Effects on Canadian Gas Prices

A five to ten year historical analysis

Capstone Project 1
By: Kevin Phan

Problem Statement

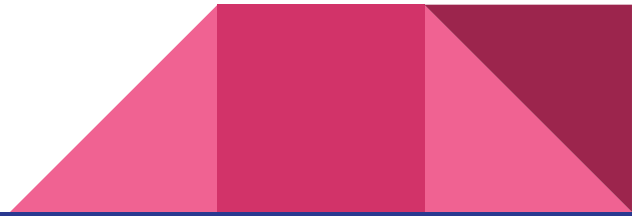
Canadian gas prices have spiked irregularly throughout the past five to ten years. By exploring trends between major cities including internal and external factors, we can determine how these prices came to be and what to expect from new gas prices moving forward

Data to explore:

- Average Canadian gas prices & tax statuses between Canadian major cities
- Refined Petroleum and Crude Oil Imports
- The carbon tax
- A major economic disturbance within the past decade

What’s to come

- Data to explore at a glance
- Data cleaning
- Data trends
- Data correlations
- Final insights and key points



Canadian Gas Prices

Canadian major cities and their average gas prices including the dates
Further categorized by tax status. Total price is the sum of **Base** and **Tax** Tax Status

	Date	Toronto	Ottawa	Thunder Bay	St. John's, Newfoundland	Charlottetown	Halifax
0	2018-01-01	85.5	85.3	84.9	74.0	77.0	74.6
1	2018-01-01	39.0	39.0	39.0	46.1	38.1	40.5
2	2018-01-01	124.5	124.3	123.9	120.1	115.1	115.1
3	2018-02-01	84.4	81.2	83.9	75.4	77.2	73.5
4	2018-02-01	38.9	38.5	38.8	46.4	38.1	40.4

Saint John, New Brunswick	Montreal	Winnipeg	Regina	Calgary	Vancouver	Tax Status
73.7	78.8	78.0	76.0	77.1	92.7	Base
40.4	48.8	29.1	30.0	34.9	48.9	Tax
114.1	127.6	107.1	106.0	112.0	141.6	Total
73.4	78.5	75.0	73.5	75.8	95.3	Base
40.3	48.8	29.0	29.9	35.0	49.0	Tax

Source:
https://data.ontario.ca/dataset/gasoline-report-canadian-gasoline-prices

Refined Petroleum and Crude Oil Imports

Import prices by the millions including the dates

Date	Refined Pe	Crude Oil
Jan-19	953	1437
Feb-19	917	1510
Mar-19	982	1642
Apr-19	1057	1730
May-19	978	1826
Jun-19	1112	1193
Jul-19	945	1352
Aug-19	1003	1600
Sep-19	1037	1556
Oct-19	1115	1749
Nov-19	1086	1681

Source: https://www150.statcan.gc.ca/n1/daily-quotidien/220607/cg-a004-eng.htm

Hard Hitter Factors

Major Economic Disturbance
- None other than the COVID-19 pandemic
- Lockdown from March 2020 to 2022

Carbon Tax
- A regulatory tax meant to curb carbon content in products such as fuel
- The steady growth of the carbon tax since it's introduction:

The consumer fuel charge started at CA$20/tCO2 in 2019, rising annually on April 1 by CA$15/tCO2 to reach CA$170/tCO2 in 2030. Revenue from the consumer-pay fuel charge was returned to individuals and families via the Canada Carbon Rebate. The remaining revenue was then distributed to farmers, small- and medium- enterprises, and Indigenous governments. After the most recent increase to CA$80/tCO2 in April 2024, the price increase for consumers was estimated at an additional three cents per litre of gasoline.

Source: https://www.carbon-direct.com/insights/the-future-of-carbon-pricing-in-canada-after-the-2025-election

Data Cleaning

	Date	Toronto	Ottawa	Thunder Bay	St. John's, Newfoundland	Charlottetown	Halifax
0	2018-01-01	85.5	85.3	84.9	74.0	77.0	74.6
1	2018-01-01	39.0	39.0	39.0	46.1	38.1	40.5
2	2018-01-01	124.5	124.3	123.9	120.1	115.1	115.1
3	2018-02-01	84.4	81.2	83.9	75.4	77.2	73.5
4	2018-02-01	38.9	38.5	38.8	46.4	38.1	40.4

```
gasPrices['Date'].describe()
```

	Date
count	267
unique	89
top	2018-01-01
freq	3

dtype: object

Fix:

```
gasPrices['Date'] = pd.to_datetime(gasPrices['Date'])
gasPrices['Date'] = gasPrices['Date'].dt.strftime('%m/%Y')
print(gasPrices)
```

	Date	Toronto	Ottawa	Thunder Bay	St. John's, Newfoundland
0	01/2018	85.5	85.3	84.9	74.0
1	01/2018	39.0	39.0	39.0	46.1
2	01/2018	124.5	124.3	123.9	120.1
3	02/2018	84.4	81.2	83.9	75.4
4	02/2018	38.9	38.5	38.8	46.4

```
petroleumImports.head()
```

	Date	Refined Petroleum	Crude Oil
0	January 2019	953.0	1437.0
1	February 2019	917.0	1510.0
2	March 2019	982.0	1642.0
3	April 2019	1057.0	1730.0
4	May 2019	978.0	1826.0

Apr-22	1525	1733					
Note(s): Data are on a balance-of-payments basis and are seasonally adjusted.							
Source(s): Table 12-10-0121-01							

Fix:

```
petroleumImports.copy()
petroleumImports = petroleumImports.dropna(axis = 0, ignore_index = False)
petroleumImports['Refined Petroleum'] = petroleumImports['Refined Petroleum'].apply(lambda x: int(x))
petroleumImports['Crude Oil'] = petroleumImports['Crude Oil'].apply(lambda x: int(x))
petroleumImports
```

