Plugged into Safety:

A primer on the hazards of working with battery electric vehicles

Workplace Safety & Prevention Services®

"As Ontario accelerates towards an electric future and continues to attract investments that are integral to building a resilient battery supply chain, the Ontario Vehicle Innovation Network (OVIN), the provincial flagship initiative for the automotive and mobility sector, is committed to supporting the development of a highly skilled workforce whose health and safety are prioritized as they build electric vehicles and battery components."

— Raed Kadri
Head of the Ontario Vehicle Innovation Network (OVIN)

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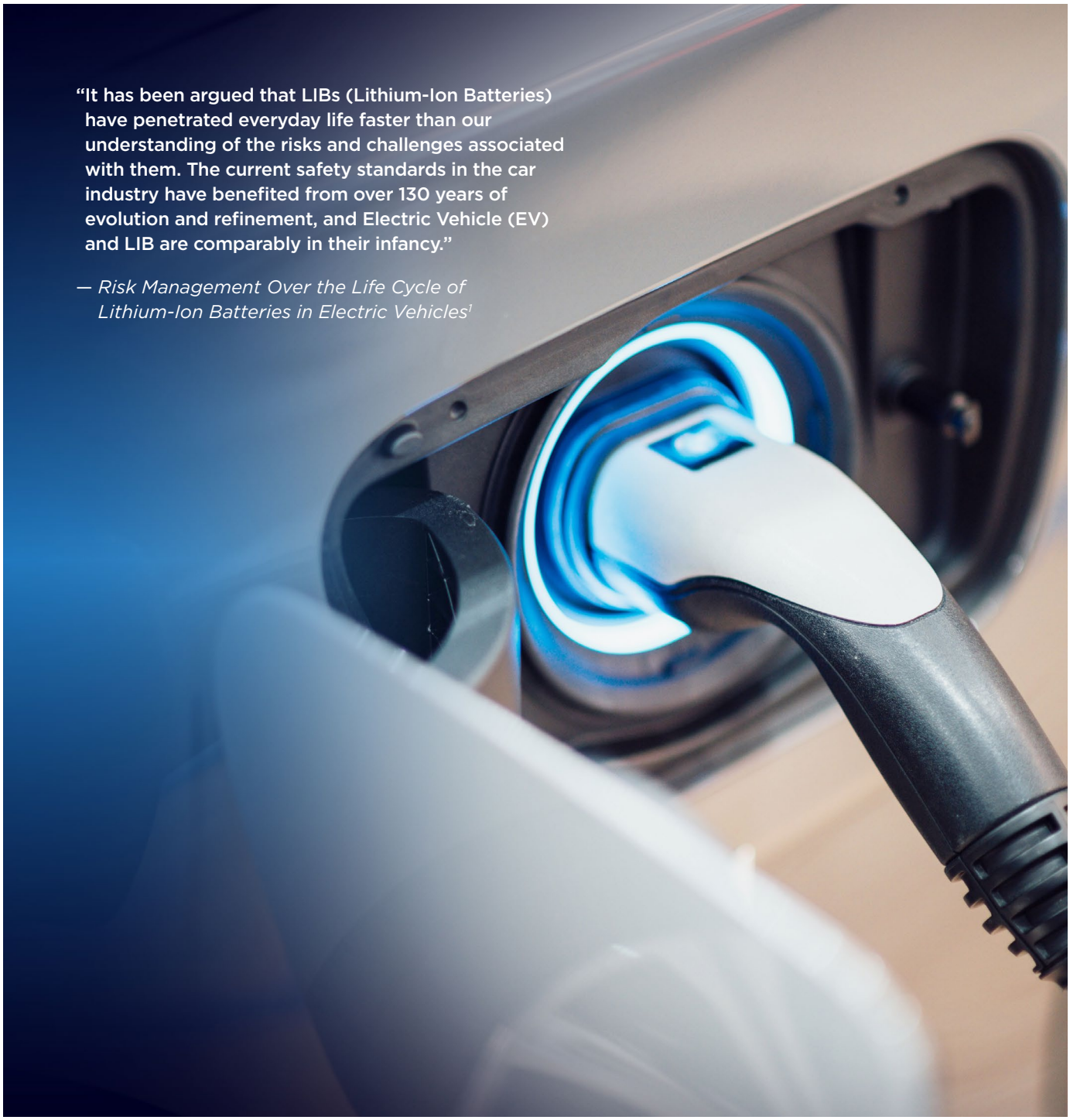


"It has been argued that LIBs (Lithium-Ion Batteries) have penetrated everyday life faster than our understanding of the risks and challenges associated with them. The current safety standards in the car industry have benefited from over 130 years of evolution and refinement, and Electric Vehicle (EV) and LIB are comparably in their infancy."

— *Risk Management Over the Life Cycle of Lithium-Ion Batteries in Electric Vehicles*[1]

Introduction

Ontario is fast becoming a leader in the green energy sector. On top of the obvious benefits to our health and the environment, the rapid growth of the battery electric vehicle (BEV) market and the development of the battery supply chain in Ontario presents an important opportunity for increased competitiveness, innovation and job creation.

