FOCAL Initiative

ICEV TO EV WORKFORCE TRANSITION LABOUR MARKET FORECAST

GOLDEN HORSESHOE 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.

This project is funded in part by the Government of Canada's Sectoral Workforce Solutions Program

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Executive Summary

Ontario's Golden Horseshoe region 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's Golden Horseshoe region for 67 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, for the Golden Horseshoe region, focuses on 17 occupations that are expected to experience significant impacts during the transition. The magnitude and timing of impacts are unique for each occupation. For example, in the Golden Horseshoe region, a large recruitment gap is expected to occur *consistently* for occupations such as manufacturing managers, motor vehicle assemblers, and construction millwrights/industrial mechanics. Most of the large recruitment gaps increase as the transition gains momentum with a peak between 2031 and 2035, and then gradually drop until 2040. This pattern is reported for;

- industrial electricians,
- electronics/electrical product manufacturing supervisors,
- electrical/electronics engineering technologists and technicians,
- motor vehicle assemblers, inspectors and tester
- electronics assemblers, fabricators, inspectors and testers and
- chemical plant operators.

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.

These labour market impacts are specific to the Golden Horseshoe region and are closely tied to a detailed scenario tracking the expected shift in vehicle assembly to EVs and the timing of investments in battery plants and related supply chain changes. Results will be different at provincial levels and across the five Ontario regions described in companion FOCAL II reports. Each region has unique industrial and demographic characteristics and labour market supply-demand dynamics are different. 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, Ontario, and five regions within Ontario. The scale and impact of the broader industry was expanded to show important links to the rest of the economy. Motor vehicle assembly and related activity are critical to the overall wellbeing 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[1].

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. This report considers the impact of the ICEV – EV transition in the Golden Horseshoe region of Ontario. The FOCAL II initiative is helping the many employers and job seekers active in the industry in the Golden Horseshoe region to 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 guided 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 plants and related changes across the supply chain. This analysis 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;

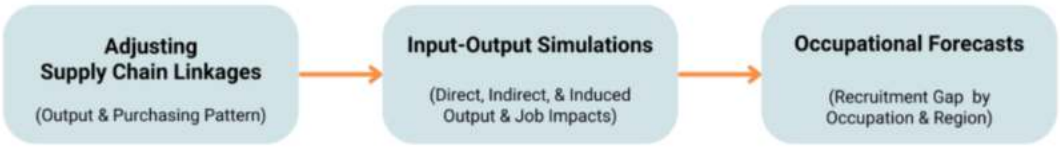
- a transition horizon from 2025 to 2040,
- 49 selected NAICS industries in
- Canada, Ontario, Quebec, Manitoba and seven regions.

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 67 key occupations for the Golden Horseshoe (Greater Toronto Area, Hamilton and Niagara) region.

[1] Source: Government of Canada Trade Data Online (https://ised-isde.canada.ca/site/trade-data-online/en).

Figure 1. Impact analysis steps



The path of the transition will be 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 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 analysis in the regions.

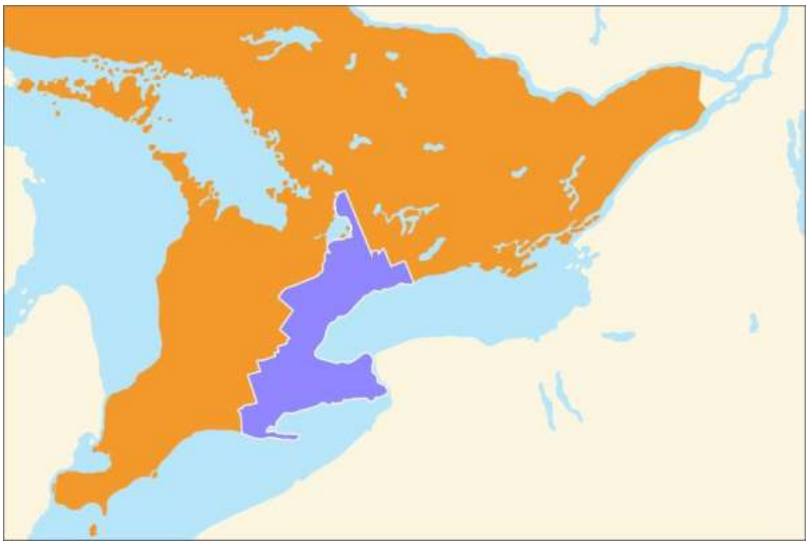
The base case scenario describes an ICEV-EV transition that will comprise both job gains and losses, changes in employment conditions, and related labour market disruptions for selected industries and occupations. Direct impacts spread out from vehicle assembly and new battery plants to alter activity across the supply chain. This includes parts producers, 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 in 17 selected occupations (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)[2].

This introduction is followed by a background on the Golden Horseshoe region of Ontario. This region is a center for production and employment in the traditional automotive industry (including vehicle assembly and parts manufacturing) and extends it to closely connected 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 17 selected occupations. Conclusions and implications are a reviewed in the final section. A list of the industries and occupations selected for the analysis, the methodology applied in the labour market models, tables of detailed impacts for the occupations and a note on skills transferability matrices are included in the appendices.

[2] 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 Golden Horseshoe region includes two Economic Regions (ERs): Toronto and Hamilton-Niagara Peninsula. The Toronto ER is the larger of the two regions and includes the cities of Toronto, Oshawa, and Oakville. The Niagara-Hamilton Peninsula includes the cities Burlington, Hamilton, and St. Catharines.



The region is home to three large OEM assembly plants: an FCA (Fiat Chrysler) plant in Brampton, a General Motors plant in Oshawa, and Ford assembly in Oakville. There are additional OEM plants located in Etobicoke which produces castings for FCA and a General Motors powertrain assembly in St. Catharines. These plants employed an estimated 12,100 workers combined in 2018. There are an estimated 184 parts suppliers in the region. Out this total, 172 of these establishments are located in the Toronto ER. Employment across all parts suppliers in the Toronto ER is estimated at nearly 32,300 in 2018. The remaining parts suppliers reside in the Hamilton-Niagara Peninsula ER where estimated employment in parts supplying is 4,700.
The coming transition from ICEVs to EVs is a major change for the Golden Horseshoe regional economy. In 2022, the regional workforce of 4,518,500 included 430,100 working in manufacturing and 33,800 in the core automotive assembly and parts industries[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:

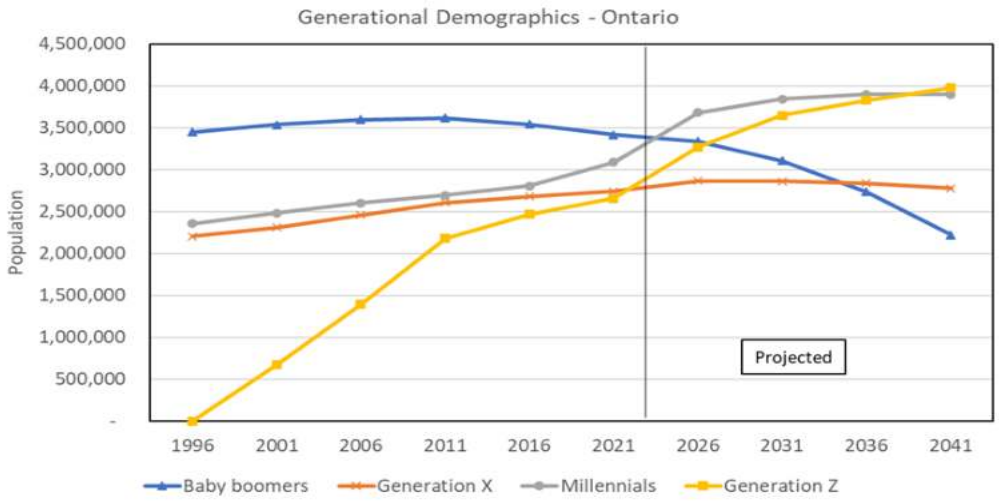
> "Businesses in manufacturing were the most likely to expect challenges recruiting staff and these levels have remained unchanged when compared to 2022. In the second quarter of 2023, nearly half (48.4%) of businesses in manufacturing expected recruiting

[3] Total employment and manufacturing employment estimates are from Metro Economics. Automotive assembly (NAICS 3361) and parts industries (NAICS 3363) employment estimates are based on data from Statistics Canada Labour Statistics Consistent with the System of National Accounts (Table 36-10-0489-01) and Automotive Policy Research Centre (APRC).

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]

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

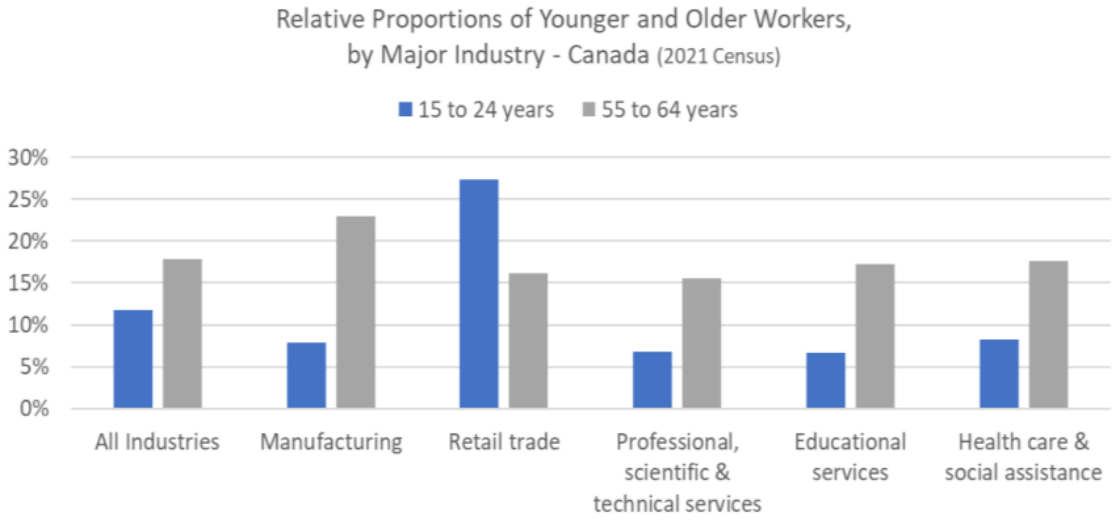


Demographic trends are not consistent across industries, however. In the manufacturing sector, there continues to be a higher proportion of older workers and a lower proportion of younger workers. As shown in Figure 3 (below), of the five largest industry sectors in Ontario, the manufacturing sector 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.

