# 2025 ZERO-EMISSION MHDV ECOSYSTEM ANALYSIS

## Electric Mobility Canada

**By EMC's Zero-Emission MHDV Working Group**

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# ABOUT EMC

Electric Mobility Canada (EMC) is the unifying and authoritative voice for the transition to electric transportation across Canada. Founded in 2006, EMC is the national industry association that enables and accelerates the transition to sustainable electric mobility through advocacy, collaboration, education, and thought leadership, with the goal of creating a cleaner, healthier, and more prosperous future for all Canadians.

EMC has 190+ member organizations, including electricity suppliers; manufacturers of light, medium, heavy, and off-road vehicles; infrastructure providers; technology companies; mining companies; research centres; government departments and agencies; cities; universities; fleet managers; unions; environmental NGOs; and EV owner groups.

Members of EMC collaborate under different working groups to identify barriers and solutions specific to different industry segments: Batteries (life cycle), Charging infrastructure (accelerating deployment), Utilities (best practices and grid planning), and MHDVs (Fleet electrification). This document was prepared by EMC's Zero-Emission MHDV Working Group.

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# ADVANCING MHD FLEET ELECTRIFICATION: PRIORITY GOVERNMENT ACTIONS

Medium- and heavy-duty zero-emission vehicles (MHD ZEVs) represent a critical lever for decarbonizing Canada's transportation sector. While progress is underway, a range of systemic barriers continue to delay widescale adoption by commercial fleets. These barriers span from upfront costs and infrastructure deployment challenges to market risks and workforce readiness. Through a multi-stakeholder prioritization process, the following key government recommendations have emerged as the most impactful and urgent to enable a smoother and faster transition to zero-emission fleets.

## Strengthen market confidence with predictable and targeted incentives

Fleets face high capital costs and limited control over long-term infrastructure and vehicle supply. Unpredictable or short-term incentives create uncertainty and delay investment decisions. Two concrete measures can reduce this friction:

> Make incentives predictable with clear start and end dates and ensure that any changes are communicated well in advance to allow for proper planning.
> Continue and increase vehicle purchase and infrastructure incentives, with tailored support by vehicle class to reflect the different economics and deployment pathways across the sector.

## Simplify access to EV and charging incentives

While incentives are essential, complex application processes and long wait times reduce their usefulness — particularly for smaller or first-time applicants.

> Continue vehicle purchase incentives for Classes 5–8.
> Streamline program delivery wherever possible to reduce administrative burden.

## Improve infrastructure deployment support and timelines

Deploying charging infrastructure remains a significant challenge due to funding gaps, administrative complexity, utility regulatory and capacity challenges, supply chain issues for electrical equipment, and long decision timelines. These challenges are particularly acute for small and medium-sized fleets, which lack the capital and internal resources to navigate complex application processes.

- Create a dedicated funding stream for MHD charging infrastructure (public, shared, and depot sites)[1], ensuring that support is tailored to the specific technical and financial needs of this sector.
- Accelerate application review and funding decisions for ZEVIP and ZETF applicants to avoid delays in fleet deployment timelines.

## Address workforce and skills gaps in fleet electrification

The shift to MHD ZEVs requires new technical competencies — from fire safety and battery diagnostics to managing new charging technologies. Current skills gaps among technicians and fleet operators limit the pace and scale of adoption.

- Offer subsidy programs for technician up-skilling, including training on EV and charger maintenance, diagnostic software, and safety protocols. This investment will help ensure reliability, reduce downtime, and enable safe operation across the fleet sector.

## Develop a national medium- and heavy-duty ZEV strategy to secure vehicle supply

Canadian fleets are facing significant hurdles in acquiring medium and heavy-duty ZEVs, placing them at a competitive disadvantage and creating uncertainty for utilities and infrastructure operators. To ensure Canada captures the economic and environmental benefits and secures a reliable supply of vehicles, we propose a national initiative to foster a predictable market.

- Work with stakeholders to establish realistic and phased-in sales targets for new MHD vehicles, including Classes 7 & 8 and school buses, that reflect technology readiness.

