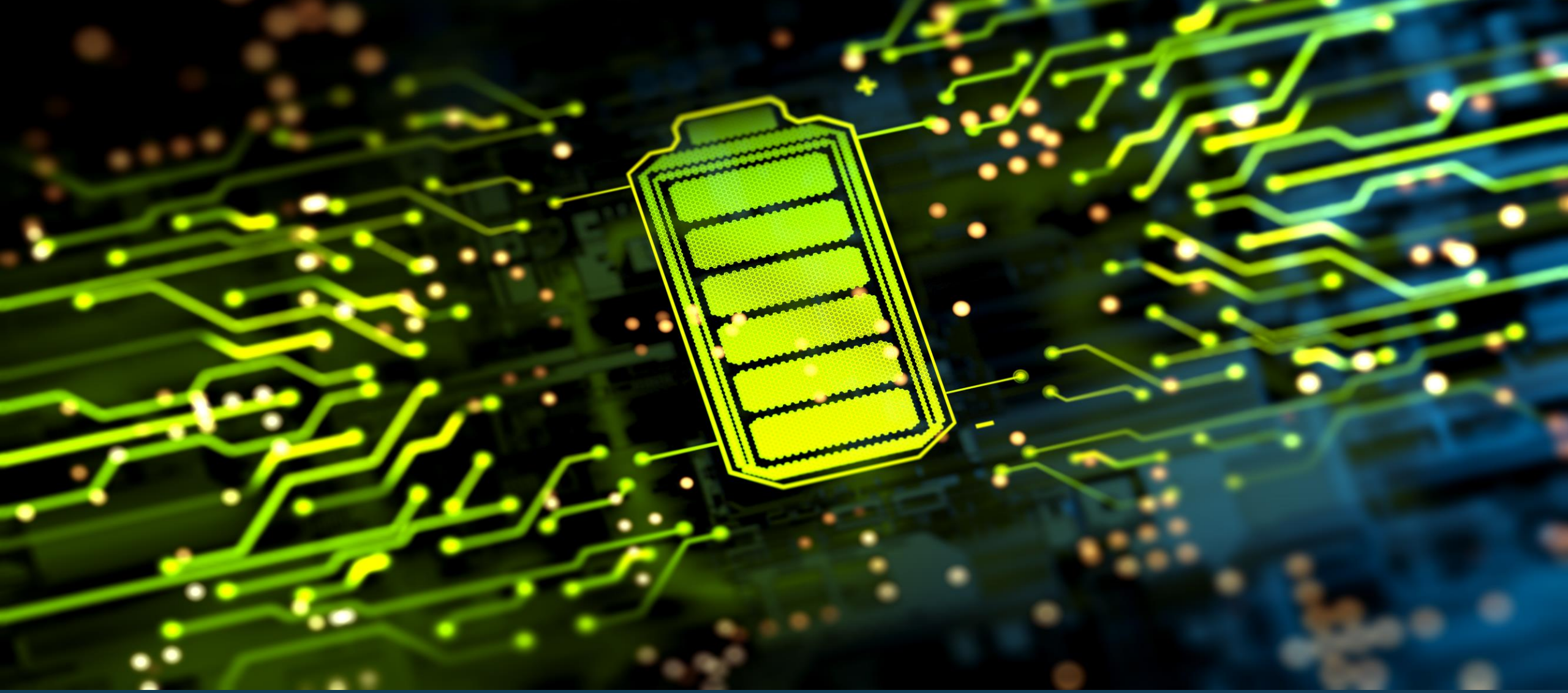

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Ontario

A Spotlight on Skills, Talent & Workforce Development: Battery Manufacturing for Electrification

Ontario Centre of Innovation – Ontario Vehicle Innovation Network (OVIN)
September 2023

OCI
Where Next Happens

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Acronyms and Glossary of Terms

Acronyms	
CAD	Computer-aided design
CAE	Computer-aided engineering
CAM	Computer-aided manufacturing
CNC	Computerized numerical control
CIP	Classification of Instructional Programs
EDI	Equity, diversity and inclusion
EV	Electric vehicle
GDP	Gross domestic product
MEDJCT	Ontario Ministry of Economic Development, Job Creation and Trade
MLITSD	Ministry of Labour, Immigration, Training and Skills Development
MRP	Material Requirement Planning
MTO	Ministry of Transportation
NAICS	North American Industry Classification System
NOC	National Occupational Classification
OCI	Ontario Centre of Innovation
OVIN	Ontario Vehicle Innovation Network
PLM	Product life-cycle management
SCADA	Supervisory control and data acquisition
WMS	Warehouse management system