[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 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.

[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).

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
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.

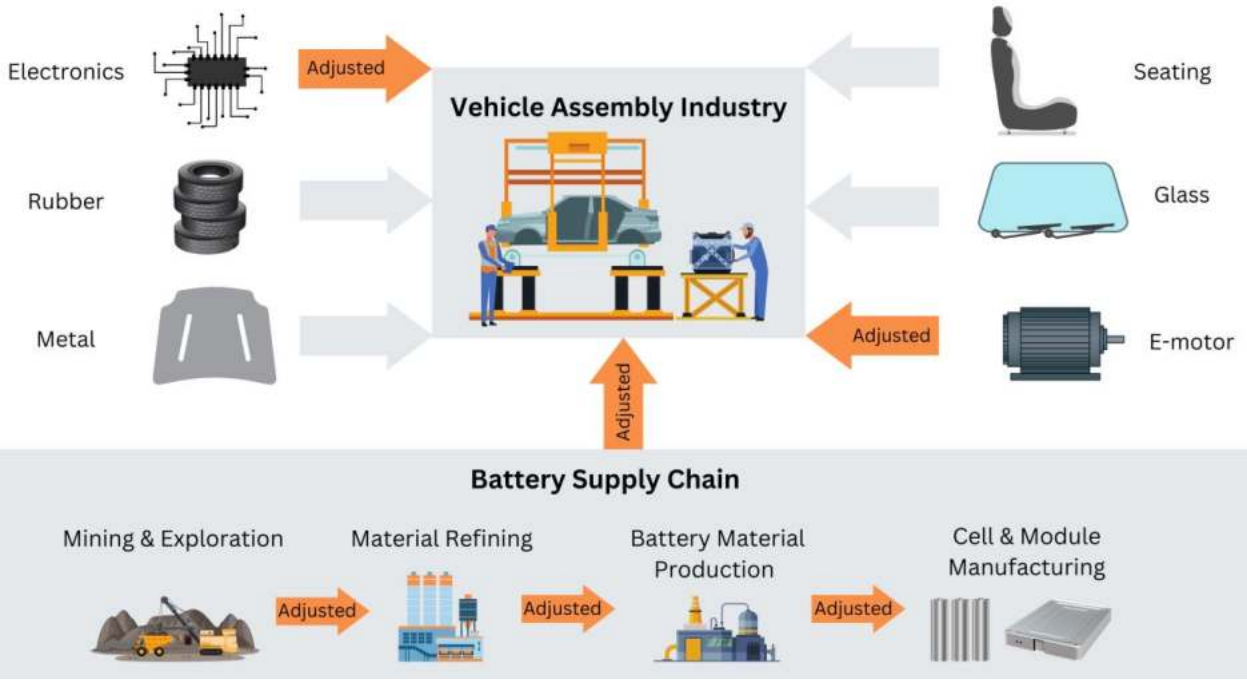
Some of these investments are concentrated in the Golden Horseshoe region and across other Ontario regions. Changes in the Golden Horseshoe region are more focused on assembly with new battery plants destined for other regions. Indeed, the distribution of these different investments across regions effects the distribution of impacts on occupations that is apparent in section 4. 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 analysis of announced investment and assembly plans to include the broader impact of these changes across the vehicle supply chain and then the overall economy of the Golden Horseshoe region.

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 over a fixed period of time. 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.

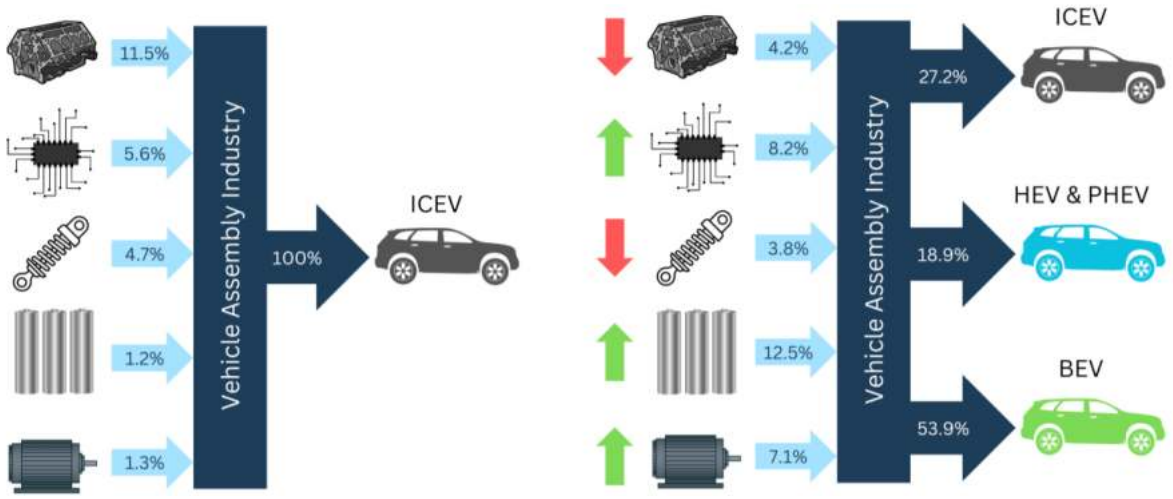
Figure 4. Adjusting automotive and battery manufacturing supply chain linkages for the impact analysis



[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

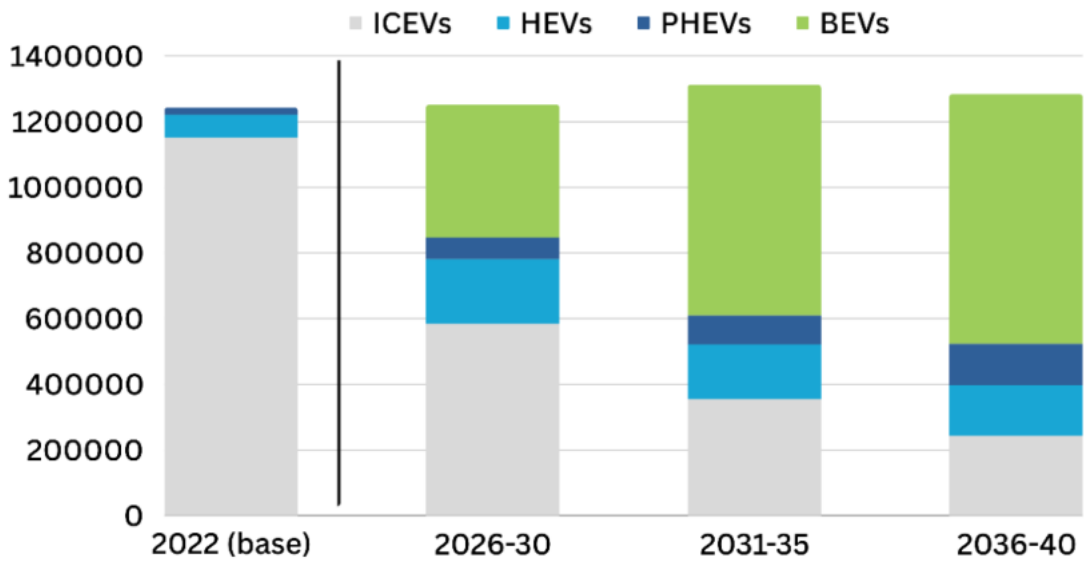
A base case scenario has been developed that combines key assumptions across these categories. The magnitude and timing of these assumptions are expressed in terms of total employment impacts by industry, which are then transformed into detailed occupational impacts.

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).

