Amped Up

Upskilling Canada's heavy-duty vehicle mechanics to support the transition to electric school buses

Pollution Probe

Mobility Futures Lab

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Pollution Probe

Pollution Probe is a Canadian charitable environmental organization founded in September 1969 by University of Toronto students and professors. Over the past 5 decades, Pollution Probe has been at the forefront of progress on a range of environmental issues. Progress on many of these issues took decades of hard work to achieve. We pursue environmental gains by working productively with governments, industry and the public, with a steadfast commitment to Clean Air, Clean Water, and a Healthy Planet. We engage people as thinkers to nurture and act on areas of consensus. Our niche in the environmental movement lies in our systems approach, which embraces three principal drivers for progress: Technology and Innovation; Rulemaking; Behavioural Change.

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Mobility Futures Lab is a leading sustainable transportation consulting firm that is at the forefront of innovation and research in the field of mobility. The firm's services are designed to help clients navigate the complex landscape of sustainable transportation, with a focus on proprietary software tools and data-driven solutions. Our approach is based on a deep understanding of the interconnections between transportation, energy, and the environment.

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The Future Skills Centre (FSC) is a forward-thinking centre for research and collaboration dedicated to driving innovation in skills development so that everyone in Canada can be prepared for the future of work. We partner with policymakers, researchers, practitioners, employers and labour, and post-secondary institutions to solve pressing labour market challenges and ensure that everyone can benefit from relevant lifelong learning opportunities. We are founded by a consortium whose members are Toronto Metropolitan University, Blueprint, and The Conference Board of Canada, and are funded by the Government of Canada's Future Skills Program.

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Executive Summary

Electric school bus (ESB) deployment is accelerating across Canada, supported by federal and provincial funding and growing fleet electrification commitments. While the transition offers environmental and operational benefits, it also introduces substantial technical shifts in maintenance practice. Diesel-based systems centered on mechanical repair are increasingly complemented by high-voltage electrical systems, battery management technologies, power electronics, regenerative braking systems, and depot-based charging infrastructure. Without parallel evolution in training systems and certification pathways, fleets risk uneven workforce readiness, increased diagnostic complexity, and greater dependence on manufacturer-controlled service networks.

This report examines how Canada can build and scale the workforce capabilities required to maintain electric school buses safely and effectively, with a focus on upskilling heavy-duty diesel mechanics and clarifying complementary training needs related to charging infrastructure. The research seeks to address four main project objectives:

- Level-set and create a baseline of existing initiatives related to upskilling heavy-duty diesel mechanics in Canada.
- Determine best practices for upskilling.
- Determine the optimal role for federal and provincial governments in supporting the creation of upskilling initiatives to support the transition to ESBs in Canada.
- Determine what skills-related measures are most effective at optimizing the transition of workers from declining to growing sectors or occupations.

The study draws on a structured literature review of safety standards, training programs, certification frameworks, and workforce development policies across Canada, complemented by qualitative stakeholder interviews with fleet operators and other sector experts. Findings were triangulated across sources and organized around vehicle systems and charging systems before being extended to broader workforce development considerations.

The analysis highlights three core themes.

High-voltage safety, battery diagnostics, and power electronics troubleshooting represent a foundational shift from mechanical repair toward electromechanical systems management. Electric school buses retain certain mechanical components, but propulsion, energy storage, and thermal management systems introduce new failure modes and diagnostic requirements. Competency gaps are most pronounced in energized system safety protocols, fault code interpretation, and battery system monitoring. Introductory OEM training at vehicle delivery is typically insufficient to support long-term in-house maintenance capacity.

Charging infrastructure expands the technical scope of fleet maintenance beyond the vehicle itself. Unlike diesel fueling, charging requires ongoing interaction with electrical equipment, communication protocols, and software platforms. Maintenance teams must distinguish between vehicle-side and charger-side faults and understand when issues fall within the scope of certified electricians or third-party vendors. Charging systems therefore become an integrated component of workforce planning rather than a separate operational function.

Canada's heavy-duty electric vehicle training ecosystem remains fragmented and lacks coordinated, portable competency pathways. OEM-delivered training is often proprietary and platform-specific, limiting skill transferability. Colleges and unions are expanding electric vehicle offerings, but structured heavy-duty electric specialization pathways remain uneven across provinces. The absence of standardized credentialing frameworks makes it difficult for employers to assess technician readiness and for workers to demonstrate transferable skills across jurisdictions or manufacturers.

These findings point to several implications for policy and practice. Core college and trade curricula should integrate meaningful electric vehicle content while preserving pathways for advanced heavy-duty specialization. Provinces can expand modular upskilling programs for in-service technicians and align them with recognized credentials to improve portability. Public funding for electric bus deployment can more consistently integrate workforce development considerations to ensure that skills capacity evolves alongside technology adoption. Industry stakeholders, training institutions, and standards bodies will need to coordinate more closely to define role-based competency tiers and certification pathways that support both safety and workforce mobility.

As electrification reshapes Canada's transportation workforce, durable worker transitions will depend on training systems that are structured, portable, and aligned with evolving technical demands. Coordinated workforce development will be essential not only to support individual technicians, but also to maintain fleet reliability and public confidence as electric school bus adoption continues to expand.

1 Introduction

School buses play a critical role in student transportation, with millions of children relying on them daily. While the iconic yellow school bus is a symbol of childhood, education and community, school buses have traditionally been diesel-powered, and thus a source of harmful emissions that cause serious human health impacts and contribute to climate change. As concerns over air quality and climate change grow, electric school buses (ESBs) are emerging as a cleaner alternative. Electric school buses produce zero tailpipe emissions, directly reducing exposure to harmful air pollutants and contributing to climate mitigation. They also serve as a symbol of active hope among younger generations who are grappling with climate anxiety. Traveling on a climate-friendly ESB provides physical health benefits through improved air quality and reinforces visible climate action within communities[1]. School bus electrification can also represent an economic opportunity in areas such as electric vehicle and battery manufacturing, electricity distribution infrastructure, and the provision of EV charging equipment and related services.

The electrification of school bus fleets is gaining momentum across Canada, driven by significant advancements in battery-electric technology over the past decade. Major school bus manufacturers have introduced electric models, supported by targeted funding initiatives such as the federal Zero Emission Transit Fund (ZETF) and complementary provincial-level incentives in certain provinces[2]. Notably, Prince Edward Island became the first Canadian province to commit to electrifying 50% of its school bus fleet by 2027, and Quebec has set a target to electrify 65% of school buses by 2030, while other provinces have introduced pilot and incentive programs to support deployment at varying levels.

Battery-electric school buses retain some similarities with their diesel counterparts, particularly in chassis and body design. However, they also introduce critical differences—most notably, high-voltage battery systems, power electronics, and charging infrastructure. These changes result in simpler drivetrains and fewer mechanical components, which can reduce long-term maintenance costs. At the same time, they require new safety protocols, diagnostic capabilities, and technical competencies that extend beyond traditional diesel training.

1 Pollution Probe (2023). An Electric School Bus Strategy for Ontario. Retrieved from: https://www.pollutionprobe.org/an-electric-school-bus-strategy-for-ontario/

2 Government of Canada (2025). Zero Emission Transit Fund. Retrieved from: https://housing-infrastructure.canada.ca/zero-emissions-trans-zero-emissions/index-eng.html

This report—developed by Pollution Probe in partnership with Mobility Futures Lab—examines the staff training requirements associated with the transition to ESBs and reviews existing certification and upskilling programs across Canada. The report outlines key technical differences between diesel and electric school buses, assesses Canada's current training landscape, identifies workforce gaps, and presents implications for policy and practice. It is intended to support:

- Fleet operators understand what the transition entails in terms of workforce readiness, and
- Policymakers, by identifying where training standards, partnerships, and investments are most needed.

The findings and recommendations are informed by a review of existing training standards, guidance documents, lessons learned from early electric school bus deployments across Canada, adapted best practices from other jurisdictions, and stakeholder interviews that provided practical insights into workforce readiness challenges.

While the focus is on school buses, many of the training principles are generalizable to other battery electric medium- and heavy-duty vehicles (MHDVs). Where applicable, the report notes when content is specific to school buses versus broadly relevant to other vehicle types.

2 Key Differences Between Diesel and Electric ESBs

Before diving into training specifics, it is crucial to understand what makes an electric school bus different from a traditional diesel bus. These differences span the propulsion system, braking and energy recovery, the way the vehicle is "refueled," and the presence (or absence) of emissions-related systems. Each of these technical differences has direct implications for how drivers operate the bus and how technicians maintain it.

