Financial & Policy Tools for Sustainable Capital Investments by Local Governments

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Disclaimer

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This project was conducted under the mentorship of City of New Westminster staff. The opinions and recommendations in this report and any errors are those of the author and do not necessarily reflect the views of the City of New Westminster or the University of British Columbia.

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Executive Summary

To complement the city of New Westminster's efforts to tackle climate change, this project was set in motion to conduct a detailed literature review on the financial and policy tools that local governments have at their disposal. These tools, then subject to their feasibility and application to a case study, aim to inform the city's policy decisions around capital investment.

The Phase - I of the project primarily involved conducting a thorough literature review of the financial and policy tools that are being used globally and in Canada, conducted as secondary research. After a thorough review of the policies that have been used, several tools were underlined and proposed to the team. These tools included internal carbon pricing, carbon taxes, cost of doing nothing frameworks, green procurement policies, an asset management strategy tool, and internal green revolving loanable funds. Post their inputs, one of the selected tools was applied to a case study, which was provided by the mentors. The proposed case study for this was decided to be that of the EV fleet life cycle analysis for the city, and the tool that was found to be the most suitable for this was the internal carbon pricing. This involved an overview of several documentations, which ultimately informed the update of a life cycle analysis documentation for the year of 2019.

The main conclusion of the case study suggested the importance of life cycle analysis in gauging feasibility of an asset and planning its usage out. Moreover, greater importance is also to be emphasized on the use of internal carbon pricing when gauging the viability of the life cycle analysis of an asset as a business case. Ultimately, the choice of an appropriate carbon price saw significant increases in the number of viable business cases, a greater monetized lifetime reduction in emissions, and greater feasibility in undertaking the EV fleet replacement altogether within a shorter timeframe.

Introduction

On the 11th of March, 2019, City Council of the City of New Westminster declared a climate emergency and established the following corporate greenhouse gas (GHG) reduction targets: 45% by 2030, 60% by 2040, and Net Zero by 2050. In pace with the City of New Westminster's efforts to address the climate emergency, like the 7 Bold Steps for Climate Change, Corporate Energy and Emissions Reduction Strategy (CEERS), and the Community Energy and Emissions Plan, (CEEP 2050), this project aimed to work in complementarity with these plans, and broaden the set of available climate-related financial and policy tools at the city's disposal.

It has been widely documented that municipal and local governments are at the forefront of the climate challenge. At the same time, local governments often also prove to have an advantageous position in dealing with these rising challenges. Local governments are particularly well placed to support the transition since cities and urban areas contain the highest population densities, consume the most energy and produce the most CO2 emissions globally (EC, 2018c). Local-level planning is important to develop renewable energy sources which have an intrinsic site-specific nature, but in addition local governments can encourage lower energy consumption as regulators, assist in identifying relevant energy-saving measures and technologies and increase citizen environmental awareness (Brandoni and Polonara, 2012, Comodi et al., 2012, Hiremath et al., 2007).

This project is an initiative in data-driven research on what plans and strategies are most suitable for the city of New Westminster for climate action. This involves a broad literature review of the climate-related financial and policy tools being used worldwide and in Canada, understanding the policy-context within which they're being used, and what are their respective rates of successes and failures. In addition to that, the project aims to understand the timelines of operation for each proposed strategy and tool and gauge their suitability for the city of New Westminster in the short-run and the long-run.

Background

This section details the Phase - I of the research conducted under this project, as well as the tools that were deemed to be the most suitable for the application to the case study provided by the city staff. It hopes to provide a basic overview of the tools that is substantial enough for the understanding of the subsequent portions of the report. Consequently, these tools are also recommended for immediate application in relevant policies that inform the city's capital investment decisions. The tools used within the case study analysis i.e. internal carbon pricing and life cycle analysis are detailed first, which is then followed by other tools that were found to be contextually appropriate, and were recommended in Phase - I.

1. Internal Carbon Pricing

In recent years, governments across the world have been developing policies aimed at reducing Greenhouse Gas (GHG) emissions. One such policy is internal carbon pricing. Carbon pricing introduces a surcharge per-unit of carbon emissions on the burning of fossil fuels and other polluting activities. Now, the introduction of the term "internal" gives it a more nuanced meaning.

In a municipal government's routine activities, they emit greenhouse gasses (GHGs). In most jurisdictions, there are no prices that are associated with these emissions, or at least in the previous few decades, there weren't. Since there are no prices to pay, or in other words no costs associated, there is an extremely low incentive for any emitting body to watch the emissions, control them, or ultimately reduce them. However, as is certain from multiple sources at this point of time, these emissions certainly lead to climate change, the drastic effects of which are more visible than ever. Therefore, when we say "internal carbon pricing", the term "internal" means that this is a price that a municipal government is setting for itself. There is no transactional component to internal carbon pricing; the municipal government doesn't actually make a payment to an outside entity based on its carbon emissions. Instead, it is a mechanism used internally to assess the financial impact of its carbon emissions and incentivize cleaner strategies. The internal carbon price is a tool for a municipal government to recognize the climate impact of its decisions, and motivate itself to find more sustainable ways to operate.

As far as carbon pricing is concerned, while the tool that we focus on – internal carbon pricing – is purely internal, there are more external and transactional forms of implementing a carbon price as well, such as a carbon tax or a cap-and-trade system. British Columbia was among the first jurisdictions in Canada to introduce a price on carbon in the form of a carbon tax, starting July 1st, 2008. The subnational policy intervention provides a prime setting to measure the effect of carbon taxes and could help settle the ongoing debate surrounding carbon pricing schemes in other jurisdictions. A cap-and-trade system, which requires companies to buy emissions quotas if one emits over their cap, were rare in the case of municipalities. Therefore, the recommendation was limited to internal carbon pricing.

