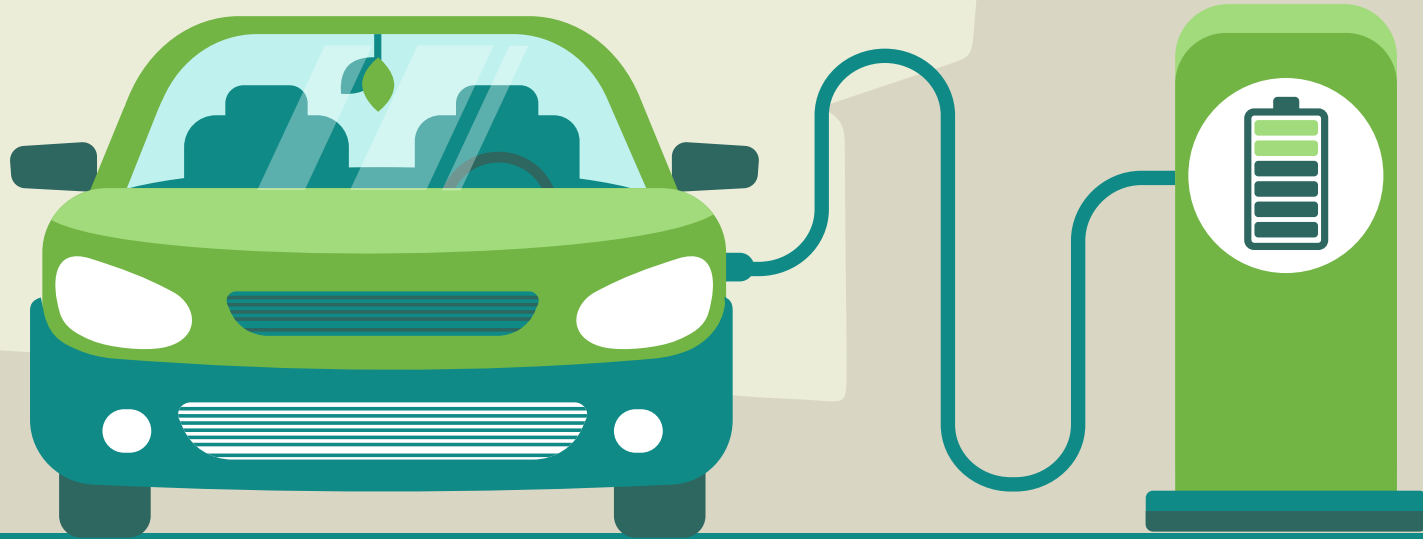


Electric Vehicle Adoption in Nova Scotia 2020-2030

PREPARED BY: DUNSKY ENERGY CONSULTING
FOR ECOLOGY ACTION CENTRE

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Fueling Change

Reliance on combustion-based transportation continues to drive spikes in greenhouse gas emissions, affecting the health of communities and the environment. Transportation is the second largest source of emissions in Canada, accounting for almost one quarter of the country's total GHG, and 27 percent in Nova Scotia.

On a route that's taken decades to travel, electric vehicles have truly and finally arrived. Car manufacturers continue to innovate on electric vehicle design and technology, with some like Volkswagen, pledging to develop only EVs by as early as 2026, and consumers are poised to change their buying habits. The question is not "if" but "when" EVs will dominate the light-duty vehicle market.

Yet, Nova Scotia is falling behind the rest of Canada and many countries across the globe in the uptake of EVs. Financial incentives for drivers, through rebates, fee exemptions and tax credits are widely-used by governments elsewhere to increase electric vehicles sales. Mandates requiring automakers to supply and sell EVs, along with upstream incentives has also proven to increase availability of EVs on sales lots.

Zero-emission vehicles are a crucial piece in rebuilding a transportation system that reduces GHG emissions, improves air quality, and moves society away from dependence on fossil fuels.

Time is a factor. Nova Scotia has committed to reducing its GHG emissions by 53% below 2005 levels by the year 2030 to remain below 1.5 C of warming. It's clear a business-as-usual approach to electric vehicles will leave us missing that mark, as well as failing to meet Federal EV targets.

Electric vehicle demand is not going to drive itself: provincial government and industry leadership is critical to electric vehicle uptake in Nova Scotia. This whitepaper aims to engage decision makers, and all Nova Scotians, in the solutions required to pave the way for a clean transportation system.

The scenarios presented in this report clearly demonstrate the need for provincial intervention in order to drive electric vehicle uptake at a rate that will allow us to meet our provincial GHG targets and our national EV targets. This whitepaper is only the beginning, and we hope it will serve to catalyze further analysis, collaboration and action on electric vehicles in Nova Scotia.

Nova Scotia has committed to reducing its GHG emissions by 53% below 2005 levels by the year 2030 to remain below 1.5 C of warming.

Acknowledgements

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While we are grateful for all the support that made this report possible, the opinions, scenarios, policies and proposals presented in this report are those of the authors alone.

The work of moving forward with low-carbon solutions in Nova Scotia take place on unceded, unsundered Mi'kmaw territory that is governed by Treaties of Peace and Friendship. All work toward the transition to a low-carbon future on this land must take place in the spirit of these treaties and in collaboration with the Mi'kmaq of Nova Scotia, and with the free, prior and informed consent of Mi'kmaw communities.



Executive Summary

The decarbonization of the transportation sector is a critical component to meeting global and national climate targets. In conjunction with increasing penetration of renewable energy in the electricity sector, electrification puts transportation, a sector responsible for nearly a quarter of Canada's greenhouse gas (GHG) emissions, on a path towards decarbonization by displacing carbon-intensive fuels with cleaner electricity resources. In addition to the environmental benefits, households and businesses can realize benefits from Electric Vehicle (EV) ownership, including improved driving experience and a significant reduction in vehicle operating costs and total cost of ownership (TCO).

Despite a notable growth in market share year-over-year globally, EV adoption remains in its infancy and faces several barriers that constrain wide-spread deployment. In Nova Scotia, EV adoption to date lags behind other jurisdictions across North America, with EVs representing less than 1% of new vehicle sales, as compared with up to 10% in leading regions. In recent years, investments made in establishing a public charging infrastructure network across Nova Scotia, the federal government's "iZEV" purchase incentive program, as well as education and awareness initiatives, have alleviated some barriers to adoption. However, the high incremental cost of EVs relative to Internal Combustion Engine Vehicles (ICEVs) and the limited availability of EVs locally continue to limit the market growth in the province.

Stakeholders from across Nova Scotia indicated that financial incentives would be a critical intervention in helping move the market forward in the province. Also, electric vehicle supply was identified as a major constraint to adoption in Nova Scotia by multiple stakeholders. Dunsky's own analysis found that 90% of dealerships in the province have **zero EVs** available for purchase. This whitepaper focuses on the impact of two key policy tools widely used by governments across North America to alleviate those barriers and accelerate EV uptake in their jurisdictions: a provincial vehicle purchase incentive and a Zero Emission Vehicle (ZEV) mandate. Our assessment shows that both policy options have a high impact on EV adoption and require provincial government intervention for implementation.

