A Case Study on the adoption of Electric vehicles (EVs) and Energy Storage in British Columbia, Canada

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ABSTRACT

This case study explores how British Columbia is adopting the use of electric vehicles (EVs) and the integration of energy storage systems. By contributing to the betterment of the province, BC adopts this initiative to reduce greenhouse gas emissions while promoting a long-term environmental sustainability. As one of the leading provinces in Canada, British Columbia has introduced a range of policies, incentives, and infrastructure developments to support the transition from fossil fuel-powered vehicles to a cleaner, renewable-energy powered transportation system. Through programs such as BC Hydro and CleanBC, the province is advancing its transportation system as well as its renewable energy integration. However, challenges such as high EV cost, and limited grid capacity still pose as obstacles to this transition.

Keywords:

British Columbia, Electric vehicles, Energy storage, CleanBC, Renewable energy

INTRODUCTION

Renewable energy is defined as the energy generated from natural sources or resources that are continuously replenished [4]. These sources include solar, wind, biomass, geothermal, and hydropower, all of which make our environment sustainable [4].

Electric vehicles (EVs) and energy storage play an important role in reducing greenhouse gas (GHG) emissions and making electricity grid more flexible [5]. The elimination of gas-powered cars with electric vehicles lowers the rate of CO_2 emissions which improves the efficiency of EVs and makes the environment sustainable [5]. Additionally, the batteries in electric vehicles (EVs) can also store energy and save it back into the grid through vehicle-to-grid (V2G) technology which provides additional energy flexibility and storage [5].

British Columbia is a province in Canada that is located on the west coast known for its concentrated population [28]. British Columbia is known to have one of the highest Electric Vehicles (EVs) adoption rate across Canada [1]. The province is leading Canada in the transition from gas-powered vehicles to zero-emission vehicles (ZEVs) [3]. In the city of Vancouver, the shift to ZEVs offers an opportunity for the reduction of greenhouse gas emission [3]. The adoption of EVs in B.C. helps keeps the air clean and protects the province natural beauty [2]. Driving an EV vehicle in B.C. is also much cheaper than driving a gas or diesel vehicle [2]. In the process of keeping the environment sustainable, energy storage also plays an important role by helping stabilize the power grid, storing excess energy for later use and ensuring a reliable electricity during emergencies or peak demand.

In this case study, I will examine how the British Columbia's strategic adoption of electric vehicles (EVs) and the implementation of advanced energy storage systems contributes to the reduction of greenhouse gas emissions by enhancing energy efficiency, fostering environmental sustainability, and promoting societal well-being for the long term of the province. By implementing the widespread use of EVs and the development of reliable energy storage infrastructure, BC tends to address the challenge of climate change to create a cleaner sustainable environment for British Columbians. It also highlights some challenges that is bound to be happen in adopting this initiative.

BACKGROUND/ LITERATURE REVIEW: ELECTRIC VEHICLE (EV) + ENERGY STORAGE LANDSCAPE IN BRITISH COLUMBIA, CANADA

Electric vehicle adoption refers to the acceptance of electric vehicles by governments, businesses, or individuals to use and integrate them into their transportation system rather than using gasoline or diesel vehicles [6]. Energy storage is defined as an effective method for storing energy that is difficult to store, such as electricity, and then retains it to be used when needed in the future [7]. Nowadays, as technology becomes more efficient, energy storage continues to play an essential role in renewable energy. Renewable energy improves system efficiency and allows electricity from sources such as solar, wind, hydropower to be stored and used effectively [8].

Energy storage refers to the process of capturing energy and storing it in a reserve for a later use [14]. When energy is being stored in a reserve for a later use, it facilitates the integration of clean and renewable energy sources into power grids for everyday use. The expansion of Renewable Energy brought about the possibility of energy storage which replaces and reduces the reliance of

fossil fuels-based energy production and environmental impacts [14]. This development tends to help countries achieve goals by providing a clean and sustainable environment for its citizen [14]. Energy storage comes in various forms such as electric vehicle batteries, home battery units, short-term grid-scale like lithium-ion batteries, and long-duration grid-scale like pumped hydropower [15]. Key benefits of energy storage include the reduction of electricity system cost in terms of the investment required. It also enhances electricity system by providing backup power when generation sources are disrupted [15].

