FOCAL Initiative

ICEV TO EV WORKFORCE TRANSITION LABOUR MARKET FORECAST

MONTREAL 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

Quebec and the Montreal region are at the center and in the early stages of the transition towards decarbonization that will have a significant impact on the heavy-duty vehicle manufacturing and related industries. Production processes and supply chains have 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 vehicle 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 may experience relatively moderate or limited 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 the Montreal area for 63 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 measures labour market supply and demand dynamics that evolve across the transition. 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 for Montreal indicate that at least six occupations that will experience significant impacts;

- electrical and electronics engineering technologists and technicians,
- tool and diemakers,
- chemical plant machine operators,
- motor vehicle assemblers, inspectors and testers, and
- electronics assemblers, fabricators, inspectors and testers.

The magnitude and timing of impacts are unique for each occupation. Quebec and Montreal are already a center for heavy-duty vehicle assembly and parts manufacturers. This role is certain to continue as many key employers have announced investments in the ICEV-EV transition. Quebec and Montreal have had notable success in attracting new investments in both battery production and major suppliers of anode, cathode, graphite and mineral materials. This pattern of investment is reflected in the occupational impacts where managers, supervisors, technicians and assemblers in electrical and electronics and chemical production are tagged as candidates for recruiting challenges. Readers will find more details on the source and likely timing of these competitive pressures in other national, provincial, and regional FOCAL II reports.

Introduction

FOCAL I reports (published in 2021) highlighted the crucial role of a broader automotive industry across Canada and Quebec. 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. [1] The FOCAL II initiative is helping employers and job seekers manage the transition from ICEV to EV. Assistance includes direct action through wage and training subsidies, and guidance in critical areas like skills transferability, diversity, immigration and apprenticeship. This support is 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 supply and related changes across the supply chain. This process provides measures of changing labour market conditions for industries and occupations. FOCAL II assesses these impacts in three steps.

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

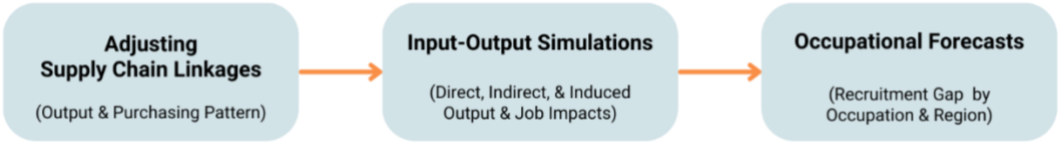
- a transition horizon from 2025 to 2040,
- 49 selected industries in,
- Canada, Ontario, Quebec, Manitoba and seven regions.

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, 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 63 key occupations for the Montreal region.

Figure 1 illustrates this three-step process.

Figure 1. Impact analysis steps



Changes in employment across the transition will be sensitive to 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, government policy, and success in

[1] *The Impact of EV Production on the Automotive Manufacturing Supply Chain: Sources, Methods and Findings, October, 2021*

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 base case scenario, combining features of the first three, is used for the labour market impact results.

The base case scenario describes an ICEV-EV transition that will comprise both job gains and losses, changes in employment conditions, and related labour market disruptions for selected industries and occupations. Direct impacts spread out from vehicle assembly, parts production, battery assembly, related chemical and mineral processes and, under 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 will be very apparent in the Montreal region, as this region has deep roots and major employers in vehicle production. Announced investments in renewed EV assembly capabilities, new battery plants, and related additions across the supply chain make the region a major focus for labour market adjustments in all the key occupations. Section 4 of the report identifies six selected occupations that have prominent impacts. Impacts across other occupations are described in detail in Appendix D[2].

This introduction is followed by a background on the Montreal region. Section 3 describes impacts across the ICEV-EV transition in key industries. Section 4 reports detailed impacts across six selected occupations. Conclusions and implications are a reviewed in the final section. A list of the industries and occupations selected for the analysis, a review of the methodology applied in the labour market models, a review of skills transferability matrices and tables of detailed impacts for the occupations are in 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 in Montreal– Background

The Montreal region is an aggregate region comprised of three Economic Regions (ERs) as defined by Statistics Canada: Montréal, Montérégie, and Laurentides. The Montreal ER is the most populous of the three regions and includes the cities of Montreal, Mount Royal, and Dorval. Taken together they are home to approximately 50% of Quebec's population and cover a land area of nearly 32,500 square kilometres.

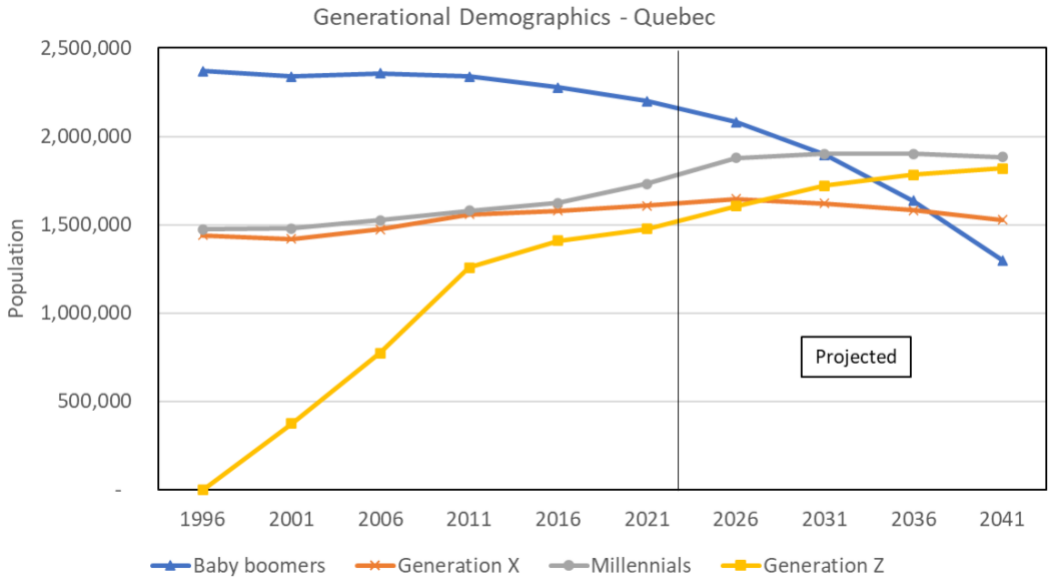
The coming transition from ICEVs to EVs will have a major impact across the region. In 2022, the regional workforce of 2,285,800 included 264,700 working in manufacturing and 3,500 in the core automotive assembly and parts industries[3]. Heavy-duty vehicle assembly and related activity are important to the overall economic well being, especially for the Montreal region but also for the broader Quebec 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[4]. Relative to other industries, employers in manufacturing often identify human resources, skills shortages and recruiting as major challenges in business development. According to Statistics Canada:

> "Businesses in manufacturing were the most likely to expect challenges recruiting staff and these levels have remained unchanged when compared to 2022. In the second quarter of 2023, nearly half (48.4%) of businesses in manufacturing expected recruiting skilled employees to be an obstacle, compared with 47.4% in the second quarter of 2022"[5].