Specifically, the analysis highlights the forecasted trajectory for EV uptake under three scenarios that reflect different policy scenarios¹:

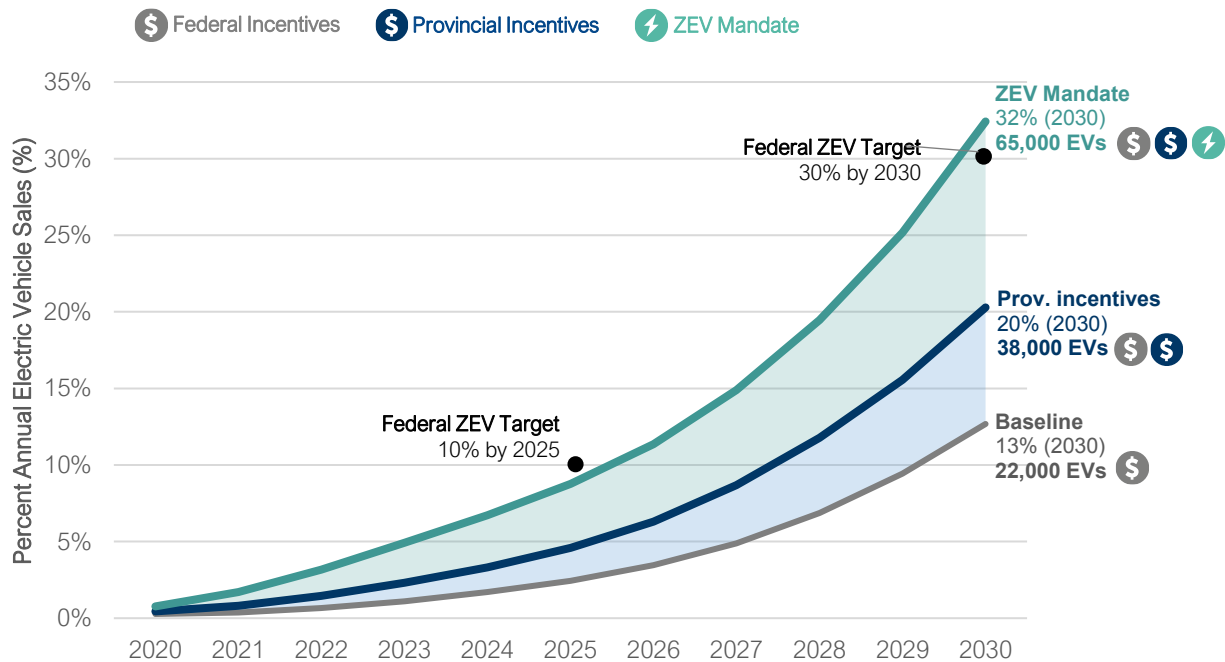
- **Baseline:** EV purchase incentives in-line with the current federal incentives, assumed to be phased out gradually by 2025.
- **Moderate (+Provincial Incentives):** Provincial EV incentives that offer a top-up to the federal rebates and increase the duration of purchase incentives to 2030.
- **High (+ZEV Mandate):** Provincial purchase incentives (highlighted in the previous scenario) coupled with a supply-side mandate to address market supply constraints.

Figure ES-1 below shows the forecasted EV uptake in Nova Scotia under each of the three modeled scenarios, highlighting forecasted EV adoption as a percent of annual light-duty vehicle sales, as well as

¹ Across all three scenarios, the analysis assumes sustained moderate investments in Level 2 and DCFC charging infrastructure. 200 L2 stations with 4 ports each and 50 DCFC stations with 2 ports each are assumed to be deployed by 2030.

the cumulative number of EVs on the road by 2030. The results also compare the forecasted adoption in Nova Scotia to the federal government’s targets for ZEV deployment nationwide (as a percent of annual vehicle sales) of 10% by 2025 and 30% by 2030.

Figure ES-1: Percent Annual Vehicles Sales by Scenario



The analysis highlights the following key takeaways:

- **Under current federal policy efforts, 22,000 EVs are expected on the road in Nova Scotia by 2030.** While the existing federal incentives will contribute to an increase of EV adoption in Nova Scotia, it is forecasted to only get Nova Scotia approximately halfway to the 2030 federal ZEV target.
- **The introduction of provincial incentives stacked up alongside the federal incentives will result in a 70% increase in EV adoption in Nova Scotia.** By 2030, EVs are forecasted to represent 20% of annual vehicle sales in the province, with 38,000 EVs on the road. However, adoption still lags behind the federal ZEV target (30% of sales by 2030) due to the constrained availability of EVs in the province.
- **A provincial ZEV mandate combined with provincial incentives can significantly increase EV uptake in Nova Scotia – exceeding 30% of sales and putting more than 60,000 vehicles on the road by 2030** (up from 0.1% of sales and 389 EVs today). These policy levers can alleviate two key barriers that face EV adoption, high incremental cost and limited vehicle supply, and put Nova Scotia on track to reaching the 2025 and 2030 federal ZEV targets.
- **Continued investment in public infrastructure deployment and favorable market conditions will be necessary to realize the forecasted market potential.** While the study focuses on vehicle purchase incentives and ZEV mandate as key policy interventions, additional levers will be necessary to achieve the forecasted market potential.

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1. Introduction

Context

The advent of Electric Vehicles (EVs) represents a significant disruption to both the transportation and energy sectors. In conjunction with increasing penetration of renewable energy in the electricity sector, electrification puts transportation, a sector responsible for nearly a quarter of Canada's greenhouse gas (GHG) emissions, on a path towards decarbonization by displacing carbon-intensive fuels used in the transportation sector with cleaner electricity resources. In addition to the environmental benefits, individuals and businesses can realize benefits from EV ownership, including improved driving experience and a significant reduction in vehicle operating costs and total cost of ownership (TCO).

Global projections forecast a rapid increase in global EV market share over the next two decades – driven by reductions in battery costs, increased deployment of charging infrastructure, and strong policy for EVs - reaching nearly 30% of annual vehicle sales by 2030 and 57% by 2040². Despite significant growth in market share year-over-year globally, EV adoption remains in its infancy and faces several barriers that constrain their deployment potential.

In Nova Scotia, EV adoption to date lags behind other jurisdictions across North America, with EVs representing significantly less than 1% of new vehicle sales. While there have been investments made in recent years in charging infrastructure that have alleviated some barriers to adoption, the high incremental cost of EVs relative to Internal Combustion Engine Vehicles (ICEVs) and the limited availability of EVs locally continue to limit the market growth in the province.

In this whitepaper, we highlight the potential for EV adoption in Nova Scotia and the impact policy interventions can have in accelerating EV uptake. Specifically, we focus on two key policy tools that are widely used by governments across North America to accelerate EV adoption: a provincial vehicle purchase incentive and a Zero Emission Vehicle (ZEV) mandate.

The following terminology is used in the report to describe EV technologies and infrastructure:

The study models the adoption of EVs - defined as any vehicle that plugs in to charge:

- **Battery Electric Vehicles (BEVs):** “pure” electric vehicles that have only an electric powertrain and plug in to charge (E.g. Chevy Bolt, Nissan Leaf)
- **Plug-in Hybrid Electric Vehicles (PHEVs):** hybrid vehicles that can plug in to charge and operate in electric mode for short distances (e.g. 30km to 85km), but that also include a combustion powertrain for longer trips. (E.g. Chevy Volt, Toyota Prius Prime)

Additionally, two types of charging infrastructure are included in the analysis:

- **AC Level 2 Charging:** 240 V power supply with rated power of 3.3 – 20 kW. A typical Level 2 charger (7.2 kW is most common today) can charge an EV at a rate of approximately 40 km of range per hour. Level 2 chargers are most commonly used at homes, workplaces and public charging locations.
- **Direct Current Fast Charging (DCFC)** – sometimes referred to as “Level 3”: DCFC have rated power of 25 to 350 kW (50 kW is currently the most common) and offering 20 – 60-minute charge for 80% of battery capacity depending on the vehicle and charge rate. A 50 kW DCFC can replenish 300 km of

² Bloomberg New Energy Finance – Electric Vehicle Outlook 2019

range per hour of charging, while newer equipment at 150 kW and above can accomplish the same in 30 minutes or less.

Lastly, the following terminology is used to describe public charging infrastructure:

- **Station:** a single site, facility or location that provides charging services. Stations can provide charging to one or more EVs at a time depending on the number of ports it includes. Represented by a single marker on a map.
- **Port:** a connector that can charge one vehicle at a time. (Note that some “dual standard” stations include connectors for different vehicle types but can only charge one vehicle at a time – considered as a single port).

