

Executive Summary

The uptake of zero emission vehicles (ZEVs) in Canada presents enormous opportunities for stakeholders across a wide range of sectors. ZEV use can contribute to clean growth and climate change strategies, as well as greenhouse gas (GHG) emissions reduction goals. There is also the potential for ZEVs to play a critical role in the broadening landscape of renewable distributed energy, storage technology and research, development and demonstration (RD&D). While Canada's ZEV sales have increased rapidly over the past several years, they currently represent only 2.2% of the total light-duty vehicle (LDV) market. A number of key barriers must be addressed in order to increase ZEV deployment across the country and to ensure the social, environmental and economic benefits of these vehicles are realized by all potential owners.

Transportation-related GHG emissions in Canada have increased by 42% since 1990 and the sector accounted for 25% of total national GHG emissions in 2016. Significant emissions reductions can be achieved by moving away from the use of fossil-fuel powered vehicles to ZEVs, particularly given Canada's low-carbon electricity mix. ZEVs have no harmful tailpipe emissions and their use contributes to improving local air quality and reducing transportation-related health impacts. The benefits of ZEV use however, extend beyond their contributions to emissions reductions. ZEVs can also provide economic benefits for drivers by way of a reduction in the total cost of ownership (TCO). This is due to the fact that ZEVs have significantly lower operation and maintenance costs when compared to vehicles with a conventional internal combustion engine (ICE). There are also benefits for building owners and cities related to ZEV deployment including the attraction of environmentally-conscious businesses and tenants, creation of new revenue streams and the ability to obtain credit towards environmental performance certification programs.

The Government of Canada has recognized that reducing transportation-related emissions will be critical for meeting its target of 30% GHG reductions below 2005 levels by 2030, as outlined in the Pan-Canadian Framework on Clean Growth and Climate Change. The framework articulates Canada's plan to

meet its climate change commitments and identifies increased ZEV use as a priority for addressing emissions from the transportation sector. A range of measures that encourage or support ZEV deployment have been implemented in support of this objective, including several initiatives related to the installation of electric vehicle (EV) charging infrastructure in multi-unit residential buildings (MURBs) and for garage orphans. For example, the federal government is supporting infrastructure installations, pilot projects and demonstrations, working to update relevant legislation and regulations, and providing educational resources specific to MURBs and garage orphans.

In early 2019, the Government of Canada also announced targets for ZEVs to account for 10% of new passenger vehicle sales by 2025, 30% by 2030 and 100% by 2040. Budget 2019 outlined further ways in which the federal government will support these adoption targets, including providing \$130 million over five years to deploy new ZEV infrastructure, \$300 million over three years for a federal purchase incentive for ZEVs that cost \$45,000 or less, \$5 million over five years to work with automakers to secure voluntary sales targets and a full tax write-off for light-, medium- and heavy-duty ZEVs purchased by businesses.

ZEV Charging in Multi-Unit Residential Buildings and for Garage Orphans

An increasing proportion of the Canadian population resides in multi-unit residential condominium and apartment buildings or dwellings without access to a driveway or garage. It is estimated that at least one-third of Canadians live in MURBs and in some large metropolitan centres, apartments are more common than single-detached homes. These MURB and garage orphan residents are potential mainstream ZEV adopters but they face a number of unique charging-related barriers that must be effectively addressed to facilitate uptake.

This report is the result of work undertaken by Pollution Probe and The Delphi Group as part of the study on ZEV Charging in MURBs and for Garage Orphans, conducted in support of Natural Resources Canada (NRCAN). The study aimed to contribute to the



ongoing development of ZEV deployment strategies by supporting capacity building and stakeholder collaboration related to charging in MURBs and for garage orphans. Key barriers and opportunities for ZEV charging in MURBs were identified and categorized, and potential solutions and best practices were explored. A suite of options for potential future action was also developed, providing a comprehensive framework for stakeholders to visualize practical actions and the potential roles necessary to enable charging in MURBs and for garage orphans.

A wide range of stakeholders have been involved in important work related to ZEV charging in MURBs and for garage orphans over the past several years. This study provided an opportunity to engage many of them and where appropriate, to contribute to knowledge-sharing across sectors. Participation of subject matter experts across the country helped to ensure local and sector-specific perspectives informed the study, enhancing the value and relevance of the findings. It will be critical for stakeholders to continue

to work together in developing solutions to support the growing demand for ZEVs by MURB residents and those without access to a garage or driveway. The study findings outlined in this report constitute a foundation upon which those with a stake in the deployment of ZEVs and installation of charging infrastructure can base their future actions.