The global electric vehicle market is expected to grow from 2.5 million in 2020 to over 30 million in 2030, and it is predicted that by 2040, BEV production will eclipse manufacturing of traditional internal combustion engine (ICE) vehicles.[2]

The Ontario government is positioning the province as a global leader in the EV supply chain, and, over the last three years, has attracted more than $28 billion in investments from global automakers and suppliers of EV batteries and battery materials.[3]

This is as big a transition as the shift from horse and buggy to the ICE automobile. However, there is no comparison when it comes to the pace of change in the market. Like all technology, this market opportunity is advancing rapidly, which presents unique challenges.

While some industries, such as battery and vehicle manufacturing, have considerable experience with EV battery safety, this is a new hazard for many industries, including auto parts suppliers, auto dealers, auto repair/body/collision service providers, tow truck operators and auto recyclers.

The lithium-ion batteries used in electric vehicles pose many serious health and safety hazards that are unknown or not fully understood. And, as many BEVs are already coming to the end of their warranty periods and even end of life, new businesses will be exposed to these hazards. These companies will need to learn and adhere to health and safety legislation and standards that may not have applied to their work environment before.

In a recent interview with OHS Magazine, Workplace Safety & Prevention Services CEO Jody Young explained, “We see a huge transformation happening right now in the auto sector with the move to electric vehicles, which is going to shift work from gas-powered engine assembly lines to electric car production.

Battery electric vehicles (BEV) are a fast-emerging form of technology. Businesses, such as auto collision centres, repair shops and auto recyclers, are beginning to see an increase in BEVs and often have a poor understanding of the health and safety hazards. This has led to apprehension about working on these vehicles.

There will be a significant need for us to work with businesses and employers operating in that sector, and really help them navigate and anticipate all of those hazards that are different from the ones they’re used to managing within their respective workplaces.”

As a first step, Workplace Safety & Prevention Services has undertaken research in collaboration with industry groups and associations to identify the hazards associated with working on or around BEVs.

This white paper, written for employers and their representatives, including engineers and HR professionals, in the auto part supply, automotive dealership, autobody repair, towing and recycling industries, is intended to be a starting point for critical conversations in the workplace.

It outlines statistics related to the growth of this market in Ontario, insights from subject matter experts, general information about lithium-ion batteries, the hazards of working on or around them, and existing legislation that can help mitigate these hazards. It also includes a job aid in the form of a checklist developed to support employers with identifying hazards associated with working on or around EV batteries in the workplace, with legislative references and recommended controls.

"In the case of battery electric vehicles (BEV), there are many trainings available, but most of these haven't been designed to meet a set industry-wide standard. Workers who took these trainings assume they are completely safe while conducting repairs. However, without a standard in place, no one can feel confident that they have all the necessary skills and knowledge to remain safe while working on a BEV. This is a significant safety issue that affects the industry nation-wide. Our goal at I-CAR Canada is to ensure that everyone has the skills and knowledge they need to conduct safe and proper repairs, which is why our EV trainings have been built to the European standard, ECER100, in the absence of a North American standard."

— Stuart Klein, VP Collision Programs, Automotive Industries Association of Canada, and, Executive Director, I-CAR Canada

The BEV Market and Battery Supply Chain Facts and Stats

THE EV MARKET IN CANADA

- In December 2023, the Government of Canada announced the Electric Vehicle Availability Mandate and set a target that beginning in 2026, at least 20% of new light duty vehicles offered for sale will be zero-emission vehicles (ZEV), and annual increases will lead to 60% by 2030 and 100% by 2035.[4]
- While vehicle registrations were down overall, ZEV registrations jumped to 13.3% in Q3 of 2023 – a 2.7 percentage point increase over the previous quarter.[5]
- Canada is the only country in the Western Hemisphere with all the raw materials required for a lithium-ion battery, with Northern Ontario already being a key producer of nickel, cobalt and copper and home to several advanced lithium and graphite mineral development projects that could feed battery supply chains in the coming years.[6]
- According to a Clean Energy Canada Report:[7]
  - Canada's EV battery supply chain could support up to 250,000 direct and indirect jobs by 2030 and add $48 billion to the Canadian economy annually.
  - Domestic battery production could help Canada achieve its ambitious target of 100 per cent zero-emission vehicles by 2035.
- It is anticipated that once up and running, the EV Battery production sector in Canada will have capacity to manufacture over two million electric vehicles annually.
- In February 2024, Canada was ranked number one among 30 countries on the BloombergNEF global lithium-ion battery supply chain ranking – an annual list that looks at each country's potential to build a secure, reliable and sustainable supply chain for lithium-ion batteries.[8]

THE BEV SUPPLY CHAIN IN ONTARIO

- Ontario is the only place in the world that the six largest automakers call home.[9]
- In the past three years, Ontario has attracted more than $28 billion in automotive and EV investments, which includes the $7-billion investment by Volkwagen for a new battery plant in St. Thomas, ON. It is anticipated that more than 100,000 auto workers will be upskilled to work in this sector.[9]
- Through the Skills Development Fund, Ontario is investing more than $4.7 million in two programs – one with AIA and the other with APMA – to help over 360 technicians and jobseekers gain the skills they need to transition and launch their careers in the automotive manufacturing sector and emerging EV field.[10]

"With rapid growth in electric vehicle production, the collaboration between APMA and WSPS stands as a powerful alliance for a safer tomorrow. Together we navigate the currents of innovation, ensuring that electrifying the future is not only sustainable, but ensures safety is a priority while progressing the EV industry."

