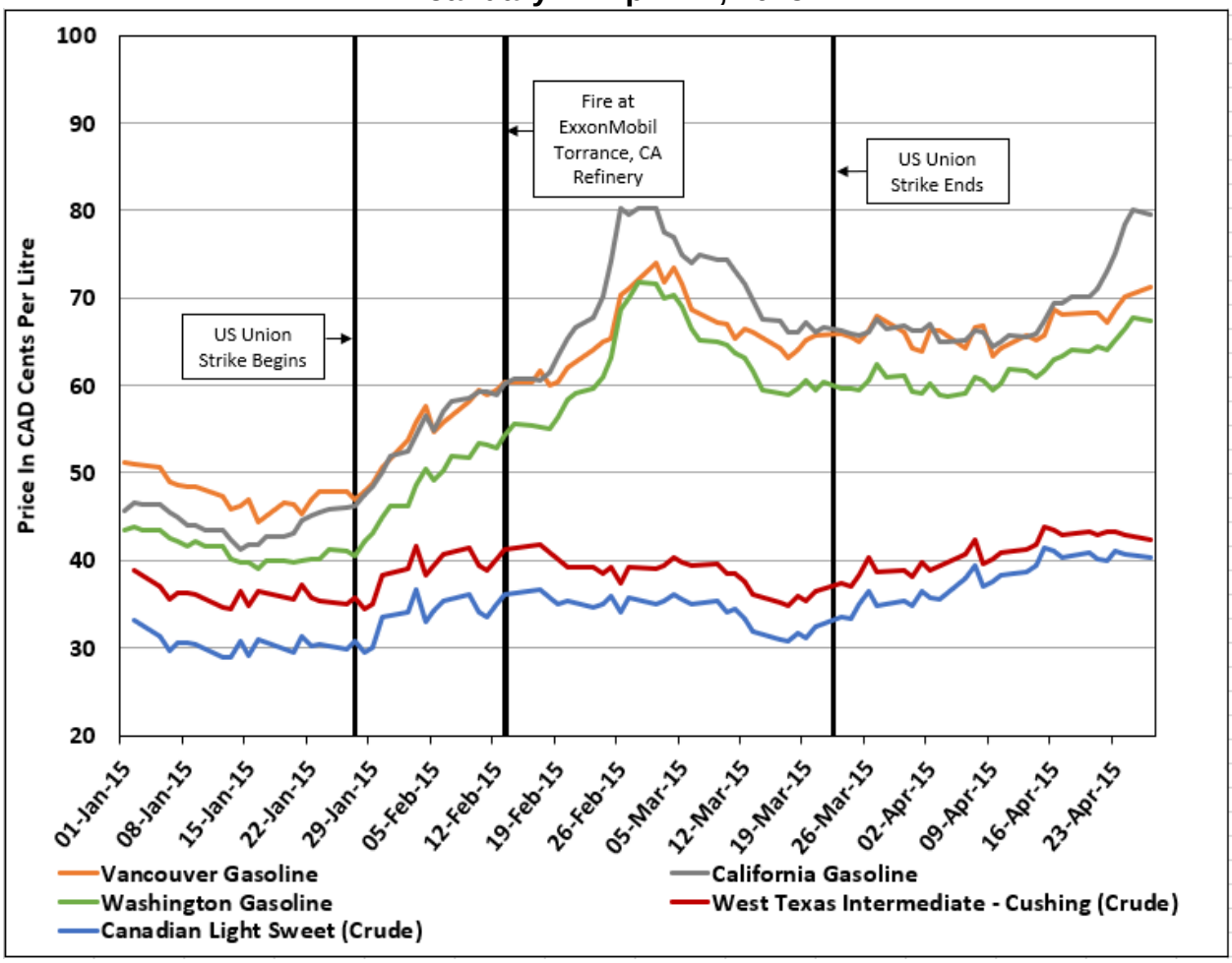
[15] Summers, Jessica, "U.S. Refinery Strike Wrap: TSO to Restart Martinez Friday," Bloomberg, March 26, 2015.

[16] "California's gasoline imports increase 10-fold after major refinery outage," U.S. Energy Information Administration, October 13, 2015, available at https://www.eia.gov/todayinenergy/detail.php?id=23312.

[17] Tuttle, Robert, "Exxon Torrance Refinery Repair Estimated by Year End: Regulator," Bloomberg, July 21, 2015.

[18] Seba, Erwin, "U.S. refinery strike spreads to one-fifth of national capacity," February 21, 2015, available at https://www.reuters.com/article/us-refineries-labor-strike/u-s-refinery-strike-spreads-to-one-fifth-of-national-capacity-idUSKBN0LP06420150222; Hsu, Tiffany, "Why gas prices in California are so much higher than elsewhere in U.S.," Los Angeles Times, March 31, 2015, available at https://www.latimes.com/business/la-fi-gas-prices-20150401-story.html. "SoCal refinery fire, Martinez Tesoro strike could impact gas prices," ABC 7 San Francisco, February 18, 2015, available at https://abc7news.com/automotive/socal-refinery-explosion-fire-could-impact-gas-prices/524238/.

Figure 4A
Daily Wholesale Regular Gasoline and Select Crude Prices
January 1 - April 27, 2015

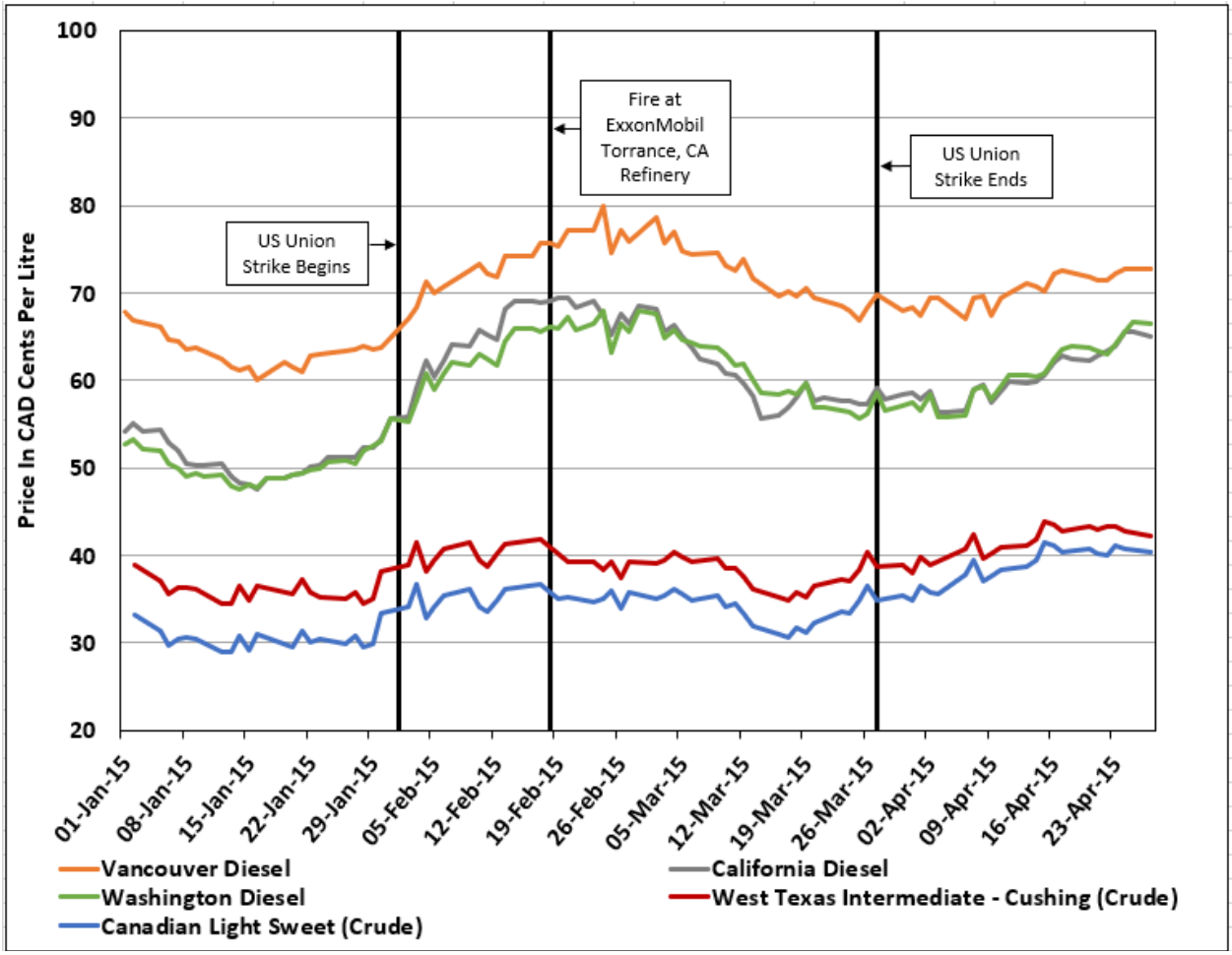


Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 4B
Difference Between Wholesale Regular Gasoline and WTI Crude Prices
Daily, January 1 - April 27, 2015

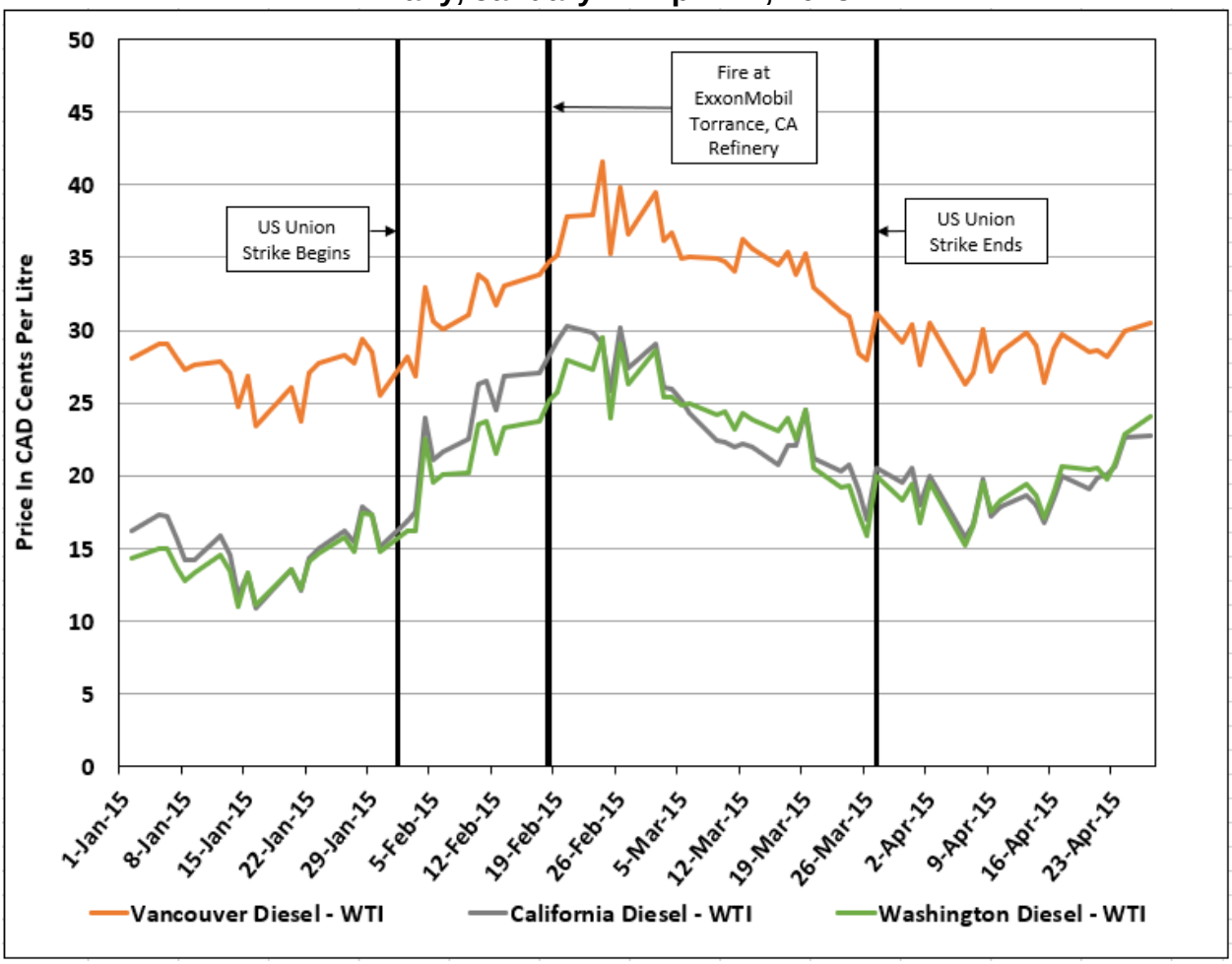
Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 5A
Daily Wholesale Diesel and Select Crude Prices
January 1 - April 27, 2015



Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 5B
Difference Between Wholesale Diesel and WTI Crude Prices
Daily, January 1 - April 27, 2015



Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Tacoma Refinery Unplanned Shutdown and Shell Scotford Malfunction

Figure 6A is a continuation of the price series shown in **Figure 4A. Figure 6A** shows wholesale gasoline and crude prices from April 6 to September 25, 2015. In the later portion of 2015, a refinery in Tacoma, Washington, and Shell's Scotford Refinery in Alberta both experienced malfunctions. The Tacoma refinery experienced a fire which resulted in an unplanned shutdown on May 6, 2015.[19] The facility was unable to resume

[19] Harvey, Christine, "TrailStone Begins Turnaround at Tacoma Refinery After Fire," Bloomberg, May 11, 2015.

normal operations until two months later in July 2015.[20] In early July, local news sources began reporting outages at several Shell gas stations in Edmonton. Shell officials stated these outages were a result of "maintenance work being done at their Scotford Refinery."[21] In August these gas station outages extended to other parts of Canada. The end date of the unplanned shutdown or curtailment at the Scotford Refinery is not available from public sources, however the last reported outages occurred in late August 2015.[22] The outages have been noted for causing upward pressure on gasoline prices.[23]

Though crude prices also rose during this time, **Figure 6B** shows the differential between wholesale fuel prices and crude prices widened during these shutdowns or curtailments. The average difference between wholesale gasoline prices and WTI for the month prior to the unplanned shutdown at the Trailstone Refinery in Tacoma was 26.0 cents in Vancouver, 30.2 cents in California, and 21.7 cents in Washington. During these outages or curtailments, the average difference between gasoline wholesale prices and WTI was 33.5 cents in Vancouver, 38.8 cents in California, and 30.6 cents in Washington. For the month after the Shell Scotford Refinery resumed normal operations, the average difference between gasoline wholesale prices and WTI was 23.4 cents in Vancouver, 28.8 cents in California, and 16.2 cents in Washington.

