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Charging Ahead: Ensuring Equity and Reliability in Canada's Electric Vehicle Network

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CSA Public Policy Centre



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Decarbonizing the transportation sector will fundamentally change the way people move around in Canada and abroad.

Executive Summary

A key component of Canada's transition to a low-carbon economy will be the decarbonization of the transportation sector. As part of this path to decarbonization, the federal government has proposed a mandatory zero-emission vehicle (ZEV) sales target of 100% for all light-duty passenger vehicles by 2035. While these vehicles may use alternative fuel sources such as hydrogen, battery electric vehicles (EVs) currently appear to hold the most potential – its market is booming as the average price of an EV continues to decline and the price of gasoline skyrockets.

There is a need to deploy hundreds of thousands of charging sites across the country and do it quickly to seize the momentum of the EV marketplace. The federal government is pushing forward with cost-sharing programs alongside numerous provincial and municipal initiatives to build sufficient public and private EV charging infrastructure. However, it is important that these long-term investments be made thoughtfully and strategically to ensure that no one is left behind in the low-carbon transition. If the future of mobility is electric, it is crucial that governments, charging network operators, and utilities work together to build a Canada-wide EV charging network that is equitable, accessible, and reliable.

This report provides an overview of Canada's EV charging infrastructure, followed by a summary of the key issues surrounding charging infrastructure deployment, such as location, physical design, reliability, and payment options. Finally, policy considerations are offered for the federal government to keep in mind as it develops a robust EV charging network:

- Deploy EV charging infrastructure through an equity lens
- Incorporate accessible design practices at the outset
- Ensure reliability for drivers
- Promote inclusive payment options

This report has been informed by interviews with subject matter experts across government and industry and policy and technical research, as well as literature reviews and a jurisdictional scan of best practices.

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Introduction

A key component of Canada's transition to a low-carbon economy will be decarbonization of the transportation sector. Transportation is the second largest source of greenhouse gas (GHG) emissions after the oil and gas sector, accounting for 24% of total emissions in Canada.[1]

Decarbonizing the transportation sector will fundamentally change the ways people move around in Canada and abroad. This shift requires a reimagining of passenger, public transit, and commercial vehicles, and an entirely new system of public and private infrastructure to support refuelling these vehicles with alternative fuels like electricity. This could be the most significant transformation in mobility since gasoline-powered cars replaced horse-drawn carriages.

As part of this path to decarbonization, the federal government has proposed a mandatory zero-emission vehicle (ZEV) sales target of 100% for all light-duty passenger vehicles by 2035, accelerating its previous deadline of 2040. While these vehicles may use alternative fuel sources such as hydrogen, battery electric vehicles (EVs) currently appear to hold the most potential—the market for EVs is booming as the average price of an EV continues to decline and the price of gasoline skyrockets.

There is a need to deploy hundreds of thousands of charging points across the country and do it quickly to capitalize on the momentum in the EV marketplace. The federal government is pushing forward with cost-sharing programs alongside numerous provincial and municipal initiatives to build sufficient public and private EV charging infrastructure. However, it is important that these long-term investments be made thoughtfully and strategically to ensure that no one is left behind in the low-carbon transition.



If the future of mobility is electric, it is crucial that governments, charging network operators, and utilities work together to build a Canada-wide EV charging network that is equitable, accessible, and reliable.

The proposed ZEV sales targets mean that by 2035, new internal combustion engine (ICE) vehicles will no longer be available for purchase. Anyone who needs to get around in a passenger vehicle—whether they have purchased a vehicle, are renting a vehicle, or participating in car sharing—will need access to EV charging points. If the future of mobility is electric, it is crucial that governments, charging network operators, and utilities work together to build a Canada-wide EV charging network that is equitable, accessible, and reliable.

Vehicle electrification stands to benefit all Canadians. As EV technology advances and prices continue to decline, the cost savings are expected to be significant—particularly for low- and moderate-income families who spend a disproportionate amount of their income on vehicle maintenance and fuel costs.[2] Decarbonization also holds the potential to improve the health and quality of life for members of equity-deserving communities who are disproportionately impacted by the consequences of local air pollution, traffic, congestion, and a warming climate.

Governments have a role to play in supporting Canadians through this transition and ensuring that the benefits are shared equitably. By learning from other jurisdictions, making purposeful investments, and collaborating with public, private, and community partners, Canadian governments can make an inclusive transition possible.

This report provides an overview of Canada's EV charging infrastructure, followed by a summary of the key issues surrounding charging infrastructure deployment, such as location, physical design, reliability, and payment options. Finally, policy considerations are offered for the federal government to keep in mind as it develops a robust EV charging network, namely, to deploy EV charging infrastructure through an equity lens, incorporate accessible design practices at the outset, ensure reliability for drivers, and promote inclusive payment options.

Canada's EV Charging Infrastructure

This section provides an overview of EVs and EV charging technology, contextualizes Canada's position within electric transportation trends globally, discusses the key policy levers available to governments, and summarizes Canada's current commitments and programs to support the transition to electric mobility.

Overview of EVs and EV Charging Technology

Discussion around ZEVs often includes battery electric vehicles, plug-in hybrid electric vehicles, and hydrogen fuel cell vehicles. The focus of this report will be on battery electric vehicles (EVs) that use an electric motor rather than an ICE and therefore require a battery rather than gasoline for power. These vehicles do not produce tailpipe emissions, although there may be emissions associated with the manufacture of the battery or charging the battery, depending on the source of electricity. Plug-in hybrid electric vehicles (PHEVs) combine both an electric battery and gasoline as fuel sources and therefore produce tailpipe emissions, although they may still qualify for some government incentives and initiatives in Canada.[3]

This report also focuses specifically on EV charging for light-duty vehicles including cars, vans, SUVs, and trucks that are used to carry passengers. Generally, these vehicles are owned by individuals, although they can also be small fleet vehicles owned by businesses such as ride-hailing or delivery services. Medium- and heavy-duty vehicles, such as buses, commercial freight and large fleet vehicles, are also significant contributors to GHG emissions in Canada and are undergoing electrification. However, the transition for these vehicles faces challenges with respect to charging infrastructure that are beyond the scope of this report.[4]

Depending on the needs of the driver and the vehicle, different charging options are required for EVs. The options are categorized by three levels. Level 1 charging can be accessed through any standard electrical outlet—this is the slowest option and best suited for overnight, home charging. Level 2 is the most common charging level as it can replenish a battery in a few hours, which is ideal for home charging as well as public locations such as retail and workplaces where drivers may spend a few hours. Level 3 or "direct current fast chargers" (DCFC) are the fastest option and ideal when a driver is short on time (e.g., travelling along highway corridors). However, this option is significantly more expensive to install and requires substantial amounts of electricity. Figure 1 provides an overview of each charging level, its technical specifications, installation costs, and ideal uses.

Figure 1: EV Charging Levels.