— Flavio Volpe
President of APMA

Learning From Others

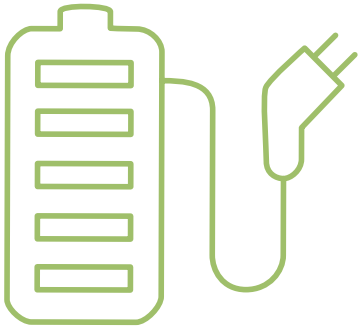
AUTO RECYCLERS: SEARCHING FOR A CLEAR AND SAFE PATH FORWARD TO KEEP A VITAL ECOSYSTEM SAFE

Steve Fletcher, Executive Director of Ontario Automotive Recycling Association, says when they polled members, they found that only two-thirds were actually "touching EV batteries." He thought it was an economic decision but learned that safety concerns drove their resistance. "Many owners said, 'I'm a small family-operated business serving my community. I don't want to put my employees at risk with something we don't understand yet. We really need to figure that out before I feel confident in allowing my staff to touch these things.'"

OARA represents 100 working recyclers in Ontario and another 50 associate members in the recycling ecosystem. Fletcher says the entry of BEVs in the marketplace is accelerating, and there is a level of resistance because there isn't a clear path forward. "Some members look for the information they need, and others just don't have the resources to do that. Because of the ecosystem we have in place, they are constantly talking to one another – sharing info about how they're managing issues. Sometimes this is great, and sometimes they share unreliable resources."

Fletcher says they need a formalized standard and corresponding resources to give members and the industry the confidence and competence to move forward safely. "Our stakeholders want clarity. I'm getting pressure from members to figure out how to deal with end-of-life and damaged batteries. We don't have all the tools and resources to guide a member through it, so our job is to educate them and connect them with organizations like WSPS."

ATS: EV BATTERIES PRESENT A TRIFECTA OF HAZARDS



When Blaine Cressman, Senior HSE Specialist, joined ATS Industrial Automation in 2022, there was a lot of excitement about the significant opportunity that EV battery work presented. However, they were in new territory from a health and safety standpoint. "It's very rare to have a truly new hazard show up in the workplace," he says.

ATS classifies batteries in the same high-risk category as robots, laser safety, and rigging practices. Cressman emphasizes, "They are a significant hazard. They are dangerous and can cause a lot of harm. When mishandled, an event with a battery is truly a nightmare. It is a trifecta of hazards – thermal, electrical and chemical."

ATS had difficulty finding information about battery safety procedures. "Most of what we found was focused on the physics and mechanics of how batteries function – not how humans interact with them."

Given that this is a new hazard and so little health and safety information is available, he says ATS is setting its own standards and adjusting as they learn. "We're slapping the tracks down in front of the train as it goes 100 mph down the track. Every time we have a conversation, new scenarios come up that we weren't expecting, so we have to tweak and refine. Almost every week, we're adjusting and refining and getting closer to something we're happy with."

ATS supports the research WSPS is doing because they count on WSPS as "a reliable source of information to lean on." Cressman says they are also keen to share what they've learned. "We can share information with others, and as younger health and safety professionals get into BEVs and they get better and smarter, I'll learn from them."

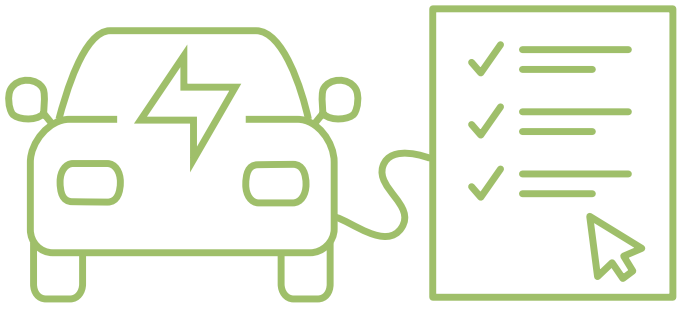
ST. CLAIR COLLEGE: STANDARDS REDUCE FEAR

St. Clair College offers one of two Electric Vehicle Technician programs in Canada. Program Coordinator and Professor Eric Ellis says there are many concerns about transitioning from internal combustion engines to battery electric vehicles; however, with information and awareness, there is no need to be fearful.

Ellis says EVs are basically computers; they require a unique skill set to diagnose dangerous, software-related issues. In addition, mechanics require expensive PPE and insulated tools to work around these high-voltage systems safely. However, he says, "The wheels are in motion. The transition is going fast, and there is no going back. We need a system to keep students, mechanics and Canadians safe. If there is a plan, people will feel calmer."

To be recognized by the Ministry of Education, St. Clair College needed safety basics in place, but little information was available. They have been using guidelines created by the Society of Automotive Engineers to fill the void.

While the guidelines have been a good starting point, Ellis supports the work that WSPS is doing because he is passionate about developing a Canadian standard. "I have a personal stake in this. It is very important. There used to be propaganda against powerlines. When they were new, people believed they would fall and electrocute them. Knowledge and awareness will help curtail fear, and if there is a standard, it will help keep people safe and healthy."



ONTARIO TECH: SHARING KNOWLEDGE IS CRITICAL IN KEEPING PEOPLE SAFE

The Automotive Centre of Excellence at Ontario Tech University is the first commercial automotive research, development and innovation centre of its kind in the world. The engineers and technicians at ACE deliver development and testing services to manufacturers and train students with the skills they need to be successful in their careers.

