FOCAL Initiative

ICEV TO EV WORKFORCE TRANSITION LABOUR MARKET FORECAST

QUEBEC 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 is 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 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 Quebec for 68 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 Quebec indicate that at least nine occupations will experience significant impacts. The magnitude and timing of impacts are unique for each occupation. Quebec is 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 has 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 2022) highlighted the crucial role of a broader automotive industry across Canada. As work concluded, it became clear that the emerging transition from internal combustion engine vehicles (ICEV) to electric vehicles (EV) was a new challenge facing the industry. The FOCAL II initiative is helping employers and job seekers manage the transition from (ICEV) to (EV). Assistance includes direct action through wage and training subsidies, and guidance in critical areas like skills transferability, diversity, immigration and apprenticeship. This support is augmented by FOCAL's analysis of the impact of new investments in EVs and the loss of ICEV-related production. The focus is on manufacturing industries, including vehicle assembly, parts production, battery supply and related changes across the supply chain. This process provides measures of changing labour market conditions for industries and occupations. FOCAL II assesses these impacts in three steps.

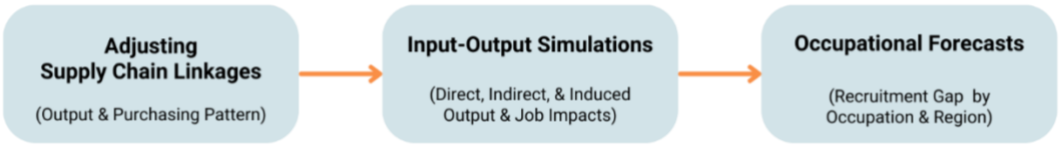
First, the EV Model estimates impacts of announced plans and expected investments and calculates new levels of production and related links across the supply chain. The analysis allocates these direct, initial impacts across;

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

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

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

Figure 1. Impact analysis steps



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 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 Quebec'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 heavy-duty vehicle assembly, parts production, battery assembly, related chemical and mineral processes and mining. Impacts are most disruptive in regions experiencing either new investments in battery plant and supply chain production or losses as internal combustion engines are phased out.

These impacts will be very apparent in Quebec, as the economy has deep roots and major employers in heavy-duty vehicle production. Announced investments in new battery plants, and related additions across the supply chain make the province a major focus for labour market adjustments in all the key occupations. Section 4 of the report identifies nine selected occupations, mostly along the supply chain for new battery production. Impacts across other occupations are described in detail in Appendix D[1].

This introduction is followed by a background on the province of Quebec. Section 3 describes impacts across the ICEV-EV transition in key industries. Section 4 reports detailed impacts across seven selected occupations. Conclusions and implications are 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.

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

The ICEV-EV Transition in Eastern Ontario – Background

The coming transition from ICEVs to EVs will have a major impact across the region. In 2022, the provincial workforce of 4,068,600 included 445,100 working in manufacturing and 7,700 in the core automotive assembly and parts industries[2]. Vehicle assembly and related activity are critical to the overall economic well being of the Quebec and Canadian economy. For example, assembled motor vehicles and parts are consistently among the top two or three exports from Canada; often second only to oil and gas extraction[3].

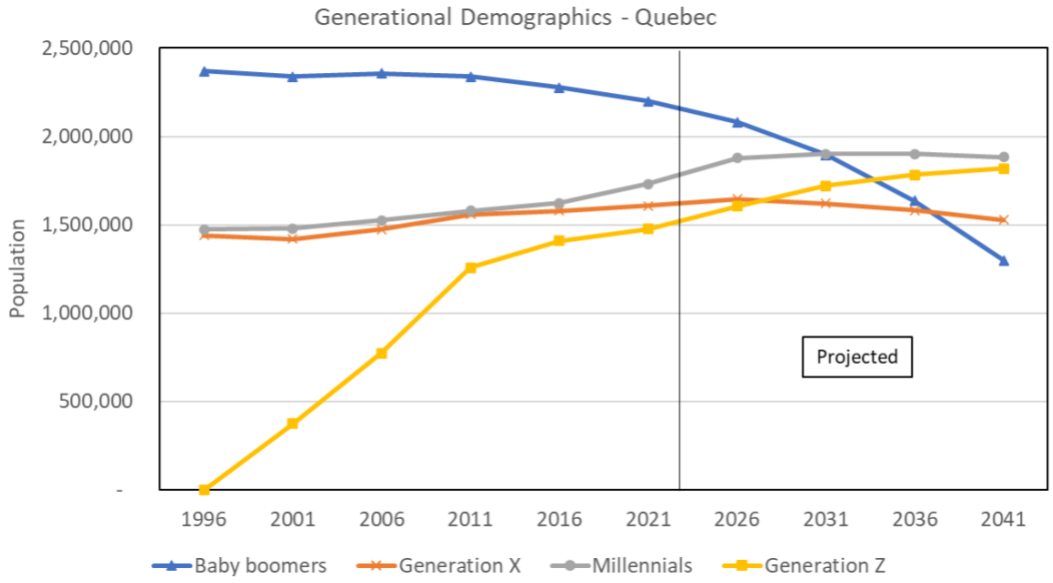
Relative to other industries, employers in manufacturing often identify human resources, skills shortages and recruiting as major challenges in business development. According to Statistics Canada:

> "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"[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 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. [5]

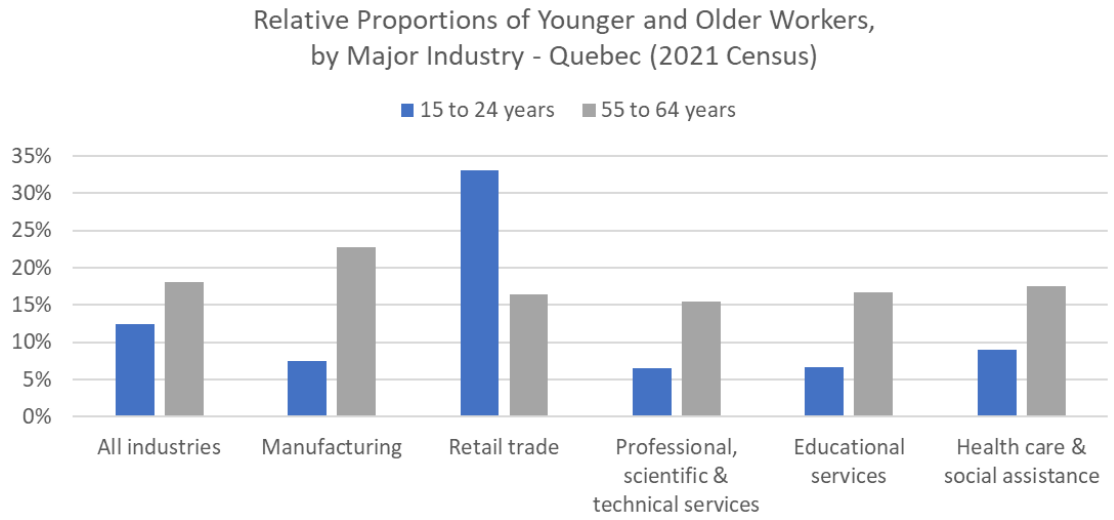
[2] Source: Statistics Canada Labour Statistics Consistent with the System of National Accounts (Table 36-10-0489-01)
[3] Source: Government of Canada Trade Data Online (https://ised-isde.canada.ca/site/trade-data-online/en).
[4] Source: 'Analysis on labour challenges in Canada, second quarter of 2023'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

Figure 2. Changing demographics in 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 in other industries is significantly lower than in the manufacturing sector and recruitment challenges related to the retirement of older workers will persist.

Figure 3. Proportions of older and younger workers in major 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[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].

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. Quebec 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 Quebec's broader automotive sector (Source: Statistics Canada, APRC)

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

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

Industry	Employment in 2022
Automobile and light-duty motor vehicle manufacturing	0
Heavy-duty truck manufacturing	3,100
Parts manufacturing	5,000
Mining	7,600
Basic chemical manufacturing	2,500
Other material processing	9,700
Battery manufacturing	3,800
Management, scientific and technical consulting services	25,000
Plastic product manufacturing	25,100
Other electronic product manufacturing	7,300
Semiconductor and other electronic component manufacturing	5,700
Iron and steel mills and ferro-alloy manufacturing	2,200
Foundries	3,200
Forging and stamping	1,400
Other automotive supply chain	245,100

The ICEV to EV transition will shift employment among the industries in the broader automative sector. The traditional leading economic role for these industries is clearly at risk as Quebec 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 Quebec has been active and successful in the global competition for battery production and investment in supplying industry capacity. 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, new battery plants and suppliers have announced plans for expansion in Quebec. 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.

In Quebec, attention focuses on the battery manufacturing announcements including the Northvolt battery production plant in Montreal. But even more notable are announced chemical manufacturing facilities producing cathode and anode materials, graphite, cobalt and lithium production and related material processing and mining announcements. These new production sites will likely supply new battery production facilities in Quebec, Ontario and in the United States. Battery production is expected to begin in 2025 and, in the base case scenario, grows to a peak in 2031. More limited changes in heavy duty vehicle 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.

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 Eastern Ontario.