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 4.1% in the total population of Quebec and 1.3% 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 6.7% in Quebec while the proportion of Baby Boomers decreased by 3.3%. As shown in Figure 2, it is expected that Millennials will outnumber Baby Boomers in Quebec by 2031 and Generation Z (born between 1997 and 2012) will outnumber Baby Boomers before 2035. [6]

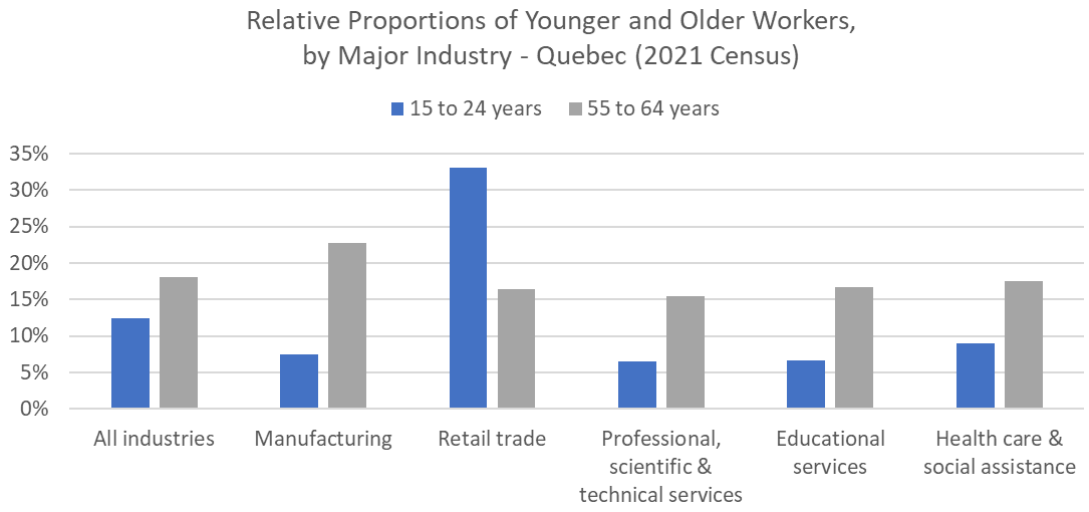
[3] Total employment and manufacturing employment estimates are from Metro Economics. Automotive assembly (NAICS 3361) and parts industries (NAICS 3363) employment estimates are based on data from Statistics Canada Labour Statistics Consistent with the System of National Accounts (Table 36-10-0489-01) and Automotive Policy Research Centre (APRC).
[4] Source: Government of Canada Trade Data Online (https://ised-isde.canada.ca/site/trade-data-online/en).
[5] 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
[6] Sources: Statistics Canada 1996 to 2021 Census (historical data); Table 17-10-0057-01 Projected population, by projection scenario, age and sex, as of July 1 (x 1,000) (projected data, M1 scenario)

Figure 2. Changing demographics in Quebec (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 Quebec, 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 is significantly higher in the manufacturing.

Figure 3. Proportions of older and younger workers in major Quebec 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 Quebec grew from 5,500 workers in 2009 to 9,900 workers in 2019. Employment decreased by 22.5% from 2019 to 2020, partly due to COVID shutdowns in Quebec and elsewhere[7]. 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)[8]. Nearly 45% percent of the Quebec activity is concentrated in the Montreal region.

Table 1 tracks the distribution of employment across the selected industries. 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. The Montreal region has a large workforce in the traditional parts and other manufacturing industries in the automotive supply chain. These numbers serve as a starting point for measuring employment impacts.

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

Industry	Employment in 2022
Automobile and light-duty motor vehicle manufacturing	0
Heavy-duty truck manufacturing	700
Parts manufacturing	2,800
Mining	1,200
Basic chemical manufacturing	1,600
Other material processing	4,900
Battery manufacturing	1,900
Management, scientific and technical consulting services	15,000
Plastic product manufacturing	13,200

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

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

Industry	Employment in 2022
Other electronic product manufacturing	3,700
Semiconductor and other electronic component manufacturing	4,000
Iron and steel mills and ferro-alloy manufacturing	1,400
Foundries	1,100
Forging and stamping	500
Other automotive supply chain	133,700

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;

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- 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.

Major investments in new battery production and EV assembly are planned for the Montreal region. Battery production is expected to begin in 2025 and, in the base case scenario, grows to a peak in 2035. Assembly activity rises and shifts to EV production from 2025 to 2035. 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.

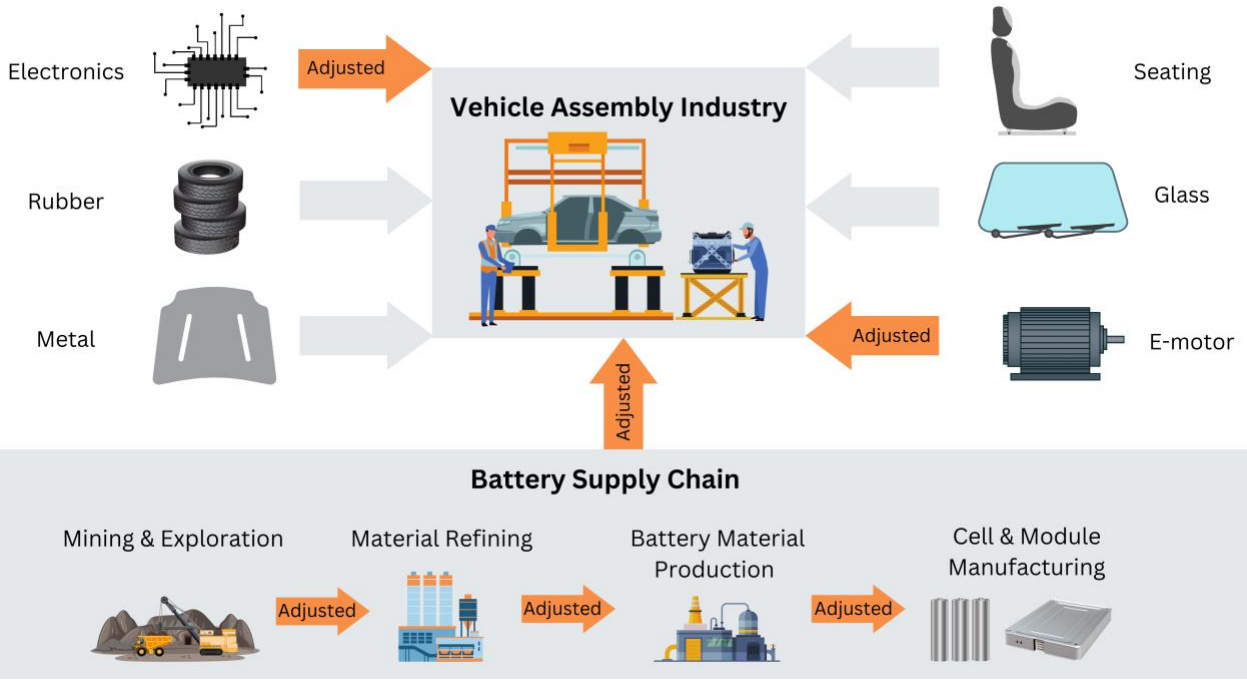
Quebec has secured even more investments in new manufacturing capacity related to EV production. This includes changes to the existing assembly processes with shifts to EVs and major new battery production capacity in the Montreal region. There are also large new manufacturing plants, in other regions of Quebec that will provide new capacity further up the supply chain in chemical and material processing relates new mineral and mining developments. This geographic distribution of the new investments and jobs is reflected in the regional impact on labour markets in specific occupations in Montreal and in the rest of Quebec. Readers should consult the Quebec report to see more details on these impacts outside Montreal.