Table 1 below provides a high-level comparison of the key differences between diesel and electric school buses, along with other key system differences (fuel/charging and emissions) which we discuss in the next sections.[3]

Table 1: Diesel and battery electric school bus key characteristics

Category	Diesel School Bus	Electric School Bus	Why It's Critical for Training
High-Voltage Safety	No high-voltage systems; mainly mechanical risks	Contains 600–800V systems for motor, battery, HVAC	Technicians must be trained on high-voltage (HV) personal protective equipment (PPE), lockout/tagout (LOTO), and zero-voltage verification (ZVV) before any servicing.
Braking System	Friction brakes only	Regenerative + friction braking	Drivers need to learn energy recovery techniques; affects range and passenger comfort
Propulsion System	Internal combustion engine (ICE) with gears and fluids	Electric motor, fewer moving parts	Technicians must shift from mechanical repairs to electrical diagnostics
Charging vs. Fueling	Fast diesel refueling at pumps	Time-dependent charging with Level 2 / DCFC	Fleet staff need to maintain and troubleshoot charge issues
Emissions and Fluids	Diesel exhaust fluid (DEF), diesel particulate filter (DPF), selective catalytic reduction (SCR), engine oil, and transmission fluid	No tailpipe emissions; fewer fluids	Eliminates some systems; focus shifts to battery and cooling system checks

3 Electric School Bus Initiative (2023). Reskilling the Workforce: Training Needs for Electric School Bus Operators and Maintenance Technicians. Retrieved from: Reskilling the Workforce: Training Needs for Electric School Bus Operators and Maintenance Technicians

2.1 Propulsion, Braking Systems and Mechanical System differences

A diesel school bus is powered by an internal combustion engine (ICE) that delivers torque through a multi-speed transmission. In contrast, an electric school bus uses one or more electric traction motors powered by a large battery pack. This fundamental difference means that electric buses have instantaneous torque and smooth acceleration without gear shifts, unlike diesel engines that take time to rev up and may shift gears. Diesel buses rely entirely on friction brakes (air brake or hydraulic brake systems) to slow down, sometimes aided by an engine brake or retarder that dissipates energy as heat. Electric buses, on the other hand, come with regenerative braking capability. When an electric bus decelerates, the motor can act as a generator, feeding energy back into the battery. This not only extends the vehicle's range but also reduces wear on the friction brakes.

Mechanically, electric buses have far fewer moving parts in the propulsion system. There is no engine with pistons, no complex transmission with many gears, and no engine-driven accessories (alternator, power steering pump, etc. are typically electric). An electric motor has only a single-speed reduction gear in most buses. This simplicity leads to lower maintenance – no oil changes, no coolant flushes for an engine radiator, no transmission fluid changes, etc.[4] However, it introduces new components like inverters and motor controllers that manage the power flow from battery to motor.

Another aspect is vehicle weight and balance: electric buses tend to be heavier (due to the battery mass) and have that weight distributed differently (often low and between the axles). Because of the battery's location and weight, technicians must lift or jack the bus carefully using hoist points specified by the manufacturer to avoid damaging the battery pack and may need higher-capacity lifts to support the additional mass.

These differences introduce new safety considerations for maintenance staff. Servicing or inspecting electric buses often requires working near high-voltage systems, making electrical safety training, proper PPE, and lockout/tagout (LOTO) procedures, which ensure equipment is de-energized before maintenance, essential. These training elements are discussed further in Section 3.

2.2 Emissions control and heating Systems

Diesel buses are equipped with extensive emissions control systems to meet environmental regulations. These include diesel particulate filters (DPFs), selective catalytic reduction (SCR) systems, diesel exhaust fluid (DEF) tanks, and exhaust gas recirculation (EGR). These components require regular maintenance and can affect vehicle reliability and operating costs if not properly serviced. Electric school buses eliminate all tailpipe emissions and associated systems, significantly reducing mechanical complexity and the need for specialized emissions servicing. Instead, operational attention shifts to battery health and power electronics, which are covered in Section 3.

Diesel buses typically use engine-generated heat to warm the cabin, circulating heated coolant through a heater core, often with the support of an auxiliary diesel heater. Electric school buses, however, cannot rely on engine waste heat. Instead, they use electric resistance heaters or increasingly, heat pump–based HVAC systems. These systems draw directly from the high-voltage battery and are among the most energy-intensive onboard systems, especially during cold weather. As a result, HVAC loads can significantly reduce the effective driving range of an ESB.

4 US Department of Energy. Alternative Fuels Data Center. Flipping the Switch on Electric School Buses: Cost Factors: Module 3. Retrieved from: https://afdc.energy.gov/vehicles/electric-school-buses-p8-m3

To address this, many OEMs continue to equip electric school buses with auxiliary diesel heaters for use in colder climates, particularly during early deployments or when battery capacity is constrained. These heaters operate independently of the propulsion system and must still be fueled and maintained, much like traditional bus heaters. Over time, as battery capacity and HVAC technologies evolve, fleets are expected to shift toward all-electric heating systems.[5]

From a training standpoint, HVAC maintenance now shifts toward high-voltage electrical diagnostics and system optimization. Technicians will need to understand the function and servicing of high-voltage cabin heaters, including Positive Temperature Coefficient (PTC) heaters and heat pump mechanics—systems unfamiliar to diesel fleet technicians. Operationally, drivers may also be required to preheat the cabin while the vehicle is plugged in, reducing battery drain during route operation.

2.3 Fueling vs. Charging Infrastructure

Electric school bus charging infrastructure differs fundamentally from diesel fueling. Diesel buses typically refuel quickly at centralized depots or commercial fuel stations, with minimal planning required. In contrast, electric school buses depend on dedicated charging infrastructure, and the speed of charging can vary significantly depending on the power level and charger type (**Table 2**). These differences directly affect route planning, dwell time between shifts, and energy management.[6]

The choice of charger type is shaped by route length, scheduling flexibility, utility pricing, and capital investment. Most school bus fleets install charging infrastructure at their depots. In rural or decentralized operations, home-based charging is sometimes considered for drivers, though this introduces new logistical and billing considerations.

Unlike fueling, charging is time-sensitive: charging during peak utility hours can lead to higher electricity costs. To address this, many fleets use Charging Management Software (CMS)—digital platforms that automate charging schedules, balance energy loads, and sometimes integrate with depot energy systems. These platforms introduce new training needs for fleet managers or operations staff who must monitor system performance and respond to alerts, issues, or utility constraints.

In short, charging is no longer just a task, it becomes a system that must be understood, planned for, and actively managed. This marks a significant departure from diesel fueling and requires upskilling of both operational and facility staff.

Table 1: Charging Power Levels for electric school buses

Charging Level	Connector/Plug Type	Voltage/Amps	Typical Power	Use Case
Level 2	J1772	240V / ~80A	~7-19.2 kW	Overnight depot or home charging
DC Fast (L3)	CCS1	480V / >100A	22–150+ kW	Mid-day charging or fast turnaround

5 Pollution Probe (2025). Electric School Bus Demonstration: An Edmonton Case Study. Retrieved from: https://www.pollutionprobe.org/electric-school-bus-demonstration-an-edmonton-case-study/

6 US Department of Energy. Flipping the Switch on Electric School Buses: Charging Infrastructure: Module 1 Retrieved from: https://afdc.energy.gov/vehicles/electric-school-buses-p4-m1

3 Research Design

Building on the technical differences between diesel and electric school buses outlined in the previous section, this research examines how Canada can build and scale the workforce capabilities required to safely maintain ESBs. The focus is on upskilling heavy-duty diesel mechanics and clarifying complementary training needs for staff interacting with charging infrastructure. As ESB deployment accelerates, training systems and certification pathways have not evolved at the same pace, creating potential gaps in workforce readiness.

This study is exploratory and descriptive in nature. Rather than testing a single hypothesis, it maps the current training landscape, identifies gaps, and develops evidence-informed recommendations for governments, fleet operators, training providers, and standards bodies. There are four main project objectives:

- Level-set and create a baseline of existing initiatives related to upskilling heavy-duty diesel mechanics in Canada.
- Determine best practices for upskilling (taking into account equity considerations).
- Determine the optimal role for federal and provincial governments in supporting the creation of upskilling initiatives to support the transition to ESBs in Canada.
- The project will also address the Future Skills Centre Strategic Question: "What skills-related measures are most effective at optimizing the transition of workers from declining to growing sectors or occupations?

To address these objectives, the research draws on two primary sources of evidence. First, a structured literature review and desktop research established a baseline of relevant standards, policies, training programs, and technical guidance. This included analysis of electrical safety standards, certification frameworks, OEM training materials, post-secondary curricula, union training programs, and federal and provincial workforce development initiatives.

Second, qualitative stakeholder engagement was undertaken to validate and contextualize findings from secondary research. Interviews with fleet operators and other sector experts provided insight into practical maintenance challenges, limitations of one-time OEM training, regional disparities in access to programs, and responsibility boundaries between maintenance technicians, electricians, and other relevant parties.