Glossary of Terms	
Automotive manufacturing	Production of vehicles using various techniques and technologies.
Automotive technologies	Technologies used in designing and producing vehicles.
Critical minerals	Subset of the raw materials needed to produce advanced products and specialized technologies.
EAI Software	Enterprise application integration software, which is used to integrate different software applications and systems within an organization.
High value-added components	Components that add significant value to a product and typically involve specialized knowledge, skills, and technology.
Riverbed Technology	Company that provides network and application performance solutions, including software and hardware products that help to optimize automated manufacturing processes.
Robotics	Use of robots and other automated machines to perform tasks and operations that would otherwise be performed by humans.
Skilled labour	Workers with specialized skills in the labour market.
Zero-emission	Elimination of greenhouse gas emissions through renewable energy sources electric or other low-emission vehicles.

Introduction

The Government of Canada has set a mandatory target for new passenger vehicle sales to be zero-emission by 2035, prompting a **significant electrification transformation** in Ontario's automotive and mobility sector.

As battery design, development, and manufacturing are **high value-added components** of the electrification value chain, Ontario's existing **competitive advantages** make it well-suited for increased local battery production and a more **prominent role** in the electric vehicle (EV) battery supply chain. This is due to Ontario's **abundant resources** of cobalt, graphite, lithium, and nickel - the primary minerals required for producing lithium-ion batteries used in today's EVs.[1]

The endowment of these minerals presents a **significant opportunity** to establish an end-to-end value chain for battery materials, positioning Ontario as a global leader in EV battery production.

In 2021, Belgian multinational corporation **Umicore** announced a **$1.5 billion investment** in an **EV plant** in Loyalist, Ontario. The project alone is expected to supply materials for up to one million EVs annually.[2]

Furthermore, in 2022, **LG Energy Solution and Stellantis** entered a $5-billion joint venture to open their first large-scale domestic **EV battery manufacturing facility** in Windsor, Ontario. This investment is anticipated to create 2,500 jobs, generate economic benefits, and contribute to Canada's net-zero emission goals.[3]

Recently, **Volkswagen**, one of Europe's largest automakers, announced that its subsidiary, Powerco, will establish **a vehicle battery plant** in St. Thomas, Ontario, with operations set to begin by 2027.[4]

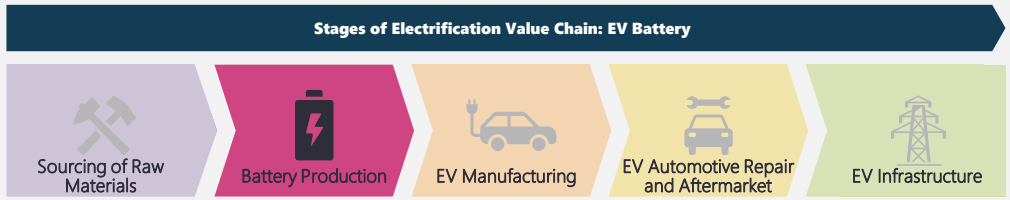
As a result of these investments, various **occupations and skills** are emerging in the battery manufacturing sector due to these investments. **Battery cells, module and design, and battery management systems** are particularly relevant areas that require expertise in electrical, mechanical, and electrochemical engineering. The increasing focus on automation and digitalization in the industry highlights the major trends in the sector, emphasizing the need for technical skills and adaptability.

Executive Summary

This spotlight highlights the following:

Ontario's Battery Manufacturing Sector

Battery Manufacturing is the second stage of the automotive Electrification value chain, and in includes various stages of production, notably, battery cell components, battery cells, battery modules, pack assembly, and battery management systems. Below is an illustration of the battery manufacturing in the electrification value chain:



This section provides an overview of Ontario's recent major sectoral advancements and features the impact of recent technological developments on labour force requirements and skills development needs in the short- and long-term.

Labour Market and Emerging Skills

This section highlights the key occupations with the largest shares of employment in the battery manufacturing sector and the associated skills that are required. It also presents a provincial labor market outlook for the next 10 years, identifying occupational gaps and emerging skills.

- Top occupational employment shares include technical roles such as mechanical, electronics, and electrical assemblers, as well as engineers.
- Current skill requirements include various technologies that demonstrate a growing adoption of software in the design and development of batteries.
- High occupational gap is expected for assembly workers and welders in the future.

Talent and Workforce Development

This section highlights the workforce education profile indicating a strong focus on qualifications in engineering and engineering-related technologies. This is complemented by an overview of Ontario-based training and development programs tailored to the emerging skills and upskilling requirements essential to the battery manufacturing sector.