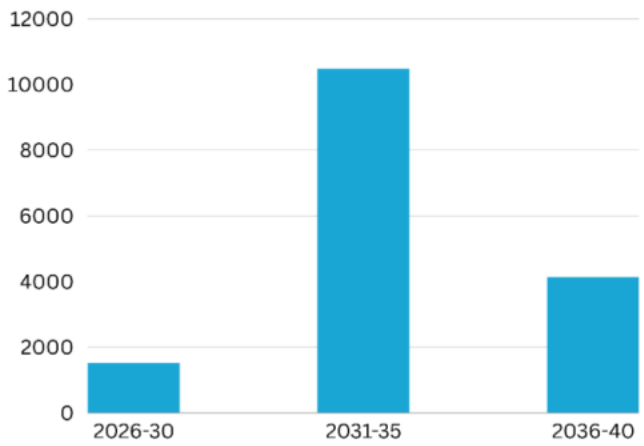
Table 2. Base case scenario - battery supply chain assumptions

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

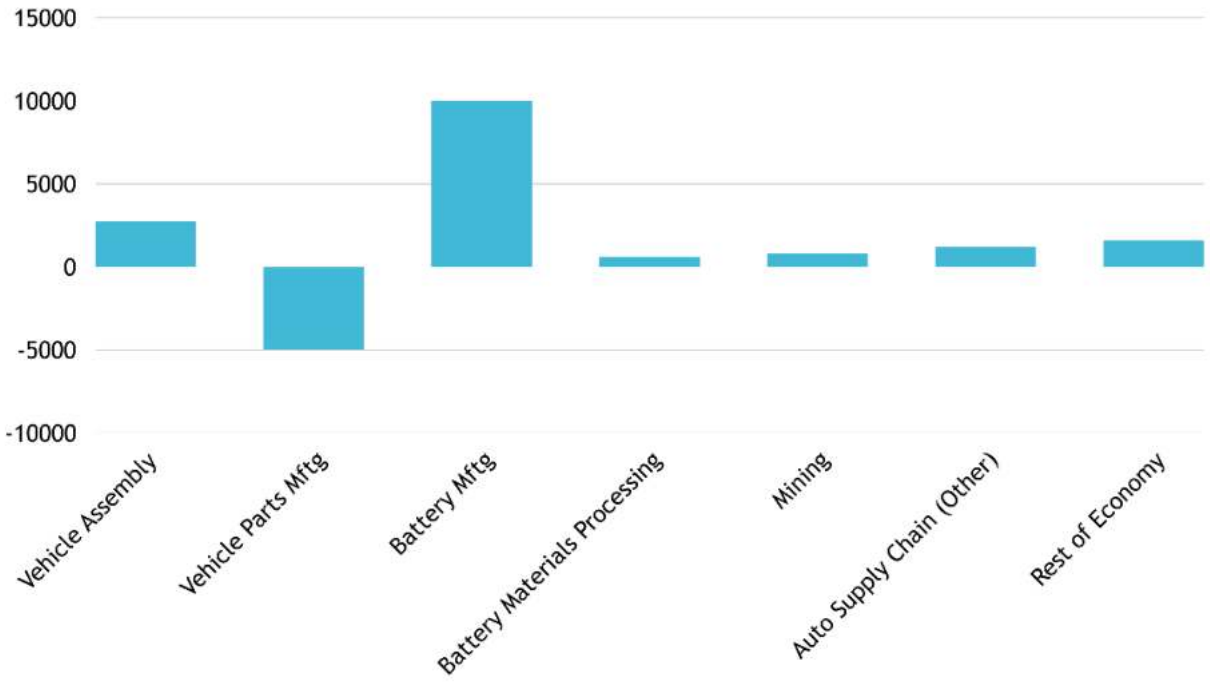
Figure 7 summarizes the total employment impacts in the base case scenario in three intervals of the transition. The total impact is positive, with gains in each of the three five-year intervals, as new activity in battery production and its supply are large enough to offset employment losses related 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 Golden Horseshoe 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 the Golden Horseshoe regional labour markets for 17 occupations. 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 most important supply-side trends are in demographics and immigration.

Occupations that are concentrated in the broader automotive sector and in key regions, like the Golden Horseshoe region, 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. Seventeen occupations that are working in the selected industries (listed in Appendix A) are the focus of this section.

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 17 occupations in the Golden Horseshoe region 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 26, 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 right panel of Figures 10 to 26, the recruitment gap for each time interval is expressed as the percentage change in employment relative to the starting level 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 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 double in size to meet expansion and replacement 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 heavily 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.

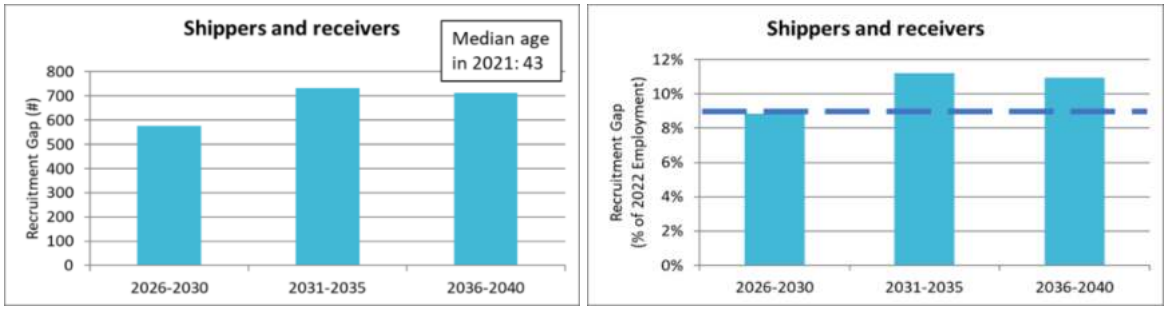
Selected Occupations

A review of the labour market impacts across the Golden Horseshoe region reveals 17 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-hand panel, in each of the following figures, contains a horizontal bar at 9%. This is the average recruitment gap for all of the selected occupations in the FOCAL II analysis within the Golden Horseshoe region 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 a box insert in the left-hand 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 its supply chain but are less prominent in assembly. This is a relatively large workforce and there are notable increases in the recruiting gaps between 2031 and 2035 in the transition. The age profile for this occupation (median age 43) is similar to all occupations (median age 42) in the selected industries in the region.

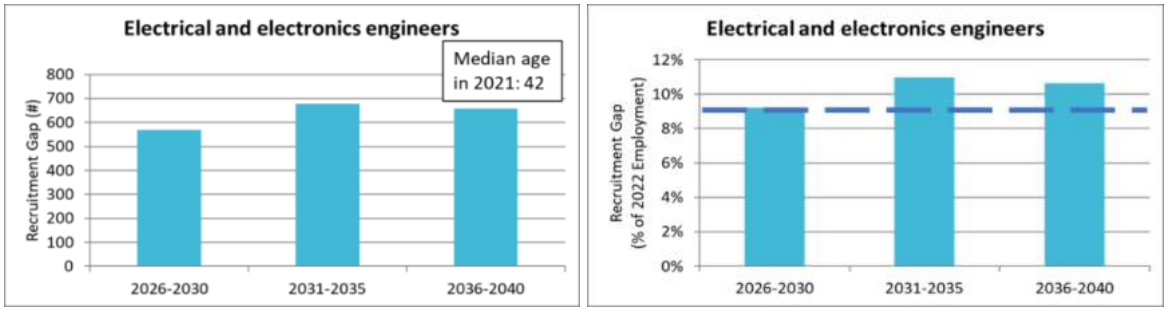
Figure 10. Recruitment gap - shippers and receivers



[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's Golden Horseshoe region is 42 years old in 2021.

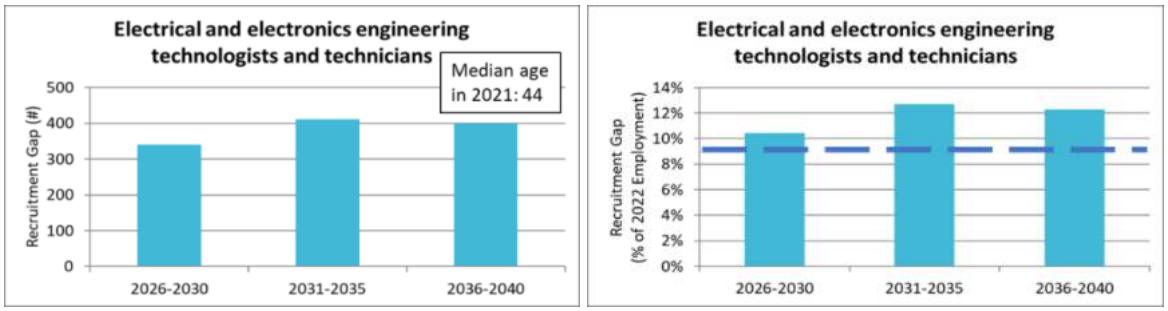
Electrical and electronics engineers (Figure 11): There is a notable shift within engineering occupations with electrical engineers increasing their share of employment. In contrast, impacts for mechanical and other engineering disciplines are limited ICEV assembly declines. Expansion demand is higher for electrical and electronic engineers that for any other engineering group. Electrical engineering is well represented in both the battery and assembly industries. A somewhat younger age profile will limit recruiting challenges. Labour market tensions will ease at the end of the transition as retirement demands declines.

Figure 11. Recruitment gap – electrical and electronics engineers



Electrical and electronics engineering technologists and technicians (Figure 12): The shift within engineering occupations, with electrical engineering increasing its share of employment, also appears for the electrical engineering technicians and technologists. This occupation 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. The age profile for this occupation is similar to the median age for all occupations in the selected industries in the region.