Methodology

Scope

This study focuses on assessing the uptake of EVs in the Light-Duty Vehicles (LDV) segment in Nova Scotia, considering both BEVs and PHEVs³. The analysis considers ICEV to be the status-quo choice for consumers (i.e. the baseline option which EV benefits and costs are compared to).

Dunsky’s Electric Vehicle Adoption (EVA) Model

The study uses Dunsky’s Electric Vehicle Adoption (EVA) Model. The EVA Model was developed to address a growing need by utilities and governments to understand the potential size of the EV market in their respective jurisdictions and corresponding impacts. Based on rigorous data, EVA leverages the modeling framework behind Dunsky’s proven Solar Adoption Model (SAM), and builds on the knowledge base and expertise of our mobility practice. EVA projects market demand for EVs based on several key factors:

- **Technical potential:** The theoretical potential for deployment based on size (annual sales and fleet size) and vehicle class (e.g. cars, SUVs, trucks, buses) of the local vehicle market as well as the availability of different powertrain types (i.e. BEV, PHEV) for each vehicle class.
- **Customer economics:** The unconstrained economic potential based on the Total Cost of Ownership (TCO) of EVs and ICEVs. The TCO calculation considers the incremental upfront vehicle cost, fuel costs, as well as operations and maintenance (O&M) costs over the vehicle’s lifetime.
- **Constrained potential:** EV-specific barriers to adoption, including range requirements, range anxiety, home charging access, and public infrastructure deployment⁴ (Level 2 and DCFC).
- **Supply-side Constraints:** Dunsky developed a proprietary tool to scan dealerships for local availability of EV models. EVA leverages this data to apply a constraint on the accessible market potential. This allows for modeling of various scenarios, including a supply-side mandate.
- **Market dynamics:** Coupling technology diffusion theory with local market data to determine the rate of adoption of EVs locally, as well as competition between vehicle types.

³ Non-plug Hybrid Electric Vehicles (e.g. the original Toyota Prius) and Fuel Cell Electric Vehicles (FCEV) are not included in the analysis.

⁴ In considering charging infrastructure barriers in a jurisdiction, the EVA model considers regional coverage (geographic coverage of public charging infrastructure based of highway lengths and number of population centers that require coverage), local availability (a measure of the capacity of charging infrastructure required to handle local demand for charging by EVs – captured through an EV/port ratio for Level 2 and DCFC), and charging time (a measure of the average charging time installed public charging infrastructure in a jurisdiction can provide)

The following approach was used in the study to forecast EV adoption in Nova Scotia:

1. **Market Segmentation and Characterization:** The LDV market was broken down into three representative light-duty vehicle segments (cars, SUVs, and trucks) that capture differences in vehicle costs, usage patterns, and EV model availability, among other factors.
2. **Model Calibration:** Using historical data on vehicle sales, costs and other parameters, EVA was benchmarked to historical EV sales in Nova Scotia (2012 – 2019), and key model parameters were calibrated to capture local market characteristics.
3. **Key inputs and assumptions:** For each vehicle segment, assumptions on average vehicle characteristics (fuel consumption, powertrain size, battery size, etc.) are used to develop a representative model of vehicles within the segment. Additional assumptions on utilization (e.g. distance traveled) and operational costs were also compiled and used to calculate a bottom-up vehicle cost and TCO for the different powertrains within each vehicle segment.

The following sources were used for Nova Scotia-specific inputs:

- **Statistics Canada:** population, area of population centers, and housing composition.
 - **Nova Scotia Power Inc.:** electricity rates
 - **NRCan Comprehensive Energy Use Database:** number of vehicles and annual vehicle sales, and fuel prices.
 - **NRCan Electric Charging and Alternative Fueling Stations Locator:** charging station deployment.
4. **Vehicle Cost:** For each vehicle class (i.e. car, truck, SUV) and drivetrain (i.e. ICE, BEV, PHEV) combination, the model develops a representative vehicle archetype to forecast EV adoption. A bottom-up vehicle cost is calculated for each vehicle type using data from Dunsky's internal database on typical vehicle characteristics for each segment (baseline vehicle cost, powertrain size and cost, vehicle efficiency, battery size and cost, etc.). The bottom-up estimates are then compared to actual vehicle models of similar characteristics on the market to validate accuracy on estimates. Future vehicle costs are calculated using the same approach by varying battery costs and other key time-dependent factors.
 5. **Vehicle Availability:** Using Dunsky's proprietary tool, we scanned the local availability of EV models across dealerships in Nova Scotia. The compiled data is used to determine the achievable market potential based on data from other jurisdictions with different levels of supply constraints. This is then used to forecast EV adoption in Nova Scotia under current constraints as well as considering increased availability in dealerships under natural market evolution and supply-side policies.
 6. **Scenario Analysis:** Using Nova Scotia-specific data complemented with national data and other assumptions based on Dunsky's professional judgment and experience from other jurisdictions, we use the calibrated model to forecast future EV adoption in Nova Scotia. Specifically, the analysis considers adoption under various scenarios reflecting different interventions and policies (e.g. purchase incentives, ZEV mandates) as well as market and technology uncertainties (e.g. electricity rates, battery costs, etc.)

Stakeholder Engagement

To validate the current landscape in Nova Scotia in terms of the effect of policies and intervention on EV adoption, our team conducted consultations with key stakeholders. Relevant market actors included local and provincial governments, utilities, industry associations, and automotive dealerships. Interviews focused on understanding the challenges and barriers specific to Nova Scotia. Insights and key quotes provided throughout this report were obtained from stakeholder interviews.

2. Market Overview

EV Adoption: Barriers and Drivers

Despite growing sales globally and across Canada, EVs still face several barriers that impede their wide-spread adoption; most notably:

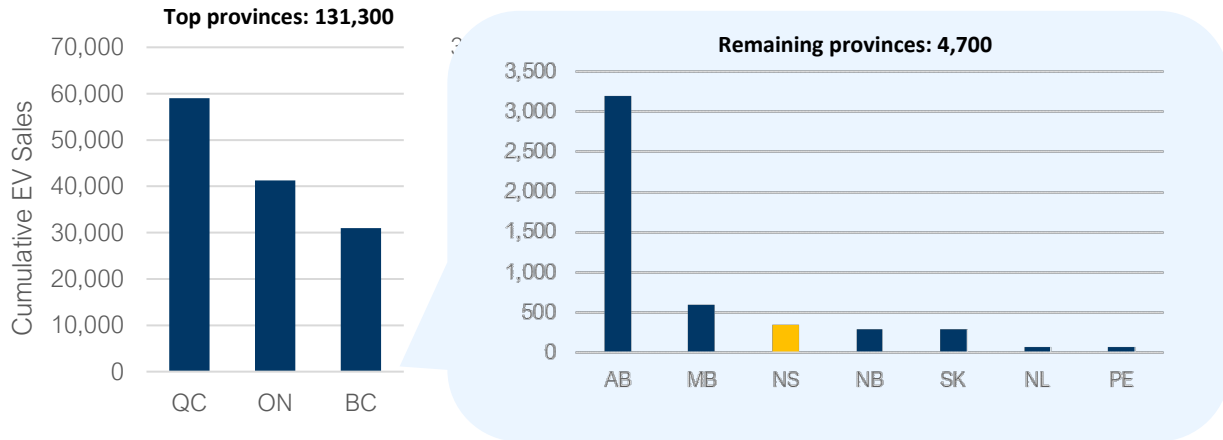
- **Incremental Purchase Cost:** The higher upfront cost of EVs relative to their Internal Combustion Engine Vehicle (ICEV) equivalent is a barrier to EV adoption. Although lifetime cost savings from avoided gasoline or diesel fuel costs, combined with reduced maintenance costs, can result in a lower total cost of ownership (TCO) for EVs, many consumers do not use a TCO approach when making decisions about major purchases.
- **Home Charging Access:** With 80-90% of EV charging expected to take place at home, lack of access to home charging for some segments of the population will limit their ability to adopt BEVs (as opposed to PHEVs). Specifically, in large urban centers, households that live in multi-unit residential buildings often face additional technical and non-technical barriers that make it challenging to install charging equipment that they can access from their usual parking location. Additionally, some households do not have access to dedicated garages or driveways.
- **Range anxiety and public charging access.** While most EV users are expected to charge their vehicles at home, deployment of public charging infrastructure is critical for alleviating “range anxiety”, or the fear of running out of charge away from home. Gaps in geographic coverage of public infrastructure can limit the ability to undertake long-distance travel. In contrast, insufficient capacity of charging infrastructure can lead to concerns about the availability of the infrastructure and potential lineups. Both real and perceived lack of public charging result in barriers to EV adoption. While access to public charging can enable PHEV users to cover greater distances without switching to gas power, range anxiety is only really a concern for BEV users.
- **Vehicle Availability:** The limited availability of existing EV models at local dealerships, as well as the lack of variety in available EV models, are a significant barrier to EV adoption. This is predominantly the case for larger vehicle segments (e.g. SUVs, pick-up trucks, minivans), for which EV models are currently limited or unavailable.
- **Lack of Awareness:** Limited information - or misinformation - about EVs, their availability, charging options, and total cost of ownership (TCO) can lead consumers to give outsized weight to the cost and risk of EVs relative to their benefits.