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 Montreal region economy.

Findings are calculated from the Statistics Canada Interprovincial Symmetric Input-Output table. Input Output tables are standard tools, for Canada and the Provinces, that track the transactions that connect industries and their customers. These tables are the best sources available to analyze the chain of transactions that link motor vehicle assembly to suppliers and to customers. The FOCAL II analysis customized the Quebec 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.[9] Figure 4 illustrates the changes introduced by FOCAL II at this stage of the analysis.

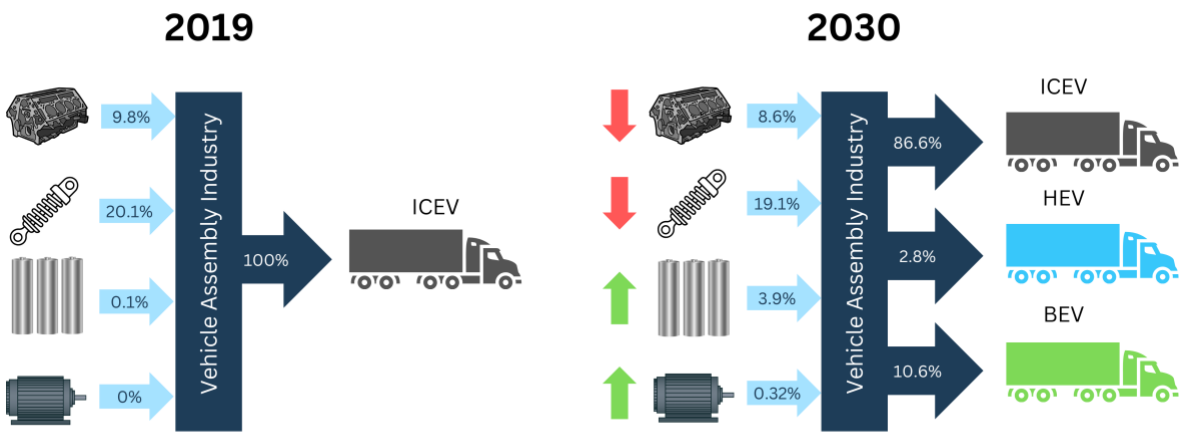
Figure 4. Adjusting automotive and battery manufacturing supply chain linkages for the impact analysis



[9] 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 are introduced in the analysis across the transition period from 2025 to 2040 and in specific categories;

Vehicle assembly, by type;

- 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

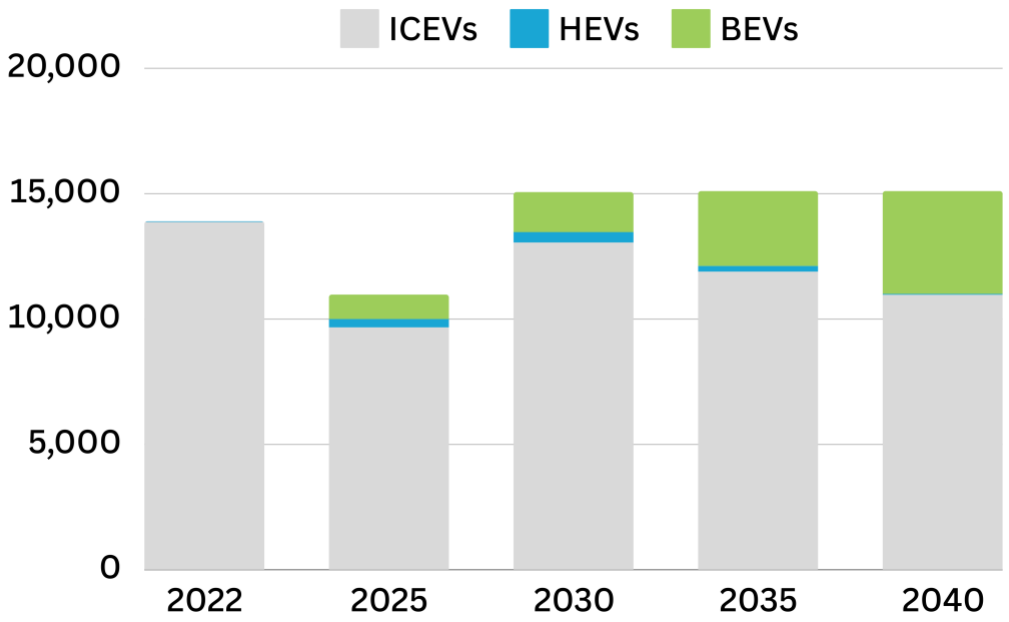
A base case scenario has been developed that combines key assumptions across these categories. The magnitude and timing of these assumptions are expressed in terms of total employment impacts by industry, which are then transformed into detailed occupational impacts.

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 33% of vehicles produced are BEVs. 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 heavy-duty vehicle production, by type of vehicle (Canada)



Note that the number of heavy duty vehicles assembled across the transition to 2040 stays roughly constant between 12,500 and 15,000 units. 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 33% 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 and one in Quebec, 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).

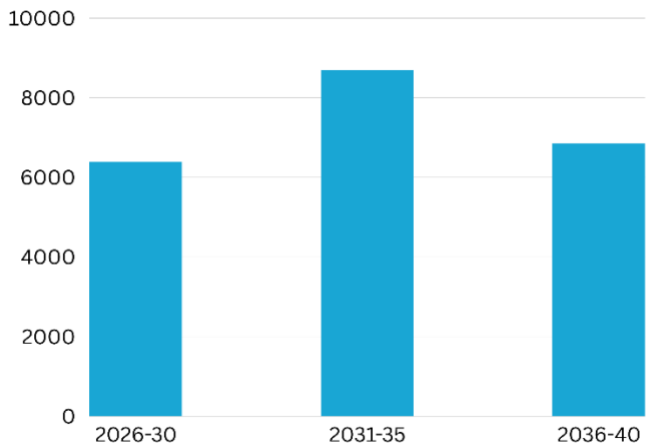
Table 2. Base case scenario - battery supply chain assumptions