British Columbia's introduction of CleanBC in 2018 aims to significantly reduce the reliance on fossil fuels used in the province and to lower climate-changing emissions by 40% by 2030 [10]. This initiative tends to collaborate with partners to build a cleaner economy and protect nature by working with the Indigenous Nations, local governments, industries, and utilities such as BC Hydro and FortisBC [10]. CleanBC Roadmap is a comprehensive plan developed by British Columbia to expand the province's actions on climate change [9]. This plan aims to intensify and accelerate climate actions by ensuring the province meets its 2030 greenhouse gas reduction and achieves a net-zero emissions by 2050 [9]. This significant shift tends to create opportunity for everyone by encouraging more business to use clean, renewable hydro power and clean energy [11].

In addition to the CleanBC strategy, BC has also supported another initiative known as Clean Energy Association of BC (CEBC) [16]. This organization plays a key role in shaping BC's clean energy landscape. It advocates for power systems that are environmentally responsible and cost-effective, and supports manufacturers, suppliers, and service providers involved in renewable energy [16]. The goal of CEBC is to maintain strong relationships with BC Hydro,

First Nation communities, environmental organizations, the public, and all levels of government both in Canada and across the world.

CASE STUDY: ELECTRIC VEHICLE (EV) ADOPTION IN BRITISH COLUMBIA

The rise of electric vehicles has been steadily increasing in BC. The sales made from zero-emission vehicles in BC has increased from 4.1 per cent in 2018, to about 22.4 per cent in 2024 [12]. Today, there are over 195,000 electric vehicles being driven in BC and within the next decade, BC Hydro projects that this number will spike up to about 700,000 to 900,000 electric vehicles [1]. To facilitate this transition from gas and diesel vehicles to electric vehicles, BC Hydro is making EV charging accessible for the citizens of British Columbia [1]. To achieve this, they intend to enhance home and depot charging options, expand public charging, and leading the EV charging market through ongoing research [1].

Figure 1 displays a BC Hydro graph that highlights the increasing growth of electric vehicles (EV) being driven by British Columbians in BC over time. In 2019, approximately 30,000 electric vehicles (EV) were driven in BC. Over the next six years, this number increased rapidly to about 180,000 vehicles driven in BC in 2024.

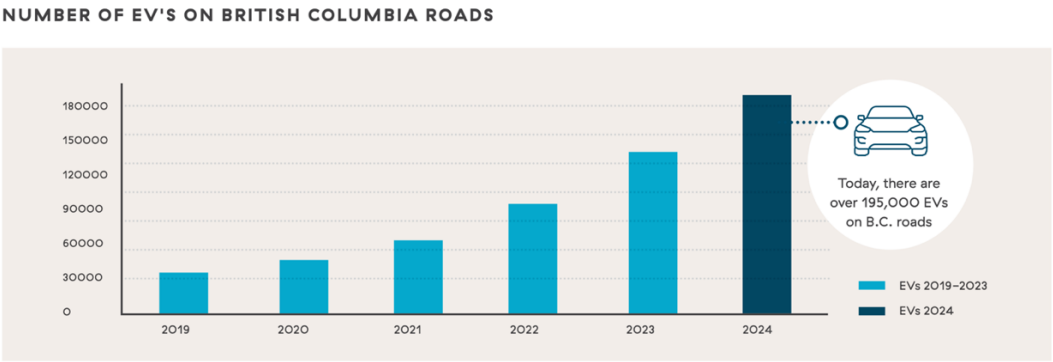

Figure 1: Number of EV's drive on BC roads| *Source: BC Hydro*

In the past year, BC Hydro has reached a major milestone by expanding its public fast-charging network for electric vehicles (EVs) to approximately 591 across B.C., installing an average of more than one port per day [19]. With 98 per cent of BC Hydro's electricity is from renewable sources, British Columbia is seen as the home to one of the fastest-growing EV markets in North America, aligning with the provincial efforts to reduce greenhouse gas emissions and advance long-term environmental sustainability. Having built one of Canada's largest public EV charging network, BC Hydro works in partnership with other companies to help reduce range anxiety and encourage British Columbians to adapt the switch from gas vehicles to electric vehicles [19].