Barriers and Solutions to EV Charging in MURBs and for Garage Orphans

A range of barriers to EV charging in MURBs and for garage orphans were identified through the review of relevant literature and the interviews conducted as part of this study. These barriers were organized according to the following six broad categories:

- **Grid Preparedness & Charging Infrastructure:** These barriers comprise those related to the electrical grid and EV charging infrastructure (not those specific to building design) as they pertain to MURBs and garage orphans.

- **Building Design & Physical Infrastructure:** Applicable only to MURBs, these barriers include those related to charging infrastructure in and around buildings.
- **Education & Awareness:** Barriers in this category relate to MURBs and garage orphans and focus on consumer, building owner and property manager awareness.
- **Regulatory & Policy:** This category covers barriers related to the regulations and policies (e.g., acts, codes, standards, process policies and bylaws)

that impact EV charging in MURBs and for garage orphans.

- **Financial:** Barriers in this category are applicable to MURBs and garage orphans and include installation and operational costs, as well as challenges related to cost-sharing.
- **Other:** These barriers are those that do not fit easily within the other categories.

Table 1 provides a high-level summary of the barriers, the type of dwelling they apply to, and potential solutions.

Table 1. Summary of Barriers and Solutions

Barrier	Brief Description	Existing MURB	New MURB	Garage Orphan	Solutions
Grid Preparedness & Charging Infrastructure Barriers					
Electrical Capacity	Barriers related to the ability of a building’s electrical system to accommodate the additional load from EV charging or the capacity of the electrical distribution system at the neighbourhood-level to accommodate EV charging.	✓	✓	✓	<ul style="list-style-type: none"> • Utility-controlled demand management • Off-peak charging • Electric Vehicle Energy Management Systems (EVEMS) • Energy storage systems • Additional research, development and pilot projects
Metering	Barriers associated with how charging stations are owned, managed and metered in a building and challenges related to customer billing and the distribution of electricity costs.	✓			<ul style="list-style-type: none"> • EVSE network solutions
Lack of Access to Charging Infrastructure	Barriers faced by garage orphans who do not have access to charging at home because they do not have a garage or dedicated parking space with an electrical outlet.			✓	<ul style="list-style-type: none"> • Demand or load management • Residential curbside charging • Increased public and workplace charging
Building Design & Physical Infrastructure Barriers					
Parking Supply	Barriers related to a limited number of parking spaces in a building, lack of regular access to a parking space or restrictions on re-assignment of parking spaces.	✓	✓		<ul style="list-style-type: none"> • Peer-to-peer charging rentals • Public charging (parking lots and curbside charging) • Swapping parking spots • Community or shared charging • Reservations and virtual waiting lists

Barrier	Brief Description	Existing MURB	New MURB	Garage Orphan	Solutions
Design	Barriers related to the physical design of a building, such as space constraints in parking lots and within electrical rooms. Also includes barriers related to the design of EVSE installation.	✓	✓		<ul style="list-style-type: none"> • Technology solutions (e.g., demand charge controllers, chargers with built-in transformers, energy storage-based charging) • Parking or charging management (i.e., multiple users per charger) • Public charging (parking lots and curbside charging)
Connectivity	Barriers related to poor cellular coverage in underground parking garages.	✓	✓		<ul style="list-style-type: none"> • Technology solutions (e.g., cellular boosting)
Education & Awareness Barriers					
Consumer Awareness	Barriers related to minimal consumer understanding and experience with EVs or a lack of resources to help properly assess how to implement EV charging.	✓	✓	✓	<ul style="list-style-type: none"> • Targeted education and outreach • Regulations • Certification programs
Condo Board or Strata Council Decision- Making and Building Owner Awareness	Barriers related to a lack of awareness and resources required by MURB owners or property managers to effectively evaluate and deploy EV charging infrastructure.	✓			<ul style="list-style-type: none"> • Targeted education and outreach • Regulations (e.g., revising condo acts, bylaws, and regulations, permits triggering EVSE requirements)
Regulatory & Policy Barriers					
Physical Barriers	Regulatory barriers related to physical infrastructure upgrades and the costs associated with installing EVSE.	✓	✓		<ul style="list-style-type: none"> • Financial support and incentives • Zoning bylaws • EVEMS • Implementing EV supportive standards in national model building code
Condo & Strata Legislation	Regulatory barriers related to the approval process for EVSE installation by a condo board or strata corporation.	✓			<ul style="list-style-type: none"> • “Right to charge” legislation
Electricity-related Legislative & Regulatory	Regulatory barriers related to cost recovery and the apportionment of electrical costs associated with the use of electricity to charge an EV in a MURB.	✓			<ul style="list-style-type: none"> • Clarity on recovery of costs for EV charging services without regulation as a public utility
Measurement Rules	Regulatory barriers related to metering requirements for EV charging.	✓	✓		<ul style="list-style-type: none"> • Approved metering solutions that enable billing for EV charging based on energy usage