Another important facet of internal carbon pricing to understand here is that, if we don't place this monetary cost on the emissions in the present, this is in essence the price that we'll be paying in the future for the abatement of the emissions. This, in other words, is known as the Future Cost of Abatement, or sometimes referred to as the cost of doing nothing.

2. Life Cycle Analysis

Life Cycle Analysis (LCA) is a systematic and comprehensive method used to assess the environmental impacts of products, processes, or services throughout their entire life cycle. It evaluates the environmental burdens associated with various stages, from raw material extraction and manufacturing to distribution, use, and disposal or recycling. The analysis considers a wide range of factors, including resource consumption, energy use, greenhouse gas emissions, air and water pollution, and waste generation. By examining the entire life cycle, LCA provides a more holistic understanding of the environmental implications, helping decision-makers identify potential environmental hotspots and opportunities for improvement.

3. The Cost of Doing Nothing

In the balancing act of managing a municipality's budgetary decisions, non-financial costs are often overlooked. This is especially the case in capital investment considerations; in part, owing to the subjective methods of calculation, and the corresponding difficulty in calculation. One such non-financial cost that is seldom incorporated is the mounting cost of climate change. Therefore, in municipal government budgets, it is harder to incorporate and push for investments in adaptation against climate change. A policy tool that is particularly helpful in this regard is the cost of doing nothing. The primary idea behind the cost of doing nothing is an evaluation of the potential long-term costs from the consequences that are associated with inaction in addressing the global, and in this case municipal, sustainability challenge.

Upon the calculation of the cost of doing nothing, the evaluated metric serves as an opportunity cost benchmark in the assessment of capital investment decisions. Here, the term opportunity cost refers to the loss of the potential gain from an alternative, when another alternative is chosen. In this case, it would count for a potential alternative investment, which would further inform the City of New Westminster's sustainable capital investment decisions, particularly in solutions that mitigate risks, preserve resources, and create a more sustainable future. Mainstreaming climate change adaptation into existing frameworks and operations is an efficient strategy to overcome implementation barriers, such as insufficient human and financial resources, lack of momentum and competing priorities (ICLEI Canada, 2016).

ICLEI – Local Governments for Sustainability, which is a global network of more than 2,500 local and regional governments committed to sustainable urban development, have a toolkit titled the Cost of Doing Nothing (CODN) Toolkit, which is an extremely useful tool in the calculation of the aforementioned costs. The toolkit comes equipped with guidance on collecting locally-relevant data to weigh the costs inaction when investing in climate action. The CODN resources also supports municipalities in framing their local data within a national and provincial/territorial context, and examines the costs and impacts of climate change across multiple knowledge systems, climate change hazard, and sectors. The toolbox is made up of the following key documents, tools, case studies, and appendices. Together, these resources provide municipalities the tools to assess the costs of doing nothing within a local context, and makes building a business case for climate adaptation as easy and simple as possible. In considerations of the impact of climate change on Canadian communities, the toolkit involves the case studies of the City of Hamilton and the City of Windsor, which can further be used as references for the calculations of the City of New Westminster.

4. Green Procurement Policies

Green Procurement Policies, that are otherwise called Sustainable Procurement Policies, are essentially policies that require sustainability-led choices when municipal governments are selecting and buying goods and services for their internal functioning. These policies go hand-in-hand with traditional considerations like price, quality, and technical features. Green Procurement Policies is an umbrella term to address any policy that may come in effect to aid environment-first choices for an organization or group. Sustainable purchasing includes sustainable choices to be made at each procurement process and aims to look beyond the short-term, lowest-cost consideration of projects, but also considers the long-term impact of that purchase.

Green Procurement Policies are one of the most commonly used tools today, with worldwide applications and practice-reviews in California (Simco and Toffel, 2014), Norway (Michelsen and Boer, 2009), and South Africa (Agyepong et al, 2017) among several other places. Owing to said increased usage of the tool, there are a great amount of case studies for references, which are increasingly varying across municipalities, countries, and continents. One of the possible extensions to this research and the report that comes from it is to evaluate the different frameworks under Green Procurement Policies and gauge their suitability for the City of New Westminster in order to develop recommendations.

5. Asset Management Strategy Tool

As far as including mitigation- and resilience-based tools for integrating climate change into plans and practices are concerned, the Federation of Canadian Municipalities' "Integrating Climate Change Considerations into Municipal Asset Management" was also assessed to be one of the more helpful tools. This resource is primarily centered on the assessment and integration of climate change within the levels of service and/or risk management frameworks, because these are the components of asset management most directly impacted by climate change.

One of the primary reasons that this tool for asset management was considered was because a revaluation of municipality's existing assets will end up informing areas for potential capital investment. Reliability is an important characteristic of most municipal services, which is often expressed as a level of service. When expressed as a potential risk, this would refer to the failure of an asset provided by the municipality. An analysis of the resilience gaps in a municipality's service areas would feed into the capital investment decisions.

There have been mentions of the four potential approaches to using this framework as per any municipalities requirements, like building from the ground up, focusing on the levels of service, focusing on the management of risks, or adapting an already existing framework. More broadly, a few of the steps that every framework contains are: identifying service areas, gathering regional and local climate change information, identifying gaps between current and target levels of service, and then identifying strategies to address gaps and risks from climate change, and finally, incorporating them into the climate action plans. The toolkit is based on a review of the best practices from 11 Canadian municipalities, including Saint John and Fredericton in NB, Kitchener and Kenora in ON, and Cowichan Valley Regional District (CVRD) and Nanaimo in BC.