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

Montreal Impacts Across Industries

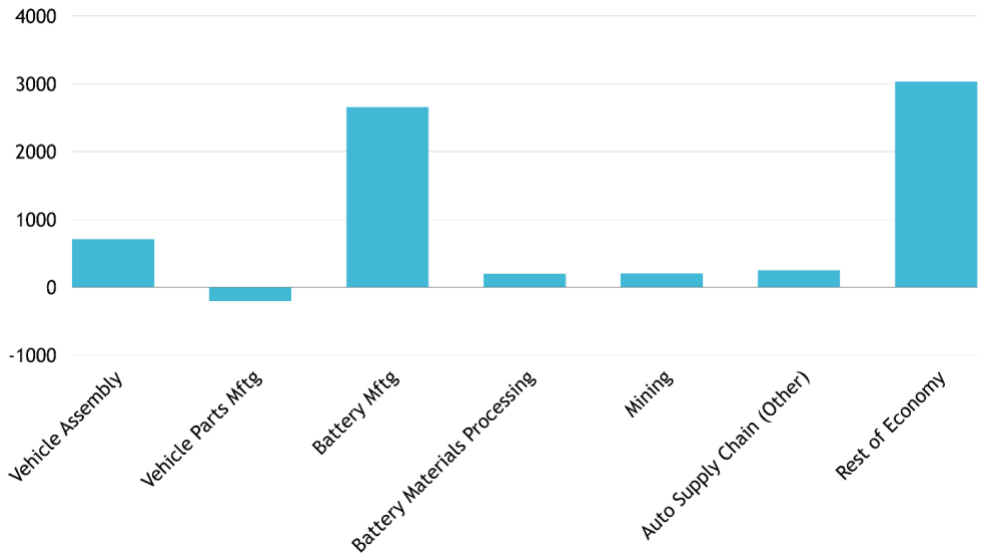
Figure 7 summarizes the total employment impacts in the base case scenario in three intervals of the transition. The total impact is positive, with gains in each of the three five-year intervals, as new activity in battery production and its supply are large enough to offset employment losses related to declining activity in gasoline engine and related production. Impacts peak at 8,700 jobs in the 2031 to 2035 period as battery operations ramp up.

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



A summary of total Quebec 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 heavy duty 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 modules, 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, Quebec



In the next section, these province-wide industry changes are allocated to occupations in the Montreal 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 Montreal regional labour markets for six occupations. FOCAL II findings signal difficulties for recruiters during the peak periods as the transition unfolds. Changing employment is linked to important supply-side trends in demographics and immigration.

Occupations that are concentrated in the broader automotive sector and in key regions participating in the transition face the biggest changes. Labour markets more distant from the investments, assembly plants, and key occupations engaged in other industries face more limited impacts. Occupations that are working in the selected industries (listed in Appendix A) are included in 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. Trends in Ontario's population 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 six occupations in the Montreal region that experience important changes in recruitment gaps at some point across the transition period. The total recruitment gap is expressed in two ways. In the left panel of Figures 10 to 15, 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, the recruitment gap for each time interval is expressed as the percentage of base year employment in 2022. In other words, the recruitment gap is not a forecast of total employment for each occupation - it is an estimate of *incremental* workers needed for an occupation, in addition to the employment in that occupation in 2022.

Large recruitment gaps for an occupation (expressed as the number of additional workers needed) indicate the magnitude of the expected recruiting effort. 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.

Selected Occupations

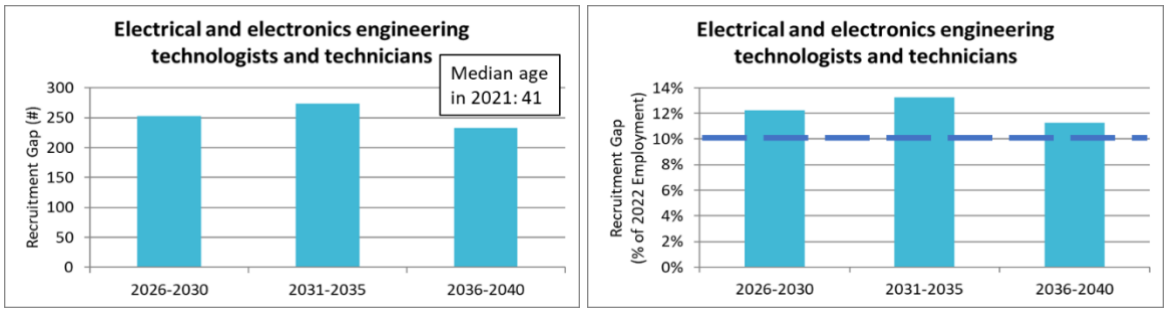
Occupations selected here have above average recruitment gaps during the transition. There are three major sources of employment change; new jobs in battery plants and their suppliers, rising and shifting assembly activity across the transition from ICEV to EV and declining employment in parts manufacturing – especially internal combustion engines and drive chains. All three of these changes are impacting important employers in the Montreal region.

Direct impacts emerge at different time intervals, with new jobs in battery and related activity peaking in the 2025-2035 period. Job losses in parts manufacturing are spread across the 2025-2040 periods and impacts across assembly activity peak in 2035. Employment impacts are distributed across many occupations but are most prominent in the following six occupations.

To illustrate the distinctive pattern of recruitment gaps, the right-hand panel in Figures 10 to 15 contains a horizontal bar at 10%. This is the average recruitment gap for all the selected occupations in the FOCAL II analysis within the Montreal region before and after the transition.[10] 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[11].

<u>*Electrical and electronics engineering technologists and technicians*</u> (Figure 10): This group of technicians and technologists (and the corresponding engineers) will be sought after in record numbers as the battery capacity reaches full production in most regions of Quebec and Ontario. While the peak gap is in 2031-2035 interval, the 2026-2030 interval also features similar recruiting intensity as new plants expand to full activity.

Figure 10. Recruitment gap – electrical and electronics engineering technologists and

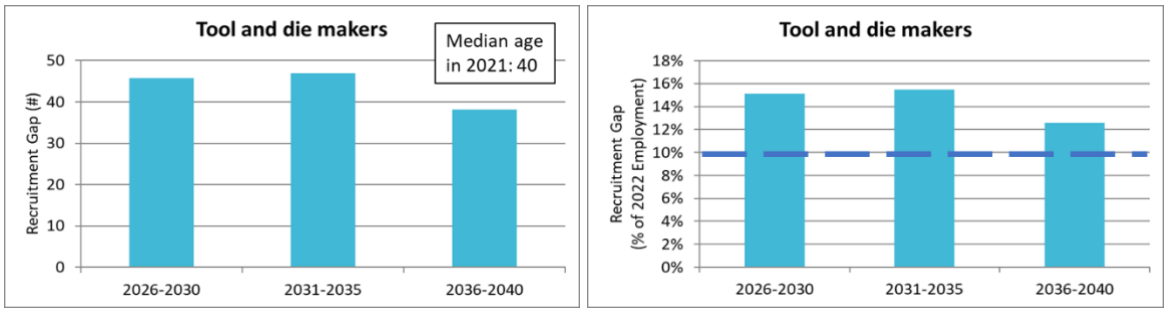


<u>*Tool and diemakers*</u> (Figure 11): Skilled trades are in high demand in most industries and regions, and this is a case where the existing shortage will be aggravated by the ICEV – EV transition. The

[10] See Appendix B for a complete list of occupations used in the analysis.
[11] 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 the Montreal region is 41 years old in 2021.