	Level 1	Level 2	Level 3 (DCFC)
Typical output	120 Volts/12 Amps	240 Volts/30 Amps	50–350 kW
Charging time (to replenish 120 km of range)	16+ hours	4 hours	5–25 minutes
Installation costs	$200–$1,500	$2,000–$10,000	$50,000–$100,000+
Typical locations	Homes, offices	Homes, offices, public spaces	Corridors, public spaces
Used by	EVs and PHEVs	EVs and PHEVs	Primarily EVs

Source: Dunsky Energy + Climate. (2022, March 31) *Canada's Public Charging Infrastructure Needs: Updated Projections*, Prepared for Natural Resources Canada. https://www.nrcan.gc.ca/sites/nrcan/files/energy/cpcin/2022-ev-charging-assesment-report-eng.pdf



There is a need to deploy hundreds of thousands of charging points across the country and do it quickly to capitalize on the momentum in the EV marketplace.

There are multiple players involved in all stages of EV charging infrastructure deployment. Each has a different role and responsibilities, although these vary greatly depending on the business model used and the regulatory environment in which they operate.[5] Key stakeholders include:

- **Network operators** provide charging as a service, similar to cellphone network operators. Each network operator has their own business model with various pricing structures, membership/subscription requirements, roaming agreements, technologies, and affiliations with utilities and/or automakers. Some network operators manufacture their own EV charging technology; others purchase from a specialized manufacturer.
- **Site hosts** own or occupy the property on which the charging equipment is installed—these can be retail businesses, commercial parking lots, traditional fuelling stations, workplaces, public lands, and more. Site hosts determine who has access to the charging equipment (e.g., consumers, employees, or the public) and earn revenue by charging user fees. In Canada, most publicly accessible charging points are owned by the site host and operated and branded by a network operator.[6]
- **Utilities** are responsible for delivering the electricity. Electrical utilities operate in complex regulatory environments in Canada—most large utilities are regulated at the provincial level, although some are self-regulated or are regulated at the municipal level.[7] Some utilities have established partnerships with specific network operators, whereas others have entered this space as network operators themselves.
- **Governments:** Federal, provincial/territorial, and municipal governments across Canada have played a significant role in advancing EV adoption and deployment of EV charging infrastructure, particularly by providing financial support to consumers and businesses through purchase subsidies, direct funding, and cost-sharing agreements. In some cases, charging points are government-owned (e.g., Quebec's Electric Circuit network). Governments also play a role in regulating this space, by regulating utilities and establishing limits on the resale of electricity, as well as regulating the mechanisms used to measure energy usage (see Payment and Billing section).

Beyond these key players, there are many other stakeholders to consider in the broader EV space—including other electric mobility providers (i.e., those that offer systems to connect various components), automakers and current and prospective drivers, as well as communities.

EV Charging in Canada

EV Adoption Rates

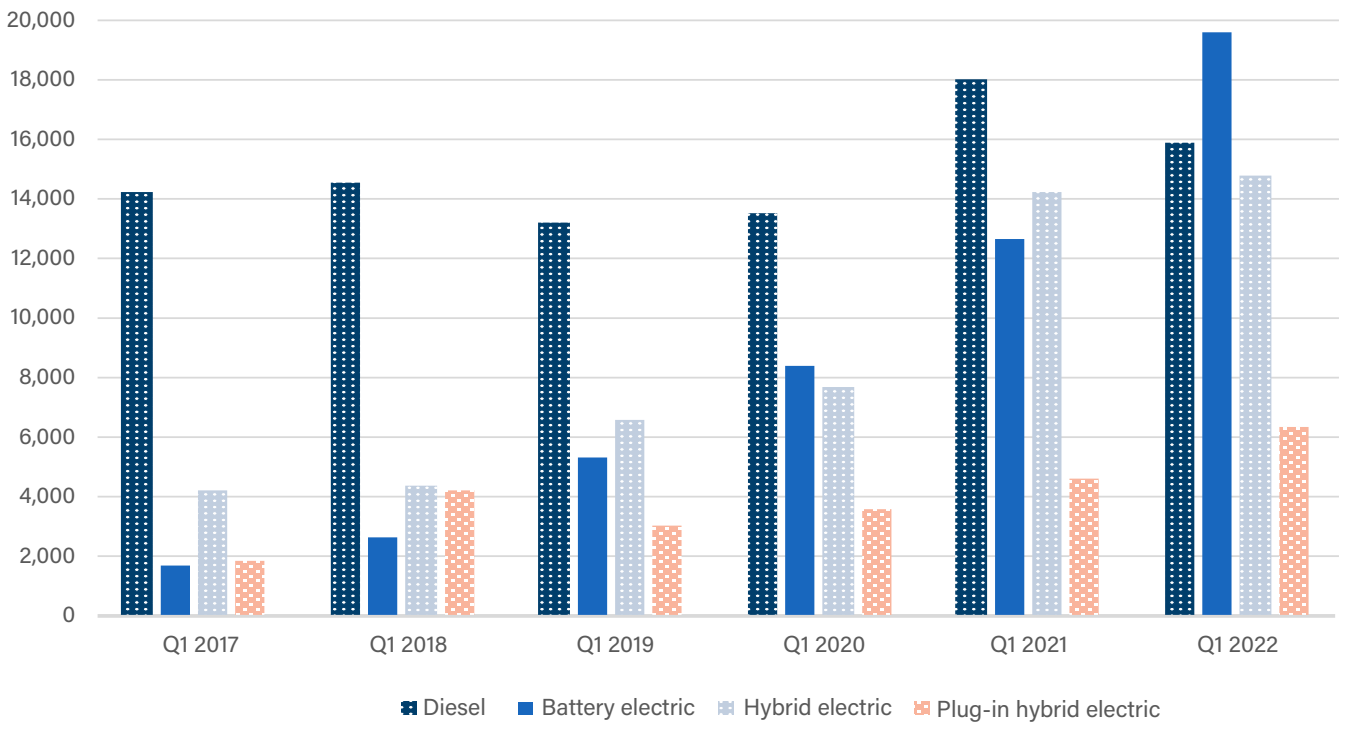
EV adoption has surged in recent years. While new vehicle registrations across Canada dropped overall in Q1 2022, the proportion of EVs among new vehicle registrations grew by 55.2% from the year prior—the highest increase ever recorded in a single quarter (see Figure 2).[8] EVs currently represent 5.8% of market share in Canada—this rate is significantly higher in provinces that have better established charging infrastructure and supportive EV policies such as Quebec (12.5%) and British Columbia (9.2%). Market share is slightly lower in Ontario (4.2%) and as low as 0.9% in Saskatchewan.[9]

In a 2022 survey of current EV owners conducted by Pollution Probe, 52% of respondents indicated that their EV purchasing decision was linked to charging infrastructure availability.[10] This strong influence of sufficient infrastructure aligns with findings in global jurisdictions—in its analysis of the Chinese market for example, the World Bank found that investing in charging infrastructure was up to four times more effective in promoting EV adoption than direct purchase incentives.[11]

EV Readiness

Based on the supply and demand of EVs and policies currently in place, concerns have been raised regarding Canada's preparedness for the oncoming wave of EV adoption. In an annual study conducted by Ernst and Young Global, Canada was ranked second last (13th out of 14 countries) in the EY Electric Vehicle Country Readiness Index.[12] As of 2022, Canada had fallen five spots on the index from the previous year, with a lack of infrastructure and affordability cited as key factors.[13] China is currently the global leader in this index, followed closely by Norway (see Figure 3).