6. Internal Green Revolving Loanable Funds

One of the simpler tools identified, that is frequently used by municipal governments for identifying capital investment opportunities, is the idea of an internal green revolving loanable fund. Under green loanable funds, a specific set of financial resources is designated for investments in projects that promote environmental conservation, renewable energy, energy efficiency, climate change mitigation, and other sustainable practices.

Projects seeking green loanable funds must meet specific eligibility criteria to demonstrate their environmental sustainability. These criteria may vary depending on the institution providing the funds but generally include factors such as carbon footprint reduction, resource efficiency, climate resilience, and compliance with relevant environmental standards and regulations.

In the case of the City of New Westminster, the recommended tool is completely internal, the proceeds from which would then be used to finance energy efficiency upgrades. For instance, Auckland is using a revolving fund to pay for improvements to buildings that are owned or administered by the city. The fund received its initial $700,000 grant in 2013 to put towards innovation and building upgrades for publicly held properties; the savings achieved from increased efficiency have been reinvested in new projects. The Auckland Council Headquarters' renovation has so far resulted in a 39% drop in energy use and a $377,000 annual savings.

Case Study

1. Introduction

Case study analysis and the recommendations that come from it primarily composited Phase - II of this project. The case study would involve the application of one of the financial or policy tools suggested in Phase - I of the project, to gauge the feasibility and fit for the City's policies. The case study was to be provided by the mentors and the team at the City of New Westminster. For this component, an analysis of the City's **Proposed Electric Vehicle Fleet Initiatives** was deemed to be the appropriate fit for the suggested tools in Phase - I of the project. Another factor that corroborated the choice of the EV fleet initiatives for the case study were the City of New Westminster's Climate Action Plans. In the Community Energy and Emissions Plan (CEEP, 2050), and the Corporate Energy and Emissions Reduction Strategy (CEERS), transportation, the City's fleet, and the adoption of EVs, are prioritized as main areas of focus, which makes for a more pertinent and relevant case study.

To give the analysis some context and reference, several documents were provided by the City Staff, including but not limited to *2022 Summary Report of the Proposed EV Fleet Initiatives*, an *Asset Management Plan for the City's EV Charging Stations (EVCS)*, and a *2019 Life Cycle Analysis (LCA) of the Proposed EV Initiatives and their Charging Infrastructure*. While the analysis used components from all of the provided documentation, the primary focus of the analysis was limited to the 2019 LCA. The 2019 LCA proposes a replacement plan for the City's current fleet, embarking the monumental shift onto EVs. While the original 2019 LCA documentation hasn't been attached as a part of this final report, a high-level overview of the assumptions and details, which are necessary for the understanding of the case study have been included, with the approval of the mentors at the City of New Westminster.

At this juncture, it is important to note that the case study is a derivative of the 2019 life cycle analysis documentation. A life cycle analysis, as mentioned earlier, looks at an asset's impact at every stage of its life, and the addition of an internal carbon pricing to that mix makes the capital investment decision more environmentally-conscious and sustainable.

2. Assumptions

As mentioned in the prior section, one of the key documentations relied upon for the case study encompassed a Life Cycle Analysis (LCA) conducted in 2019 for the EV fleet for the City of New Westminster, including the associated EV Charging Stations (EVCS) infrastructure. This is an essential component to note, because it contributes to a more holistic LCA, accounting for the costs not just on the vehicular front, but also on their charging. Broadly, to conduct the 2019 LCA appropriately, certain assumptions were made with regards to **fuel, electricity, and carbon,** and some regarding **vehicles' life cycle** (replacement cost, target payback period, and so on). Under the purview of this project, some of these assumptions were updated to current (2023) levels, while others were kept constant at their (2019) levels. All of the aforementioned assumptions are detailed underneath, with respective tables for the EV fleet breakdown by department.

2.1 Fuel, Electricity, and Carbon Assumptions

The fuels considered under the 2019 Life Cycle Analysis, corresponding to the composition of the City of New Westminster's fleet, included **diesel, gas, and propane**. In accordance with the 2019 estimated pricing levels, the LCA used Diesel priced at $1.50 per liter, Gas priced at $1.60 per liter, and Propane priced at $1.00 per liter. In one of the updates to the Life Cycle Analysis, these metrics were updated to 2023 estimated pricing levels. Therefore, for the context of the case study, **diesel**[1] was priced at **$1.87 per liter**, **gas**[2] was priced at **$1.99 per liter** (taken as an average of regular and premium unleaded gasoline as self-service filling stations), and **propane**[3] was priced at **$1.26 per liter**, for Vancouver, British Columbia. These numbers were averaged from the Statistics Canada website, which keeps a province-wise monthly record of fuel prices.

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[1]https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810000101&pickMembers%5B0%5D=2.4&cubeTimeFrame.startMonth=01&cubeTimeFrame.startYear=2023&cubeTimeFrame.endMonth=07&cubeTimeFrame.endYear=2023&referencePeriods=20230101%2C20230701

[2]https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810000101&pickMembers%5B0%5D=2.4&cubeTimeFrame.startMonth=01&cubeTimeFrame.startYear=2023&cubeTimeFrame.endMonth=07&cubeTimeFrame.endYear=2023&referencePeriods=20230101%2C20230701

[3]https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810000101&pickMembers%5B0%5D=2.4&cubeTimeFrame.startMonth=01&cubeTimeFrame.startYear=2023&cubeTimeFrame.endMonth=07&cubeTimeFrame.endYear=2023&referencePeriods=20230101%2C20230701

As far as **electricity consumption** of the EVs is concerned, it is essential to note that the 2019 Life Cycle Analysis assumes a constant **20% energy cost of using EVs to Internal Combustion Engines (ICEs)**, which is a reasonable assumption that this case study takes forward. However, this assumption also circumvents this case study's analysis because it takes away the heterogeneity in the fuel consumption and the EV charging patterns. Instead, it imparts a constant 80% savings in switching from an ICE to an EV. For instance, let's take a Gas vehicle that has an annual fuel usage of 1,592.05 liters, which makes its annual fuel costs approximately $3,168. By our assumption of 20% Energy Cost of EVs to ICEs, the charging costs of the replacement EV will be $634, or 20% of $3,168.