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The above priority actions are part of our *2025 MHDV ecosystem gap analysis*, which includes an assessment of barriers to electrification under four pillars: Planning, vehicles, infrastructure and operations. **The full analysis is presented in the following pages.**

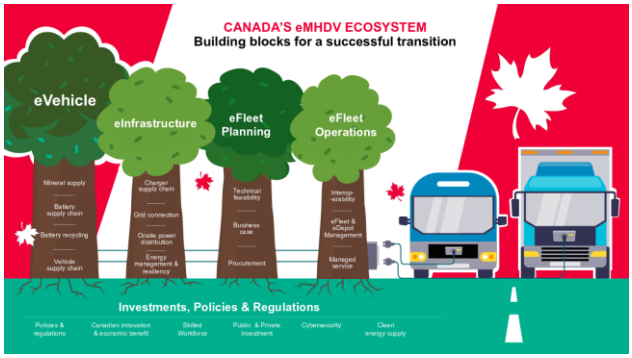

[1] Encompasses (1) public and behind fence infrastructure, and (2) private and public sector fleets.

# ZERO-EMISSION MHDV ECOSYSTEM GAP ANALYSIS

This document presents the third edition of Electric Mobility Canada's (EMC) Zero-emission medium- and heavy-duty vehicle (ZE MHDV) ecosystem gap analysis. Developed by EMC's ZE MHDV Working Group, this report reflects the collective insight and priorities of a diverse group of industry stakeholders working to accelerate the electrification of medium- and heavy-duty vehicles across Canada.

The working group's mandate is to support the development of public policies that will drive the transition to zero-emission MHDVs. It brings together 48 representatives from 37 organizations, including fleet operators, utilities, charging infrastructure providers, vehicle manufacturers, fleet services, charging networks, standards bodies, academic institutions, and non-profit organizations. The report is a direct result of this collaborative effort.

This updated ecosystem analysis builds on two earlier publications:




- The first edition (2022), which established a foundational overview of ecosystem gaps (link)


- The second edition (2024), which significantly expanded the analysis and introduced a more detailed structure and framing of solutions (link).

In this edition, we identify 52 distinct ecosystem gaps organized under four key pillars: **Planning**, **vehicles**, **charging infrastructure**, and **operations**. For each gap, the working group has outlined relevant government and industry actions, solutions, or ideas to help address the challenges. This document is intended as both a reference and a call to action—supporting policy development, industry alignment, and collaborative progress toward a zero-emission commercial vehicle future in Canada.

# PILLAR 1 – PLANNING:
# Lowering capital costs to reach TCO parity remains the top gap

## 1-A: Business case

| CURRENT STATE | IDEAL STATE | MESSAGES |
|---|---|---|
| [1] CAPEX hurdle remains. | Total cost of ownership (TCO) parity (or beyond), making BEVs the obvious choice. | • Continue and increase incentives on vehicles and infrastructure, with tailored incentives to different vehicle classes. |
| | Planning confidence around government incentive support availability and timelines. | • Make incentives predictable with clear start and end dates; communicate any changes in advance to allow businesses to adapt. |
| [2] Lack of data on vehicle and battery health, maintenance / repair, utility upgrade costs for charging infrastructure and resale value makes it difficult to calculate the business case and secure financing. | Easy access to data on technology risks and costs for grid connection; understanding on how utilities charge for connections. | • Build an open database comparing TCO of electric vehicles (EVs) to internal combustion engine vehicles (ICE), including demand charges, charge management, and emissions costs. Approach Prof. Trancik's lab at MIT to develop an MHDV version of CarbonCounter.com.<br>• Provide ready-to-use business case templates tailored for different industries.<br>• Make software tools available for efficient MHDV design and cost optimization.<br>• Advocate for a safety net from the CIB regarding vehicle and battery residual values.<br>• Encourage data-sharing by OEMs, fleets, and utilities<br>• Fund expert consultants to gather and interpret data into actionable insights for decision-makers.<br>• Provide long-term visibility on targets and offer incentives for large customers to drive fleet operator transition (e.g., IKEA's model of aligning transport providers with long-term sustainability goals)<br>• Share Canadian success stories (like NACFE Run on Less & IVI in Quebec)<br>• Fund a central repository of data on MHD vehicles and chargers available in the Canadian market. |
| [3] Grid benefits (esp. for school bus with V2G potential) cannot be factored into the business case due to technology, regulation, and industry maturity. | Grid benefits can be included in business cases. | • Fund pilot programs to enable fleets & utilities to quantify the benefits of V2G |
| [4] Planning for resiliency of MHD charging poorly understood. | In MHD ZEV deployments, planning for resilience is understood. | • Build awareness of energy solutions behind the meter, costs and benefits. |