Equity, Diversity and Inclusion

This section explores current trends in the representation of minority groups in Ontario's battery manufacturing sector employment. It further examines national and global diversity and inclusion initiatives in the sector, highlighting priorities to promote employment access for underrepresented groups.

This spotlight serves as an introductory informational booklet and is part of a series covering various segments of the automotive and mobility sector. For more information on the highlighted knowledge, tools, skills, and abilities, please refer to the cited references and other relevant sources, including other OVIN publications.

Ontario's Battery Manufacturing Potential at a Glance

Ontario is uniquely positioned to leverage its resource endowment to become a leader in battery manufacturing.

Several key global industry players are pursuing next-generation battery design, development and manufacturing in Ontario[2,3,4]

- Umicore
- LG Energy Solution
- Stellantis
- Volkswagen/Powerco

Battery is an integral part of the Electrification transformation, accounting for approximately 30% of the total cost of EVs:[5]

The automotive manufacturing sector* accounts for **2%** of Ontario's GDP.

Since 2020, Canada and Ontario have received investments over $25 billion from global automakers and suppliers of electric vehicles batteries and materials.

The availability of skilled labour workforce supports Ontario's semiconductor, electrical equipment and related components sector.

As of 2021, 13,480 workers are employed in Ontario's semiconductor and electrical equipment industries[6]

Top in-demand occupations

- Labourers in processing, manufacturing and utilities
- Machinery and transportation equipment mechanics (except motor vehicles)
- Machining, technical metal forming, shaping and erecting trades

Top skills required in semiconductor and electrical equipment industries

- Cloud Computing
- Extract Transform and Load (ETL)
- Ada Automation Software
- Riverbed Technology
- Enterprise application integration (EAI) software

EDI Snapshot[7]

Women representation

35.5%

Indigenous representation

1.4%

Visible Minority representation

53.2%

Looking ahead, Ontario's labour force requirements for battery manufacturing point to greater digitalization and technical skills.

Reskilling

may help workers adapt to increased digitalization

Expected in-demand occupations

- Electronics assemblers, fabricators, inspectors and testers
- Welders and related machine operators
- Motor vehicle assemblers, inspectors and testers

Expected Skill Gaps

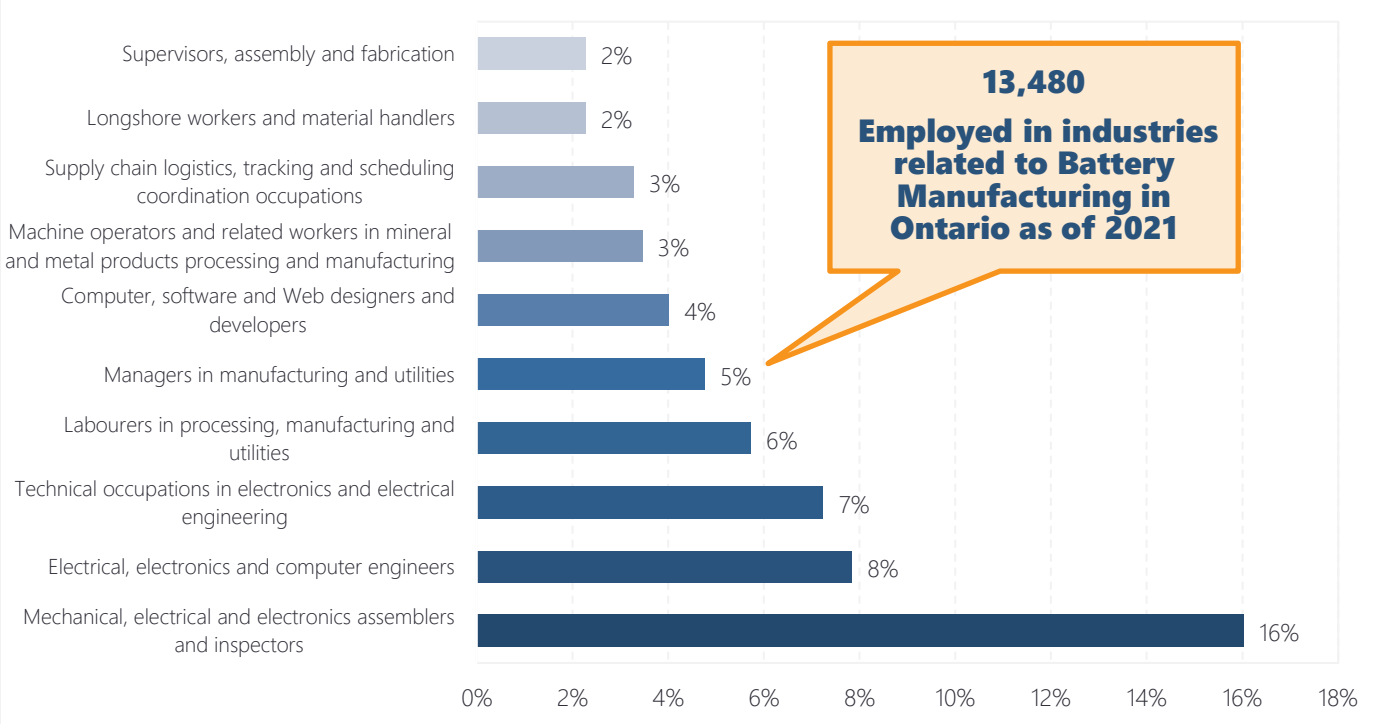
- Enterprise resource planning (ERP) system
- Supervisory control and data acquisition systems
- 3D computer aided design software
- Materials requirement planning software