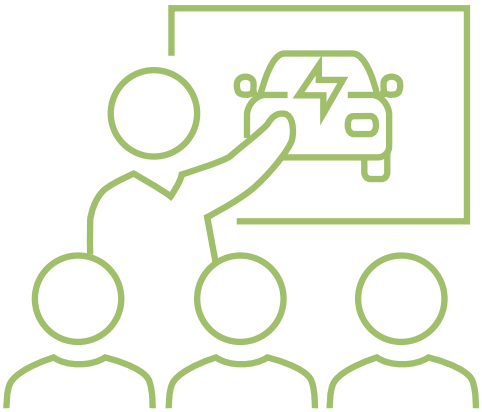
“OEMs come to us with their pre-production and production battery properties, and we subject them to a number of tests that are unparalleled anywhere in the industry.” Says ACE Senior Manager, Rick Szymczyk.

“While we host clients, research and building competencies are also part of our core business. We work with our academic and research partners to design and develop battery-based solutions that we learn from industry partners. We apply them to our R&D efforts and then use them to build talent to support the ACE operation.”

“I see people repurposing batteries the same way they would a 12V battery. However, in any propulsion or hybrid or electric vehicle battery, you need to have a battery management system to ensure it remains in a normal range of operation and it operates safely. These systems are designed and tested to a very high standard.”

To keep students and the team at ACE safe, he says they interview OEMs before they bring products in, and they work closely with professionals including security, fire and emergency services, technicians and electricians to help prevent and be ready for any unwanted events. They also learn from their industry partners. “We have working groups with industry stakeholders where they share best practices, lessons learned, and policies and procedures relative to battery and electrification safety.”

Ontario Tech is committed to sharing knowledge about best practices and expertise with others in the industry, including OEMs, small and medium start-ups, and organizations like WSPS. “We want to be part of the solution and address the gap that exists, as we have always done with new technology.“



Battery Basics

According to Battery University, "The building blocks of a battery are the cathode and anode, and these two electrodes are isolated by a separator. The separator is moistened with electrolyte and forms a catalyst that promotes the movement of ions from cathode to anode on charge and in reverse on discharge."

The anode releases electrons during discharge, and the cathode absorbs them. Anodes are always negative and cathodes are positive.[11]

Each EV has a battery management system that is responsible for balancing the voltage, currents and temperatures among cells and can shut down the battery if needed.

"In North America, there are approximately 180,000 car fires each year. If you look at BEVs, even adjusting for the population, the rate of fire and thermal events is lower than in gasoline vehicles. The hazards are different, the treatment is different, but statistically there is evidence that there are fewer incidents if they are designed and treated properly and training is provided."

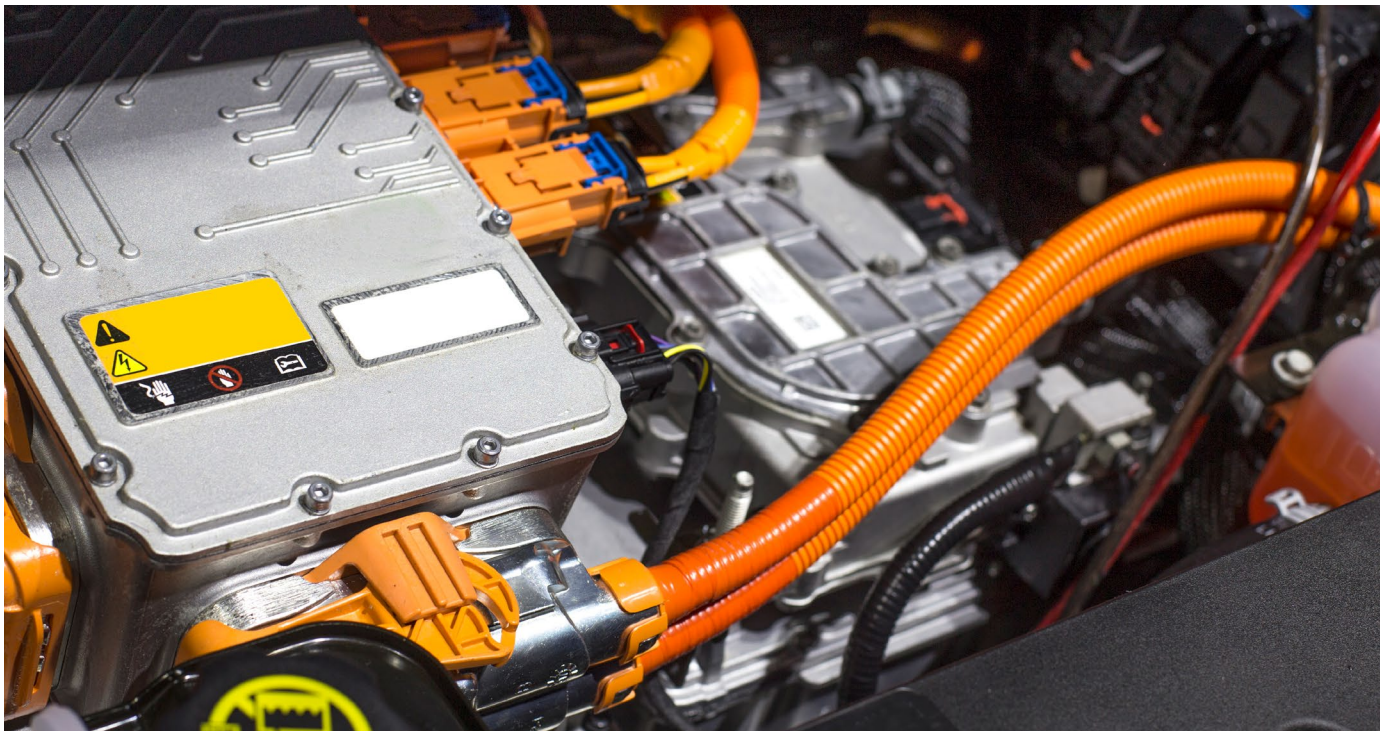
— Rick Szymczyk
Senior Manager, Automotive Centre of Excellence, Ontario Tech University