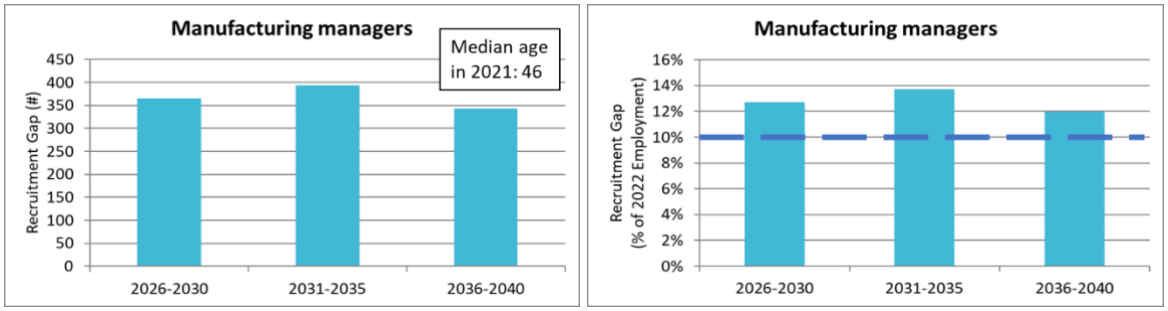
workforce for most skilled trades is smaller than other occupations but their specialized skills can be critically important. Other trades (e.g. machinists, industrial electricians and millwrights) have a similar profile but tool and die makers have the highest gap. A relatively old age profile adds to the challenge.

Figure 11. Recruitment gap – tool and diemakers



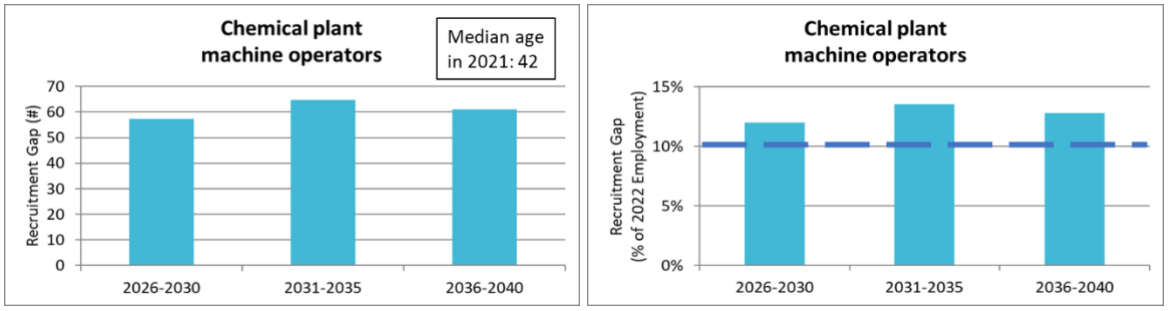
Manufacturing managers (Figure 12): This is the largest workforce and most widespread example of recruiting challenges for managers and supervisors. Age profiles are usually older for managers and supervisors and special recruiting attention is often requires in these occupations. Recruiting challenges are already high currently and this is to some extent due to replacement demand.

Figure 12. Recruitment gap - manufacturing managers



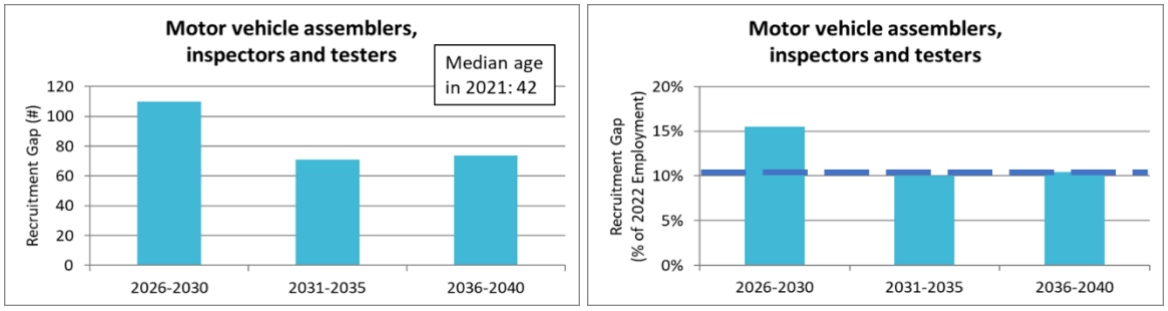
Chemical plant machine operators (Figure 13): This is a midsize and specialized workforce with moderate recruitment gaps prior to the transition. The age profile is average. These operators and the related technicians and supervisors are in short supply, in regions surrounding Montreal, as major new investments in chemical and material processing come on stream. Quebec's success attracting new chemical facilities will create a large challenge even in the Montreal region. More details on these changes is available in the Quebec report.

Figure 13. Recruitment gap – chemical plant machine operators



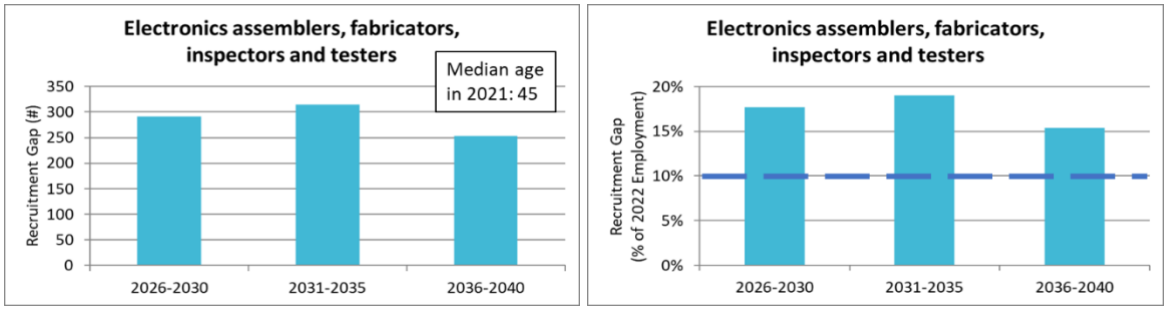
Motor vehicle assemblers, inspectors and testers (Figure 14): This key workforce is being challenged as assembly shifts from ICE vehicles to battery electric vehicles. In the base case scenario, there is a moderate ramping up in electric vehicle assembly to 2030 and a flat profile over the final decade of the transition. Workers joining new BEV assembly need to be recruited and trained in the first five years.

Figure 14. Recruitment gap – motor vehicle assemblers, inspectors and testers



Electronics assemblers, fabricators, inspectors and testers (Figure 15): This occupation is a relatively large workforce at the start of the transition and there are shortages in the labour market even as the transition begins. This is to some extent a function of the older age profile and ongoing retirements. Note that the recruitment gap tops 20% in 2031-2036 and this is the highest among all the occupations in Montreal and Quebec. Recruits are heading for the new battery facility and this expansion is the most powerful force driving expansion demand in Quebec across the transition.

Figure 15. Recruitment gap – electronics assemblers, fabricators, inspectors and testers



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 management and supervision, engineering, skilled trades and assemblers. Results for these occupations signal widespread labour shortages. Examples of this include electronics assemblers, fabricators, inspectors and testers, manufacturing managers; electrical and electronics engineering technologists and technicians, labourers, most supervisor workforces, and many the skilled trades.

Impacts reflect very different types of change to employment and work conditions across industries and occupations. Impacts may be caused by added new jobs in battery plants or lost jobs in the ICEV supply chain. In contrast, managers, supervisors and assemblers in the assembly and parts industries may face changing work conditions where employers will be able to transfer staff to new EV assembly lines. For managers, supervisors and assemblers in electronics manufacturing, the impacts will often be in new jobs and skills, often in new plants.