Current Landscape in Nova Scotia

There are roughly half a million light-duty vehicles currently registered in Nova Scotia and about 50,000 vehicles sold annually. By the end of 2019, EVs represented 0.3% of annual vehicle sales, with a total of 389 EVs on the roads.

Compared to other parts of Canada, Nova Scotia has had a relatively limited EV market falling significantly behind other leading markets in Canada. Specifically, EV adoption in Canada today is centered in the three provinces that have provided or currently provide purchase incentives for EVs, among other supporting policies and investments; Quebec, Ontario, and British Columbia. However, of the Atlantic provinces, Nova Scotia has the highest EV adoption, as highlighted in Figure 2.

Figure 2: Cumulative EV Sales by Province as of Q3 2019⁵



The following factors have shaped the current landscape for EV adoption in Nova Scotia:

- In the Canadian context, provincial incentives have proven to have a clear impact on adoption, as demonstrated by QC, BC, and ON. There is also evidence of the long-term impact of incentives, with Ontario’s EV market share of new vehicle sales remaining well ahead of other provinces despite rebates ending in 2018. The lack of provincial incentives have put **Nova Scotia behind the leading jurisdictions in Canada**.
- The introduction of the **federal government’s “iZEV” purchase incentive program** in 2019 has helped overcome some of the barriers associated with the higher up-front cost of EVs, and sales have increased in recent months. However, the overall offer in Nova Scotia is less generous than other provinces with combined provincial and federal incentives.
- Nova Scotia has so far seen significant investment in **public charging infrastructure** thanks to initiatives led by Nova Scotia Power Inc. (NSPI) and some private organizations with the support of the federal government through Natural Resources Canada’s Electric Vehicle and Alternative Fuel Infrastructure Deployment Initiative (EVAFIDI). At the end of 2019, 66 Level 2 stations and 17 Direct Current Fast Charging (DCFC) stations were estimated to be installed across the province. These deployments provide EV drivers with access to significantly more charging infrastructure and alleviate important barriers to adoption. However, **ongoing expansions will be required**, and there’s uncertainty around future investments given that the Nova Scotia Utility and Review Board rejected NSPI’s request to make rate-based investments in charging infrastructure.
- Recent **education and awareness efforts** through the Clean Foundation’s “Next Ride” initiative have been successful to date with more than 89 events, over 1,200 test drives, and 5,000 engagements. Also, the Clean Foundation has developed a web platform (EV Assist Nova Scotia) to provide information on EV basics, owning an EV, electric charging, and available infrastructure in Nova Scotia.
- One of the key barriers to adoption in Nova Scotia is the limited availability of **EV models in dealerships**. Dunsky’s analysis showed that only 1 in 10 dealerships in Nova Scotia have at least one EV available for purchase. This has been further echoed by local stakeholders who acknowledged long wait times and a complete lack of availability of certain models.

“Electric vehicles are not readily available in Nova Scotia and there are issues on the supply side, for example the wait time for the Hyundai Kona is 10 months”

⁵ Electric Mobility Canada (2019), “[Electric Vehicle Sales in Canada – Q3 2019](#)”

3. Policy Toolkit

Key Policy Levers

In this section, we explore key policy levers and market interventions available to governments and other market actors to alleviate barriers facing EVs in their jurisdictions and accelerate uptake. Specifically, we consider the following levers:

- **Public charging deployment:** While most charging is typically done at home overnight, public charging infrastructure provides additional flexibility for EV drivers covering longer distances and can provide an alternative for those without access to charging at home.
- **Home charging access:** Initiatives to increase home charging access for potential EV adopters can address a key barrier facing EVs. Specifically, incentives to cover the upfront cost of installing a home charger, as well as addressing the issue of chargers in MURBs through retrofits and building code requirements.
- **Outreach and Education:** To address information barriers facing EVs, initiatives to educate and increase awareness of EVs can be key. For example, EV marketing and awareness campaigns, test drive events, and “leading by example” (e.g. electrification of government and utility fleets) can increase awareness of EVs by correcting misconceptions and addressing perceived barriers to adoption.
- **Financial Incentives:** Policy actions in the form of financial incentives through rebates, fee exemptions or tax credits have been widely used by governments globally to incentivize EV adoption and reduce the incremental cost of EVs relative to ICEV.
- **Non-financial incentives:** Non-financial benefits offered to EV drivers can incent adoption. Key examples include providing EVs access to High-occupancy Vehicle (HOV) lanes or preferential parking access for zero-emission vehicles.
- **Supply-side policies:** Government policies that require automakers to supply and sell EVs, as well as upstream/midstream incentives for automakers/auto dealers that can help alleviate the limited availability of EVs in a jurisdiction.

Qualitative Assessment of Policy Options

To identify potential options for government intervention, we conducted a qualitative assessment of key policies to identify the ones most applicable to the Nova Scotia context and suitable for provincial government intervention. Leveraging our team’s knowledge of the Nova Scotia market and EV market across North America, and considering inputs from stakeholders in the province engaged as part of this project, each policy option was evaluated against the following criteria:

- **Impact on adoption:** The estimated level of impact the lever would have on EV adoption in the province;
- **Need for provincial intervention:** An assessment of the necessity for the provincial government to step in (as opposed to other actors); and
- **Implementation Cost:** The relative cost to the government for implementing the lever.

Table 1 below shows the results of the evaluation.

Low Impact or Need		High Impact or Need
High Cost		Low Cost

Table 1—Qualitative Assessment Matrix of Key Policy Levers

Levers		Key Considerations	Impact on Adoption	Need for Provincial Intervention	Implementation Cost
Public Charging Deployment	Level 2	Less impactful than DCFC in terms of addressing barriers to adoption. Lower cost, meaning that a larger array of actors are likely to participate.			
	DCFC	High impact in terms of addressing range anxiety and enabling longer trips. High costs and low revenue opportunities mean there is a lack of investment in this space. Early deployments have been led by the utility, but there will be a need for ongoing expansion in the future: filling gaps in the map, densifying in urban areas, and adding capacity on highway corridors to avoid congestion. The utility does not have a clear mandate to pursue ongoing investment.			
Increasing Home Charging Access	Home Charger Incentives	Installation of charging equipment in single-family homes is not a significant barrier to adoption. Incentives can be tied to utility programs to encourage the installation of network-connected charging equipment that can enable “smart charging” to minimize impacts on the grid.			
	MURBs Retrofits	Not as high a priority as in other jurisdictions with larger urban areas, but still an important challenge for areas with significant existing MURB building stock as in the HRM.			
	Building Code Changes	Not as high a priority as in other jurisdictions with larger urban areas, but ensuring new buildings are designed with charging infrastructure in mind is much cheaper than retrofits after the fact. May require coordination between HRM and the provincial government.			
Outreach and Education	Awareness Campaigns	Can have a significant impact in accelerating adoption at relatively low cost. Existing initiatives led by Clean Foundation are a good start, but ongoing support is required.			

