A SNAPSHOT OF

Skills, Talent & Workforce Development: Vehicle Electrification

OVIN
AUTONOMOUS • CONNECTED • ELECTRIC

Ontario

OCI
Where Next Happens

JANUARY
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ONTARIO CENTRE OF INNOVATION – ONTARIO VEHICLE INNOVATION NETWORK (OVIN)

Table of Contents

Acronyms

AARO Automotive Aftermarket Retailers of Ontario

AUTOSAR Automotive Open System Architecture

BEVs Battery Electric Vehicles

EV Electric Vehicle

HEVs Hybrid Electric Vehicles

INCA Integrated Calibration and Application Tool

NETCO National Electrical Trade Council

OASIS Online Apprentice Support Initiatives for Success

OVIN Ontario Vehicle Innovation Network

OEMs Original Equipment Manufacturers

PHEVs Plug-in Hybrid Electric Vehicles

STEM Science, Technology, Engineering and Mathematics

Glossary of Terms

Aftermarket – Secondary market of parts for replacement, collision, appearance, and performance.

Automation – Application of technology to monitor and control the production and delivery of products and services.

AUTOSAR – Open and standardized software architecture for automotive electronic control units.

Battery Management Systems – Technology dedicated to the oversight of a battery pack.

C – General-purpose computer programming language.

C++ – High-level general-purpose programming language.

(Vehicle) Electrification – Process of powering vehicles by electricity.

INCA – Measurement, calibration and diagnostic software published by ETAS.

Java – High-level, class-based, object-oriented programming language.

MATLAB – Proprietary multi-paradigm programming language and numeric computing environment developed by MathWorks.

Python – Interpreted, object-oriented, high-level programming language with dynamic semantics.

Robotics – Design, construction, operation, and use of robots.

Introduction

In June 2021, the Government of Canada announced a mandatory target for new sales of passenger vehicles to be **zero-emission by 2035**.[1] To that end, the province of Ontario has announced plans to **produce 400,000 electric and hybrid vehicles by 2030**. The province is **home to five of the top global automakers** – Stellantis, Ford, General Motors, Honda, and Toyota – and is the second-largest vehicle-producing jurisdiction in North America, just behind Michigan.[2] Further, job postings in the Electrification sector **increased by 13%** between June 2021 and June 2022.[3]

To maintain its position in the global electric vehicle (EV) market, Ontario needs to reposition vehicle and parts production plants for the production of EVs, and **invest in skills for EV manufacturing and services**.

A recent example of such a shift in the province is Stellantis' 2022 announcement about plans to **assemble next generation hybrid and electric vehicles** in its Brampton and Windsor factories. This is complemented by similar efforts by original equipment manufacturers (OEMs) as well as provincial and federal governments.[4]

The province is committed to **expanding into battery manufacturing**, a key sector in the electrification value chain and one that has seen significant growth globally.[5]

In July 2022, it was announced that Umicore, which is a leader in metals refining worldwide, would **build a $1.5 billion plant in the province**, which is expected to **generate 1,000 jobs** during construction and hundreds of full-time positions during operations.[6]

As the automotive and parts manufacturing industry **transitions to the low-carbon economy** and embraces advanced digital and automation technologies, a workforce with a broader mix of skills, training and experience will be required.

Some of these **emerging skills** in the electrification value chain include digital skills, knowledge of advanced manufacturing, software development for vehicle electronics, and battery design. Additionally, skills related to battery and charging technologies, along with EV and infrastructure maintenance, and repair skills are expected to be **high in demand**.[7]

In addition to this technical knowledge, non-technical skills and abilities, such as communication skills, leadership, motivation, a learning mindset, and problem-solving skills will all be **differentiating factors** for the labour pool.

Executive Summary

This spotlight highlights the following:

Electrification Value Chain

Electrification in transportation is a critical element of transition towards a sustainable future. This section provides a summary-level overview of automotive electrification highlighting the broad stages embedded in the process of powering vehicles with electricity. This includes raw materials processing, battery production, EV manufacturing, EV automotive repair and aftermarket, as well as the required EV infrastructure. For each stage, the top in-demand occupations are featured drawing from current job openings locally, nationally and globally.