Finally, the **internal carbon price** used in the 2019 EV Life Cycle Analysis is **$150.**

2.2 Vehicle Life Cycle Assumptions

In the context of the vehicle Life Cycle Assumptions, no changes have been made in the case study as against the 2019 Life Cycle Analysis. Therefore, this keeps the **replacement cycle** of a Regular EV at **10 Years**, and that of a High Kilometer EV (> 25,000 Km/Yr) at **5 years**.

Midlife cost, which can be understood as the cost that an asset will incur in its midlife, which is usually its operations and maintenance phase, has been kept at **0%**. This is a realistic assumption because EVs are often considered to have lower operation and maintenance costs compared to ICE vehicles, requiring no oil changes, using regenerative braking, and so on. In addition to that, keeping the Midlife Cost at 0% attributes a reasonable simplification to the Life Cycle Analysis. **Salvage savings**, or the residual value of an asset at the end of its useful life is kept at **10% of the EV Cost**.

Finally, the **EV infrastructure target payback period** is assumed to be **40 Years**, while the **ev charger target payback period** is assumed to be **10 Years**.

2.3 Fleet Breakdown by Department

For the EV Fleet Breakdown, the Summary Presentation for the 2022 Update to the Proposed EV Fleet Initiatives was made available, which projects 136 EV Candidates by 2040. However, the analysis in the case study report relies on the **116 Proposed EV candidates from 2019**. This is owing to the unavailability of the data to trace the respective departments' EV requirements and tracking the changes between 2019 and 2022. These 116 proposed EV candidates have been detailed department-wise underneath:

Vehicle Site	Number of Vehicles
Police	38
Eng Ops	36
Parks Yard	15
#1 Fire Hall	9
City Hall	6
Parking Patrol	4
#3 Fire Hall	2
Cemetery	2
#2 Fire Hall	1
QP arena	1
Nursery	1
CG Pool	1
Grand Total	116

3. Analysis and Results

This case study follows the update of the 2019 Life Cycle Analysis for the proposed EV fleet initiatives with an internal carbon price that is in-tune with the recommendations of a **Metro Vancouver Research Group**.

To begin with, let's break down these aforementioned recommendations. This group, composed of Metro Vancouver, TransLink, City of Richmond, and City of Vancouver, came together with the primary purpose of providing a science-based and defensible basis for [4]determining an internal carbon price for organizations in the Metro Vancouver region.

[4] Recommendations 2019-2021 were formed by imputation

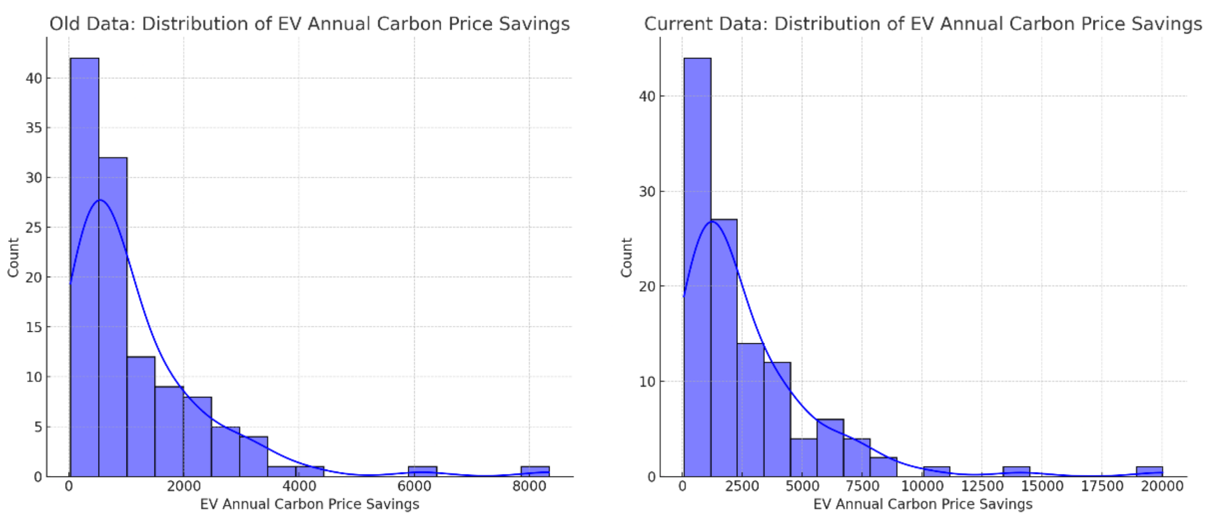
Among the methodologies considered, the group looked at the Social cost of carbon, global benchmarking, and a regional targets-based approach. Ultimately, owing to common discounting concerns, the *social cost of carbon* was rejected. Similarly, in part due to the difficulty in determining similarities across regions, the *global benchmarking* approach was eliminated. Finally, a **regional targets-based approach** was used to determine the following carbon price recommendations for the region of Metro Vancouver, as a mark-up on the Federal/BC internal carbon price.