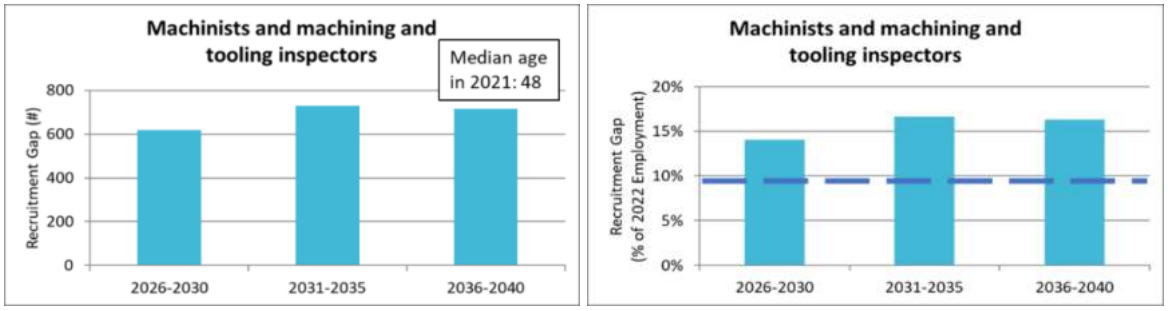
Figure 12. Recruitment gap – electrical and electronics engineering technologists and technicians



Machinists and machining and tooling inspectors (Figure 13): 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 2040 as the transition gains momentum. Note that machinists, and the other skilled trades that follow, are well represented in the traditional parts industries. Expansion demand estimated here is a net calculation that captures both gains from new EV related production and losses in the parts industry as employment falls there across the

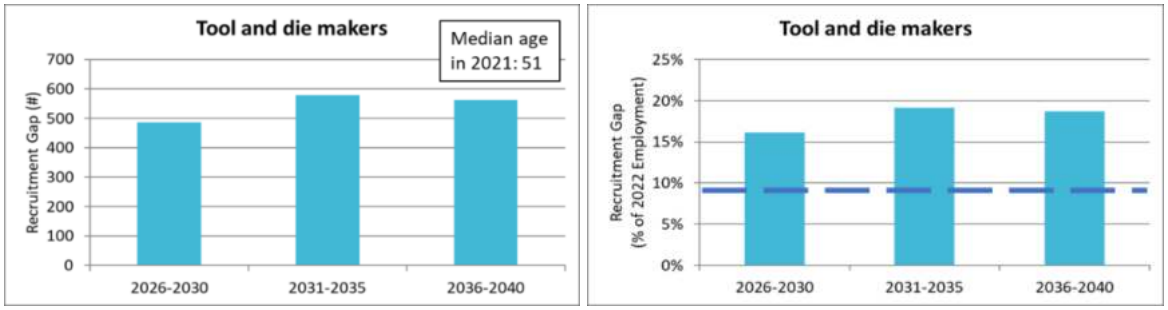
transition. Workers in this trade are older (with a median age of 48), compared to workers in all occupations across the industries selected for this analysis.

Figure 13. Recruitment gap – machinists and machining and tooling inspectors



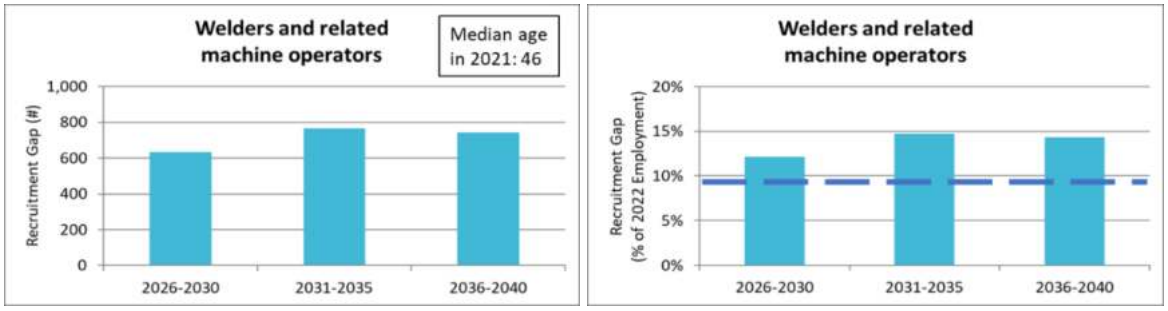
Tool and die makers (Figure 14): This trade plays a moderate role in both battery production and assembly. Impacts on employment here will create higher recruitment gaps as the transition moves forward. Note that tool and die makers and the other trades are well represented in the traditional parts industries. Expansion demand estimated here is a net calculation that captures both gains from new EV related production and losses in the parts industry as employment falls there across the transition. The older age profile and very high recruitment gaps characterize starting conditions as the transition begins.

Figure 14. Recruitment gap – tool and die makers



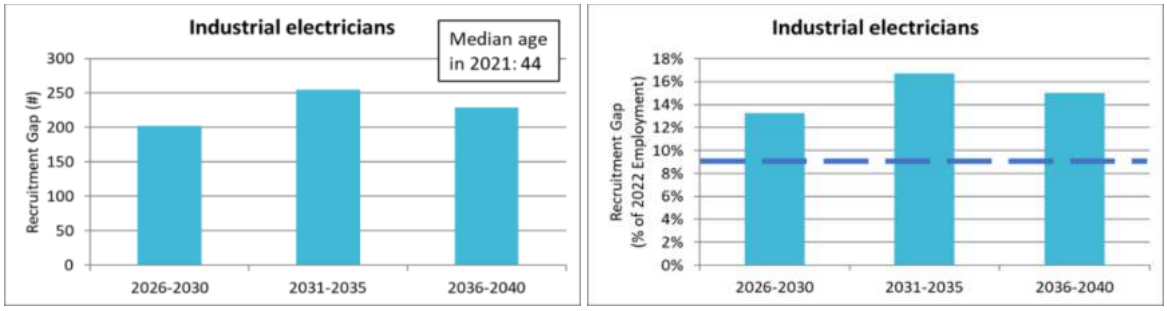
Welders and related machine operators (Figure 15): Welders are included to emphasize the general shortages among the skilled trades. Welders are reported to be working in all the key industries – but are most heavily represented in the traditional parts industry. As noted in the other trades, the expansion demand for welders includes both gains in assembly and battery production and possible job losses in the traditional parts industries. A moderately old age profile (with a median age of 46) would contribute to the above average recruitment gaps.

Figure 15. Recruitment gap – welders and related machine operators



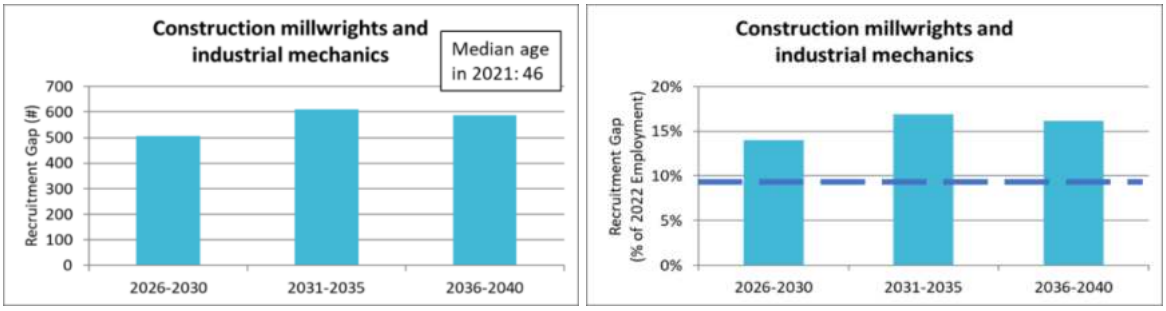
Industrial electricians (Figure 16): This skilled trade plays a moderately stronger role in the assembly industry compared to battery plants. An increasing role here will create higher recruitment gaps as the transition moves forward. Industrial engineers have an age profile comparable to all occupations in the selected industries in this region, and a lower recruitment gap at the start of the transition.

Figure 16. Recruitment gap - industrial electricians



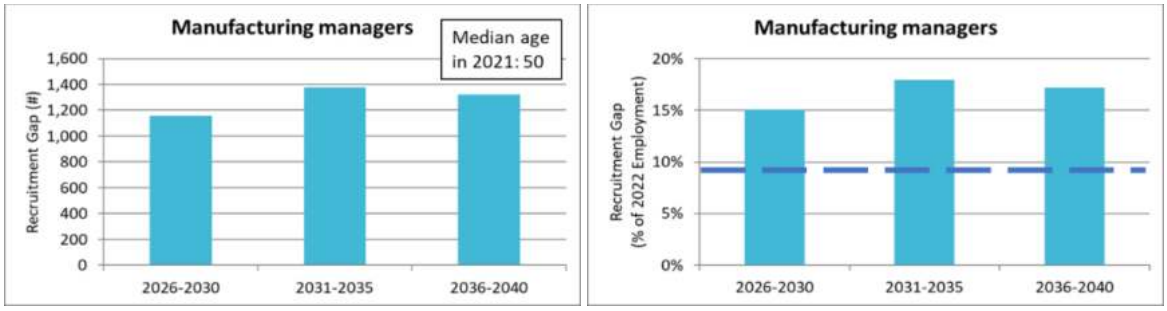
Construction millwrights and industrial mechanics (Figure 17): This trade plays a notable role in both assembly and battery industries and will be key in the startup of new production processes. Millwrights have a strong share in the traditional parts industry and some jobs may be lost here across the transition. Employment impacts here will create higher recruitment gaps as the transition moves forward. The trade has an older age profile (with a median age of 46), with moderate recruitment gaps at start and a moderate peak indicating a modest ICEV-EV impact.

Figure 17. Recruitment gap – construction millwrights and industrial mechanics



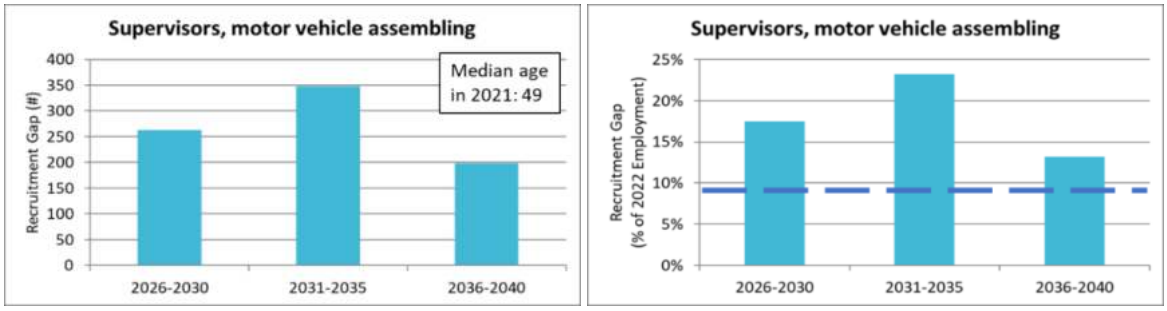
Manufacturing managers (Figure 18): This occupation has a notably high representation in all of the selected industries but especially in battery production, so that the transition aggravates already large recruitment gaps. There is an older age profile for this occupation (with a median age of 50), with a high recruitment gap at the start and across the transition.