Note: *The automotive manufacturing sector is defined as NAICS 3326, 3335, 3344, 3353, 3359, 3361, 3362, and 3363. The broader mobility sector additionally considers NAICS 3336, 3364, 3365, 3366, and 3369.

Current Labour Market Insights

Top 10 Occupations in Battery Manufacturing[8]

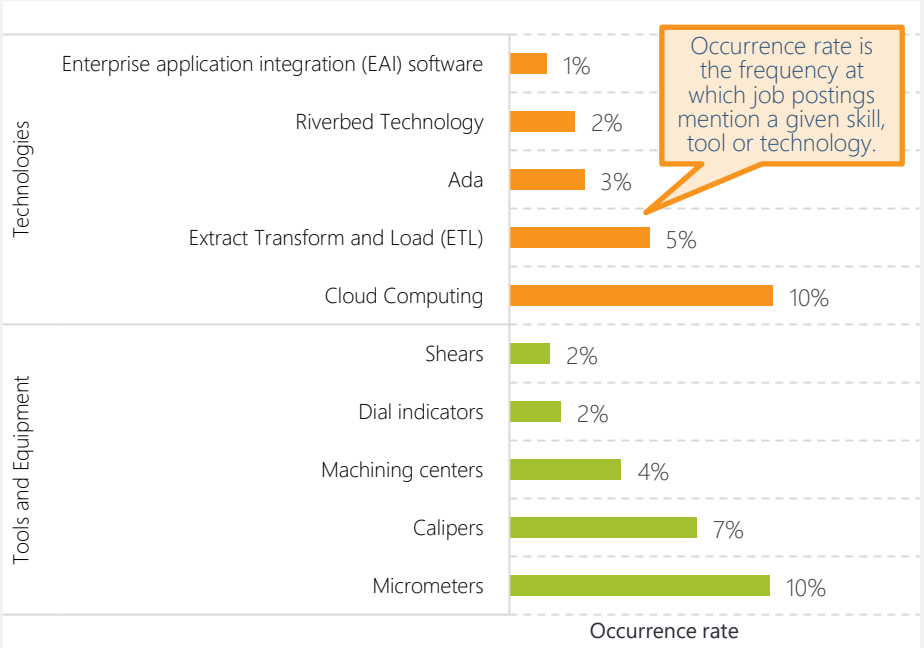
- The figure below presents the top 10 occupations based on employment in semiconductor, electrical equipment and related components industries, which encompass activities relevant to battery manufacturing.
- The top 10 occupations relevant to battery manufacturing include roles such as:
  - Engineers and computer, software and web designers/developers (e.g., systems designers and programmers involved in battery design and software solutions for battery optimization)
  - Workers in supply chain logistics and material handlers are also important for the transportation of advanced and sensitive chemical materials and manufactured electrodes.



Note: The occupations in this chart are the top ten occupations with the highest employment as a share of total employment in Battery Production (NAICS 3359 and 3344).