	Date	Refined Petroleum	Crude Oil
0	January 2019	953	1437
1	February 2019	917	1510
2	March 2019	982	1642
3	April 2019	1057	1730
4	May 2019	978	1826
5	June 2019	1112	1193
6	July 2019	945	1352
7	August 2019	1003	1600
8	September 2019	1037	1556
9	October 2019	1115	1749

Some Data Extraction

Saint John, New Brunswick	Montreal	Winnipeg	Regina	Calgary	Vancouver	Tax Status
73.7	78.8	78.0	76.0	77.1	92.7	Base
40.4	48.8	29.1	30.0	34.9	48.9	Tax
114.1	127.6	107.1	106.0	112.0	141.6	Total
73.4	78.5	75.0	73.5	75.8	95.3	Base
40.3	48.8	29.0	29.9	35.0	49.0	Tax

```
gas_base = gasPrices[0::3]
gas_base
```

St. John's, Newfoundland	Charlottetown	Halifax	Saint John, New Brunswick	Montreal	Winnipeg	Regina	Calgary	Vancouver	Tax Status
74.0	77.0	74.6	73.7	78.8	78.0	76.0	77.1	92.7	Base
75.4	77.2	73.5	73.4	78.5	75.0	73.5	75.8	95.3	Base
75.9	78.6	73.8	73.7	81.0	78.1	78.0	80.4	102.1	Base
83.3	84.2	82.5	81.2	87.5	91.0	86.4	89.3	104.5	Base
88.8	91.1	88.0	86.6	91.9	95.1	92.9	94.0	109.1	Base

```
gas_tax = gasPrices[1::3]
gas_tax
```

St. John's, Newfoundland	Charlottetown	Halifax	Saint John, New Brunswick	Montreal	Winnipeg	Regina	Calgary	Vancouver	Tax Status
46.1	38.1	40.5	40.4	48.8	29.1	30.0	34.9	48.9	Tax
46.4	38.1	40.4	40.3	48.8	29.0	29.9	35.0	49.0	Tax
46.5	38.4	40.4	40.4	49.2	29.1	30.2	35.2	49.4	Tax
47.5	39.3	41.7	41.5	50.1	29.8	30.6	35.7	50.7	Tax
48.4	40.2	42.5	42.3	50.8	30.0	30.9	35.9	50.9	Tax

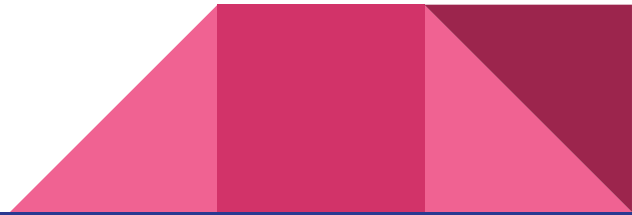
```
gas_total = gasPrices[2::3]
gas_total
```

St. John's, Newfoundland	Charlottetown	Halifax	Saint John, New Brunswick	Montreal	Winnipeg	Regina	Calgary	Vancouver	Tax Status
120.1	115.1	115.1	114.1	127.6	107.1	106.0	112.0	141.6	Total
121.8	115.3	113.9	113.7	127.3	104.0	103.4	110.8	144.3	Total
122.4	117.0	114.2	114.1	130.2	107.2	108.2	115.6	151.5	Total
130.8	123.5	124.2	122.7	137.6	120.8	117.0	125.0	155.2	Total
137.2	131.3	130.5	128.9	142.7	125.1	123.8	129.9	160.0	Total