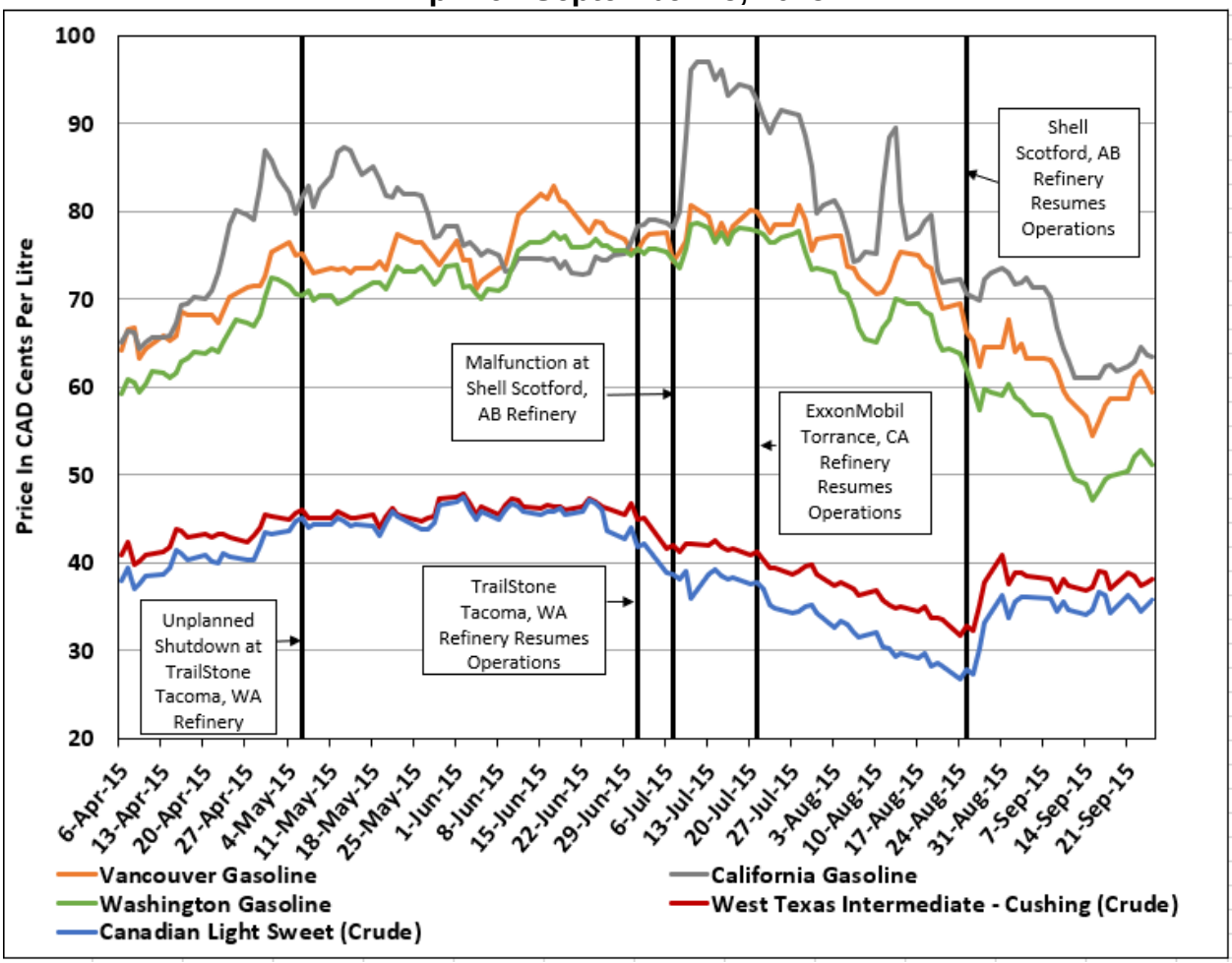
[20] Harvey, Christine, "TrailStone Begins Turnaround at Tacoma Refinery After Fire," Bloomberg, May 11, 2015.

[21] Ramsay, Caley, "Several Edmonton Shell stations run dry at the pump," Global News, July 7, 2015, available at https://globalnews.ca/news/2097683/several-edmonton-shell-stations-run-dry-at-the-pump/.

[22] "Some Winnipeg Shell gas stations run out of fuel," CBC Canada, August 25, 2015, available at https://www.cbc.ca/news/canada/manitoba/some-winnipeg-shell-gas-stations-run-out-of-fuel-1.3203840.

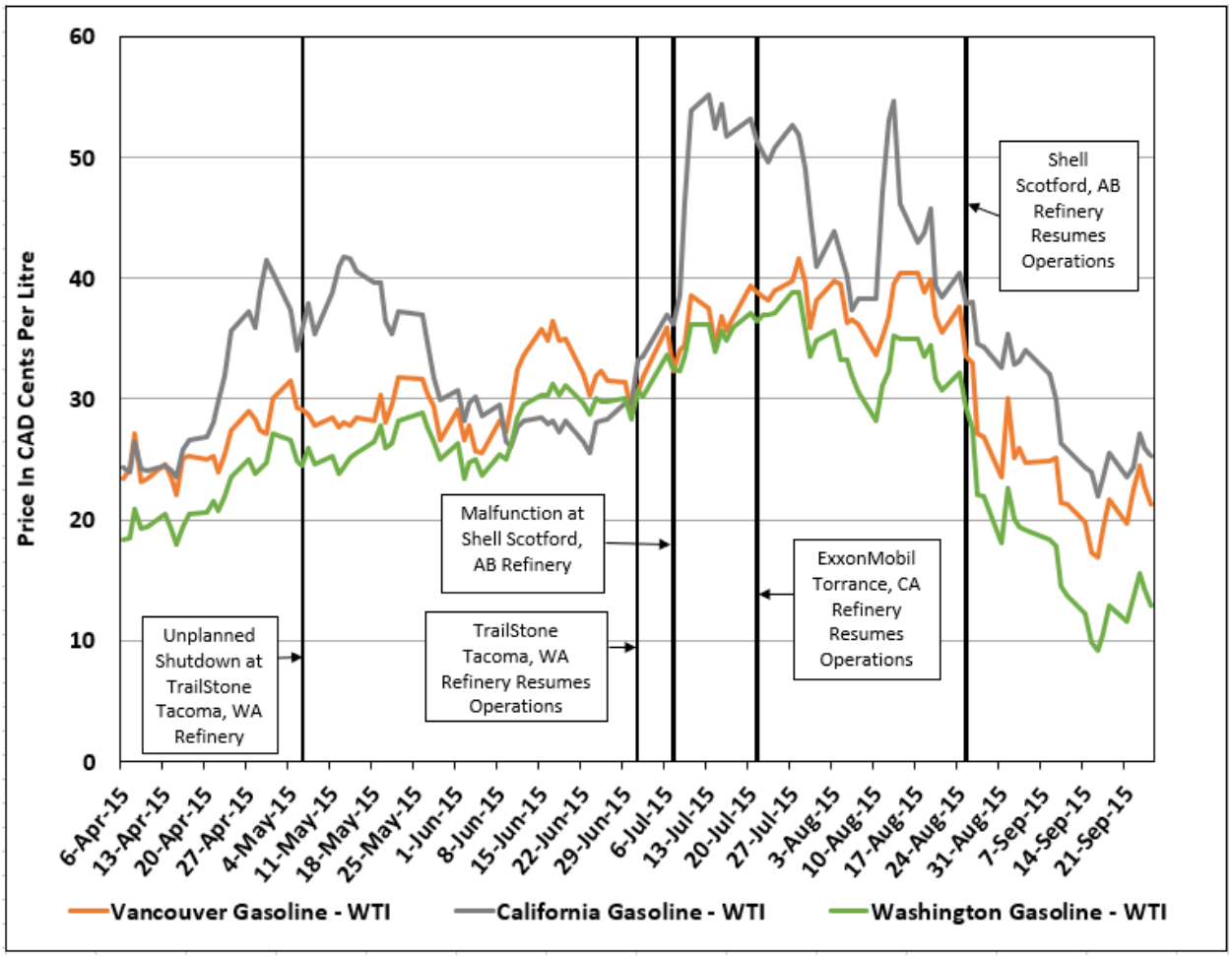
[23] Ramsay, Caley, "Several Edmonton Shell stations run dry at the pump," Global News, July 7, 2015, available at https://globalnews.ca/news/2097683/several-edmonton-shell-stations-run-dry-at-the-pump/.

Figure 6A
Daily Wholesale Regular Gasoline and Select Crude Prices
April 6 - September 25, 2015



Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 6B
Difference Between Wholesale Gasoline and WTI Crude Prices
Daily, April 6 - September 25, 2015



Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Alberta Wildfires and Suncor Edmonton Refinery Shutdown

Figure 7A covers the period from April 1 to August 5, 2016. Wildfires started in Alberta in early May 2016.[24] Shortly after the start of these wildfires, several upstream oil extraction operations were forced to shut down or reduce production.[25] Suncor's

[24] Plenty, Rebecca, "Oil Town Evacuated as Wildfire Curbs Canadian Oil Sands Output," Bloomberg, May 4, 2016.

[25] Plenty, Rebecca, "Oil Town Evacuated as Wildfire Curbs Canadian Oil Sands Output," Bloomberg, May 4, 2016.

Edmonton refinery also experienced an unplanned shutdown on May 27, 2016.[26] The combination of the unplanned shutdown and reduced upstream production at Suncor's oil-sands sites as a result of the wildfire resulted in shortages of gasoline and diesel at Petro-Canada stations across Western Canada.[27] The outage was also connected to a five cent differential in wholesale Western Canadian gas prices compared with Ontario.[28] By June 13, 2016, Suncor's Edmonton refinery had resumed normal operations, and the upstream crude oil extraction operations began to return to normal as well.[29] By July 5, 2016, the wildfires in the oil sands region were under control.[30]

Crude prices increased during the time when upstream production was curtailed, but the difference between wholesale gasoline prices and crude oil prices was largely unchanged, especially in Vancouver. Effects were seen in diesel, however. **Figure 7B** show the price differentials for diesel relative to WTI. The differential between wholesale diesel prices and WTI increases as upstream and downstream facilities curtail or cease operations and declines as facilities come back into production. The differences are most pronounced for Vancouver. The average difference between wholesale diesel prices and WTI for the month prior to the start of the wildfires was 18.5 cents in Vancouver, 12.6 cents in California, and 8.4 cents in Washington. During these outages the average difference between diesel wholesale prices and WTI was 25.9 cents in Vancouver, 14.5 cents in California, and 16.4 cents in Washington. For the month after the wildfires were brought under control, the average difference between diesel wholesale prices and WTI was 25.4 cents in Vancouver, 12.8 cents in California, and 14.5 cents in Washington.

---

[26] Tuttle, Robert, "Suncor Says Edmonton Refinery Gasoline-Making Unit Restarting," Bloomberg, June 9, 2016.