It is very important to note that the group's recommendations started from the year 2022, extending till 2030 and beyond. Therefore, using data from the British Columbia government's carbon pricing from 2019 - 2021, the group's recommendations were imputed as a part of the case study. This gives us the following framework for internal carbon pricing:

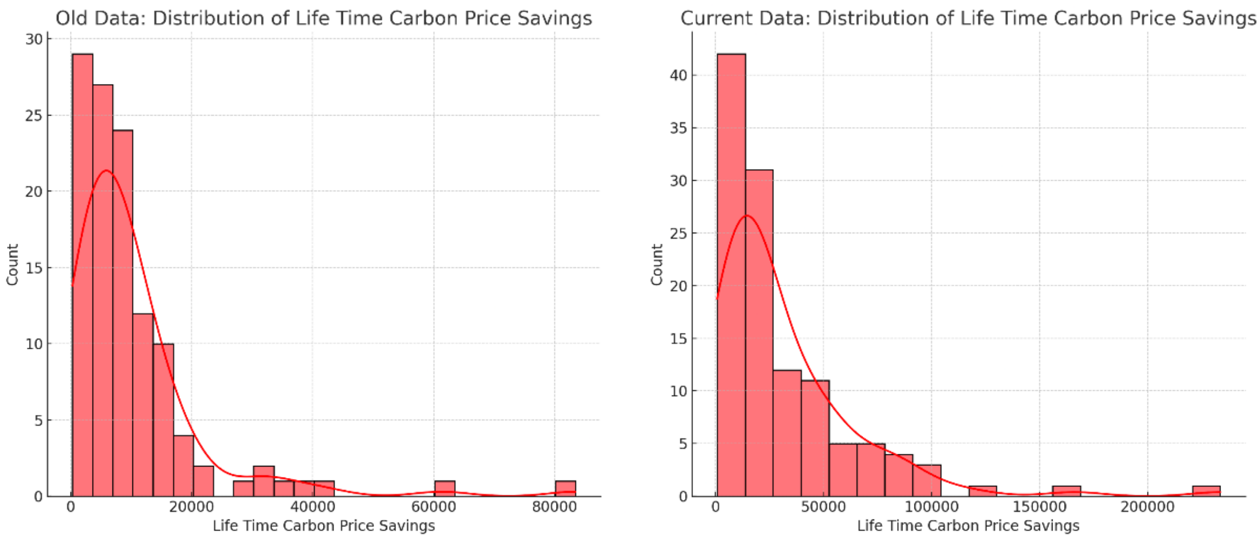
Year (As of April 1st)	Federal/BC Carbon Tax ($/tonne)	Total Internal CP, (inclusive of Federal/BC CP) ($/tonne)
2019	$40	$290
2020	$40	$290
2021	$45	$295
2022	$50	$300
2023	$65	315
2024	$80	330
2025	$95	345

2026	$110	360
2027	$125	375
2028	$140	390
2029	$155	405
2030	$170	420
2030+	$170	+ $15/tonne every year after 2030

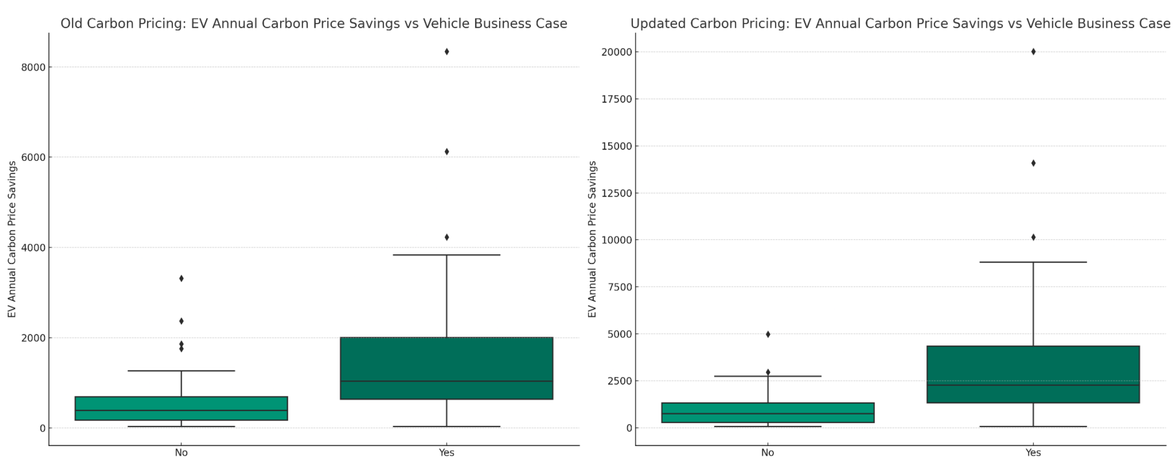
Upon the application of this new internal carbon price to this case study, we note some significant changes in the economics of the EV fleet replacement decisions. As mentioned previously, the internal carbon price taken as a part of the Life Cycle Analysis was $150.