Figure 2: New vehicle registrations, by fuel type (excluding gasoline), 2017-2022.



Source: Statistics Canada. (2022, October 11). New Vehicle Registrations, by Fuel Type (2017–2022). New motor vehicle registrations, quarterly. Statistics Canada. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2010002401



Figure 3: Global leaders in EV-readiness.

China

- Significant battery manufacturing capacity and supply chain control
- High consumer demand: 51% of drivers expect next vehicle to be an EV
- Widespread charging infrastructure

Norway

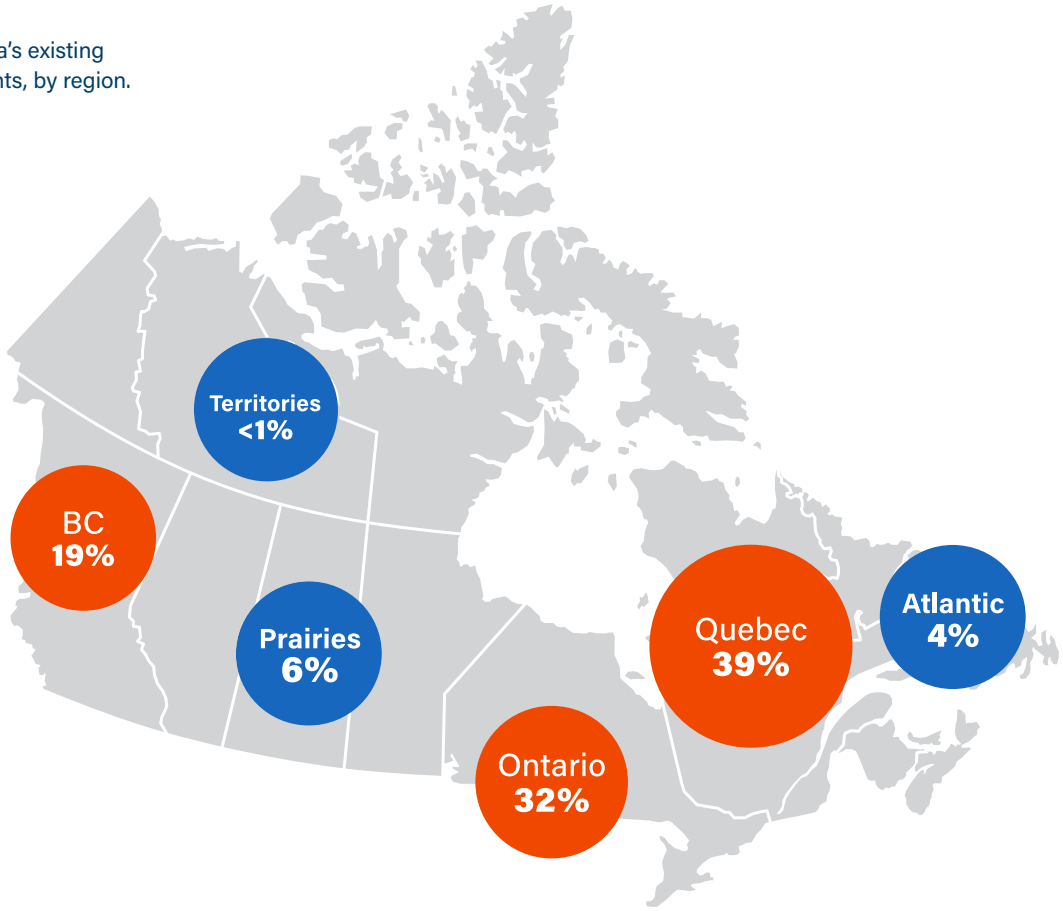
- Strong regulation and tax benefits
- Significant adoption: 70% of new vehicle registrations in 2021
- Dedicated EV lanes and parking infrastructure

Sweden

- Robust manufacturing presence
- High consumer uptake: over 40% of market share in 2021
- Strong energy ecosystem

Source: Ernst & Young Global Ltd. (2022, September 6). Press Release. China, Norway and Sweden lead the pack on electric vehicle readiness – EY study. https://www.ey.com/en_gl/news/2022/09/china-norway-and-sweden-lead-the-pack-on-electric-vehicle-readiness-ey-study

Figure 4: Canada's existing EV charging points, by region.



Source: Mogile Technologies Inc. (2022, March 31). Biennial Snapshot of Canada's Electric Charging Network and Hydrogen Refuelling Stations for Light-duty Vehicles. https://www.nrcan.gc.ca/energy-efficiency/transportation-alternative-fuels/resource-library/3489

While the ideal ratio of EVs to public charging points depends on a number of factors, the 2021 ratio in Canada remained much higher than the global average—meaning that more vehicles are attempting to use each public charging point. As of 2021, the global average ratio was 10 EVs per public charging point whereas Canada had nearly 20 EVs per public charging point.[14] China has only 7 EVs per public charging point, which brings down the global average.[15] The EU recommends that member states work towards a ratio of 10 EVs to public charging point, although the average across the EU was around 14 in 2021.[16]

Existing EV Charging Infrastructure

In a 2022 report prepared by Mogile Technologies for Natural Resources Canada, a snapshot of existing charging points available on its ChargeHub database showed a total of 15,718 Level 2 charging points and 3,784 Level 3 charging points across 7,967 sites that were publicly accessible and either fully operational or expected to be operational by summer 2022.[17]

Geographically, about 39% of these were in Quebec, and approximately 90% of all charging points captured were in Quebec, British Columbia, and Ontario (see Figure 4). The analysis found that 28 network providers were actively operating in Canada, although about 70% of charging points were affiliated with four major providers.[18]