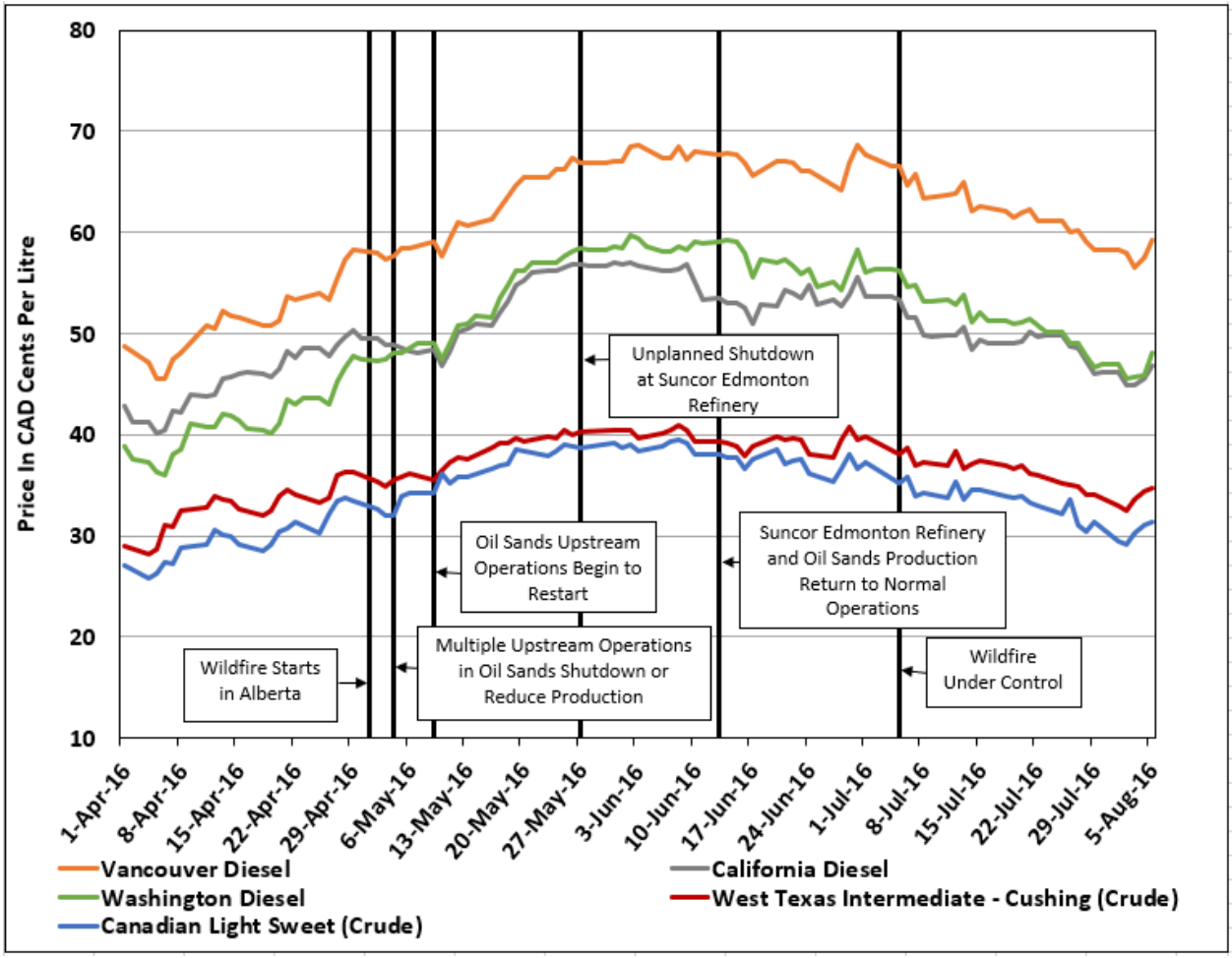
[27] Plenty, Rebecca, "Western Canada Facing Gasoline Shortages Amid Alberta Fires," Bloomberg, June 1, 2016.

[28] Bickis, Ian, "Wildfires, refinery outage behind Petro-Canada fuel shortages in the West," The Canadian Press, June 3, 2016, available at https://business.financialpost.com/commodities/energy/wildfires-refinery-outage-behind-petro-canada-fuel-shortages-in-the-west/.

[29] Tuttle, Robert, "Suncor Edmonton Refinery Returns to 'Planned Operations'," Bloomberg, June 13, 2016.

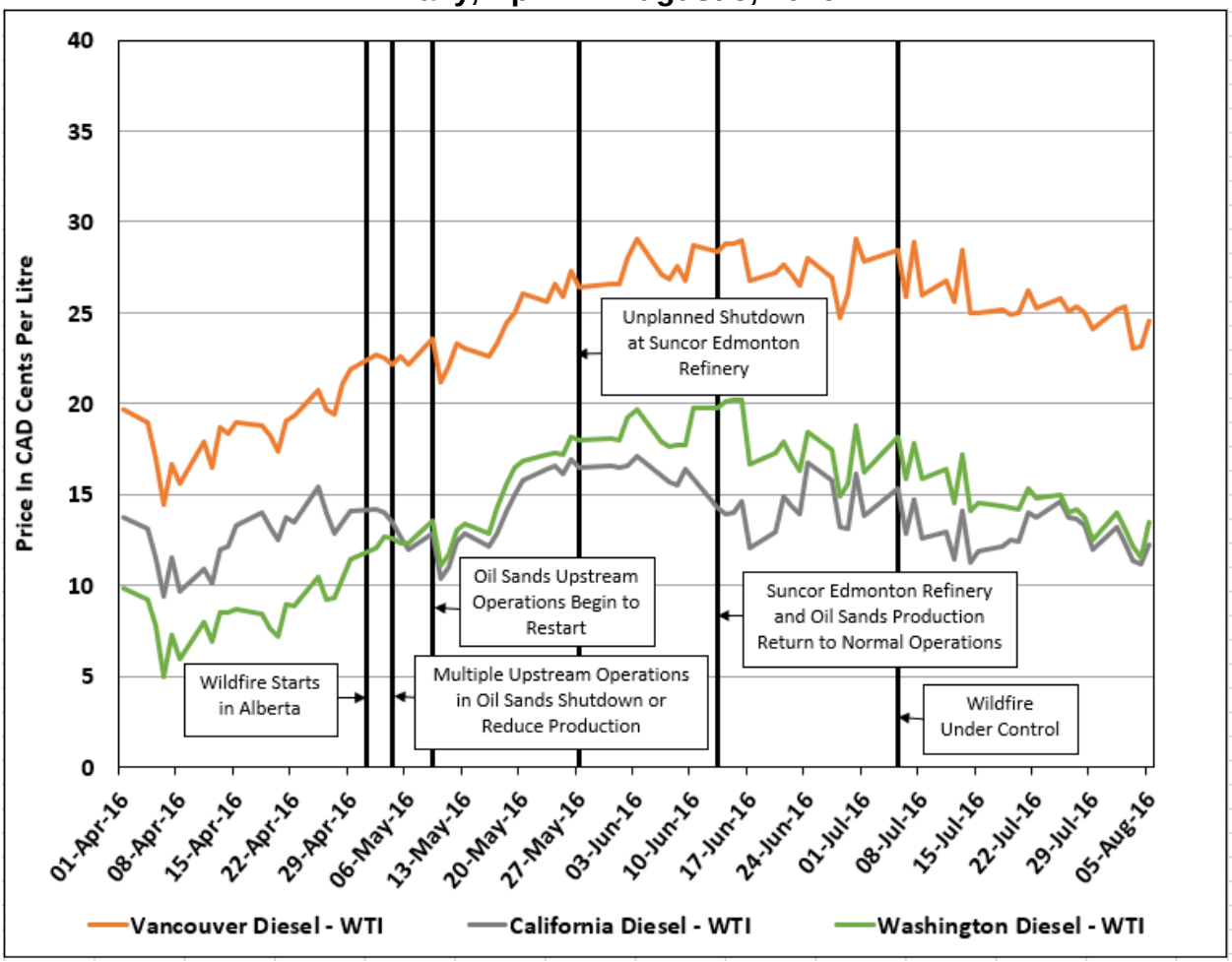
[30] "Fort McMurray wildfire now considered under control," *CBC News,* July 5, 2016, available at https://www.cbc.ca/news/canada/edmonton/fort-mcmurray-wildfire-now-considered-under-control-1.3664947.

Figure 7A
Daily Wholesale Diesel and Select Crude Prices
April 1 - August 5, 2016



Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 7B
Difference Between Wholesale Diesel and WTI Crude Prices
Daily, April 1 - August 5, 2016



Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Hurricane Harvey and Puget Sound Refinery Turnaround

Figures 8A and **9A** show wholesale fuel and crude prices from July 25 to December 5, 2017, for gasoline and diesel. During this time two major events occurred that may have impacted the differential between wholesale fuel prices and crude oil prices. The first event was a hurricane, dubbed Harvey, which had large impacts in PADD 3. Harvey initially made landfall on August 25 in Texas and shortly thereafter several refineries

were forced to shutdown, representing nearly 1.724 million barrels per day of capacity.[31] At its peak Harvey resulted in nearly one quarter of the U.S.'s refining capacity being offline. By September 22, 2017, nearly all refineries had resumed operations with the exception of one facility in Port Arthur, Texas.[32] The same week Harvey made landfall, several regions in the U.S. reported increased gas prices including the West Coast.[33] Shortly after this, press reports linked Harvey to higher gasoline prices throughout Canada.[34] Following this, a refinery owned by Shell in Puget Sound underwent a significant maintenance turnaround. This turnaround started in late September and lasted approximately one and a half months.[35] This turnaround was the most extensive turnaround the facility had undertaken since its construction.

Figures 8B and **9B** show the price differentials for gasoline and diesel relative to WTI. The average difference between wholesale gasoline prices and WTI for the month prior to the effects of Hurricane Harvey was 37.0 cents in Vancouver, 22.0 cents in California, and 21.8 cents in Washington. During the PADD 3 and Shell Puget Sound Refinery outages, the average difference between gasoline wholesale prices and WTI was 37.4 cents in Vancouver, 22.0 cents in California, and 20.1 cents in Washington. For the month after Shell Puget Sound's turnaround ended, the average difference between gasoline wholesale prices and WTI was 33.8 cents in Vancouver, 16.6 cents in California, and 18.2 cents in Washington.

The average difference between wholesale diesel prices and WTI for the month prior to the effects of Harvey was 26.6 cents in Vancouver, 18.3 cents in California, and 19.2 cents in Washington. During these outages the average difference between diesel wholesale prices and WTI was 34.0 cents in Vancouver, 23.2 cents in California, and 26.2 cents in Washington. For the month after Shell Puget Sound's turnaround ended, the average difference between diesel wholesale prices and WTI were 33.1 cents in Vancouver, 20.8 cents in California, and 24.6 cents in Washington.

---

[31] White, Dylan and Lee Williams, "Aftermath of Hurricane Harvey Lingers over U.S. Refinery Markets," Genscape, September 21, 2017, available at https://www.genscape.com/blog/aftermath-hurricane-harvey-lingers-over-us-refinery-markets.

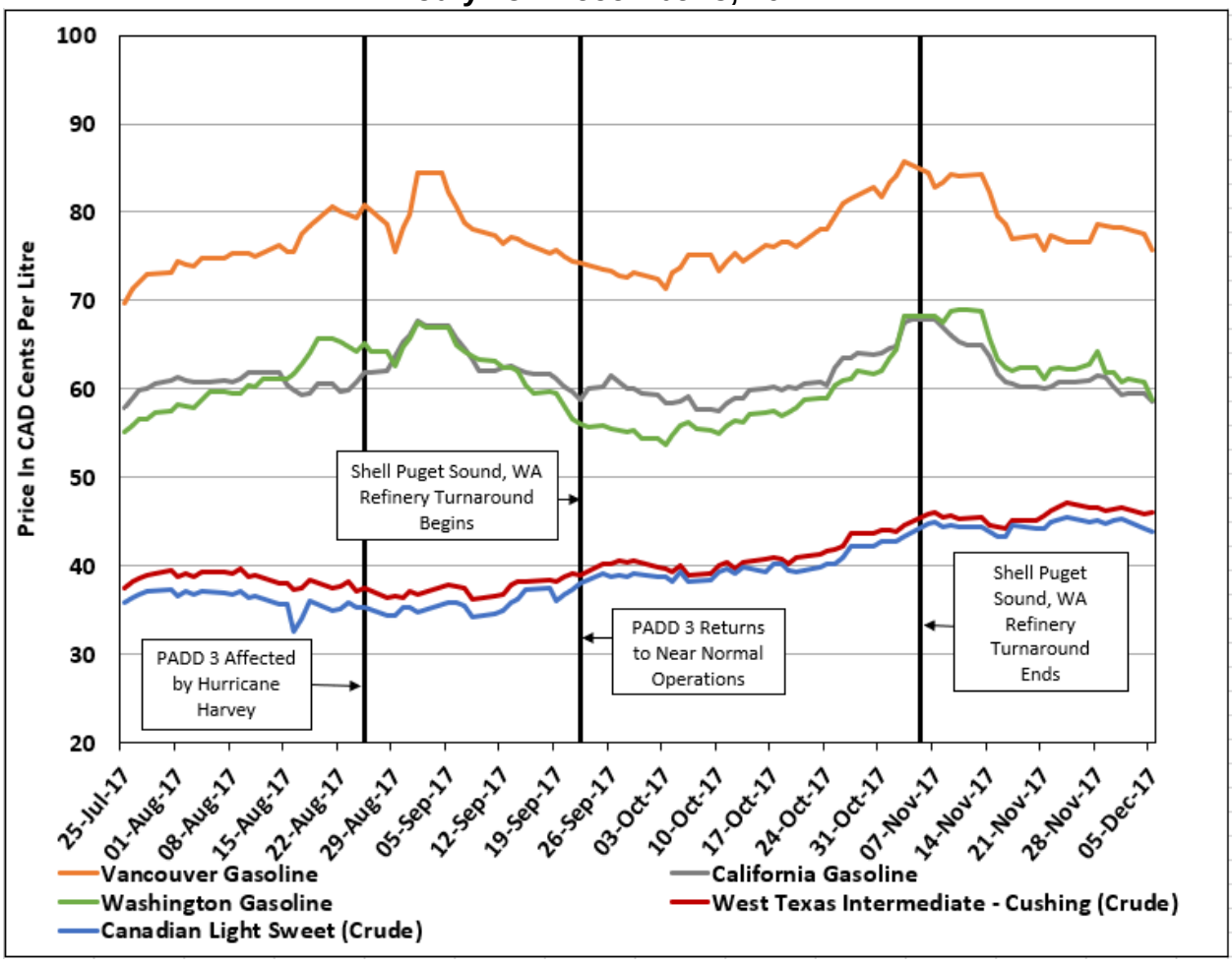
[32] Blum, Jordan, "Refiners, petrochemical plants on the rebound from Harvey," Houston Chronicle, September 22, 2017, available at https://www.houstonchronicle.com/business/energy/article/Refiners-petrochemical-plants-on-the-rebound-12222556.php.