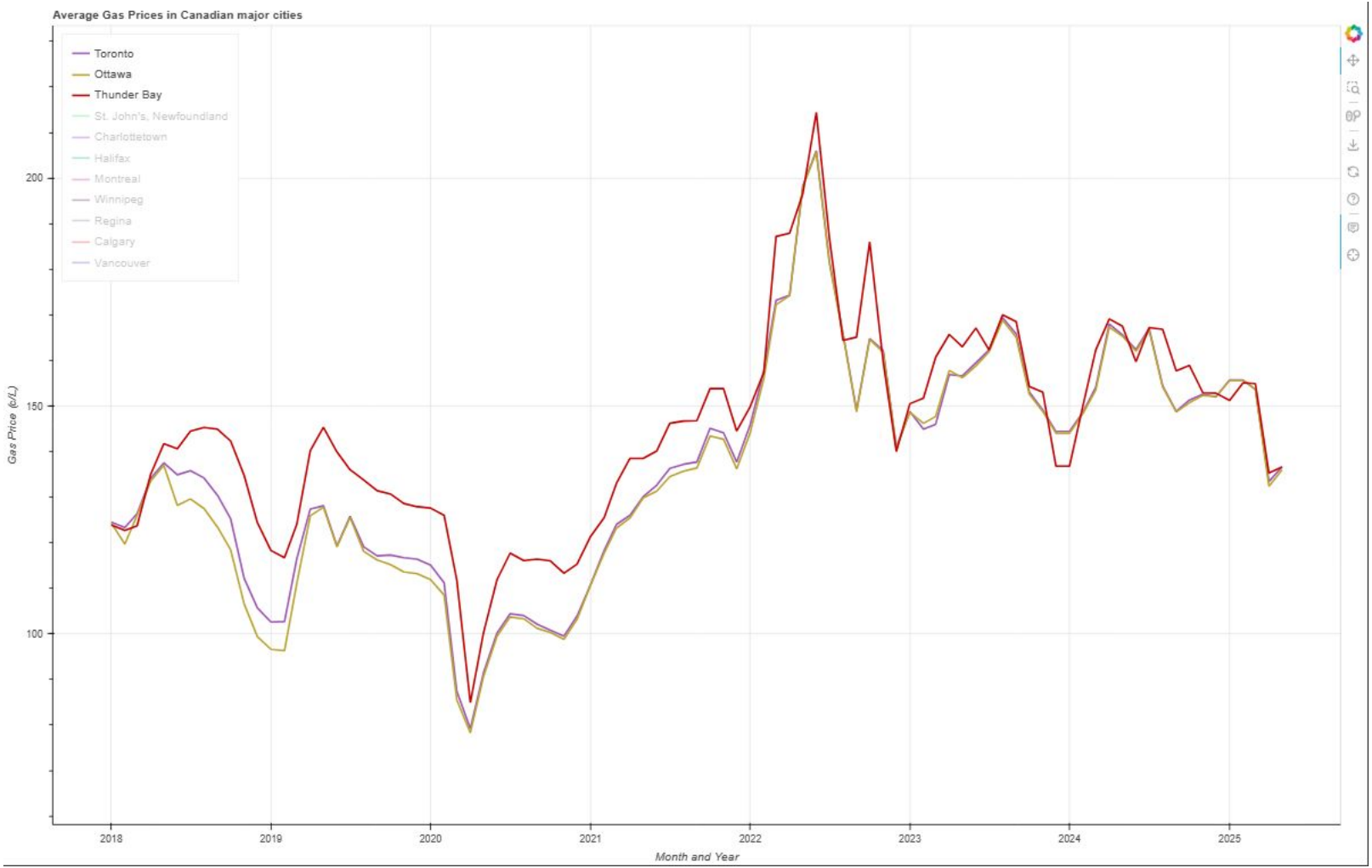
Data Trends

Overview

- Average total gas prices
- Average tax on gas prices
- Average base gas prices



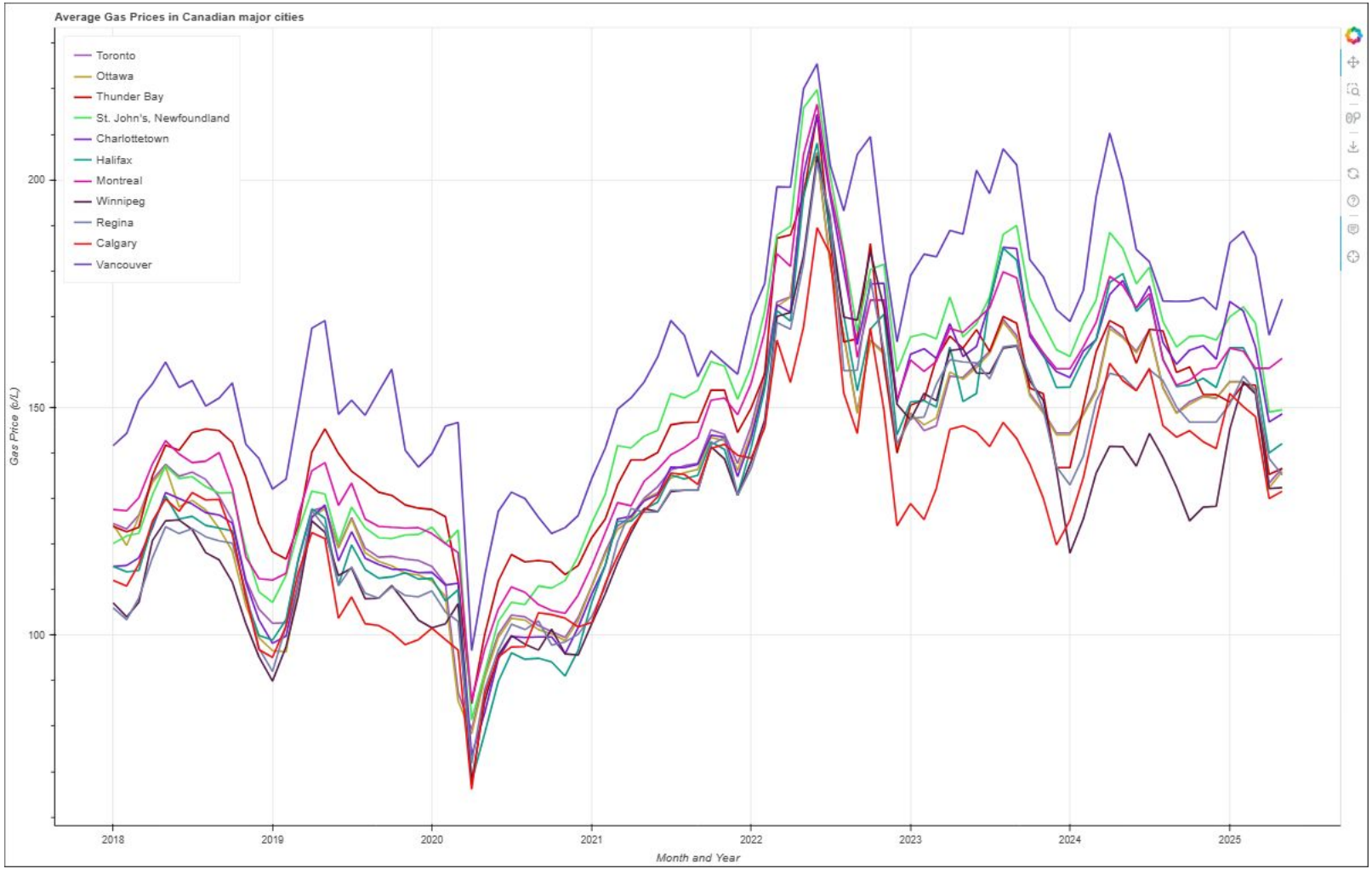
Ontario

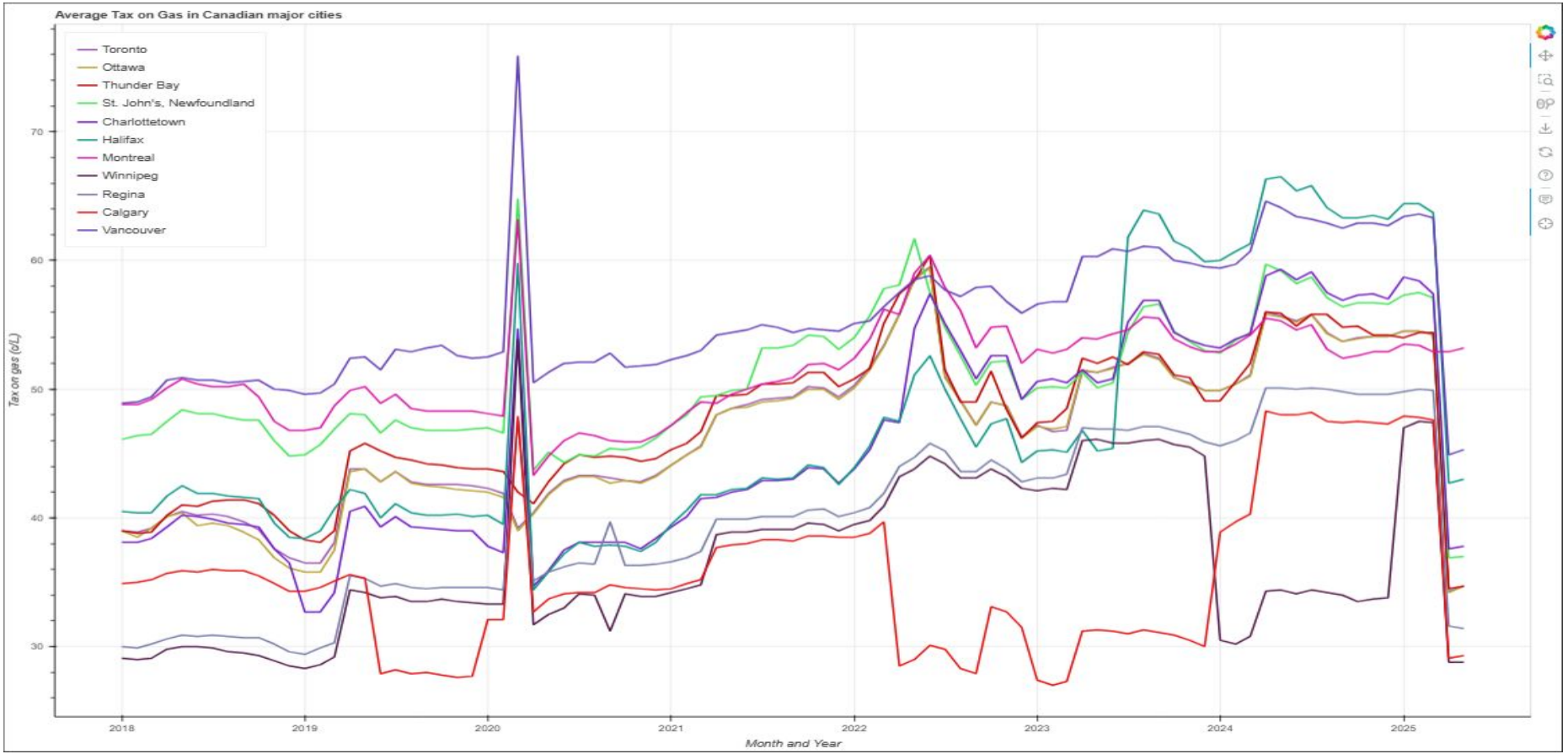

Average Gas Prices in Canadian major cities
Toronto
Ottawa
Thunder Bay
St. John's, Newfoundland
Charlottetown
Halifax
Montreal
Winnipeg
Regina
Calgary
Vancouver
200
150
100
Gas Price (¢/L)
2018
2019
2020
2021
2022
2023
2024
2025
Month and Year