Barrier	Brief Description	Existing MURB	New MURB	Garage Orphan	Solutions
Financial Barriers					
Installation Costs	Barriers related to the costs associated with EVSE installation in a MURB or at a residential curbside.	✓	✓	✓	<ul style="list-style-type: none"> Technology solutions (e.g., demand charge controllers, charger with a built-in transformer) Swapping parking spots Regulations (e.g., EV ready parking requirements or design for 100% in new MURBs and for major renovations) Funding or support programs
Operation & Maintenance Costs	Barriers related to the cost of operating and maintaining EVSE.	✓	✓		<ul style="list-style-type: none"> Funding or support programs Low-rate charging
Cost Sharing	Barriers related to the inability of MURB owners and property managers to charge for electricity separate from the utility or restrictions on the resale of electricity.	✓	✓		<ul style="list-style-type: none"> New financial or operating models (e.g., financial recovery independent of utility costs, utility owned or operated EVSE, privately owned or operated EVSE and networked chargers) Charging solutions (e.g., flat fee-based charging, rate based charging) Public charging in parking lots and curbside
Other Barriers					
Rental-specific Barriers	Barriers related to the lack of incentives for renters and landlords to invest in infrastructure upgrades and EVSE installation, as well as challenges associated with liability.	✓	✓	✓	<ul style="list-style-type: none"> Regulatory solutions to allow EVSE installation Public charging in parking lots and curbside

Matrix of Actions

A suite of coordinated actions will be required to effectively address the barriers faced by potential ZEV owners residing in MURBs or those who do not have a dedicated parking spot. Three matrices of action related to new MURBs, existing MURBs, and garage orphans were developed as part of this study to help facilitate capacity building and stakeholder collaboration on addressing these barriers. A clear understanding of the broader interconnections that exist across barriers provides opportunities to determine appropriate and complementary solutions that will not unintentionally create new challenges. The three matrices of action provide an effective

visual map that will allow stakeholders to identify opportunities where they can make meaningful contributions.

Potential actions are organized under the following broad categories:

- Grid Preparedness & Charging Infrastructure:** These barriers comprise those related to the electrical grid and EV charging infrastructure (not those specific to building design) as they pertain to MURBs and garage orphans.
- Building Design & Physical Infrastructure:** Applicable only to MURBs, these barriers include

those related to charging infrastructure in and around buildings.