In BC Hydro's new report released in April 2025, its highlights the efforts put over the past decade to build a robust EV charging network across British Columbia. It highlights several recent milestones achieved, including the expansion of its public charging infrastructure, the opening of 22 new hubs across all regions each equipped with 8 to 22 ports, the deployment of 350-kilowatt chargers provided at some locations to deliver up to 100 kilometers of range in just five minutes, its recognition as one of the top six public EV charging network provider across North America, and the completion of the Electric Highway, where the government of B.C. installed EV chargers approximately every 150 kilometers along major routes in September 2024 [19].

Government policies and incentives are also supporting the adoption of EVs growth and infrastructure in BC by expanding and building EV charging stations in the province. The Go Electric Public Charger program makes provision to people or organizations to get money to help cover the cost of building EV chargers [20]. Indigenous applicants can receive up to 90% of the cost with a maximum of $130,000 per fast-charging station, and $7,500 per level 2 charging

station. Other applicants can get up to 50% of the cost with a maximum of $80,000 per fast-charging station and $5,000 per level 2 charging station [20]. The province also aims to have at least10,000 public EV charging stations in B.C. by 2030 in their The CleanBC Roadmap initiative [20].

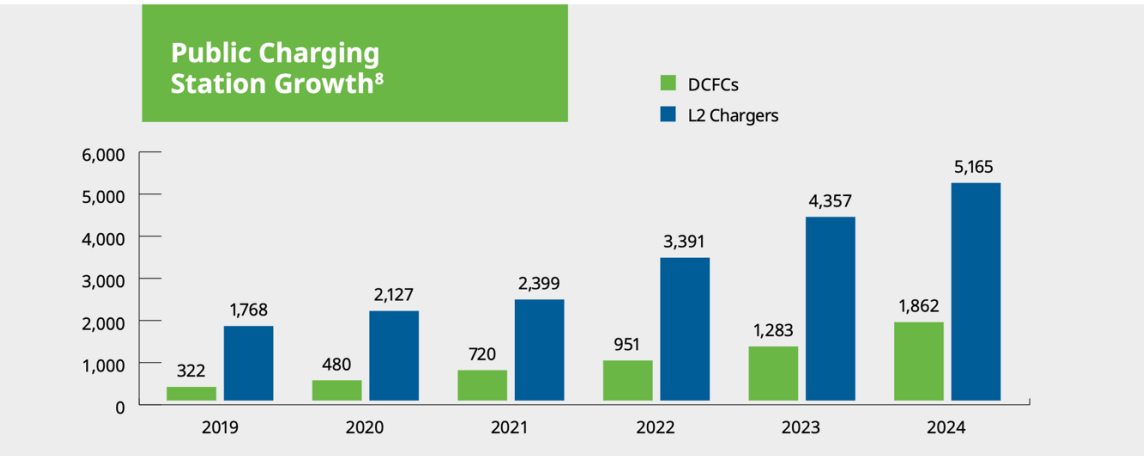

Figure 2: Public Charging Station Growth | *Source: CleanBC Go Electric*

The above figure 2 shows a graph of the growth of public charging stations in British Columbia, Canada, from 2019 to 2024. This graph highlights the increasing number of two types of public EV charging ports provided in British Columbia:

- **DCFCs (Direct Current Fast Chargers):** these types of chargers are often used for road trips by providing rapid power delivery to one's vehicle battery by reducing the charging time. The green bars on the graph represent the DCFCs showing how its availability has increased over the years, but not as much as that of L2 chargers [20].
- **L2 Chargers (Level 2 chargers):** these types of chargers provide a higher rate of AC charging through 240V electricity in residential setting or 208V in commercial setting which makes it common for home, workplace, and public use [22]. The blue bars on the graph

represents the Level 2 chargers. Compared to the DC fast chargers, their numbers have risen significantly over the years from 2019 to 2024, showing high demand and their efficient use for charging electric vehicles [20].