The analytical approach translated technical differences between diesel and electric school buses into workforce competencies and mapped those competencies against existing training structures. Findings were triangulated across literature and stakeholder insights to identify consistent themes and areas of misalignment. Equity considerations were integrated into this analysis, including barriers to training access, representation within the maintenance workforce, and the potential workforce impacts of electrification. Rather than organizing results by methodology, findings are structured around practical domains — vehicle systems and charging systems — and extended into workforce-development considerations such as role-based training tiers and certification pathways.

This research has several limitations. Stakeholders willing to be interviewed for an electric school bus related research project may be more likely to support a transition to electrification, which may introduce selection bias. Training programs and OEM service policies are evolving rapidly, and the study focuses primarily on Ontario and Quebec, which may limit generalizability to other provinces. Despite these limitations, triangulation across sources strengthens the validity of the conclusions. The resulting analysis provides a structured baseline of workforce readiness and identifies actionable levers to improve training accessibility, portability, and alignment with Canada's emerging electric school bus ecosystem.

4 Findings

4.1 Maintenance Technician Training Needs

Maintenance technicians are the backbone of keeping the school bus fleet running safely. The transition from diesel to electric propulsion dramatically changes what a technician needs to know and do. While certain mechanical systems carry over (brakes, suspension, steering, body repairs), the introduction of high voltage electrical systems, battery packs, and electronic controls means technicians must develop entirely new competencies.

This section outlines the training needs for maintenance staff in two broad categories: vehicle systems (everything on the bus itself, from high-voltage components to regenerative braking and even the remaining mechanical parts) and charging systems and infrastructure (since the charging equipment is often maintained by the same department or in close coordination with it). Each sub-topic identifies what technicians need to learn and why, building on many differences highlighted in Section 2.

4.1.1 High Voltage Safety Procedures and Responsibilities

Electric school buses operate at high voltages—typically between 400 to over 700 volts DC—which introduces serious risks that diesel mechanics may not have previously encountered. The most urgent training priority for maintenance technicians is therefore high-voltage (HV) safety. Understanding the dangers of electric shock and arc flash (a sudden release of energy caused by an electrical fault) is essential, as is the discipline to follow strict safety protocols before interacting with any HV system.[7]

Technicians must first be able to identify high-voltage components and wiring, which are typically marked by orange cables and labeled enclosures. This includes the battery pack, inverter, traction motor, onboard charger, and other HV devices. Tasks involving any of these systems must only be undertaken after ensuring the system is de-energized and following appropriate safety procedures using appropriate tools (**Table 3**).

Table 3: Required PPE and Tools for High-Voltage Work

Equipment / Tool	Purpose
Insulated rubber gloves (with leather protectors)	Protects hands from electric shock when handling HV components
Arc-rated face shield and clothing	Protects against arc flash hazards during HV work
Dielectric boots or stand-on insulated mat	Prevents current flow through the technician's body
Safety glasses	Protects eyes from debris or electrical arcs
Multimeter	Measures high voltage safely for diagnostic and verification purposes
HV-rated test equipment	Specialized tools for safely working on EV systems

7 National Rural Transit Assistance Program (2022). Electric Vehicle Maintenance Best Practices. Retrieved from: https://www.nationalrtap.org/Resources/Best-Practices-Spotlight/Electric-Vehicle-Maintenance

Central to safe servicing is the process of zero-voltage verification and lockout/tagout (LOTO). Before any maintenance can be performed on high-voltage components, whether that's opening a battery service cover, replacing a coolant pump, or accessing an inverter, the technician must follow OEM-specific depowering procedures and verify that no residual voltage remains. Training should include the full sequence of steps for LOTO, supported by hands-on practice and written protocols (**Table 4**).

Table 4: Illustrative Lockout/Tagout (LOTO) Procedure for Electric School Bus Servicing

Step	Action
1	**Shut down the vehicle** using the main power switch or key to stop all operations
2	**Wait the OEM-specified minimum time** (often several minutes) for capacitors to discharge
3	**Disconnect the HV interlock loop** or service disconnect, if applicable
4	**Attach lockout device** to prevent reactivation (physical lock or battery disconnect lock)
5	**Tag the vehicle** with warning signage indicating service is in progress
6	**Verify zero voltage** at multiple test points using a multimeter (a device used to measure voltage, current, and resistance)
7	**Document and proceed** only after confirming system is safe

While the bulk of technician attention is on the vehicle itself, some service tasks also touch the charging infrastructure. Charger units connect to both grid power and high-voltage DC output, meaning they carry similar hazards. Technicians must be made aware of which tasks they are allowed to perform, such as connector inspections or routine monitoring, and which should be referred to certified electricians. Clear protocols must be established by fleet operators and vendors to define these boundaries and integrate them into training.

4.1.2 Vehicle Systems

Electric school buses introduce a new set of drivetrain, battery, and control technologies that require technicians to expand their skillsets well beyond conventional diesel maintenance. Several subsystems, particularly thermal management, affect multiple vehicle domains, from batteries to HVAC to onboard chargers. Understanding their shared components and controls is key to successful diagnostics.

Many of these subsystems are linked through shared thermal management loops. Effective heating and cooling strategies not only protect battery health, but also support propulsion efficiency, HVAC performance, and auxiliary system reliability.

4.1.2.1 Propulsion and Powertrain Components

Unlike diesel drivetrains with multi-speed transmissions and engine-driven accessories, electric school buses use simplified single-speed drivetrains powered by electric traction motors. Technicians must understand the following:

- **Traction motors:** How they produce torque, cooling requirements, and diagnostic methods.
- **Inverters and motor controllers:** Components that regulate motor speed and torque. Training should cover fault code interpretation and thermal management systems.
- **Power electronics:** DC-DC converters, onboard chargers, and auxiliary power units require both electrical and thermal diagnostics. Many are sealed and modular, so training should include when to repair versus replace.
- **Battery management systems (BMS):** While programming is typically handled by OEM tools or authorized personnel, technicians should be able to interpret data such as state of health (SOH), cell balance status, and thermal performance.

- **Battery thermal management systems:** How ESBs regulate battery temperature using coolant loops, electric pumps, and (in some models) integrated heat pumps or chillers. Training should cover inspection, diagnostics, and service procedures, with awareness of how faults can trigger BMS warnings or performance restrictions.

Many of these propulsion elements involve electronics and Controller Area Network (CAN) bus communications, a system that allows different vehicle components to exchange data without a central computer, meaning greater reliance on computer-based diagnostics. Predictive maintenance will also play an increasing role, with onboard telematics and software providing fault alerts, usage data, and trend monitoring. Technicians need to be familiar with these platforms and know how to respond to early indicators of system stress.[8]

Because these propulsion systems are so dependent on cooling and heating to maintain safe operating temperatures for batteries, motors, and power electronics, technicians will often encounter faults that span across domains. The same coolant loops, pumps, and controls that regulate batteries and inverters also interact with HVAC and braking auxiliaries, topics covered in the following section.

4.1.2.2 Mechanical and Auxiliary Systems

Technicians must also adapt their skills for mechanical domains that now interface with high-voltage electrical and thermal systems. While many components such as suspension, chassis, and steering remain largely unchanged from diesel buses and continue to operate at low voltage, others, like HVAC and braking, now integrate with high-voltage electronics. Updated training is required to safely inspect, maintain, and troubleshoot these systems.

- HVAC systems: Many ESBs use high-voltage Positive Temperature Coefficient (PTC) heaters or heat pump systems. These replace diesel-based coolant loops but can impose significant battery range penalties. Training should cover how these systems are powered, how to conduct performance checks, and how to safely isolate them during service.
- Braking systems: Regenerative braking introduces electronic brake blending, where friction brakes are supplemented or partially replaced by the electric motor during deceleration, which slows the vehicle by generating electricity and feeding it back to the battery. Technicians must learn to recognize reduced wear patterns, check for rust or corrosion on rotors/pads, and confirm calibration between the electronic control unit and the mechanical brake system.
- Auxiliary systems: Air compressors (for air brakes), power steering pumps, and coolant pumps may all be electrically driven. These systems often require new troubleshooting workflows and may present issues with noise, vibration, or startup sequencing that were not present in diesel vehicles.

4.1.3 Charging Infrastructure and Diagnostics

Beyond onboard vehicle systems, technicians must also engage with the charging infrastructure that enables daily operations. Electric school buses rely on purpose-built charging equipment that requires technicians to develop new knowledge and routines. While they are typically not responsible for deep servicing of chargers, technicians play a critical front-line role in ensuring functionality and diagnosing faults, particularly when charging failures may originate from the bus itself.