[33] "Harvey Drives Up Gas Prices Nationwide," AAA Newsroom, August 2017, available at https://newsroom.aaa.com/2017/08/harvey-drives-gas-prices-nationwide/.

[34] "Harvey causes gas prices in Canada to soar," CTV News, September 1, 2017, available at https://www.ctvnews.ca/canada/harvey-causes-gas-prices-in-canada-to-soar-1.3571911; "Pain at the pumps: Gas prices rising this Labour Day long weekend," CBC News, September 1, 2017, available at https://www.cbc.ca/news/business/gasoline-prices-harvey-canada-1.4271767. "Gas prices likely to jump another five cents per litre tomorrow, say insiders," News 1130, September 1, 2017, available at https://www.citynews1130.com/2017/09/01/gasoline-prices-jump-overnight-bc/.

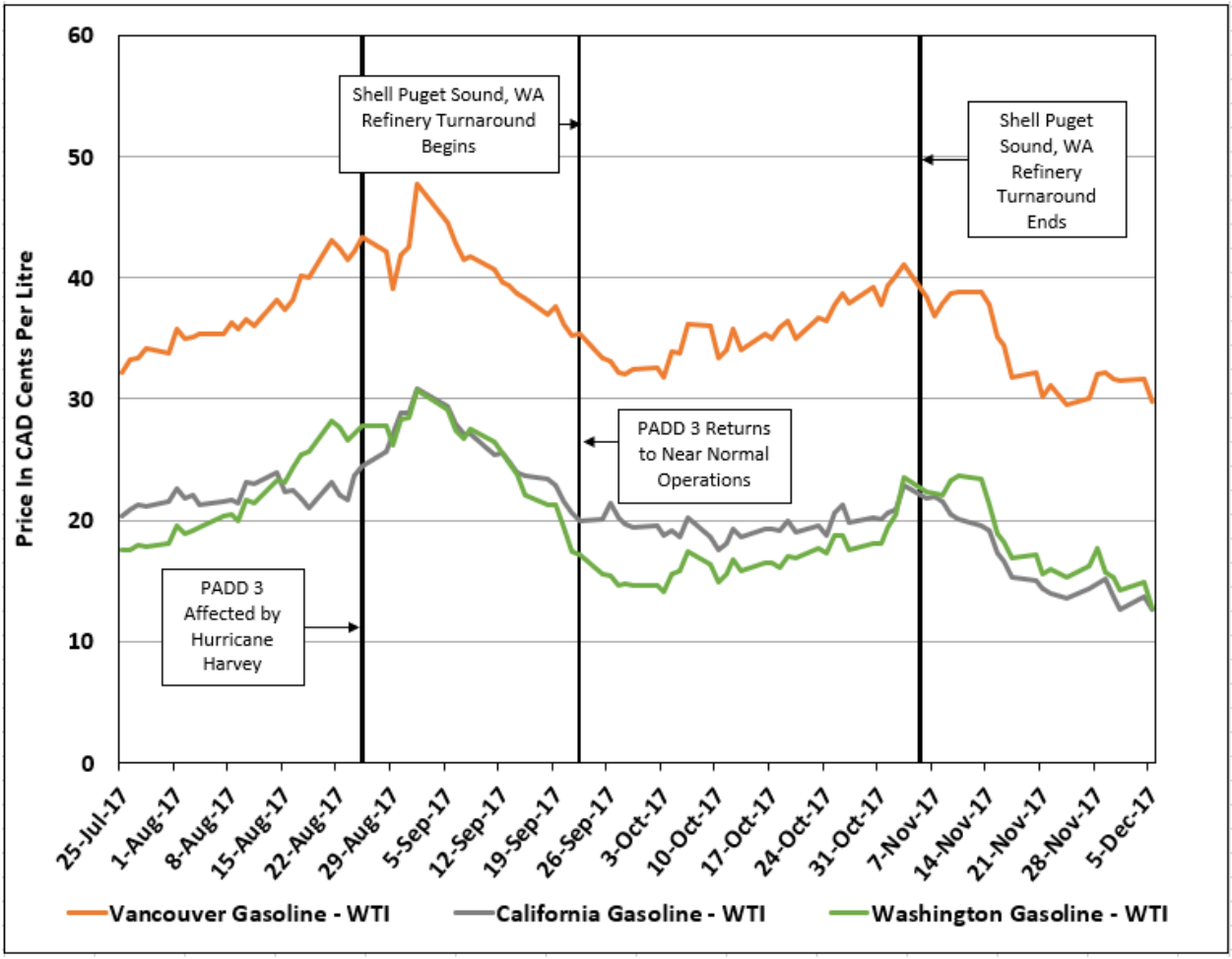
[35] "Shell Puget Sound Refinery Announces Planned Maintenance," Shell, September 6, 2017, available at https://www.shell.us/about-us/projects-and-locations/puget-sound-refinery/puget-sound-refinery-news-events/shell-puget-sound-refinery-announces-planned-maintenance.html.

Figure 8A
Daily Wholesale Regular Gasoline and Select Crude Prices
July 25 - December 5, 2017



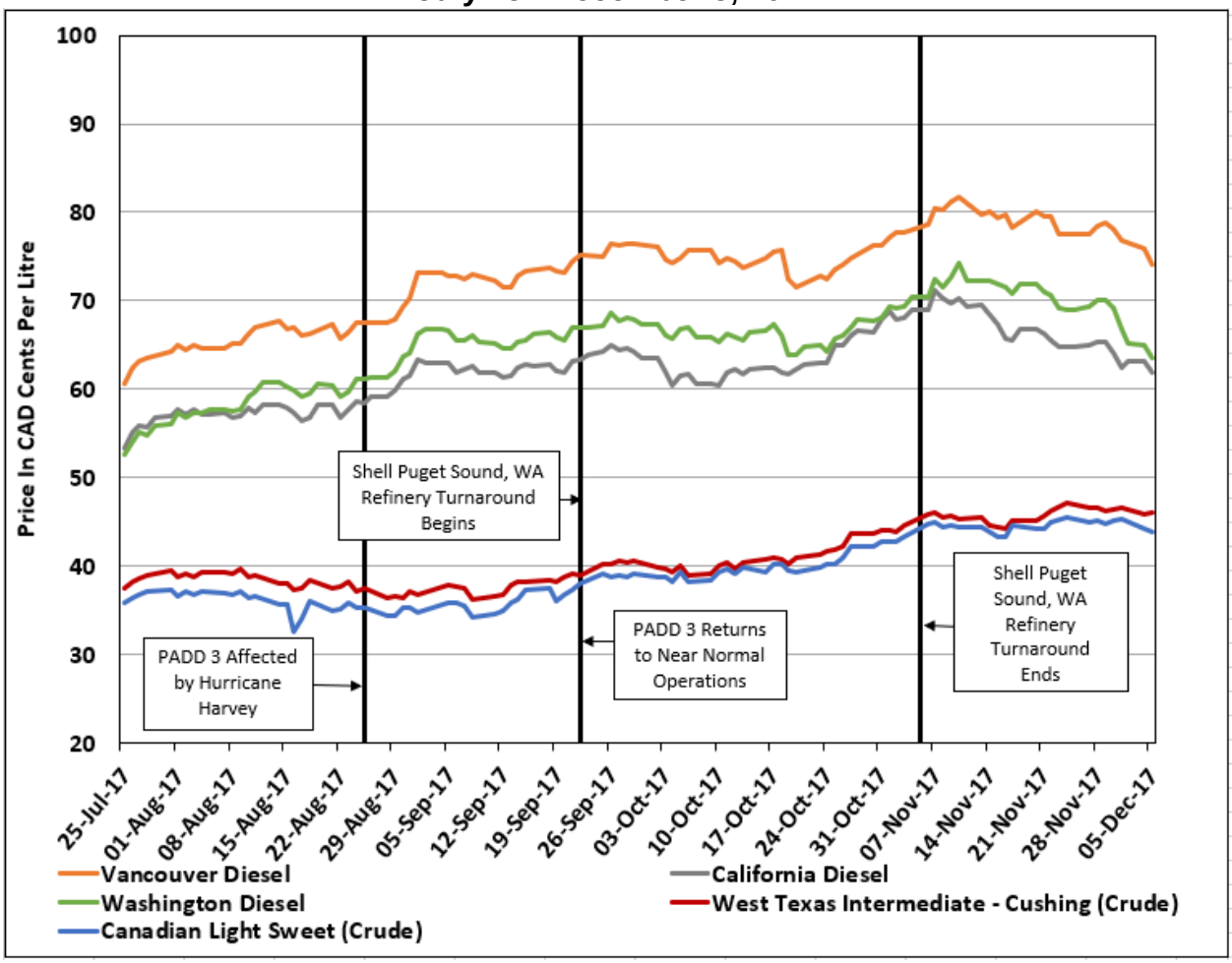
Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 8B
Difference Between Wholesale Gasoline and WTI Crude Prices
Daily, July 25 - December 5, 2017



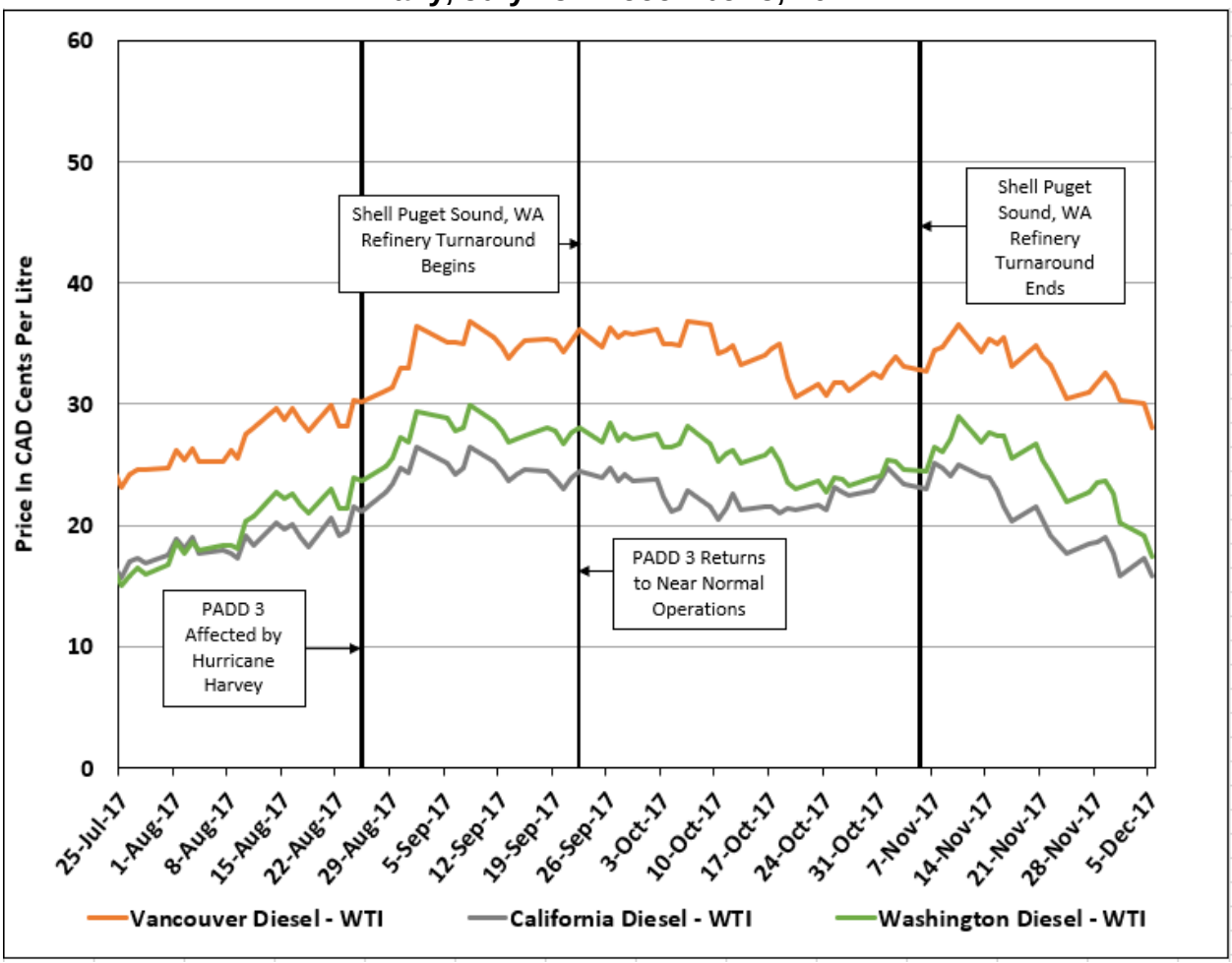
Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 9A
Daily Wholesale Diesel and Select Crude Prices
July 25 - December 5, 2017



Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 9B
Difference Between Wholesale Diesel and WTI Crude Prices
Daily, July 25 - December 5, 2017



Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Parkland Burnaby Turnaround and Imperial Strathcona Turnaround

Figures 10A and **11A** show wholesale fuel and crude prices from January 1 to June 15, 2018, for gasoline and diesel. Over this time period both Parkland's Burnaby facility and Imperial's Strathcona facility underwent extensive planned maintenance turnarounds. The Burnaby facility began its turnaround in February 2018, and it was completed by April 9, 2018, lasting approximately 8 weeks.[36] Around the time the Burnaby turnaround

[36] "Parkland Fuel Corporation Announces Successful Completion of Turnaround," Global News Wire, April 9, 2018, available at https://www.globenewswire.com/news-release/2018/04/09/1467013/0/en/Parkland-

ended, Imperial began its own turnaround on April 4, 2018. It lasted 72 days, meaning the facility was not fully back online until June 15, 2018.[37] At the time, both wholesale fuel and crude oil prices had been experiencing an upward trend.

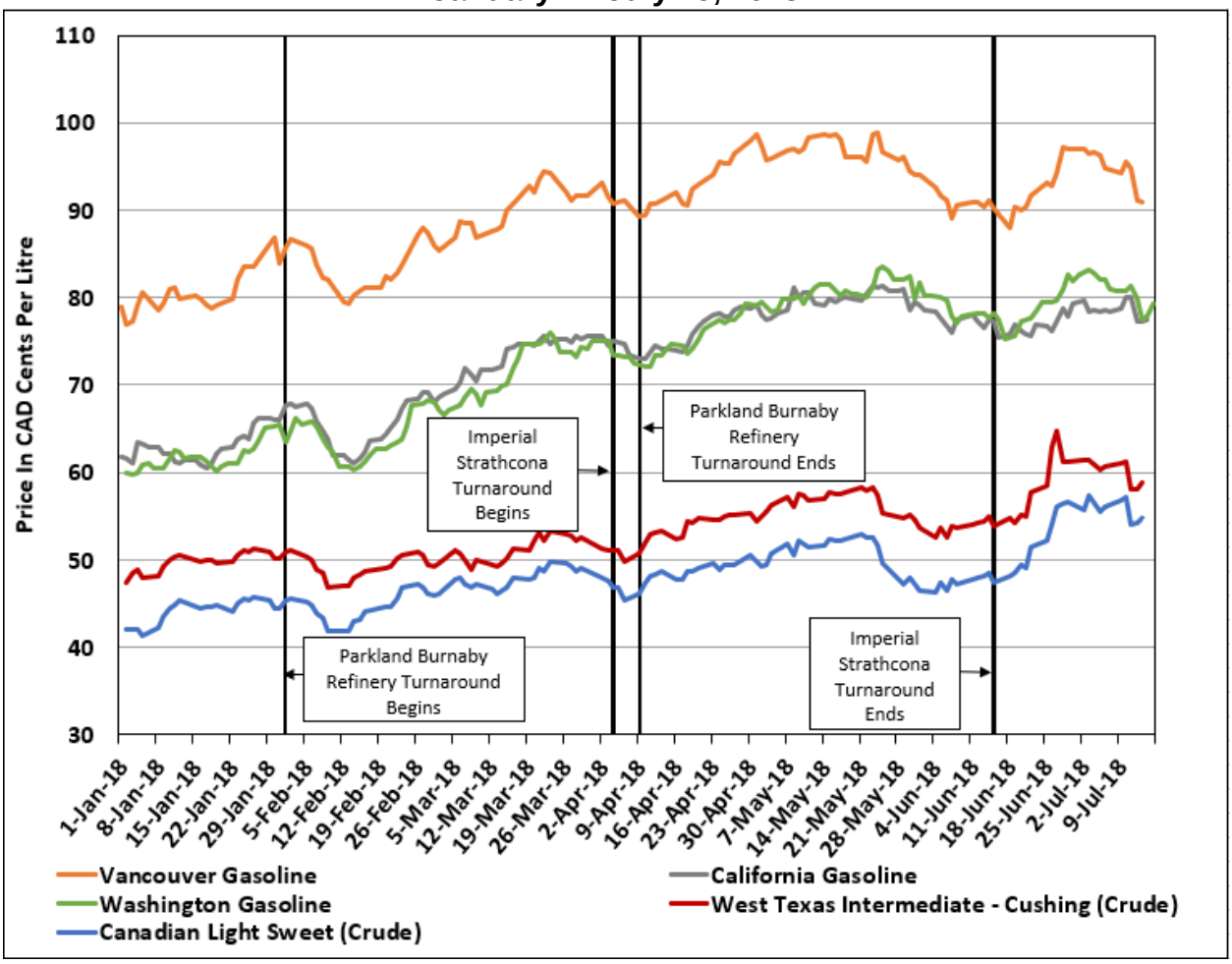
Figures 10B and **11B** show the price differentials for gasoline and diesel relative to WTI. During the time of the turnarounds, the price differentials all increased substantially, and they declined leading up to and after the end of the Imperial Strathcona turnaround. The average difference between wholesale gasoline prices and WTI for the month prior to the start of the Burnaby turnaround was 31.2 cents in Vancouver, 13.2 cents in California, and 12.1 cents in Washington. During these turnarounds, the average difference between gasoline wholesale prices and WTI was 38.3 cents in Vancouver, 21.4 cents in California, and 21.0 cents in Washington. For the month after the Strathcona turnaround, the average difference between gasoline wholesale prices and WTI was 34.2 cents in Vancouver, 18.4 cents in California, and 20.6 cents in Washington.

The average difference between wholesale diesel prices and WTI for the month prior to the Burnaby turnaround was 32.4 cents in Vancouver, 17.6 cents in California, and 17.2 cents in Washington. During these turnarounds the average difference between diesel wholesale prices and WTI were 35.0 cents in Vancouver, 19.8 cents in California, and 22.9 cents in Washington. For the month after the Strathcona turnaround, the average difference between diesel wholesale prices and WTI was 28.6 cents in Vancouver, 17.5 cents in California, and 22.8 cents in Washington.

Fuel-Corporation-Announces-Successful-Completion-of-Turnaround.html; Parkland Fuel Corporation Annual Report 2017, p. 21.

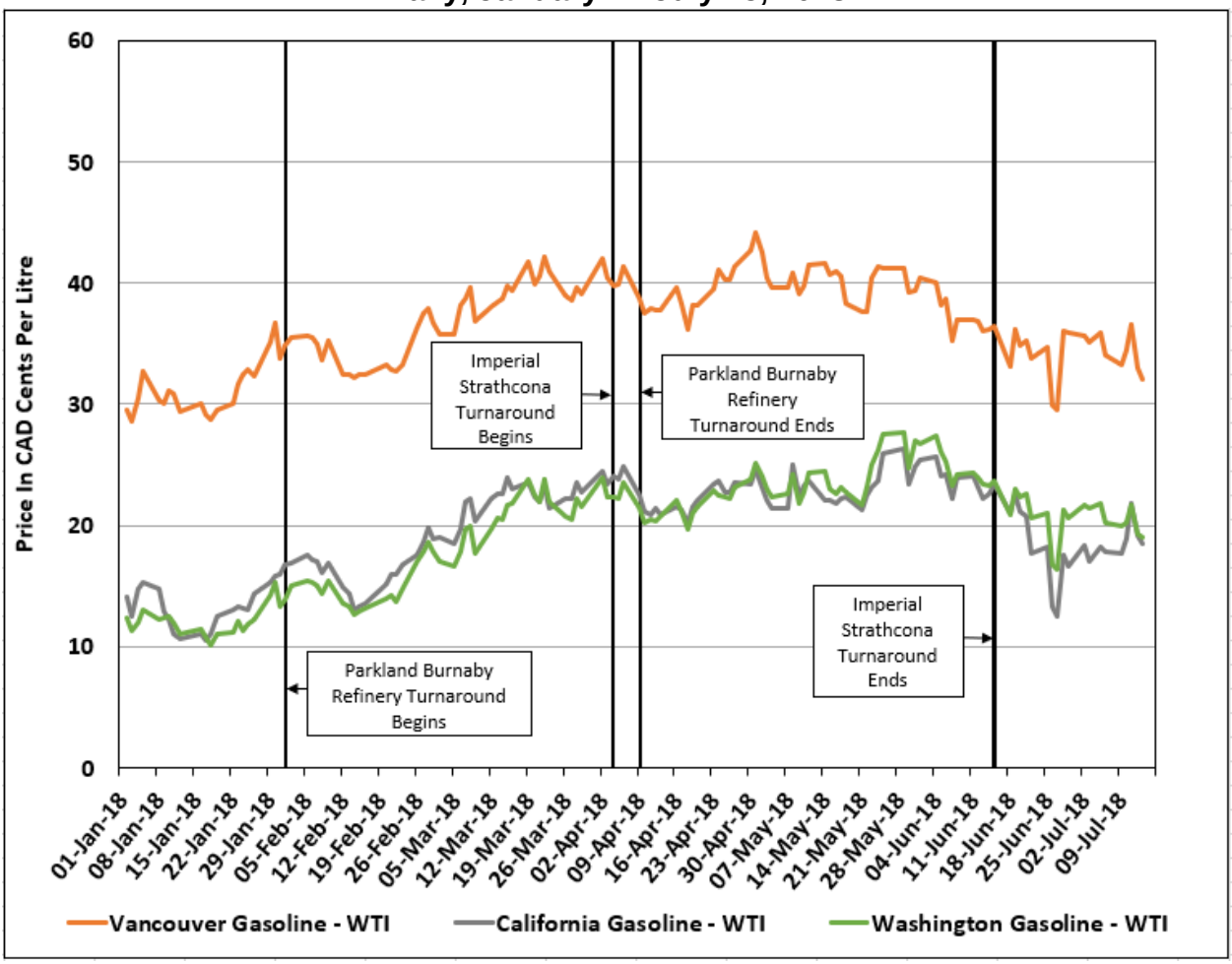
[37] "Imperial says Strathcona refinery units shut for several weeks for planned work," April 5, 2018, available at https://boereport.com/2018/04/05/imperial-says-strathcona-refinery-units-shut-for-several-weeks-for-planned-work/; Nickel, Rod and John Benny, "Imperial Oil seeks to diversify refinery's supply after Syncrude outage," July 27, 2018, available at https://www.reuters.com/article/us-imperial-oil-results/imperial-oil-seeks-to-diversify-refinerys-supply-after-syncrude-outage-idUSKBN1KH1F2.