Emerging Skills

This section highlights skills that are intrinsic to the industry and have been emerging to become increasingly in-demand by employers. The identified skills are a mix of emerging skills as well as upskilling requirements in tandem with the advancement of electrification. The identified skills are further categorized into the following skill types:

General skills

Physical labour, verbal/written communications, etc.

Specialized skills

Vehicle charging equipment repair

Technical knowledge

Technical battery knowledge, knowledge of EV components and parts, etc.

Tools and equipment

Machinery operation, EV driving ability and experience, etc.

Talent Development Programs

This section provides an overview of Ontario-based as well as national and global training and development programs. These are grounded on the emerging skills as well as upskilling requirements in select traditional sectors identified previously, such as programs for upskilling for automotive manufacturers to transition into EV manufacturing.

Equity, Diversity and Inclusion

This section presents a review of diversity and inclusion initiatives in the electrification sector, including priorities to promote under-represented groups in the sector in both access to EV technology as well as employment in the sector. In particular, Forth, a non-profit organization, and its activities are highlighted to showcase as a model to inspire similar change in other jurisdictions.

This spotlight is intended to be used as a introductory informational booklet. It forms part of a series of spotlights to cover more segments in the automotive and mobility sector. More information on the highlighted knowledge, tools, skills, and abilities may be found in the cited references and/or other relevant sources including other OVIN publications.

Charging Ahead: Emergence of Electrification Value Chain

This section highlights the various stages of Electrification value chain activities, ranging from refining raw materials to developing required infrastructure. For each stage, the top in-demand occupations are featured.[8,9,10]

Stages of Electrification Value Chain

Sourcing of Raw Materials

Mining and refining of raw minerals used for battery production, such as lithium, cobalt, graphite, aluminum and nickel.

- Industrial engineer
- Processing plant worker and technician
- Material handlers

Battery Production

Various stages of production, notably battery cells, battery modules, pack assembly, and battery management systems.

- Battery engineer
- Electrical engineer
- Mechanical engineer

EV Manufacturing

Development and assembly of the battery pack, vehicle body, complex electronics, and other parts.

- Manufacturing engineer
- Manufacturing technician
- Systems engineer
- Automotive assemblers

EV Automotive Repair and Aftermarket

Service, repair, and maintenance for EVs after they have been sold to the final user.

- EV service technician
- Electronics technician
- EV mechanics

EV Infrastructure

Captures the installation and maintenance of specialized infrastructure geared toward EVs, including charging stations.

- Electrician
- Electrical engineer
- Integration engineer
- Software engineer

Top In-demand Occupations

The occupations presented below are the top in-demand positions reflected in current job openings in each value chain in Ontario, nationally and globally. Overlap of occupations between the various parts of the value chain is contingent on the frequency in which they occur with respect to its associated value chain activities. The broad occupations listed here represent sector-specific roles; for instance, Mechanical Engineer includes roles in BEV calibration, EV battery, etc.

Note: This list is not exhaustive and is intended to be used as a starting point for those venturing into Electrification.

How will Electrification Reshape Skills

This section highlights skills corresponding to various parts of the value chain, including:[8,9,10]

Emerging Skills that are increasingly in-demand by employers

Traditional Skills that continue to be in-demand, including upskilling to meet evolving needs of the sector, where applicable

The skills are further categorized into the type of skill, defined as:

- **General Skills:** developed capacities that an individual are expected to have to be effective
- **Specialized Skills:** developed capacities that require vocational training and/or professional qualifications
- **Technical Knowledge:** ability to leverage organized sets of information, typically acquired through educational programs
- **Tools and Equipment:** the adoption of specialized tools and technologies (digital, mechanical, etc.) used to perform tasks

Sourcing of Raw Materials

Physical Labour
Processing plant workers and technicians are often required to carry heavy loads of batch processing material and other manual tasks such as manual scooping.