Technicians should be trained to perform regular inspections of charging equipment. This includes checking for wear or damage on connector plugs and cables, ensuring proper plug storage, and monitoring charger displays or dashboard indicators for faults.[9]

8 C40 Cities (2022). Understanding Zero-Emission bus Maintenance. Retrieved from: https://www.c40cff.org/knowledge-library/understanding-zero-emission-bus-maintenance

9 National Academies Press (2021). Guidebook for Deploying Zero-Emission Transit Buses. Retrieved from: https://www.nationalacademies.org/publications/25842

A key diagnostic distinction lies between Level 2 (AC) and Level 3 (DC fast charging) systems:

- **Level 2 (AC) charging:** Uses the onboard charger within the vehicle to convert AC to DC. If an issue arises during AC charging, the fault may originate from either the external EVSE or the vehicle's onboard systems. Technicians must learn to differentiate these cases, access diagnostic codes, pull logs with OEM software, and follow safe removal and replacement (R&R) procedures for the onboard charger when necessary.

- **Level 3 (DC fast charging):** Bypasses the onboard charger and delivers DC power directly to the battery. In these cases, faults are more likely to originate in the charger itself or from communication errors between the charger and the bus. Technicians must recognize when the issue lies outside their role and escalate to certified electricians or the vendor.

To clarify responsibilities, training programs should include orientation on charger components and technician boundaries, as summarized in **Table 5**.

Table 5: Typical Charging Infrastructure Responsibilities

Task	Maintenance Technician	Electrician / Vendor
Visual inspection of connectors and cables	✔	—
Plug/unplug bus and verify charge start	✔	—
Check CMS for faults or failed sessions	✔	—
Replace fuses inside charger	✖	✔
Access internal wiring panels	✖	✔
Reset charger via software interface	✔	✔

Technicians should also understand the basics of charging communication protocols (e.g., J1772 or CCS1) and how misalignment or handshake failures can interrupt charging. Familiarity with Charging Management Software (CMS) is essential for monitoring sessions, resetting charging events, and identifying repeated failures.

By understanding how to inspect, diagnose, and escalate charging-related issues, technicians help minimize downtime and ensure reliable daily operation of the electric school bus fleet.

4.2 Training Standards, Competency Frameworks, and Certification Pathways

As electric school buses become more widespread, training must evolve beyond informal knowledge transfer. A structured approach is needed, one that defines training levels by role, aligns with recognized standards, evaluates staff competency, and ensures consistent delivery across regions. This section outlines how electric school bus training programs can be formalized and scaled. It covers tiered training frameworks tailored to staff roles, existing certification programs and safety standards, current upskilling initiatives in Canada, and the role of government and public funding in expanding training access.

4.2.1 Role-Based Training Tiers and Staff Mapping

Electric school bus deployments involve a wide range of personnel, from drivers and dispatchers to technicians and facility managers, each with distinct training needs. A one-size-fits-all training approach is inefficient and risks either overtraining or leaving critical gaps. A tiered framework ensures each role receives the appropriate level of knowledge and safety training without unnecessary burden.

4.2.1.1 Training Tiers by Role Complexity

Organizations like the World Resources Institute (WRI) and several OEMs have already developed multi-level training models.[10] Building on these, the table below outlines five training tiers applicable to ESB fleet staff:

Table 6: Training Levels for Electric School Bus Roles

Level	Name	Description	Intended Audience
Level 0	Awareness Training	Introductory overview of ESB technology, benefits, and basic safety concepts. Designed to build buy-in and dispel misconceptions.	All staff (including school administrators, students, aides)
Level 1	Operator Training	Covers basic operation, pre/post-trip checks, charging procedures, and emergency steps from a driver's perspective.	Drivers, dispatchers, route planners
Level 2	High Voltage Safety & Maintenance	Teaches how to work safely around HV components using PPE, LOTO, and de-energization protocols.	Maintenance techs, garage supervisors, facilities staff
Level 3	Advanced Propulsion and Systems Training	In-depth training on electric drive systems, diagnostics, power electronics, and OEM tools for troubleshooting.	EV-specialist technicians, advanced fleet staff, OEM service technicians
Level 4	Master-Level Troubleshooting & Certification	Focused on deep systems knowledge, complex diagnostics, and integration. Often leads to formal certifications or OEM-equivalent credentials.	Senior technicians, lead mechanics, in-house EV champions

4.2.1.2 Role Mapping: Who Needs What Training

Mapping staff to these tiers is important to ensure each role gets appropriate training. This structured approach ensures everyone gets what they need, and nobody is under- or over-trained for their role. It also helps with scheduling training.

Table 7: Role and training level requirements

Role	Recommended Training Level(s)	Notes
Bus Drivers	Level 0, Level 1, some Level 2	Driver trainers may benefit from some HV safety awareness (e.g. emergency procedures).
Dispatchers / Route Planners	Level 0, selected Level	Understanding charging and range supports efficient 1 scheduling.
Fleet / Transportation Managers	Level 0, overviews of Levels 1 & 2	Needed for oversight, budgeting, and risk mitigation.
Maintenance Technician I (Generalists)	Level 0, Level 2 diagnostics.	Must know HV safety, even if not performing advanced
Maintenance Technician II (EV Specialists)	Levels 2, 3, possibly 4	Core team for electric system diagnostics and repairs.
Facilities Staff	Level 0, tailored Level 3	Focused on infrastructure maintenance, charger safety, and power systems.
Students / Riders	Level 0 (basic)	Supports safety culture and awareness around charging infrastructure.

By clearly defining training tiers and aligning them with roles, fleet operators can ensure every staff member has the tools and knowledge they need, without unnecessary training overload. This also aids budgeting, scheduling, and measuring readiness across the organization.

10 World Resources Institute (2024). Electric School Bus Training Standards. Retrieved from: https://electricschoolbusinitiative.org/sites/default/files/2024-11/Electric%20School%20Bus%20Training%20Standards%20-%20Electric%20School%20Bus%20Initiative%20%28November%202024%29.pdf

4.2.2 Existing Frameworks and Guidelines

To build a credible and scalable electric school bus training program, it is essential to align with existing industry standards and certifications. These frameworks provide a foundation for developing curricula, evaluating competency, and potentially offering staff recognized credentials. The most relevant organizations and standards include ASE, CSA, Red Seal, NFPA, and SAE.

ASE (Automotive Service Excellence):
ASE is a widely recognized U.S.-based certification body for automotive technicians, also accepted in Canada. Traditionally, ASE's S-series has focused on school bus technicians working with diesel engines. For electric vehicles, ASE now offers:

- **L3 Certification:** Covers diagnostics and repair of light-duty hybrid and electric vehicles. While not tailored to heavy-duty vehicles, it helps technicians develop foundational EV knowledge

- **xEV Electrical Safety Certifications:** Includes high-voltage safety training (e.g., HV Safety Level 2), focused on safely working around energized EV systems.

Although no ASE test exists as of 2025 for heavy-duty EVs, this gap may close as the market matures. In the meantime, fleets can leverage existing ASE EV certifications as part of upskilling programs.

CSA (Canadian Standards Association):
CSA Group offers an Automotive Electric Vehicle Technician Certification designed to standardize qualifications for high-voltage EV service in Canada and beyond. Key features include:

- Requires prerequisites such as Red Seal certification or ASE Master Technician status.

- Demonstrates competency in battery systems, diagnostics, charger interfacing, and safety procedures.

- Provides a nationally recognized credential aligned with Canadian workforce needs.

This certification helps bridge the training gap for medium- and heavy-duty EVs, making it directly relevant to ESB service teams.

Red Seal Program
The Red Seal Program is Canada's national standard for skilled trades certification, allowing qualified tradespeople to have their credentials recognized across all provinces and territories.

Relevant trades include:
- Truck and Transport Mechanic
- Automotive Service Technician
- Heavy-Duty Equipment Technician

Graduating from a Red Seal–endorsed program signifies consistent training and competency standards nationwide. However, Red Seal currently includes only limited EV content (e.g., a small number of diagnostic questions on hybrid and electric systems). EV-specific training is typically delivered through supplemental programs such as CSA certifications or college-led micro-credentials.

NFPA (National Fire Protection Association):
While CSA Z462 is Canada's standard for electrical safety in the workplace, many ESB-related safety procedures and training materials also reference NFPA 70E, its U.S. counterpart. NFPA resources are widely used by OEMs and training vendors.

Key references include:

- **NFPA 70E:** Standard for electrical safety in the workplace, underpinning HV safety training such as PPE use, Lockout/Tagout, and arc flash boundaries.

- **EV Safety Training for First Responders:** While targeted at emergency personnel, it reinforces safety principles that also inform technician awareness.

Canadian programs often cross-reference CSA Z462 and NFPA 70E, and both should be integrated into ESB safety training.