BATTERY HAZARDS

Thermal Runaway Events

A thermal runaway event can be triggered by damage to a battery cell — mechanically, through a collision or damage due to an internal or external short, or as a result of electrochemical damage caused by overcharging or discharging, or external temperature.

When one of these faults elevates the cell temperature, or a portion of the cell, the materials inside begin to break down and can trigger an exothermic reaction. As the temperature increases, so does the decomposition rate, which causes rapid heating of the cell and can lead to fire or explosion.[12] This reaction may spread to nearby cells and modules, intensifying the event.



- BEV fires are very rare, but the severity of fires can be catastrophic.[13]
- After a collision, it can take anywhere from minutes to days for a thermal runaway event to occur.
- It is more difficult to extinguish a battery fire than it is a gas-powered engine fire. They combust differently and can take up to 40 times more water to extinguish.[14]

Electrical Hazards

The electrical system of an electric vehicle is complex and involves high-voltage components, which pose several hazards.

High-voltage – The battery pack in an EV is composed of several cells grouped into modules. The number varies depending on the vehicle. Battery packs usually operate at a high-voltage between 300-800 volts, and in some cases, even higher. Contact with high-voltage parts of the battery can result in severe injury and even death.

Energy stored in the battery – EV batteries store a large amount of energy that can be disconnected from the drivetrain and other high-voltage systems, but cannot be dissipated, which can cause electrical shocks or arcing when working on or in the battery system.

Arc flash and arc blast – This occurs when there is a rapid release of electrical energy due to a short circuit or other fault and can cause severe burns and injuries.

Capacitor discharge – Capacitors can retain charge, for a period of time, even after the battery is disconnected. This stored energy can cause unexpected shocks.

"In ICE vehicles, the hazards are well-established and well-known. If you see an ICE vehicle running, you know it is a dangerous, fast-moving, loud, metal object, and there is a risk. EVs aren't inherently more dangerous; the dangers are just different. With EVs, the safety systems are opaque, and there is no way of knowing about the hazards before you're in danger."

— Eric Ellis
Program Coordinator and Professor, St. Clair College

Understanding Employer Duties

Employer duties are outlined in section 25 of the Ontario OH&S Act. Below you will find some **highlights from sections 25(2) (a)(d),(h)**. These references have been included to provide some examples of how the employer can demonstrate compliance with these sections.

2) WITHOUT LIMITING THE STRICT DUTY IMPOSED BY SUBSECTION (1), AN EMPLOYER SHALL,

(a) provide information, instruction, and supervision to a worker to protect the health or safety of the worker

Here are some examples of what this duty may involve:

- Develop and implement safety procedures related to EV battery hazards. Procedures to be implemented could include hazardous energy control, chemical safety, control of thermal run away and musculoskeletal disorders.
- Inform workers about potential hazards associated with working on or around EV batteries (share the hazard list).
- Train workers on how to use equipment. Include standard operating procedures and manufacturers' guidelines.
- Supervisors must provide instruction and supervision to workers. Documentation of interactions and activities can demonstrate this.

(d) acquaint a worker or a person in authority over a worker with any hazard in the work and in the handling, storage, use, disposal and transport of any article, device, equipment or a biological, chemical or physical agent;

Here are some examples:

- The employer must be able to show they have provided workers and supervisors with information related to hazards they may be exposed to in the workplace.
- The employer must also provide information related to how to handle, store, use, dispose and transport EV batteries safely. This information should include the manufacturers' requirements, industry good practices and comply with applicable standards and legislation.
- Ensure workers are trained on all aspects of Safety Data Sheets (SDS).
- Educate workers about physical hazards such as thermal runaway. What it is, signs of thermal runaway and safety precautions to reduce the risk.
- Be aware of how to handle, transport and store EV batteries in both new and damaged condition.

(h) take every precaution reasonable in the circumstances for the protection of a worker;

- Provide training on the use, inspection, and storage of personal protective equipment (PPE) specific to different hazards.
- Conduct regular safety inspections of the workplace to identify and address potential hazards.
- Document and address any safety concerns promptly.
- Perform hazard assessments before starting new tasks or projects.
- Develop and train workers on standard operating procedures for tasks they are directed to complete. Include safety precautions in these documents.

Electric Vehicle (EV) – Safety Hazards Associated with Working On or Around the Battery

Ontario is attracting over $16 billion in investments by global automakers and suppliers of EV batteries and battery materials to position the province as a global leader on the EV supply chain. It is anticipated that, over time, more than 100,000 workers in the Province of Ontario will be upskilled to work in this emerging sector. The health and safety hazards of working on or around EV batteries and the applicable legislation and standards are not well understood by employers in Ontario. WSPS is working with industry partners to help close this knowledge gap. Below is a list of hazards associated with handling, working on, storing and repairing EV batteries. The battery build process itself is outside the scope of this project.