Engineering occupations will see 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 important 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 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 eliminate jobs in internal combustion engines, transmissions and exhaust systems.

A final, general observation 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 long-term gains in labour productivity or relative declines in employment across the base case scenario. The second is the demographic trend to fewer retirements and lower age profiles in the later years of the transition as Baby Boomers leave the workforce.

Tracking these labour market changes suggests potential labour mobility across occupations. 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 skill profiles [12]. An example of a skills transferability matrix for the electronic assemblers, fabricators, inspectors and testers occupation is shown in Appendix E. 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.

Conclusions and Implications

The ICEV-EV transition, in the base case scenario, will create major disruptions in labour markets for six specific occupations in the Montreal region. Recruiting challenges will emerge in these labour markets, reaching a peak between 2026 and 2035 as EV assembly builds to a peak and new battery and related supply production comes on stream. Recruiting for management, engineering, skilled trades and assembly occupations will add to 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 filling jobs created in the new battery cell, module and related supplier production where, in some cases, unique skills and training will define entirely new occupations. At the other extreme that will be lost jobs in gasoline engine, transmission and related manufacturing across the ICEV supply chain. This will create a small but important source of job seekers with important experience, but possibly 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.

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

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.

The broad range and depth of HR challenges clarifies the critical impact of the ICEV-EV transition. These changes are both a challenge and a reward. Human resources management risks are not new to manufacturing in the region, but the scale of EV related changes may raise these risks to new, higher levels. There is a major reward here as the transition, as represented in the base case scenario, will leave all of Quebec, in 2040, with a larger and well 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 as far as new mining potential. This is, after all, Canada's second most important export industry and circumstances described here confirm its emergence as a new and global force.

Appendices

Appendix A – Industries Analyzed in the Labour Market Impact Model

Table 3. 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 4. List of occupations analyzed in the labour market impact model (Montreal Region)

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.

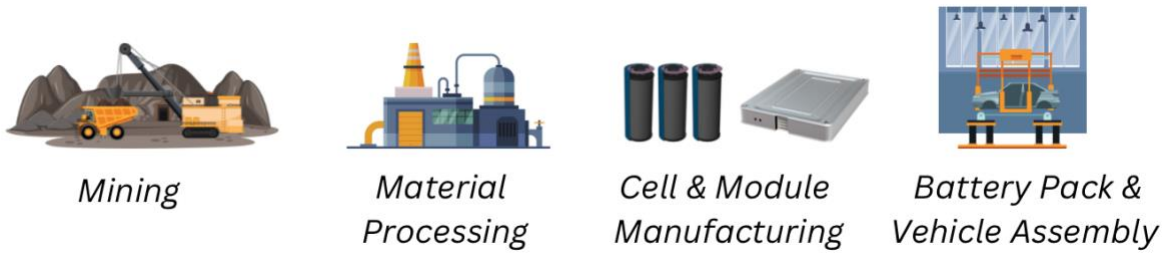
1. New EV production
2. Economic impacts across the supply chain
3. Labour market impacts by region and occupation

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 16.

Figure 16. The EV supply chain



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

2. Economic impacts across the supply chain

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

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

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

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

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

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

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

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

industries. Finally, IO impacts calculated in the models are not time specific. Thus, the EV production analysis, at the first research stage, sets out specific assumptions of the scheduling of the start and completion of new activity across the transition from 2025 to 2040.

3. *Labour market impacts by occupation and region*

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

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

Expansion Demand

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

Expansion demand for each occupation was determined by taking the overall employment forecast by industry and transforming that forecast from the industry level to the occupation level within each industry.

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

Replacement Demand

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

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

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.

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 5. Expansion demand – detailed results (Montreal Region)

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

Expansion Demand	2026-30	2031-35	2036-40	2025-40
22100 Chemical technologists and technicians	10	10	0	10
22220 Computer network and web technicians	10	0	0	10
22222 Information systems testing technicians	0	0	0	0
22301 Mechanical engineering technologists and technicians	20	10	-10	30
22302 Industrial engineering and manufacturing technologists and technicians	20	10	-10	30
22310 Electrical and electronics engineering technologists and technicians	40	30	-20	50
22312 Industrial instrument technicians and mechanics	0	0	0	0
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	10	0	0	10
72020 Contractors and supervisors, mechanic trades	0	0	0	0
72100 Machinists and machining and tooling inspectors	20	10	-10	20
72101 Tool and die makers	10	10	0	10
72106 Welders and related machine operators	40	10	-10	40
72200 Electricians (except industrial and power system)	10	0	0	10
72201 Industrial electricians	10	0	0	10
72400 Construction millwrights and industrial mechanics	30	20	-10	30
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	10	0	0	10
73300 Transport truck drivers	10	0	0	10
73400 Heavy equipment operators	10	0	0	10
75101 Material handlers	50	30	-20	50
83100 Underground production and development miners	0	0	0	0
90010 Manufacturing managers	50	30	-20	60
92021 Supervisors, electronics and electrical products manufacturing	10	10	0	10
92024 Supervisors, other products manufacturing and assembly	0	0	0	0
93101 Central control and process operators, petroleum, gas and chemical processing	10	10	-10	20

Expansion Demand	2026-30	2031-35	2036-40	2025-40
94100 Machine operators, mineral and metal processing	10	10	0	10
94101 Foundry workers	10	0	0	10
94104 Inspectors and testers, mineral and metal processing	0	0	0	0
94105 Metalworking and forging machine operators	0	0	0	0
94106 Machining tool operators	0	0	0	0
94110 Chemical plant machine operators	0	0	0	0
94111 Plastics processing machine operators	10	0	0	0
94200 Motor vehicle assemblers, inspectors and testers	40	-10	0	30
94201 Electronics assemblers, fabricators, inspectors and testers	50	40	-30	60
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	10	10	0	10
94204 Mechanical assemblers and inspectors	20	0	0	10
94212 Plastic products assemblers, finishers and inspectors	0	0	0	0
94213 Industrial painters, coaters and metal finishing process operators	10	0	0	10
95100 Labourers in mineral and metal processing	0	0	0	10
95102 Labourers in chemical products processing and utilities	20	10	-10	20
95109 Other labourers in processing, manufacturing and utilities	30	20	-10	30

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 6. Replacement demand – detailed results (Montreal Region)

Replacement Demand	2026-30	2031-35	2036-40	2025-40
11200 Human resources professionals	140	160	160	460
13201 Production and transportation logistics coordinators	40	50	50	150
14400 Shippers and receivers	190	220	220	620
14402 Production logistics workers	0	0	0	0