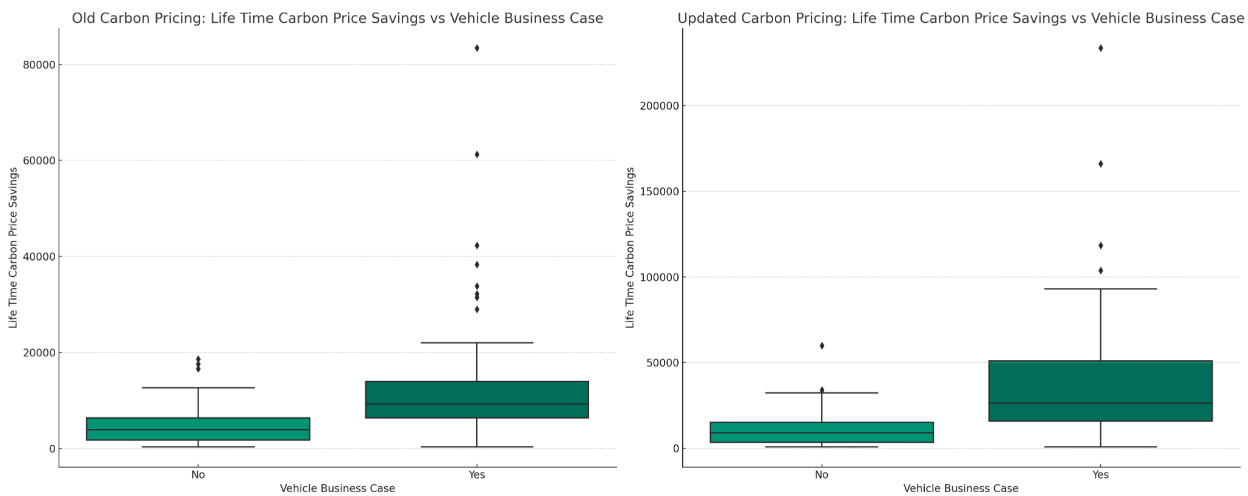
Therefore, when we place a monetary value on the reduction of the emission, it amounted to **$1,163,493.89** in terms of the reduction over the entire lifetime of the EVs. However, with the introduction of the incremental internal carbon pricing, over the lifetime of all the EVs, it amounted to **$3,606,591.93**. This is an increment of **209%** in the monetary value of the reduction of emissions. This can be observed in the comparison across the annual monetized GHG reductions and the lifetime monetized GHG reductions, across the data with the older Carbon Price ($150) and the incremental updated carbon price. Herein, the Y-axis on this graph represents the count of cars, and the X-axis represents the amounts of monetized reductions.



Now, let's understand another important aspect of the case study, which talks about investments into the EV fleet, including their charging infrastructure as a **business case.** The viability of a business case basically means that a business, or in this case an undertaken investment, is (or has the potential to be) successful. A viable business case is profitable, which means it has more revenue coming in than its spending on the costs of running the business. Therefore, this makes a viable business case a very important component of a cost-benefit analysis.



In the context of the case study, this means that over the lifetime of the EV, benefits in the form of fuel savings, or maintenance savings, and especially the benefits from the monetization of the reduction in carbon emissions, outweigh the costs of phasing them in, **and their infrastructure**. If we look at the data with the older internal carbon price, the number of viable business cases was **68**, which is approximately **58%** of the fleet. However, with the incremental updated internal carbon price, the new number of viable business cases goes up to **79,** which is approximately **69%** of the fleet. That counts for a significant increase of 11 vehicles, or approximately **9%** of the fleet. These metrics are further detailed by these Boxplots underneath.



As can be observed in the differences in the graphs, we see that the EVs that have a viable business case i.e. "Yes" instead of "No" tends to have **higher savings**, both annually and lifetime. However, it is also important to note the differences in the X-axes levels across the two panels. The updated internal carbon pricing leads to more savings, and ultimately more viable business cases.

For supplementary information, let's look at the data with the **old internal carbon price**:

- Vehicles with a 'No' as a business case:
  - Mean Lifetime Carbon Price Reductions: approximately $582.14
  - Median Lifetime Carbon Price Reductions: $390.55
  - Range of Reductions: $27.45 to $3317.45

- Vehicles with a 'Yes' as a business case:
  - Mean Lifetime Carbon Price Reductions: approximately $1527.29
  - Median Lifetime Carbon Price Reductions: $1037.18
  - Range of Reductions: $27.87 to $8339.61

Now, let's look at the data with the **updated internal carbon price**:

- Vehicles with a 'No' as a business case:
  - Mean Lifetime Carbon Price Reductions: approximately $1066.76
  - Median Lifetime Carbon Price Reductions: $746.82
  - Range of Reductions: $68.63 to $4981.67
- Vehicles with a 'Yes' as a ness Case:
  - Mean Lifetime Carbon Price Reductions: approximately $3387.65
  - Median Lifetime Carbon Price Reductions: $2278.13
  - Range of Lifetime Carbon Price Reductions: $58.53 to $20015.07

Recommendations & Next Steps

One of the paramount things that is demonstrated by the research undertaken in this project, and complemented by this case study, is that in order to make more sound decisions that are grounded in sustainability as a municipal government, tools like **internal carbon pricing** and **Life Cycle Analysis (LCA)** are indispensable. Understanding the total cost of ownership of electric vehicles (EVs) is made easier with the help of the LCA. It takes into account not just the up-front prices but also the costs of fuel, upkeep, and other ongoing costs. On the other hand, internal carbon pricing can help the local government by appropriately pricing the benefits of a policy, encourage the adoption of low-carbon technologies, processes, and behaviors, and can serve as a hedge against future regulatory risks (World Bank, 2017).

In every business' basic cost-benefit analysis, the application of an internal carbon pricing allows us to calculate and put a **monetary value** on the unforeseen benefits that the municipality receives from reduction in the greenhouse gas emissions. As we put a monetary value on these greenhouse gas emissions, it is once again important to note that there is no exchange or payment, but just an internal mechanism used to assess the financial impact of emissions and incentivize cleaner strategies. Topically, in the case study, while the target payback for the EV fleet is 40 Years, the enablement of an appropriate Carbon Price hastens that timeframe, and allows for the payback back to be quicker, which is also evident by the higher number of business cases. Although, with the current availability of data, that reduction in time is hard to quantify.