Ontario & Newfoundland

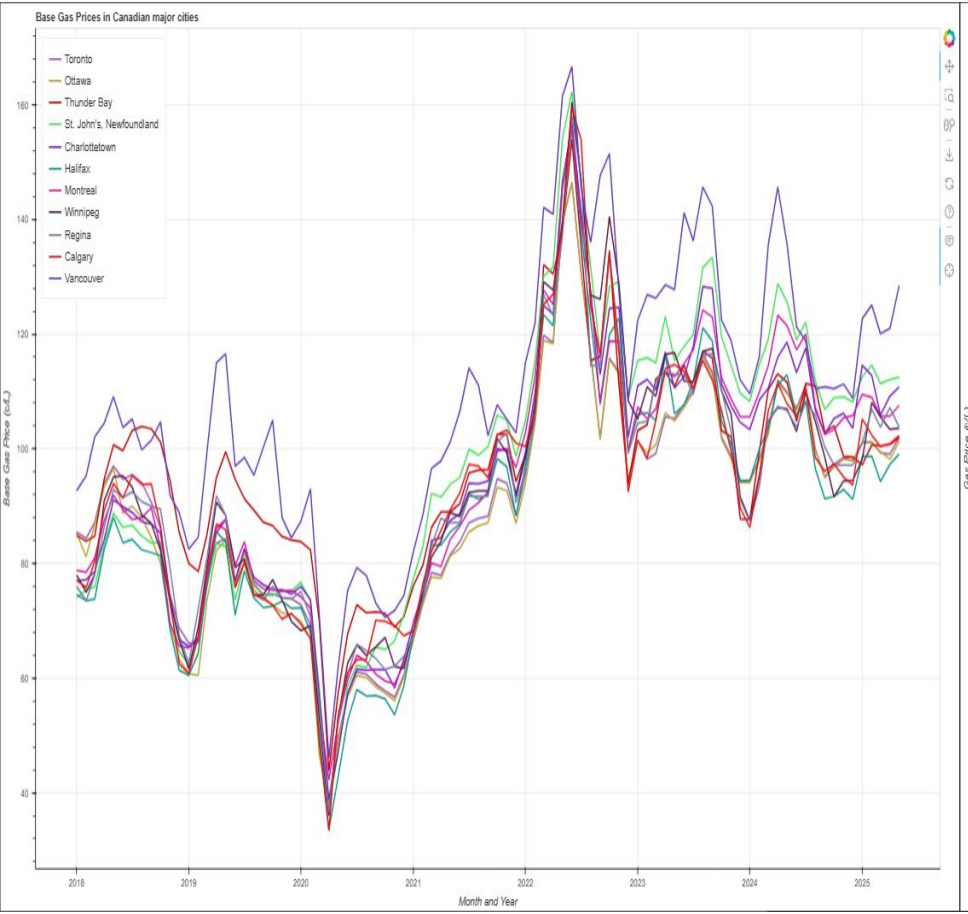
Ontario, Newfoundland, Alberta

All


Average Gas Prices in Canadian major cities
Toronto
Ottawa
Thunder Bay
St. John's, Newfoundland
Charlottetown
Halifax
Montreal
Winnipeg
Regina
Calgary
Vancouver
200
150
100
Gas Price (¢/L)
2018
2019
2020
2021
2022
2023
2024
2025
Month and Year



The consumer fuel charge started at CA$20/tCO2 in 2019, rising annually on April 1 by CA$15/tCO2 to reach CA$170/tCO2 in 2030. Revenue from the consumer-pay fuel charge was returned to individuals and families via the Canada Carbon Rebate. The remaining revenue was then distributed to farmers, small- and medium- enterprises, and Indigenous governments. After the most recent increase to CA$80/tCO2 in April 2024, the price increase for consumers was estimated at an additional three cents per litre of gasoline.


Base Gas Prices in Canadian major cities
Toronto
Ottawa
Thunder Bay
St. John's, Newfoundland
Charlottetown
Halifax
Montreal
Winnipeg
Regina
Calgary
Vancouver
Base Gas Price (¢/L)
Month and Year


Average Gas Prices in Canadian major cities
Toronto
Ottawa
Thunder Bay
St. John's, Newfoundland
Charlottetown
Halifax
Montreal
Winnipeg
Regina
Calgary
Vancouver
Gas Price (¢/L)
Month and Year