Figure 18. Recruitment gap – manufacturing managers



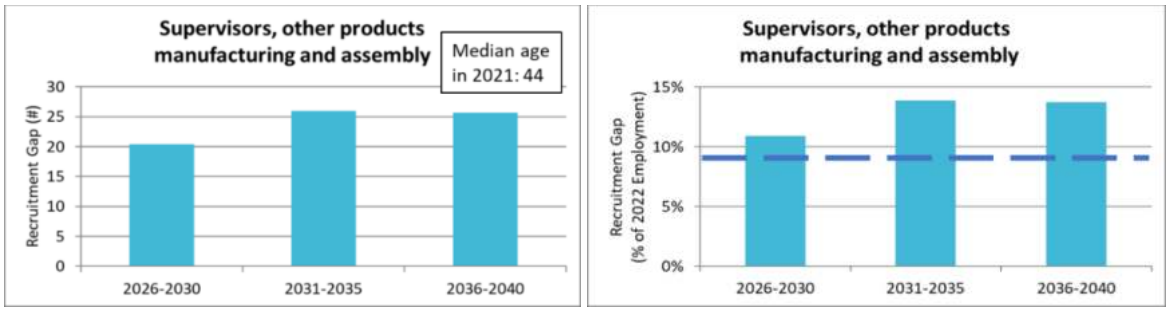
Supervisors, motor vehicle assembling (Figure 19): This workforce will be on the front line of the market adjustments as the transition moves forward. In the base case scenario total assembly grows only moderately but there is a shift from ICEV to hybrids and EVs that will alter working conditions. The workforce has an older age profile (with a median age of 49), and high recruitment gap at the start with sharp peak indicates significant ICEV-EV impact. This is a large workforce and the sharp peak in recruiting in the 2031 – 2035 period signals challenges for this occupation.

Figure 19. Recruitment gap – supervisors, motor vehicle assembling



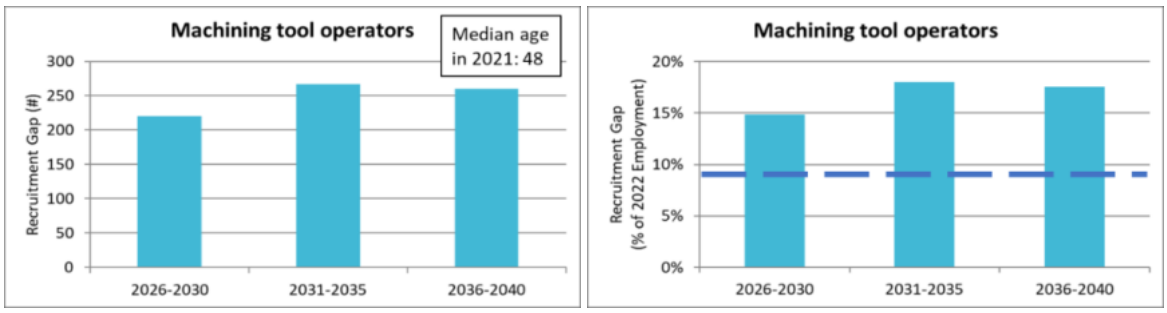
<u>*Supervisors, other products manufacturing and assembly*</u> (Figure 20): This workforce is included to reflect relatively high recruitment gaps that emerge across the supply chain. These demands are outside of the assembly and battery industries. The starting recruitment gap for this group is low and there is a steep gain in hiring challenges in the next five years.

Figure 20. Recruitment gap – supervisors, other products manufacturing and assembly



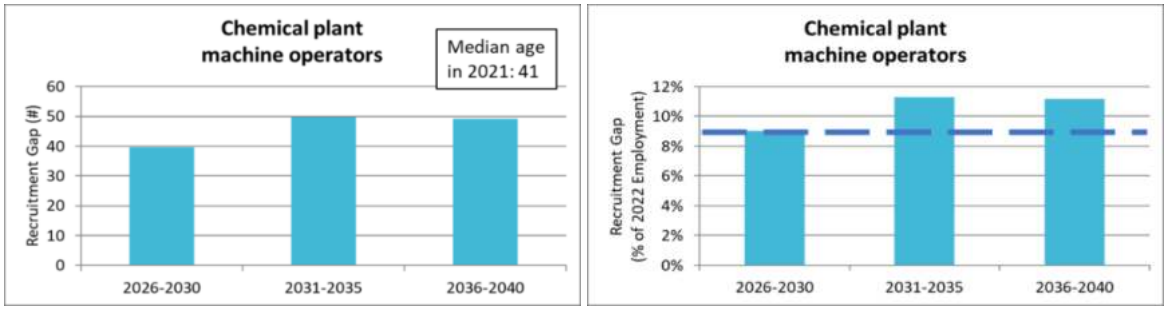
<u>*Machining tool operators*</u> (Figure 21): This occupation is included to mark the very high gap in an important skill. These operators are not, generally, working in the core vehicle and battery related industries. But the impact of the transition reaches them as indirect impacts radiates out from the direct impacts. This workforce has a high recruitment gap as the transition begins and the ICEV-EV transition will add to these challenges. The age profile for this occupation (with a median age of 48) is relatively older than all occupations in the selected industries.

Figure 21. Recruitment gap – machining tool operators



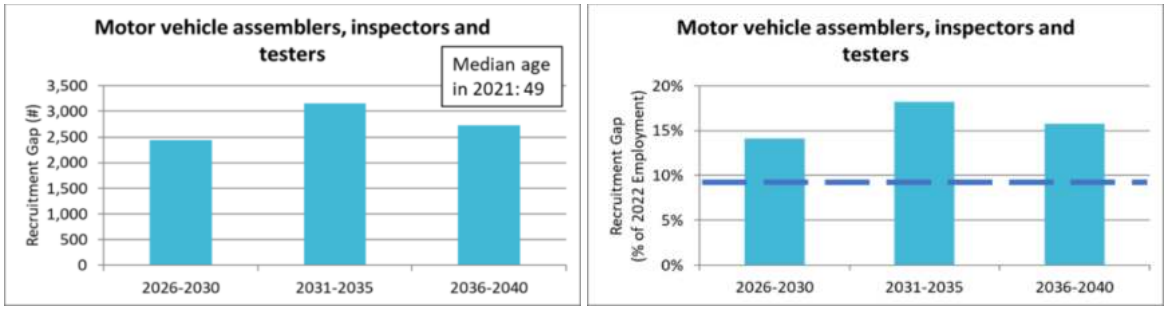
Chemical plant machine operators (Figure 22): This workforce is another example of an occupation with transition impacts farther up the supply chain as battery production begins in the 2026 – 2030 period. Current recruitment gaps are only moderate for this group and there will be an increase in challenges as the transition gains momentum.

Figure 22. Recruitment gap – chemical plant machine operators



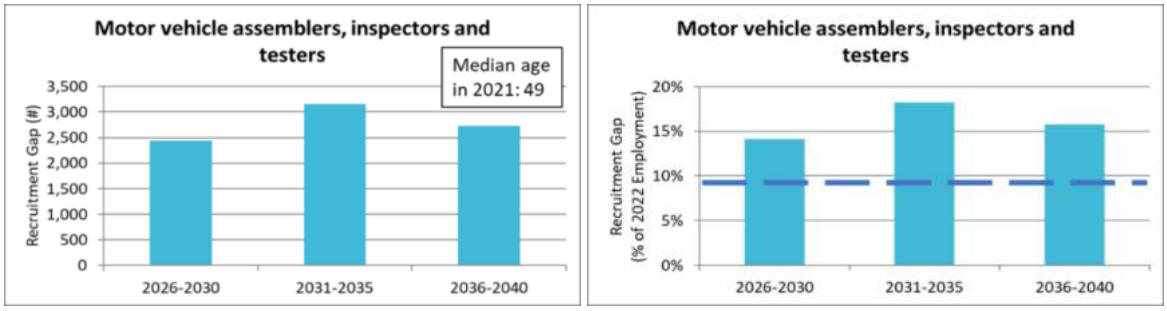
Motor vehicle assemblers, inspectors and testers (Figure 23): Conditions for this occupation capture the impacts at the end of the supply chain. As noted with other occupations, market peaks are concentrated in the 2031-2035 interval. This is the largest workforce among the selected occupations. Recruitment gaps are high as the transition is beginning. The older age profile (with a median age of 49) increases retirement and this is a continuing challenge that existed prior to the transition. The modest increase across the interval indicates a limited impact from expansion demand ICEV-EV transition as total assembly numbers do not change much. The biggest impact would be retraining ICEV assemblers for EV assembly.