Most importantly, in the case of a life cycle analysis, the application of an internal carbon price is what allows for **business cases** to be **viable** in the first place. As mentioned earlier, in the planning of municipal governments, while the focus is consistently on costs, this allows us to assign a monetary value to the benefits that will come from the implementation of a policy like an EV Fleet, which is the need of the hour. **If there is no introduction or implementation of the internal carbon price in the Life Cycle Analysis, hardly any of the business Cases will be viable.** The implementation of an internal carbon price only makes the case for the introduction of EVs more robust, and consequently, the analysis was resoundingly in favor of the introduction of the EV Fleet. In addition to that, it is also crucial to understand that with the impending challenges of Climate Change, a fixed internal carbon price ($150) in the course of the a decade isn't feasible, and corroborating the recommendations of the Metro Vancouver Research Group, it should be instituted in an incremental fashion, which is checked up on periodically.

Lawley & Thivierge (2018) implemented a regression, finding that a 5 cent per liter Carbon Price lowered gasoline consumption by 8 percent. A similar paper by Xiang & Lawley (2019) found that the British Columbia Carbon Price decreased natural gas consumption by 7 percent. A time-series approach allowed Bernard & Kichian (2019) to conclude that a Carbon Price reduces diesel consumption by 1.3 percent. Antweiler & Gulati (2016) investigated the causal channel for reduced gasoline consumption using regressions, finding that drivers reduced their distance driven and selected more fuel efficient vehicles. While these results deal with external Carbon Prices, it is not hard to trace this impact onto internal carbon prices as well. Implementing these strategies can go a long way in allowing local governments to monitor and ultimately control their greenhouse gas emissions. Therefore, quite broadly, phasing these tools into a municipality's regular capital investments is one of the first recommendations from this project.

In addition to that, as far as simpler tools for sustainable capital investments are concerned, as previously mentioned the City of New Westminster already has a **Climate Action Levy**. Therefore, akin to this, savings generated from the switch to more sustainable alternatives can be **earmarked** to be reinvested into more sustainable projects. This is similar to, but less formal, than the idea of an internal green revolving fund. This approach can also help align economic incentives with sustainability goals and demonstrate a commitment to addressing climate change (Klenert et al., 2018).

Municipalities are in a unique position to take action on climate change. They can document and track their GHG emissions with high accuracy on a small scale, develop detailed programs that target these emissions, and implement policies that promote sustainability (Bulkeley and Betsill, 2005). Therefore, the City of New Westminster, while it is already ahead in its application and use of tools to make its capital investment decisions, like a Life Cycle Analysis of Buildings, which is also a priority on the CEEP and CEERS documents, with the inclusion of internal carbon pricing.

To conclude, the immediate incorporation of Life Cycle Analysis and internal carbon pricing into municipal policy-making, along with earmarking climate or carbon tax revenue for sustainability initiatives, are recommended strategies for local governments to proactively address the climate crisis.