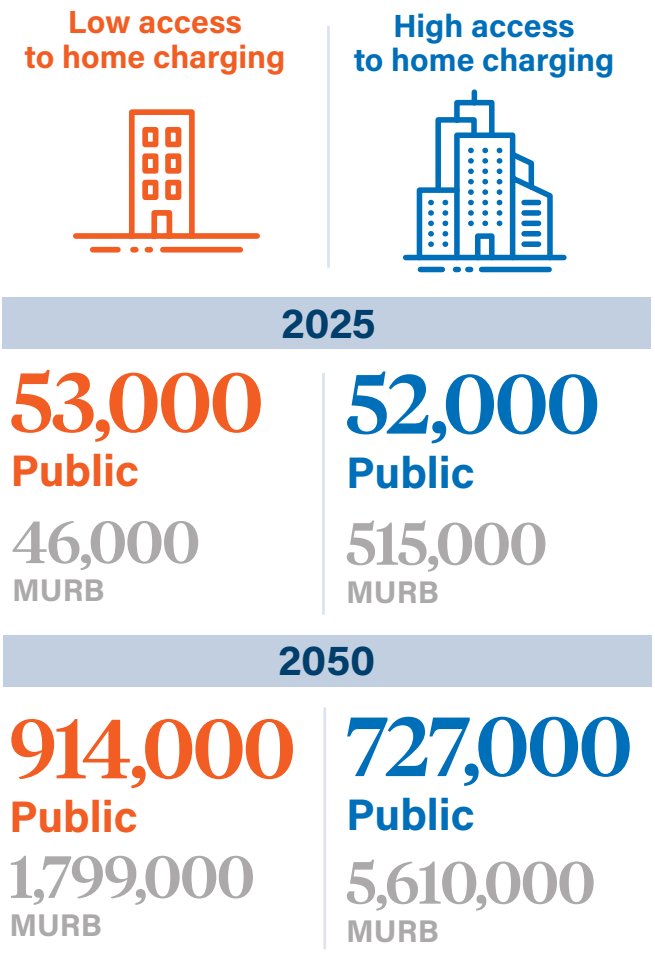
EV Charging Needs

Newly updated analysis, conducted by Dunsky Energy + Climate Consultants on behalf of Natural Resources Canada, concluded that Canada will need a significant acceleration in the deployment of charging infrastructure in the next 5–10 years. This will require an investment of approximately C$20 billion over the next 30 years, although the study did not address how much of this investment would come from each level of government, nor the split between public or private sources.[19]

The analysis included two scenarios to reflect the difference in public charging needs based on the extent to which Canadians have access to home charging.

In the near-term—by 2025— there will need to be 52,000–53,000 public charging points. However, the need for public charging point access grows as the supply of EVs increases. As Canada approaches the proposed 100% ZEV sales target in 2035, there will need to be 442,000 public charging points in the high home access scenario, compared to 469,000 in the low home access scenario. By 2050, Canada will require 914,000 public charging points if there continues to be low access to home charging options (see Figure 5).

Figure 5: Canada's EV charging needs, by year and scenario.



Source: Source: Dunsky Energy + Climate. (2022, March 31) *Canada's Public Charging Infrastructure Needs: Updated Projections*, Prepared for Natural Resources Canada. https://www.nrcan.gc.ca/sites/nrcan/files/energy/cpcin/2022-ev-charging-assesment-report-eng.pdf

Policy Levers and Current Programs

Governments have multiple policy levers available to them to support the transition to low-carbon transportation, such as direct funding, cost-sharing contribution agreements, purchase subsidies, mandatory sales targets, and other regulatory and legislative changes.

For governments around the world, the most significant policy tool in advancing EV adoption to date has been financial incentives—particularly subsidizing the purchase of EVs. The International Energy Agency (IEA) has noted that the deployment of charging infrastructure will be the most important next step for governments to scale up—and many countries are pursuing this objective through funding mechanisms as well as legislative changes.[20] In addition, several countries have announced a mandatory phase-out of ICE vehicles along varying timelines. In Canada, the federal government is pursuing a combination of these programs, as summarized below:

- **Mandates/sales targets:** The federal government has proposed that all new light-duty cars and passenger trucks must be zero-emission by 2035, accelerating the previous phase-out goal of 2040. The government has also set interim targets of at least 20% by 2026 and at least 60% by 2030.[21] The details of this proposed policy, such as compliance mechanisms, are still being finalized.
- **Purchase incentives:** The Incentives for Zero-Emission Vehicles (iZEV) program offers up to C$5,000 towards eligible vehicles for individuals, which is applied at point-of-sale through dealerships. Note that the program currently only applies to new vehicles. There is also a tax write-off for ZEVs to support business adoption.[22]
- **Infrastructure deployment:** The Zero Emission Vehicle Infrastructure Program (ZEVIP) has committed C$680 million, delivered through cost-sharing contribution agreements, for eligible charging infrastructure projects in public spaces, on-street parking, workplaces, multi-unit residential buildings (MURBS), and commercial and public fleets. ZEVIP will be complemented by a new C$500 million program, launched by the Canada Infrastructure Bank, that aims to provide capital support for large-scale EV charging projects.



The goal of Canada's federal infrastructure programs is to de-risk installation and initiate a business case for the private sector to build the necessary EV charging infrastructure.[23] The private sector is currently deploying significant charging projects across the country—for example, Petro-Canada, Volkswagen, and General Motors have announced major investments in expanding access to public EV charging. That said, encouraging private investment will be necessary where the business case for building charging infrastructure is still lacking, particularly in the short term.

These programs are being delivered alongside numerous policies and initiatives at the provincial/territorial and municipal levels across Canada. For example, both British Columbia and Quebec introduced mandatory sales targets that preceded those at the federal level. Purchase incentives for light-duty vehicles are available in British Columbia, Quebec, Yukon, Nova Scotia, Prince Edward Island, New Brunswick, Newfoundland and Labrador, and Northwest Territories—some of which are stackable, meaning both federal and provincial incentives can be combined to further reduce the purchase cost of an EV.[24]

When it comes to EV charging infrastructure, a number of provincial governments are involved in deployment. They are using different approaches such as setting formal targets (Yukon), legislative changes (British Columbia), and direct investment—with specific funding programs directed towards supporting EV charging in MURBS (British Columbia), for businesses (New Brunswick), along major highways (Newfoundland and Labrador), and for municipalities (Alberta).[25] There are countless initiatives at the municipal level—these include local targets and funding, as well as the use of zoning, licensing, and other bylaws to require buildings to be EV-ready, enable charging for on-street and public parking areas, and even to license extension cords on public sidewalks to safely provide charging options where infrastructure cannot be installed.

These pockets of innovation offer important learnings and potential opportunities to scale up. However, they can also contribute to a patchwork approach that creates confusion for drivers and a lack of consistency across the country. As Canada continues its path to low-carbon transportation, drivers will need consistent and seamless access to a robust EV charging network regardless of their route and destination. As such, this report focuses on considerations at the national level—specifically, how the federal government can take a leadership role in supporting Canada-wide EV charging infrastructure by applying best practices and collaborating with provincial/territorial and municipal governments and First Nations and Indigenous communities, as well as industry and community partners.



Canada's charging network must accommodate the needs of the approximately one-third of the population who reside in MURBs

Key Issues in Deploying EV Charging Infrastructure

As the federal government continues to push forward with its deployment of EV charging infrastructure, there are some important areas that must be addressed to ensure the network is equitable, accessible, and reliable. This section discusses four key issues that require more careful attention than they have received to date: location, physical design, reliability, and payment options.