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

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

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

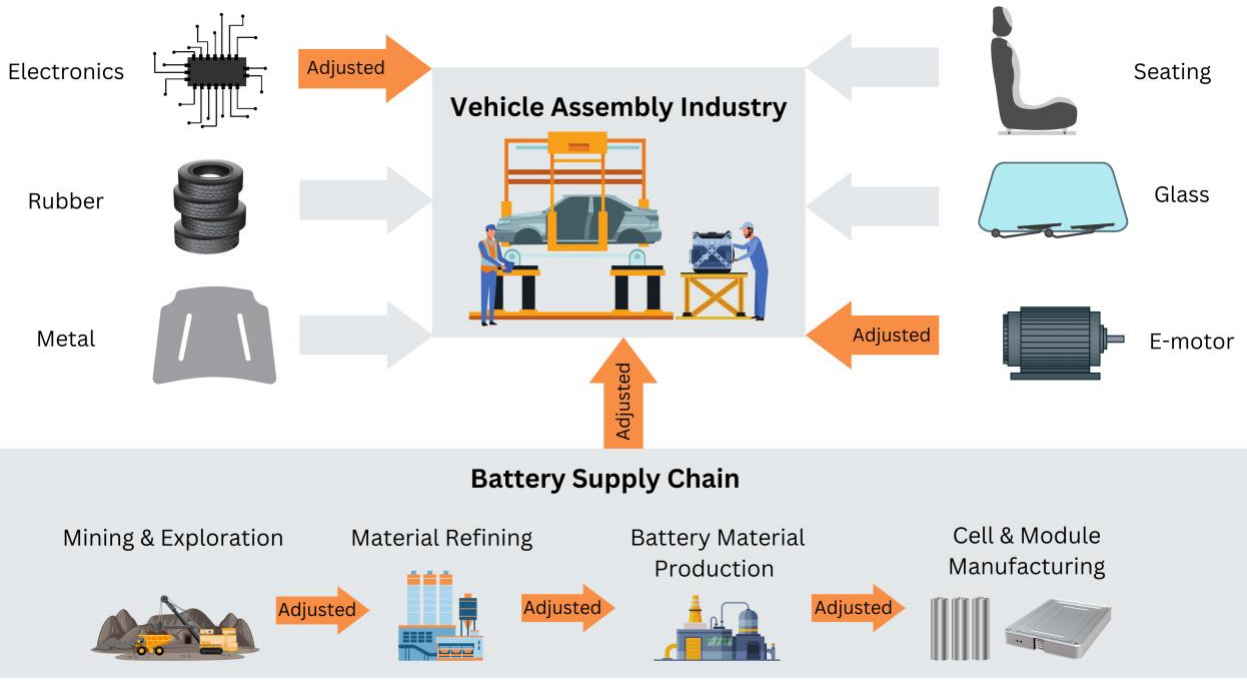
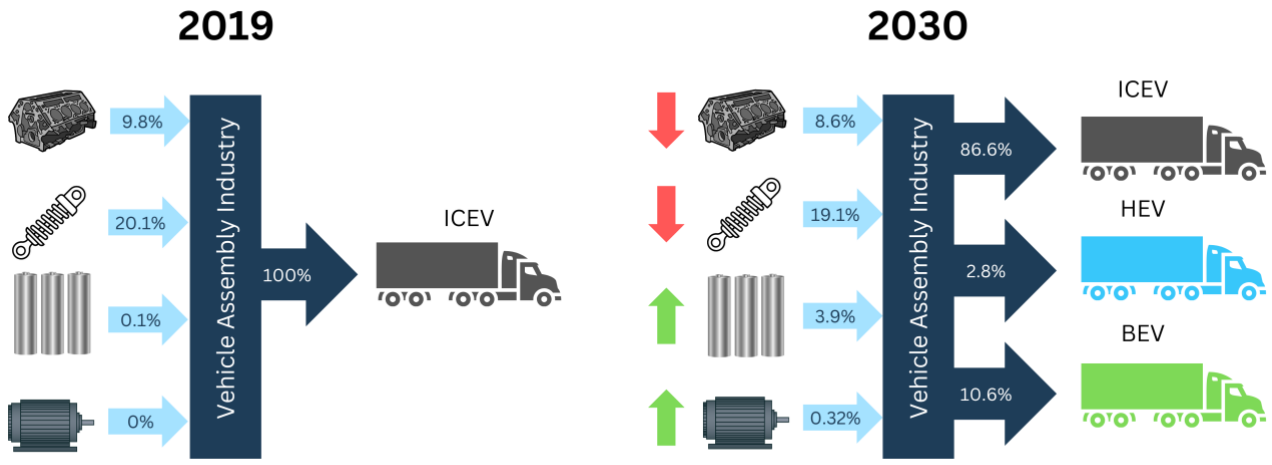


Figure 5 provides an example of the changes that are imposed based on analysis of the core industry links from parts manufacturers to assembly. Changes in the distribution of inputs into vehicle assembly, seen in the diagram, capture changes between 2019 and 2030 from the base case scenario.