| CURRENT STATE | IDEAL STATE | MESSAGES |
|---|---|---|
| [5] CFR: Lack of certainty around Clean Fuel Regulation future scenarios & impact for fleet owners | CFR is maintained & its impact is well-understood and leveraged by fleet owners, utilities, and other industry stakeholders | • Maintain and simplify the CFR as a major lever for driving MHD transition. Conduct awareness campaigns on CFR with fleet owners and publish calculation examples. |
| [6] Trucking: Continued perception that EVs do not work for trucking | Strong understanding of use cases that can be electrified with currently available technology and what is coming | • Focus efforts on use cases with strongest ROIs while continuing awareness campaigns to address specific concerns of heavy-duty trucking community |
| [7] New tech: Concerns about the introduction of new technologies including battery management and charger management software. | New technology is well-understood and widespread, including in the perception of all stakeholders. | • Ensure awareness activities include new technology such as software and batteries |
| [8] Fleets often lease their operating space, making it difficult to invest in permanent charging infrastructure | Newer warehouse designs and EV charging point sharing technology make it more efficient to install MHD charging infrastructure | • Fund innovation in modular or semi-permanent infrastructure design to support leased spaces. In leased facilities, ensure future readiness by requiring pre-installed conduits and upgradeable service foundations |
| [9] Limited space for MHD parking & charging points at depots | Facilities are rewarded for having charging infrastructure or becoming dedicated MHD depot charging facilities | • Remove barriers to depot-based charging solutions in high-demand regions and key freight corridors, ensuring adequate access for long-haul fleets |
| [10] Current deployments are CAPEX-funded pilots with heavy government funding; in the absence of government funding, unclear how CAPEX will be funded | Successful deployments of Truck- or Transportation-as-a-Service (TaaS) and/or Charging-as-a-Service (CaaS) enable operators to electrify while easing CAPEX and OPEX burdens | • Ensure funding streams allow for both CAPEX and as-a-service models |

# 1-B: Organizational capacity

| CURRENT STATE | IDEAL STATE | MESSAGES |
|---|---|---|
| [11] Funding application process is complex and lengthy | Funding is easy to apply for and quick to receive with minimal reporting requirements | • Simplify application processes, reduce approval times, and consider point-of-sale rebates or less cumbersome approaches for fleets |
| [12] Fleets lack planning capacity in this new multi-disciplinary domain | Fleets have easy access to expert resources both internally and externally, and mature planning tools and methods. | • Continue funding for planning to help fleets get started and build capacity |
| [13] Fleet managers need more technical expertise in EV operations, particularly charging infrastructure and regulatory requirements | Fleet managers have access to expert planning assistance. | • Collaborate with EV educators to develop national certification programs and training initiatives (Electric Truck 101); leverage the new CUTA ZEB training program |
| [14] Lengthy buying decisions due to the high number of internal stakeholders involved newness and rapid change of technology | Buying decisions are made quickly by widely available experts running an efficient and well-understood process with mature technology and robust data sets. | • Showcase examples of fleets who have matured their internal processes (e.g., using transit) and continue to fund sharing of data and case studies to increase confidence |
| [15] Smaller fleets at risk of lagging behind due to the lack of resources to plan, apply for funding and make buying decisions | Small fleets electrify at the same rate as large ones, benefiting from adaptable solutions that fit their needs with financial, educational and planning packages. | • Create a resource centre/program providing access to additional resources for smaller fleets; consider tailored incentives that protect residual value for small fleets |