Figure 10A
Daily Wholesale Regular Gasoline and Select Crude Prices
January 1 - July 15, 2018



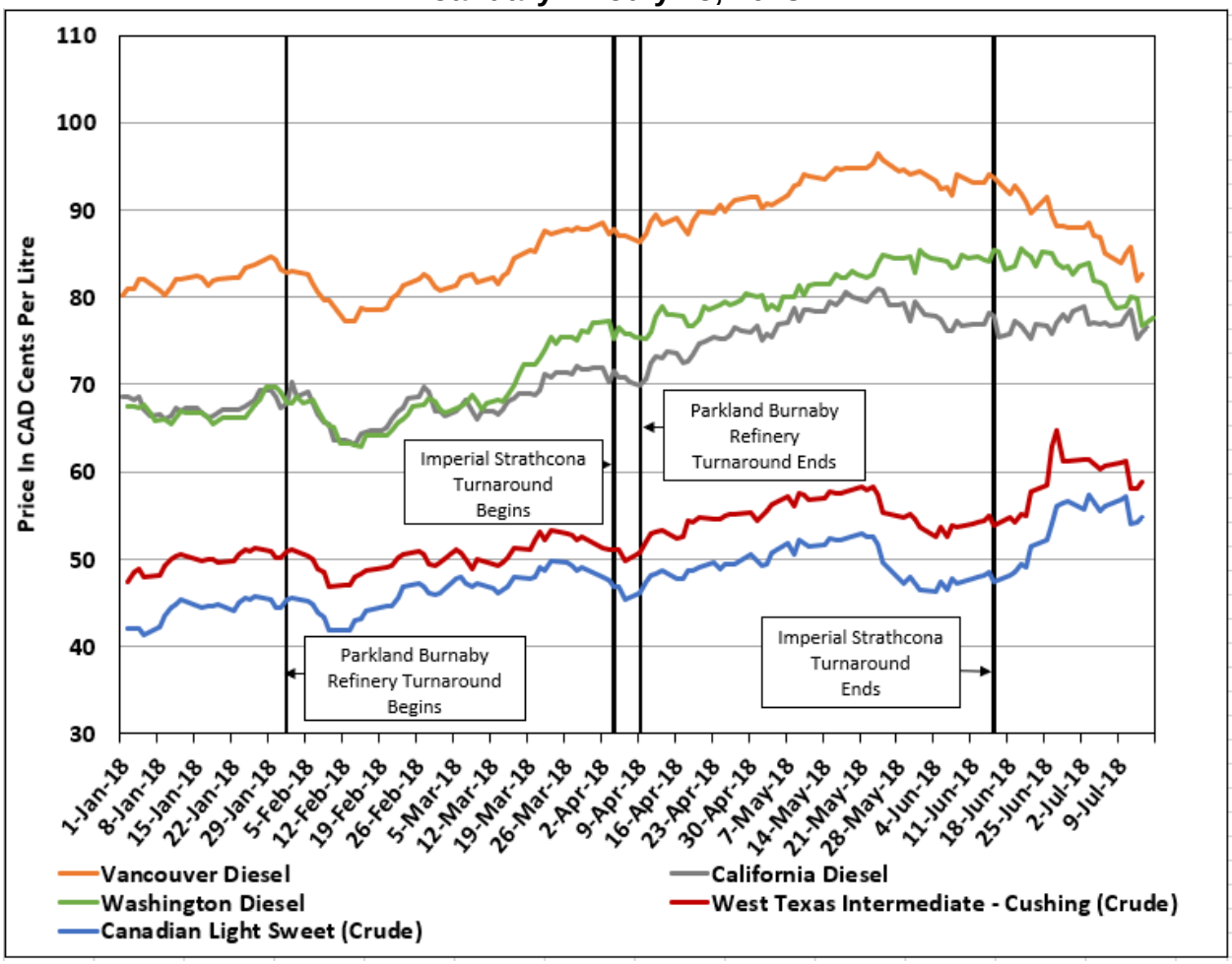
Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 10B
Difference Between Wholesale Gasoline and WTI Crude Prices
Daily, January 1 - July 15, 2018



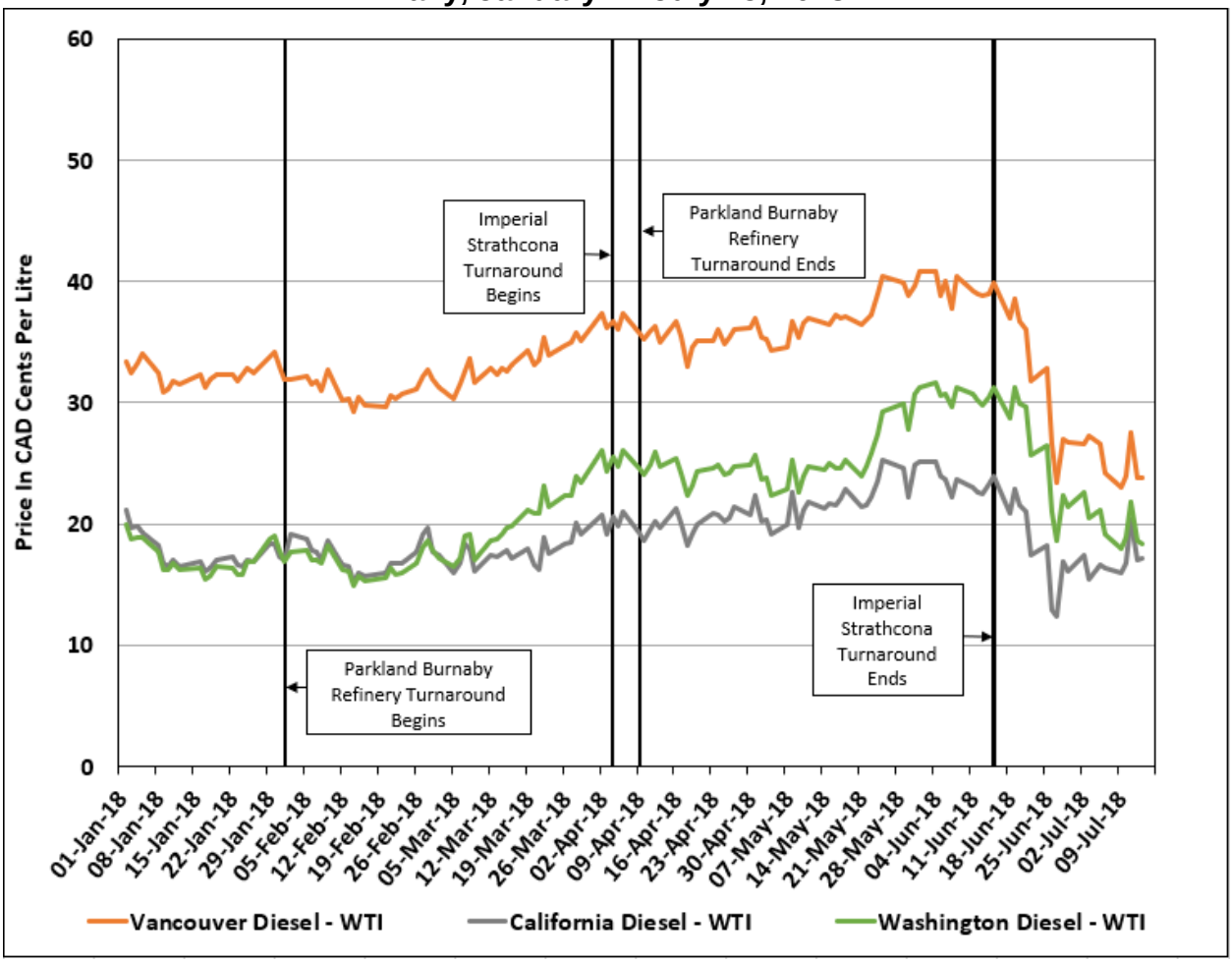
Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 11A
Daily Wholesale Diesel and Select Crude Prices
January 1 - July 15, 2018



Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 11B
Difference Between Wholesale Diesel and WTI Crude Prices
Daily, January 1 - July 15, 2018



Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Prince George Pipeline Fire

Figures 12 A/B and **13 A/B** relate to events previously reviewed during my July 17, 2019, presentation. **Figures 12A** and **13A** show prices from September 9 to November 9, 2018, and cover the time period immediately before and after the October 2018 Prince George natural gas pipeline fire.[38] This fire caused several Washington state refineries to either shutdown or curb operations because natural gas from the pipeline is

[38] Marino, David and Rachel Adams-Heard, "Gas Flows Resume After Canada Pipe Rupture Hits Oil Refiners," Bloomberg, October 10, 2018, available at https://www.bloomberg.com/news/articles/2018-10-10/gas-line-breakforces- northwest-u-s-refiners-to-curb-production.

used as a fuel source at these refineries.[39] As noted in my July 17, 2019, presentation, the Prince George pipeline fire was linked in trade press to soaring fuel prices in the Pacific Northwest region and across the West Coast.[40]

Figures 12B and **13B** show the price differentials for gasoline and diesel relative to WTI.The price effects from the Prince George pipeline fire were sudden. The average difference between wholesale gasoline prices and WTI for the seven days prior to the date of fire was 33.7 cents in Vancouver, 22.8 cents in California, and 21.6 cents in Washington. During the day of the fire, and the subsequent six days, the average difference between gasoline wholesale prices and WTI were 38.3 cents in Vancouver, 24.2 cents in California, and 26.7 cents in Washington. For the following seven days, the average difference between gasoline wholesale prices and WTI was 35.3 cents in Vancouver, 24.2 cents in California, and 25.6 cents in Washington.[41]

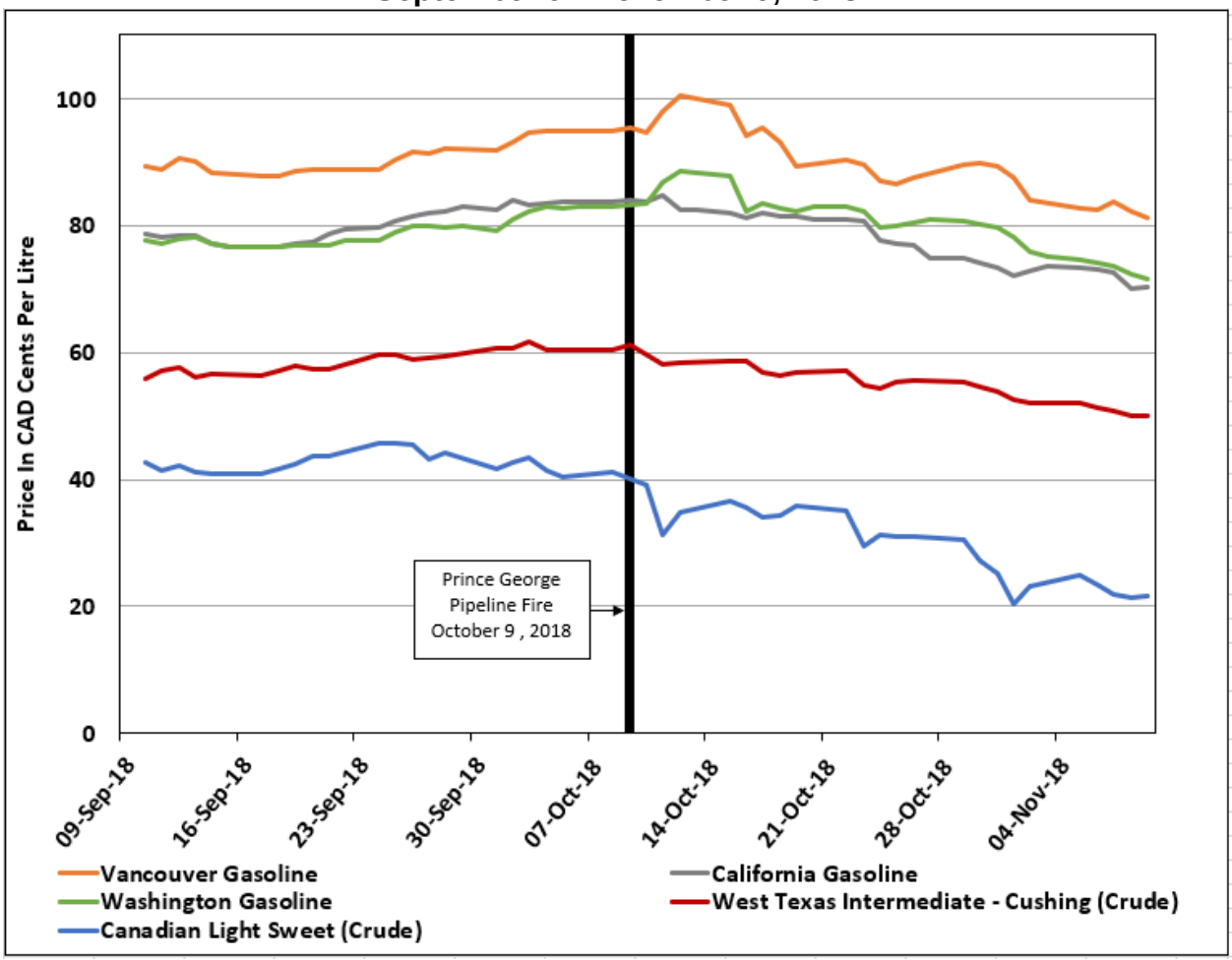
The average difference between wholesale diesel prices and WTI for the seven days prior to the date of the fire was 33.3 cents in Vancouver, 23.5 cents in California, and 22.2 cents in Washington. During the day of the fire, and the subsequent six days, the average difference between diesel wholesale prices and WTI was 35.7 cents in Vancouver, 24.9 cents in California, and 25.1 cents in Washington. For the following seven days, the average difference between diesel wholesale prices and WTI was 37.4 cents in Vancouver, 25.2 cents in California, and 27.2 cents in Washington.

[39] "Update 2 – A third Washington Refinery Curbs Operations After Natgas Pipe Fire," Reuters¸ October 11, 2018, available at https://www.reuters.com/article/refinery-operations-andeavor-anacortes/update-2-a-thirdwashington- refinery-curbs-operations-after-natgas-pipe-fire-idUSL2N1WR1F5.

[40] "Update 2 – A third Washington Refinery Curbs Operations After Natgas Pipe Fire," Reuters¸ October 11, 2018, available at https://www.reuters.com/article/refinery-operations-andeavor-anacortes/update-2-a-thirdwashington- refinery-curbs-operations-after-natgas-pipe-fire-idUSL2N1WR1F5.