Levers		Key Considerations	Impact on Adoption	Need for Provincial Intervention	Implementation Cost
	Lead by Example	Less of an overall impact compared to targeted awareness campaigns but can contribute positively to awareness while building capacity within the local market and delivering savings to utility/government fleets on a TCO basis. The provincial government can also play a coordinating role to encourage other actors as well.	Yellow	Green	Yellow
Financial Incentives	Purchase Rebates	Strong impact on adoption as it directly addresses the high upfront cost of EVs, but typically only feasible at the federal or provincial level due to the costs and coordination required.	Green	Green	Red
	Fees Exemptions and Tax Credits	Provincial governments have a number of existing mechanisms to enact these types of incentives, but they have less of an impact in terms of directly addressing the upfront purchase costs of EVs	Yellow	Green	Yellow
Non-Financial Incentives	HOV Lane Access	Can be a low-cost and impactful incentive for EV adoption in some jurisdictions, but there is limited applicability in NS due to the lack of highway corridors with existing HOV lanes.	Yellow	Yellow	Green
	Preferential Parking	Typically implemented by local governments.	Yellow	Yellow	Green
Supply-Side Policies	Supply Mandate	High impact on EV adoption, especially in markets with limited local availability of EVs. No cost to government besides administration and compliance monitoring.	Green	Green	Green
	Midstream Incentives	Lower incentive levels required than consumer purchase incentives, though there is limited experience with this approach in North America.	Yellow	Yellow	Yellow

This study focuses on two key policy tools; a provincial vehicle purchase incentive for EVs and a ZEV supply mandate. Our qualitative assessment showed that both policy options have a high impact on EV adoption. Also, both levers have a strong need for provincial intervention with a limited number of other actors that can intervene.

While not the focus of this study, two other policy levers were identified that would benefit from intervention from the provincial government: ongoing **DCFC investment** and requirements for **charging access in MURBs**:

- There has been progress made to date in Nova Scotia in terms of the deployment of DCFC infrastructure, but ongoing expansion is required. Nova Scotia Power's application to invest in DCFC deployment was rejected by the Nova Scotia Utility and Review Board, and they have not been given a mandate to play a role in this space. In other jurisdictions, including California and Quebec, utilities have been identified by governments and regulators as key actors to address market failures and support ongoing deployment of charging infrastructure. The provincial government may have a role to play in determining an appropriate role for Nova Scotia Power in charging infrastructure deployment and making necessary legislative or regulatory adjustments.
- While the percentage of residents in MURBs is lower in Nova Scotia than in some other provinces, access to charging in MURBs is still an important barrier to adoption in the Halifax Regional Municipality (HRM). The municipality can champion this effort but may require provincial support specifically as it related to changes to building codes.

Incentives & ZEV Mandate

The higher upfront cost of EVs relative to ICEVs remains one of the key barriers to EV adoption. While cost reduction trends are expected over the next decade, a cost forecast analysis recently conducted by Dunsky showed that price parity⁶ for medium-sized LDVs would likely be as far as 2030. In addition, our analysis showed that the total cost of ownership (TCO) breakeven point for an EV purchased in 2020 would be close to 10 years in the absence of financial incentives.

The use of **financial incentives** to encourage the adoption of EVs has proven to be an effective policy lever in overcoming these barriers across many jurisdictions⁷. The market in Canada follows the same trend, with leading jurisdictions (QC, ON, BC) being ones that have implemented a provincial financial incentive. As highlighted earlier, incentives also seem to have long-term impacts, with Ontario remaining well ahead of other provinces even after the government stopped the incentives in 2018.

Stakeholders from across Nova Scotia indicated that financial incentives would be a critical intervention in helping move the market forward in the province. Specifically, upfront purchase incentives were highlighted as most likely to address cost barriers from a consumer's perspective directly. While there are several other approaches to offering financial incentives, including tax credits and discounts on annual fees, studies have shown that upfront incentives are the most effective in influencing adoption⁸ by directly addressing the high upfront incremental cost of EVs.

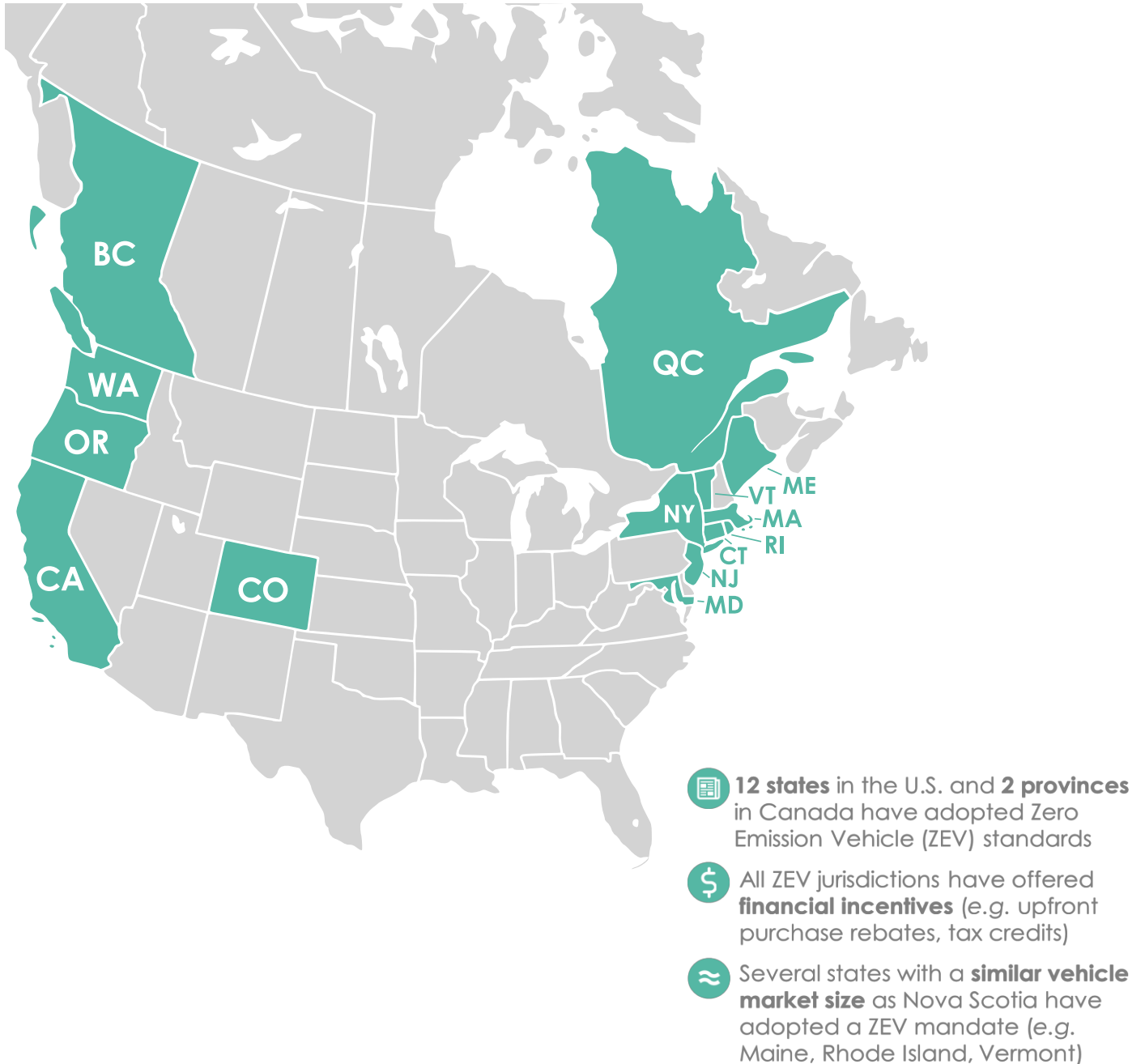
⁶ Price parity is the point at which the purchase price of an electric vehicle is equivalent to the purchase price of a similar internal combustion engine vehicle.