# PILLAR 2 – VEHICLES:
# Top gap is higher cost of MHD ZEVs

## 2-A: Vehicle supply

| CURRENT STATE | IDEAL STATE | MESSAGES |
|---|---|---|
| [16] Vehicle supply is uneven across vehicle classes with resulting spotty sales and service coverage. Lack of sales targets in Canada while several U.S. jurisdictions have them causes risk of supply being pulled away from Canada | Robust supply & demand across all classes makes Canada a competitive market so that OEMs invest in manufacturing footprint expansion, robust sales and service coverage. Sales targets and bulk procurement has helped drive production to scale, enabling lower costs | • Work with stakeholders to establish realistic and phased-in sales targets for new MHD vehicles, including Classes 7 & 8 and school buses, that reflect technology readiness; for provinces who don't yet have one, set a 2030 target for MHD sales.<br>• Continue demand stimulation until the market reaches scale and adopt a Canadian Fleets Electrify Initiative that combines peer collaboration, funding and technical support, and drives bulk procurement |
| [17] Many EV box trucks (Class 4-6) in Canada have limited range or long charging times (3 hours) due to large batteries and slow DC charging speeds (75-80 kW), restricting them to depot charging and limiting the use of public fast-charging stations | A wide range of electric box trucks with range >= 300 km and able to use public fast-charging use are available | • Encourage Canadian supply of box trucks with longer range and faster charging |
| [18] Unstable supply chain: EV OEMs can find it hard to commit to suppliers, worsening supply chain risk due to inconsistent demand and lengthy time from OEM investment to cash return | Stronger demand and better cash flows ease the financial risk for OEMs. As a result, EV OEMs provide a stable 12–18-month forecast of investment in new products and production lines to their suppliers | • Continue demand stimulation policies to increase future sales predictability<br>• Continue programs to help OEMs' financial stability (e.g., operating capital loans) and foster OEM investment in production and R&D |
| [19] MHDV dealers are discouraged by the high acquisition costs, limited profitability and effort requirements, particularly from traditional OEMs. | MHD ZEVs yield a profitable business case for all, and dealers are convinced of the benefits. Staff have the expertise to sell and support MHDV ZEVs. | • Support an awareness program specifically targeted to educate MHD ZEV dealers on the use cases with best TCO for their vehicle class(es) |
| [20] Battery supply chain for MHD ZEV (including all elements required for battery packs) is at an early stage of development | A robust, local battery supply chain exists to support MHD vehicles | • Continue efforts to localize battery supply chain; assess if battery second life and recycling can help address materials supply in MHD vehicles |
| [21] Trade restrictions on MHD ZEV components and the strong possibility of U.S. tariffs | Trade agreements make component import/export easy, and a robust local supply chain ensures resilience | • Ease import and export restrictions on top components for MHD ZEVs<br>• Build a robust Canadian MHD ZEV supply chain |

# 2-B: Vehicle costs

| CURRENT STATE | IDEAL STATE | MESSAGES |
|---|---|---|
| [22] MHD ZEVs cost more than their ICE equivalents. Some incentives are in place to help (federally: iMHZEV, ZETF, CPTF + provincially only in BC and Quebec). Some programs are onerous to apply for, have long response times, and are subject to sudden change | MHD ZEVs are at cost parity with ICE in the ideal state. In the interim, incentives for vehicle purchase are required. Incentives need to be simple to apply for, fast to approve and predictable | • Continue vehicle purchase incentives for Class 5-8 and specifically:<br>a. Roll out a vehicle purchase incentive in Ontario<br>b. ZETF/CPTF: Simplify application process and reduce turnaround time and hold a consultation with stakeholders to improve clarity on rules, adequate and predictable level of financing and efficient process (voucher-style program).<br>c. iMHZEV: Increase amount per vehicle and consider demand-side regulation for government and large fleets.<br>d. Credits for upfront cash are preferred to tax credits<br>e. Consider how incentives can drive local economic benefit<br>f. Ensure incentives are used for the MHD vehicles vs. light-duty |


# PILLAR 3 – CHARGING INFRASTRUCTURE: Top gap Is shortening grid upgrade timelines

## 3-A: Electrical design

| CURRENT STATE | IDEAL STATE | MESSAGES |
|---|---|---|
| [23] Fleets & dealers lack unbiased expertise to translate operational needs into load inputs for a utility | Easy access to funding & expertise for fleet & site assessments.<br><br>Neutral consultants who don't have a conflict of interest | • Ensure that fleets have access to a list of proven entities who can provide fleet & load studies which will meet utility needs |
| [24] Risk of assets being oversized due to lack of optimization study | Studies conducted to ensure loads are optimized<br><br>Optimized and managed load to supply constraints | • Create awareness of the need to optimize loads before making new investments<br>• Design for future scalability and anticipate future utility upgrades (e.g., installing conduits in the ground)<br>• Promote utility-led managed charging and make managed charging a criterion or requirement for funding |