Replacement Demand	2026-30	2031-35	2036-40	2025-40
20010 Engineering managers	120	130	130	380
20012 Computer and information systems managers	390	440	440	1,260
21101 Chemists	30	40	40	100
21211 Data scientists	0	0	0	10
21220 Cybersecurity specialists	30	30	30	90
21221 Business systems specialists	60	60	60	180
21222 Information systems specialists	710	800	800	2,310
21223 Database analysts and data administrators	60	70	70	210
21230 Computer systems developers and programmers	280	310	310	890
21231 Software engineers and designers	200	220	220	640
21232 Software developers and programmers	180	210	210	600
21233 Web designers	30	30	30	100
21234 Web developers and programmers	130	140	140	400
21301 Mechanical engineers	150	170	170	480
21310 Electrical and electronics engineers	200	230	230	660
21311 Computer engineers (except software engineers and designers)	80	90	90	250
21320 Chemical engineers	20	20	20	50
21321 Industrial and manufacturing engineers	40	50	50	140
21322 Metallurgical and materials engineers	10	10	10	20
22100 Chemical technologists and technicians	30	30	30	90
22220 Computer network and web technicians	170	200	200	570
22222 Information systems testing technicians	10	20	20	40
22301 Mechanical engineering technologists and technicians	80	100	100	280
22302 Industrial engineering and manufacturing technologists and technicians	50	50	50	150
22310 Electrical and electronics engineering technologists and technicians	240	270	270	790
22312 Industrial instrument technicians and mechanics	30	40	40	110
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	60	60	60	190
72020 Contractors and supervisors, mechanic trades	0	0	0	10
72100 Machinists and machining and tooling inspectors	270	310	310	890
72101 Tool and die makers	40	50	50	130

Replacement Demand	2026-30	2031-35	2036-40	2025-40
72106 Welders and related machine operators	230	260	260	760
72200 Electricians (except industrial and power system)	0	0	0	10
72201 Industrial electricians	10	10	10	30
72400 Construction millwrights and industrial mechanics	100	110	110	320
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	60	60	60	180
73300 Transport truck drivers	280	300	300	880
73400 Heavy equipment operators	40	40	40	120
75101 Material handlers	510	570	570	1,650
83100 Underground production and development miners	0	0	0	0
90010 Manufacturing managers	340	390	390	1,110
92021 Supervisors, electronics and electrical products manufacturing	10	10	10	20
92024 Supervisors, other products manufacturing and assembly	0	10	10	10
93101 Central control and process operators, petroleum, gas and chemical processing	10	10	10	30
94100 Machine operators, mineral and metal processing	40	50	50	130
94101 Foundry workers	30	40	40	110
94104 Inspectors and testers, mineral and metal processing	10	10	10	20
94105 Metalworking and forging machine operators	80	90	90	260
94106 Machining tool operators	50	60	60	170
94110 Chemical plant machine operators	60	70	70	200
94111 Plastics processing machine operators	270	300	300	870
94200 Motor vehicle assemblers, inspectors and testers	80	90	90	250
94201 Electronics assemblers, fabricators, inspectors and testers	260	290	290	840
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	30	30	30	100
94204 Mechanical assemblers and inspectors	10	10	10	20
94212 Plastic products assemblers, finishers and inspectors	80	90	90	260

Replacement Demand	2026-30	2031-35	2036-40	2025-40
94213 Industrial painters, coaters and metal finishing process operators	40	40	40	120
95100 Labourers in mineral and metal processing	10	10	10	20
95102 Labourers in chemical products processing and utilities	110	120	120	340
95109 Other labourers in processing, manufacturing and utilities	180	200	200	580

New Entrants

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

Table 7. New entrants – detailed results (Montreal Region)

New Entrants	2026-30	2031-35	2036-40	2025-40
11200 Human resources professionals	30	30	30	90
13201 Production and transportation logistics coordinators	20	20	20	70
14400 Shippers and receivers	50	50	50	170
14402 Production logistics workers	0	0	0	10
20010 Engineering managers	10	10	10	40
20012 Computer and information systems managers	30	30	30	100
21101 Chemists	10	10	10	20
21211 Data scientists	10	10	10	40
21220 Cybersecurity specialists	10	10	10	20
21221 Business systems specialists	20	10	10	50
21222 Information systems specialists	100	100	90	310
21223 Database analysts and data administrators	10	10	10	40
21230 Computer systems developers and programmers	100	90	90	300
21231 Software engineers and designers	70	70	60	220
21232 Software developers and programmers	140	140	130	430
21233 Web designers	20	20	20	50
21234 Web developers and programmers	130	130	120	410
21301 Mechanical engineers	60	60	50	170
21310 Electrical and electronics engineers	40	40	40	120
21311 Computer engineers (except software engineers and designers)	10	10	10	40

New Entrants	2026-30	2031-35	2036-40	2025-40
21320 Chemical engineers	10	10	10	20
21321 Industrial and manufacturing engineers	20	20	20	50
21322 Metallurgical and materials engineers	0	0	0	10
22100 Chemical technologists and technicians	10	10	10	20
22220 Computer network and web technicians	60	50	50	170
22222 Information systems testing technicians	50	50	50	150
22301 Mechanical engineering technologists and technicians	30	30	30	90
22302 Industrial engineering and manufacturing technologists and technicians	10	10	10	40
22310 Electrical and electronics engineering technologists and technicians	30	30	20	80
22312 Industrial instrument technicians and mechanics	0	0	0	10
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	10	10	10	30
72020 Contractors and supervisors, mechanic trades	10	10	10	20
72100 Machinists and machining and tooling inspectors	30	30	30	80
72101 Tool and die makers	0	0	0	10
72106 Welders and related machine operators	50	50	50	150
72200 Electricians (except industrial and power system)	10	10	0	20
72201 Industrial electricians	10	10	10	20
72400 Construction millwrights and industrial mechanics	30	20	20	80
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	10	10	10	40
73300 Transport truck drivers	20	20	20	50
73400 Heavy equipment operators	10	10	10	20
75101 Material handlers	100	100	90	310
83100 Underground production and development miners	0	0	0	10
90010 Manufacturing managers	20	20	20	80
92021 Supervisors, electronics and electrical products manufacturing	0	0	0	10

New Entrants	2026-30	2031-35	2036-40	2025-40
92024 Supervisors, other products manufacturing and assembly	0	0	0	10
93101 Central control and process operators, petroleum, gas and chemical processing	0	0	0	10
94100 Machine operators, mineral and metal processing	10	10	10	30
94101 Foundry workers	10	10	10	20
94104 Inspectors and testers, mineral and metal processing	0	0	0	10
94105 Metalworking and forging machine operators	10	10	10	30
94106 Machining tool operators	10	10	10	30
94110 Chemical plant machine operators	10	10	10	20
94111 Plastics processing machine operators	30	30	30	110
94200 Motor vehicle assemblers, inspectors and testers	10	10	10	30
94201 Electronics assemblers, fabricators, inspectors and testers	20	20	20	50
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	0	0	0	10
94204 Mechanical assemblers and inspectors	10	10	10	20
94212 Plastic products assemblers, finishers and inspectors	10	10	10	20
94213 Industrial painters, coaters and metal finishing process operators	10	10	10	30
95100 Labourers in mineral and metal processing	10	10	0	20
95102 Labourers in chemical products processing and utilities	20	20	20	70
95109 Other labourers in processing, manufacturing and utilities	30	30	30	90

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 8. Recruitment gap (#) – detailed results (Montreal Region)