MUSCULOSKELETAL DISORDER HAZARDS

HAZARD	HAZARD DETAILS	IMPACTED INDUSTRIES	LEGISLATION
High Force	Depending on vehicle size and class, lithium-ion batteries can weigh between 300-600 kg.	Manufacturing, repair shops lifting/ lowering from vehicle	OHSA s. 25(1)(c), (2)(a)(d)(h) (employer responsibilities) Reg. 851 s. 45(a) (material handling), 51 (lifting devices)
Force/Awkward Posture	Working on and around an EV battery during repair can be associated with high forces and awkward postures depending on the task being completed.	Manufacturing, autobody/collision after damage, recyclers	OHSA s. 25(1)(c), (2)(a)(d)(h) (employer responsibilities) Reg. 851 s. 45(a) (material handling)

SAFETY HAZARDS

HAZARD	HAZARD DETAILS	IMPACTED INDUSTRIES	LEGISLATION
Crush Hazard	Potential for battery to crush worker(s) while lifting/lowering battery or moving around workplace.	Dealerships, autobody, collision, recyclers	OHSA s. 25(1)(c), (2)(a)(d)(h) (employer responsibilities)
Electrocution-Low Voltage System	EV has low and high-voltage systems. Some examples of how electrocution can occur include direct contact with battery terminals (two points), contact with damaged or exposed parts of the battery system, touching components before energy has been dissipated (can retain charge after vehicle is turned off), bridging of circuits with tools touching cables or connectors.	Dealerships, autobody, collision, recyclers, emergency response/towing	OHSA s. 25(1)(a)(b)(c)(d), 25(2)(a)(d)(h) (employer responsibilities) Reg. 851 s. 42 (LOTO), 42.1 (live work), 43 (electrical tools), 79 (PPE training), 81 (eye protection), 84 (skin protection) CSA Z460.20

HAZARD	HAZARD DETAILS	IMPACTED INDUSTRIES	LEGISLATION
Electrocution-High Voltage	EV has low and high-voltage systems. The high-voltage system can exceed 800 Volts. In some cases, work must be completed on the high-voltage system. When disconnecting the high-voltage system there is also a risk of electrocution in an EV.	Dealerships, autobody, collision, recyclers, emergency response/towing	OHSA s. 25(1)(a)(b)(c)(d), (2)(a)(d)(h) (employer responsibilities) Reg. 851 s. 42 (LOTO), 42.1 (live work), 43 (electrical tools), 79(PPE training), 81 (eye protection), 84 (skin protection) CSA Z460.20
Arc Flash	Arc flash may occur when working on or near the high-voltage electrical system and there is a short circuit, when the battery is being serviced and connections are made or broken under load, a fault or damage to components can also be a source.	Dealerships, autobody, collision, recyclers, emergency response/towing	OHSA s. 25(1)(a)(b)(c)(d), (2)(a)(d)(h) (employer responsibilities) Reg. 851 s. 42 (LOTO), 43 (electrical tools), 79 (PPE training), 81 (eye protection), 84 (skin protection)
Thermal Runaway-Fire Explosion	This is a self-sustaining reaction in which the cell heats up rapidly and can ignite or explode. An electric short causes current to pass through the positive and negative end of the battery causing the battery to heat up and damage the internal components. Once the internal components are damaged, the reaction will increase and potentially spread to other cells.	Battery storage, all stages of EV battery life, extra risk after damage	OHSA s. 25(2)(a)(d)(h) (employer responsibilities), 42 (Training on physical agents) Reg. 851 s. 130 (Physical Agents) Reg. 213/07: Fire Code
Electrical	Electrical short to chassis – It is possible for an EV to develop a short to the chassis, either due to a manufacturing defect or damage. This could result in the body of the vehicle being energized and causing the potential for electrocution. There would be no visual indication of this hazard.	Manufacturing defect, or after collision	OHSA s. 25(1)(a)(b)(c)(d), 25(2)(a)(d)(h) (employer responsibilities) Reg. 851 s. 42 (LOTO), 42.1 (live work), 43 (electrical tools) CSA Z460.20
Electrical	Contact with/damaged high-voltage cables or battery while moving an EV with a forklift or other mechanical material handling device.	Recyclers, towing	OHSA s. 25(1)(a)(b)(c)(d) (2)(a)(d)(h) (employer responsibilities) Reg. 851 s. 43 (electrical tools), 45 (material handling), 51 (lifting device), 53 (traveling crane), 54 (mobile equipment) Reg. 851 s. 42 (LOTO),

HAZARD	HAZARD DETAILS	IMPACTED INDUSTRIES	LEGISLATION
Electrical	Risk of damage to the battery if welding connections are made close to the battery.	Dealerships, autobody, collision	OHSA s. 25(1)(a)(b)(c)(d), 25(2)(a)(d)(h) (employer responsibilities)
Unintended Movement/ Starting	Potential for vehicle to start unexpectedly if proximity key is left in the vehicle or a potential short circuit has occurred.	Dealerships, autobody, collision, recyclers, emergency response/towing	OHSA s. 25(1)(a)(b)(c)(d), (2)(a)(d)(h) (employer responsibilities), 26(1)(k) (written instructions) Reg. 851 s. 57 (immobilized vehicle), 76 (blocking)
Identification of Hybrid/BEV	Some Hybrid/BEVs may not be identified as having a high-voltage system, resulting in unexpected contact with high-voltage system.	Dealerships, autobody, collision, recyclers, emergency response/towing	OHSA s. 25(2)(a)(d)(h) (employer responsibilities)
Vehicle Modifications	Deliberate or inadvertent changes to battery management system, or battery, can cause unexpected changes to the battery operation including design, operation and safety.	Dealerships, autobody, collision, recyclers, emergency response/towing	OHSA s. 25(2)(a)(d)(h) (employer responsibilities)