Operation of furnaces
The processing of raw minerals requires workers to know and operate furnaces as the refining process often requires working with molten metals.

Heavy vehicle handling experience
Workers in processing plants often need to handle heavy vehicles and machinery, such as forklifts, to move materials.

Verbal and written communications
Workers and technicians in refining plants coordinate with multiple team members to complete processes.

Battery Production

Science and engineering education
Employers value higher education in the areas of physics, engineering, and computer science. Many require graduate level degrees.

Technical battery knowledge
General knowledge of the battery production value chain is required. Working knowledge of battery systems for battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and hybrid electric vehicles (HEVs), amongst others, is valuable.

Knowledge of specialized automotive software
Software is common in battery production settings, such as integrated calibration and application tool (INCA) and automotive open system architecture (AUTOSAR), is in high demand for the sector.

Battery software skills
Workers are expected to be proficient in battery and energy management systems. Programming skills in Java, Python, MATLAB, C++, and C are in high demand.

How will Electrification Reshape Skills

This section is a continuation of skills that are intrinsic to the sector and have become increasingly in-demand by employers. These skills for each part of the value chain are also reflected in the training programs in the automotive sector that are embodied in the forward transformation of Electrification.[8,9,10]

- **General Skills:** developed capacities that an individual are expected to have to be effective
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EV Manufacturing

Physical Labour
EV manufacturing requires workers to assemble parts on conveyor belts, which means workers have to be prepared for light lifting and standing for long periods of time.

Machinery operation
Many tasks in the EV manufacturing process require workers to be able to operate machinery and perform quality checks.

Advanced manufacturing knowledge
Workers are expected to learn new technologies that improve traditional processes and increase efficiency, such as robotics and automation.

Electronic systems development
Includes the knowledge and skills required for the design and development of all electronic systems required for EV manufacturing and accessories.

EV Automotive Repair and Aftermarket

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Emerging Skills **Traditional Skills**

How will Electrification Reshape Skills

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EV Infrastructure

Electrical engineering skills
Technicians are expected to have practical training and knowledge to service EVs, such as batteries and electric powertrains.

Software engineering skills
EV infrastructure technology requires extensive knowledge of software design and scripting; knowledge of languages such as C, C++, and Python is in-demand.

Electrician skills
Traditional electrician training is required to install and service EV charging equipment. Knowledge of current electrical codes and electrical installation of EV equipment is also necessary.

Vehicle charging equipment diagnostics and repair
Electricians and technicians need to be trained to service and maintain equipment, such as charging stations and be familiar with the complete EV charging ecosystem.

Emerging Skills **Traditional Skills**

Future Skills and Talent Development

This section provides an overview of Ontario-based, national and global training and development programs. These are grounded on the emerging skills as well as upskilling requirements in select traditional sectors identified previously.[8]

Top Curricula in Vehicle Electrification

Ontario[9]

EV repair and maintenance programs
These programs specialize in providing up-to-date knowledge to automotive technicians so that they can transition into the service of EVs.

Understanding of EV components and parts
Courses and programs focus on providing general understanding of EVs, including internal components, batteries, and functioning.

EV critical safety issues for maintenance
Courses that help automotive technicians to understand safety issues that may arise from servicing EVs and potential measures to be taken.

Global[10]

Skills and knowledge programs for cell production
Programs designed to equip workers with the skills needed to transition to jobs in the battery sector, e.g., in fields such as battery cell production or pack assembly.

Skills and knowledge programs for EV manufacturing
Programs designed to allow automotive manufacturing workers to upskill so that they can work in EV manufacturing.

Select Training Programs and Courses in Ontario

Institution	Program
George Brown College	EV Technician Program
Automotive Industries Association of Canada and St. Lawrence College	EV Upskill
Centre for Mechatronics and Hybrid Technologies (CMHT) at McMaster University	HEV Course
Cambrian College	Industrial Battery EV Maintenance Certificate Program
Automotive Aftermarket Retailers of Ontario (AARO) and Auto Aide Technical Services	AARO EV Training
Niagara College	Hybrid/EVs – Introduction and Orientation
Centennial College	Hybrid/EV Certification
National Electrical Trade Council	EV Infrastructure
(NETCO) Online Apprentice Support Initiatives for Success (OASIS)	Training Program

Note: This list is not exhaustive and is intended to be used as a starting point for those venturing into Electrification.