## 3-B: Incentives

| CURRENT STATE | IDEAL STATE | MESSAGES |
|---|---|---|
| [25] No dedicated incentive for MHD infrastructure | Dedicated MHD infrastructure incentive incl. for charging plazas that accommodate larger vehicles | • Create dedicated funding for MHD charging infrastructure |
| [26] Complicated financial instruments to fund MHD charging infrastructure and related planning. | Streamlined point-of-purchase incentives, tax rebates, or exemptions to pay for charging infrastructure and planning | • Augment existing funding sources with a preference for point-of-purchase, especially beyond QC & BC, while ensuring equipment is properly installed and activated for its intended use |
| [27] Applicants face administrative burdens and long wait times for their funding requests, especially for small businesses | Fast turnaround on any programs that require application and reduced barriers for entry for small and medium fleets | • Provide faster decisions to ZEVIP & ZETF applicants<br>• Push for maintaining successful programs and emulate BC's programs |

## 3-C: National infrastructure

| CURRENT STATE | IDEAL STATE | MESSAGES |
|---|---|---|
| [28] Lack of a national charging infrastructure plan for transport | National zero-emission freight corridor strategy[2] and workplan | • Fund the work for a national zero-emission freight corridor strategy, integrating government land use |

## 3-D: Grid capacity planning

| CURRENT STATE | IDEAL STATE | MESSAGES |
|---|---|---|
| [29] Utilities receive fleet plans late in the process, leaving insufficient time to implement upgrades if required | Utilities are involved early on, and both fleets & utilities have an early understanding of grid upgrade required<br><br>Utilities mandated to provide clear rules & regulations regarding power upgrades specific to capacity, zoning etc. | • Utilities have a proactive engagement strategy to engage early with fleets (e.g. BC Hydro best practices guide, Fleet advisory service)<br>• Build platforms for fleets to share electrification plans early with utilities.<br>• Declare maximum power upgrade available and outline the steps for fleets to navigate the upgrade process |
| [30] Utilities face policy uncertainty due to government (federal and provincial) changes, the need to plan long-term electrification without full future clarity (rate filings), and insufficient funding from OEB to support electrification | Improving capacity forecasting and planning processes which can be achieved by sharing information between LDCs and stakeholders | • Utilities to develop EV load forecasting tools internally as well as testing and modeling different rate structures.<br>• Utilities to publish grid upgrade plans, barriers and in which geographies opportunities exist to electrify fleets |
| [31] Fleets lack awareness of potential multi-year wait for grid upgrade at desired site | Fleets can easily access a map of grid upgrade times | • Fund study to map grid capacity / upgrade times which fleets can access in planning |
| [32] Fleet and facility operators lack guidance and process for alternative infrastructure options that may accelerate grid connection such as battery storage or portable chargers | Locations where battery storage can help accelerate are clear so business cases can be put forth | • Fund study and provide guidance for where battery storage can accelerate fleet electrification |
| [33] Lack of public utility data to help industry in evaluating customer requests about deployment timelines for EV trucks in their fleets | Real-time grid data access will give fleets better visibility into existing capacity and available power to enhance planning and efficiency. This data supports fleet customers with charging and better estimate time to deliver charging solutions for their trucks | • Provinces and regulators to ensure transparency in planning for large utility connections in distribution and warehousing districts through a utility-scale mapping initiative, like Southern California Edison's DRPEP platform<br>• Implement nationwide capacity information maps: The OEB recently a phased approach to implementing Capacity Information Maps. Phase 1 required distributors to publish (as of March 3, 2025) capacity information at both station and feeder levels and remaining capacity calculated base on the annual summer or winter peak of the station or feeder |