CHEMICAL HAZARDS

HAZARD	HAZARD DETAILS	IMPACTED INDUSTRIES	LEGISLATION
Chemical Exposure	Lithium-ion batteries contain electrolytes that can be made up of various chemicals. Risk of exposure is minimal when the battery is in good repair or intact. When the battery is damaged, potential exposure to the electrolytes can occur. Exposure to these chemicals can be associated with toxicity or corrosiveness. Accidental exposure can lead to chemical burns as well as respiratory issues.	Manufacturing, autobody/collision after damage, recyclers	OHSA s. 25(1)(a)(b)(c)(d), (2)(a)(d)(h) (employer responsibilities) Reg. 851 s. 79 (PPE training), 81 (eye protection), 84 (skin protection), 124 (eye washes/shower), 130 (Chemical exposure training), 126 (safe removal of material), 127 (ventilation) Reg. 833 Reg. 860

HAZARD	HAZARD DETAILS	IMPACTED INDUSTRIES	LEGISLATION
Flammable	Damaged or defective batteries can pose a fire hazard during handling/transportation or storage. Additionally, individual cells/modules may be packaged in combustible materials such as cardboard, that allow for damage during transportation, and make it difficult to identify damage.	All stages, elevated risk after damage, recyclers	OHSA s. 25(2)(a)(d)(h) (employer responsibilities) Reg. 851 s. 123 (Fire extinguishers) Reg. 213/07: Fire Code Reg. 860
Flammable Chemicals	Fire hazard if flammable chemicals contact electricity or arc, including gloves contaminated with oils.	Dealerships, autobody, collision, recyclers	OHSA s. 25(1)(a)(b)(c)(d), (2)(a)(d)(h) (employer responsibilities) Reg. 851 s. 79 (PPE training), 81 (eye protection), 84 (skin protection), 124 (eye washes/ showers), 130 (Chemical exposure) Reg. 213 (Fire Code) Reg. 860 (WHMIS) Reg. 833 (Bio/Chemical Agents)
Chemical Exposure-Hydrofluoric Acid (HF)	When a lithium-ion battery is damaged, overcharged, or exposed to elevated temperatures, the chemicals inside can break down into other hazardous compounds. The LiPF6 within the battery can produce hydrofluoric acid (HF) if it is exposed to high heat. The addition of water may decrease the temperature at which this reaction occurs. HF is a highly corrosive and toxic substance that can cause severe burns upon contact and can be lethal if inhaled.	Manufacturing, Autobody/Collision after damage, recyclers	OHSA s. 25(1)(a)(b)(c)(d), (2)(a)(d)(h) (employer responsibilities) Reg. 851 s. 79 (PPE training), 81 (eye protection), 84 (skin protection), 124 (eye washes/shower), 130 (Chemical exposure) Reg. 860 (WHMIS) Reg. 833(Bio/Chemical Agents)

HAZARD	HAZARD DETAILS	IMPACTED INDUSTRIES	LEGISLATION
Thermal Runaway Byproducts	The chemical reactions during thermal runaway can produce gases like carbon dioxide, carbon monoxide, hydrogen, and hydrocarbons. Depending on the location of the battery storage (inside) and the size of the battery the presence of these gases can be toxic.	Battery storage, all stages of EV battery life, extra risk after damage	OHSA s. 25(1)(a)(b)(c)(d), (2)(a)(d)(h) (employer responsibilities) Reg. 851 s. 130 (Chemical Agents)
Improper Battery System Coolant	If battery system coolant is replaced with improper coolant it may result in an increased risk of thermal runaway if the system develops a leak.	Dealerships, collision	OHSA s. 25(1)(a)(b)(c)(d), (2)(a)(d)(h) (employer responsibilities) Reg. 851 s. 130 (Chemical exposure) Reg. 860 (WHMIS)
Flammable Chemicals in AC	Some AC refrigerants contain flammable oils, which if used in a high-voltage BEV AC System could result in a fire.	Dealerships, collision	OHSA s. 25(1)(a)(b)(c)(d), (2)(a)(d)(h) (employer responsibilities) Reg. 851 s. 130 (Chemical exposure)

PHYSICAL HAZARD

HAZARD	HAZARD DETAILS	IMPACTED INDUSTRIES	LEGISLATION
Lithium-ion Battery Fire Resulting in a Thermal Runaway	The temperature produced by a thermal runaway fire in a lithium-ion battery will depend on battery size, chemistry, state of charge etc. A substantial amount of heat is produced during a thermal runaway event. Temperatures can reach between 200-300° C+ which can result in burns to the worker, and smoke inhalation.	Battery storage, all stages of EV battery life, extra risk after damage or improper repairs	OHSA s. 25(1)(a)(b)(c)(d), (2)(a)(d)(h) (employer responsibilities), 42 (Training on physical agents)

PSYCHOSOCIAL HAZARD

HAZARD	HAZARD DETAILS	IMPACTED INDUSTRIES	LEGISLATION
Stress	Unknown hazards can lead to increased fear and stress while working on EVs.	Dealerships, autobody, collision, recyclers, emergency response/towing	OHSA s. 25(2)(h) CSA Z1003

Looking Ahead

Canada has set ambitious targets for the availability of zero-emission vehicles in the coming decade, and the wheels are already in motion with respect to Ontario becoming a leader in the BEV supply chain. As a result, auto parts suppliers, auto dealers, auto repair/body/collision service providers, tow truck operators, and auto recyclers are experiencing increased demand for BEV service and support, but they are apprehensive in the absence of reliable, comprehensive health and safety resources.