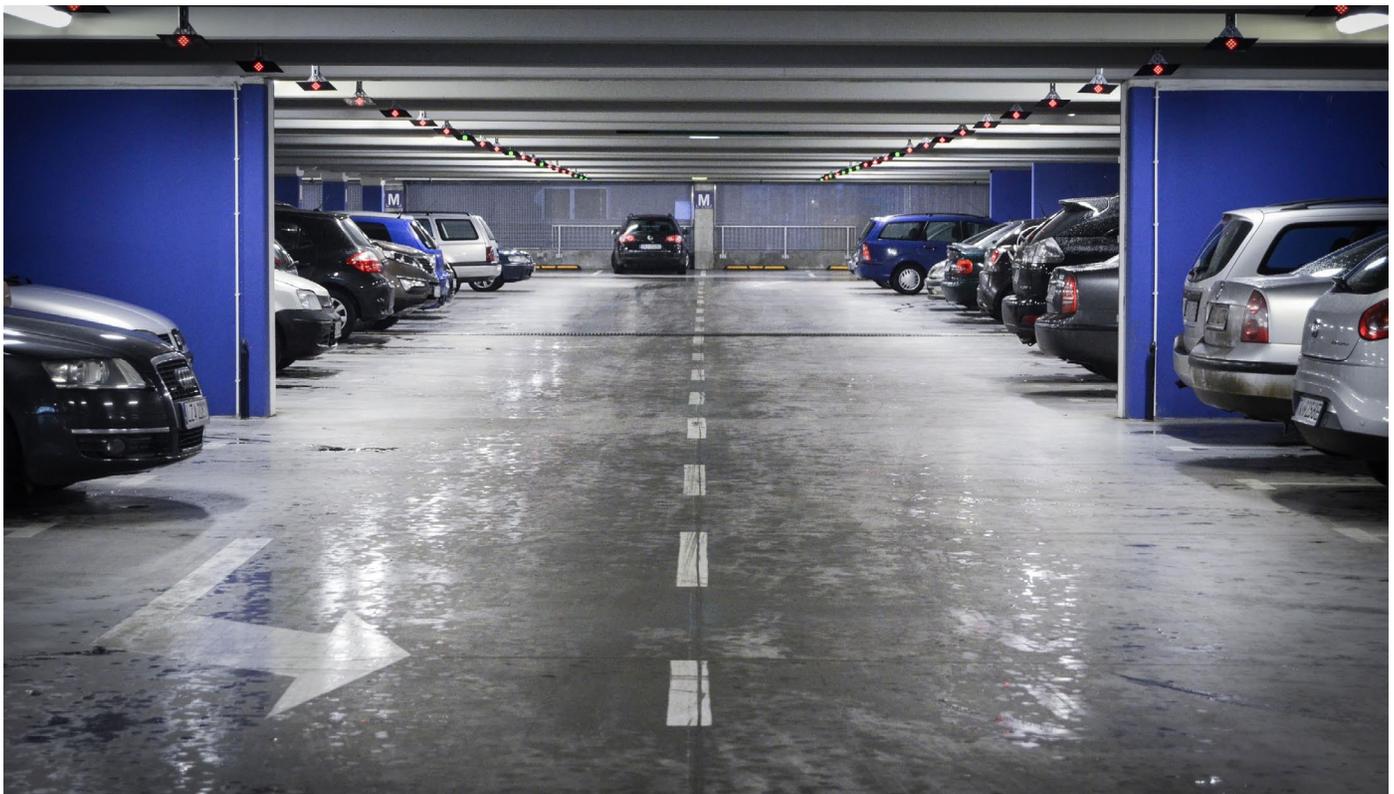
- **Education & Awareness:** Barriers in this category relate to MURBs and garage orphans and focus on consumer, building owner and property manager awareness.
- **Regulatory & Policy:** This category covers barriers related to the regulations and policies (e.g., acts, codes, standards, process policies and bylaws) that impact EV charging in MURBs and for garage orphans.
- **Incentives & Support Programs:** This category of actions involves financial and other support programs, such as technical advisory services, and is applicable to MURBs and garage orphans.
- **Complementary Actions:** These actions comprise those that are supportive of the EV sector in general and may not be directly related to facilitating charging in MURBs or for garage orphans.

This study identified that many stakeholders involved in work related to MURBs and garage orphans have no formal means of connection and are therefore unaware of each other's actions, successes and lessons learned. As previously noted, it will be critical for a range of stakeholders to collaborate on

the development and implementation of effective solutions to the barriers identified in this report. The following stakeholders have a potential role to play in enabling ZEV charging in MURBs and for garage orphans:

- Government (federal, provincial/territorial and municipal)
- Utilities and electricity providers
- Industry, including technology companies and EVSE providers
- Real estate developers
- Property management and apartment building owners
- Condo and strata boards
- Academia, civil society and advocacy organizations
- EV owners and associations
- Automakers

Each of these stakeholder groups may have specific actions that they are more suited to leading within the matrices. There will also be opportunities for stakeholders to support each other and to form partnerships for effective collaboration related to others.



GRID PREPAREDNESS & CHARGING INFRASTRUCTURE	EDUCATION & AWARENESS	REGULATORY & POLICY	SUPPORT PROGRAMS & INCENTIVES	COMPLEMENTARY ACTIONS
Ensure loads associated with EV charging by garage orphans is accounted for in neighbourhood-level distribution system planning ■				Develop supportive policies, electrification targets and incentive programs to signal support for long-term market growth ■
				Explore options for enabling utilities to own and operate EV charging infrastructure ■ ■

LEGEND

- Government actions
- Utility & electricity provider actions
- Industry & EVSE provider actions
- Real estate developer actions
- Property management & apartment building owner actions
- Condo & strata board actions
- Academia, civil society & advocacy organization actions
- EV owners & associations actions
- Automaker actions