Base

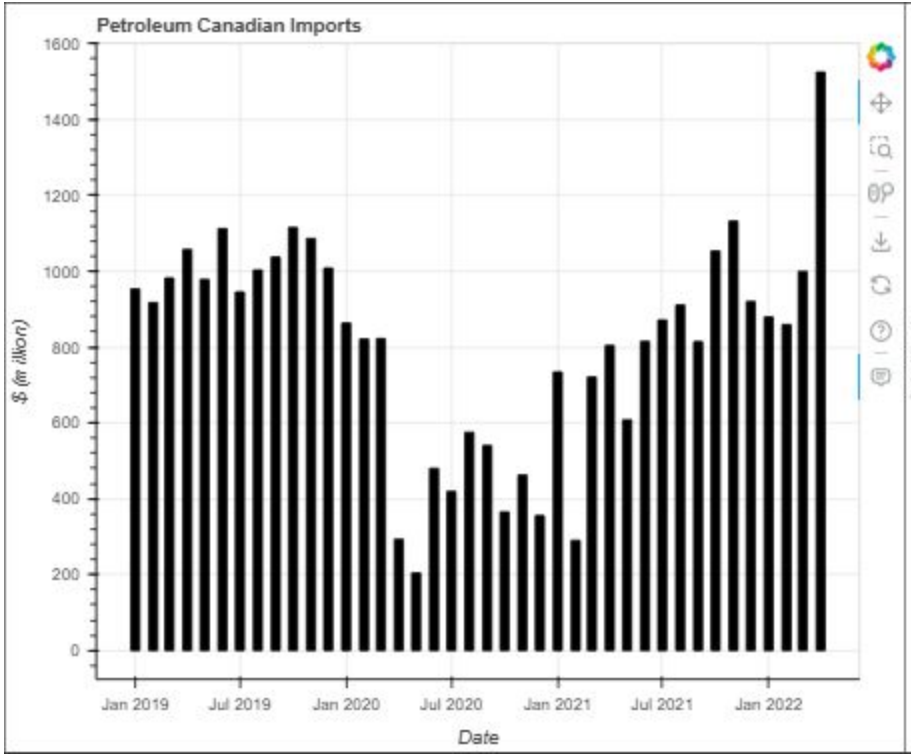
Total

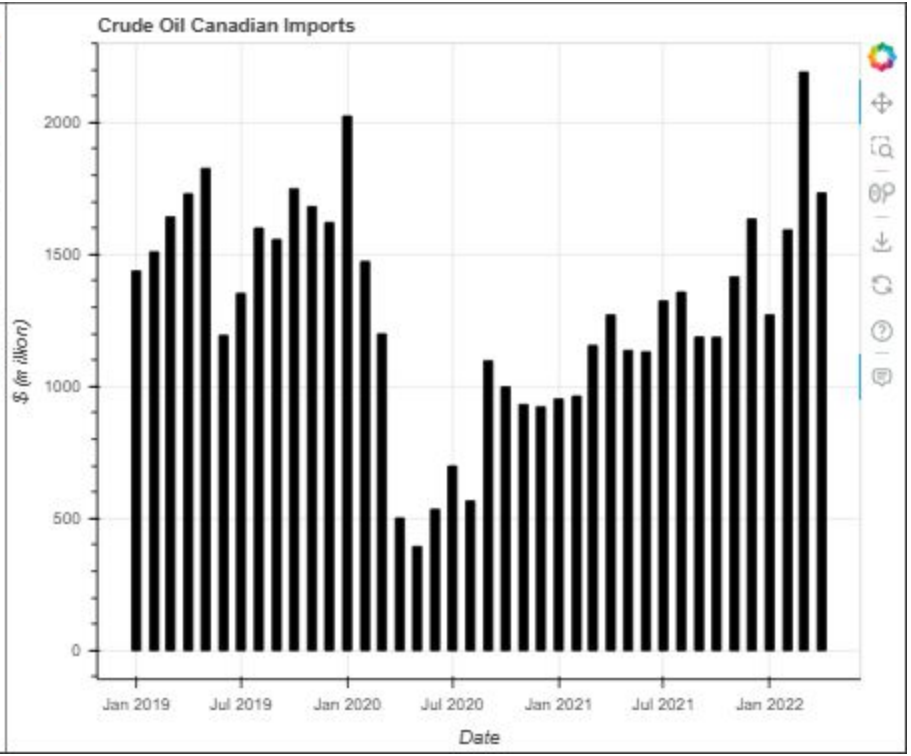
Data Correlation

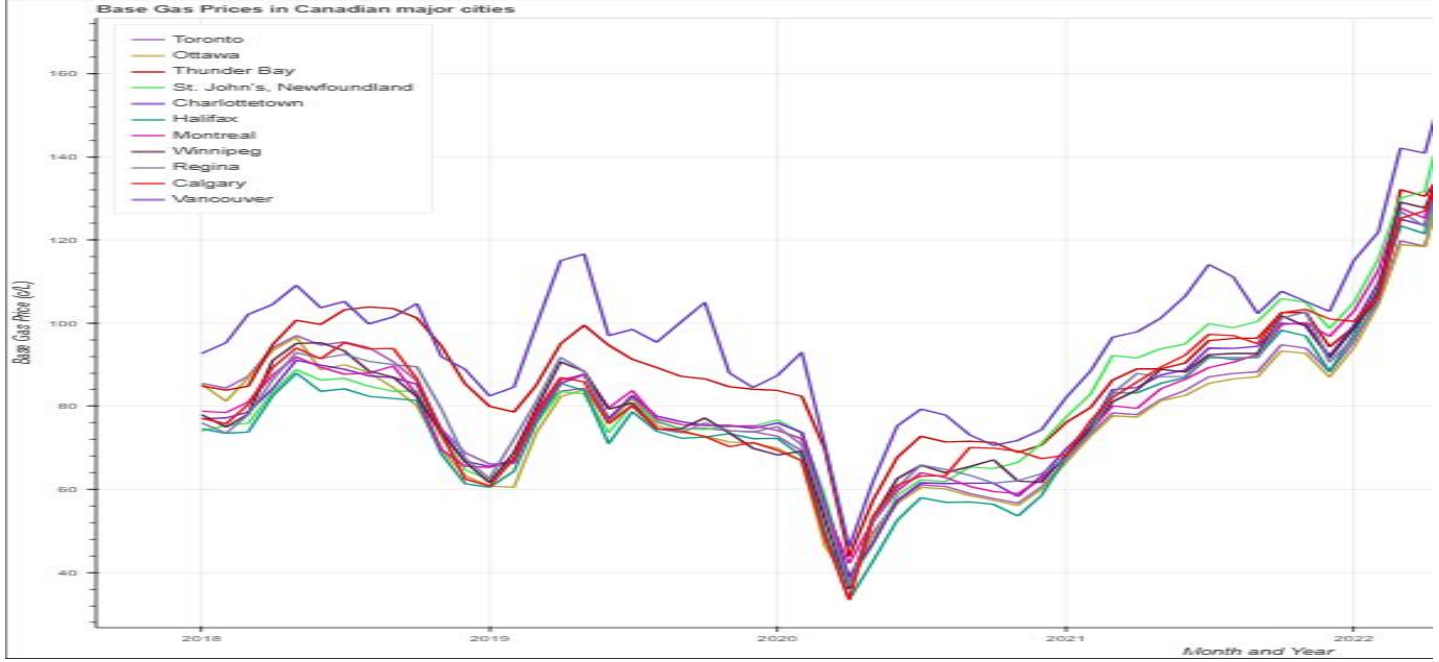
Overview

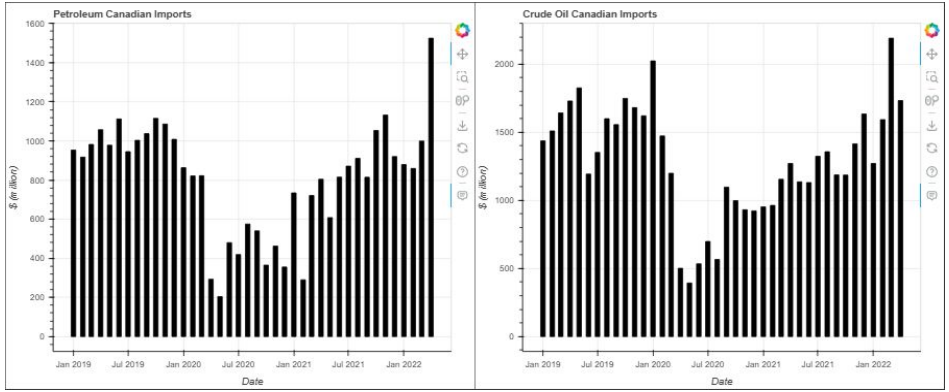
- COVID-19 and Refined Petroleum & Crude Oil Imports relationship
- Base Gas Prices and Refined Petroleum & Crude Oil Imports relationship
- Gas Prices during peak COVID-19 period vs. mean gas price of each city
- Tax on gas prices and the (now) former Carbon Tax relationship (Inception and the election’s changes)