SAE (Society of Automotive Engineers)
SAE develops foundational engineering standards that guide EV design and infrastructure. Relevant standards and certifications for ESBs include:

- **SAE J1772:** Defines the Level 1 and Level 2 AC charging connector and communication protocol used for overnight and depot charging.
- **SAE J1772 Combo (CCS1):** Extends J1772 to support Level 3 DC fast charging, used for mid-day or turnaround charging needs.
- **SAE J2344:** "Guidelines for Electric Vehicle Safety," outlining recommended design and service practices, including HV interlocks (safety circuits that disable high voltage when a component is opened or removed), disconnects (devices that physically isolate high-voltage power), and system labeling.
- **SAE J2990/J2990-1:** Best practices for safely handling hybrid and electric vehicles in maintenance and service contexts.
- **SAE EVSE Technician Certification:** Certification program for those working on charging station installation and maintenance, relevant to facility electricians and depot infrastructure staff.

Together, these standards and certifications form the foundation for building credible ESB training programs. They also highlight current gaps, particularly in heavy-duty EV certifications, that fleets and training providers must address through supplemental instruction and partnerships with OEMs or colleges.

4.2.3 Existing Upskilling Initiatives

Across Canada, a mix of OEMs, educational institutions, government agencies, and non-profit organizations are beginning to address the electric vehicle (EV) skills gap, sometimes with a focus on electric school buses. While efforts are still emerging and often fragmented, several initiatives provide useful models for workforce development. The largest upskilling burden falls on maintenance technicians, as most programs are designed to help existing diesel-trained mechanics transition safely and confidently to electric systems.

OEMs training programs:
Most electric school bus manufacturers—including Lion Electric, Blue Bird, Thomas Built, and IC Bus—offer training as part of vehicle procurement.[11] These sessions typically provide hands-on instruction specific to each OEM's technology, focusing on vehicle systems, safety procedures, and maintenance basics. However, there are important limitations:

- Trainings are usually one-time events at delivery, with little ongoing support.
- Curriculum is proprietary and brand-specific, limiting knowledge transfer between platforms.
- OEMs often restrict high-voltage battery work and warranty repairs to their own technicians or authorized dealers, which can delay service if local staff are not certified.

While these trainings are valuable, they should be seen as a starting point, not a substitute for broader workforce development.

Community College and Technical Programs:
Canada's network of colleges, polytechnics, and union training centers is expanding its EV offerings to prepare both new entrants and experienced tradespeople. While few programs focus exclusively on school buses, many cover transferable competencies such as:

- High-voltage safety
- Battery diagnostics
- EV propulsion systems
- Charger interfacing

Several institutions now offer short courses or micro-credentials aimed at upskilling mid-career mechanics. This is especially important for school bus technicians trained in the diesel era who now need to safely service electric drivetrains.

11 US Department of Energy (2023). Alternative Fuels Data Center. Part 7: Driver and Technician Training. Retrieved from: https://afdc.energy.gov/files/pdfs/electric-school-bus-education-part-7.pdf

The federal government has also created an online directory of EV-related programs across Canada, supporting awareness and enrollment.[12]

Industry Associations and Non-Profit Initiatives
A growing number of non-profits and industry organizations are creating free or low-cost materials to support technician training. While many are U.S.-based, their resources are often applicable in the Canadian context.

Examples include:

- **World Resources Institute (WRI):** Developed the Electric School Bus Training Standards (2024)—a tiered, open-access framework that school districts and training providers can adapt to local needs.[13]
- **National Alternative Fuels Training Consortium (NAFTC) and the Electrification Coalition:** Developed EV bus maintenance modules suitable for Canadian fleets.[14]
- **ESB Learning Center:** Funded by the U.S. EPA and DOE, this platform offers a four-part webinar series tailored to school bus electrification, including maintenance considerations.[15]

These resources offer useful entry points for districts and contractors building internal training programs or supplementing formal education. While most focus on technicians, there is growing interest in extending training to facilities staff and utility partners—critical to supporting safe and effective ESB deployments.

4.2.4 Government Funding and Policy Initiatives

Government involvement in workforce development for electric vehicle maintenance is emerging in Canada, though efforts remain uneven across jurisdictions. While most federal funding has focused on vehicle deployment and infrastructure, some provinces, particularly Quebec, have begun investing directly in technician training. Mobile training units and hybrid delivery models may help extend access to rural and remote school districts.

Provincial Investments

- **Quebec:** In April 2023, the provincial government announced a $7 million investment over three years to train mechanics in electric and hybrid heavy-duty vehicle maintenance.[16] The resulting program includes:
  - A 196-hour intensive training curriculum covering electric buses, trucks, and other heavy vehicles.
  - An estimated reach of 240 mechanics and repairers across the province.
  - A "train-the-trainer" model involving 20 master trainers to ensure continued program delivery.

This builds on earlier EV-focused training developed by the CPCPA[2] in 2020, which launched programs for EV mechanics and body repair.

- **Ontario:** Within Ontario, there exist a number of funding opportunities, including the Canada-Ontario Job Grant (COJG), the Skills Development Fund Training Stream and Ontario's Micro-credentials Challenge Fund, that either have assisted, or have the potential to assist with the upskilling of technicians and mechanics to work on electric vehicles. These programs are not, however, specific to electric school buses.

12 Natural Resources Canada (2025). Zero-emission vehicle technician training opportunities. Retrieved from: Zero-emission vehicle technician training opportunities

13 World Resources Institute (2024). Electric School Bus Training Standards. Retrieved from: https://electricschoolbusinitiative.org/sites/default/files/2024-11/Electric%20School%20Bus%20Training%20Standards%20-%20Electric%20School%20Bus%20Initiative%20%28November%202024%29.pdf

14 Transit Training Work (2021). Battery Electric Bus Familiarization. Retrieved from: https://www.transittraining.net/courseware/details/battery-electric-bus-familiarization

15 US Joint Office of Energy and Transportation (2024). Electric School Bus Training and Workforce Development. Retrieved from: https://driveelectric.gov/school-districts-training

16 Electric Autonomy Canada (2023). Quebec commits $7 million to train mechanics to service heavy-duty EVs, hybrids. Retrieved from: https://electricautonomy.ca/news/2023-04-19/quebec-heavy-duty-evs-training-program/

- **British Columbia:** Through the CleanBC initiative, the province has funded technician training for light-duty EVs. For medium- and heavy-duty vehicles, training has so far been linked to specific pilot projects such as the *Electric Commercial Vehicle Pilots Program*.

Federal Involvement
At the federal level, there are no large-scale training programs dedicated to electric school bus maintenance. However, Natural Resources Canada (NRCan) has supported workforce upskilling through the Zero-Emission Vehicle Awareness Initiative (ZEVAI), funding technician training initiatives in partnership with colleges and industry groups. NRCan has also created a nationwide directory of ZEV training opportunities, helping Canadians identify relevant post-secondary and short-term programs. The Sustainable Jobs Training Fund by Employment and Social Development Canada (ESDC), meanwhile, funds a number of initiatives related to the clean economy, including those related to electric vehicle maintenance.

Other federal programs, such as the Canada Infrastructure Bank (CIB) and Infrastructure Canada's Zero Emission Transit Fund (ZETF), primarily target capital investments (vehicles and chargers). While not training-focused, applicants are required to demonstrate workforce readiness plans and may allocate capital budget to cover additional staff training and upskilling needs.

4.3 Equity in the Transition to Electrification

Within the scope of this report, equity is considered through a workforce lens, focusing on access to training, participation in upskilling programs, and the ability of workers to transition into roles associated with electric school bus (ESB) maintenance.[17]

As ESB deployment accelerates, maintenance work is shifting toward high-voltage systems, diagnostics, and charging infrastructure. Ensuring that workers can access the training required to support these systems is central to both workforce readiness and an equitable transition.

The analysis highlights several challenges related to workforce equity.

Participation in the heavy-duty vehicle maintenance workforce remains uneven. For example, women represent a small share of the workforce, reflecting persistent barriers to entry and advancement in the sector.[18] Without targeted efforts, these patterns are likely to carry over into EV-related training and roles.

Access to training is not evenly distributed across operators. Larger fleets are typically better positioned to access OEM training and allocate internal resources to upskilling. Smaller and geographically dispersed operators face constraints related to cost, travel, and time. This creates the risk of uneven workforce readiness across regions and fleet types.

The current training ecosystem also remains fragmented. A mix of OEM-specific training, college programs, and emerging certifications provides multiple entry points but lacks standardization. As a result, workers may face unclear progression pathways, and employers may have difficulty assessing technician competency. The absence of widely recognized, portable credentials further limits workforce mobility.[19]

Addressing these challenges will require a more structured and accessible training ecosystem.