Figure 23. motor vehicle assemblers, inspectors and testers



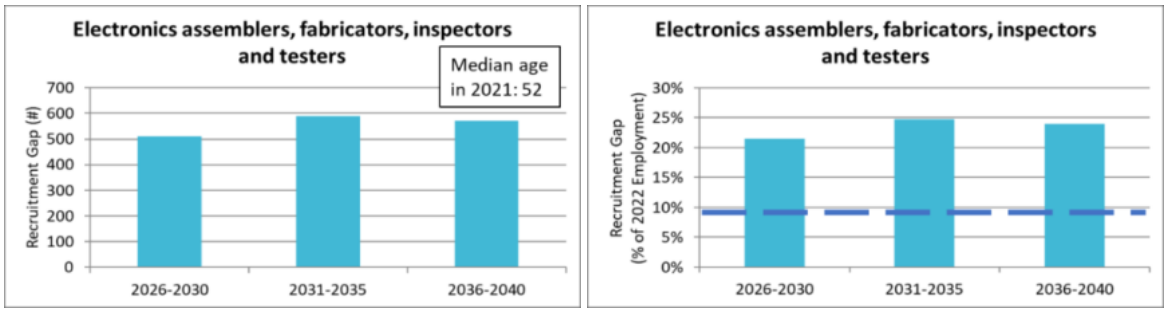
Electronics assemblers, fabricators, inspectors and testers (Figure 24): Expansion demand is strong here, with a very high peak as the battery capacity starts up in the 2026-2030 period. Recruitment gaps, as a percent of base employment, are highest of any occupations. This reflects the older age profile (median age 52) and biggest peak in recruitment as battery production comes online.

Figure 24. Recruitment gap – electronics assemblers, fabricators, inspectors and testers



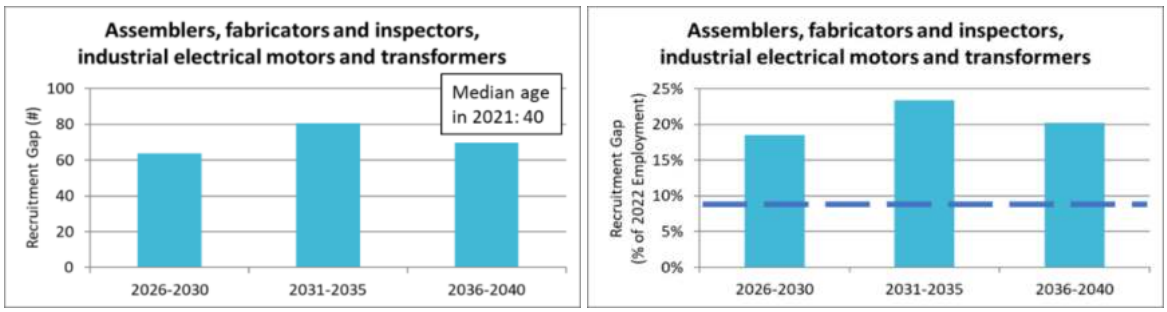
<u>*Electronics assemblers, fabricators, inspectors and testers*</u> (Figure 24): Expansion demand is strong here, with a very high peak as the battery capacity starts up in the 2026-2030 period. Recruitment gaps, as a percent of base employment, are highest of any occupations. This reflects the older age profile (median age 52) and biggest peak in recruitment as battery production comes online.

Figure 25. Recruitment gap – electronics assemblers, fabricators, inspectors and testers



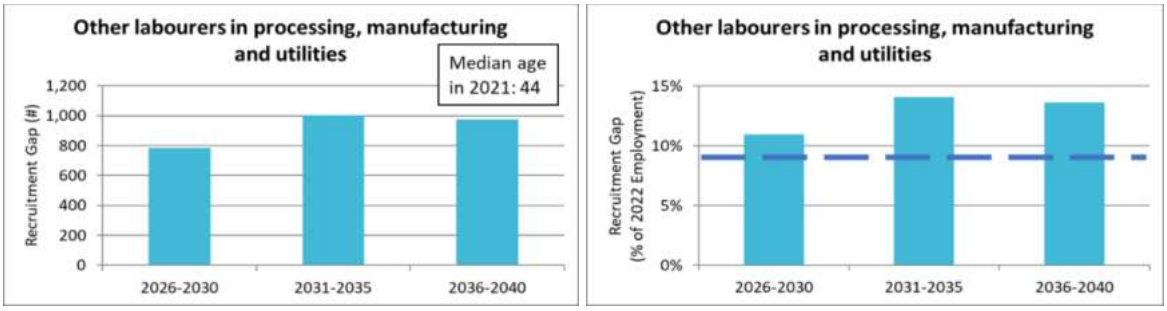
<u>*Assemblers, fabricators and inspectors, industrial electrical motors and transformers*</u> (Figure 25): This smaller workforce is traditionally employed in other electrical industries as well as in battery production. The workforce does not work in assembly. Recruitment gaps as a percent of base employment are the second highest, lagging only electronics assemblers. The younger age profile (with a median age of 40) will limit retirements.

Figure 26. Recruitment gap – assemblers, fabricators and inspectors, industrial electrical motors and transformers



Other labourers in processing, manufacturing and utilities (Figure 26): This large workforce is employed across the electrical industries engaged in battery production and its supply chain. The recruitment gap for labourers is low to start but jumps to nearly 15% of 2022 base year employment as the transition get 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 distributed across many industries. A key question would be what skills, training and experience would be needed for these changes.

Figure 27. 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 across the Golden Horseshoe region 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. Examples of this include; electronics assemblers, fabricators, inspectors and testers, manufacturing managers; electrical and electronics engineering technologists and technicians, most supervisor workforces and all of the trades.

The transition will aggravate existing skill shortages and concentrate them in electrical related occupations.

Results also show recruitment gaps peaking in the 2031-2035 interval. Direct impacts are taken from the pattern of announced investment plans and shifts in assembly. Industries in the Golden Horseshoe region will experience different changes. The spike in regional recruitment gaps in the 2031 to 2035 interval reflects the relative importance of vehicle assembly in the Golden Horseshoe.

The impacts anticipated here reflect very different types of change to employment and work conditions across industries and occupations. For most of the 17 occupations, the impacts will

be caused by added new jobs, or lost jobs in the ICEV supply chain and/or adding new skills as the workforce moves on to 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 often 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.

Notes in the engineering occupations 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 some 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 be lower 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 gains in labour productivity or relative declines in employment across the base case scenario. EVs are less labour intensive that ICEVs. 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 recruitment gaps shift across regions, industries, and occupations. 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 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[11]. An example of a skills transferability matrix for the electronic assemblers, fabricators, inspectors and testers occupation is shown in Appendix E.

11 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.

Readers are invited to review FOCAL findings for the matrices on the FOCAL website: www.futureautolabourforce.ca. The STMs will assist recruiters and job seekers as they navigate the transition of workers across occupations and sectors.

FOCAL findings offer a similar insight into the potential for inter-regional labour mobility for occupations as differences in recruitment gaps emerge in the regional analysis. For example, results reported here for the Golden Horseshoe region can be compared to results for Eastern Ontario, Kitchener-Waterloo-Barrie, London-Stratford-Bruce Peninsula, and Windsor-Sarnia regions. 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 compares labour market conditions in the Golden Horseshoe region to the other regions for the transition interval 2026 to 2030. This interval focuses on the peak level of new battery plant activity. At this time in the transition, labour markets promise to be most strained in London and Windsor-Sarnia. Seen from the perspective of recruiters and job seekers in the Golden Horseshoe region, Table 3 identifies differences in the recruitment gaps across the 17 selected occupations covered here in this report.

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 manufacturing managers into the Golden Horseshoe region from the **Eastern Ontario region**. 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 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%

Selected Occupations	Eastern Ontario	Golden Horseshoe	Kitchener-Waterloo - Barrie	London-Stratford-Bruce Peninsula	Windsor -Sarnia
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%
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 17 occupations in the Golden Horseshoe region. Recruiting challenges will emerge in these labour markets, with the peak challenges concentrated between 2026 and 2035 as new battery production and EV assembly builds to a peak. Recruiting for engineering, skilled trades and assembly occupations will face skills challenges and general shortages. For many

occupations, 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. 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 be 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 this 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 four 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 the Golden Horseshoe region. In this base case scenario, with cautious assumptions about the transition, the number of jobs created exceeds the number lost. Labour market challenges will emerge in the region as the transition from 2025 to 2040 unfolds.

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 manufacturing in the region, but the scale of EV related changes will 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 the Golden Horseshoe region, 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, 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 (Golden Horseshoe)

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 28. 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[12]. 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. 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.

[12] 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.