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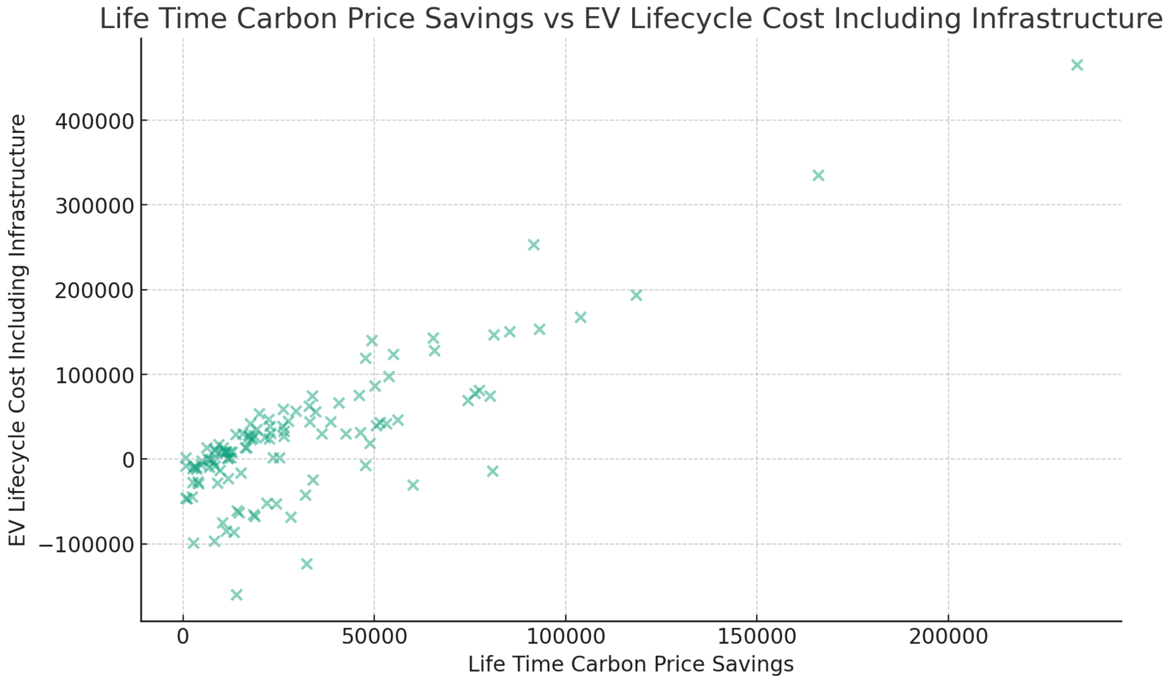
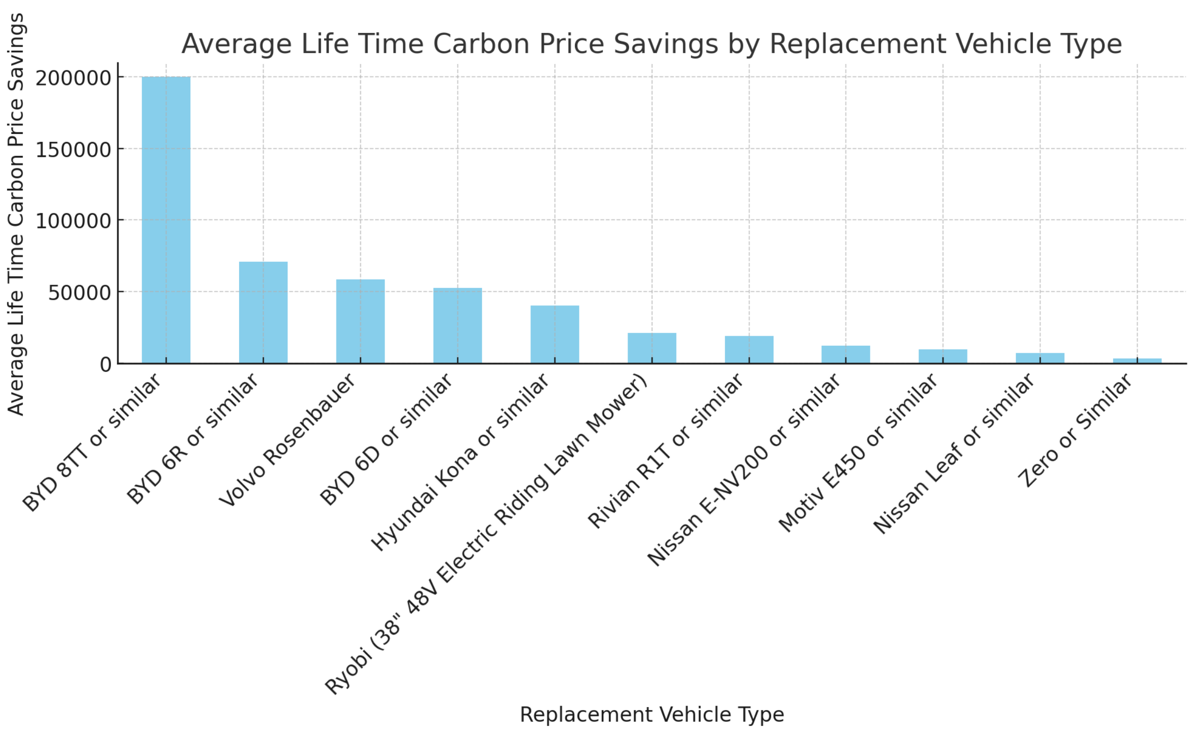
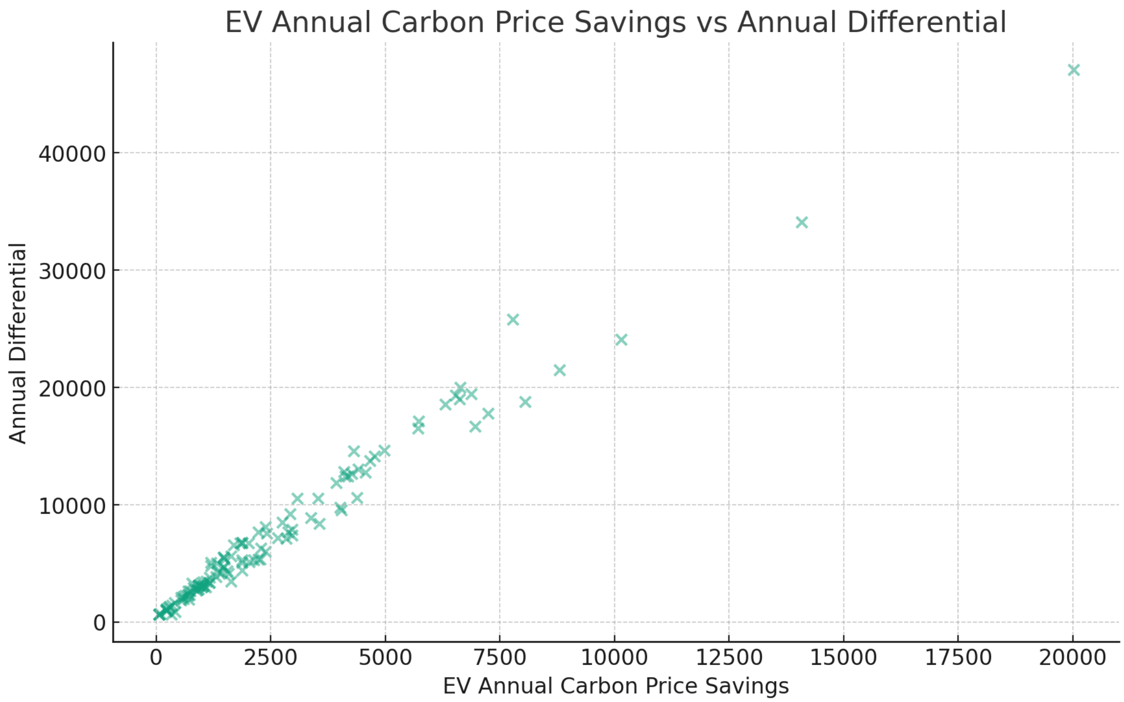
Appendix

Supplementary Graphs



This scatterplot basically explains that vehicles with higher Lifetime Carbon Price Savings also tend to have a higher life cycle cost.





This scatterplot basically explains vehicles with annual carbon price savings tend have a higher annual differential (Annual Cost - Benefits).