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Skills needs for zero-emissions vehicle and battery manufacturing in Ontario

Summary for policymakers

PLACE Centre
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The PLACE Centre, which stands for Propelling Locally Accelerated Clean Economies, focuses on the complex challenges limiting clean economic growth in Canadian communities. Our core approach is "place-based," meaning the PLACE team works with all levels of government, industry, and civil society organizations to ensure regions across Canada have the solutions needed to overcome the challenges they face in advancing clean economic growth. With this approach, the PLACE team can create practical, place-based recommendations where everyone involved can collaborate and work towards making progress in solving these problems. That way, every region and community across the country can be included in, and benefit from, Canada's growing clean economy.

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Smart Prosperity Institute is a national research network and policy think tank based at the University of Ottawa. We deliver world-class research and work with public and private partners to advance practical policies and market solutions for a stronger, cleaner economy.

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Skills needs for zero-emissions vehicle and battery manufacturing in Ontario

The automotive industry in Ontario (ON) is shifting gears, undergoing one of its biggest transformations so far. The transition to zero-emissions vehicles (ZEVs), as well as increasing digitization and automation, are revolutionizing the industry.[1] According to the Government of Ontario, over the past two years, the province has attracted $16.5 billion in investments from global automakers, the Canadian federal government, and ZEV batteries and battery materials[2] suppliers to grow its emerging ZEV and battery manufacturing supply chain. These investments include:

- Stellantis and LG Energy Solutions' $5 billion battery cell factory in Windsor, ON;
- General Motors' $2.3 billion investment in upgrading its Brampton, ON and Ingersoll, ON facilities;
- Ford Motor Company's $1.8 billion retooling of its Oakville, ON plant; and,
- Volkswagen's battery manufacturing plant in St. Thomas, ON.[3]

Businesses, unions, educational institutions, and policymakers face a challenge in navigating an uncertain future about how this transition might play out in the coming years and how the automotive manufacturing workforce will be affected. As the industry evolves, so will the skills and knowledge workers need to fill emerging roles. By identifying what new skill requirements these jobs will bring, and by developing smart and collaborative approaches and policies to train, upskill, and reskill workers, Ontario and the communities in its automotive manufacturing hubs can begin to realize the benefits of the shift to ZEVs.

This summary document, captures the ideas, analysis, and recommendations put forward in two Smart Prosperity Institute reports detailing the skills and labour needs, as well as the workforce planning challenges, in the ZEV and battery supply chain: *Shifting gears: How Ontario's push to manufacturing zero-emissions vehicles will impact the workforce,* and *Future-proofing the automotive workforce: Supporting Ontario's auto sector workers through the ZEV transition*. Research for these reports was collected through a combination of surveys, interviews, and informal discussions with stakeholders across Ontario's automotive sector, supplemented by a literature review and quantitative analysis of workers' future skills and knowledge needs. Additionally, two in-person workshops in Windsor and London were hosted to discuss the specific challenges the sector faced in each region. For more insights about the methodologies used to generate these findings, please refer to the appendices of *Shifting gears.*

Abbreviations

CAPC	Canadian Automotive Partnership Council
FSTP	Federal Skilled Trades Program
ICEV	Internal combustion engine vehicle
NAICS	North American Classification System
OEM	Original Equipment Manufacturer
PSI	Post-secondary institution
ZEV	Zero-emissions vehicle

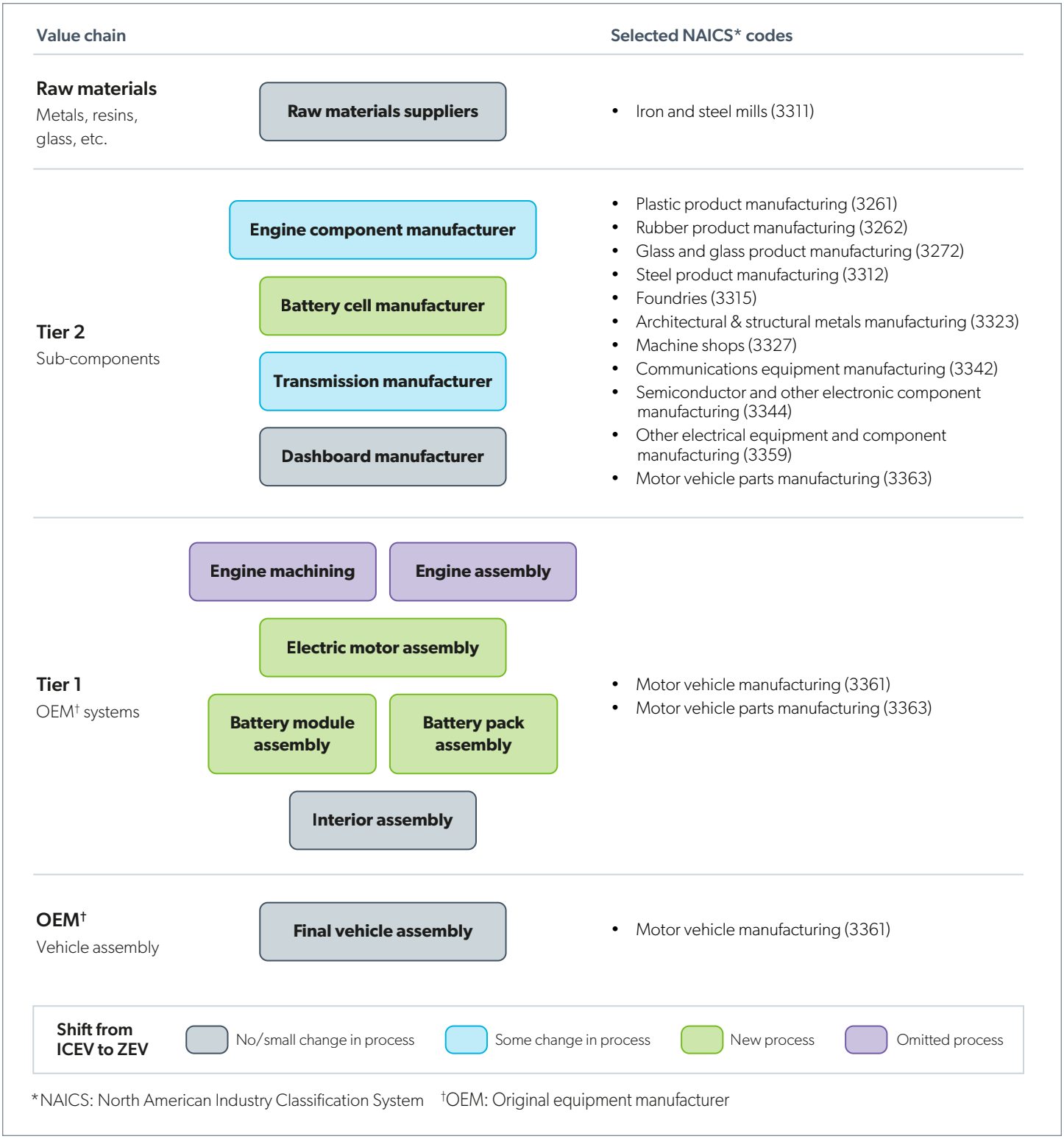
What are the differences between manufacturing internal combustion engine vehicles (ICEVs) and zero-emissions vehicles (ZEVs)?

Skills and labour requirements differ between producing ICEVs and ZEVs because the end-use technologies differ, and so do the components and processes that go into building and assembling them. The differences in end-use technology revolve around changes to the powertrain.[4] The main components of an ICEV powertrain — the engine and auxiliary systems — are unnecessary in a ZEV. Instead, these are replaced by a battery pack, consisting of modules with battery cells, and an electric motor.[5] Additionally, ZEVs also require changes to some components and inputs such as the use of lighter steel, a greater use of plastics, and more semiconductors and copper to power software systems.[6]

Additionally, increased automation and digitization within the manufacturing process will alter existing workers' skills and knowledge requirements. Skills in software design, coding, programming, and battery management will be in greater demand. Automation is unlikely to prove a threat to jobs, given the stark labour shortages the sector currently faces and the role automating tasks plays in supporting expanded facility operations.[7] Figure 1 represents how these differences between technologies impact the full automotive and automotive parts supply chain, with new and impacted sectors highlighted.

Despite some sectors that produce internal combustion engines being impacted, the overall picture for Canada is strong. The shift to ZEVs is not expected to dramatically change the size of the workforce in Canada's automotive and automotive parts sector.[8] Instead, it is about sustaining, rather than growing, Canada's automotive workforce.

Figure 1: What are the differences between the internal combustion engine vehicle (ICEVs) and zero-emissions vehicle (ZEV) supply chain?[9]



*NAICS: North American Industry Classification System †OEM: Original equipment manufacturer

How will this shift impact the skills workers need to work in the automotive sector?

Certain occupations and sectors will see increases in demand, especially those with electrical and chemical expertise. Jobs like controls technicians, chemical engineers, electrical and electronics engineers, industrial engineers, materials engineers, manufacturing technologists, mechanical engineering technicians, and software developers have been identified as key occupations for the future of ZEV and battery manufacturing. While some roles will see growth in new sectors like battery production and parts assembly, the majority of individuals impacted will work in jobs and sectors that already exist today. Workers in these sectors will therefore need to upskill to add new skills or knowledge areas to their existing knowledge bases or potentially reskill from one occupation into another. Table 1 summarizes some emerging skills needs and shows where shifts will be most impactful within the sector.

Table 1: Sub-sector summary of trends, and their impacts on occupations and skills[10]

Sub-sector: North American Industry Classification System (NAICS)	Trends impacting sub-sector	Future occupations in demand	Future skills in demand
Primary metal manufacturing (331)	• Increased use of advanced high-strength or ultra-high strength steel • Different processes and equipment required to manipulate high or ultra-high strength steel	• Engineers • Technologists • Technicians • Construction millwrights • Industrial mechanics • Plant supervisors	• Chemical • Mechanical • Equipment maintenance and selection • Operations monitoring • Computers and electronics • Communication • Production and processing • Critical thinking
Plastics and rubber production manufacturing (326)	• 30% reduction in quantity of plastics • New areas of growth in temperature resistant plastics • Absence of certain rubber components and alternative design of existing components	• Data analyst • Artificial Intelligence and machine learning specialists • Software and application developers • Plant supervisors	• Chemical • Mechanical • Material handling • Engineering and technology • Programming • Automation • Problem solving • Mathematics • Computer and electronics • Critical thinking
Non-metallic mineral product manufacturing (327)	• Increased automation in the long term	• Engineers • Technologists • Technicians • Construction millwrights • Industrial mechanics	• Computer and electronics • Communication skills • Production and processing • Critical thinking • Operations monitoring
Fabricated metal product manufacturing (332)	• Lightweighting of products • Requirement for certain products to be conductive • Adapted products to accommodate increased working with high-strength steel, aluminium, and plastics	• Mechanical engineers • Industrial engineers • Manufacturing engineers • Computer programmers • Maintenance and plant supervisors	• Engineering and technology • Design • Production and processing • Electrical and fire safety • Programming • Problem solving • Decision making • Critical thinking • Computers and electronics • Mathematical
Computer and electronic product manufacturing (334)	• Semiconductor content per car doubles • Faster innovation cycle	• Materials (including electronics) assemblers • Maintenance and plant supervisors	• Complex problem solving and troubleshooting • Systems knowledge • Design • Programming • Critical thinking • Production and processing • Computer and electronics • Mathematical • Operations monitoring • Communication skills

Sub-sector: North American Industry Classification System (NAICS)	Trends impacting sub-sector	Future occupations in demand	Future skills in demand
Electrical equipment, appliance and component manufacturing (335)	• Increased battery manufacturing • Increased research and development	• Chemical engineers • Chemists • Material scientists • Electrical engineers • Mechanical engineers • Maintenance and plant supervisors	• Electrical • Mechanical • Equipment maintenance • Systems analysis and evaluation • Critical thinking • Production and processing • Computer and electronics • Mathematical • Operations monitoring • Communications skills • Battery knowledge
Transportation equipment manufacturing (336)	• Absence of internal combustion engine • Power electronic components result in different assembly processes and machinery, automation and controls • Fewer components	• Software developers and engineers • Battery management system engineers • Plant supervisors • New hybrid roles between millwright and general operator	• Production and processing • Critical thinking • Communication skills • Mechanical • Computer and electronics • Systems knowledge • Battery knowledge

What will be required of the workforce to learn these new skills?

As workers, employers, and employment stakeholders consider what is needed to help workers learn new skills, a few key points will be important to remember:

There is a greater need for upskilling within the workforce than full retraining.

Stakeholders believe that existing workers in the auto sector will largely need to upskill (acquire new knowledge or skill sets on top of existing skills) rather than reskill or fully retrain (change existing skill sets) to fill emerging roles.[11] Many stakeholders even say that upskilling for many occupations could be completed in as little as one to four weeks.

A broad knowledge base, alongside technical and cognitive skills, is vital across the ZEV sub-sectors.

The top knowledge elements that currently rank as fundamental across the sub-sectors are the English language, production and processing, and mathematics. The top skills that currently rank as fundamental are critical thinking, monitoring, and operations monitoring. This shows that non-technical skills will be the most in-demand across all industries, indicating a greater need for social and emotional skills training.

The aging demographic of automotive manufacturing is viewed as a challenge for the sector.

Almost two-thirds of surveyed respondents (62.5%) thought the aging and retiring workforce of the automotive manufacturing sub-sectors would be a driver of future skills and labour shortages.

A lack of sufficient training or upskilling opportunities for new or transitioning workers working in the ZEV supply chain is a major issue affecting workforce planning.

In a survey conducted for this research, two-thirds (66.7%) of surveyed respondents identified a "lack of appropriate education and training options" for students and recent graduates as a main reason for expected future skills shortages. More than half (58.3%) of respondents also identified "a lack of reskilling and retraining options for current workers" as another challenge. Both challenges point to the importance of updating existing curricula for degree and diploma programs, as well as developing new programming for emerging roles.

Box 1

Who makes up Ontario's automotive workforce?

According to the 2021 census, 78% of Ontario's automotive sector workforce is men.[12] Compared to other sectors (22.3%), older workers (aged 55 or older) make up a much higher share of workers (26.5%). Youth (aged 15-24) make up only 10.5% of employees within the automotive manufacturing sector.[13] The sector is dominated by full-time employment, with 98.5% of workers in full-time roles.[14] Within Ontario, over 93% of workers in the automotive sector are concentrated in five regions: Toronto (29.7%), Kitchener–Waterloo–Barrie (24.2%), Windsor–Sarnia (15.8%), London (12.7%), and Hamilton–Niagara Peninsula (11%).[15] At the time of writing, researchers could not find any publicly available information on the ethnic make-up of the automotive sector workforce in Ontario nor data on average educational attainment for workers within the supply chain. Additionally, these individuals work in key occupations throughout the supply chain for both ICEVs and ZEVs. Many of the occupations are skilled trades, and special focus is given in this report to challenges facing skilled trades professionals. Table 2 details the occupations within Ontario with the highest overall employment in the automotive supply chain to provide a sense of the current composition of the automotive workforce.

Table 2: Occupation (NOC Title), Total number of Ontario (ON) workers employed in the occupation[16]

Occupation	Total employment (ON)
Material handlers (manual)	85,630
Motor vehicle assemblers	49,345
Software engineers and designers	47,365
Shippers and receivers	40,550
Manufacturing managers	30,740
Welders	26,090
Sales and account representatives — wholesale trade (non-technical)	25,930
Mechanical engineers	23,075
Construction millwrights and industrial mechanics	22,400
Machinists	13,560
Supervisors, supply chain, tracking and scheduling co-ordination occupations	11,955
Industrial engineering and manufacturing technologists	8,040
Industrial electricians	7,635
Tool and die makers	7,260

Occupation	Total employment (ON)
Industrial and manufacturing engineers	7,060
Supervisors, motor vehicle assembling	6,890
Mixing machine operators — plastics processing	6,350
Electronics assemblers	5,450
Metalworking machine operators	5,095
Labourers in metal fabrication	4,475
Mechanical assemblers	3,875
Labourers in rubber and plastic products manufacturing	3,145
Plastic products assemblers and finishers	2,210
Machine operators, mineral and metal processing	2,120
Supervisors, plastic and rubber products manufacturing	1,635
Other metal products machine operators	1,220
Supervisors, other mechanical and metal products manufacturing	1,015

What challenges need to be overcome to help workers in the sector undertake the training and education they will need?

In navigating the changes in skills and knowledge needs, workers will likely need to seek additional training or education. Even if the scale of training required is quite manageable for most workers, the system supporting current training and education system for the sector will make this process more challenging, costly, and stressful than it needs to be. For workers, delays and inefficiencies have real costs. A young person seeking an apprenticeship may lose weeks of wages while they wait for delays in processing certifications and licenses. A mid-career immigrant may need to spend their savings to pay their bills and work for years in 'survival jobs' while waiting to have their international credentials and experience recognized. An experienced professional who already possesses 75% of the skills needed to work in roles in the clean economy supply chain may not see training or education programs developed specifically for workers like them and wrongly conclude this industry shift will cost them their jobs.

While these challenges are felt by workers, their impacts are also borne by stakeholders. This can be seen throughout the automotive sector, in everything from job vacancies in the automotive manufacturing sector, which limit employers' ability to meet demands or stay competitive, to employer complaints about the skills and quality of their new or recent graduate applicants and hires. Following the announcements of incoming ZEV and electric battery plants, there is a vital need to better prepare post-secondary instutitions, union members, students, and community support organizations to respond to these plants' upcoming labour needs. Tackling the biggest challenges within this system should be the priority of governments and stakeholders in Ontario, given the volume of change that is expected in a sector currently employing over 130,000 workers.[17]

What challenges are faced by younger workers (aged 15-24)?

- Younger workers have negative perceptions of the sector, as careers within the space are perceived as involving repetitive manual labour, low levels of economic security, and potentially even physical danger. While this is not aligned with current realities in the sector, it is informed by advice received from family members who have been adversely impacted by layoffs in previous economic cycles.
- Lack of exposure to skilled trades education is reducing interest in working in the sector. This is exacerbated by years of reduced investment in technical education from provincial governments, as well as a de-emphasizing of technical programming at the high school level. Despite recent efforts to address the issue (including the re-introduction of a mandatory technological education credit to graduate from Ontario high schools), this perception abounds.
- A lack of gender diversity in the sector dissuades women from pursuing a career in the industry through a mix of subliminal messaging, cultural and workplace norms, and a lack of flexibility offered to working mothers.
- Insufficient settlement and support services for international students prevent those who wish to stay and work in Canada from learning critical fundamentals around workplace cultural norms. Companies also continue to place an emphasis on having Canadian work experience, which many international students do not have.

What challenges are faced by mid-career workers (aged 25-59)?

- Terms of employment (responsibilities and benefits that come with a job, including salary, benefits, and accountabilities) are not always friendly to all workers. Working mothers, for example, report that balancing shift schedules with childcare responsibilities is difficult enough that they often leave the sector.
- Wages provided by small and mid-sized enterprises (SMEs) are also not typically as high as wages offered by larger manufacturers. This frequently causes workers to shift towards larger employers that offer benefits negotiated by unions, such as higher wages, additional paid holidays, and more frequent cost-of-living adjustments.
- Newcomers to Canada with foreign skilled trades experience face high barriers to entry through existing immigration programs, which limits the number of skilled trades professionals that emigrate. Since its inception in 2013, the Federal Skilled Trades Program (FSTP), an immigration program dedicated to skilled trades workers, has never reached its maximum capacity. This is largely attributed to the time it takes to enter the workforce through the program, which is so long that many immigrants simply come to Canada as international students instead.
- Policies that help overcome the barriers faced by different groups (such as women and economic immigrants) in working in the automotive sector are frequently not aligned with the challenges they face. This is largely because policymakers do not currently collect data on hiring and retention rates for different groups. This lack of information leads to policies that are frequently based on assumptions and anecdotes, meaning they then fail to tackle the challenges these groups face.
- Insufficient settlement and integration services to help newcomers, their families, and employers who hire immigrant workers imposes costs on all parties. Workers often cannot find support to learn local languages or business norms, and companies are often asked to pay for services they cannot afford (such as corporate housing or making transportation options available for staff).

- Many employers do not invest in corporate training for fear of workers being poached by other companies. In some cases, even if employers are willing to pay for it, they are not willing to compensate workers for time taken off to retrain, which creates a disincentive for workers to pursue the training needed to remain employed in a changing sector.

What challenges are faced by older workers (aged 60+)?

- The primary justification for wanting to keep aging adults in the workforce is to alleviate the pressures faced by employers and younger employees. However, it is unclear if steps are being taken to alleviate some of the challenges and discrimination aging adults often face in manufacturing roles. Older workers endure greater difficulties working with older or outdated equipment since it is more physically strenuous to operate and maintain.[18] They may also be subjected to stereotyping and discrimination (i.e., ageism) from colleagues, as well as changes in social status that feel like a degradation of accomplishment and responsibility.[19]
- Workers who have experienced layoffs or been part of a "labour adjustment" (an industry term for the management of voluntary or involuntary layoffs) may have a harder time reintegrating into the workforce due to social pressures, stereotypes, or the sense of disrespect and betrayal that an individual may feel after being laid off by a company they had been employed at for decades. This may make an aging adult less interested in remaining in the sector.
- Programs with evidence of high efficacy rates at finding new roles for older workers, such as Unifor's Action Centres (which report 80%–95% placement rates for laid-off individuals), face high bureaucratic hurdles to receive support and have limited capacity to help the volume of workers who ask for support once they are operational.

What challenges impact all workers, regardless of their age and career status?

- In 2022, Ontario's manufacturing sector had a lower average hourly wage ($30.83) than the overall average hourly wage ($32.94) across all industries for all workers (aged 15 and above). A 2019 report on wages from the Automotive Policy Research Centre identified that some production and skilled trades occupations' wages across NAICS 3361 (Motor vehicle manufacturing) and NAICS 3363 (Motor vehicle parts manufacturing) were "…not keeping pace with wages in other sectors such as construction or utilities" and that wages were lower in parts production than in assembly.[20] Lower-than-average wages may dissuade younger workers from joining the sector in the first place. In the middle of their careers, workers may seek to upskill or change occupations to pursue higher-wage roles, especially as they may have bigger family responsibilities relative to earlier stages. For older workers, lower-than-expected wages may prompt earlier retirement decisions, such as reducing their work hours or leaving the workforce entirely.
- Information asymmetry between employers, workers, and students impacts everyone. This refers to the dearth or uncertainty of information about what various stakeholders need to do to better prepare and equip workers for the ZEV transition. Information asymmetry is felt most clearly around new investments that are set to create thousands of jobs. This issue affects workers early in their careers when their training institutions are unsure of what potential employers (original equipment manufacturers, parts manufacturers, etc.) will want to see in their new graduates and are thus unsure how best to curate the curriculum so that the students' skills and knowledge are not outdated or deemed insufficient in the labour market. In the middle of their careers, a lack of information makes it difficult for workers to know what to upskill or reskill in, especially if they seek roles in new facilities. Stakeholders stressed this tension was felt particularly amongst union workers in this phase of their career looking to upskill and improve their candidacy before interviewing for roles at new facilities, which the incoming Windsor battery manufacturing facility (i.e. NextStar Energy Inc.)[21] has already pledged to allow union members to do. Meanwhile, a lack of information may cause older workers to struggle to see how their current skill sets could be valued in the market, leading them to leave the workforce early and deprive younger workers of their expertise and mentorship.

What is needed from governments and employers to address these challenges?

To tackle information symmetry, the federal government should:

- **Strengthen the mandates of the Canadian Automotive Partnership Council (CAPC) to address uncertainty about future skills training needs and tackle sectoral talent shortages.** This would allow for a more responsive and collaborative automotive workforce development system that goes beyond securing investments. It would begin sharing skills requirements, best practices, and resources, as well as informing education and training programs amongst automotive manufacturers/suppliers, workers, government, and educators.
- **Ensure new facilities that receive government support also come with mandates for participation in CAPC.** This specifically targets automotive investments that receive government support and are above a certain threshold (i.e., expected to directly employ over 250 people). This will allow for more coordinated skills and education approaches so best practices can be standardized across the sector.

To lower barriers to entry in the sector faced by women and economic immigrants, the federal government should:

- **Make international students eligible for the Student Work Placement Program to help international students get sector-relevant Canadian work experience and address employer concerns.** This program offers funding to SMEs to hire co-op students and interns. Currently, international students are ineligible to receive funding, which limits their ability to get Canadian work experience while studying and reduces the likelihood they will remain in Canada after graduation.
- **Adjust proof of funds requirements for international students applying to skilled trades programs in order to make pursuing a technical education in Canada more attractive to prospective applicants, and fund post-secondary institutions (PSIs) to administer settlement services for international students.** When applying to Canadian educational programs, prospective students have to illustrate "proof of funds" within their application to prove they have sufficient funding to support themselves while studying. To make skilled trades more attractive, proof of funds requirements for skilled trades students should remain fixed (as requirements for university applicants increase over time). Additionally, more settlement services for international students should be administered by PSIs, instead of community non-profits, given students' familiarity with their institutions and institutions' greater familiarity with their students' needs.
- **Amend the application process for the FSTP to allow the two current phases of applying (applying to determine eligibility for the qualification exam and sitting for the exam to determine receipt of certificate of qualification) to be merged into one step.** This would reduce the time and uncertainty associated with this immigration stream, which has never reached its annual maximum intake capacity since its inception in 2013.

To support a more diverse and inclusive automotive sector, the Government of Ontario should:

- **Give mandates to local workforce planning boards to work with employers to proactively identify and support candidates from underserved and equity-deserving communities.** To accomplish this, workforce planning boards should work with employment service providers, PSIs, and community groups to identify skilled professionals from equity-deserving communities, ensure job ads are shared with these groups, and connect with employers to ensure these candidates are fairly considered.
- **Lower the costs (monetary and time) associated with having international credentials and experience recognized for foreign workers looking to find roles in the automotive sector.** Ontario has some of the highest costs in Canada for licensing assessments in a range of credentialed occupations, and steps should be taken to more closely align with the monetary and time costs applicants face in other provinces.

To support the growth and retention of skilled trades workers, the Government of Ontario should:

- **Allow Provincial Adjustment Advisory Programs to fund community-level adjustment programs, which would allow programs like Unifor's Action Centres to engage with a wider array of workers impacted by the ZEV transition.** This would change the model away from the Action Centres being created for facility-specific layoffs, which is essential given levels of disruption are expected to increase in the years to come, and allow supports to be given to a wider array of individuals impacted by the transition. This could increase the likelihood that skilled workers in the automotive supply chain impacted by layoffs find roles in the ZEV supply chain.
- **Create financial incentives for retiring tradespeople to return to colleges as instructors to ensure they can supervise/pass on knowledge to new students.** This would allow students to benefit from the experience and wisdom of older professionals, help PSIs hire additional workers, and offer additional income and opportunities for workers looking to exit the workforce.

To help support training and education efforts:

- **PSIs who are already responsible for educating workers through the ZEV supply chain should develop short-term, targeted micro-credentials to support upskilling efforts for mid-career professionals, in partnership with employers.** This pathway will be appropriate for many occupations, but not all. In some cases, such as with skilled tradespeople in Red Seal trades, expanding the scopes of practice would be a path to upskilling that better leverages existing knowledge, relationships, and resources. In this case, training would be led by a skilled trades group and not by PSIs. This points to the need for a suite of approaches depending on what will fit best for a given occupation.

Conclusion

In order for communities and workers to prosper amidst the transition from ICEVs to ZEVs, Ontario and Canada as a whole must continue to act boldly on regional investments and advance the ZEV and battery manufacturing sectors. The growth of this sector presents opportunities for the revival of the automotive industry, providing good, high-quality careers for communities that support local economies. For some areas where rapid sectoral evolution and demand for higher-skilled workers are expected to be significant, collaborative support from government, industry, and educational institutions will be needed to ensure that workers are prepared by tackling the challenges identified in this report. A multi-faceted focus on talent — sourcing new entrants and upskilling and retraining existing workers — will enable the province's ZEV and battery manufacturing sector to foster a thriving automotive industry while moving towards a net-zero emissions future for the sector, region, and country.

For additional details and discussion on any of the ideas, analysis or recommendations presented in this summary for policymakers, please read Smart Prosperity Institute's two reports *Shifting gears: How Ontario's push to manufacturing zero-emissions vehicles will impact the workforce,* and *Future proofing the automotive workforce: Supporting Ontario's auto sector workers through the ZEV transition.*

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