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 (Golden Horseshoe Region)

Expansion Demand	2026-30	2031-35	2036-40	2025-40
11200 Human resources professionals	0	10	0	0
13201 Production and transportation logistics coordinators	-10	10	0	-10
14400 Shippers and receivers	-10	30	0	-10
14402 Production logistics workers	0	0	0	0
20010 Engineering managers	0	10	0	0
20012 Computer and information systems managers	0	10	0	0
21101 Chemists	0	0	0	0
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	10	10	0	10
21223 Database analysts and data administrators	0	0	0	0
21230 Computer systems developers and programmers	0	0	0	0
21231 Software engineers and designers	10	20	-10	20
21232 Software developers and programmers	10	10	0	10
21233 Web designers	0	0	0	0
21234 Web developers and programmers	0	0	0	0
21301 Mechanical engineers	20	50	-10	30
21310 Electrical and electronics engineers	10	30	0	30
21311 Computer engineers (except software engineers and designers)	0	0	0	0
21320 Chemical engineers	0	0	0	0
21321 Industrial and manufacturing engineers	0	10	0	0
21322 Metallurgical and materials engineers	0	0	0	0

Expansion Demand	2026-30	2031-35	2036-40	2025-40
21330 Mining Engineers	0	0	0	0
22100 Chemical technologists and technicians	0	0	0	0
22220 Computer network and web technicians	0	0	0	0
22222 Information systems testing technicians	0	0	0	0
22301 Mechanical engineering technologists and technicians	0	20	0	0
22302 Industrial engineering and manufacturing technologists and technicians	0	10	0	0
22310 Electrical and electronics engineering technologists and technicians	10	20	0	10
22312 Industrial instrument technicians and mechanics	0	0	0	0
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	0	0	0	0
72020 Contractors and supervisors, mechanic trades	0	0	0	0
72100 Machinists and machining and tooling inspectors	-10	20	0	-10
72101 Tool and die makers	-10	10	-10	-20
72106 Welders and related machine operators	-10	30	-10	-10
72200 Electricians (except industrial and power system)	0	0	0	0
72201 Industrial electricians	0	20	0	10
72400 Construction millwrights and industrial mechanics	-10	20	-10	-10
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	0	20	0	10
73300 Transport truck drivers	0	10	0	0
73400 Heavy equipment operators	0	0	0	0
75101 Material handlers	-10	70	-20	0
83100 Underground production and development miners	0	0	0	0
90010 Manufacturing managers	-10	50	-10	0
92020 Supervisors, motor vehicle assembling	90	130	-20	160
92021 Supervisors, electronics and electrical products manufacturing	-10	10	0	0
92023 Supervisors, other mechanical and metal products manufacturing	0	0	0	0

Expansion Demand	2026-30	2031-35	2036-40	2025-40
92024 Supervisors, other products manufacturing and assembly	0	0	0	0
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	0	0	0	0
94100 Machine operators, mineral and metal processing	-10	0	0	-10
94101 Foundry workers	-10	-10	0	-10
94104 Inspectors and testers, mineral and metal processing	0	0	0	0
94105 Metalworking and forging machine operators	-10	10	0	-10
94106 Machining tool operators	-10	10	0	-10
94110 Chemical plant machine operators	0	0	0	0
94111 Plastics processing machine operators	0	20	0	0
94200 Motor vehicle assemblers, inspectors and testers	50	360	-100	120
94201 Electronics assemblers, fabricators, inspectors and testers	0	20	-10	0
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	10	20	10	40
94204 Mechanical assemblers and inspectors	10	10	0	10
94212 Plastic products assemblers, finishers and inspectors	0	10	0	0
94213 Industrial painters, coaters and metal finishing process operators	0	20	0	10
95100 Labourers in mineral and metal processing	0	0	0	-10
95102 Labourers in chemical products processing and utilities	0	0	0	0
95109 Other labourers in processing, manufacturing and utilities	-30	50	0	-10

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 (Golden Horseshoe Region)

Replacement Demand	2026-30	2031-35	2036-40	2025-40
11200 Human resources professionals	360	390	390	1,200
13201 Production and transportation logistics coordinators	160	180	180	540
14400 Shippers and receivers	860	960	960	2,910
14402 Production logistics workers	10	10	10	40
20010 Engineering managers	420	470	470	1,430
20012 Computer and information systems managers	720	810	810	2,460
21101 Chemists	100	110	110	350
21211 Data scientists	30	40	40	120
21220 Cybersecurity specialists	70	70	70	230
21221 Business systems specialists	210	230	230	700
21222 Information systems specialists	1,520	1,680	1,680	5,130
21223 Database analysts and data administrators	130	140	140	440
21230 Computer systems developers and programmers	320	360	360	1,090
21231 Software engineers and designers	740	820	820	2,500
21232 Software developers and programmers	670	740	740	2,260
21233 Web designers	70	70	70	230
21234 Web developers and programmers	320	340	340	1,060
21301 Mechanical engineers	770	850	850	2,580
21310 Electrical and electronics engineers	790	870	870	2,660
21311 Computer engineers (except software engineers and designers)	260	290	290	900
21320 Chemical engineers	80	90	90	270
21321 Industrial and manufacturing engineers	200	220	220	670
21322 Metallurgical and materials engineers	30	30	30	100
21330 Mining Engineers	20	30	30	80
22100 Chemical technologists and technicians	80	90	90	270
22220 Computer network and web technicians	310	360	360	1,080
22222 Information systems testing technicians	70	80	80	250
22301 Mechanical engineering technologists and technicians	430	480	480	1,450
22302 Industrial engineering and manufacturing technologists and technicians	240	270	270	820
22310 Electrical and electronics engineering technologists and technicians	490	540	540	1,660
22312 Industrial instrument technicians and mechanics	10	20	20	50

Replacement Demand	2026-30	2031-35	2036-40	2025-40
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	220	240	240	740
72020 Contractors and supervisors, mechanic trades	30	30	30	90
72100 Machinists and machining and tooling inspectors	760	840	840	2,560
72101 Tool and die makers	550	620	620	1,870
72106 Welders and related machine operators	830	920	920	2,810
72200 Electricians (except industrial and power system)	30	30	30	100
72201 Industrial electricians	240	270	270	830
72400 Construction millwrights and industrial mechanics	620	690	690	2,100
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	150	170	170	510
73300 Transport truck drivers	220	240	240	740
73400 Heavy equipment operators	60	60	60	200
75101 Material handlers	2,170	2,410	2,420	7,340
83100 Underground production and development miners	0	0	0	0
90010 Manufacturing managers	1,280	1,430	1,430	4,340
92020 Supervisors, motor vehicle assembling	200	240	250	720
92021 Supervisors, electronics and electrical products manufacturing	50	50	50	160
92023 Supervisors, other mechanical and metal products manufacturing	40	40	40	120
92024 Supervisors, other products manufacturing and assembly	30	30	30	100
93100 Central control and process operators, mineral and metal processing	30	40	40	110
93101 Central control and process operators, petroleum, gas and chemical processing	30	40	40	110
94100 Machine operators, mineral and metal processing	70	80	80	240
94101 Foundry workers	40	40	40	120
94104 Inspectors and testers, mineral and metal processing	50	60	60	170
94105 Metalworking and forging machine operators	300	340	340	1,020
94106 Machining tool operators	260	290	290	890

Replacement Demand	2026-30	2031-35	2036-40	2025-40
94110 Chemical plant machine operators	60	70	70	200
94111 Plastics processing machine operators	610	680	680	2,060
94200 Motor vehicle assemblers, inspectors and testers	2,970	3,350	3,370	10,160
94201 Electronics assemblers, fabricators, inspectors and testers	570	630	630	1,930
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	70	80	80	230
94204 Mechanical assemblers and inspectors	50	50	50	160
94212 Plastic products assemblers, finishers and inspectors	200	220	220	670
94213 Industrial painters, coaters and metal finishing process operators	200	220	220	680
95100 Labourers in mineral and metal processing	150	170	170	530
95102 Labourers in chemical products processing and utilities	40	50	50	140
95109 Other labourers in processing, manufacturing and utilities	1,180	1,300	1,310	3,980

New Entrants

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

Table 8. New entrants – detailed results (Golden Horseshoe Region)

New Entrants	2026-30	2031-35	2036-40	2025-40
11200 Human resources professionals	170	160	150	520
13201 Production and transportation logistics coordinators	130	120	120	390
14400 Shippers and receivers	270	250	240	820
14402 Production logistics workers	30	30	20	80
20010 Engineering managers	70	60	60	210
20012 Computer and information systems managers	180	170	170	560
21101 Chemists	40	40	40	130
21211 Data scientists	140	130	130	430
21220 Cybersecurity specialists	90	80	80	270
21221 Business systems specialists	120	110	110	360
21222 Information systems specialists	480	450	430	1,470

New Entrants	2026-30	2031-35	2036-40	2025-40
21223 Database analysts and data administrators	60	50	50	170
21230 Computer systems developers and programmers	190	180	170	590
21231 Software engineers and designers	970	920	880	2,970
21232 Software developers and programmers	970	920	880	2,960
21233 Web designers	140	140	130	440
21234 Web developers and programmers	530	500	480	1,630
21301 Mechanical engineers	350	340	320	1,080
21310 Electrical and electronics engineers	240	220	210	730
21311 Computer engineers (except software engineers and designers)	130	120	120	400
21320 Chemical engineers	70	60	60	200
21321 Industrial and manufacturing engineers	100	90	90	300
21322 Metallurgical and materials engineers	10	10	10	40
21330 Mining Engineers	10	10	10	30
22100 Chemical technologists and technicians	40	40	30	110
22220 Computer network and web technicians	190	180	170	590
22222 Information systems testing technicians	60	60	60	190
22301 Mechanical engineering technologists and technicians	170	160	150	510
22302 Industrial engineering and manufacturing technologists and technicians	110	100	100	340
22310 Electrical and electronics engineering technologists and technicians	160	150	140	480
22312 Industrial instrument technicians and mechanics	10	10	10	30
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	30	20	20	80
72020 Contractors and supervisors, mechanic trades	30	20	20	80
72100 Machinists and machining and tooling inspectors	140	130	120	420
72101 Tool and die makers	50	50	50	160
72106 Welders and related machine operators	190	180	170	580
72200 Electricians (except industrial and power system)	20	20	20	60
72201 Industrial electricians	40	40	40	140