In addition to the providing EV charging infrastructure for the general public, the Go Electric EV Charger Rebate program also gives individuals and organizations the opportunity to purchase and install Level 2 charging stations at their houses, apartments, townhouses, and workplaces [20]. This provision is available to everyone including First Nations communities and Indigenous organizations making it an inclusive initiative. The rebate program also provides up to five hours of free support services for individuals and organization to discuss their potential plans on installing the EV charging station with an EV Advisor [20]. Figure 3 shows the statistics of EV Charger in British Columbia from January to December 2024, summarizing the achievements of the CleanBC Go Electric EV Charger Rebate Program.

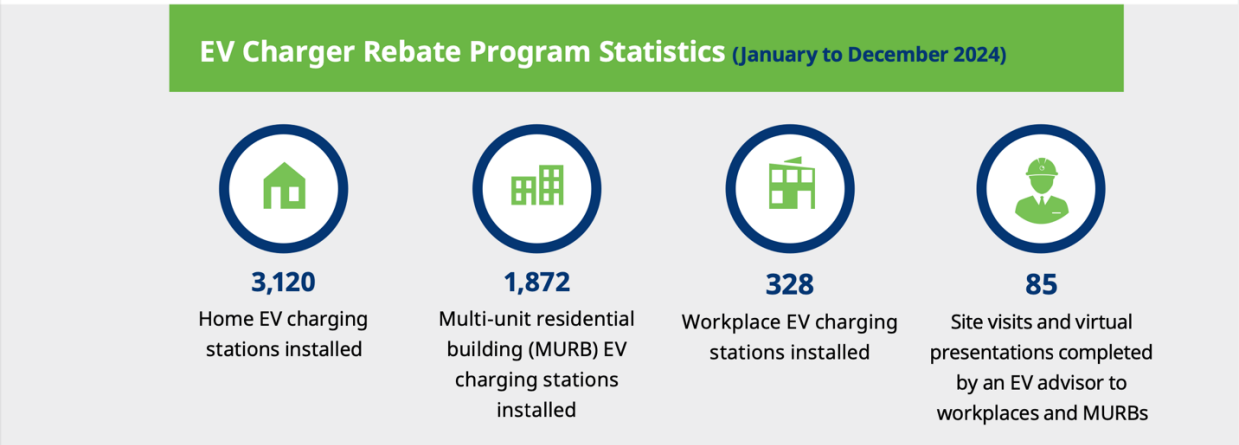

Figure 3: EV Charger Rebate Program Statistics | *Source: CleanBC Go Electric*

CASE STUDY: ENERGY STORAGE INTEGRATION IN BRITISH COLUMBIA, CANADA

For more than three decades, the Clean Energy Association of British Columbia (CEBC) has acted as a central advocate for BC's clean energy sector. It provides policies and builds partnership that support an affordable, and equitable clean energy for BC [17]. In 2024, CEBC collaborated with the government of British Columbia to develop an equitable Clean Energy future for all its citizens [17]. One of the best and cost-effective way for BC to meet future energy demand is by using energy more efficiently. This would enable people and business to save money by using less energy [18].