Location: Home vs. Public Charging Points

A robust charging network will require both home charging points and publicly accessible charging points across various locations, including retail, workplaces, and along major transportation corridors. Currently, however, up to 80% of EV charging occurs at home, and access to home charging is one of the most influential factors in the decision to purchase an EV.[26] In a recent survey of current EV owners, 85% of respondents indicated that they reside in a single-family house or townhouse with dedicated parking, compared to only 12% of respondents who reside in MURBs.[27]

Canada's charging network must accommodate the needs of the approximately one-third of the population who reside in MURBs. This proportion is even higher in urban areas. To expand charging options for MURB residents, some jurisdictions have introduced requirements that parking in new buildings must be "EV-ready," meaning that there must be sufficient electrical capacity and infrastructure (e.g., electrical outlets) to install EV charging points in the future. In Canada, this has so far only occurred at the local level, although the extent to which a municipality can effectively address this depends on their enabling legislation at the provincial level.[28] In British Columbia for example, where municipalities have broader discretion to implement such requirements through zoning bylaws, 21 municipalities have moved these requirements forward—compared to only one in Ontario (Toronto) and one in Quebec (Laval).[29]

While provincial governments are responsible for implementing their own building codes and have the ability to introduce EV-ready requirements for new and substantially renovated buildings, as of 2022 none have done so for MURBs.[30] The federal government publishes model codes, including the National Building Code and National Energy Code, which can be voluntarily adopted by provincial governments either in full or in part—however, national model codes do not currently reflect any language for EV-ready requirements.

Existing MURBs face technical, financial, governance, and regulatory barriers in relation to installing EV charging equipment.[31] For example, MURBs often have limited parking spaces or no parking at all. Those that do have parking may have the costs of electricity equally distributed across all residents regardless of usage (i.e., bulk-metering). This is particularly true in older buildings and can generate frustration among residents who are not using the charging infrastructure available to EV drivers. The use of EV energy management systems, which use smart technology to control the electricity shared among multiple vehicles, can be a helpful solution to this concern.[32]

Billing electricity usage directly to individual units (i.e., suite metering) also addresses this issue, but buildings may not have meters connected to the parking areas, with high costs associated with installing a new one.[33] In many cases, parking spaces are not "EV-ready" at all—and the process of planning, retrofitting, and installing EV charging equipment in these scenarios is both complicated and costly. As a result, property owners are more likely to make incremental changes rather than comprehensive retrofits, although these incremental changes can cause electrical issues and end up being more expensive over the long term.[34]

When it comes to governance and regulatory challenges, there are distinctions to be made within the MURB housing stock and its residents, and important equity considerations to be addressed. For example, the MURB categorization captures an individual who owns a condominium with or without dedicated parking, as well as a tenant in rental housing who may have a parking space or may depend entirely on street parking. Condominiums have unique governance structures that pose challenges to installing charging equipment—for example, condo boards or strata corporations may require that a minimum number of members agree to the installation.[35] This has led provinces such as Ontario to introduce "right to charge" legislation aimed at ensuring these processes do not create additional barriers to accessing EV charging.

Tenants, however, are more likely to feel a lack of agency in requesting EV charging access from their landlord, and property owners may be hesitant to invest in equipment when tenancy is more short-term in nature than ownership.[36] Such investments in rental housing can also result in higher rent prices as property owners may pass the costs of capital improvements onto tenants, which disproportionately impacts lower-income residents and erodes the overall affordable rental housing stock—a major concern in large urban centres. Furthermore, the incremental changes that property owners are likely to make can have implications for equitable access to charging points over the long term. In buildings with limited electrical capacity, this capacity will be directed to support early adopters—who are likely to be higher-income residents—at the expense of occupants who may need access at a later time.

Those residing in MURBs, particularly renters in older apartment buildings, are also more likely to be low-income, racialized, and immigrant individuals and families.[37] While EV ownership rates may be low among these demographic groups currently, this does not negate the importance of providing long-term charging access for these residents as EV adoption grows in the coming years. This is highlighted by the ongoing housing crisis across Canada, in which many are being pushed out of areas that have become unaffordable, particularly large urban centres such as Toronto and Vancouver. As residents move further away and their public transit options become more limited, vehicle access (whether owning, renting, or car-sharing) may be necessary to access employment and other services.[38]

Experts have noted that, given the numerous barriers to installing EV charging in some MURBs, public charging can be a viable alternative—however, the infrastructure must be both sufficiently available and affordable. While there are numerous factors that influence the cost of electricity that is used to charge an EV (e.g., level of charge, time of day), it is more convenient and often more cost effective to charge at home than to rely on public charging services. There may also be a natural tendency for the market to build infrastructure where there is existing EV ownership and therefore strong demand, although it will be critical to build in underserved areas to induce demand. Drivers are more likely to own an EV if they have a charging point available within one kilometre of where they live,[39] and governments must ensure that already marginalized communities are not left behind in the transition to low-carbon transportation.



There are growing concerns that existing public EV charging infrastructure in Canada and elsewhere has been built in a way that is not universally accessible.

Physical Design

There are growing concerns that existing public EV charging infrastructure in Canada and elsewhere has been built in a way that is not universally accessible.

This is particularly true for people with disabilities who use mobility devices such as wheelchairs—charging points are often not installed at grade (e.g., they are on a curb without a ramp) or in parking spaces that use gravel, which makes it difficult, if not impossible, to navigate in a wheelchair.[40] Furthermore, the parking spaces may not have a sufficiently wide allowance for a driver with reduced mobility to get in and out of the vehicle as well as access the charging point. Charging cables tend to be quite heavy and difficult to use if both arms are not available—particularly for fast charging points—and can sometimes be installed too high to be reached.[41] There are also accessibility concerns regarding the placement of screens and payment devices at charging stations, as well as problems with visibility and signage.

Accessibility advocates have made great strides in communicating the challenges they face to governments and operators.[42] In Canada, this has resulted in some leading utility providers such as BC Hydro initiating a series of retrofits to their existing stations to ensure accessible use over the next three years and incorporating these elements into future site plans.[43] Similarly, Hydro Quebec began improving accessibility of its stations in 2020 and now includes accessibility criteria in its approval of EV charging stations, requiring that equipment providers comply with a recognized accessibility standard.[44] Hydro Quebec also publishes technical installation guidance that includes some consideration for reduced-mobility drivers.[45]

Despite these improvements, there are no clear requirements, regulations, or consistent standards that must be met for accessibility in deploying Canada's EV charging infrastructure. While discrimination based on mental and physical disability is prohibited under federal and provincial human rights legislation, more must be done to ensure that a driver can access a consistently accessible charging network across Canada. Some provinces have enacted legislation to remove barriers that affect people living with disabilities, which would have some relevant application to EV charging (e.g., generally accessible parking spaces). However, none of these provinces have developed specific standards or guidance for accessibility of EV charging infrastructure.