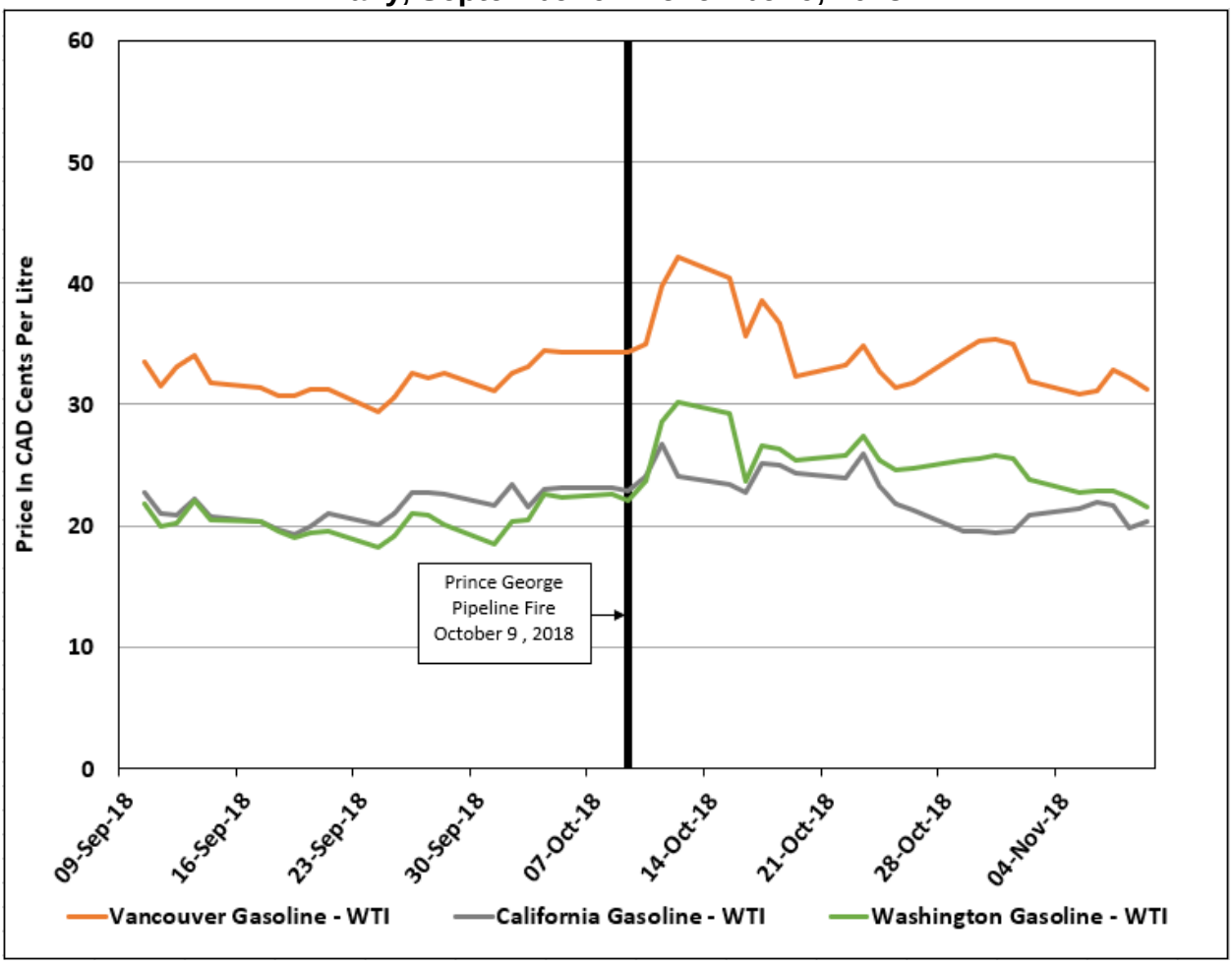
[41] The dates used for the average difference calculations for the Prince George fire are as follows: The seven days leading up to the fire (October 2 – October 8, 2018), the day of the fire and the subsequent six days (October 9 – October 15, 2018), the following seven days (October 16 – October 22, 2018).

Figure 12A
Daily Wholesale Regular Gasoline and Select Crude Prices
September 9 - November 9, 2018



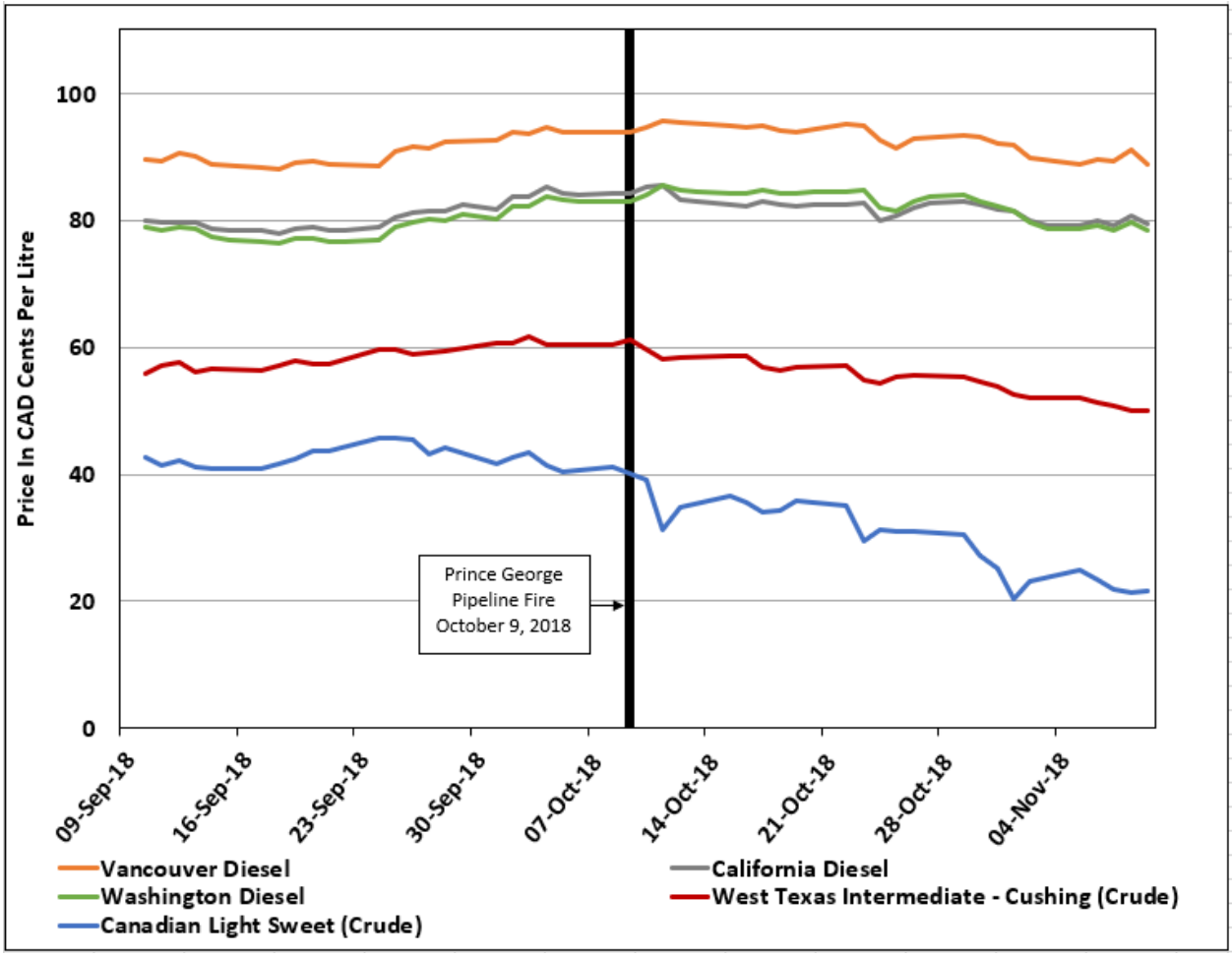
Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 12B
Difference Between Wholesale Gasoline and WTI Crude Prices
Daily, September 9 - November 9, 2018



Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 13A
Daily Wholesale Diesel and Select Crude Prices
September 9 - November 9, 2018



Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 13B
Difference Between Wholesale Diesel and WTI Crude Prices
Daily, September 9 - November 9, 2018

Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Carson Refinery Fire and Benicia Refinery Malfunction

Figures 14A/B and **15A/B** relate to two early 2019 refinery malfunctions in California that were also addressed in my July 17, 2019, presentation. As noted in my presentation, the two malfunctions were connected to gasoline price spikes in California.[42] **Figures 14A** and **15A** show crude oil and wholesale gasoline and diesel

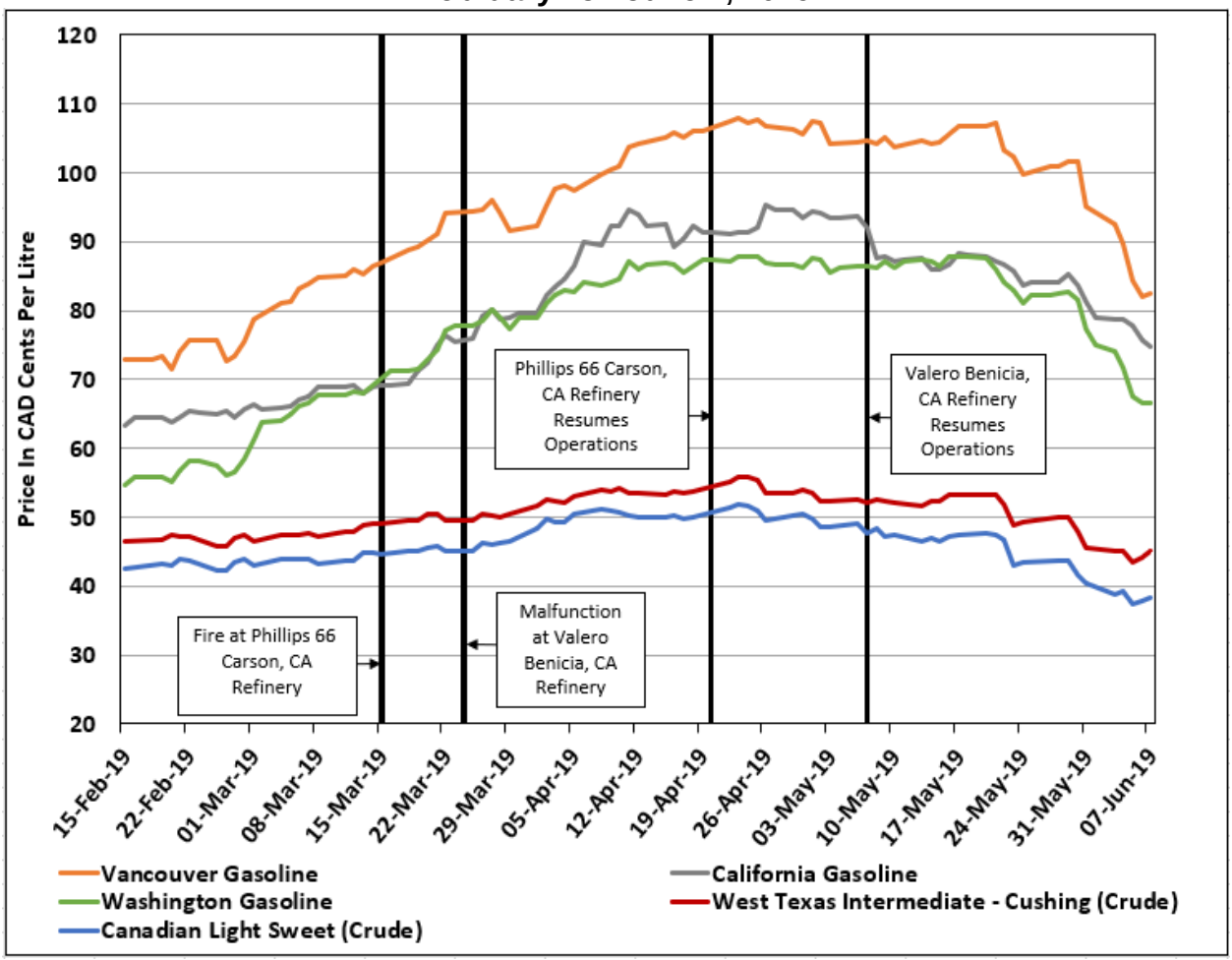
[42] Kunthara, Sophia, "California gas prices spike after refinery problems," San Francisco Chronicle, March 27, 2019, available at https://www.sfchronicle.com/business/article/California-gas-prices-spike-after-refinery-13720606.php.

prices from February 15 to June 7, 2019. As noted during my presentation, the effects of these refinery malfunctions are more pronounced for gasoline.

Figures 14B and **15B** show the price differentials for gasoline and diesel relative to WTI. The average difference between wholesale gasoline prices and WTI for the month prior to these refinery outages was 31.7 cents in Vancouver, 19.0 cents in California, and 14.4 cents in Washington. During these outages the average difference between gasoline wholesale prices and WTI was 47.6 cents in Vancouver, 33.7 cents in California, and 30.1 cents in Washington. For the month after these outages, the average difference between gasoline wholesale prices and WTI were 49.8 cents in Vancouver, 34.4 cents in California, and 31.6 cents in Washington. Wholesale gasoline prices and differentials between these prices and crude oil prices only start to decline two weeks after the Valero Benicia refinery resumes operations.