Through BC Hydro's energy efficiency programs, British Columbians have been able to save more than 7,000 gigawatt hours (GWh) of electricity every year. This amount of energy alone can power more than 700,000 homes annually which represents roughly 35% more energy than the Site C dam will generate [18]. Figure 4 displays a graph that compares BC Hydro electricity rate charges, with previous government's 10-year rate plan and the overall inflation in BC. Over the period from 2017/18 to 2024/25, BC Hydro electricity rates increased to about 11.3% which was below both the 21.2% projected under the old plan and the 26.9% increase in inflation. This graph shows how BC Hydro kept the electricity rate increases relatively low, even as the cost of living in BC rose much faster [18].

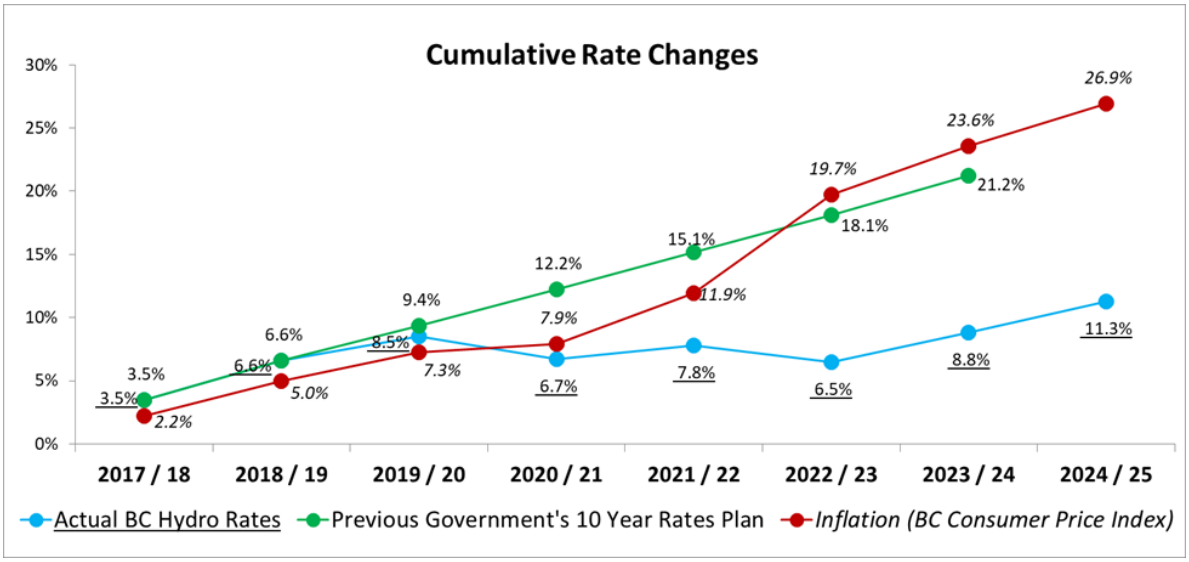

Figure 4: Cumulative Rate Changes. | *Source: BC Hydro*

In order to assist individuals and business produce their own electricity, BC Hydro is providing rebates for the installation of rooftop solar and battery solar systems [23]. This way, they will be able to reduce energy cost, and feed clean energy back into the grid. Released in the province's new clean-energy strategy on June 27, 2024, this strategy focuses on building a clean-energy economy, generating new jobs and opportunities, while still keeping electricity affordable [23].

Today, eligible homeowners in British Columbia can now receive BC Hydro rebates for as much as $10,000 for installing solar photovoltaic (PV) system and battery-storage systems together. These rebates are also made available for apartment buildings, schools, community organizations, local governments, small business, and Indigenous communities ranging from $50,000 to $150,000 based on the applicant [23]. This initiative is part of British Columbia's Clean Energy Strategy, Powering Our Future, which outlines the importance of the action's government is taking to accelerate the shift from fossil fuels to clean energy [23]. Opportunities such as investing over $700 million in BC Hydro energy-efficiency program over the next three

years will represent a 60% increase from the previous budget and is expected to save approximately $80 million annually by 2026, while reducing energy wastage [23].