⁷ *Providing the Spark: Impact of financial incentives on electric vehicle adoption*, Journal of Environmental Economics and Management

⁸ *Principle for Effective Electric Vehicle Incentive Design* (2016), The International Council on Clean Transportation

While financial incentives, deployment of charging infrastructure, and awareness campaigns can be critical tools to help increase consumer demand for EVs, EV adoption can remain stifled by the lack of availability of EVs due to vehicle supply constraints. **Electric vehicle supply** was identified as a major constraint in Nova Scotia by multiple stakeholders. Dunsky’s own analysis found that 90% of dealerships in the province have no EVs available for purchase. Stakeholders identified a number of barriers to entry for dealerships looking to begin selling EVs, including training of sales staff and service technicians, and the cost of specialized tools and charging infrastructure. Also, multiple stakeholders indicated that automakers are prioritizing markets where they are mandated to sell electric vehicles over Nova Scotia, with some dealerships struggling to receive inventory and putting customers on months-long waiting lists.

Figure 3 – Map of ZEV States/Provinces in North America



Many jurisdictions in North America have adopted the California ZEV standard, which requires automakers to sell a certain number of electric vehicles based on the overall vehicle sales in the province/state. The program works based on a credit system, where each EV sold earns a number of credits based on the type of technology and its battery range. The automotive industry has traditionally pushed back against ZEV mandates citing them as a high burden on their business. However, recent developments seem to indicate otherwise, with GM calling for a National ZEV program⁹, and Colorado¹⁰ becoming the first state to adopt a ZEV mandate with support from two major industry groups (Alliance of Automobile Manufacturers and Global Automakers).

Several states with a similar vehicle market size to Nova Scotia have successfully adopted a ZEV mandate (e.g. Maine, Rhode Island, Vermont). It is also important to note that all ZEV states/provinces have also adopted demand-side policies (*i.e.* financial incentives). This ensures that proper steps are taken to ensure there is sufficient consumer demand to meet the mandated supply targets. Table 3 in Appendix B provides a summary of all 14 states and provinces in North America with a ZEV mandate in place or in development, including information about available incentives and overall market size.

Several stakeholders in Nova Scotia indicated that the province would benefit significantly from the introduction of both a ZEV mandate and a provincial incentive program. In combination with parallel efforts in education and charging infrastructure deployment, provincial incentives would stimulate strong consumer demand for EVs, while a ZEV mandate would ensure that interested consumers would find EVs available for purchase in local automotive dealerships in sufficient supply to satisfy that demand.

⁹ <https://media.gm.com/media/us/en/gm/news.detail.html/content/Pages/news/us/en/2018/oct/1026-emissions.html>

¹⁰ <https://www.edf.org/media/colorado-becomes-first-state-central-us-adopt-zero-emission-vehicle-standards>

4. Analysis Results

Scenarios

Policy and program support can have a significant impact on driving EV sales in a jurisdiction by addressing key barriers facing potential adopters. To assess potential pathways for EV adoption in Nova Scotia, three scenarios that reflect different levels of government interventions were developed:

- **Baseline:** A baseline that assumes sustained moderate investments in Level 2 and DCFC charging infrastructure¹¹ and EV purchase incentives in-line with current federal incentives phasing out by 2025.
- **Provincial Incentives:** A market trajectory that assumes additional provincial policy support through increased value and duration of purchase incentives (provincial government support).
- **ZEV Mandate + Prov. Incentives:** Strong provincial policy support for EVs through a supply-side mandate to address market supply constraints, accompanied by the provincial purchase incentives highlighted in the previous scenario.

Table 2. Baseline, Moderate, and High Scenario Parameters

	BASELINE (Federal Incentives)	MODERATE (+ Provincial Incentives)	HIGH (+ ZEV Mandate)
Total Vehicle Purchase Incentive	\$2,500 incentive for PHEVs \$5,000 incentive for BEVs (ramp down over time, final year of incentives in 2025)	\$5,000 incentive for PHEVs \$10,000 incentive for BEVs (ramp down over time, final year of incentives in 2030)	\$5,000 incentive for PHEVs \$10,000 incentive for BEVs (ramp down over time, final year of incentives in 2030)
ZEV Mandate	NO	NO	YES

Forecasted Uptake

In this section, we highlight the forecasted uptake under each of the three modeled scenarios. Figure 4 shows the forecasted EV adoption as a percent of annual light-duty vehicle sales, as well as the cumulative number of EVs on the road by 2030. The results also compare the forecasted adoption in Nova Scotia under each scenario to the federal government’s targets for ZEV deployment nationwide (as a percent of annual vehicle sales) of 10% by 2025 and 30% by 2030.

Baseline Scenario: No Action

While EV penetration continues to increase under the Baseline Scenario, the market experiences a relatively slow growth over the next ten years, with EVs only reaching a market share of 2% of LDV sales in 2025 and 13% by 2030. Most notably, under this scenario, EV adoption falls significantly short of the federal ZEV targets of 10% by 2025 and 30% by 2030. Under this scenario, approximately 3,500 EVs are expected to be on the road in Nova Scotia by 2025, and 22,000 by 2030.

¹¹ An assumption of 200 L2 stations with 4 ports each and 50 DCFC stations with 2 ports each by 2030.

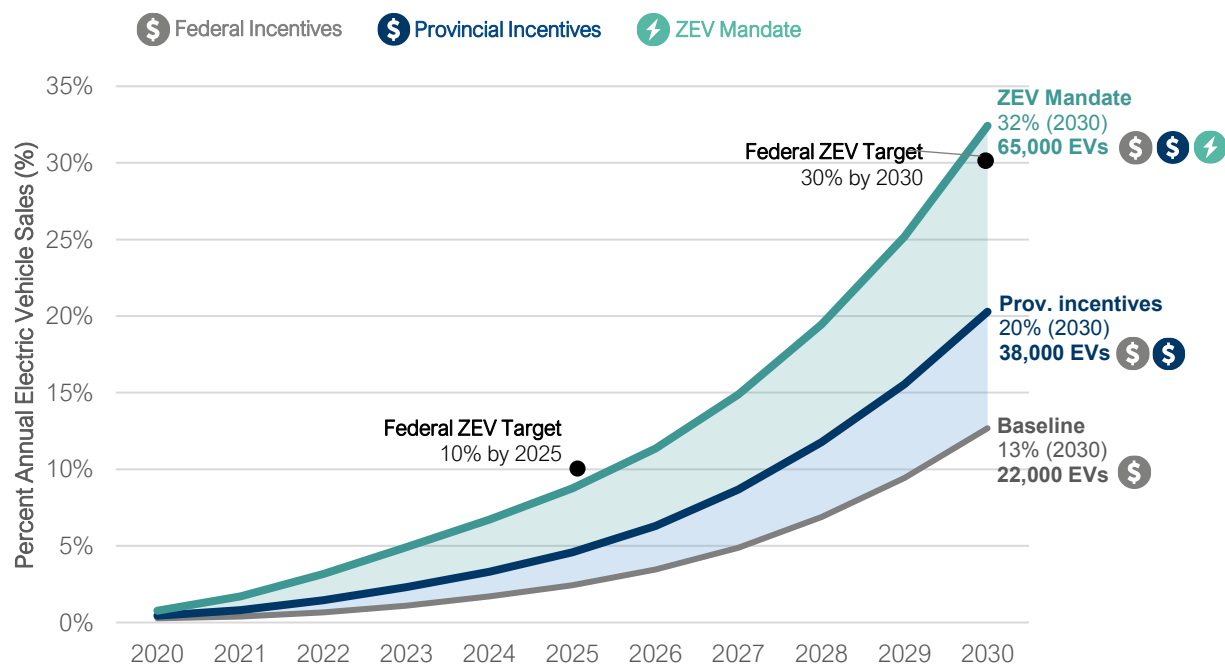
Moderate: Provincial Incentives Scenario