Inspiring Change with Change: Equity, Diversity & Inclusion

This section demonstrates the current landscape and priorities to promote under-represented groups in the electrification sector. Notably, this overview is complemented with two international equity, diversity and inclusion initiatives that can help inform forthcoming efforts in Canada.[11]

Equity, Diversity and Inclusion Initiatives

Equitable Access to Electric Transportation Technologies

Various organizations across the world have made it a priority to ensure that access to new technology relating to the emergence of vehicle electrification, is equitable.

Mobility sector stakeholders acknowledge that there is potential for electrification to support economic and social development in underserved communities. Organizations actively advocate for equitable installation and management of EV infrastructure grids.

Increased Participation of Women and Visible Minorities in the Automotive Electrification

Historically, the automotive industry has been a male-dominated field, with low female participation compared to other sectors, and this is prevalent across the value chain to various degrees. For instance, the female share of employment in automotive parts manufacturing and aftermarket, maintenance and repair is approximately 21% while the share is slightly higher in mobility planning and infrastructure at approximately 27%.13 With the recent transformations, such as the evolution of vehicle electrification seen in the past decade, there have been prominent efforts to attract more women into Science, Technology, Engineering and Mathematics (STEM) fields.

Forth – Empowering Mobility

Forth, a non-profit trade association based in the United States, has a variety of initiatives for industry and public sector stakeholders in the electrification sector including the promotion of EV affordability, accessibility, and education and awareness programs in historically underserved communities. Their goal is to make transportation electrification accessible for all by advocating and helping to remove barriers to adoption that are embedded in transportation policies and investments.[12]

Women of Electric Vehicles

Automotive and mobility sector organizations have recognized that increased gender and racial diversity are some of the key drivers of success and innovation in the automotive and mobility sector going forward. For instance, Women of Electric Vehicles, a female-led organization founded in 2013 in Portland, Oregon, is a pioneering program dedicated to increasing the proportion of women working and leading in every part of the EV value chain, from a battery engineer to an electric bus driver, to an executive.[14]

Note: These initiatives are not exhaustive and are intended to be used as a sample of equity, diversity and inclusion efforts.

About OVIN

Leading Ontario's Automotive and Mobility Transformation

The automotive industry is undergoing a significant shift, with technological advances and evolving mobility preferences redefining its future.

OVIN, led by the Ontario Centre of Innovation (OCI), is supported by the Government of Ontario's Ministry of Economic Development, Job Creation and Trade (MEDJECT), Ministry of Labour, Immigration, Training and Skills Development (MLITSD) and Ministry of Transportation (MTO). Through OVIN, Ontario is at the forefront of this transformation. OVIN capitalizes on the economic potential of advanced automotive technologies and smart mobility solutions such as connected and autonomous vehicles, and electric and low-carbon vehicle technologies, while enabling the province's transportation and infrastructure networks to plan for and adapt to this evolution.

OVIN is accelerating the development and commercialization of next generation electric, connected and autonomous vehicle and mobility technologies and supporting Ontario's role as the manufacturing hub of Canada, while leveraging critical minerals development in Ontario's North.

OVIN has five main objectives:

1. Foster the commercialization of Ontario-made advanced automotive technologies and smart mobility solutions
2. Showcase the Province of Ontario as the leader in the development, testing, piloting and adoption of the latest transportation and infrastructure technologies
3. Drive innovation and collaboration among stakeholders at the convergence of automotive and technology
4. Leverage and retain Ontario's highly skilled talent, and prepare Ontario's workforce for jobs of the future in the automotive and mobility sectors
5. Harness the Province of Ontario's regional strengths and capabilities, and bridge its automotive and technology clusters to promote the development of EV and power train technologies in Ontario

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