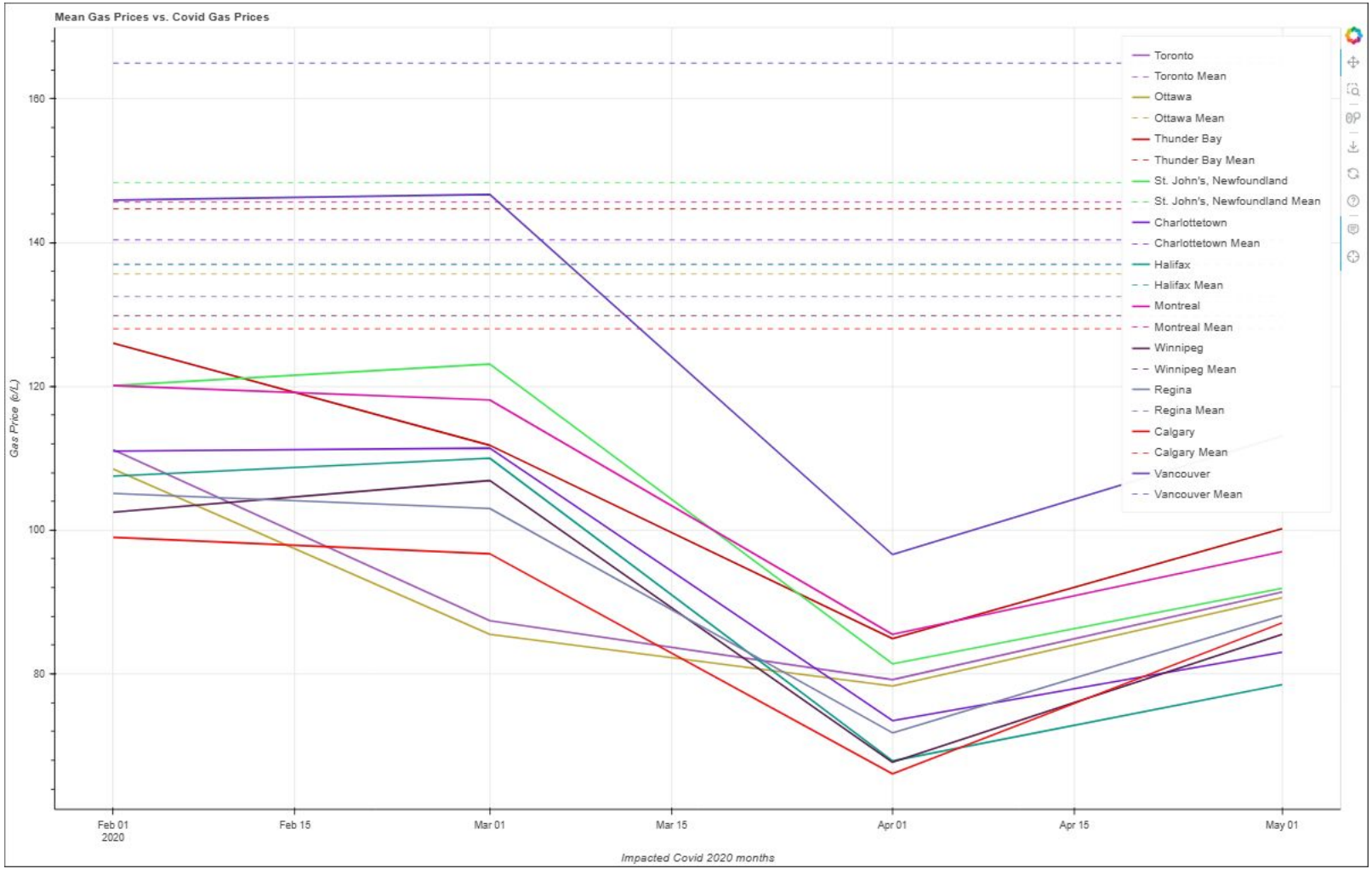
Note: Data only shown is between 2019 and Q1 2022





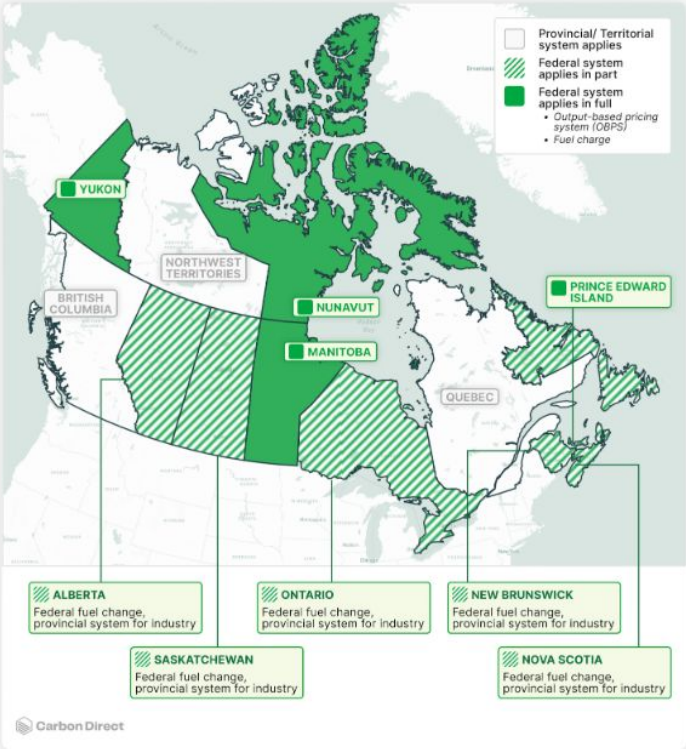

Base Gas Prices in Canadian major cities
Toronto
Ottawa
Thunder Bay
St. John's, Newfoundland
Charlottetown
Halifax
Montreal
Winnipeg
Regina
Calgary
Vancouver
Base Gas Price ($/L)
160
140
120
100
80
60
40
2018
2019
2020
2021
2022
Month and Year