Improving access to training is a key priority, particularly for smaller operators and those in rural or remote regions. Flexible delivery models, including modular programs, hybrid

17 Pollution Probe (2023). Electric School Bus Operational Assessment: A Calgary Demonstration Case Study. Retrieved from: https://www.pollutionprobe.org/electric-school-bus-operational-assessment-a-calgary-demonstration-case-study/

18 AIA Canada (2025). Closing the gap: Supporting women's leadership in the auto care sector. Retrieved from: https://www.aiacanada.com/news/closing-the-gap-supporting-womens-leadership-in-the-auto-care-sector/

19 Canadian Electric School Bus Alliance (2025). Embedding Equity in Canada's Transition to Electric School Buses. Retrieved from: https://eschoolbusalliance.ca/wp-content/uploads/2025/08/CESBA_Equity_Report.pdf

learning formats, and mobile training units, can help reduce barriers to participation. Financial support mechanisms, such as subsidies or wage replacement during training periods, can further support in-service technicians.

Greater alignment across training programs is also needed. Linking programs to defined competency tiers and recognized certifications can help create clearer and more portable pathways for workers, while improving employer confidence in technician qualifications.

Broadening participation will be important to ensure that the transition does not reinforce existing workforce imbalances. This includes targeted outreach, partnerships with training institutions, and the integration of inclusive practices into program design.

A more accessible, coordinated, and inclusive training system will be critical to ensuring that workforce development keeps pace with ESB deployment while supporting a broader range of workers in the transition.

5 Implications and Future Directions

Electrifying a school bus fleet is a complex undertaking, but its success ultimately depends on workforce readiness. The technology can only deliver its intended benefits if the people operating and maintaining it are adequately trained and supported. This report has outlined the key differences between diesel and electric school buses and translated them into specific training needs.

For technicians, high-voltage electrical safety is the first priority. Before developing advanced skills, they must be proficient in the use of personal protective equipment (PPE), lockout/tagout (LOTO) procedures, and verification of de-energization. Beyond safety, technicians require training on core electric powertrain components, including batteries, electric motors, inverters, and charging systems. This includes both diagnostic capabilities—such as interpreting battery health and fault codes—and procedural knowledge for safely isolating and servicing high-voltage systems. While many mechanical components remain, their interaction with electrical systems must also be understood.

Overall, the transition requires technicians to evolve from primarily mechanical roles to electromechanical troubleshooting. Training programs should reflect this shift by emphasizing electrical fundamentals, system-level understanding, and a safety-first approach.

Recommendations

- **Update College Curricula Across Provinces**
  Provinces should ensure that trade school and college programs eligible for Red Seal certification integrate core EV-related content. While not all technicians will specialize in EVs, foundational knowledge of key systems will better prepare graduates to pursue advanced certifications (e.g., ASE L3, CSA EV Technician).
- **Fund Upskilling Programs for Existing Technicians**
  Most in-service technicians will not benefit from curriculum changes targeting new entrants. Provinces should therefore fund or subsidize modular upskilling programs, delivered through colleges or unions, with a focus on high-voltage safety, diagnostics, and hands-on experience with electric drivetrains and charging systems.
- **Create a Red Seal Endorsement Pathway for EV Technicians**
  The federal government should explore establishing a Red Seal EV endorsement for relevant trades (e.g., Truck and Transport Mechanic or Automotive Service Technician). This would enable alignment across provinces and formalize EV specialization pathways.
- **Tie Training Requirements to Public Funding**
  Public funding programs supporting electric school bus adoption should require workforce training plans as part of eligibility. OEMs receiving public funding should also be expected to provide training that extends beyond initial vehicle delivery and supports long-term maintenance capability.

- **Accelerate Certification Development Through Standards Bodies**
  Standards organizations such as CSA and ASE should accelerate the development of heavy-duty EV certifications. These certifications will support consistent training frameworks and enable fleet operators to assess technician qualifications more effectively.

- **Clarify Training Needs by Role Through Public Resources**
  Non-profits and OEMs should collaborate to map common job roles (e.g., driver, maintenance technician, facilities staff) to relevant training levels and certifications. Publishing this information in a clear and accessible format will help smaller operators plan training more effectively and avoid gaps or redundancies.

- **Integrate Equity into Workforce Development Programs**
  Governments and training providers should incorporate equity considerations into ESB workforce development initiatives, including targeted outreach, reducing barriers to participation, and tracking representation across training programs.[20]

20 Canadian Electric School Bus Alliance (2025). Embedding Equity in Canada's Transition to Electric School Buses. Retrieved from: https://eschoolbusalliance.ca/wp-content/uploads/2025/08/CESBA_Equity_Report.pdf

Annex: Supporting Materials

Annex A: Inventory of Programs and Skills Frameworks

Canada

Federal Policies and Programs

Department	Program	Program Type	Years in Effect	Description and Outcomes	Links
Natural Resources Canada	Zero-Emission Vehicle Awareness Initiative (ZEVAI)	Awareness Initiatives	5	Funding technician training initiatives in partnership with colleges and industry groups	Link
Natural Resources Canada	Federal Zero Emission Working Group	Resource portal	1	Nationwide directory of ZEV training opportunities, helping Canadians identify relevant post-secondary and short-term programs	Link
Housing, Infrastructure and Communities Canada (HICC)	Zero Emission Transit Fund	Funding	4	The Zero Emission Transit Fund (ZETF) supports public transit and school bus operators in planning for electrification, including supporting the purchase of 5,000 zero emission buses and associated infrastructure. Eligible expenditures include external training and incremental costs of recipient employees.	Link Link Link
Employment and Social Development Canada	Sustainable Jobs Training Fund	Funding	1	The Sustainable Jobs Training Fund seeks to support training projects to help workers gain new skills or upgrade existing skills to attain jobs in the low-carbon economy. One of the focus areas is electric vehicle maintenance. Funding amounts are $8 million to $15 million per project.	Link Link

Private Sector Policies and Programs

Organization	Program	Program Type	Years in Effect	Description	Links
New Flyer	New Flyer Institute	Manufacturer-provided training	N/A	The New Flyer Institute provides training to customers of New Flyer. New Flyer works with its customers to design and deliver training intended to improve skillsets that already exist, and to retrain in new skillsets including electrification.	Link

Canada

Educational Institution Policies and Programs

Institution	Program	Program Type	Years in Effect	Description	Links
CSA (Canadian Standards Association)	Automotive Electric Vehicle Technician Certification	Certification	1	CSA Group offers an Automotive Electric Vehicle Technician Certification designed to standardize qualifications for high-voltage EV service in Canada and beyond.	Link
British Columbia Institute of Technology	AUTO 4011: Electric Vehicle Technology and Service	Course	N/A	This course prepares Automotive Service Technicians (AST) to diagnose, repair and service high-voltage electric vehicles safely. Learning outcomes include the ability to apply high voltage safety procedures and distinguish maintenance procedures for high voltage vehicles.	Link
Southern Alberta Institute of Technology (SAIT)	ELCV 001: Electric Vehicle Technology and Service	Course	N/A	This course builds on an extant understanding of conventional vehicle systems to allow learners to service and diagnose common high-voltage electric vehicles. Content includes battery construction, electric motor controllers, auxiliary accessories and more.	Link
Nova Scotia Community College (NSCC)	Electric Vehicle Safe Service and Maintenance	Microcredentials	N/A	Teaches learners how to demonstrate high voltage safety procedures when providing maintenance on electric vehicles; service high voltage powertrain systems to manufacturer and industry standards and explain maintenance procedures for battery and hybrid electric high voltage vehicles, among other benefits.	Link
Camosun College	CEET 100V Electric Vehicle Technology and Service Micro-Credential	Micro-Credential	N/A	Micro-Credential program providing Automotive Service Technicians an entry point to the skills required to repair, diagnose and service high-voltage EVs in a safe manner.	Link

Quebec

Quebec Policies and Programs

Department	Program	Program Type	Years in Effect	Description	Links
Quebec Government	Heavy-duty electric and hybrid vehicle maintenance training program	Workforce Skills Development and Recognition Fund (WSDRF)	2	A 196-hour intensive training curriculum covering electric buses, trucks, and other heavy vehicles. An estimated reach of 240 mechanics and repairers across the province. A "train-the-trainer" model involving 20 master trainers to ensure continued program delivery.	Link