As we move closer to the goal of zero emissions, we mustn't lose sight of the ever-present goal of zero injuries and fatalities in the workplace. Employers need to be better equipped to anticipate BEV hazards and require support in understanding how to apply legislation in their workplaces.

WSPS' research and the experiences of the subject matter experts featured in this white paper highlight the need for:

- Resources to support Ontario employers in understanding and complying with provincial legislative requirements
- BEV and hybrid vehicle training standards for automotive service technicians
- Updates to CSA standards to include application to BEVs
- A requirement for individuals providing training on BEVs to have appropriate credentials

Working together and sharing knowledge, insights and expertise, we can deepen our collective knowledge of hazards related to working on or around BEVs and understanding of the provincial legislation that exists to keep workers safe.

Please watch for more information, and in the meantime, if you have questions or would like assistance, please call us at **1 877 494 9777** or fill out the contact form on the WSPS website (WSPS.CA).

Partners

Thank you to the following organizations for their assistance with this research and generosity in sharing their experiences and expertise related to battery electric vehicles and battery safety.

About Workplace Safety & Prevention Services

Workplace Safety & Prevention Services™ (WSPS) is a not-for-profit organization committed to protecting Ontario's workers and businesses.

It serves more than 174,000 member firms and 4.2 million workers across the agricultural, manufacturing and service sectors. A proud partner in the province's occupational health and safety system and a trusted safety advisor since 1917, WSPS has a rich history of making workplaces safer.

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References

1 "Risk management over the life cycle of lithium-ion batteries in electric vehicles", ScienceDirect, www.sciencedirect.com/science/article/pii/S136403212100527X

2 Ontario Government, "Driving Prosperity: The Future of Ontario's Automotive Sector" 2021 [PDF] https://files.ontario.ca/medjct-driving-prosperity-ontario-automotive-plan-phase-2-en-2021-11-23.pdf

3 "Ford says Northern Ontario mines will create economic boom", Northern Ontario Business, January 2024, https://www.northernontariobusiness.com/industry-news/mining/ford-says-northern-ontario-mines-will-help-create-economic-boom-8154772

4 Government of Canada, "Canada's Electric Vehicle Availability Standard (regulated targets for zero-emission vehicles)", https://www.canada.ca/en/environment-climate-change/news/2023/12/canadas-electric-vehicle-availability-standard-regulated-targets-for-zero-emission-vehicles.html

5 "Zero-emission Vehicles Surged to 13.3% in Q3 2023", S&P Global. https://electricautonomy.ca/2023/11/15/q3-2023-sp-global-zero-emission-registrations

6 Ontario Government, "Driving Prosperity: The Future of Ontario's Automotive Sector" landing page, https://www.ontario.ca/page/driving-prosperity-future-ontarios-automotive-sector

7 "When Building Canada's EV battery supply chain, the sum is greater than the parts", Clean Energy Canada, 2023, https://cleanenergycanada.org/when-building-canadas-ev-battery-supply-chain-the-sum-is-greater-than-the-parts/#:~:text=It%20found%20that%20Canada%20has,to%20the%20Canadian%20econo

8 "For the first time, Canada has surpassed China to Lead BloombergNEF's annual ranking based on an analysis of 46 metrics in five categories", Electric Autonomy Canada, February 2024, https://electricautonomy.ca/2024/02/05/canada-top-spot-bloombergnef-battery-supply-chain-ranking/#:~:text=Mail-,For%20the%20first%20time%2C%20Canada%20has%20surpassed%20China%20to%20lead,ion%20battery%20supply%20chain%20ranking

9 "Ford says Northern Ontario mines will create economic boom", Northern Ontario Business, January 2024, https://www.northernontariobusiness.com/industry-news/mining/ford-says-northern-ontario-mines-will-help-create-economic-boom-8154772

10 "New projects will prepare people for good-paying careers in Ontario's growing auto sector", Ontario Government, May 2023, https://news.ontario.ca/en/release/1003085/ontario-providing-free-training-for-auto-workers

11 "Battery Building Blocks", Battery University, https://batteryuniversity.com/article/bu-104b-battery-building-blocks

12 "Thermal Runaway: Understanding the Fundamentals to Ensure Safer Batteries", Battery Power Online, https://www.batterypoweronline.com/news/thermal-runaway-understanding-the-fundamentals-to-ensure-safer-batteries/

13 "Gas vs. Electric Car Fires", AutoinsuranceEZ, https://www.autoinsuranceez.com/gas-vs-electric-car-fires/

14 "Up to 150,000 litres needed to put out a fire in an electric vehicle", International Association of Fire and Rescue Services, https://www.ctif.org/news/150-000-liters-water-needed-put-out-fire-electric-car#:~:text=%E2%80%9CNormally%20a%20car%20fire%20you,pack%20once%20it%20starts%20burning.%22

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