Top Skill Requirements[9]

- Job postings (2018-2022) show that technical skills presented in the chart below are high in demand in the labour market. Qualified workers are also expected to have a strong command on general skills which are effective competencies and transferable across roles.
- Notably, various technologies reflecting greater uptake of automation processes are often requested by employers, including:
  - Precision measuring tools (micrometers, calipers, etc.)
  - Automated machine operations (shears, machining centers, etc.)
  - Digital technologies such as EAI software, Riverbed Technology, etc. which are integrated software applications and hardware that are used to streamline automated manufacturing processes



Skills Outlook and Expected Gaps

Labour Market Gap Outlook[10]

- The labour market outlook for 2023-32 time period is developed based on projected growth in:
  - **Demand:** sector expansion driven by economic growth, replacement demand arising from retirements in the sector, and workers transitioning to other sectors; and
  - **Supply:** new workforce entrants, including new graduates and trainees, immigrants, and workers from related sectors.

Expected Labour Market Gaps by Occupation Category

Expected labour market gaps are determined based on the difference in future labour demand and supply.

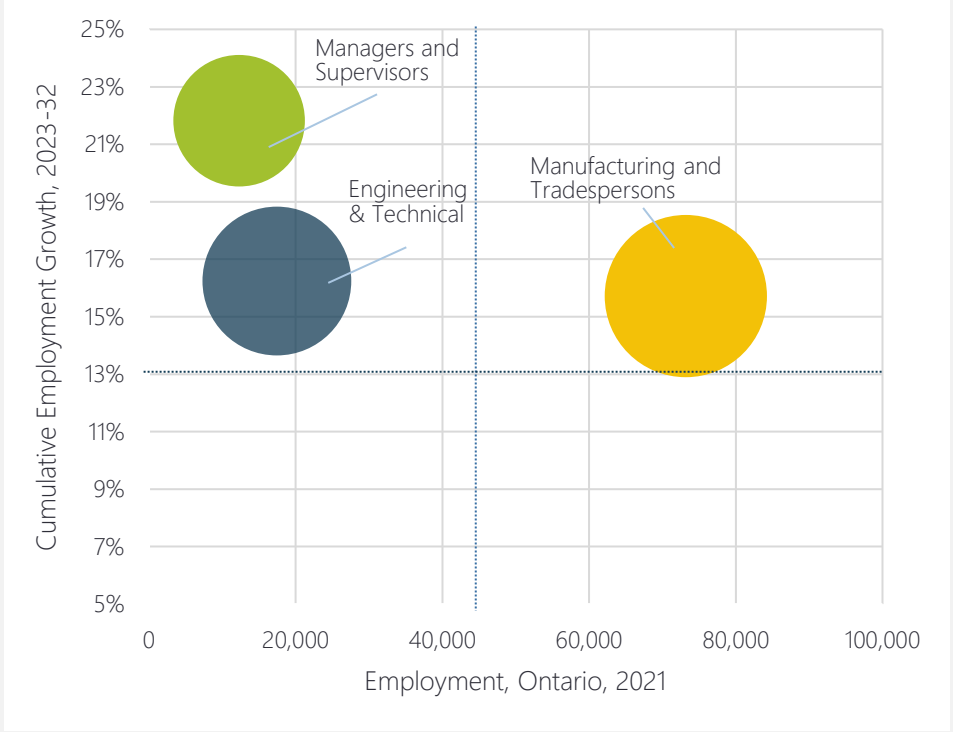
High

Moderate

High and moderate labour force gaps indicate that projected total demand for workers exceeds availability of workers in the labour market, suggesting potential challenges in finding qualified workers. **High gaps** are more acute and prominent for manufacturing competencies, and given high level of employment and expected growth, this is a high priority for talent attraction.