Private Sector Policies and Programs

Organization	Program	Program Type	Years in Effect	Description	Links
Comité paritaire de l'industrie des services automobiles (CPA)	EV Safety Attestation	Attestation	N/A	This training introduces automotive workers to the systems of hybrid and electric vehicles covering component identification,safety protocols, and safe intervention techniques. Participants will strengthen their understanding of electrical fundamentals, learn how to handle EV technologies safely, and receive an official training attestation upon completion.	Link
Comité paritaire de l'industrie des services automobiles (CPA)	Compétences VÉ – Véhicule lourd (Heavy-Duty Electric and Hybrid Vehicle Training)	Structured certification pathway (Compétences VÉ) for heavy-duty vehicle mechanics and apprentices.	N/A	The Compétences VÉ program provides a province-wide, industry-recognized certification for maintaining and repairing hybrid and electric heavy-duty vehicles. Through five progressive training levels, participants strengthen their understanding of electrical systems, safety procedures, and EV technologies specific to heavy vehicles. Graduates gain certified competencies recognized by employers across Québec, enhancing their qualifications for work on modern hybrid and electric fleets.	Link
CAMO-Route	Formation continue en mécanique d'autobus électriques	Short-term continuing education program (Formation continue) — 30-hour in-person course, with an optional 24-hour preparatory module in basic electricity.	N/A	This continuing education program is designed for heavy-vehicle mechanics employed by passenger transport companies who are transitioning to electric bus maintenance. The 30-hour hands-on training (plus optional 24-hour refresher in electricity) provides practical knowledge in diagnosing, maintaining, and repairing electric bus systems. Employers benefit from an 85% wage subsidy during training and potential reimbursement of travel and accommodation costs. The program strengthens workforce readiness for fleet electrification, ensuring technicians can safely and effectively maintain next-generation zero-emission buses.	Link

Quebec

Educational Institution Policies and Programs

Institution	Program	Program Type	Years in Effect	Description	Links
CÉGEP Saint-Jérôme	AEC Technologie des véhicules électriques	Attestation d'études collégiales (AEC) – College-level technical diploma offered in-person	N/A	This advanced technical program trains professionals in the design, manufacturing, inspection, and maintenance of electric vehicle technologies and intelligent transport systems. Aimed at individuals with prior education or experience in mechanics, electrotechnics, or electrical engineering, it equips graduates with hands-on expertise in propulsion systems, quality control, and prototype development. Upon completion, graduates are prepared to work closely with engineers, supporting innovation and contributing to the rapidly growing green mobility sector.	Link
Centre de services scolaire de Montréal (CSSDM)	AEP – Mécanique de véhicules électriques (Program Code 4246)	Attestation d'études professionnelles (AEP) —a professional studies certificate in the motorized equipment maintenance sector	N/A	This 645-hour AEP program (≈ 6 months) trains mechanics in diagnosing, maintaining, and repairing the electrical, electronic, and electromechanical systems of hybrid and electric vehicles. Core competencies include circuits, high voltage charging, regenerative braking, thermal control, communication networks, and system interrelations. Graduates become electric vehicle mechanics, ready to enter a labor market with strong demand, and in some programs benefit from wage reimbursement during training.	Link
Centre de formation professionnelle de la Baie-James (CFPBJ) — with financial and technical support from the Société du Plan Nord (SPN) and multiple industry partners including Normet Canada, Sandvik, MacLean Engineering, Épiroc Canada, Toromont Cat, Cam Tech Formation, and others.	AEP – Mécanique d'engins de chantier hybrides et électriques (in development)	Attestation d'études professionnelles (AEP) —professional studies certificate (first of its kind in Québec for hybrid and electric heavy equipment mechanics)	2	Developed in northern Québec, this innovative AEP program trains mechanics in the maintenance and repair of hybrid and electric heavy-duty construction machinery. It responds to a critical regional need for qualified workers capable of servicing electrified equipment in remote industrial sectors such as mining and forestry. Through partnerships with leading equipment manufacturers, the program provides access to cutting-edge tools and high-voltage training environments, preparing graduates to safely maintain and troubleshoot next-generation heavy machinery while supporting Québec's energy transition and regional economic growth.	Link

Quebec

Educational Institution Policies and Programs, con't.

Institution	Program	Program Type	Years in Effect	Description	Links
INNOVISTE — in collaboration with the Ministère de l'Éducation du Québec (MEQ) and participating Centres de formation professionnelle (CFP) across Québec (as part of the COUD project).	AEP – Mécanique de véhicules électriques (Formule ATE – Alternance Travail-Étude)	Attestation d'études professionnelles (AEP) —short-term professional certificate combining classroom and paid workplace learning.	N/A	Delivered under INNOVISTE's COUD initiative, this 645-hour AEP program provides accelerated qualification for automotive service workers through an alternating work-study (ATE) format — roughly 365 hours in class and 280 hours in industry. Participants gain hands-on experience diagnosing, maintaining, and repairing electric vehicle systems while earning wages during training. The program equips mechanics with the practical skills and safety knowledge needed to service Québec's rapidly growing EV fleet, directly supporting the province's 2035 zero-emission vehicle sales target.	Link

Ontario

Ontario Policies and Programs

Department	Program	Program Type	Years in Effect	Description and Outcomes	Links
Ministry of Labour, Immigration and Skills Development	Canada-Ontario Job Grant (COJG)	Funding	11	The Canada-Ontario Job Grant (COJG) provides funding for businesses to train employees and upgrade their skills. Employers can train existing employees or new hires. There is a maximum contribution of $10,000 per trainee.	Link Link
Ministry of Labour, Immigration and Skills Development	Skills Development Fund Training Stream	Funding	4	The Skills Development Fund Training Stream seeks to increase Ontario's economic growth through providing funding for organizations for projects to address hiring, training and retention challenges. One of its aims is to respond to U.S. tariffs through supporting skilled trades and industrial sectors such as automotive. In March 2025, the Ontario government announced an investment in "The Electric Vehicle (EV), Hybrid, and Advanced Driver Assistance Systems (ADAS) Technologies training program, which would provide maintenance and repair training to technicians.	Link Link Link
Ministry of Colleges, Universities, Research Excellence and Security	Ontario's Micro-credentials Challenge Fund	Funding	4	Ontario provided $5 million through Round 2 of the Ontario Micro-credentials Challenge Fund to support the expansion or co-creation of micro-credentials to help address labour market gaps in Ontario. Priority sectors included electric vehicles. An example of a supported program is "Hybrid Electric Vehicle Program (Maintenance and Repair)" at Centennial College.	Link

Ontario

Ontario Policies and Programs, con't

Department	Program	Program Type	Years in Effect	Description and Outcomes	Links
Ontario Vehicle Innovation Network (OVIN)	Talent Strategy & Roadmap	Roadmap	N/A	Through its Talent Strategy & Roadmap, Ontario is seeking to respond to the transformation of the mobility and automotive sector and mitigate impacts on its labour force. This roadmap includes a number of initiatives, including the provision of a digital Upskilling Platform providing short-term courses and resources to help upgrade skillsets in Ontario.	Link

Private Sector Policies and Programs

Organization	Program	Program Type	Years in Effect	Description	Links
Used Car Dealers Association of Ontario	Centennial College Electric and Hybrid Vehicle Training Program	Funding and Course	1	The UCDA and Centennial College partnered to provide this course, which offers 50% off the cost of basic programs. Basic programs include "High Voltage Safety CESD 110" and "Hybrid and Electric Vehicle Introductory Overview CESD 109".	Link Link

Educational Institution Policies and Programs

Department	Program	Program Type	Years in Effect	Description	Links
Automotive Industries Association of Canada (AIA Canada), Conestoga College, Fanshawe College and St. Lawrence College	EV Upskill program	Certification	3	Launched in 2022, this modular, weekend-based program allowed working technicians to take eight standalone EV training modules, free of charge thanks to government funding. Participants could complete as many or as few modules as needed, with a certificate awarded for completing the full series. This flexible format has proven effective in reaching tradespeople who cannot take time off for full-time study.	Link
Centennial College	Hybrid and Electric Bus Courses	Course	N/A	Centennial College's Hybrid and Electric Bus Courses include "High Voltage Safety and Hybrid Vehicle Systems"; "Introduction to Hybrid and Electric Bus Overview"; "Introduction to High Voltage Battery Systems"; "Hybrid and Electric Bus Maintenance and Accessory Systems" and more.	Link
St. Clair College	Electric Drive Vehicle Technician	Diploma program	N/A	Diploma program preparing students for careers as an Electric Vehicle Technician in the repair, maintenance and service of electric vehicles.	Link