In addition to concerns regarding the lack of accessible design, current EV drivers also report feeling unsafe while waiting for their vehicles to charge using existing infrastructure.[46] Public charging stations are often built in remote or isolated locations with poor lighting



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and insufficient monitoring that leave drivers feeling vulnerable to potential danger. In particular, women across Canada, the US, and the UK have raised concerns about using public charging infrastructure, especially at night.[47] Design elements that prioritize safety and security of drivers are key to ensuring that charging infrastructure will be used.

Reliability

The reliability of public EV charging infrastructure is critical to building confidence in EV technology, increasing adoption, and enhancing overall driver experience. The concept of "range anxiety"—the fear of running out of charge before reaching the next charging point—is well understood and industry has come a long way in both advancing battery technology for longer battery life and debunking myths about battery capacity and range. However, the anxiety about reaching a charging point and realizing that it cannot be used is equally significant.[48]

Since data is not comprehensively collected nation-wide on how frequently a charging point is operational (uptime) or not operational (downtime), little is known about the reliability of the existing network. However, the Mogile Technologies report, using data collected through the ChargeHub platform, offers a snapshot from January 2022, which showed that 5.9% of Level 2 charging points were not operational, along with 4.7% of Level 3 charging points.[49] While that number may seem small, analysis from network operator FLO shows that a 95% uptime (approximately 5% downtime) translates into availability for only 347 days of the year.[50] The difference between 95% and 99% uptime represents 14 days that a charging point is unavailable, which, when applied to a nation-wide network, has significant implications for drivers.

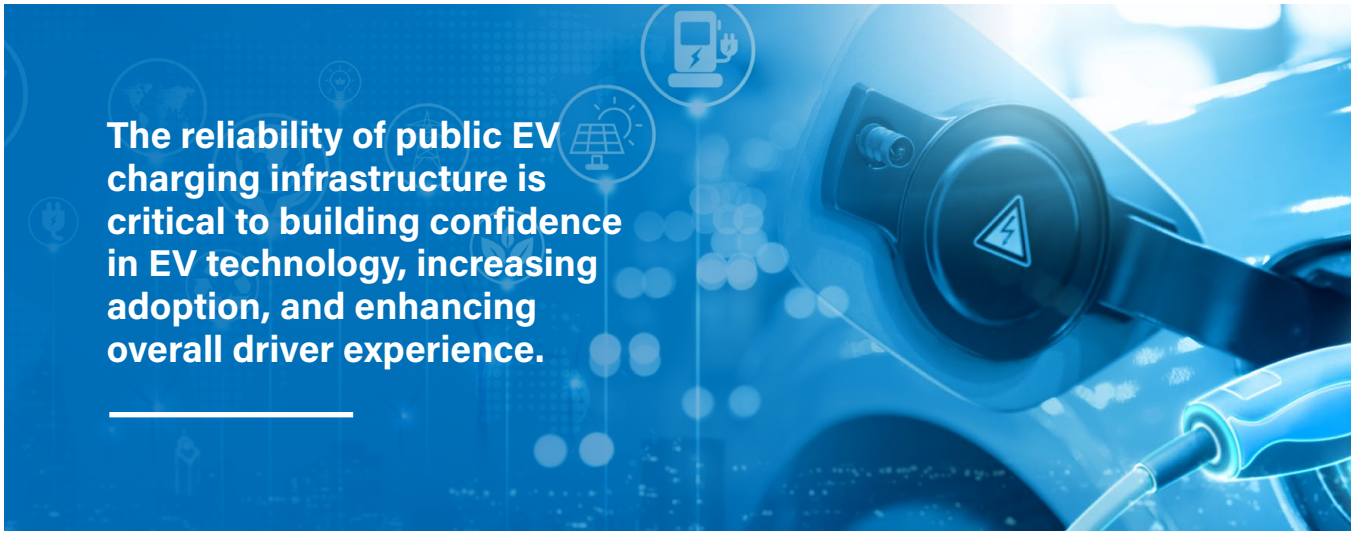
The reliability snapshot seems to coincide with public attitudes. In Pollution Probe's 2022 survey of EV owners, 21% of respondents agreed that the charging points they attempt to use are often not operational. This number is lower in provinces like Quebec (12%) that have more mature EV markets and charging infrastructure but increases to 30% in Ontario. The current state of EV charging reliability in Canada highlights the need for improvement to deliver consistent service.

The federal government has not entered the reliability space from a reporting or regulatory standpoint; efforts have been more focused on encouraging deployment than operations and maintenance. There is also no industry standard or common definition of what the appropriate uptime of EV charging points should be. Reliability is a complicated concept, with many contributing factors, varying definitions, and multiple stakeholders to consider. Industry leaders have raised this lack of consistent understanding of reliability as potentially risky—when there is a discrepancy between what service providers claim and what drivers experience on the ground, this contributes to the erosion of confidence in EV technology.[51]

Payment and Billing

Concerns around payment and billing methods for public EV charging use are also coming to the forefront. Depending on the location and charging level, some public charging points may be free of charge, while others come with a cost, particularly for faster charging services such as those that provide Level 2 or 3 charging. Services that come with a cost often require network subscriptions and smartphone applications to process payment—which requires access to a mobile device with network connection—rather than credit or debit cards. Furthermore, given how decentralized Canada's charging network is currently, drivers would need to register with multiple networks to have sufficient access to public charging points.[52]

Roaming agreements among network operators, which allow drivers to access charging across networks without additional subscriptions, are a helpful development in addressing the issue. These agreements can be peer-to-peer (i.e., between two operators) or through a centralized hub that connects multiple operators. Peer-to-peer arrangements are more common in Canada and the US, where a number of major providers have roaming agreements to enable greater access. However, the legal, technical, and business processes required to establish and maintain these arrangements can be complex—particularly for smaller operators and new market entrants.[53] As the EV market grows and more network operators enter this space, there will likely be challenges in scaling up this model. Currently, awareness and understanding



of the agreements in practice is also very low among drivers—when asked, only 6% of current EV drivers surveyed had a clear understanding of the scope of roaming agreements.[54]

In theory, competition among networks should benefit consumers through lower pricing. However, the lack of payment interoperability creates inconvenience and unnecessary costs for drivers overall and disproportionately impacts those on the lower end of the income scale. Policymakers across US states, as well as industry associations in Canada, have raised this is as a barrier to advancing widespread and equitable EV adoption.[55] Furthermore, approximately 15% of Canada's population is financially excluded or "underbanked", meaning that they are partially or entirely excluded from mainstream financial services.[56] Financially excluded individuals may have difficulty accessing credit cards, which are often required for payment of EV charging services, either directly or through a smartphone application. Financial exclusion is more likely to impact low-income individuals, Indigenous communities, and single-parent families.[57]

Consumer-facing interoperability for payment options has a significant impact on the driver and their experience. There are other interoperability issues with EV technology, such as systems management interoperability, however, these are beyond the scope of this report.