Under the Provincial Incentives Scenario, incentives accelerate the uptake of EVs in Nova Scotia significantly compared to the Baseline Scenario. Cumulative EV sales increase by 87% in 2025 (~6,000 EVs) and 71% in 2030 (~38,000), adding approximately 16,000 additional electric vehicles on the road by 2030. While forecasted adoption in Nova Scotia still falls short of the 2025 and 2030 federal ZEV targets, EV sales reach 5% of LDV sales by 2025, 20% by 2030.

High: Provincial Incentives + ZEV Mandate Scenario

Under the Supply-side Mandate Scenario, significant acceleration in EV adoption in Nova Scotia is forecasted. In the short-term (2025), adoption is accelerated (compared to the Baseline and Provincial Incentives Scenarios) due to alleviating supply constraints by 2023. Relative to the Baseline Scenario, cumulative EV sales increase by 265% in 2025 (~13,500 EVs) and 191% in 2030 (~64,500 EVs), adding almost 42,500 additional electric vehicles on the road by 2030. In the short-term, EV sales reach 9% of annual LDV sales by 2025, slightly below the federal ZEV target of 10%. In the long-term, steady growth in EV market share is expected to reach 32% of annual LDV sales, exceeding the 30% federal ZEV target.

Figure 4 – Percent Annual Vehicles Sales by Scenario



Sensitivity Analysis

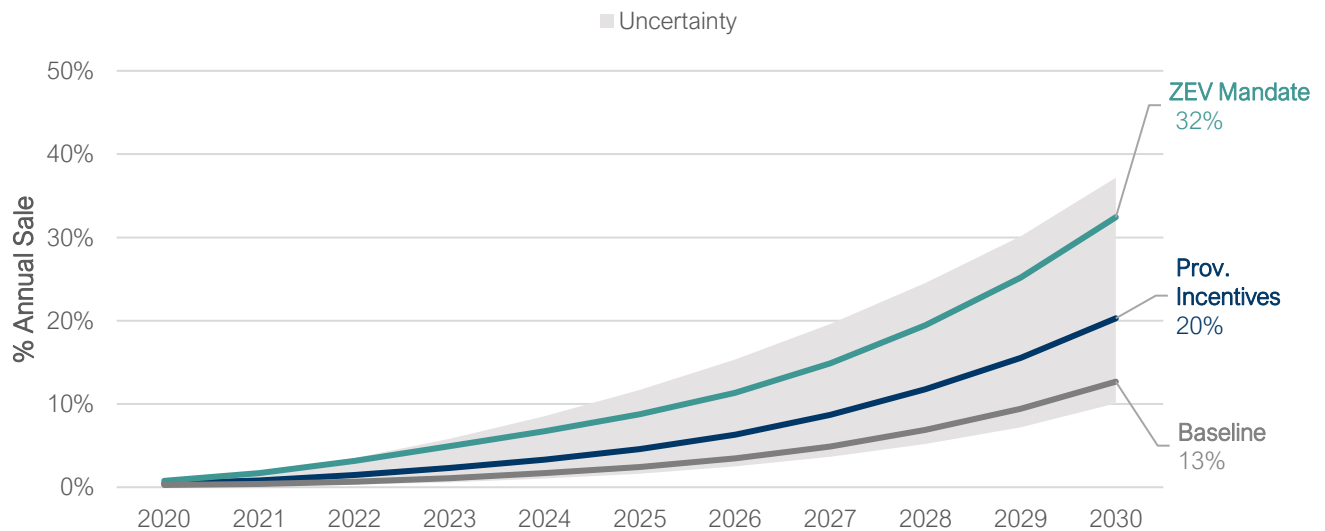
In addition to the modeled policy levers, exogenous technology and market factors can also influence EV adoption in Nova Scotia. Most notably, we assess the impact of three key factors that have a significant impact on EV sales:

- **Battery costs:** Battery costs represent a significant portion of the incremental cost of EVs over ICEV equivalents, and therefore have a substantial impact on the economics of EV adoption. While battery costs have been on a rapid decline trajectory, there is uncertainty around future costs.

- **EV model availability:** The limited global availability of EV models on the market today limits customer choice and EV adoption, particularly for vehicle segments that have no EV-equivalent model available today (e.g. pick-up trucks). While our model captures the anticipated availability of new models per industry announcements and roadmaps, there remains some uncertainty.
- **Electricity and gasoline prices:** A key value proposition of EVs is the reduction in the TCO of vehicles by displacing expensive gasoline with cheaper electricity. However, electricity and, especially, gasoline prices are subject to swings that can impact the relative attractiveness of EVs.

To highlight the impacts of these uncertainties on the forecasted adoption, we assess a “best-case” and “worst-case” scenario through varying these factors coupled with the Baseline and *ZEV Mandate + Prov. Incentives* policy and program scenarios previously examined to estimate an upper and lower bound for EV adoption in Nova Scotia. The results of the analysis are presented in Figure 5. For example, the most conservative estimate shows that EVs will remain below 10% of sales by 2030 versus 13% of sales under the Baseline Scenario. On the other hand, the most aggressive estimate shows that the ZEV Mandate Scenario will hit both the 2025 and 2030 federal ZEV targets approaching the 40% mark.

Figure 5. Percent Annual Vehicle Sales by Scenario with Conservative and Aggressive Sensitivity Bounds Shaded in Grey



Societal Impacts

While the study does not quantify the societal benefits associated with EV adoption, below we highlight key impacts that the forecasted EV adoption will bring to Nova Scotia:

- **Emission reductions:** By displacing fuel consumption with electricity from the grid, EVs can significantly reduce GHG emissions. Emission reduction includes both direct tailpipe emissions and “upstream” emissions from production and transport of gasoline. Modeling done by researchers at the University of Toronto Transportation and Air Quality Group quantified the potential GHG reduction from the deployments of electric passenger vehicles and buses.

The results showed a potential reduction of 8 megatons of GHG emissions, equivalent to the output of two coal plants¹². The potential for EVs to reduce emissions in Nova Scotia's transportation sector is likely to only increase over the next decades, particularly considering efforts to decarbonize the province's electricity mix.

- **Cost savings:** Considering both the incremental cost of EVs relative to conventional ICEV in the short-term as well as the operational cost savings (i.e. lower fuel spending and maintenance costs), EVs can bring Nova Scotia households and businesses millions in cost savings from the reduction in vehicle total cost of ownership. For example, Hydro Quebec estimates the potential annual savings on fuel cost in the order of \$1,677 for an annual distance traveled of 20,000 km¹³.
- **Ratepayer benefits:** The increased electricity sales resulting from the electricity consumption associated with EV charging loads will drive utility revenues and can result in cost savings to utility ratepayers. Benefits can be maximized by ensuring that the cost of supplying the new loads are minimized by leveraging load management techniques such as smart charging, which can reduce the peak impacts of EVs.
- **Health Benefits:** One of the most significant sources of air pollution in urban areas is vehicle traffic. Air pollution is a health concern as it is linked to many health conditions and diseases. Moreover, Canadian research has shown that marginalized socio-economic groups are disproportionately exposed to air pollution, and would benefit more from pollution reduction¹⁴. A study conducted for the Greater Toronto Hamilton Area (GTHA) found that air pollution causes more than 3000 premature deaths every year. Modeling showed that a shift to 100% electric passenger vehicles would result in the prevention of over 300 premature deaths per year¹¹.