Recruitment Gap (#)	2026-30	2031-35	2036-40
11200 Human resources professionals	120	130	130
13201 Production and transportation logistics coordinators	40	30	30
14400 Shippers and receivers	150	170	160
14402 Production logistics workers	<10	<10	<10
20010 Engineering managers	120	130	120
20012 Computer and information systems managers	370	410	400
21101 Chemists	30	30	30
21211 Data scientists	<10	<10	<10
21220 Cybersecurity specialists	20	20	20
21221 Business systems specialists	40	50	50
21222 Information systems specialists	620	710	710
21223 Database analysts and data administrators	50	60	60
21230 Computer systems developers and programmers	190	220	220
21231 Software engineers and designers	130	150	150
21232 Software developers and programmers	50	70	80
21233 Web designers	10	20	20
21234 Web developers and programmers	<10	10	20
21301 Mechanical engineers	140	140	100
21310 Electrical and electronics engineers	190	210	180
21311 Computer engineers (except software engineers and designers)	60	70	70
21320 Chemical engineers	10	20	10
21321 Industrial and manufacturing engineers	30	40	30
21322 Metallurgical and materials engineers	<10	<10	<10
22100 Chemical technologists and technicians	30	30	20
22220 Computer network and web technicians	130	150	140
22222 Information systems testing technicians	<10	<10	<10
22301 Mechanical engineering technologists and technicians	80	80	60
22302 Industrial engineering and manufacturing technologists and technicians	60	50	30
22310 Electrical and electronics engineering technologists and technicians	250	270	230
22312 Industrial instrument technicians and mechanics	30	40	30
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	50	60	50
72020 Contractors and supervisors, mechanic trades	<10	<10	<10
72100 Machinists and machining and tooling inspectors	270	290	270
72101 Tool and die makers	50	50	40

Recruitment Gap (#)	2026-30	2031-35	2036-40
72106 Welders and related machine operators	220	230	210
72200 Electricians (except industrial and power system)	<10	<10	<10
72201 Industrial electricians	10	10	<10
72400 Construction millwrights and industrial mechanics	100	100	80
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	50	50	50
73300 Transport truck drivers	270	290	280
73400 Heavy equipment operators	40	40	30
75101 Material handlers	460	500	460
83100 Underground production and development miners	<10	<10	<10
90010 Manufacturing managers	360	390	340
92021 Supervisors, electronics and electrical products manufacturing	10	10	<10
92024 Supervisors, other products manufacturing and assembly	<10	<10	<10
93101 Central control and process operators, petroleum, gas and chemical processing	20	20	<10
94100 Machine operators, mineral and metal processing	40	40	30
94101 Foundry workers	30	40	30
94104 Inspectors and testers, mineral and metal processing	<10	<10	<10
94105 Metalworking and forging machine operators	70	80	80
94106 Machining tool operators	50	50	50
94110 Chemical plant machine operators	60	60	60
94111 Plastics processing machine operators	240	270	270
94200 Motor vehicle assemblers, inspectors and testers	110	70	70
94201 Electronics assemblers, fabricators, inspectors and testers	290	310	250
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	40	40	30
94204 Mechanical assemblers and inspectors	20	<10	<10
94212 Plastic products assemblers, finishers and inspectors	70	80	80
94213 Industrial painters, coaters and metal finishing process operators	40	40	30
95100 Labourers in mineral and metal processing	10	<10	<10
95102 Labourers in chemical products processing and utilities	100	100	90
95109 Other labourers in processing, manufacturing and utilities	170	190	160

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 9. Recruitment gap (% of 2022 base year employment) – detailed results (Montreal Region)

Recruitment Gap (% of 2022 Base Year Employment)	2026-30	2031-35	2036-40
11200 Human resources professionals	7%	8%	8%
13201 Production and transportation logistics coordinators	4%	4%	3%
14400 Shippers and receivers	6%	7%	6%
14402 Production logistics workers	2%	1%	<1%
20010 Engineering managers	10%	11%	9%
20012 Computer and information systems managers	8%	9%	9%
21101 Chemists	8%	8%	6%
21211 Data scientists	<1%	<1%	<1%
21220 Cybersecurity specialists	3%	4%	4%
21221 Business systems specialists	4%	5%	5%
21222 Information systems specialists	8%	9%	9%
21223 Database analysts and data administrators	6%	7%	7%
21230 Computer systems developers and programmers	4%	5%	5%
21231 Software engineers and designers	3%	4%	4%
21232 Software developers and programmers	1%	1%	1%
21233 Web designers	2%	2%	2%
21234 Web developers and programmers	<1%	<1%	<1%
21301 Mechanical engineers	5%	5%	4%
21310 Electrical and electronics engineers	9%	10%	8%
21311 Computer engineers (except software engineers and designers)	4%	5%	5%
21320 Chemical engineers	4%	4%	2%
21321 Industrial and manufacturing engineers	4%	4%	3%
21322 Metallurgical and materials engineers	2%	3%	3%
22100 Chemical technologists and technicians	8%	8%	6%
22220 Computer network and web technicians	4%	4%	4%
22222 Information systems testing technicians	<1%	<1%	<1%
22301 Mechanical engineering technologists and technicians	6%	6%	5%

Recruitment Gap (% of 2022 Base Year Employment)	2026-30	2031-35	2036-40
22302 Industrial engineering and manufacturing technologists and technicians	7%	7%	4%
22310 Electrical and electronics engineering technologists and technicians	12%	13%	11%
22312 Industrial instrument technicians and mechanics	19%	21%	21%
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	9%	10%	9%
72020 Contractors and supervisors, mechanic trades	<1%	<1%	<1%
72100 Machinists and machining and tooling inspectors	10%	11%	10%
72101 Tool and die makers	15%	15%	13%
72106 Welders and related machine operators	8%	9%	8%
72200 Electricians (except industrial and power system)	2%	1%	<1%
72201 Industrial electricians	4%	3%	1%
72400 Construction millwrights and industrial mechanics	6%	7%	5%
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	7%	6%	6%
73300 Transport truck drivers	17%	18%	17%
73400 Heavy equipment operators	11%	11%	9%
75101 Material handlers	9%	10%	9%
83100 Underground production and development miners	1%	<1%	<1%
90010 Manufacturing managers	13%	14%	12%
92021 Supervisors, electronics and electrical products manufacturing	7%	7%	1%
92024 Supervisors, other products manufacturing and assembly	1%	1%	1%
93101 Central control and process operators, petroleum, gas and chemical processing	8%	7%	<1%
94100 Machine operators, mineral and metal processing	5%	6%	4%
94101 Foundry workers	9%	10%	8%
94104 Inspectors and testers, mineral and metal processing	1%	2%	2%
94105 Metalworking and forging machine operators	10%	11%	11%
94106 Machining tool operators	7%	8%	7%
94110 Chemical plant machine operators	12%	14%	13%
94111 Plastics processing machine operators	12%	13%	13%
94200 Motor vehicle assemblers, inspectors and testers	16%	10%	10%
94201 Electronics assemblers, fabricators, inspectors and testers	18%	19%	15%
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	16%	17%	12%
94204 Mechanical assemblers and inspectors	8%	<1%	<1%

Recruitment Gap (% of 2022 Base Year Employment)	2026-30	2031-35	2036-40
94212 Plastic products assemblers, finishers and inspectors	13%	14%	14%
94213 Industrial painters, coaters and metal finishing process operators	7%	6%	5%
95100 Labourers in mineral and metal processing	2%	2%	<1%
95102 Labourers in chemical products processing and utilities	9%	9%	8%
95109 Other labourers in processing, manufacturing and utilities	11%	12%	10%

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 17. 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%