[2] National zero-emission freight corridor strategy

## 3-E: Grid connection

| CURRENT STATE | IDEAL STATE | MESSAGES |
|---|---|---|
| [34] MHDV connection requests treated equivalently to other load connection requests; utilities are bound by rate-based spending regulations for grid improvements, which are several times longer than commercial fleet electrification timelines | Utilities proactively upgrade capacity so they are ready when MHD fleets need to connect<br><br>V2X & batteries reduce size of upgrade required<br><br>Streamlined, proactive and early planning process with strong bi-directional sharing of information between fleet and utility | • Regulators allow for proactive system upgrades with focus on geographies with most potential for fleet electrification<br>• Regulators and utilities support fleets use of battery storage and pilot V2X benefits<br>• Enable/support a 3rd party to bring fleets and utilities together for planning (rf: EPRI-style) |
| [35] Utilities lack clarity on where demand will arise | Utilities have market intelligence to efficiently target system upgrades and project electrification demand in some areas | • Fund temporal & spatial MHD-driven demand pre-planning for top geographies and utilities (e.g., EPRI, Asset Market) |
| [36] Process to contact utility and request connection upgrade is lengthy; different utilities have different interconnection requirements, creating challenges in procurement and deployment standardization | Utilities provide a quick connection process for fleets and respect enforceable timelines for grid connections | • Reduce time for grid connection (via funding incentives / requirement / new prioritization)<br>• Identify and share best practices in utility internal processes that enable fleet/transport charging customer projects to proceed in a timely manner<br>• Expand the Ontario EV Connection Process to other provincial markets and clarify that it applies to MHDV charging, with stronger enforcement of the EVCCP across all utilities |
| [37] 600V service complicates compatibility and supply chain efficiency, increasing costs and delays | Harmonizing the 600V standard with the North American 480V | • Have utilities offer 480V service |
| [38] Lack of skilled electrical trades to support increased number and scale of grid upgrades | Plentiful skilled labour in the utility sector. | • Ensure gaps in utility skilled labour are well-understood and being actioned by education services (colleges and universities) |

## 3-F: Lead times

| CURRENT STATE | IDEAL STATE | MESSAGES |
|---|---|---|
| [39] Long lead times (>12 months) on key electrical equipment | Lead times < 3 months on key electrical equipment | • Close supply chain gaps in power distribution equipment, including transformers and switchgear (in consultation with Electro federation Canada) |

## 3-G: Interoperability and standards for chargers

| CURRENT STATE | IDEAL STATE | MESSAGES |
|---|---|---|
| [40] Lack of robust interoperability between charger & charger management software (OCPP) | All components of charging infrastructure are interchangeable | • Support approaches to test / standardize OCPP implementations |
| [41] Lack of standard roaming protocols to ensure interoperability between charging networks | Roaming protocols are widespread | • Promote adoption of OCPI to facilitate roaming across charging networks for MHD vehicles |
| [42] Lack of finalized Megawatt Charging Standard (MCS) to enable large truck electrification | MCS is defined and standardized products commercially deployed and available | • Support finalization of MCS and Canadian pilots / technology |
| [43] Some deployment and pilot projects with inductive charging underway, but technology is in early development phase | Industry standards for inductive charging have been developed | • Encourage the development of industry standards for inductive charging |

## 3-H: Ownership model

| CURRENT STATE | IDEAL STATE | MESSAGES |
|---|---|---|
| [44] Fleets are responsible for all power-distribution upgrades from utility meter, potentially leading to increased delay | Clear understanding of best model for infrastructure upgrades (leave to fleet owner or mandate utilities to do so, like California) | • Study whether shifting responsibility to utility could speed up deployment. |
| [45] MHD fleet owners can't access shared charging infrastructure | A nationwide charging system is available, helping fleets manage risks of traffic and weather (esp. for long-haul) | • Consider funding MHD charging network with DCFC + MW charging / rest stops in each jurisdiction (following Quebec model) |

# PILLAR 4 – OPERATIONS:
# Top gap Is skills for successful MHD ZEV Operations

## 4-A: People

| CURRENT STATE | IDEAL STATE | MESSAGES |
|---|---|---|
| [46] Lacking skills and expertise in *hazard & fire safety* | Trained workforce leading to high comfort and safety knowledge related to operating, servicing, and responding to emergencies involving MHD EVs, including fire/ fire suppression training, and working with and around high-voltage batteries | • Fund battery / high voltage safety and fire response training for fleet personnel, service and maintenance technicians, and emergency responders<br>• Develop & communicate industry standards related to battery safety and fire response.<br>• Provide general EV training and awareness material or templates, including safety considerations, that organizations can adopt into their training programs for drivers and staff who may interact with the vehicles |
| [47] Lacking skills and expertise in *service & repairs* | Trained workforce equipped with knowledge and skillset needed to service an EV fleet for all MHD vehicle classes & infrastructure | • Support the development of a strong third-party network of service providers for both vehicles and chargers, with policy to ensure original equipment manufacturers accept third-party servicing and offer third parties accreditation/training and tools<br>• Standardize requirements for qualified technicians (310T- Truck and Coach Technician), regularly updated and accredited (SAE).<br>• Offer subsidy programs for technician up-skilling for vehicles and chargers, including software systems |
| [48] Lacking skills and expertise in *vehicle and infrastructure management* | Fleets have a strong and skilled talent bench, with robust internal processes and partners to allow them to efficiently run their fleets | • Create leadership training programs for fleet managers, sustainability officers and facility managers to help them lead the transition, covering best practices in planning for and operating EVs, case studies, and how to measure success [topics: Planning, sustainability principles, best practices, case studies, measuring success]<br>• Fund development of a "ZEV fleet operations toolbox" offering guidance and best practices on software, hardware, services and protocols needed for optimal fleet operations |