Low

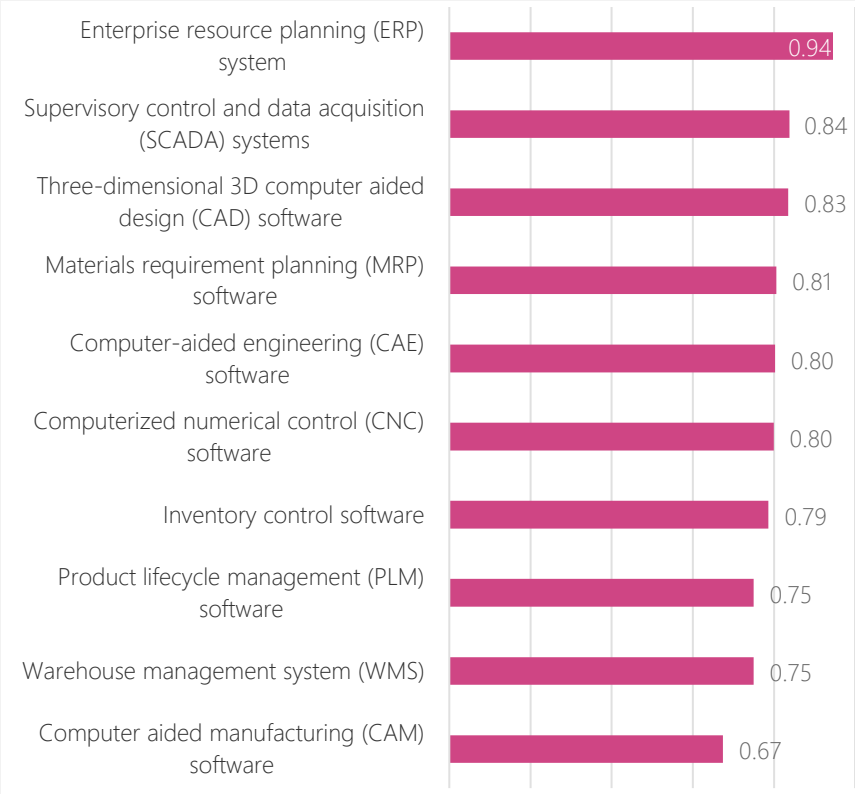
Low labour force gaps indicate sufficient availability of workers in compared to what employers demand. Low gaps are prominent for managerial occupations. Some trades are also expected to have a low gap, such as power engineers and power systems operators.



Note: The size of the bubble indicates the relative magnitude of the expected occupational gap for each occupation. The employment numbers denote employment for a combination of industries and occupations relevant to the sector.

Expected Skills Gap, 2023-32[11]

- Based on occupational gaps, skills gap is derived as the difference between skills demand and supply projections. This helps identify emerging technical skills for the next ten years (2023-32).
- Presented below are standardized scores to illustrate skills where the highest gaps are expected, such as ERP, SCADA, etc., indicating potential need for skill development.

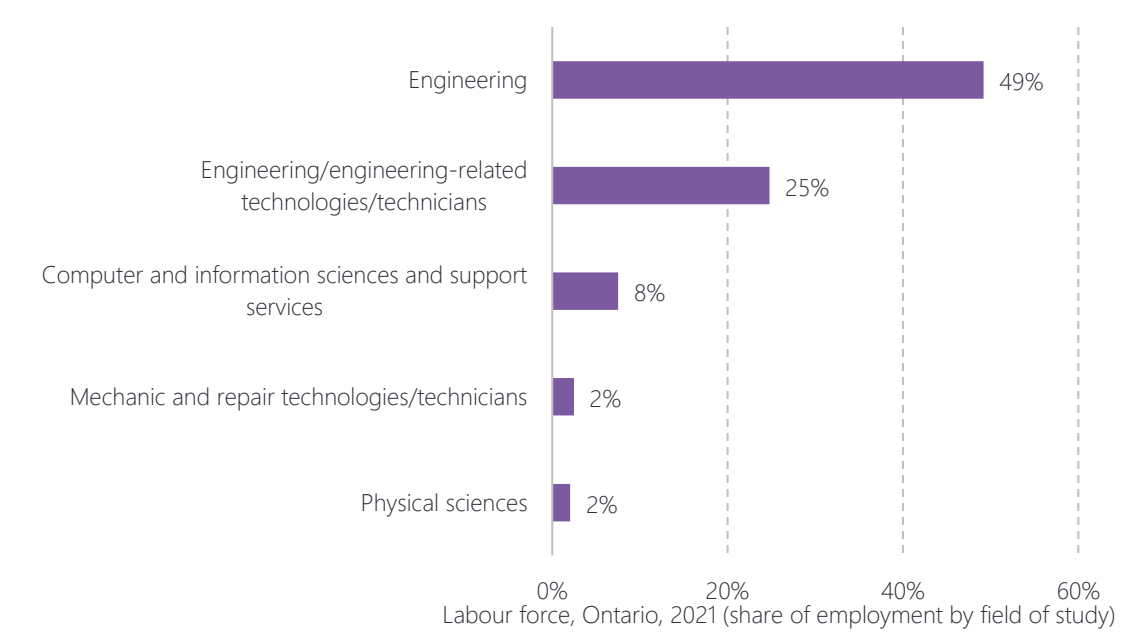


Note: Please see Methodology and Data Limitations section on page 13 for further detail on the skills gap analysis.

Training and Education Requirements and Programs

Workforce Education Profile and Requirements[12]

- The most common fields of study among workers in the battery manufacturing sector are engineering and engineering technologies, which account for 62% of all workers who completed a study program. Specifically, for battery development and production related competencies, electrical, mechanical, chemical and mechatronics engineering are common.
- Additionally, 15% of employees were trained in business, management, marketing and related fields.
- Further, 8% of workers in the segment studied computer and information sciences, while 2% trained in mechanic and repair technologies.