Petroleum Canadian Imports
$ (in Mion)
1600
1400
1200
1000
800
600
400
200
0
Jan 2019
Jul 2019
Jan 2020
Jul 2020
Jan 2021
Jul 2021
Jan 2022
Date
Crude Oil Canadian Imports
$ (in Mion)
2000
1500
1000
500
0
Jan 2019
Jul 2019
Jan 2020
Jul 2020
Jan 2021
Jul 2021
Jan 2022
Date


Mean Gas Prices vs. Covid Gas Prices
Gas Price (¢/L)
160
140
120
100
80
Feb 01
2020
Feb 15
Mar 01
Mar 15
Apr 01
Apr 15
May 01
Impacted Covid 2020 months
Toronto
Toronto Mean
Ottawa
Ottawa Mean
Thunder Bay
Thunder Bay Mean
St. John's, Newfoundland
St. John's, Newfoundland Mean
Charlottetown
Charlottetown Mean
Halifax
Halifax Mean
Montreal
Montreal Mean
Winnipeg
Winnipeg Mean
Regina
Regina Mean
Calgary
Calgary Mean
Vancouver
Vancouver Mean

Prior to the announcement of changes to Canada's carbon pricing system on March 14, 2025 (entered into effect on April 1, 2025), the federal carbon pricing system had two parts:

1. A regulatory charge on fossil fuels like gasoline and natural gas, known as the *consumer-pay fuel charge* or *consumer-pay carbon tax*.
2. A performance-based system for industries known as the *Output-Based Pricing System (OBPS)* or *industrial carbon tax*.



Source: https://www.carbon-direct.com/insights/the-future-of-carbon-pricing-in-canada-after-the-2025-election

Update to the Pan-Canadian Approach to Carbon Pollution Pricing 2023-2030

Note

On March 14, 2025, the federal government announced its intention to refocus federal carbon pollution pricing requirements on ensuring carbon pricing systems are in place across Canada on a broad range of greenhouse gas emissions from industry.

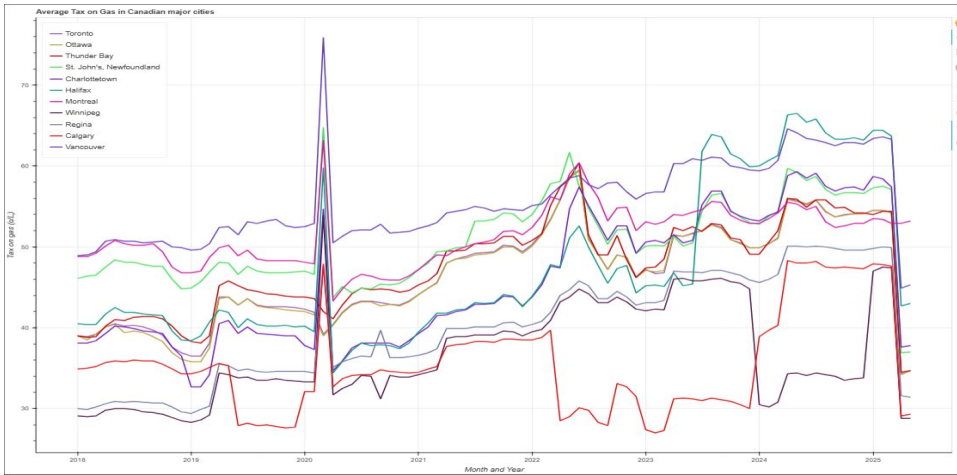
As part of this announcement, the federal government is removing the requirement for provinces and territories to have a consumer-facing carbon price in place. The federal government is setting federal fuel charge rates to zero as of April 1, 2025 and will be considering broader amendments to the *Greenhouse Gas Pollution Pricing Act*.

The federal government intends to engage provinces, territories, Indigenous Peoples and stakeholders on changes to the minimum national stringency standards for carbon pollution pricing, known as the federal 'benchmark' criteria.

Changes would focus the benchmark on ensuring industrial pricing systems continue to maximize emissions reductions and encourage the transition to low carbon technologies, while protecting industry against competitiveness and carbon leakage impacts. The goal of the benchmark criteria would continue to be that systems are similarly stringent, fair and effective, and the review will consider opportunities to strengthen industrial carbon markets so that they deliver the incentives needed for major decarbonization projects across industry.

In the interim, all existing industrial carbon pricing systems that currently align with the benchmark are anticipated to continue to be sufficiently stringent if no significant design changes are made.

Source: https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/carbon-pollution-pricing-federal-benchmark-information/federal-benchmark-2023-2030.html



Final Insights and Key Points

- Amount of refined petroleum & crude oil imports has a direct influence on base gas prices
- The carbon tax plays a role in how gas prices have spiked throughout the past 5-10 years
- We can expect gas prices to steadily decrease with the overhaul of the carbon tax at the federal level and if the amount of petroleum and crude oil import is not excessive