# 4-B: Data and software

| CURRENT STATE | IDEAL STATE | MESSAGES |
|---|---|---|
| [49] Data: OEMs often restrict access to comprehensive vehicle diagnostics data, limiting operators' ability to optimize fleet management, perform predictive maintenance, and integrate with third-party charging and management systems, ultimately hindering operational efficiency and interoperability | OEMs provide open and standardized access to vehicle diagnostics data, empowering operators with full transparency and control over their assets, enabling data-driven decision-making, seamless integration with diverse systems, and fostering a more competitive and innovative EV ecosystem | • Encourage data access for vehicle owners and collaborate on data standards (such as COVESA), ensuring interoperability and enabling data-driven fleet management<br>• Ensure privacy by design protocols are in place to minimize cybersecurity threats (see cybersecurity section)<br>• Provide fleets with boilerplate language that contractually allows:<br>• Access to diagnostics<br>• Third-party (self) repair<br>• OEM compliance with standards<br>• Data residency: awareness of impact and cost of any data residency requirements |
| [50] Cybersecurity: Risk of unauthorized access to EV systems and connected infrastructure could lead to data breaches, vehicle manipulation, and service disruptions | A secure and resilient EV ecosystem where vehicles, charging infrastructure, and related systems are protected from cyberattacks, ensuring data privacy, operational reliability, and user safety | • Support leadership and collaboration between government and international partners (e.g. via the Canadian Center for Cyber Security) to advance research and development on cybersecurity for the EV sector, including intrusion detection, threat intelligence, and vulnerability management<br>• Develop cybersecurity standards: Establish and enforce robust cybersecurity best practices and standards for EVs, charging infrastructure, and communication protocols (for example, ISO 27000 for IT and IEC 62443 for OT).<br>• Prioritize security by design: Integrate cybersecurity considerations throughout the entire EV and charging systems lifecycle, from design and development to manufacturing and deployment.<br>• Implement robust authentication and authorization: Employ strong authentication and authorization mechanisms to prevent unauthorized access to EV systems and data. (industry recommendation)<br>• Conduct penetration testing and vulnerability assessments: Proactively identify and mitigate security weaknesses through regular security testing. (industry recommendation) |
| [51] Interoperability and integration: Fragmented firmware/software updates across EVs, charging infrastructure, and fleet management systems create integration challenges, risking system conflicts, downtime, and unpredictable behavior, ultimately hindering fleet reliability and efficiency | A unified and robust approach to firmware/software updates across the EV ecosystem ensures seamless integration, predictable performance, and minimized downtime, enabling efficient fleet operations and maximizing uptime | • Robust testing and validation: Support test centers where testing and validation of updates across different systems and scenarios can happen before release, minimizing the risk of unexpected issues.<br>• Standardized APIs and communication protocols: Industry-wide adoption of standardized APIs and communication protocols for seamless data exchange between EVs, charging infrastructure, and fleet management system<br>• Interoperability Advocacy: Build awareness on the challenges, issues and complexity connecting the different silos in operational systems and standards bodies to ensure cross-collaboration (e.g. ISO 15118). |

# 4-C: Assets

| CURRENT STATE | IDEAL STATE | MESSAGES |
|---|---|---|
| [52] Service offerings in start-up mode (both vehicle & infrastructure); access to vehicle and charger spare parts and service - repairs and maintenance is limited, leading to long downtime | Mature service offerings in the market including uptime guarantees, backed by robust staffing and training; operators have access to reliable and qualified service providers for preventative, remote, and on-site maintenance; EV parts are available and where applicable, standardized | • Incentivise the establishment of a robust supply chain for electric truck and charging infrastructure parts, ensuring timely availability and replacement part assurances that would be available to qualified service providers |