¹² Clearing the Air: How Electric Vehicles and Trucks Can Reduce Pollution, Improve Health and Save Lives in the Greater Toronto and Hamilton Area

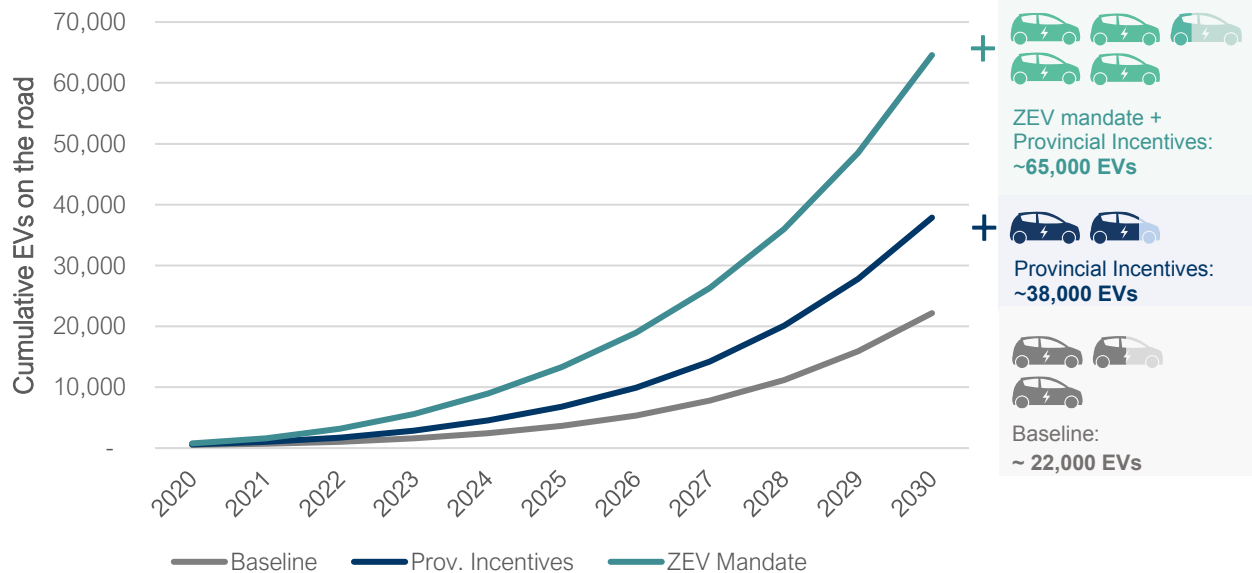
¹³ <https://www.hydroquebec.com/transportation-electrification/electric-vehicles/calculate-your-savings.html>

¹⁴ Canadian Institute for Health Information, Urban Physical Environments and Health Inequalities, March 2011

5. Key Takeaways and Considerations

The study assesses EV adoption potential in Nova Scotia under different policy and market conditions. Results from the three modeled scenarios representing Baseline, Provincial Incentives, and ZEV Mandate trajectories for EV adoption in Nova Scotia are summarized in Figure 6 below.

Figure 6: Cumulative EV Sales by Scenario



The analysis highlights four key takeaways:

- **Current federal policy efforts will get Nova Scotia approximately halfway to the 2030 federal ZEV target.** The Baseline Scenario, which includes existing federal incentives, will contribute to an increase of adoption of EVs in Nova Scotia; however, it is clear that a joint provincial and federal effort will be required to achieve the 30% ZEV target by 2030.
- **Provincial incentives will increase adoption but will not be sufficient to meet the 2030 federal ZEV target.** The introduction of provincial incentives stacked up alongside the federal incentives will result in a significant increase in EV adoption in 2025 and 2030. However, wider adoption will remain limited due to the lagging availability of electric vehicle supply.
- **ZEV mandate combined with provincial incentives will be critical in getting Nova Scotia to 30% by 2030.** Despite adoption in Nova Scotia currently significantly lagging the leading markets across Canada, our analysis highlights that under a ZEV mandate scenario accompanied by provincial incentives, there is significant potential for EV uptake in Nova Scotia – exceeding 30% of sales and putting more than 60,000 vehicles on the road by 2030 (up from 0.1% of sales and 389 EVs today).
- **Continued investment in public infrastructure deployment and favorable market conditions will be necessary to achieve high market demand.** While the modeled levers are generally forecasted to increase total EV adoption in Nova Scotia, our analysis assumed ongoing investment in charging infrastructure, which would be necessary to realize high market shares.

APPENDICES



Appendix A: Additional Resources

Table A-1: List of ZEV states/provinces and available incentives

State/Province	Provincial/State Incentives	Federal Incentives	New Vehicle Market Size relatively to NS
British Columbia	Up to \$3,000 rebate	Up to \$5,000 rebate	2.5x
Quebec	Up to \$8,000 rebate		9x
Washington	Retail Sales Tax Reduction (ZEV policy recently passed)	Up to \$7,500 tax credit	
Colorado	Up to \$4,000 tax credit		
California	\$2,500 rebate		49x
Maryland	\$3,000 tax credit, \$700 rebate on wall connectors and installation		8x
Connecticut	\$500-\$2,000 rebate		4x
Massachusetts	Up to \$2,500 rebate		9x
New York	Up to \$2,000 rebate		25x
New Jersey	Up to \$5,000 rebate (2020)		15x
Oregon	Up to \$2,500 (battery size)		4x
Vermont	Up to \$5,000 rebate (2020)		≈
Rhode Island	Up to \$2,500 (battery size)		≈
Maine	Up to \$2,000 (limited time)	2x	

About Dunsky

Dunsky is a leading Canadian firm specialized in the design, evaluation and analytical support of leading clean energy and electric mobility initiatives across North America. Founded in 2004, Dunsky's staff brings extensive experience identifying and assessing clean energy opportunities – whether they involve new technologies, advanced industry practices or innovative market strategies – across Canada and the U.S. Our expertise is focused primarily on energy efficiency, renewable energy, and clean mobility through three services areas:

- **Quantify Opportunities:** We quantify clean energy opportunities, including the technical, economic and achievable rates of adoption under a variety of market conditions, scenarios and constraints.
- **Design Strategies:** We help our clients develop effective strategies to achieve their clean energy goals. We notably design and assess policy and regulatory frameworks, incentive programs and plans, financing strategies, infrastructure investment options and more.
- **Evaluate Performance:** We help our clients evaluate the performance of those same strategies, with a view toward continuous improvement. This may include impact and process evaluations, market assessments or portfolio-wide reviews.

Dunsky's clean mobility practice includes a strong emphasis on transportation electrification. Recent electrification clients have notably included the governments or utilities of every Canadian province, multiple federal government departments, and similar clients in the U.S. We help our clients understand the options, forecast market adoption, assess the business case, and design both regulatory and market-based strategies.

Our work on EVs leverages our energy demand-side management (DSM) practice by assessing synergistic opportunities like demand response, load management, energy storage and renewable energy in order to minimize EV grid and cost impacts, while maximizing benefits for all stakeholders.

Overview

Expertise



EFFICIENCY

Renewables



RENEWABLES

Mobility



MOBILITY

Quantify Opportunities



QUANTIFY
Opportunities

Design Strategies



DESIGN
Strategies

Evaluate Performance



EVALUATE
Performance

Clients



GOVERNMENTS
UTILITIES
BUSINESS + NON-PROFITS



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