When it comes to billing, operators in Canada have only been permitted to bill for the use of EV charging based on time (or a flat rate), not by electricity use. Measurement Canada, the federal agency responsible for ensuring accuracy in the selling of measured goods, regulates this space to protect consumers and businesses against loss resulting from inaccurate or unreliable measurement of energy. Without technical standards, billing based on energy usage (i.e., per kilowatt hour/kWh) could leave consumers and businesses vulnerable to inaccurate or unreliable billing and is therefore prohibited.[58] However, billing based on the amount of time used can also result in inequalities and overall lack of options for drivers. Since there are multiple factors that impact how much energy is pulled from the grid within a certain period (e.g., temperature, how many other vehicles are charging, etc.), under the time-use model, two drivers could be billed very different amounts but receive the same level of charge.

Allowing for kWh billing across all charging levels is important to provide greater options to drivers. Following extensive consultation, Measurement Canada has announced that this will be permitted later in 2022, although with interim measures in place while the agency continues consultation to finalize an appropriate framework. There are many factors that must be considered to develop this framework, including the added costs to operators to install measurement devices, accuracy requirements, complaints processes, verification mechanisms, and compliance timelines.



Policy Considerations

Before the federal government accelerates its efforts to deploy EV charging infrastructure, there should be a pause for consideration of how to prioritize equity, accessibility, and reliability in the earliest stages of planning. This section provides an overview of how infrastructure can be deployed through an equity lens, incorporate accessible design at the outset, ensure reliability for drivers, and promote inclusive payment options for Canadians.

Deploy Charging Infrastructure through an Equity Lens

Deployment of EV charging infrastructure is a long-term investment—what is built today will set the stage for the future of low-carbon transportation. It is therefore critical that the locations that are chosen for development—particularly those that are funded by public dollars—are strategic and sufficiently serve communities.

In the near term, it will be fundamental to close the gap between MURB residents and those living in single-family homes and townhouses when it comes to EV home-charging access. Many subject matter experts have highlighted the need for both increased funding and more comprehensive support programs for MURB property owners. The CleanBC EV Ready Retrofit Program has been applauded for its approach to supporting comprehensive EV-ready retrofits, particularly in MURBs. The program provides funding support from the earliest stages, including rebates to cover the costs of obtaining a licensed electrical contractor or engineer to develop an EV-ready plan for the building, the costs of the electrical infrastructure to implement the plan, as well as the costs to purchase and install the individual charging points.[59]

Providing this level of support is necessary for MURBs, which face higher costs and more technical complications than other dwelling types. The federal government currently provides funding through cost-sharing agreements for the charging infrastructure itself—however, if the ZEVIP program were to be expanded or include a separate stream of funding to provide support for comprehensive EV-ready retrofits, this could significantly improve the uptake among MURB property owners.

There are likely to be areas across Canada where uptake of these programs remains limited given the challenges at hand—particularly in the short term. In areas that have a density of housing where installation is too difficult, too costly, or there will be limited uptake by property owners (e.g., rental tower communities), the federal government should prioritize the installation of publicly accessible fast-charging infrastructure (i.e., Level 3). Collaboration with provincial and municipal

governments and local organizations will be important to help identify underserved areas and community needs. This applies to high-density urban areas as much as it does to rural, remote, First Nations, and diesel-dependent communities—each will face a very different path to decarbonization and require very different community resources. Moving forward, governments, utilities and network providers should also consider strategies aimed at ensuring that charging fees remain affordable for drivers who rely entirely on public charging services.

In its allocation of funding for both MURB and public EV charging infrastructure, the federal government should earmark dedicated funds for underserved areas with increased funding contributions. Currently, the program is largely market-driven, providing funding for 50% of costs to eligible projects for which applications are received and approved; projects led by Indigenous businesses and communities are eligible for up to 75%. This component of the program is a good example of how equity can be delivered through the allocation of funds, and there is an opportunity to expand this type of targeted and strategic effort.

Canada should also take note of emerging funding initiatives in the US, particularly from utilities in New York and California. In New York, for example, the EV Make-Ready Program delivered by New York Joint Utilities has earmarked US$206 million of its US$701 million program to directly benefit disadvantaged communities.[60] The program provides financial incentives up to 100% of the costs to install publicly accessible Level 3 infrastructure in disadvantaged communities and up to 100% of the costs for Level 2 charging points in MURBs located in disadvantaged communities.[61]

For new buildings, the federal government should lead by example and lay the foundation for widespread access to EV-ready parking by embedding specific requirements in national model codes.[62] While provincial governments do not need to apply the same requirements in their own building codes, this is an important first step to promote standardization and consistency across the country. The success of the EV-ready requirements in British Columbia's municipal bylaws can serve as guidance for these model codes.[63] National model codes could also be a helpful avenue for setting standards related to equity and accessibility.



Over the longer term, the federal government should begin to strategize around how to incentivize provinces to adopt these model requirements (e.g., through funding conditions) and may consider the potential expansion of model codes to address existing building requirements.[64] Local governments in California have begun to take this approach—while this offers great potential to future-proof buildings, careful consideration should be given to any unintended consequences around affordability.

Incorporate Accessible Design at the Outset

The "curb cut" effect describes what happens when policies, programs, and physical infrastructure are designed to accommodate those facing the most significant barriers: it benefits everyone.[65] Too often, infrastructure is designed for able-bodied people and accessibility is an afterthought—resulting in later costly upgrades, workarounds, and retrofits to ensure that everyone can benefit. There are examples of this everywhere—in public spaces, buildings, and transportation systems, as well as the policies and regulations that govern them.

Governments, network operators, site hosts, and utilities have an opportunity to create an accessible charging network from the beginning. Much of the country's EV charging infrastructure has yet to be built—by designing for barrier-free access at the outset, the charging network of the future can be used by everyone. This will eliminate the inevitable costly retrofits of infrastructure not built with a universal design approach as EV adoption grows.

In the near term, the federal government should ensure that new infrastructure that is funded in part through the ZEVIP program incorporates accessible design—this can be done by reviewing site plans of applicants and including accessibility as a specific criterion to receive funding. Moving forward, there should be technical guidance and specific requirements that must be met for all charging infrastructure built in Canada to ensure that drivers can experience consistent access the country.

Canada should monitor the US in this regard: the US Access Board has recently released a document that outlines technical assistance and announced its intention to publish a notice of proposed rulemaking on accessible EV charging points.[66] As with many other sectors, alignment between Canadian and American standards will benefit both consumers and businesses.

In the UK, the British Standards Institute (BSI) has recently published an open-access standard for accessible EV charging. The development of this standard has been a collaborative effort of the BSI, the UK Government Office for Zero Emission Vehicles, and Motability—a national charity that assists people living with disabilities in obtaining accessible vehicles. People living with disabilities were engaged in every stage of the development process, and Designability—a charity that supports more independent living for those with disabilities and a member of the steering committee involved—has published complementary design guidance materials to support operators.[67] This process can offer lessons on collaboration and co-development with those with lived experience.