Labour force, Ontario, 2021 (share of employment by field of study)

Note: Engineering comprises of instructional programs that prepare individuals to apply mathematical and scientific principles to the solution of practical problems. Engineering technologies/technicians comprises of instructional programs that prepare individuals to apply basic engineering principles and technical skills in support of engineering and related projects.

Talent and Workforce Development Programs

Below is a selection of programs, trainings and certificates across Canada accessible to current and aspiring workers in the EV battery sector in Ontario.

Cambrian College
- Based in Ontario
- Industrial Battery Electric Vehicle Maintenance Certificate Program

UL Solutions
- Based in Ontario
- Electric Vehicle Battery Testing and Certification
- Courses on the large batteries used in EV

Hilti
- Offered online
- Training providing practical knowledge on lithium-ion battery technology in cordless power tools

HEVPD & D CREATE (Hybrid Electric Vehicle Powertrain Design & Development)
- Offered online
- Based in Ontario
- Hybrid and Battery Electric Vehicle Powertrain Design and Development

University of Guelph
- Based in Ontario
- Electrochemical Technology Centre

Northern College
- Offered online
- Based in Ontario
- Battery - Electric Vehicle course

Makermax Systems Inc.
- Offered online
- Based in British Columbia
- Electric Vehicle Battery and Battery Management Systems

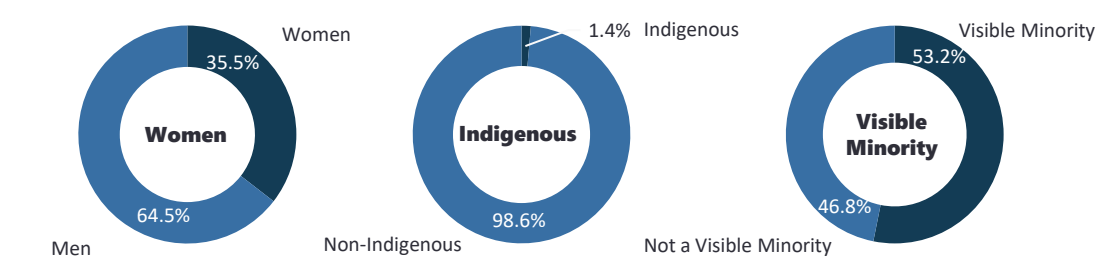
CFT Canada
- Based in Quebec
- Lithium battery courses, including regulatory aspects of transporting lithium batteries

Vancouver Island University
- Based in British Columbia
- Courses for battery and fasteners which covers concepts of battery maintenance and servicing

Equity, Diversity, and Inclusion

Current Minority Groups Representation in Battery Manufacturing[13]

Based on 2021 employment, women and Indigenous groups are underrepresented in Ontario's semiconductor, electrical equipment and related components industries.



Current Initiatives Across Canada

Public and private organizations have developed various initiatives to promote equity, diversity and inclusion (EDI) in the Canadian battery production sector going forward.

access employment

Access Employment offers a well-curated electrical engineering connections program for internationally trained electrical engineering professionals. The program helps immigrants and refugees to upskill.

CBA Canadian Battery Association

The CBA ensures that leaders of the battery sector have sufficient knowledge of the regulations and data to take well-informed decisions. It believes in equal accessibility of knowledge to all members.

The 50-30 Challenge

The Government of Canada has developed the 50-30 Challenge initiative to encourage partner organizations to reach 50% gender parity and 30% representation from minority groups, including racial minorities, LGBTQ2, among others.

impact canada

Impact Canada facilitates the Women in Cleantech Challenge, which is a federal initiative aimed at improving the gender balance in STEM careers and, in particular, clean technology businesses.

Mennonite new life centre

The Mennonite New Life Centre of Toronto is a community-based settlement agency, and it offers several bridging programs including Bridge for Immigrant Women Reskilling into IT coding Professions.

HUMBER

Humber College provides a specialized bridging program for immigrants who are trained IT professionals. It aims to equip participants with the skills as well as assistance in sector specific employment advisory services.

Organizations worldwide are promoting EDI in battery production

MIT Electrochemical Energy Lab

EEL offers an inclusive and supportive environment by engaging and collaborating in electrochemical research with people of all races, genders, and disability statuses.

MY BATTERY RECYCLERS Recycling what matters

My Battery Recyclers create opportunities for small local and diverse businesses to actively participate in the battery supply chain, with a focus on promoting underrepresented communities.