BC's Centre for Innovation and Clean Energy (CICE) in partnership with BC Hydro has announced the Call for Energy Storage Innovation [25]. This initiative aims to explore new technologies and approaches to advance energy storage and strengthen the innovations of electricity grid across the province of British Columbia [24]. This program offers up to $3 million in non-dilutive funding to support projects that speed up the commercialization of clean energy technologies which shows the joint commitment between CICE and BC Hydro. The goal of this program is to expand British Columbia's renewable energy sources, decarbonize the energy sector, and promote electrification [25]. This partnership creates a unique opportunity for BC to lead in the development and implementation of innovative grid solutions.

British Columbia has made a significant progress in transitioning towards a cleaner and more sustainable energy solution through its adoption of Electric Vehicles (EVs) and the integration of Energy Storage. Through British Columbia's policies, partnerships, incentives, and infrastructure developments, it shows a strong commitment to reducing greenhouse gas emissions and increasing the possibility of implementing renewable energy usage.

In as much as this is a positive step for the province of British Columbia, it is also important to consider some of the potential barriers and challenges it may face. The adoption of electric vehicles and energy storage offers benefits such as reducing greenhouse gas emissions, creating a cleaner sustainable environment, ability to save energy, and lowering electricity cost through efficient energy use. It also creates awareness amongst people who want to know more about this imitative as well as creating job opportunities for individuals.

As the transportation sector shift from fossil fuel-powered vehicles (i.e. gasoline and diesel engines) towards electricity, the demand for electricity increases. Despite its high demand, the expansion of Electric Vehicles (EVs) offers benefits for reducing CO2 emissions. The implementation of Electric Vehicle (EVs) using electricity which is mostly generated from low-carbon source helps in the replacement of internal combustion engine vehicles which helps in reducing Co2 emissions [5]. Secondly, with EVs flexible charging and discharging infrastructure, a greater proportion of renewable energy sources can be utilized for transportation [5]. And lastly, the batteries in EVs can also serve as a supplemental energy storage through vehicle-to-grid (V2G) schemes [5]. In conclusion, the shift from gasoline and diesel vehicles to electric vehicles increases electricity demand but also offers some environmental benefits such as supporting a cleaner and more efficient energy system.

The high prices of electric vehicles is most likely going to be a challenge in adopting this initiative. Electric vehicles are more expensive than a regular gasoline powered vehicle due to the high cost of batteries production [27]. So that rapid switch to EVs might be difficult for individuals who cannot afford it even though EVs are cheaper to operate in the long run. Another challenge would be the high cost of installing public charging stations for people to use. Building these charging stations might require a lot of equipment, construction, utility connection fees [27]. If British Columbia expands its public EV charging stations, it will require significant efforts and financial investment to build and maintain these stations across different regions in BC. Lastly, since the province's electrical system was not originally built to handle large-scale EV charging demand, there will be limited grid capacity for energy storage.

CONCLUSION

In conclusion, British Columbia's adoption of electric vehicles (EVs) and the integration of energy storage systems shows how the province is committed to creating a cleaner and more sustainable environment for the future. From the information and case studies explored in this paper, it is evident that British Columbia is actively working towards promoting the use of electric vehicles and integrating energy storage systems to support individuals, and businesses. It also aims to reduce greenhouse gas emissions, improve energy efficiency, and build a transportation system that relies less on fossil fuels. Through the identified policies used in this essay, BC has positioned itself as one of the provinces in Canada in the shift toward low-carbon transportation. The high increase of Electric Vehicle (EV) ownership, the expansion of fast-charging networks, and the new programs supporting solar and battery storage all demonstrate how this significant transition benefit both the local communities and the environment. It is also important to note that while there is an advantage to this adoption, there are also some disadvantages to it. The expense of building public charging stations, the high purchase cost of EVs, and limited grid capacity are challenges that could be faced to slow down progress if not addressed properly. As electricity demand increases, it is advisable that the province of British Columbia continues to strengthen its grid, by making EV adoption more affordable and healthier for everyone.

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