In designing public infrastructure for the future, it is important to consider accessibility in the broadest terms. This includes designing for physical disabilities as well as others such as cognitive and invisible disabilities. Accessible design should also apply to all components of the charging experience, including the parking space and charging equipment, as well as the technology that processes payment (e.g., payment device screens and smartphone applications) and surrounding areas. For example, design elements that prioritize the safety and security of drivers must also be incorporated into public EV charging infrastructure deployment. In Canada, network operators are currently exploring potential solutions to the safety concerns that have been raised, considering better lighting, more security cameras, and on-site amenities.[68]

Ensure Reliability for All Drivers

If building EV charging infrastructure is the current priority, ensuring reliability of that infrastructure must be the next step. Given the lack of current regulation, industry standard, or common definition of reliability in Canada, the federal government should consider entering this space to improve the driver experience and maintain confidence in EV technology.

As a first step, it would be beneficial to begin collecting data on uptime and downtime of existing EV charging infrastructure to better understand the scope of the issue and root causes of problems. Currently, it is difficult to draw conclusions about the reliability of the network at a macro level—while many operators are collecting information about charging sessions, this data is not always comparable to that of other operators (e.g., different data points are collected and formatted in different ways). The systems that collect and maintain this data are evolving rapidly, and operators tend to consider such detailed data to be proprietary and confidential.[69] Requiring that aggregated, standardized data on usage and reliability be submitted to the federal government will begin to provide a picture of the current landscape and identify the reliability issues that need to be addressed.

Reliability must be defined and understood before assigning metrics such as minimum standards. This should be done in partnership with industry to ensure that the expectations are reasonable, achievable, and do not negatively impact the business case for the private sector to continue building out EV charging infrastructure. Reliability is a complex issue with many considerations that require greater clarity, such as the roles and responsibilities of the multiple players involved in operating and delivering EV charging. For example, while a network operator has control over the reliability of their network through the software used, they cannot influence upstream energy issues that fall under the utility's responsibility.[70]

Moving forward, the federal government should consider setting minimum uptime requirements for EV charging points across Canada; jurisdictions, including both the UK and the US, have recently announced such requirements. In the UK, new legislation will require operators to maintain a 99% reliability rate.[71] In the US, the Department of Transportation has laid out an extensive proposal for the country's EV charging network, including a minimum 97% uptime. Canada



By learning from other jurisdictions, making purposeful investments, and collaborating with all levels of government as well as industry and community partners, Canada can make an inclusive transition to low-carbon transportation possible.

should monitor the developments in each of these jurisdictions, particularly the US, and coordinate a specific response that's relevant for the Canadian context.

Given that it is impossible for a site to be operational 100% of the time, it will also be important to build redundancy into the network (i.e., intentional duplication) by requiring EV charging sites to have more than one charging point. Doing so will ensure that if one charging point has malfunctioned, other options will be available for drivers, which is particularly important in rural areas and on remote stretches of highway. This has been highlighted as a best practice by policymakers and industry leaders alike and was addressed in Canada's updated analysis of charging needs.[72]

Promote Inclusive Payment Options

While voluntary roaming agreements between operators are promising and should be encouraged, policymakers in Canada should consider strategies that promote open access for payment. Open access generally means that a driver can arrive at any available charging point that requires payment and still receive a charge without barriers such as subscription requirements and fees.

Canada has not yet addressed open access payment through standards or regulation. In the absence of regulation, provinces such as British Columbia have introduced alternative solutions to improve access such as Radio Frequency Identification (RFID) cards that can be used at stations operated by multiple service providers. In Norway, a global leader in EV adoption, the Norwegian EV Association has taken a similar approach.[73] Other jurisdictions, however, have introduced specific legislation to ensure interoperability of payment options and open access for drivers—including the Netherlands, Portugal, the UK, and several US states.[74]

For example, the California Air Resources Board (CARB) introduced regulations in 2019 that govern multiple aspects of EV charging equipment, including payment standards. The regulations require that all charging points that require payment have multiple payment options available, including a credit card reader or kiosk, mobile payment, and a toll-free phone



number.[75] CARB also prohibits network operators from requiring drivers to have a membership or subscription in order to access a charging point. Importantly, these regulations are being phased in (i.e., based on the technology and installation date of each charging point) with compliance mandatory by 2033, which allows the industry to adapt over time. Other US states have enacted similar requirements, including Massachusetts and New Hampshire.[76]

The Northeast States for Coordinated Air Use Management (NESCAUM) outlines potential policy approaches to open access. Requiring universal payment options for publicly funded charging infrastructure or networked charging points, similar to the approach that CARB has taken, would be a helpful solution.[77] Enabling multiple forms of payment is key for extending equitable access to all drivers. To go a step further, governments could also require universal roaming among networked charging points that are publicly available. Standards would play a key role in this solution; compliance with a specific communications protocol would make universal roaming a reality by ensuring the systems of network operators can communicate with one another and share information.[78]

The federal government should consider these options to promote open access—this will become increasingly important as new network operators enter this space to serve growing EV demand in the coming years. Strategies that promote open access can improve the experience for all drivers by streamlining the billing process, enabling more inclusive payment options for those experiencing financial exclusion, and alleviating unnecessary financial burden on low- and moderate-income drivers by eliminating membership fees.

Finally, as Measurement Canada continues its efforts to develop a framework and standards for kWh billing, it will be critical to incorporate industry perspectives to ensure different payment models are made possible to provide greater options for drivers as well as operators. However, it will be important to ensure that consumer protection and accurate measurement is front and centre of this process.

Conclusion

As government and industry prepare to spend millions of dollars to advance Canada's EV charging network, keep pace with the global demand for low-carbon transportation, and increase consumer confidence with a seamless driving experience, it is critical that these long-term infrastructure investments are made thoughtfully and strategically to ensure that no one is left behind in the low-carbon transition.

While EV ownership rates may be low among specific demographic groups in 2022, this does not negate the importance of providing long-term charging options for all Canadians as EV adoption grows in the coming years. Decarbonization efforts, particularly electrification of transportation, hold the potential to benefit equity-deserving communities and those disproportionately impacted by the effects of air pollution and climate change.

To harness this opportunity, policymakers should deploy EV charging infrastructure through an equity lens, incorporate accessible design from the outset, maximize reliability for drivers regardless of their route or destination, and promote inclusive payment options. The federal government should use these principles to guide their deployment strategies and funding decisions in the coming years, and learn from the success stories across Canada and abroad.

By learning from other jurisdictions, making purposeful investments, and collaborating with all levels of government as well as industry and community partners, Canada can make an inclusive transition to low-carbon transportation possible.

Methodology

The research process for this report included key informant interviews with subject matter experts across government, industry, and policy and technical research, as well as literature reviews and a jurisdictional scan of best practices. The content was also reviewed by external experts, who provided comments on an earlier draft.

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