United States

United States Policies and Programs

Department	Program	Program Type	Years in Effect	Description and Outcomes	Links
Joint Office of Transportation and Energy	Electric School Bus Training and Workforce Development	Webinar	2	This platform offers a four-part webinar series tailored to school bus electrification, including maintenance considerations	Link
US EPA	Clean School Bus	Resources	3	Workforce Development and Training Resources. These resources provide useful insights for workforce development and fleet transition planning at school districts.	Link
NFPA (National Fire Protection Association)	NFPA 70E: Standard for electrical safety in the workplace, underpinning HV safety training such as PPE use, Lockout/ Tagout, and arc flash boundaries. EV Safety Training for First Responders: While targeted at emergency personnel, it reinforces safety principles that also inform technician awareness.	Safety training	N/A	While CSA Z462 is Canada's standard for electrical safety in the workplace, many ESB-related safety procedures and training materials also reference NFPA 70E, its U.S. counterpart. NFPA resources are widely used by OEMs and training vendors.	Link
California Energy Commission (CEC) – Transportation Energy Division	Zero-Emission Vehicle (ZEV) Workforce Training and Development Strategy: A Roadmap for Clean Transportation Program Funding	Government Strategy and Funding Framework — part of the Clean Transportation Program, authorized under Assembly Bill 118 (2007) and reauthorized by Assembly Bill 126 (2023).	2024-2035	The ZEV Workforce Training and Development Strategy defines the CEC's long-term vision for workforce development supporting California's transition to zero-emission vehicles and infrastructure. It establishes objectives, timelines, and funding priorities to expand training programs, develop equitable career pathways, and coordinate public–private workforce initiatives across clean transportation sectors. Through the Clean Transportation Program, it supports job creation, economic inclusion, and sustainable labor-market growth aligned with California's 2035 and 2045 zero-emission targets.	Link
Workforce Development Institute (WDI), New York State — in collaboration with state agencies, school districts, bus contractors, OEMs, and labor unions	Electric School Bus Workforce Initiative – Pre-Training Course & Workforce Strategy	Government-funded online workforce training (4 self-paced modules)	2023 (2 years)	This free, state-sponsored online program includes four introductory modules designed to prepare drivers, technicians, and school district staff for the transition to electric school buses. The modules cover EV fundamentals, high-voltage safety, charging infrastructure, and operational considerations specific to school bus fleets. Delivered through the eSchoolBusWorkforce.org platform, the training helps workers gain baseline technical and safety awareness before entering hands-on manufacturer or college-level certification programs. The initiative supports New York State's mandate for a 100% zero-emission school bus fleet by 2035, while promoting equitable access to clean transportation jobs	Link

United States

Private Sector Policies and Programs

Organization	Program	Program Type	Years in Effect	Description	Links
World Resources Institute (WRI)	Electric School Bus Initiative	Resources	4	Developed the Electric School Bus Training Standards (2024)—a tiered, open-access framework that school districts and training providers can adapt to local needs.	Link
ASE (Automotive Service Excellence)	L3 Certification and xEV Electrical Safety Certifications	Certification	2	ASE is a widely recognized U.S.-based certification body for automotive technicians, also accepted in Canada Traditionally, ASE's S-series has focused on school bus technicians working with diesel engines. L3 Certification: Covers diagnostics and repair of light-duty hybrid and electric vehicles. While not tailored to heavy-duty vehicles, it helps technicians develop foundational EV knowledge xEV Electrical Safety Certifications: Includes high-voltage safety training (e.g., HV Safety Level 2), focused on safely working around energized EV systems.	Link
Blue Bird Corporation — Blue Bird Academy / Technician Training	Blue Bird Technician Training / Associate Level Certification & Online Courses	Manufacturer-led certification / continuing education	N/A	Through the Blue Bird Academy, technicians gain knowledge of bus systems, preventative maintenance, safety, propulsion (including electric), and diagnostic techniques. The program includes both in-person and 100% online modules, culminating in a manufacturer-recognized certification that strengthens the service network and supports technician career advancement.	Link
Thomas Built Buses — Thomas Built Institute	Thomas Built Technician Training / Thomas Built Institute Workshops	Manufacturer-led continuing education / hands-on training workshop	N/A	Technicians attend short, intensive hands -on training sessions (often under one week) covering bus systems, emissions technologies, electrical systems, diagnostics, and product updates. Graduates earn continuing education credit (up to ~28 hours) and enhance their technical skills to maintain Thomas Built school buses more efficiently, reinforcing dealer and fleet capabilities.	Link
IC Bus / International® Trucks	IC Bus Tech EmPOWERment / Dealership Training & Apprenticeship Program	Manufacturer-led workforce development / recruitment & training initiative	N/A	This program connects dealers with technical schools and offers pathways for technicians to be trained and recruited into dealership networks. It supports training in both electric and internal combustion systems, offering internships, work-study, and technical support. Graduates may secure roles in dealership service centers with competitive wages, enhancing support for electrified fleets.	Link

United States

Educational Institution Policies and Programs

Department	Program	Program Type	Years in Effect	Description	Links
California Community Colleges / San Diego Community College District, in partnership with the California Energy Commission (CEC)	Advanced Transportation & Logistics Initiative (ZEV / Alternative Fuel Training Expansion)	State-funded higher-education / curriculum development and training expansion project (within the community college system)	2019	This initiative expands zero-emission, hybrid, and alternative-fuel vehicle technical training across California community colleges by funding curriculum development, faculty training, lab equipment purchases, and ZEV certificate programs. As a result, partner colleges have introduced or enhanced light-, medium-, and heavy-duty EV / alternative-fuel courses, built technician capacity, supported equitable access to clean-transportation careers, and aligned workforce capabilities with California's clean-vehicle targets.	Link
Advanced Transportation & Logistics (ATL) Initiative, under the California Community Colleges system, led by Cerritos College in partnership with the California Energy Commission (CEC)	Electric School Bus Technician Training Program	State-funded higher-education / technical certification (free modular courses through community colleges)	2022	The Electric School Bus Technician Training Program equips school-district and fleet mechanics with hands-on skills to service battery-electric school buses. Developed under the ATL Initiative, the curriculum includes six short courses such as High-Voltage Familiarization, Heavy-Duty Electrical 1 & 2, and EV Supply Equipment (EVSE) Systems. Delivered by partner colleges—Cerritos College serving as lead—the program combines classroom and lab instruction at no cost to participants, supporting workforce readiness for California's ZEV transition and enhancing fleet maintenance capacity.	Link
Hudson Valley Community College (HVCC), Troy, NY, in partnership with NYSERDA and regional employers	A.A.S. Degree in Electric and Autonomous Vehicles	Higher education – associate degree program in applied science	2022	HVCC's degree program prepares automotive students and working technicians for careers maintaining electric and autonomous vehicle systems, including those found in school buses. The curriculum covers EV propulsion, battery systems, charging infrastructure, sensors, and diagnostics. Graduates receive hands-on training using industry-standard equipment and enter the workforce with skills aligned to support New York's electric-school-bus transition and broader clean-mobility goals.	Link

Annex B: Glossary of Terms

ESB: Electric School Bus

EV: Electric Vehicle

EVSE: Electric Vehicle Supply Equipment

HV: High Voltage

LOTO: Lockout/Tagout

ZVV: Zero Voltage Verification

OEM: Original Equipment Manufacturer

BMS: Battery Management System

CAN: Controller Area Network

DCFC: Direct Current Fast Charging

CMS: Charging Management Software

PPE: Personal Protective Equipment

PTC: Positive Temperature Coefficient

NFPA: National Fire Protection Association

CSA: Canadian Standards Association

ASE: Automotive Service Excellence

SAE: Society of Automotive Engineers

ZETF: Zero Emission Transit Fund

ZEVAI: Zero Emission Vehicle Awareness Initiative

COJG: Canada-Ontario Job Grant

OVIN: Ontario Vehicle Innovation Network

AEP: Attestation d'etudes professionnelles

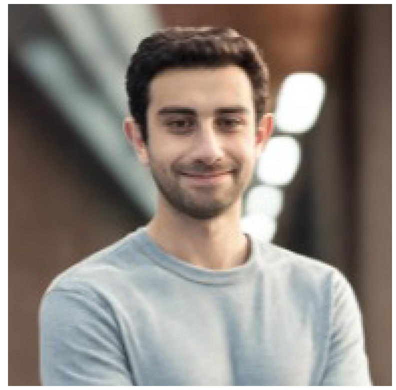
Annex C: Biographies

Cedric Smith

Cedric Smith is the Director, Transportation at Pollution Probe, in which capacity he leads the team's research, fundraising and stakeholder engagement in areas including light-, medium- and heavy-duty vehicle decarbonization.

Cedric represents Pollution Probe in fora including the Canadian Electric School Bus Alliance (CESBA) steering committee, the Ontario Electric School Bus Alliance (OESBA) steering committee and various working groups of the federal Zero Emission Vehicle Council.

Cedric is a sought-after thought leader on clean transportation, having appeared in outlets including the Globe & Mail, the Financial Post and Electric Autonomy. Prior to his time at Pollution Probe, Cedric worked as a Program Manager with the Pembina Institute, leading the organization's work in Future Skills, Just Transition and sustainable finance.



Marc Saleh

Marc Saleh, PhD, is the Founder and Lead Consultant at Mobility Futures Lab (MFL), a Canadian firm specializing in sustainable transportation solutions. At MFL, he leads projects on electric vehicle feasibility, charging infrastructure planning, zero-emission vehicle pilot deployments, and technology and market assessments in the transportation sector.

Marc's expertise spans economic and environmental modeling, EV energy consumption analysis, charging system design, and the development of mapping and software tools to support fleet electrification. He earned his PhD from the University of Toronto's Transportation Research Institute, where his research focused on emerging technologies to reduce transportation emissions.

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