New Entrants	2026-30	2031-35	2036-40	2025-40
72400 Construction millwrights and industrial mechanics	110	100	100	330
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	60	60	50	180
73300 Transport truck drivers	80	80	70	250
73400 Heavy equipment operators	20	20	20	60
75101 Material handlers	1,090	1,030	990	3,340
83100 Underground production and development miners	10	10	10	30
90010 Manufacturing managers	110	100	100	330
92020 Supervisors, motor vehicle assembling	30	30	30	80
92021 Supervisors, electronics and electrical products manufacturing	10	10	10	40
92023 Supervisors, other mechanical and metal products manufacturing	10	10	10	40
92024 Supervisors, other products manufacturing and assembly	10	10	10	20
93100 Central control and process operators, mineral and metal processing	10	10	10	30
93101 Central control and process operators, petroleum, gas and chemical processing	40	40	40	130
94100 Machine operators, mineral and metal processing	20	20	20	70
94101 Foundry workers	10	10	10	20
94104 Inspectors and testers, mineral and metal processing	10	10	10	40
94105 Metalworking and forging machine operators	60	60	50	190
94106 Machining tool operators	40	30	30	110
94110 Chemical plant machine operators	20	20	20	60
94111 Plastics processing machine operators	100	100	90	320
94200 Motor vehicle assemblers, inspectors and testers	580	560	530	1,800
94201 Electronics assemblers, fabricators, inspectors and testers	60	60	50	180
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	10	10	10	50
94204 Mechanical assemblers and inspectors	30	30	30	110

New Entrants	2026-30	2031-35	2036-40	2025-40
94212 Plastic products assemblers, finishers and inspectors	20	20	20	70
94213 Industrial painters, coaters and metal finishing process operators	70	60	60	200
95100 Labourers in mineral and metal processing	100	100	90	320
95102 Labourers in chemical products processing and utilities	20	20	20	60
95109 Other labourers in processing, manufacturing and utilities	370	350	330	1,120

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 (Golden Horseshoe Region)

Recruitment Gap (#)	2026-30	2031-35	2036-40
11200 Human resources professionals	190	240	240
13201 Production and transportation logistics coordinators	20	60	60
14400 Shippers and receivers	580	730	710
14402 Production logistics workers	<10	<10	<10
20010 Engineering managers	350	420	410
20012 Computer and information systems managers	540	640	640
21101 Chemists	60	70	70
21211 Data scientists	<10	<10	<10
21220 Cybersecurity specialists	<10	<10	<10
21221 Business systems specialists	90	120	120
21222 Information systems specialists	1,040	1,240	1,250
21223 Database analysts and data administrators	70	90	90
21230 Computer systems developers and programmers	130	180	180
21231 Software engineers and designers	<10	<10	<10
21232 Software developers and programmers	<10	<10	<10
21233 Web designers	<10	<10	<10
21234 Web developers and programmers	<10	<10	<10
21301 Mechanical engineers	430	560	520
21310 Electrical and electronics engineers	570	680	660
21311 Computer engineers (except software engineers and designers)	140	170	170

Recruitment Gap (#)	2026-30	2031-35	2036-40
21320 Chemical engineers	10	30	30
21321 Industrial and manufacturing engineers	90	140	130
21322 Metallurgical and materials engineers	20	20	20
21330 Mining Engineers	10	20	20
22100 Chemical technologists and technicians	40	50	50
22220 Computer network and web technicians	120	180	180
22222 Information systems testing technicians	10	30	30
22301 Mechanical engineering technologists and technicians	260	330	320
22302 Industrial engineering and manufacturing technologists and technicians	130	180	170
22310 Electrical and electronics engineering technologists and technicians	340	410	400
22312 Industrial instrument technicians and mechanics	10	10	10
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	190	220	220
72020 Contractors and supervisors, mechanic trades	<10	10	10
72100 Machinists and machining and tooling inspectors	620	730	720
72101 Tool and die makers	490	580	560
72106 Welders and related machine operators	630	770	740
72200 Electricians (except industrial and power system)	10	20	20
72201 Industrial electricians	200	250	230
72400 Construction millwrights and industrial mechanics	510	610	590
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	100	130	110
73300 Transport truck drivers	140	170	170
73400 Heavy equipment operators	40	50	50
75101 Material handlers	1,060	1,450	1,410
83100 Underground production and development miners	<10	<10	<10
90010 Manufacturing managers	1,160	1,380	1,320
92020 Supervisors, motor vehicle assembling	260	350	200
92021 Supervisors, electronics and electrical products manufacturing	30	50	40
92023 Supervisors, other mechanical and metal products manufacturing	20	30	30
92024 Supervisors, other products manufacturing and assembly	20	30	30
93100 Central control and process operators, mineral and metal processing	20	30	30
93101 Central control and process operators, petroleum, gas and chemical processing	<10	<10	<10

Recruitment Gap (#)	2026-30	2031-35	2036-40
94100 Machine operators, mineral and metal processing	30	60	60
94101 Foundry workers	20	30	30
94104 Inspectors and testers, mineral and metal processing	30	40	40
94105 Metalworking and forging machine operators	230	280	280
94106 Machining tool operators	220	270	260
94110 Chemical plant machine operators	40	50	50
94111 Plastics processing machine operators	500	600	580
94200 Motor vehicle assemblers, inspectors and testers	2,440	3,150	2,730
94201 Electronics assemblers, fabricators, inspectors and testers	510	590	570
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	60	80	70
94204 Mechanical assemblers and inspectors	20	30	20
94212 Plastic products assemblers, finishers and inspectors	180	210	200
94213 Industrial painters, coaters and metal finishing process operators	140	180	160
95100 Labourers in mineral and metal processing	50	80	80
95102 Labourers in chemical products processing and utilities	20	30	30
95109 Other labourers in processing, manufacturing and utilities	780	1,000	970

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 (Golden Horseshoe Region)

Recruitment Gap (% of 2022 Base Year Employment)	2026-30	2031-35	2036-40
11200 Human resources professionals	5%	7%	7%
13201 Production and transportation logistics coordinators	1%	3%	3%
14400 Shippers and receivers	9%	11%	11%
14402 Production logistics workers	<1%	<1%	<1%
20010 Engineering managers	9%	10%	10%

Recruitment Gap (% of 2022 Base Year Employment)	2026-30	2031-35	2036-40
20012 Computer and information systems managers	5%	7%	7%
21101 Chemists	7%	8%	8%
21211 Data scientists	<1%	<1%	<1%
21220 Cybersecurity specialists	<1%	<1%	<1%
21221 Business systems specialists	3%	4%	4%
21222 Information systems specialists	6%	7%	7%
21223 Database analysts and data administrators	5%	6%	6%
21230 Computer systems developers and programmers	4%	5%	5%
21231 Software engineers and designers	<1%	<1%	<1%
21232 Software developers and programmers	<1%	<1%	<1%
21233 Web designers	<1%	<1%	<1%
21234 Web developers and programmers	<1%	<1%	<1%
21301 Mechanical engineers	6%	8%	8%
21310 Electrical and electronics engineers	9%	11%	11%
21311 Computer engineers (except software engineers and designers)	4%	4%	4%
21320 Chemical engineers	1%	3%	3%
21321 Industrial and manufacturing engineers	5%	7%	6%
21322 Metallurgical and materials engineers	6%	7%	7%
21330 Mining Engineers	7%	8%	8%
22100 Chemical technologists and technicians	7%	8%	8%
22220 Computer network and web technicians	3%	4%	4%
22222 Information systems testing technicians	1%	2%	2%
22301 Mechanical engineering technologists and technicians	7%	9%	9%
22302 Industrial engineering and manufacturing technologists and technicians	5%	8%	7%
22310 Electrical and electronics engineering technologists and technicians	10%	13%	12%
22312 Industrial instrument technicians and mechanics	2%	4%	3%
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	15%	17%	17%
72020 Contractors and supervisors, mechanic trades	<1%	2%	1%
72100 Machinists and machining and tooling inspectors	14%	17%	16%
72101 Tool and die makers	16%	19%	19%
72106 Welders and related machine operators	12%	15%	14%
72200 Electricians (except industrial and power system)	3%	5%	5%
72201 Industrial electricians	13%	17%	15%
72400 Construction millwrights and industrial mechanics	14%	17%	16%

Recruitment Gap (% of 2022 Base Year Employment)	2026-30	2031-35	2036-40
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	7%	10%	8%
73300 Transport truck drivers	7%	9%	8%
73400 Heavy equipment operators	9%	11%	11%
75101 Material handlers	6%	8%	7%
83100 Underground production and development miners	<1%	<1%	<1%
90010 Manufacturing managers	15%	18%	17%
92020 Supervisors, motor vehicle assembling	18%	23%	13%
92021 Supervisors, electronics and electrical products manufacturing	6%	11%	10%
92023 Supervisors, other mechanical and metal products manufacturing	10%	14%	13%
92024 Supervisors, other products manufacturing and assembly	11%	14%	14%
93100 Central control and process operators, mineral and metal processing	7%	8%	8%
93101 Central control and process operators, petroleum, gas and chemical processing	<1%	<1%	<1%
94100 Machine operators, mineral and metal processing	4%	7%	7%
94101 Foundry workers	11%	13%	15%
94104 Inspectors and testers, mineral and metal processing	10%	13%	13%
94105 Metalworking and forging machine operators	12%	14%	14%
94106 Machining tool operators	15%	18%	18%
94110 Chemical plant machine operators	9%	11%	11%
94111 Plastics processing machine operators	14%	17%	16%
94200 Motor vehicle assemblers, inspectors and testers	14%	18%	16%
94201 Electronics assemblers, fabricators, inspectors and testers	21%	25%	24%
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	18%	23%	20%
94204 Mechanical assemblers and inspectors	3%	6%	3%
94212 Plastic products assemblers, finishers and inspectors	16%	18%	18%
94213 Industrial painters, coaters and metal finishing process operators	8%	11%	10%
95100 Labourers in mineral and metal processing	3%	4%	4%
95102 Labourers in chemical products processing and utilities	6%	7%	7%
95109 Other labourers in processing, manufacturing and utilities	11%	14%	14%

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 29. 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%