PROTERRA

Proterra offers training, education, upliftment, and continual evolution in battery technology. Its objective is to create a safer and more equitable environment for all.

Stakeholders in the sector are improving EDI by[14]

Upskilling the Immigrants

Agencies, with the support of government and education institutions, provide multiple upskilling programs to immigrants and make them job ready.

Engaging with Indigenous Communities

Raw materials from Ontario's mines are vital for EV battery supply chains. With 142 active agreements, Indigenous communities and mining companies work to enhance environmental protection, employment, training, and profit sharing.

Offering Equitable Environment

Companies in the sector are working continuously to provide training, education, and upliftment to all the groups, and no one faces any disadvantages due to the lack of it.

Opportunities to increase women's representation in battery manufacturing include[15]

Providing Women with Information Platforms

Stakeholders can support this by developing information materials and creating educational partnerships so that women may have accessible knowledge of open opportunities in the field.

Addressing Women Turnover Rate

Companies can implement internal policies to support an inclusive workforce for women where working conditions and advancement opportunities are fair and equitable regardless of gender.

Promoting Women in Leadership Positions

Companies in the field can make an active effort to promote women's representation in leadership positions across all levels, ensuring a platform for women's advocacy in the workplace.

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 (MEDJCT), Ministry of Labour, Immigration, Training and Skills Development (MLITSD) and Ministry of Transportation (MTO). Through OVIN, Ontario is at the forefront of the automotive and mobility sector's 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 in Ontario's North which are integral to battery 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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Methodology and Data Limitations

Methodology

An overview of the methodology of the analysis is presented below:

- Skill gaps were defined based on the average occurrence rate of a skill in job posting related to the segment and the average occurrence rate of the same skill in relevant job seeker profiles. Occurrence rate is the frequency or percentage of job postings that mention a given skill, tool, or technology, in relevant occupations. Skill gaps where demand exceeded supply are included in the report.
- Occupational demand is projected based on industry's forecasted growth as per Oxford Economics, in combination with expected changes in the demand for workers, including annual change in employment by occupation and replacement demand. Replacement demand is based on estimated rates of exit from the labour force due to retirement, emigration or death. Exit rates are based on the Canadian Occupational Projection System (COPS) data.
- Occupational supply is projected based on three distinct sources: school leavers (i.e. postsecondary graduates and apprenticeship completions), immigrants, and job changers (i.e. individuals currently in the workforce who may enter the sector).
- Occupational labour gaps were determined subtracting total projected supply from total projected demand across all forecast years (2023-2032).The skills outlook was based on occupational projections for a common set of skills available in both job postings (demand) and job seeker profiles (supply).
- The degrees required by employers in battery manufacturing are reflected in the most common fields of study for workers currently employed in the segment. These fields are identified by triangulating field of study (CIP), occupation (NOC), and industry (NAICS) data.

Data Limitations

Identified limitations with the datasets and approach used in the analysis include:

- Skills data were collected from Vicinity Jobs, a labour market analytics firm, at the level of occupations (4-digit NOC) and grouped into occupation categories based on the similarity of their roles within each segment of the automotive and mobility sector, including information regarding the education level and workforce characteristics (e.g., skills, knowledge, tools & technology) required in postings by occupation.
- The analysis of skills was limited by the availability and completeness of data. There were gaps in terms of job posting and job seeker profiles in Vicinity Jobs data, which means that the estimations of skills demand, supply, and gap should be considered as a ranking rather than a definitive estimation.
- Future skill insights were limited by the skills present in current state data from job posting and job seeker profiles, meaning "new" skills that are not related to occupations in the present could not be identified.
- The data used for the analysis of representation of women, visible minorities, and Indigenous groups in Ontario's employment by industry and by occupation is sourced from Statistics Canada's latest Census from 2021. Data for non-binary gender groups are not available at the level of granularity in this analysis.

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Disclaimer

This report was commissioned by the Ontario Centre for Innovation (OCI) through a Request for Proposals titled "Labour Market Research Insights: Talent & Workforce Strategy Update," dated September 30, 2022, and has been prepared by a third-party vendor.

In preparing this report, we have relied on information provided by others, and we do not accept responsibility for the content, including accuracy and completeness, of such information.

We emphasize that any forward-looking projections or forecasts are based on interpretations or assessments of available information at the time of writing this report. Therefore, readers and recipients of this report should not place undue reliance on the report and are cautioned to perform their own due diligence, investigations, and analysis before placing reliance on it.

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