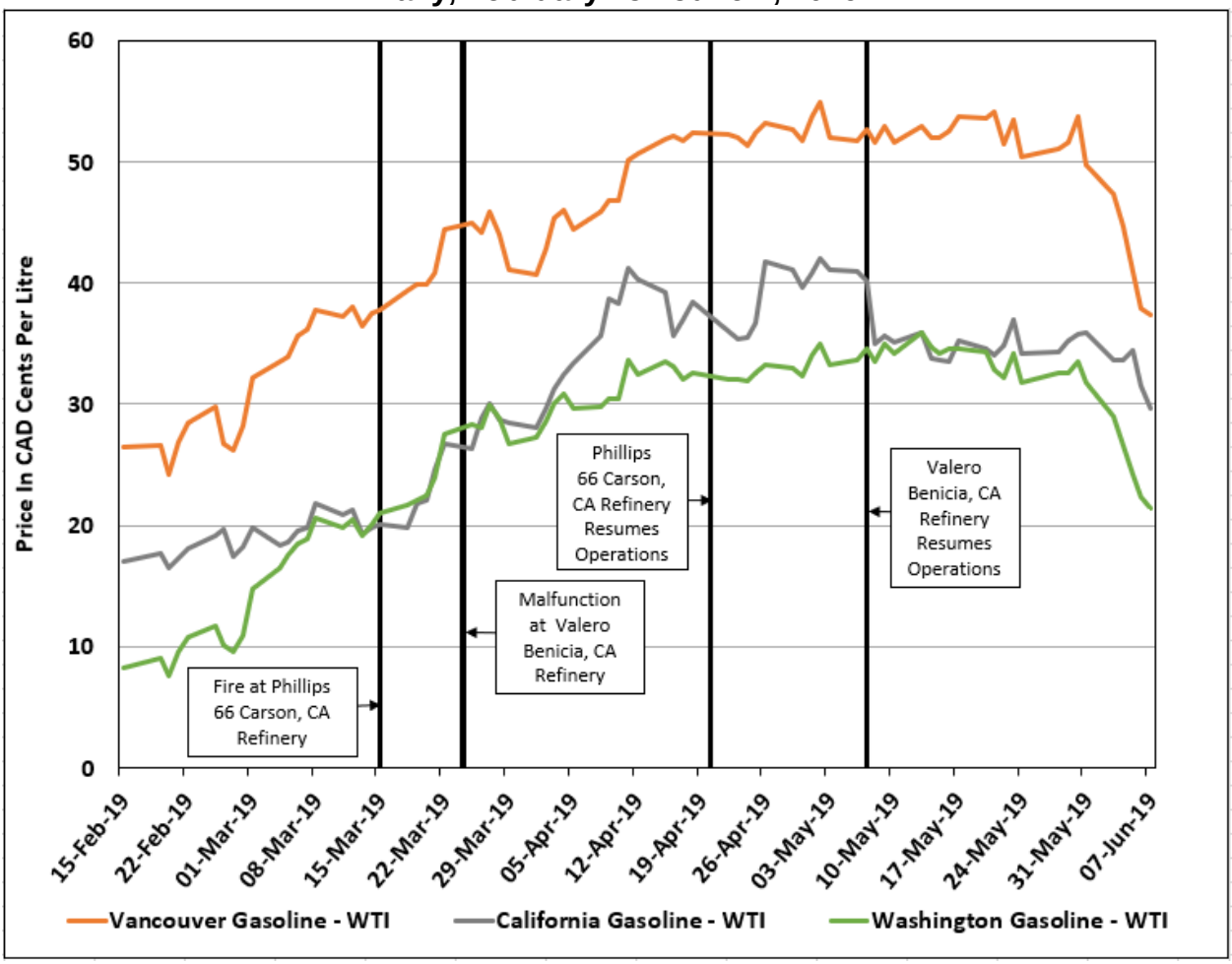
The average difference between wholesale diesel prices and WTI for the month prior to these outages was 35.1 cents in Vancouver, 23.5 cents in California, and 22.6 cents in Washington. During these events the average difference between diesel wholesale prices and WTI were 33.8 cents in Vancouver, 26.3 cents in California, and 22.1 cents in Washington. For the month after these events, the average difference between diesel wholesale prices and WTI were 36.2 cents in Vancouver, 31.3 cents in California, and 23.9 cents in Washington. As with gasoline, diesel prices and differentials only begin to fall two weeks after the Valero Benicia refinery resumes operations.

Figure 14A
Daily Wholesale Regular Gasoline and Select Crude Prices
February 15 - June 7, 2019



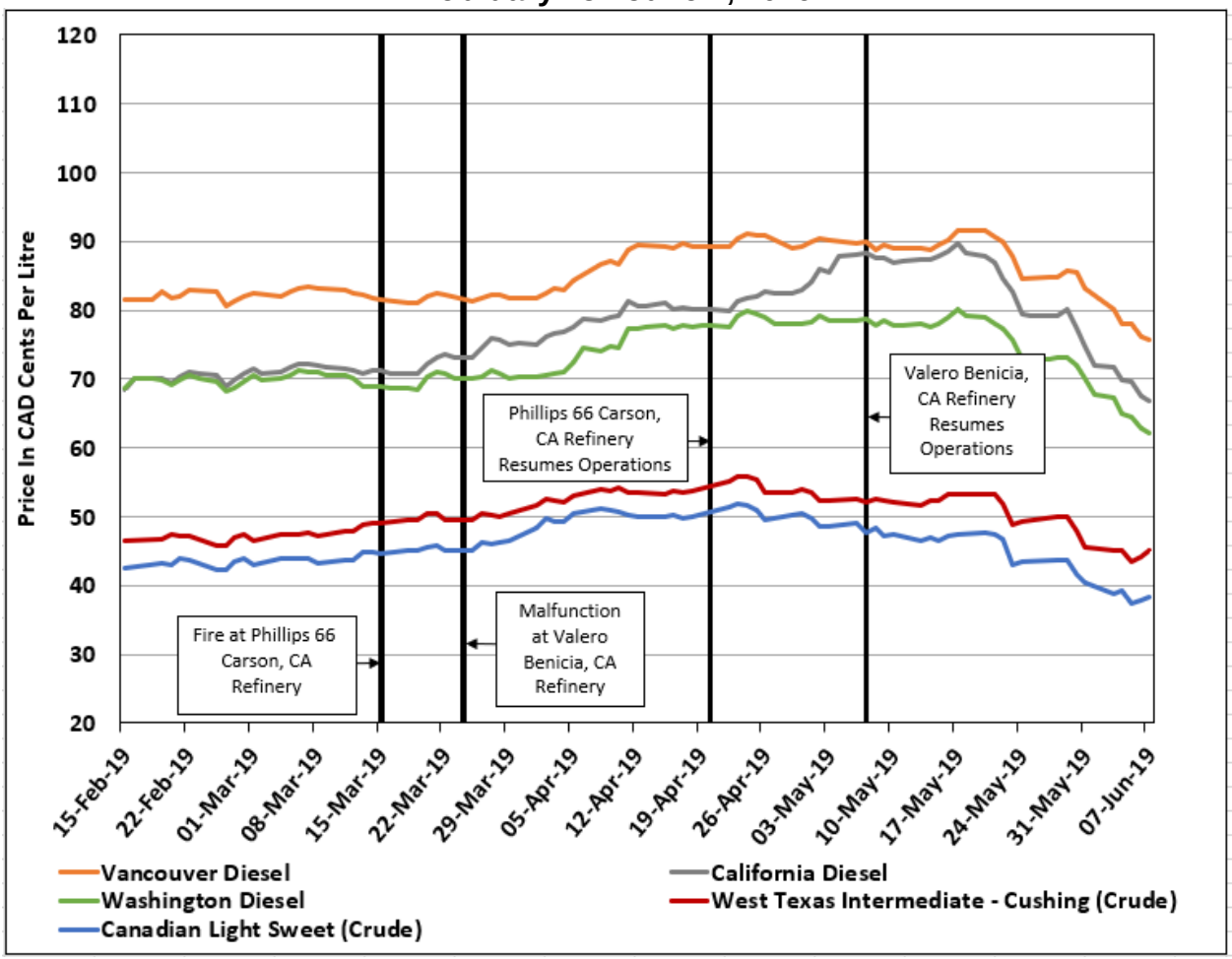
Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 14B
Difference Between Wholesale Gasoline and WTI Crude Prices
Daily, February 15 - June 7, 2019



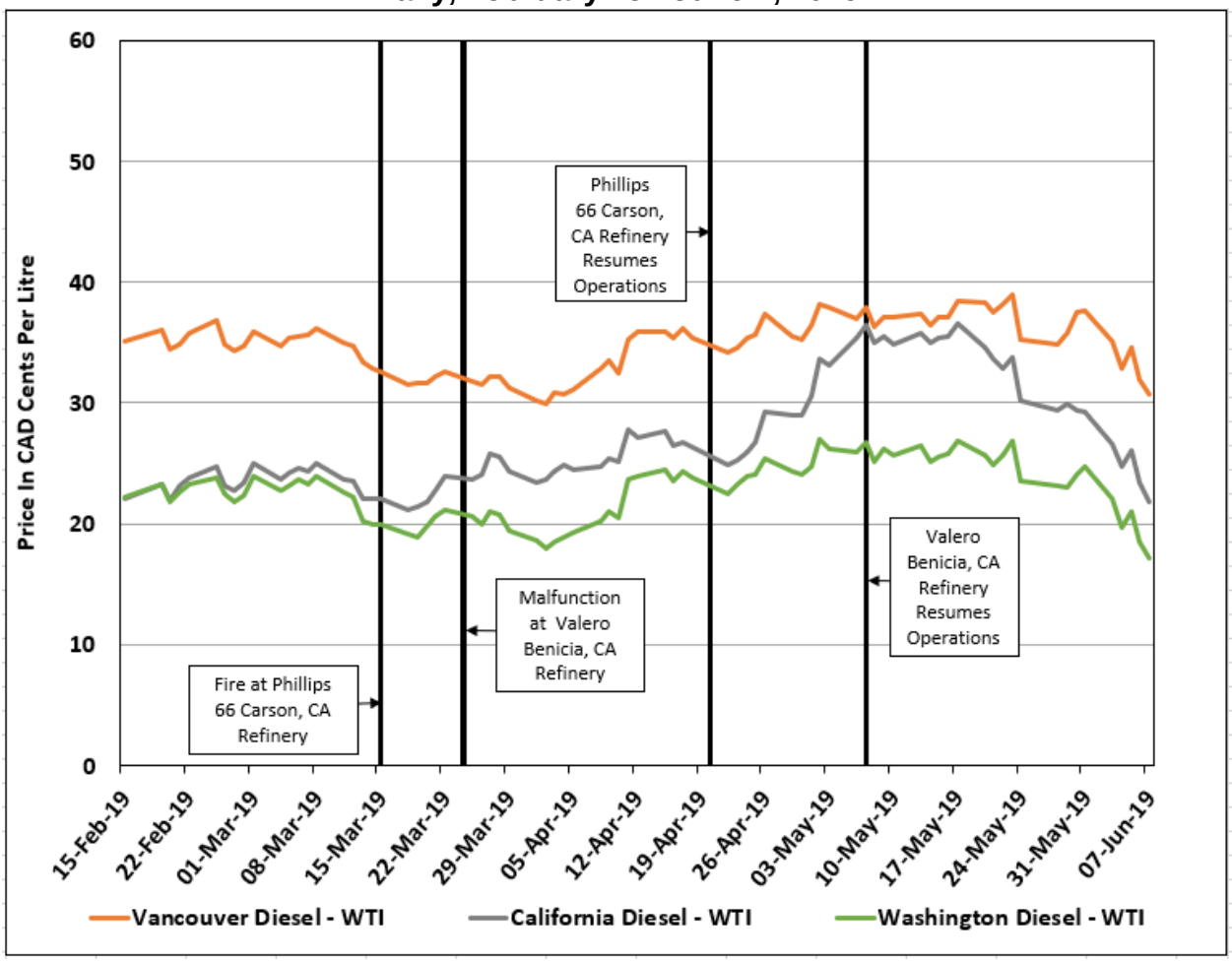
Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 15A
Daily Wholesale Diesel and Select Crude Prices
February 15 - June 7, 2019



Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.

Figure 15B
Difference Between Wholesale Diesel and WTI Crude Prices
Daily, February 15 - June 7, 2019



Sources: Kent Petroleum Price Data, Kent Group Ltd., available at https://charting.kentgroupltd.com/; Gasoline and Diesel Rack Pricing Data, OPIS, for more information see https://www.opisnet.com/about/rack-pricing-coverage-city/. "Transportation Fuel Prices," Natural Resources Canada, available at https://www.nrcan.gc.ca/our-natural-resources/domestic-and-international-markets/transportation-fuel- prices/4593; "Petroleum & Other Liquids - Spot Prices," United States Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm.