FOCAL Initiative

ICEV TO EV WORKFORCE TRANSITION LABOUR MARKET FORECAST

ONTARIO REPORT

MARCH 2024

About the FOCAL Initiative

The Future of Canadian Automotive Labourforce (FOCAL) Initiative, funded by the Government of Canada, is a collaboration of the Canadian Skills Training and Employment Coalition (CSTEC), the Automotive Policy Research Centre (APRC) and Prism Economics and Analysis.

The FOCAL Initiative has produced labour market information and data related to Canada's automotive manufacturing sector, examined key trends affecting the automotive labour market, and produced forecasts of supply and demand for key occupations in the broader automotive sector.

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Executive Summary

Ontario is in early stages of a transition towards decarbonization that will have a significant impact on the automotive manufacturing sector. Production processes and supply chains have already begun to shift their focus from internal combustion engine vehicles (ICEVs) to electric vehicles (EVs).

Occupation impacts are influenced by the characteristics and timing of the transition. For some occupations (such as electronics assemblers), the number of needed workers and the tasks that they perform is very closely tied to the type of vehicle being produced. Those occupations will be significantly impacted by the ICEV-EV transition. Other occupations (such as computer network technicians) may experience relatively moderate or little impact if the tasks that they perform are not associated with the type of vehicle produced. Therefore, it is important to examine occupation-level impacts so that industries can ensure that they have the right number of workers with the right skills throughout the transition.

This report explores the labour market impact of the ICEV-EV transition in Ontario for 69 occupations in 49 industries, across a forecast horizon from 2025 to 2040. The term '*recruitment gap*' is the primary indicator of occupation-level impacts in this report. The recruitment gap is a measure that captures labour market supply and demand dynamics that evolve during the forecast period. Because occupational demand is contingent on the number and type of vehicles being produced, a specific base case production scenario was defined as the context for the analysis. Demographic trends (which influence the entrance of young workers and exit of older workers from the labour force) and immigration were also incorporated into the analysis.

Results of the analysis indicate that several occupations are expected to experience significant impacts during the transition. The magnitude and timing of impacts are unique for each occupation. For example, at the provincial level a large recruitment gap is expected to occur *consistently* for occupations such as engineering managers, tool and die makers, and shippers and receivers. Large recruitment gaps are expected to occur towards the *beginning* of the forecast horizon and gradually dissipate for occupations such as industrial electricians, electronics/electrical product manufacturing supervisors, and electrical/electronics engineering technologists and technicians. Recruitment gaps are expected to peak in the *middle* of the transition period for occupations such as motor vehicle assemblers and motor vehicle assembler supervisors. In other words, employers throughout the supply chain will face recruitment pressures that are occupationally specific and timed to different phases of the ICEV-EV transition. This report describes occupational impacts for Ontario. However, results will be different at

regional levels because of industrial characteristics and labour market supply-demand dynamics unique to those areas. Readers are encouraged to review national, provincial, and regional occupational forecast reports, along with other related publications that have been produced as part of the FOCAL II initiative.

Introduction

FOCAL I reports (published in 2022) highlighted the crucial role of a broader automotive industry across Canada. As work concluded, it became clear that the emerging transition from internal combustion engine vehicles (ICEV) to electric vehicles (EV) was a new challenge facing the industry. The FOCAL II initiative is helping employers and job seekers manage the transition from (ICEV) to (EV). Assistance includes direct action through wage and training subsidies, and guidance in critical areas like skills transferability, diversity, immigration and apprenticeship. This support is augmented by FOCAL's analysis of the impact of new investments in EVs and the loss of ICEV-related production. The focus is on manufacturing industries, including vehicle assembly, parts production, battery supply and related changes across the supply chain. This process provides measures of changing labour market conditions for industries and occupations. FOCAL II assesses these impacts in three steps.

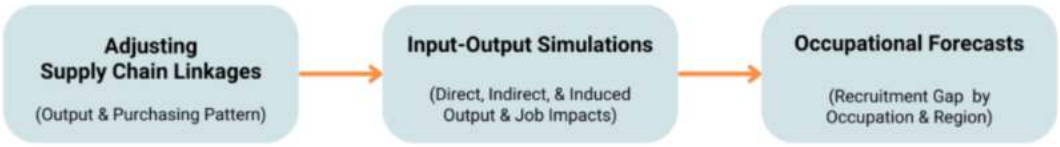
First, the EV Model estimates impacts of announced plans and expected investments and calculates new levels of production and related links across the supply chain. The analysis allocates these direct, initial impacts across;

- a transition horizon from 2025 to 2040
- 49 selected NAICS industries in
- Canada, Ontario, Quebec, Manitoba and seven regions.

Second, the direct impacts of new EV facilities are extended into the broader economy to estimate indirect impacts across all supplying industries and induced impacts related to changes in employment and incomes. This second step uses an expanded input-output capability that captures changes in the distribution of purchases across the supply chain and new patterns of local and external supply.

Third, the full range of impacts on employment are translated into labour market impacts that track changes in recruiting and job search conditions. This report describes these final, labour market impacts across 68 key occupations for Canada. Figure 1 illustrates this three-step process.

Figure 1. Impact analysis steps



Impacts of the transition are sensitive to changes in many factors. These include consumer acceptance of EVs, the timing and scale of investment in new production facilities, emerging economies of scale and technological advances that reduce vehicle and component costs, government policy, and success in Canada securing EV production mandates. Three scenarios

have been created, with each reflecting a different set of outcomes for each of these factors. The scenarios are described fully in the FOCAL II report titled '*The Shift to EV Production in Canada's Automotive Manufacturing Sector: Assessing the Economic and Labour Market Impacts'*. A variation of these scenarios is summarized in a base case scenario that is used for the labour market impact model.

The base case scenario describes an ICEV-EV transition that will comprise both job gains and losses, changes in employment conditions, and related labour market disruptions for selected industries and occupations. Direct impacts spread out from vehicle assembly, parts producers specialized in combustion engines and transmissions and electronic parts, battery assembly, related chemical and mineral processes and, under certain assumptions, mining. Impacts are most disruptive in regions experiencing either new investments in battery plant production or losses as internal combustion engines are phased out. These impacts create a variety of changes, with large and pronounced effects nationally in some occupations (examples are described in Section 4 of this report) and more limited impacts across other occupations (impacts for all selected occupations are described in detail in Appendix D)[1].

This introduction is followed by a profile of employment for Ontario that comprises the traditional automotive industry (including assembly and parts manufacturing) and extends it to emerging industries in the production and supply chain for EVs. Section 3 describes impacts across the ICEV-EV transition in key industries. Section 4 reports detailed impacts across 20 selected occupations. Conclusions and implications are a reviewed in the final section. A description of the base case scenario, a list of the industries and occupations selected for the analysis, the methodology applied in the labour market models, and tables of detailed impacts for the occupations are located in Appendices.

[1] Occupation impacts vary by province and region, due to differences in industrial characteristics and other labour market supply/demand dynamics unique to those areas. See provincial and regional reports for details.

The ICEV-EV Transition – Background

The coming transition from ICEVs to EVs is a major change for the Ontario economy. In 2022, the provincial workforce of 7,197,600 included 694,900 working in manufacturing and 100,200 in the core automotive assembly and parts industries[2]. Motor vehicle assembly and related activity are critical to the overall well-being of the Ontario economy. For example, assembled motor vehicles and parts are consistently among the top two or three exports from Canada, often second only to oil and gas extraction[3].

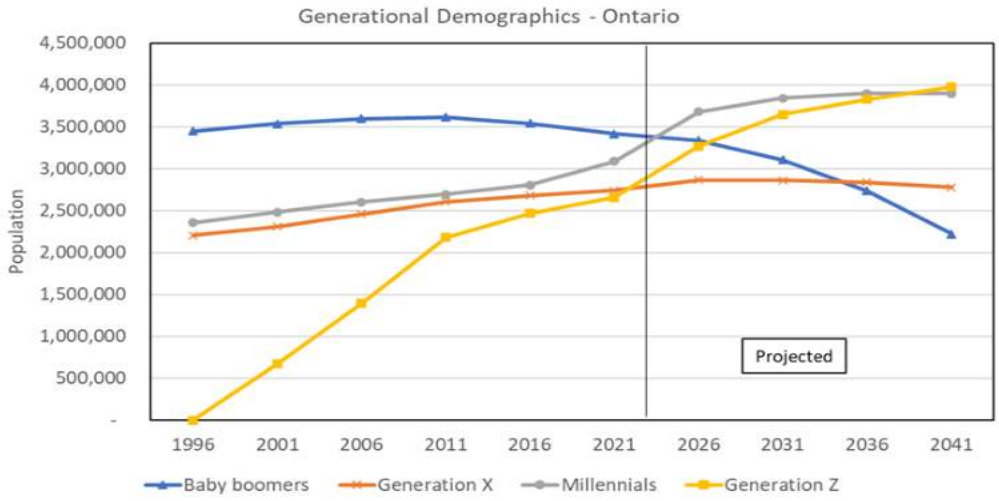
Relative to other industries, employers in manufacturing often identify human resources, skills shortages and recruiting as a major challenge in business development. According to Statistics Canada:

> "Businesses in manufacturing were the most likely to expect challenges recruiting staff and these levels have remained unchanged when compared to 2022. In the second quarter of 2023, nearly half (48.4%) of businesses in manufacturing expected recruiting skilled employees to be an obstacle, compared with 47.4% in the second quarter of 2022"[4].

Demographic change has contributed to recruitment challenges in recent years, as the population of Baby Boomers (born between 1946 and 1965) retires. The 2021 Census tracked an increase of 5.8% in the total population of Ontario and 4.3% in the working age population between 15 and 69 compared to 2016. However, the composition of the workforce has been shifting. Baby Boomers now represent a decreasing proportion of the population and immigration, while younger generations increase in relative size. For example, between 2016 and 2021, the proportion of Millennials (born between 1981 and 1996) increased by 10.1% in Ontario while the proportion of Baby Boomers decreased by 3.6%. As shown in Figure 2, it is expected that Millennials will outnumber Baby Boomers in Ontario before 2026 and Generation Z (born between 1997 and 2012) will outnumber Baby Boomers before 2031. [5]

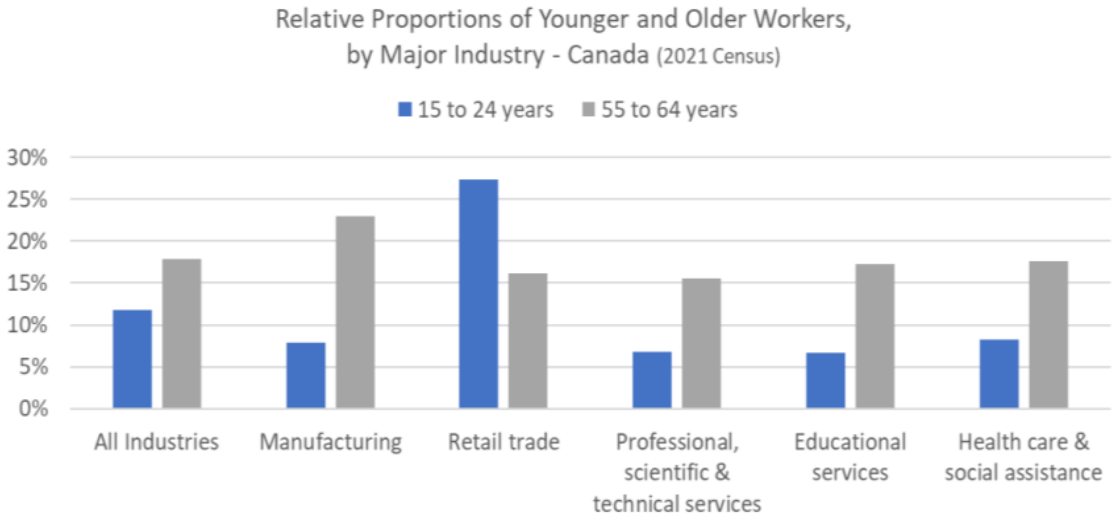
[2] Source: Statistics Canada. Table 36-10-0489-01 Labour statistics consistent with the System of National Accounts (SNA), by job category and industry
[3] Source: Government of Canada Trade Data Online (https://ised-isde.canada.ca/site/trade-data-online/en).
[4] Source: 'Analysis on labour challenges in Canada, second quarter of 2023' https://www150.statcan.gc.ca/n1/pub/11-621-m/11-621-m2023009-eng.htm
[5] Sources: Statistics Canada 1996 to 2021 Census (historical data); Table 17-10-0057-01 Projected population, by projection scenario, age and sex, as of July 1 (x 1,000) (projected data, M1 scenario)

Figure 2. Changing demographics in Ontario (Source: Statistics Canada)



Demographic trends are not consistent across industries, however. In the manufacturing sector, there continues to be a higher proportion of older workers and a lower proportion of younger workers. As shown in Figure 3 (below), of the five largest industry sectors in Ontario, the manufacturing sector has the highest proportion of employees in the 55 to 64 age group. Thus, the number and proportion of Baby Boomers transitioning out of the labour force in other industries is significantly lower than in the manufacturing sector and recruitment challenges related to the retirement of older workers will persist.

Figure 3. Proportions of older and younger workers in major Ontario industries (Source: 2021 Census)



Research in FOCAL I made the case for defining a broader automotive sector that adds key industries in the manufacturing and technology supply chain to the traditional grouping of assembly and parts manufacturing. Defined traditionally (i.e. NAICS 3361 Motor vehicle

manufacturing and 3363 Motor vehicle parts manufacturing), automotive employment in Ontario grew from 79,400 workers in 2009 to 102,400 workers in 2019. Employment decreased by 14% from 2019 to 2020, primarily due to COVID shutdowns in Ontario and elsewhere[6]. The core automotive workforce continues to recover to pre-COVID levels.

Over 98% of national employment in vehicle and parts manufacturing is concentrated in three provinces: Ontario (representing 89% of total national employment in these two industries), Quebec (with approximately 7% of national employment), and Manitoba (with slightly more than 2% of national employment)[7]. Less than 2% of the Ontario activity is concentrated in the Eastern Ontario region and this is mostly in the parts and related industries.

Table 1 tracks the distribution of the selected industries included in the emerging automotive workforce. In this FOCAL II analysis, the broader automotive industry is defined to include specific new industries joining the automotive supply chain for EV production. This includes battery manufacturing, chemicals, material processing and mining. These numbers serve as a starting point for measuring employment impacts.

Table 1. 2022 Employment in Ontario's broader automotive sector (Source: Statistics Canada, APRC)

Industry	Employment in 2022
Automobile and light-duty motor vehicle manufacturing	31,900
Heavy-duty truck manufacturing	200
Parts manufacturing	62,500
Mining	5,000
Basic chemical manufacturing	4,800
Other material processing	15,200
Battery manufacturing	7,200
Management, scientific and technical consulting services	70,000
Plastic product manufacturing	44,600
Other electronic product manufacturing	10,800
Semiconductor and other electronic component manufacturing	9,900
Iron and steel mills and ferro-alloy manufacturing	13,000

[6] Source: Statistics Canada. Table 36-10-0489-01 Labour statistics consistent with the System of National Accounts (SNA), by job category and industry

[7] Ibid. This estimate is calculated using the aggregation of NAICS 3361 (motor vehicle parts manufacturing) and 3363 (motor vehicle parts manufacturing).

Industry	Employment in 2022
Foundries	4,000
Forging and stamping	2,600
Other automotive supply chain	571,700

The ICEV to EV transition will shift employment among the industries in the broader automotive sector. The traditional leading economic role for these industries is clearly at risk as Canada must now compete for its place in the new world of EV production. Attention is focused on the crucial role of batteries in the new EVs and Ontario has been active and successful in the global competition for battery production. FOCAL II research tracks the likely path of the transition across industries and occupations as supply chains are redefined for EVs.

Table 1 tracks employment across 49 selected industries. These comprise the core assembly and parts producers, and include additional upstream industries (e.g., relating to battery production) in the evolving supply chain. A list of the specified industries featured in the labour market impact analysis, identified as the most important players in the EV transition, are found in Appendix A. The major investments driving the transition have been documented in the media. Vehicle assemblers, parts manufacturers and new battery plants have announced plans for expansion in Canada. These investments include;

- new battery plants,
- commitments to transform existing assembly plants to accommodate high volume EV assembly,
- new production facilities to supply battery plants with specialized components including;
    - anode, cathode, specialized metal processes,
    - mining and mineral processing for speciality rare metals.

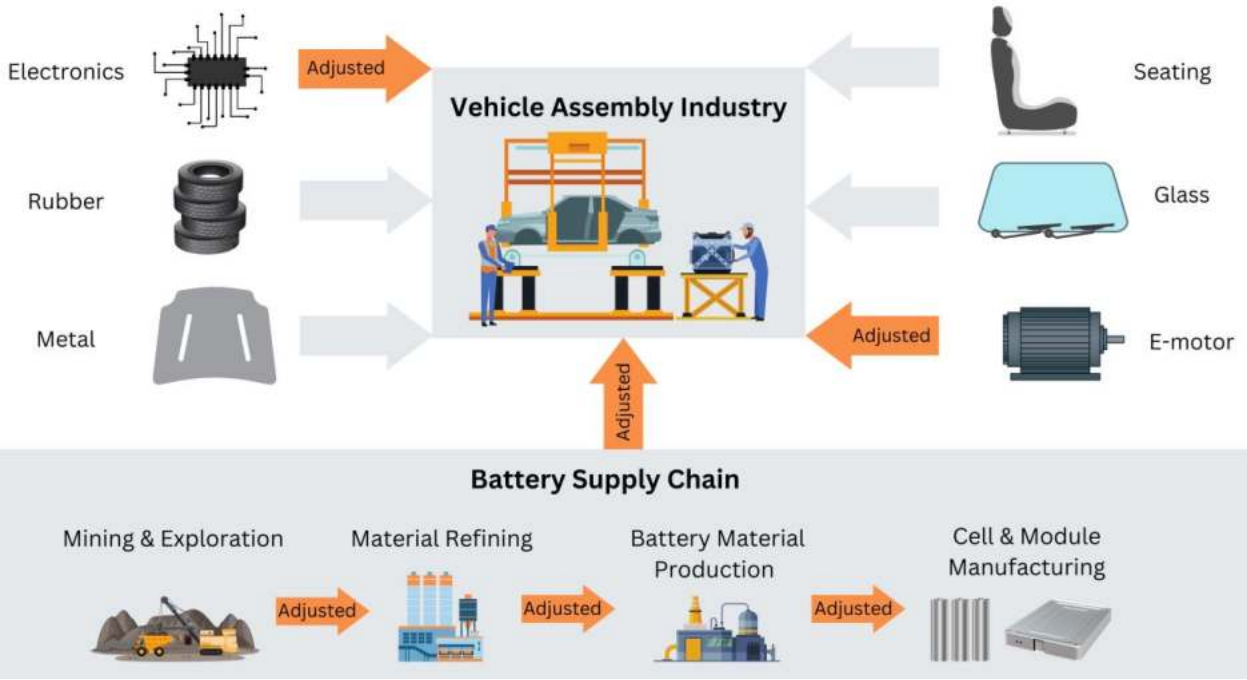
These investments are concentrated in regions across Ontario but also include new and expanded facilities in Quebec and Manitoba. FOCAL II research transforms these plans into specific changes to the current supply chain including the impact on production by industries and timing of the changes across a transition from 2025 to 2040.

Industry Impacts Across the ICEV - EV Transition

This section extends the initial analysis of announced investment and assembly plans to include the broader impact of these changes across the vehicle supply chain and then the overall Ontario economy.

Findings are calculated from the Statistics Canada Interprovincial Symmetric Input-Output table. Input Output tables are standard tools, for Canada and the Provinces, that track the transactions that connect industries and their customers. These tables are the best sources available to analyze the chain of transactions that link motor vehicle assembly to suppliers and to customers. The FOCAL II analysis customized the Ontario IO tables by replacing ICEV supply chains with estimates of new EV supply chains, including the addition of the new battery production facility and related investments in new chemical, mineral and mining production capabilities.[8] Figure 4 illustrates the changes introduced by FOCAL II at this stage of the analysis.

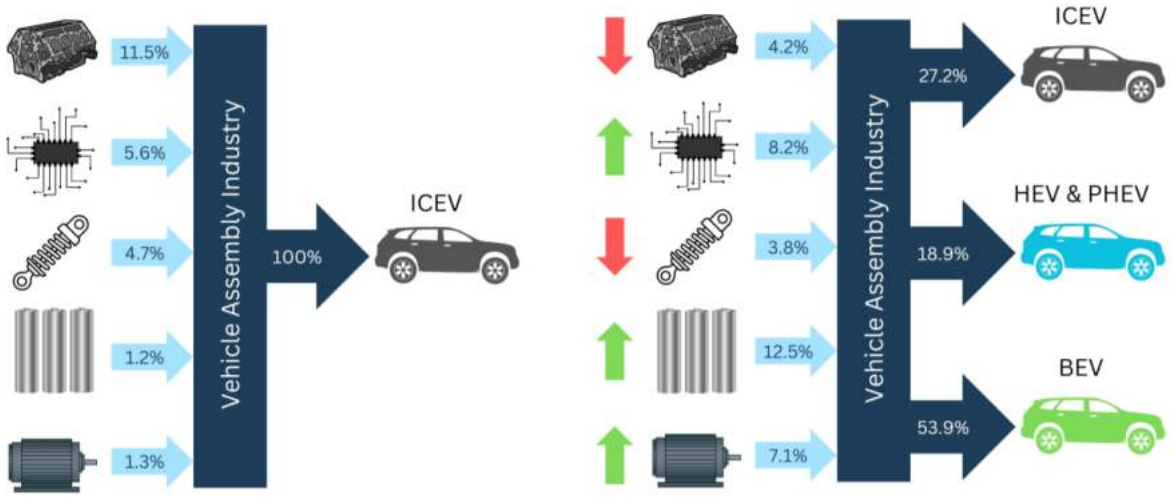
Figure 4. Adjusting automotive and battery manufacturing supply chain linkages for the impact analysis



[8] See Introduction section and Appendix C for more detailed information about the methodology used in the FOCAL II analysis.

Figure 5 provides an example of the changes that are imposed based on analysis of the core industry links from parts manufacturers to assembly. Changes in the distribution of inputs into vehicle assembly, seen in the diagram, capture changes between 2019 and 2030 from the base case scenario.

Figure 5. Vehicle assembly industry supply inputs



Results are reported at three levels of impact. First, d*irect impacts* are the initial change introduced by new levels of vehicle assembly by type, new battery plants and related outputs. Second, the IO system calculates *indirect impacts* that reflect changes in output and sales in response to direct impacts. For example, parts manufacturers, chemical and mineral processing suppliers will alter sales to meet the requirements of battery production. Third, *induced impacts* reflect how changing employment and incomes alter consumer purchases. Total impacts are the sum of direct, indirect and induced impacts.

Base Case Scenario

Direct impacts, which will determine the overall employment impacts, are introduced in the analysis across the transition period from 2025 to 2040 and in specific categories;

- Internal combustion
- Hybrid
- Plug in hybrid
- Battery electric

New battery plants operating, by;

- Plant capacity and suppliers;

The battery supply chain, consisting of;

- Cathode and anode suppliers
- Material filtering and processing
- Mining

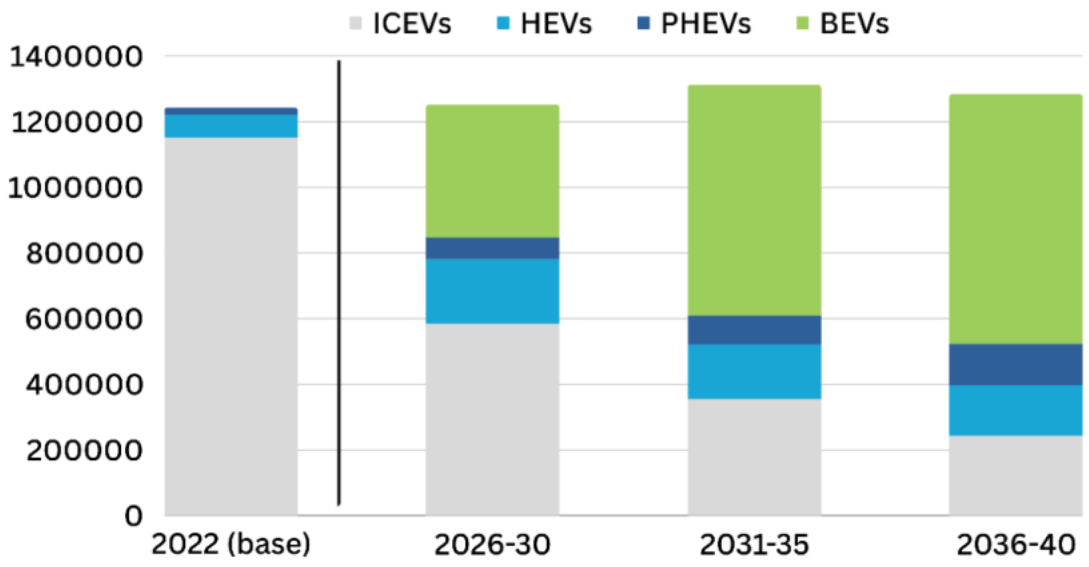
A base case scenario has been developed that combines key assumptions across these categories. The magnitude and timing of these assumptions are expressed in terms of total employment impacts by industry, which are then transformed into detailed occupational impacts.

Base Case Scenario Assumptions

The base case scenario assumes a specific path in the transition from ICEVs to EVs. At the start of the transition, vehicle production is overwhelmingly ICEVs with a relatively small number of EVs. By the end of the transition, in 2040, the production mix inverts so that 60% of vehicles produced are EVs. For the impact analysis, the overall transition is divided into intervals. The relative mix of ICEVs and EVs change from one interval to the next. Occupational impacts evolve accordingly.

Figure 6 illustrates the transition in national vehicle production, expressed in units produced. The first column illustrates the production mix at the start of the transition.

Figure 6. Base case scenario – estimated vehicle production, by type of vehicle (Canada)



Note that the number of vehicles assembled across the transition to 2040 stays roughly constant between 1.2 and 1.3 million. Further, the base case scenario reflects a slow pace of adoption of EVs in the market, with BEV production increasing from less than 1% of total vehicle production in 2022 to nearly 60% by 2040. This relatively low assembly level and slow acceptance of BEVs limits employment impacts relative to the 2022 base. This, in turn, limits the indirect impacts originating from assembly.

The base case scenario assumes that four new battery production facilities will be operating in Canada by 2040. The employment impact analysis assumed that these plants will be operating at less than full capacity and accessing one third of needed cathode, anode, mineral and other battery supply chain inputs from Canadian suppliers (see Table 2).

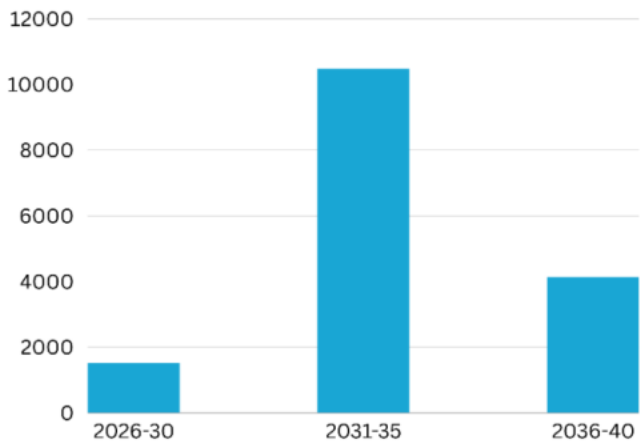
Table 2. Base case scenario - battery supply chain assumptions

Battery Production & Supply Chain	Assumptions
Battery manufacturing (4 plants)	100 GWh
Cathode & anode manufacturing	32.5 %
Material filtering & processing	32.5 %
Mining	32.5 %

Ontario Impacts Across Industries

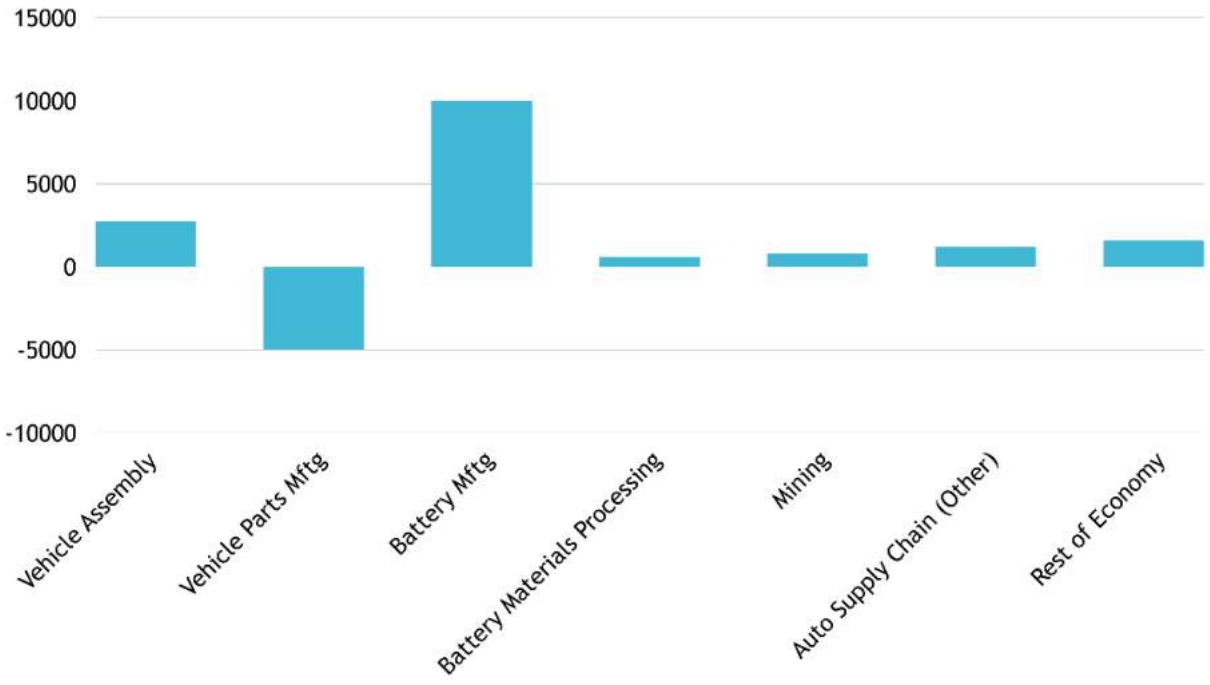
Figure 7 summarizes the total employment impacts in the base case scenario in three intervals of the transition. The total impact is positive, with gains in each of the three five-year intervals, as new activity in battery production and its supply are large enough to offset employment losses related to declining activity in gasoline engine and related production. Initial job gains are limited due to declining assembly and a lag in new battery startups. Impacts peak at 10,500 jobs in the 2031 to 2035 period as battery operations ramp up.

Figure 7. Total impact of ICEV-EV transition on employment - all industries, Ontario



A summary of total Ontario employment impacts, across the transition from 2025 to 2040, by industry is shown in Figure 8. Note that positive impacts are distributed among the battery cell and module manufacturing plants and changes in assembly. The base scenario assumptions distribute limited gains in total vehicle assembly as well as the production mix changes through the transition period but the total number of vehicles assembled rises slowly to 2035 and then declines to 2040. The decline in parts industry production reflects a shift in activity out of the traditional parts production, e.g. internal combustion engines and related areas like transmissions. Electric vehicles will source a much smaller portion of inputs from the traditional parts manufacturers. Activity across the supply chain shifts to battery module, cells and their related suppliers. EV production is less labour intensive than ICEV production and this contributes to lower employment impacts in the last years of the transition.

Figure 8. Total impact of ICEV-EV transition (2025 to 2040) on employment by industry category, Ontario



In the next section, these province-wide industry changes are allocated to occupations in the Windsor-Sarnia region. Labour market impacts are then calculated.

Labour Market Impacts by Occupations

This section of the report describes the impacts of the ICEV – EV transition on labour markets for 20 occupations in Ontario. FOCAL II findings signal difficulties for recruiters and job seekers during the peak and trough periods as the transition unfolds from 2025 to 2040. Changing employment and market conditions, driven by change in the broader vehicle industry, are set against other key trends affecting the labour force available to meet demands. The largest supply-side trends are in Ontario's demographics and immigration.

Occupations that are concentrated in the broader automotive sector and in key regions participating in the transition face the biggest changes. Labour markets more distant from the investments, assembly plants, and key occupations engaged in other industries face more limited impacts. Twenty occupations from the selected industries (listed in Appendix A) are included in this section as the focus of the discussion.

Recruitment Gaps

FOCAL has created a "recruitment gap" measure for each occupation and regional market. Recruitment gaps are calculated annually for each occupation and region and summed across the transition intervals. High and rising recruitment gaps signal tight markets with skill and general labour shortages and lower gaps signal broader labour availability and more job search challenges. The recruitment gap (pictured below in Figure 9) is defined as expansion demand plus replacement demand less new entrants.

Figure 9. Recruitment gap components

Expansion demand is measured by the annual change in employment and these changes are determined by the impacts reported above. Change in expansion demand is primarily due to start up and growth in EV assembly activity, new battery production and related impacts across the supply chains. Expansion demand would be reduced by elimination of internal combustion engines and related supply chains. Economies of scale and evolving technology in EV assembly and battery technology will have a long-term impact lowering employment. In these and other ways, attributes and assumptions included in the base case scenario will effect impacts across occupations.

Replacement demand is the sum of exits from the workforce due to retirements and mortality. Demographic trends have created challenges for recruiting, especially related to Baby Boomers (born between 1946 and 1965) who have been retiring in increasing numbers for more than a decade. These changes have focused human resource management on issues like succession planning and skills training. The last of the Baby Boomers turn 65 in 2030, so the wave of retirements will fade across the last ten years of the transition. This suggests lower recruitment gaps in occupations as they shift to younger age profiles.

New entrants are individuals entering the workforce for the first time. This includes young graduates from education and training programs, and immigrants. Lower birth rates over many years have limited growth in Ontario's natural youth population from age 15 to 30 and this has limited the number of new entrants. It is important to note that these demographic effects are changing at the same time as the ICEV-EV transition.

The recruitment gap measure has been constructed to signal the overall effect of these changes across the transition as employment impacts are distributed among occupations. Future immigration patterns will play a large role in market conditions.

Impacts on Occupations

FOCAL II results identify 20 occupations in Ontario that experience notably large recruitment gaps at some point across the transition period. Results are measured as the sum the recruitment gap for each year over three separate intervals. The total recruitment gap is expressed in two ways. In the left panel of Figures 10 to 29, the recruitment gap for each time interval is displayed as the number of additional workers needed, above and beyond the 2022 base year employment. In the left panel of Figures 10 to 29, the recruitment gap for each time interval is expressed as the percentage difference in employment relative to the starting level of employment in 2022. In other words, the recruitment gap is not a forecast of total employment for each occupation - it is an estimate of *incremental* workers needed for an occupation, in addition to the current employment in that occupation in 2022.

Large recruitment gaps for an occupation (expressed as a headcount, or the number of additional workers needed) indicate the magnitude of the recruiting effort that will be needed. Recruitment gap percentages that approach 100%, for example, imply that the impact in an occupation may need to essentially double in size to meet operational demands. Large recruitment gaps, expressed as a percent of base year employment, suggest more acute recruiting pressures and potential skill shortages because the supply of workers will likely be insufficient to meet demand.

For occupations with older age profiles, recruitment gaps may be exacerbated by both expansion demand and replacement demand. For occupations with younger age profiles (implying low replacement demand), recruitment gaps may nevertheless appear if expansion demand is high. In other words, recruiting pressures may result from *high expansion demand* (for occupations that are in demand due to large impacts across the ICEV – EV transition), *high replacement demand*

(for occupations skewing towards older workers), and/or *low numbers of new entrants* into the occupation. Detailed results for each selected occupation are found in Appendix D.

These components of the recruitment gap manifest differently for each occupation and for each regional market. Components of the recruitment gap likely change during different stages of the transition period (e.g., as the Baby Boomers finish exiting the labour force, as battery plants are built and assembly plants re-tooled for EV production, and so on).

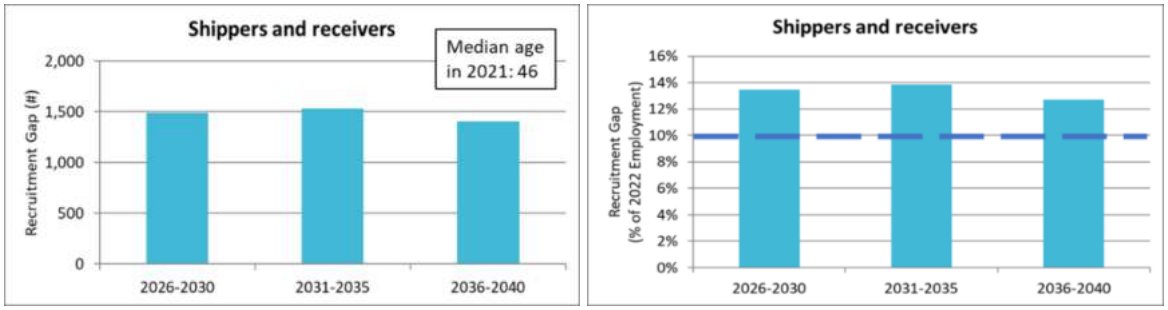
Selected Occupations

A review of the labour market impacts across Ontario reveals 20 occupations where gaps are large and linked to the ICEV – EV transition. Impacts for each occupation can be related to many factors. A profile of these circumstances reveals more specific recruiting challenges and job search opportunities.

To illustrate the distinctive pattern of recruitment gaps for the selected occupations, the right panel for each of the following figures contains a horizontal bar at 10%. This represents the recruitment gap for all of the selected occupations in the FOCAL II analysis across the transition.[9] This key reference point highlights both the total gap as a percent of base year employment and the distinctive peaks and troughs. There is also an box insert in the left panel indicating the median age for each occupation[10].

Shippers and receivers (Figure 10): Shippers and receivers are well represented in the battery industry and less prominently in assembly. This is a relatively large group and recruitment gaps are consistently high throughout the ICEV-EV transition. Workers in this occupation are somewhat older (with a median age of 46), compared to workers in all occupations (median age 43 years old) across all of the industries selected for this analysis.

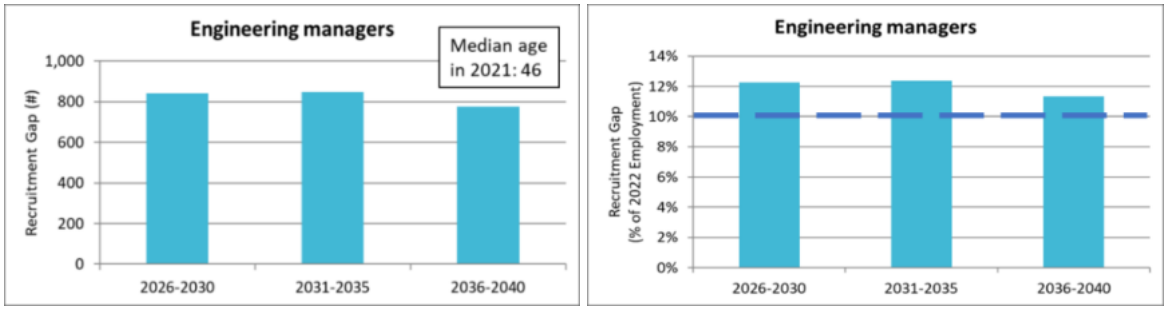
Figure 10. Recruitment gap - shippers and receivers



[9] See Appendix B for a complete list of occupations used in the analysis.
[10] Median ages are calculated using 2021 Census data for each occupation in selected industries (see Appendix A for list of industries). The median age for all occupations in the selected industries in Ontario is 43 years old in 2021.

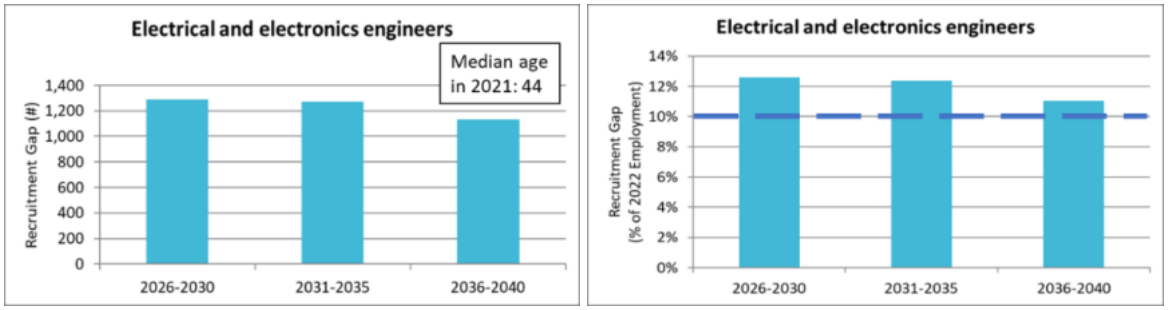
Engineering managers (Figure 11): This occupation is well represented in the battery industry and less so in assembly. Impacts will include both new jobs, losses in the ICEV supply chain, and adding new skills to managers moving into the EV-related production. Labour market tensions will start to ease at the end of the transition as retirement demands decline. Workers in this occupation are somewhat older (with a median age of 46), compared to workers in all occupations (median age 43 years old) across all of the industries selected for this analysis.

Figure 11. Recruitment gap – engineering managers



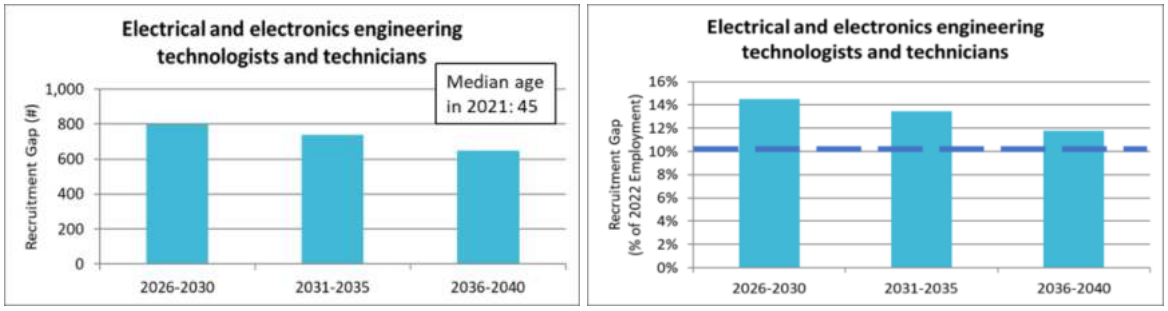
Electrical and electronics engineers (Figure 12): There is a notable shift within engineering occupations as electrical and electronics engineers increase their share of employment during the transition period. Expansion demand across the entire transition period is higher for electrical and electronic engineers that for any other engineering group (see Appendix D for detailed results). Electrical engineering is well represented in both the battery and assembly industries.

Figure 12. Recruitment gap – electrical and electronics engineers



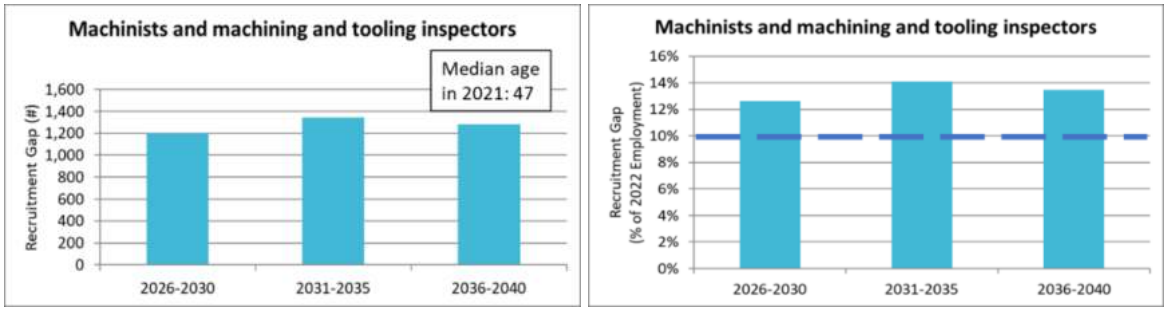
Electrical and electronics engineering technologists and technicians (Figure 13): The shift within engineering occupations, with electrical and electronics engineers increasing their share of employment, also appears for the technicians and technologists. (In contrast, data in Appendix D shows that expansion demand for mechanical engineering technologists and technicians are relatively limited, reflecting a decline in ICEV assembly). Electrical and electronics engineering is well represented in both the battery and assembly industries. Expansion demand is higher for electrical and electronics than for any other engineering technician and technology group. A moderately older age profile and new EV projects contribute to a high recruitment gap at the start of the transition.

Figure 13. Recruitment gap – electrical and electronics engineering technologists and technicians



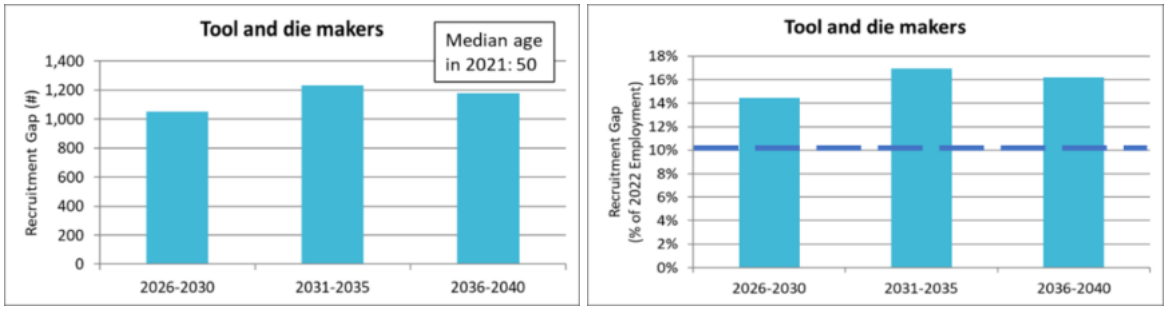
Machinists and machining and tooling inspectors (Figure 14): This trade plays a moderately stronger role in the battery industry compared to assembly. An increasing role here will create higher recruitment gaps in 2026 to 2030 as the transition gains momentum. Workers in this occupation are somewhat older (with a median age of 47), compared to workers in all occupations across the industries selected for this analysis.

Figure 14. Recruitment gap – machinists and machining and tooling inspectors



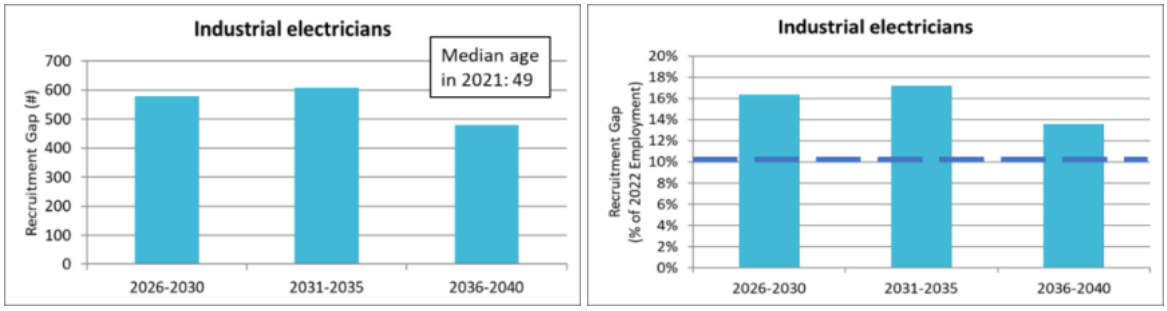
Tool and die makers (Figure 15): This trade plays a moderate role in both battery production and assembly. Impacts on employment here will create higher recruitment gaps as the transition moves forward. A notably older age profile relative to all workers in the selected industries and high recruitment gaps characterize conditions as the transition unfolds.

Figure 15. Recruitment gap – tool and die makers



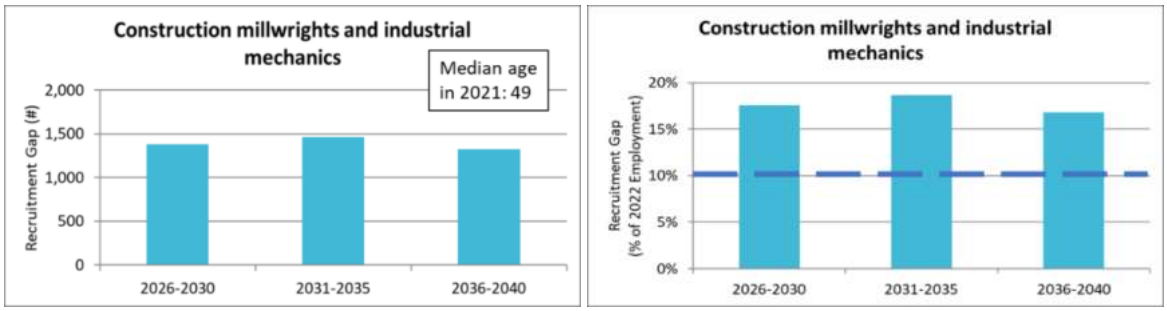
Industrial electricians (Figure 16): This trade plays a moderately stronger role in the assembly industry compared to batteries. An increasing role here will create higher recruitment gaps as the transition moves forward, but pressures will gradually dissipate towards the end of the transition. Industrial electricians have an older age profile relative to all workers in the selected industries.

Figure 16. Recruitment gap - industrial electricians



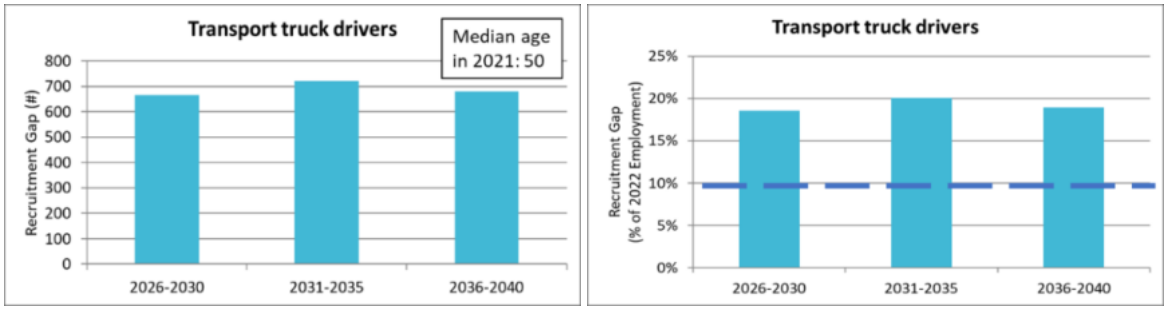
Construction millwrights and industrial mechanics (Figure 17): This trade plays a notable role in both assembly and battery industries and will be key in the startup of new production processes. Millwrights have a strong presence in the traditional parts industry and some jobs may be lost here across the transition. The trade has an older age profile, which will contribute to recruitment gaps during the first part of the transition period.

Figure 17. Recruitment gap – construction millwrights and industrial mechanics



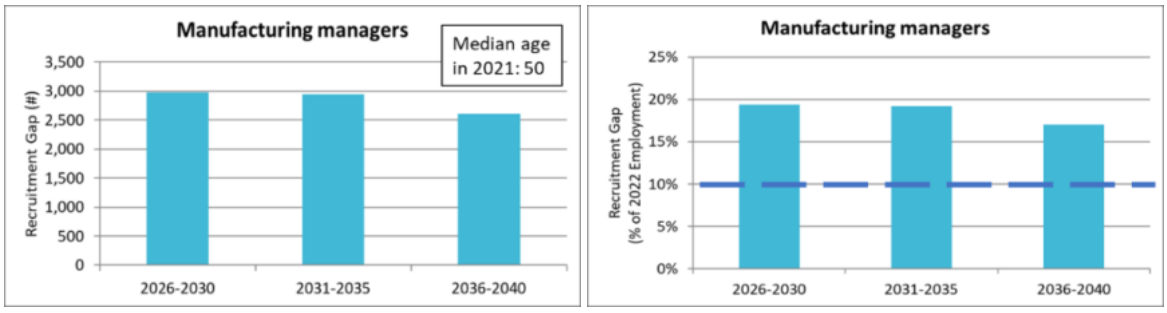
Transport truck drivers (Figure 18): This occupation plays a modest role in the selected industries, but has a higher recruitment gap as a percentage of base year employment compared to other trades and support occupations. Already high recruitment gaps will persist as the transition moves forward. This workforce has a notably older age profile and existing shortages will be aggravated across the transition.

Figure 18. Recruitment gap – transport truck drivers



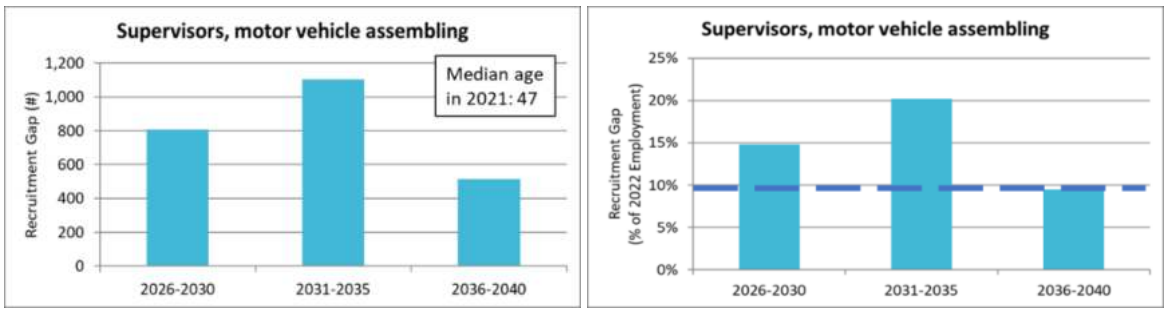
Manufacturing managers (Figure 19): This occupation has a notably high representation in all the selected industries but especially in battery production so that the transition aggravates already large recruitment gaps. There is an older age profile for this occupation, with a high recruitment gap at the start and across the transition, dissipating slightly towards the end of the transition period.

Figure 19. Recruitment gap – manufacturing managers



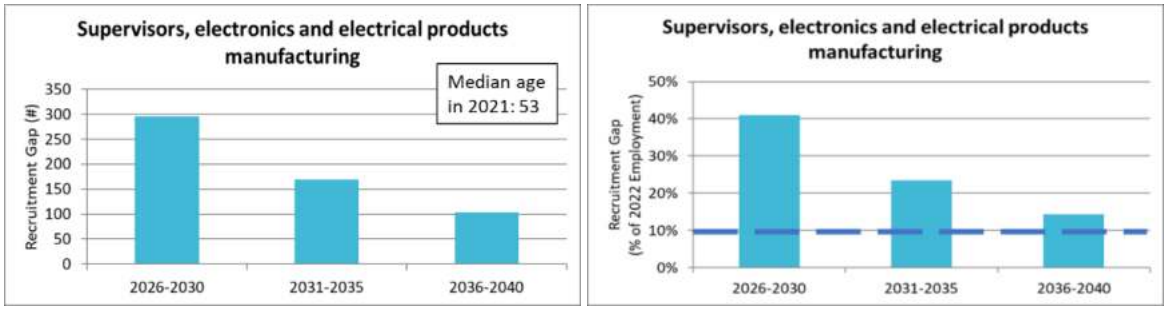
Supervisors, motor vehicle assembling (Figure 20): This workforce will be on the front line of the market adjustments as the transition moves forward. In the base case scenario total assembly grows only moderately but there is a shift from ICEVs to hybrids and EVs that will alter working conditions. This is a large workforce with a relatively older age profile. The sharp recruitment gap peak in the 2031 – 2035 period signals challenges for this occupation.

Figure 20. Recruitment gap – supervisors, motor vehicle assembling



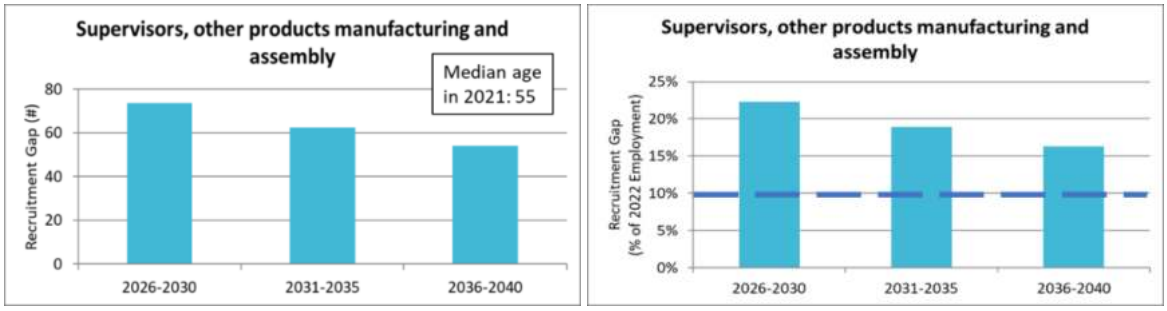
Supervisors, electronics and electrical products manufacturing (Figure 21): Expansion demand is strong for this occupation, especially in the startup of the transition as the new battery production and supply chain impacts. Recruitment gaps as a percent of base employment are highest of any occupations. To add to the expected strain on hiring, this group has a significantly older age profile, with higher expected retirements that will contribute to the sharp recruitment gap peak in the 2026-2030 interval.

Figure 21. Recruitment gap – supervisors, electronics and electrical products manufacturing



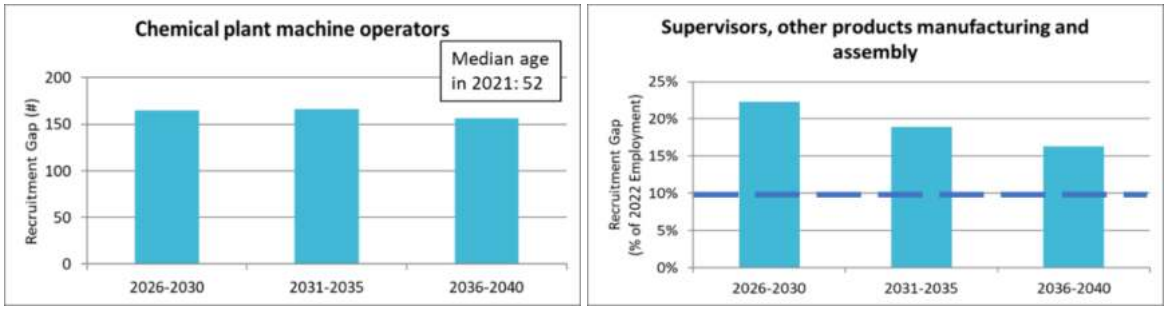
Supervisors, other products manufacturing and assembly (Figure 22): This workforce stands out with the sharp peak in the 2026-2030 interval when battery production is starting up. Much of the demand pressure will be in key industries in the battery supply chain. The median age for workers in this occupation is 55 years old, which is substantially higher than the median age for all occupations in the selected industries.

Figure 22. Recruitment gap – supervisors, other products manufacturing and assembly



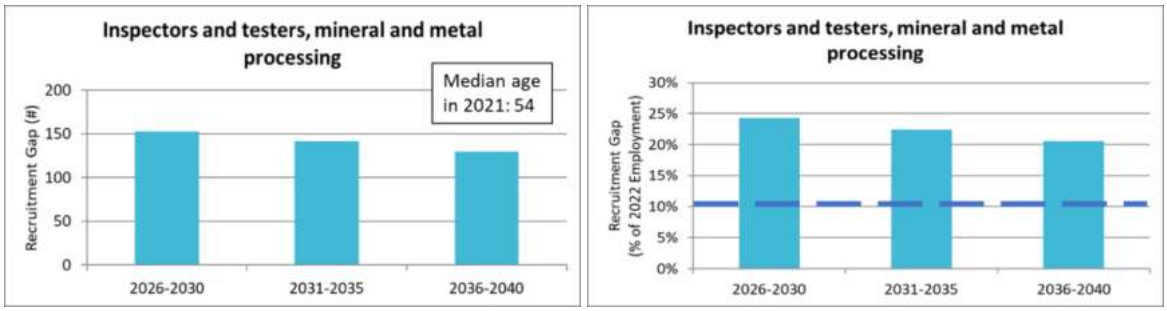
Chemical plant machine operators (Figure 23): This workforce is another example of an occupation with transition impacts farther up the supply chain, as battery production begins in the 2026 – 2030 period. As with many of the other occupations summarized here, the age profile for this occupation is relatively older than all occupations in the selected industries.

Figure 23. chemical plant machine operators



Inspectors and testers, mineral and metal processing (Figure 24): This small workforce, and the next occupation selected, stand out as they represent transition impacts farther up the supply chain in the minerals processing and mining industries. The base case scenario has only limited increases in Canadian production at this point in the supply chain, but the modest gain appears to be enough to disrupt labour markets as the transition gains momentum. The high median age for this occupation indicates additional replacement demand challenges in the early part of the transition period.

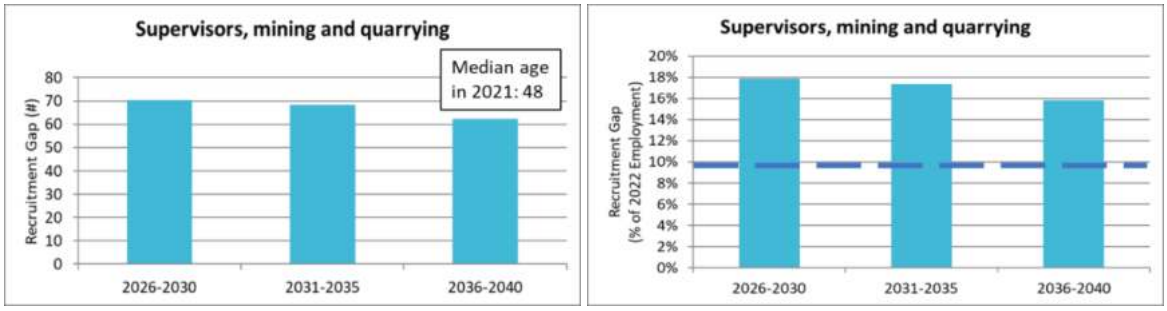
Figure 24. Recruitment gap – inspectors and testers, mineral and metal processing



Supervisors, mining and quarrying (Figure 25): This second, small workforce is added here to illustrate the appearance of mining related labour market impacts in the transition. There will be a sharp jump in recruiting challenges for this and other mining and mineral related workers during the transition period, expressed as a percentage of base year employment in 2022. Indeed, the base case impacts in mining and mineral supply are limited and there is a potential for much more development of minerals across Ontario to supply the EV production that is measured in other FOCAL II scenarios.[11] Workers in this occupation have a moderately higher age profile, compared to workers in all occupations in the selected industries.

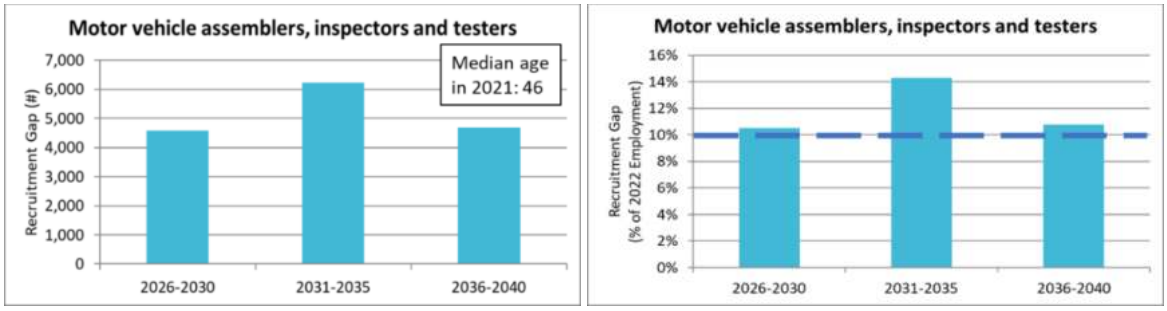
[11] See the FOCAL II report '*The Shift to EV Production in Canada's Automotive Manufacturing Sector: Assessing the Economic and Labour Market Impacts'* for details of other scenarios.

Figure 25. Recruitment gap – Supervisors, mining and quarrying



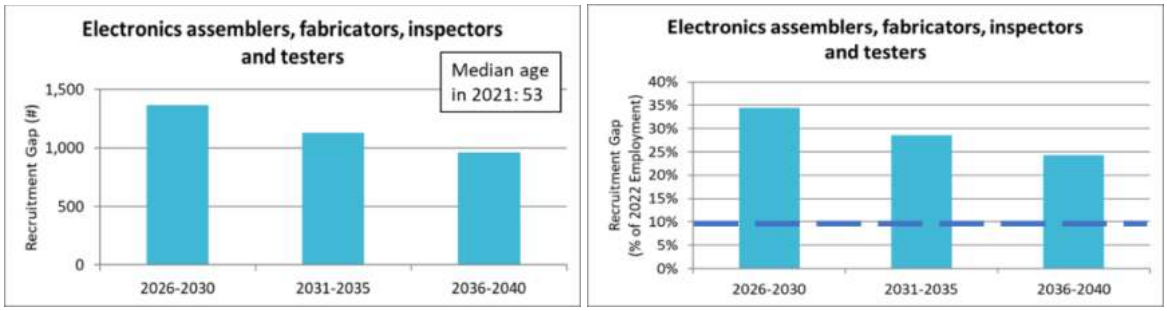
<u>*Motor vehicle assemblers, inspectors and testers*</u> (Figure 26): Conditions for this occupation feature significant impacts at the end of the supply chain. As noted with similar occupations (such as supervisors, motor vehicle assemblers), market peaks are concentrated in the 2031-2035 interval. This is a large workforce with traditionally higher structural unemployment than other occupations cited here. Recruitment gaps are high for this workforce. The older age profile increases retirement and this is a continuing challenge that existed prior to the transition.

Figure 26. Recruitment gap – motor vehicle assemblers, inspectors and testers



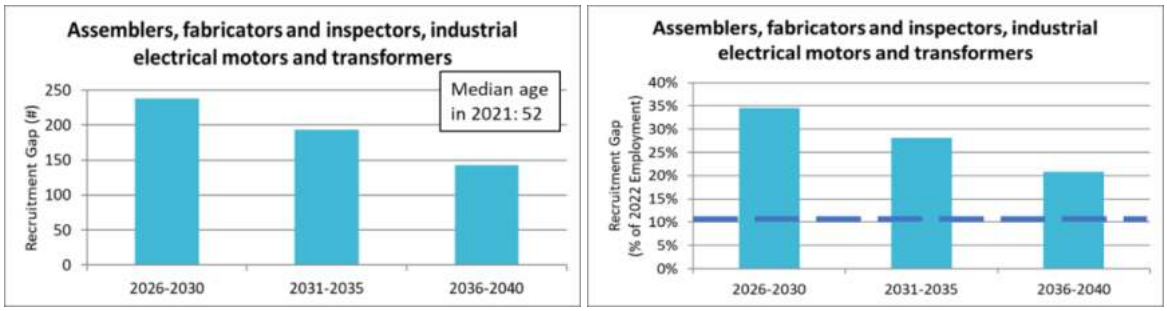
<u>*Electronics assemblers, fabricators, inspectors and testers*</u> (Figure 27): Expansion demand is strong here with a very high peak as the battery capacity starts up in the 2026-2030 period. Recruitment gaps as a percent of base employment are highest of the selected occupations. High replacement demand early in the transition period compounds the expansion demand pressure.

Figure 27. Recruitment gap – electronics assemblers, fabricators, inspectors and testers



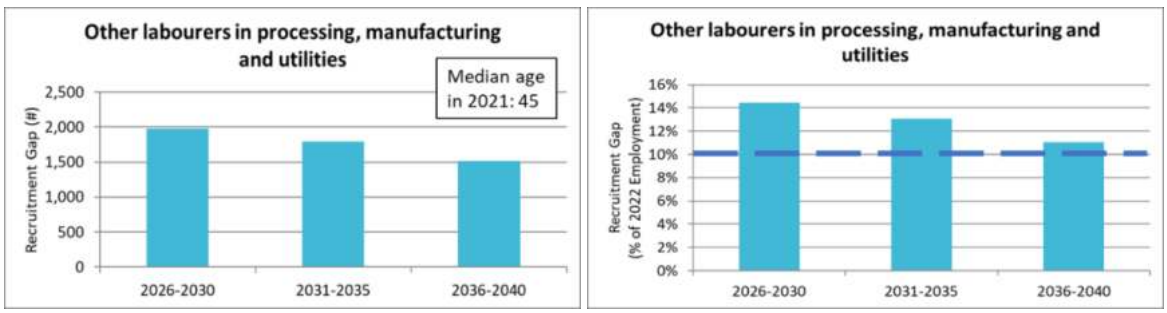
Assemblers, fabricators and inspectors, industrial electrical motors and transformers (Figure 28): This smaller workforce is traditionally employed in other electrical industries as well as in the battery industry, with a limited role in assembly. The older age profile contributes to the biggest recruitment gap peak in the 2026 – 2030 interval, as battery production comes online.

Figure 28. Recruitment gap – assemblers, fabricators and inspectors, industrial electrical motors and transformers



Other labourers in processing, manufacturing and utilities (Figure 29): This large workforce across the electrical industries is engaged in battery production. The recruitment gap for labourers rises to over 14% of 2022 base year employment as the ICEV-EV transition gets underway. Given the large number of labourers to be added, along with the assemblers noted above, labour market challenges will be concentrated here and pressure will build in the next few years. Jobs filled here will be largely new positions in the battery plants. A key question would be skills, training and experience that would be needed for these new arrivals.

Figure 29. Recruitment gap – other labourers in processing, manufacturing and utilities



Implications for Recruiting and Job Search

This section draws out some implications and trends in the findings.

Results indicate that hiring challenges will be concentrated in engineering, skilled trades and assemblers. Results for these occupations in Ontario certainly reflect the ICEV to EV transition but skills shortages are also, in part, inherited from the past. This implies that recruitment gaps, in many occupations, are high as the transition begins. The transition will aggravate some existing skills shortage situations and concentrate them in electrical-related occupations.

Results also distribute the rising recruitment gap roughly equally across the three main transition intervals. Direct impacts, taken from the pattern of announced changes, signal a peak in employment, during the 2026 – 2030 interval, as this is the period of the largest gains in battery related production. The modest spike in Ontario recruitment gaps in the 2031 – 2035 interval reflect the province-wide impact of rising vehicle assembly and this impact is more apparent as the findings are reported on key regions. These impacts will be set out in more detail in regional reports.

The impacts anticipated here reflect very different changes to employment and work conditions across industries and occupations. For most the 20 occupations listed here, the impacts will include added new jobs, lost jobs in the ICEV supply chain, and adding new skills as the workforce moves on to the EV-related production. For managers, supervisors and assemblers in the assembly industry these impacts may be part of changing work conditions where existing assemblers will be able to transfer staff to new EV assembly lines. For managers, supervisors and assemblers in electronics assembly the impacts will be in new jobs and skills, often in new plants. For a relatively small workforce, mostly on the ICEV supply chain related to gasoline engines, transmissions, exhaust systems and a few other areas, the impacts will be lost employment.

Observations for the engineering occupations (in the previous pages) mention a shift from mechanical to electrical engineering across the transition. Indeed, the expansion demand gains for electrical engineers, technicians and technologists exceed the gains of all other engineering disciplines taken together. Another factor here is the dominant role of mechanical engineers in the traditional parts industry where job losses are expected.

There is a similar shift across the skilled trades. Expansion demand gains for machinists, tool and die makers, industrial electricians and millwrights reflect their new prominence in the battery and related industries. But the reported employment impacts are the *net* result and include job losses for these trades. Employment of these trades in the parts industry will be eroded as ICEV production closes down and eliminates jobs in gasoline engine, transmissions and exhaust systems.

A final, general observation about the results notes that recruitment gaps tend to decrease in the final 2036 - 2040 interval. This is related to two anticipated changes that span the transition. The

first is the trend to higher productivity and lower vehicle and battery costs across the supply chain as the technologies and processes mature and global markets grow. These changes anticipate modest but long-term declines in employment across the base case scenario. The second is the demographic trend to fewer retirements and lower age profiles in the later years of the transition as Baby Boomers leave the workforce.

Tracking these labour market changes invites further commentary on labour mobility that might result as variations in recruitment gaps emerge across regions, industries, and occupations. These opportunities for balancing markets are becoming apparent at the provincial level where measures add regions and industries together. Reports on labour market impacts in specific regions will highlight these possibilities even more clearly.
For example, quite distinct recruitment gaps are apparent across occupations and regions that signal the potential for mobility. FOCAL has prepared skills transferability matrices (STMs) that track the potential for filling openings in occupations with a skills shortage with candidates from related occupations with similar skills profiles[12]. Readers are invited to review FOCAL findings for the matrices on the website: www.futureautolabourforce.ca. More specific examples of opportunities for recruiters and job seekers related to skills transferability are highlighted in the regional reports. The STMs will assist all stakeholders in engaging in the transitioning of workers to other occupations and sectors in the event of technological changes and economic disruptions.

FOCAL findings offer a similar insight into the potential for inter-regional labour mobility across occupations as differences in recruitment gaps emerge in the regional analysis. Individual regional reports for Eastern Ontario, the Golden Horseshoe, Kitchener-Waterloo-Barrie, London-Stratford-Bruce Peninsula and Windsor-Sarnia all reveal quite distinct impacts. This in, in part, a consequence of the specific investments and production plans announced across the EV industry. Each regional report includes the measures for recruitment gaps for occupations; revealing higher and lower gaps for specific occupations across regions. There is a clear potential for inter-regional workforce mobility implied here.

A summary of this perspective on the FOCAL II results can be seen in Table 3. The table describes labour market conditions across Ontario regions for the transition interval 2026-2030. This interval focuses on the ramping up of new battery production facilities across Ontario. At this time in the transition, labour markets promise to be most strained in the London-Stratford-Bruce Peninsula and Windsor-Sarnia regions, as major investments in battery plants and their suppliers open operations. In the circumstances described in the base case scenario, activity in the assembly industry peaks around 2035 moving labour market pressures out a few years in other regions. Indeed, there are regions like Eastern Ontario where impacts are limited across the entire

[12] FOCAL has developed Skills Transferability Matrices (STMs) using artificial intelligence (AI) and complex algorithms for occupations in the sector to help identify transferable skills, tasks, technical knowledge and abilities across other occupations and sectors.

transition. In Table 3, the 20 selected occupations covered here for Ontario are highlighted and estimated recruitment gaps are noted across all the regions.
Presented in this way, it is tempting to anticipate inter-regional labour mobility that would balance demands. Recruiters in regions with high recruitment gaps might look to regions with lower gaps. So, for example, it might be possible to recruit electronic and electrical engineers and technicians and technologists into the Windsor-Sarnia region from the Golden Horseshoe. Of course, such mobility will depend on many other factors. In addition, the relative gaps among regions will change across intervals and they might be very different in a different EV transition scenario.

Table 3. Regional comparison of recruitment gaps (% of 2022 base year employment), selected occupations – 2026-2030

Selected Occupations	Eastern Ontario	Golden Horseshoe	Kitchener-Waterloo - Barrie	London-Stratford-Bruce Peninsula	Windsor -Sarnia
14400 Shippers and receivers	7%	9%	5%	15%	20%
20010 Engineering managers	8%	9%	8%	19%	22%
21310 Electrical and electronics engineers	13%	9%	8%	15%	25%
22310 Electrical and electronics engineering technologists and technicians	12%	10%	6%	18%	28%
72100 Machinists and machining and tooling inspectors	8%	14%	9%	9%	5%
72101 Tool and die makers	17%	16%	7%	14%	11%
72201 Industrial electricians	<1%	13%	8%	14%	27%
72400 Construction millwrights and industrial mechanics	7%	14%	10%	15%	16%
73300 Transport truck drivers	9%	7%	13%	22%	22%
82020 Supervisors, mining and quarrying	*	*	*	*	*
90010 Manufacturing managers	5%	15%	12%	20%	24%
92020 Supervisors, motor vehicle assembling	*	18%	13%	12%	17%
92021 Supervisors, electronics and electrical products manufacturing	<1%	6%	3%	*	*
94110 Chemical plant machine operators	11%	9%	<1%	*	*
94200 Motor vehicle assemblers, inspectors and testers	13%	14%	7%	9%	8%

Selected Occupations	Eastern Ontario	Golden Horseshoe	Kitchener-Waterloo - Barrie	London-Stratford-Bruce Peninsula	Windsor -Sarnia
94201 Electronics assemblers, fabricators, inspectors and testers	23%	21%	1%	86%	120%
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	*	18%	22%	*	*
95109 Other labourers in processing, manufacturing and utilities	<1%	11%	4%	23%	25%

* Regional findings are suppressed for occupations with fewer than 100 employees

Readers are encouraged to investigate these labour market outcomes at the regional details in FOCAL II reports.

Conclusions and Implications

The ICEV – EV transition, in the base case scenario, will create disruptions in labour markets for at least 20 occupations in Ontario. Recruiting challenges will emerge in these labour markets, with the peak challenges concentrated between 2026 and 2035 as EV assembly builds to a peak and new battery and related supply production comes online. Recruiting for engineering, skilled trades and assembly occupations will face skills challenges and general shortages. In many cases, the ICEV-EV transition demands arrive when markets are already challenged by, among other things, high levels of retirements.

The actual nature of these impacts will vary. Occupations with older age profiles are almost certainly already candidates for HR programs that focus on retention, succession and training in new technologies and work supervision. One challenge will be filing new jobs created in the new battery cell, module and related supplier production where, in some cases, unique skills and training will define entirely new occupations. At the other extreme that will be lost jobs in gasoline engine, transmission and related manufacturing across the ICEV supply chain. This will create a small but important source of job seekers with important experience, but possible needs to upgrade training.

Another area will be occupations in vehicle assembly where jobs might be transferred across existing processes from ICEV to new EV production, perhaps even in the same company or facility. One example of change will be the addition of work assembling battery modules into battery packs – likely in, or close to, final assembly.

Labour market shifts in all these areas, industries and occupations will have skill, training qualification and geographic dimensions. Thus, recruiters and job seekers may find themselves in proximity to jobs and candidates in nearby regions or related occupations having transferable

skills and experience. FOCAL II regional labour market reports for three provinces and seven regions will consider these possibilities as they dig deeper into these dimensions and reveal important variations across the ICEV-EV transition.

This report summarizes the scope and scale of the transition for Ontario. In this base case scenario, with cautious assumptions about the transition, the number of jobs created exceeds the number lost. Labour market challenges in this case will prompt recruitment gaps to emerge across the country as the transition from 2025 to 2040 unfolds.

These challenges are spread across many occupations and regions. Seeing this many specific HR challenges clarifies the critical impact of the ICEV-EV transition. These changes are both a risk and a reward. HR risks are not new to Canadian manufacturing, but the scale of EV related changes may raise these risks to new, higher levels. There is a major reward here as the transition, as represented in the base case scenario, will leave Canada in 2040 with a larger and almost completely adapted automotive vehicle industry. Other FOCAL II scenarios show more dramatic success as Canadian assembly of EVs increases its share of markets and a larger and longer supply chain reaches back to new mining potential. This is, after all, Canada's second most important export industry and circumstances described here confirm its emergence as a new and global force.

Appendices

Appendix A – Industries Analyzed in the Labour Market Impact Model

Table 4. List of industries analyzed in the labour market impact model, with NAICS industry codes

Industry (NAICS Code)
2122 Metal ore mining
2123 Non-metallic mineral mining and quarrying
3132 Fabric Mills
3133 Textile and Fabric Finishing and Fabric Coating Mills
3251 Basic chemical manufacturing
3252 Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments Manufacturing
3255 Paint, coating and adhesive manufacturing
3259 Other chemical product manufacturing
3261 Plastic product manufacturing
3262 Rubber product manufacturing
3272 Glass and glass product manufacturing
3279 Other non-metallic mineral product manufacturing
3311 Iron and steel mills and ferro-alloy manufacturing
3312 Steel product manufacturing from purchased steel
3313 Alumina and aluminum production and processing
3314 Non-ferrous metal (except aluminum) production and processing
3315 Foundries
3321 Forging and stamping
3322 Cutlery and hand tool manufacturing
3323 Architectural and structural metals manufacturing
3325 Hardware manufacturing
3326 Spring and Wire Product Manufacturing
3327 Machine shops, turned product, and screw, nut and bolt manufacturing
3328 Coating, engraving, cold and heat treating and allied activities
3329 Other fabricated metal product manufacturing
3335 Metalworking machinery manufacturing
3341 Computer and peripheral equipment manufacturing
3342 Communications equipment manufacturing
3344 Semiconductor and other electronic component manufacturing
3345 Navigational, measuring, medical and control instruments manufacturing
3351 Electric lighting equipment manufacturing
3353 Electrical equipment manufacturing
3359 Other electrical equipment and component manufacturing
3361 Motor vehicle manufacturing:
336110 - Automobile and light Duty Motor Vehicle Manufacturing
336120 - Heavy-duty truck manufacturing

Industry (NAICS Code)
3363 Motor vehicle parts manufacturing:
336310 - Motor vehicle gasoline engine and engine parts manufacturing
336320 - Motor vehicle electrical and electronic equipment manufacturing
336330 - Motor vehicle steering and suspension components (except spring) manufacturing
336340 - Motor vehicle brake system manufacturing
336350 - Motor vehicle transmission and power train parts manufacturing
336360 - Motor vehicle seating and interior trim manufacturing
336370 - Motor vehicle metal stamping
336390 - Other motor vehicle parts manufacturing
415 Motor vehicle and motor vehicle parts and accessories merchant wholesalers
4173 Computer and communications equipment and supplies merchant wholesalers
4931 Warehousing and storage
5413 Architectural, engineering and related services
5415 Computer systems design and related services
5416 Management, scientific and technical consulting services

Appendix B – Occupations Analyzed in the Labour Market Impact Model

Table 5. List of occupations analyzed in the labour market impact model (Ontario)

Occupation (NOC21 code)
11200 Human resources professionals
13201 Production and transportation logistics coordinators
14400 Shippers and receivers
20010 Engineering managers
20012 Computer and information systems managers
21101 Chemists
21211 Data scientists
21220 Cybersecurity specialists
21221 Business systems specialists
21222 Information systems specialists
21223 Database analysts and data administrators
21230 Computer systems developers and programmers
21231 Software engineers and designers
21232 Software developers and programmers
21233 Web designers
21234 Web developers and programmers
21301 Mechanical engineers
21310 Electrical and electronics engineers
21311 Computer engineers (except software engineers and designers)
21320 Chemical engineers
21321 Industrial and manufacturing engineers
22100 Chemical technologists and technicians
22220 Computer network and web technicians
22222 Information systems testing technicians
22301 Mechanical engineering technologists and technicians
22302 Industrial engineering and manufacturing technologists and technicians
22310 Electrical and electronics engineering technologists and technicians
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations
72100 Machinists and machining and tooling inspectors
72101 Tool and die makers
72106 Welders and related machine operators
72201 Industrial electricians
72400 Construction millwrights and industrial mechanics
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers
73300 Transport truck drivers

Occupation (NOC21 code)
75101 Material handlers
90010 Manufacturing managers
92021 Supervisors, electronics and electrical products manufacturing
93101 Central control and process operators, petroleum, gas and chemical processing
94100 Machine operators, mineral and metal processing
94105 Metalworking and forging machine operators
94106 Machining tool operators
94110 Chemical plant machine operators
94111 Plastics processing machine operators
94200 Motor vehicle assemblers, inspectors and testers
94201 Electronics assemblers, fabricators, inspectors and testers
94212 Plastic products assemblers, finishers and inspectors
94213 Industrial painters, coaters and metal finishing process operators
95100 Labourers in mineral and metal processing
95102 Labourers in chemical products processing and utilities
95109 Other labourers in processing, manufacturing and utilities

Appendix C– Methodology Notes

There are three distinct research steps needed to provide accurate and detailed impacts that span the supply chain, industries and occupations.

1. New EV production
2. Economic impacts across the supply chain
3. Labour market impacts by region and occupation

1. New EV production

The FOCAL II EV Transition report presents a detailed analysis of new EV production. This includes careful review of the supply chain for EV assembly, battery technology and of announced plans for new battery production facilities and related changes in the supply chain. The review spans the supply chain; reaching upstream to chemical manufacturing, mineral processing and mining potential. In addition, the analysis tracks the related decline in assembling ICEV. The timing and magnitude of new production and shifts in the supply chain have been set out with alternative scenarios that reflect possible future outcomes.

The new EV production analysis estimates specific changes expected in industries spanning four stages in the supply chain for assembled motor vehicles, as illustrated in Figure 25.

Figure 30. The EV supply chain

The second step in the research assesses how these specific and direct changes to industrial activity will impact the broader automotive industry, its supply chain and the overall economy.

2. Economic impacts across the supply chain

At this stage the analysis calculates broader estimates of impacts on industry output and employment across the entire economy with detail set out for 55 selected industries in 10 regions and three provinces. Results in this second stage are impacts on industry employment – the key driver for labour market impacts.

Specific changes, estimated for the four stages and ten industries established in the EV Production analysis, are translated into broader economic measures using the system of Input-

Output Tables. These tables are an economy wide accounting system that measures transactions connecting industries and customers. These are produced annually for Canada and the provinces/territories covering over 250 industries and 180 types of final customers.
Input-output (IO) tables are prepared by Statistics Canada as part of the system of national accounts. Calculations draw on surveys and economic statistics each year to update the detailed pattern of purchases and sales that link activity and spread the impact of changes across the economy. Annual measures track the pattern of each industry's purchases from suppliers and sales to both other "downstream" industries and final purchasers (e.g. exports, investments, government spending, and household consumption).

The tables are converted into an IO model that can be used to calculate the impacts of changes across the economy. The FOCAL II research creates new versions of these national and provincial IO models to estimate the impacts of the new EV production changes described in the first research stage. Specific changes are taken from the new EV production analysis and applied in the IO models. For example, the IO model analysis is based on;

1. new production levels for EVs and ICEVs in the assembly industry
2. new production levels for internal combustion engines
3. a new pattern of suppliers to the assembly industry
4. new production levels announced for battery plants
5. a new pattern of suppliers to battery production
6. new production levels announced for chemical, mineral and mining production

These changes are described as "direct" impacts that will be introduced into the economy at a specific time and place in the transition from ICEV to Evs. The magnitude and timing of direct impacts are different in each scenario.

Each direct impact prompts a series of indirect impacts across the economy as the pattern of purchases and sales changes according to the structure of the economy set out in the IO tables. A final round of induced impacts are included as the IO model tracks the changes in household income and the associated change in expenditures.

Finally, the IO model totals the direct, indirect and induced impacts on employment in each industry. These employment impacts are the key drivers for labour market analysis.

It is important to note some features of IO models that need to be reflected in the interpretation of findings. First, given the complexity of these models, there is a time lag in the release of tables such that, at the time of FOCAL II research, the most up to date IO data for Canada and the provinces was from 2019. Advanced features in our system allowed for the addition of base year data for 2022. Also, IO models do not contain measures of the production capacity of individual industries and calculated impacts are not constrained. This is important in, for example, the analysis of the impacts of the transition across Canada's mining and mineral processing industries. Finally, IO impacts calculated in the models are not time specific. Thus, the EV

production analysis, at the first research stage, sets out specific assumptions of the scheduling of the start and completion of new activity across the transition from 2025 to 2040.

3. *Labour market impacts by occupation and region*

Regional Labour Market reports provide analysis of the labour market impacts, including measures of market conditions for approximately 70 occupations[13]. These results are linked to further labour market and human resource management implications and related conditions in training, immigration, apprenticeship, diversity and other areas. This analysis assesses the likelihood of skill and labour shortages and other market imbalances in specific occupations and regions as the transition from ICEV to EV progresses.

Labour market models track both patterns of hiring and labour demand as well as elements of labour supply. Three broad components of employment and hiring are identified; expansion demand, replacement demand and recruitment gaps.

Expansion Demand

Expansion demand is defined by the employment impacts generated by the IO model analysis described above. These impacts are linked to the direct industry changes associated with the transitions from ICEV to EV in the selected industries and the broader economy. Employment changes by industry are spread across the transition interval from 2025 to 2040 and are specific to each transition scenario. These impacts are intended to highlight labour market disruptions. Expansion demand for each occupation was determined by taking the overall employment forecast by industry and transforming that forecast from the industry level to the occupation level within each industry.

The transformation from industry impacts to occupation impacts was accomplished by using industry (NAICS) and occupation (NOC) data from the 2021 Census.

Replacement Demand

Labour market conditions for each occupation and region will depend on other factors. The most critical of these are the demographic trends that are working their way through the economy. This includes the aging of the population, immigration and other factors. To capture these effects, a measure is added for replacement demand or estimates of retirement and mortality by occupation and region.

Final replacement demand changes were based on summing occupational estimates of labour force exits due to retirements and deaths across every age-year between 15 and 69 years. Mortality and exit rates were available from Statistics Canada at the national and provincial level.

[13] Findings for occupations with base year employment of less than one thousand (for national results) or less than one hundred (for provincial and regional results) are suppressed due to data reliability concerns.

Regional estimates incorporate provincial mortality and exit rate data, based on availability of data. Mortality and exit rates were applied to the existing single-year demographic profile by occupation by industry.

Labour market conditions were summarized by these measures to provide signals of possible skill and labour shortages across the transition in each occupation and region.

New Entrants

A similar demographic trend is captured with a measure of new entrants. Also linked to demographics and participation, this measure captures the effect of young entrants and the more volatile effects of immigration.

Total new entrants by province were based on historic data and projections of total population and labour force participation rates. Population projections were taken from Statistics Canada population projection data. Labour force participation rates were assumed to remain equal to 2022 levels for the transition period.

Recruitment Gaps

The recruitment gap comprises the interaction of three different labour market supply and demand components: expansion demand, replacement demand, and new entrant dynamics.

The recruitment gap is defined as;

Recruitment Gap = Expansion Demand plus Replacement Demand less New Entrants

The recruitment gap was calculated for 68 selected occupations in 49 industries in the national analysis (see Appendix A and B, respectively). As noted in the report, it represents expansion demand plus replacement demand less new entrants.

Other Methodology Notes

2022 Base Year Employment

The base year for the forecast was 2022. Although problematic due to COVID-related labour market adjustments from 2020 to 2023, it was the most recent year in which complete data on employment by industry was available. Base year employment was determined using multiple data sources, including Statistics Canada, APRC, Metro Economics, and Prism Economics and Analysis.

Occupation Age Profiles

Single-year age profiles (by occupation and by industry) were produced from 2021 Census data. Census data was collected during May 2021, in the midst of COVID-related labour market disruptions.

Appendix D – Detailed Results

This Appendix contains detailed tables of occupational impacts for each component of the recruitment gap: expansion demand (Table 5), replacement demand (Table 6), and new entrants (Table 7). These are followed by tables that show recruitment gaps expressed as headcounts (Table 8) and as a percentage of 2022 base year employment (Table 9).

Expansion Demand

Expansion demand impacts reflect the direct industry changes associated with the transitions from ICEV to EV in the selected industries and the broader economy. Values for each column in Table 7 are expressed as expansion demand relative to 2022 base year employment.

Table 6. Expansion demand – detailed results (Ontario)

Expansion Demand	2026-30	2031-35	2036-40	2025-40
11200 Human resources professionals	40	30	-20	40
13201 Production and transportation logistics coordinators	90	20	-40	70
14400 Shippers and receivers	240	50	-90	190
14402 Production logistics workers	0	10	0	0
20010 Engineering managers	130	30	-40	120
20012 Computer and information systems managers	40	20	-20	40
21101 Chemists	10	0	0	10
21211 Data scientists	0	0	0	0
21220 Cybersecurity specialists	0	0	0	0
21221 Business systems specialists	0	0	0	0
21222 Information systems specialists	40	30	-20	40
21223 Database analysts and data administrators	0	0	0	0
21230 Computer systems developers and programmers	0	10	0	10
21231 Software engineers and designers	70	60	-20	90
21232 Software developers and programmers	60	30	-20	60
21233 Web designers	0	0	0	0
21234 Web developers and programmers	0	10	0	0
21301 Mechanical engineers	140	150	-60	180
21310 Electrical and electronics engineers	280	80	-80	280
21311 Computer engineers (except software engineers and designers)	40	10	-10	40
21320 Chemical engineers	40	10	-20	40
21321 Industrial and manufacturing engineers	110	50	-50	90
21322 Metallurgical and materials engineers	0	0	0	0
21330 Mining Engineers	0	0	0	0

Expansion Demand	2026-30	2031-35	2036-40	2025-40
22100 Chemical technologists and technicians	10	0	-10	10
22220 Computer network and web technicians	40	10	-20	30
22222 Information systems testing technicians	0	0	0	0
22301 Mechanical engineering technologists and technicians	50	40	-30	40
22302 Industrial engineering and manufacturing technologists and technicians	20	30	-20	0
22310 Electrical and electronics engineering technologists and technicians	220	40	-70	190
22312 Industrial instrument technicians and mechanics	10	0	0	0
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	0	10	0	0
72020 Contractors and supervisors, mechanic trades	0	10	0	0
72100 Machinists and machining and tooling inspectors	80	40	-40	60
72101 Tool and die makers	10	30	-40	-30
72106 Welders and related machine operators	120	60	-60	80
72200 Electricians (except industrial and power system)	20	0	-10	20
72201 Industrial electricians	140	80	-50	140
72400 Construction millwrights and industrial mechanics	170	70	-80	130
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	20	60	-10	40
73300 Transport truck drivers	60	20	-20	50
73400 Heavy equipment operators	50	10	-10	40
75101 Material handlers	370	170	-160	310
82020 Supervisors, mining and quarrying	10	0	0	10
83100 Underground production and development miners	30	0	-10	20
84100 Underground mine service and support workers	10	0	0	0
90010 Manufacturing managers	530	150	-190	440
92020 Supervisors, motor vehicle assembling	340	520	-90	640
92021 Supervisors, electronics and electrical products manufacturing	170	10	-50	150

Expansion Demand	2026-30	2031-35	2036-40	2025-40
92023 Supervisors, other mechanical and metal products manufacturing	20	10	-10	20
92024 Supervisors, other products manufacturing and assembly	20	0	-10	20
93100 Central control and process operators, mineral and metal processing	0	0	0	0
93101 Central control and process operators, petroleum, gas and chemical processing	90	0	-30	70
94100 Machine operators, mineral and metal processing	100	0	-40	70
94101 Foundry workers	-20	-20	-10	-50
94104 Inspectors and testers, mineral and metal processing	30	0	-10	20
94105 Metalworking and forging machine operators	60	10	-30	40
94106 Machining tool operators	50	10	-30	30
94110 Chemical plant machine operators	30	0	-10	20
94111 Plastics processing machine operators	50	30	-30	50
94200 Motor vehicle assemblers, inspectors and testers	480	1,230	-430	680
94201 Electronics assemblers, fabricators, inspectors and testers	420	30	-130	350
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	110	40	-10	150
94204 Mechanical assemblers and inspectors	50	50	-20	70
94212 Plastic products assemblers, finishers and inspectors	0	10	0	10
94213 Industrial painters, coaters and metal finishing process operators	60	60	-20	80
95100 Labourers in mineral and metal processing	30	0	-20	0
95102 Labourers in chemical products processing and utilities	10	0	0	0
95109 Other labourers in processing, manufacturing and utilities	600	110	-200	500

Replacement Demand

Replacement demand represents occupational estimates of labour force exits due to retirements and deaths across every age-year between 15 and 69 years. Values for each column in Table 8 are expressed as replacement demand relative to 2022 base year employment.

Table 7. Replacement demand – detailed results (Ontario)

Replacement Demand	2026-30	2031-35	2036-40	2025-40
11200 Human resources professionals	660	740	740	2,240
13201 Production and transportation logistics coordinators	350	400	390	1,190
14400 Shippers and receivers	1,690	1,910	1,900	5,770
14402 Production logistics workers	70	80	80	230
20010 Engineering managers	820	920	920	2,790
20012 Computer and information systems managers	1,240	1,400	1,400	4,240
21101 Chemists	180	200	200	610
21211 Data scientists	60	70	70	200
21220 Cybersecurity specialists	150	170	170	520
21221 Business systems specialists	390	430	430	1,310
21222 Information systems specialists	2,520	2,810	2,810	8,540
21223 Database analysts and data administrators	230	260	260	780
21230 Computer systems developers and programmers	470	520	520	1,570
21231 Software engineers and designers	1,270	1,410	1,410	4,310
21232 Software developers and programmers	1,080	1,210	1,210	3,680
21233 Web designers	130	140	140	420
21234 Web developers and programmers	450	500	500	1,520
21301 Mechanical engineers	1,410	1,570	1,570	4,770
21310 Electrical and electronics engineers	1,420	1,590	1,590	4,800
21311 Computer engineers (except software engineers and designers)	530	590	590	1,790
21320 Chemical engineers	200	220	220	660
21321 Industrial and manufacturing engineers	370	420	420	1,260
21322 Metallurgical and materials engineers	80	80	80	250
21330 Mining Engineers	70	70	70	220
22100 Chemical technologists and technicians	160	180	180	550
22220 Computer network and web technicians	510	570	570	1,730
22222 Information systems testing technicians	130	150	150	440
22301 Mechanical engineering technologists and technicians	850	960	960	2,900

Replacement Demand	2026-30	2031-35	2036-40	2025-40
22302 Industrial engineering and manufacturing technologists and technicians	580	650	650	1,970
22310 Electrical and electronics engineering technologists and technicians	850	960	960	2,910
22312 Industrial instrument technicians and mechanics	60	60	60	200
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	470	530	530	1,600
72020 Contractors and supervisors, mechanic trades	140	160	160	480
72100 Machinists and machining and tooling inspectors	1,500	1,660	1,660	5,060
72101 Tool and die makers	1,250	1,400	1,400	4,260
72106 Welders and related machine operators	1,380	1,530	1,530	4,650
72200 Electricians (except industrial and power system)	80	90	90	270
72201 Industrial electricians	530	610	620	1,850
72400 Construction millwrights and industrial mechanics	1,410	1,590	1,590	4,800
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	360	410	410	1,250
73300 Transport truck drivers	700	790	790	2,390
73400 Heavy equipment operators	150	170	170	500
75101 Material handlers	3,610	4,060	4,060	12,290
82020 Supervisors, mining and quarrying	60	70	70	210
83100 Underground production and development miners	100	110	110	330
84100 Underground mine service and support workers	30	30	30	90
90010 Manufacturing managers	2,620	2,960	2,960	8,940
92020 Supervisors, motor vehicle assembling	570	690	710	2,060
92021 Supervisors, electronics and electrical products manufacturing	130	170	160	480
92023 Supervisors, other mechanical and metal products manufacturing	50	50	50	160
92024 Supervisors, other products manufacturing and assembly	60	70	70	200
93100 Central control and process operators, mineral and metal processing	70	90	80	260

Replacement Demand	2026-30	2031-35	2036-40	2025-40
93101 Central control and process operators, petroleum, gas and chemical processing	200	230	220	680
94100 Machine operators, mineral and metal processing	190	220	220	660
94101 Foundry workers	70	80	80	230
94104 Inspectors and testers, mineral and metal processing	140	150	150	460
94105 Metalworking and forging machine operators	550	620	620	1,880
94106 Machining tool operators	520	580	580	1,760
94110 Chemical plant machine operators	170	190	190	580
94111 Plastics processing machine operators	1,070	1,200	1,200	3,640
94200 Motor vehicle assemblers, inspectors and testers	6,010	6,830	6,880	20,680
94201 Electronics assemblers, fabricators, inspectors and testers	1,020	1,180	1,170	3,520
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	140	180	180	520
94204 Mechanical assemblers and inspectors	170	200	200	600
94212 Plastic products assemblers, finishers and inspectors	330	370	370	1,110
94213 Industrial painters, coaters and metal finishing process operators	400	460	460	1,380
95100 Labourers in mineral and metal processing	390	440	440	1,340
95102 Labourers in chemical products processing and utilities	80	90	90	280
95109 Other labourers in processing, manufacturing and utilities	2,160	2,440	2,440	7,380

New Entrants

This measure captures the movement of young people into the labour force as well as immigration.

Table 8. New entrants – detailed results (Ontario)

Replacement Demand	2026-30	2031-35	2036-40	2025-40
11200 Human resources professionals	660	740	740	2,240
13201 Production and transportation logistics coordinators	350	400	390	1,190
14400 Shippers and receivers	1,690	1,910	1,900	5,770
14402 Production logistics workers	70	80	80	230

Replacement Demand	2026-30	2031-35	2036-40	2025-40
20010 Engineering managers	820	920	920	2,790
20012 Computer and information systems managers	1,240	1,400	1,400	4,240
21101 Chemists	180	200	200	610
21211 Data scientists	60	70	70	200
21220 Cybersecurity specialists	150	170	170	520
21221 Business systems specialists	390	430	430	1,310
21222 Information systems specialists	2,520	2,810	2,810	8,540
21223 Database analysts and data administrators	230	260	260	780
21230 Computer systems developers and programmers	470	520	520	1,570
21231 Software engineers and designers	1,270	1,410	1,410	4,310
21232 Software developers and programmers	1,080	1,210	1,210	3,680
21233 Web designers	130	140	140	420
21234 Web developers and programmers	450	500	500	1,520
21301 Mechanical engineers	1,410	1,570	1,570	4,770
21310 Electrical and electronics engineers	1,420	1,590	1,590	4,800
21311 Computer engineers (except software engineers and designers)	530	590	590	1,790
21320 Chemical engineers	200	220	220	660
21321 Industrial and manufacturing engineers	370	420	420	1,260
21322 Metallurgical and materials engineers	80	80	80	250
21330 Mining Engineers	70	70	70	220
22100 Chemical technologists and technicians	160	180	180	550
22220 Computer network and web technicians	510	570	570	1,730
22222 Information systems testing technicians	130	150	150	440
22301 Mechanical engineering technologists and technicians	850	960	960	2,900
22302 Industrial engineering and manufacturing technologists and technicians	580	650	650	1,970
22310 Electrical and electronics engineering technologists and technicians	850	960	960	2,910
22312 Industrial instrument technicians and mechanics	60	60	60	200
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	470	530	530	1,600
72020 Contractors and supervisors, mechanic trades	140	160	160	480
72100 Machinists and machining and tooling inspectors	1,500	1,660	1,660	5,060

Replacement Demand	2026-30	2031-35	2036-40	2025-40
72101 Tool and die makers	1,250	1,400	1,400	4,260
72106 Welders and related machine operators	1,380	1,530	1,530	4,650
72200 Electricians (except industrial and power system)	80	90	90	270
72201 Industrial electricians	530	610	620	1,850
72400 Construction millwrights and industrial mechanics	1,410	1,590	1,590	4,800
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	360	410	410	1,250
73300 Transport truck drivers	700	790	790	2,390
73400 Heavy equipment operators	150	170	170	500
75101 Material handlers	3,610	4,060	4,060	12,290
82020 Supervisors, mining and quarrying	60	70	70	210
83100 Underground production and development miners	100	110	110	330
84100 Underground mine service and support workers	30	30	30	90
90010 Manufacturing managers	2,620	2,960	2,960	8,940
92020 Supervisors, motor vehicle assembling	570	690	710	2,060
92021 Supervisors, electronics and electrical products manufacturing	130	170	160	480
92023 Supervisors, other mechanical and metal products manufacturing	50	50	50	160
92024 Supervisors, other products manufacturing and assembly	60	70	70	200
93100 Central control and process operators, mineral and metal processing	70	90	80	260
93101 Central control and process operators, petroleum, gas and chemical processing	200	230	220	680
94100 Machine operators, mineral and metal processing	190	220	220	660
94101 Foundry workers	70	80	80	230
94104 Inspectors and testers, mineral and metal processing	140	150	150	460
94105 Metalworking and forging machine operators	550	620	620	1,880
94106 Machining tool operators	520	580	580	1,760
94110 Chemical plant machine operators	170	190	190	580
94111 Plastics processing machine operators	1,070	1,200	1,200	3,640

Replacement Demand	2026-30	2031-35	2036-40	2025-40
94200 Motor vehicle assemblers, inspectors and testers	6,010	6,830	6,880	20,680
94201 Electronics assemblers, fabricators, inspectors and testers	1,020	1,180	1,170	3,520
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	140	180	180	520
94204 Mechanical assemblers and inspectors	170	200	200	600
94212 Plastic products assemblers, finishers and inspectors	330	370	370	1,110
94213 Industrial painters, coaters and metal finishing process operators	400	460	460	1,380
95100 Labourers in mineral and metal processing	390	440	440	1,340
95102 Labourers in chemical products processing and utilities	80	90	90	280
95109 Other labourers in processing, manufacturing and utilities	2,160	2,440	2,440	7,380

Recruitment Gap (#)

The recruitment gap is defined as expansion demand plus replacement demand less new entrants. Values for each column in Table 10 are expressed as the recruitment gap relative to 2022 base year employment.

Table 9. Recruitment gap (#) – detailed results (Ontario)

Replacement Demand	2026-30	2031-35	2036-40	2025-40
11200 Human resources professionals	660	740	740	2,240
13201 Production and transportation logistics coordinators	350	400	390	1,190
14400 Shippers and receivers	1,690	1,910	1,900	5,770
14402 Production logistics workers	70	80	80	230
20010 Engineering managers	820	920	920	2,790
20012 Computer and information systems managers	1,240	1,400	1,400	4,240
21101 Chemists	180	200	200	610
21211 Data scientists	60	70	70	200
21220 Cybersecurity specialists	150	170	170	520
21221 Business systems specialists	390	430	430	1,310
21222 Information systems specialists	2,520	2,810	2,810	8,540
21223 Database analysts and data administrators	230	260	260	780

Replacement Demand	2026-30	2031-35	2036-40	2025-40
21230 Computer systems developers and programmers	470	520	520	1,570
21231 Software engineers and designers	1,270	1,410	1,410	4,310
21232 Software developers and programmers	1,080	1,210	1,210	3,680
21233 Web designers	130	140	140	420
21234 Web developers and programmers	450	500	500	1,520
21301 Mechanical engineers	1,410	1,570	1,570	4,770
21310 Electrical and electronics engineers	1,420	1,590	1,590	4,800
21311 Computer engineers (except software engineers and designers)	530	590	590	1,790
21320 Chemical engineers	200	220	220	660
21321 Industrial and manufacturing engineers	370	420	420	1,260
21322 Metallurgical and materials engineers	80	80	80	250
21330 Mining Engineers	70	70	70	220
22100 Chemical technologists and technicians	160	180	180	550
22220 Computer network and web technicians	510	570	570	1,730
22222 Information systems testing technicians	130	150	150	440
22301 Mechanical engineering technologists and technicians	850	960	960	2,900
22302 Industrial engineering and manufacturing technologists and technicians	580	650	650	1,970
22310 Electrical and electronics engineering technologists and technicians	850	960	960	2,910
22312 Industrial instrument technicians and mechanics	60	60	60	200
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	470	530	530	1,600
72020 Contractors and supervisors, mechanic trades	140	160	160	480
72100 Machinists and machining and tooling inspectors	1,500	1,660	1,660	5,060
72101 Tool and die makers	1,250	1,400	1,400	4,260
72106 Welders and related machine operators	1,380	1,530	1,530	4,650
72200 Electricians (except industrial and power system)	80	90	90	270
72201 Industrial electricians	530	610	620	1,850
72400 Construction millwrights and industrial mechanics	1,410	1,590	1,590	4,800

Replacement Demand	2026-30	2031-35	2036-40	2025-40
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	360	410	410	1,250
73300 Transport truck drivers	700	790	790	2,390
73400 Heavy equipment operators	150	170	170	500
75101 Material handlers	3,610	4,060	4,060	12,290
82020 Supervisors, mining and quarrying	60	70	70	210
83100 Underground production and development miners	100	110	110	330
84100 Underground mine service and support workers	30	30	30	90
90010 Manufacturing managers	2,620	2,960	2,960	8,940
92020 Supervisors, motor vehicle assembling	570	690	710	2,060
92021 Supervisors, electronics and electrical products manufacturing	130	170	160	480
92023 Supervisors, other mechanical and metal products manufacturing	50	50	50	160
92024 Supervisors, other products manufacturing and assembly	60	70	70	200
93100 Central control and process operators, mineral and metal processing	70	90	80	260
93101 Central control and process operators, petroleum, gas and chemical processing	200	230	220	680
94100 Machine operators, mineral and metal processing	190	220	220	660
94101 Foundry workers	70	80	80	230
94104 Inspectors and testers, mineral and metal processing	140	150	150	460
94105 Metalworking and forging machine operators	550	620	620	1,880
94106 Machining tool operators	520	580	580	1,760
94110 Chemical plant machine operators	170	190	190	580
94111 Plastics processing machine operators	1,070	1,200	1,200	3,640
94200 Motor vehicle assemblers, inspectors and testers	6,010	6,830	6,880	20,680
94201 Electronics assemblers, fabricators, inspectors and testers	1,020	1,180	1,170	3,520
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	140	180	180	520
94204 Mechanical assemblers and inspectors	170	200	200	600

Replacement Demand	2026-30	2031-35	2036-40	2025-40
94212 Plastic products assemblers, finishers and inspectors	330	370	370	1,110
94213 Industrial painters, coaters and metal finishing process operators	400	460	460	1,380
95100 Labourers in mineral and metal processing	390	440	440	1,340
95102 Labourers in chemical products processing and utilities	80	90	90	280
95109 Other labourers in processing, manufacturing and utilities	2,160	2,440	2,440	7,380

Recruitment Gap (% of 2022 base year employment)

Recruitment gap values from the previous table are expressed in Table 11 as a percentage of 2022 base year employment.

For example: If the recruitment gap percentage is 100%, then employment in the occupation would have to double in size relative to 2022 employment levels (taking into consideration demographic and immigration supply-side transitions in the labour market) to meet increased demand associated with the ICEV-EV transition as defined by the base case scenario.

Table 10. Recruitment gap (% of 2022 base year employment) – detailed results (Ontario)

Replacement Demand	2026-30	2031-35	2036-40	2025-40
11200 Human resources professionals	660	740	740	2,240
13201 Production and transportation logistics coordinators	350	400	390	1,190
14400 Shippers and receivers	1,690	1,910	1,900	5,770
14402 Production logistics workers	70	80	80	230
20010 Engineering managers	820	920	920	2,790
20012 Computer and information systems managers	1,240	1,400	1,400	4,240
21101 Chemists	180	200	200	610
21211 Data scientists	60	70	70	200
21220 Cybersecurity specialists	150	170	170	520
21221 Business systems specialists	390	430	430	1,310
21222 Information systems specialists	2,520	2,810	2,810	8,540
21223 Database analysts and data administrators	230	260	260	780
21230 Computer systems developers and programmers	470	520	520	1,570
21231 Software engineers and designers	1,270	1,410	1,410	4,310
21232 Software developers and programmers	1,080	1,210	1,210	3,680

Replacement Demand	2026-30	2031-35	2036-40	2025-40
21233 Web designers	130	140	140	420
21234 Web developers and programmers	450	500	500	1,520
21301 Mechanical engineers	1,410	1,570	1,570	4,770
21310 Electrical and electronics engineers	1,420	1,590	1,590	4,800
21311 Computer engineers (except software engineers and designers)	530	590	590	1,790
21320 Chemical engineers	200	220	220	660
21321 Industrial and manufacturing engineers	370	420	420	1,260
21322 Metallurgical and materials engineers	80	80	80	250
21330 Mining Engineers	70	70	70	220
22100 Chemical technologists and technicians	160	180	180	550
22220 Computer network and web technicians	510	570	570	1,730
22222 Information systems testing technicians	130	150	150	440
22301 Mechanical engineering technologists and technicians	850	960	960	2,900
22302 Industrial engineering and manufacturing technologists and technicians	580	650	650	1,970
22310 Electrical and electronics engineering technologists and technicians	850	960	960	2,910
22312 Industrial instrument technicians and mechanics	60	60	60	200
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	470	530	530	1,600
72020 Contractors and supervisors, mechanic trades	140	160	160	480
72100 Machinists and machining and tooling inspectors	1,500	1,660	1,660	5,060
72101 Tool and die makers	1,250	1,400	1,400	4,260
72106 Welders and related machine operators	1,380	1,530	1,530	4,650
72200 Electricians (except industrial and power system)	80	90	90	270
72201 Industrial electricians	530	610	620	1,850
72400 Construction millwrights and industrial mechanics	1,410	1,590	1,590	4,800
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	360	410	410	1,250
73300 Transport truck drivers	700	790	790	2,390
73400 Heavy equipment operators	150	170	170	500
75101 Material handlers	3,610	4,060	4,060	12,290

Replacement Demand	2026-30	2031-35	2036-40	2025-40
82020 Supervisors, mining and quarrying	60	70	70	210
83100 Underground production and development miners	100	110	110	330
84100 Underground mine service and support workers	30	30	30	90
90010 Manufacturing managers	2,620	2,960	2,960	8,940
92020 Supervisors, motor vehicle assembling	570	690	710	2,060
92021 Supervisors, electronics and electrical products manufacturing	130	170	160	480
92023 Supervisors, other mechanical and metal products manufacturing	50	50	50	160
92024 Supervisors, other products manufacturing and assembly	60	70	70	200
93100 Central control and process operators, mineral and metal processing	70	90	80	260
93101 Central control and process operators, petroleum, gas and chemical processing	200	230	220	680
94100 Machine operators, mineral and metal processing	190	220	220	660
94101 Foundry workers	70	80	80	230
94104 Inspectors and testers, mineral and metal processing	140	150	150	460
94105 Metalworking and forging machine operators	550	620	620	1,880
94106 Machining tool operators	520	580	580	1,760
94110 Chemical plant machine operators	170	190	190	580
94111 Plastics processing machine operators	1,070	1,200	1,200	3,640
94200 Motor vehicle assemblers, inspectors and testers	6,010	6,830	6,880	20,680
94201 Electronics assemblers, fabricators, inspectors and testers	1,020	1,180	1,170	3,520
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	140	180	180	520
94204 Mechanical assemblers and inspectors	170	200	200	600
94212 Plastic products assemblers, finishers and inspectors	330	370	370	1,110
94213 Industrial painters, coaters and metal finishing process operators	400	460	460	1,380
95100 Labourers in mineral and metal processing	390	440	440	1,340

Replacement Demand	2026-30	2031-35	2036-40	2025-40
95102 Labourers in chemical products processing and utilities	80	90	90	280
95109 Other labourers in processing, manufacturing and utilities	2,160	2,440	2,440	7,380

Appendix E – Skills Transferability Matrix (STM) Example

FOCAL has developed Skills Transferability Matrices (STMs) using artificial intelligence (AI) and complex algorithms for occupations in the sector to help identify transferable skills, tasks, technical knowledge and abilities across other occupations and sectors. A sample STM is shown below (Figure 17). See the FOCAL website (www.futureautolabourforce.ca) for a more detailed description and additional STMs.

Figure 31. Skills transferability matrix – electronic assemblers, fabricators, inspectors and testers

Electronic Assemblers, Fabricators, Inspectors and Testers					
Occupations	Skills	Technology	Tasks	Abilities	Total
Machine operators and inspectors, electrical apparatus manufacturing	96%	100%	74%	96%	92%
Assemblers and inspectors, electrical appliance, apparatus & equipment manufacturing	96%	100%	74%	95%	91%
Assemblers, fabricators and inspectors, industrial electrical motors and transformers	94%	100%	75%	94%	91%
Mechanical assemblers and inspectors	94%	92%	60%	92%	84%
Boat assemblers and inspectors	92%	92%	61%	91%	84%
Motor vehicle assemblers, inspectors and testers	93%	92%	58%	91%	83%
Other products assemblers, finishers and inspectors	92%	92%	58%	91%	83%
Plastic products assemblers, finishers and inspectors	92%	92%	56%	93%	83%
Inspectors and testers, mineral and metal processing	91%	92%	54%	91%	82%
Inspectors and graders, textile, fabric, fur and leather products manufacturing	91%	92%	54%	91%	82%
Machining tool operators	88%	63%	34%	84%	67%
Metalworking and forging machine operators	88%	54%	41%	82%	66%
Contractors and supervisors, machining and metal forming trades	71%	58%	12%	81%	56%
Industrial painters, coaters and metal finishing process operators	89%	21%	23%	86%	55%
Supervisors, electrical products manufacturing	67%	54%	12%	78%	53%