Figure 5. Vehicle assembly industry supply inputs



Results are reported at three levels of impact. First, *direct 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;

Heavy-Duty Vehicle assembly, by type;

- Internal combustion
- Hybrid
- Battery electric

New battery plants operating, by;

- Cells, modules, packs
- 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.

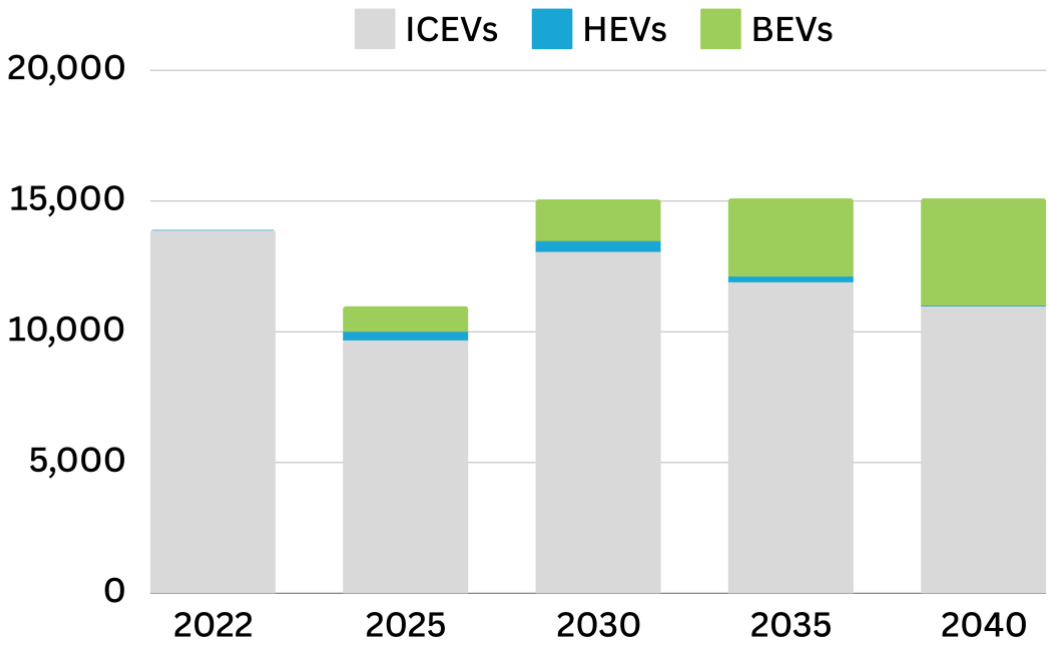
Base Case Scenario Assumptions

The base case scenario assumes a specific path in the transition from ICEVs to EVs. At the start of the transition, heavy 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 one third 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 heavy vehicle production, expressed in units produced. The first column illustrates the production mix at the start of the transition.

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 15,200. Further, the base case scenario reflects a slow pace of adoption of BEVs 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 one new battery production facility will be operating in Quebec by 2040. Several chemical and material processing plants will be opening; building a longer and more robust supply chain that reaches back to mining new minerals. Much of this production will be located close to resource sources. 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

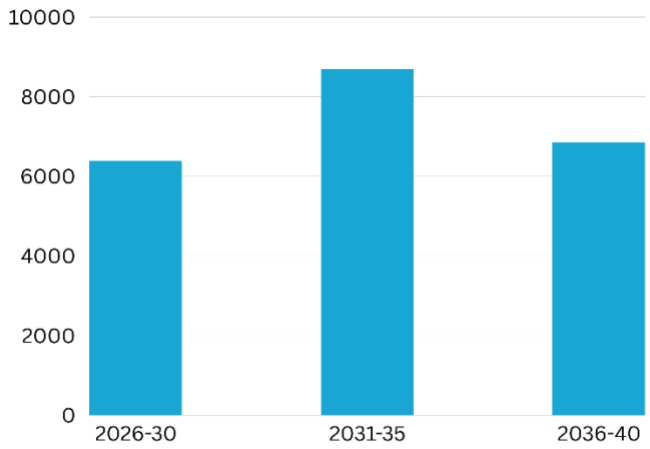
Battery Production & Supply Chain	Assumptions
Battery manufacturing (4 plants)	100 GWh
Cathode & anode manufacturing	32.5 %
Material filtering & processing	32.5 %

Mining	32.5 %

Quebec Impacts Across Industries

Figure 7 summarizes the total employment impacts in the base case scenario in three intervals across 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 internal combustion engines and related production. Impacts peak at 8,700 jobs in the 2031 to 2035 period as battery operations ramp up.

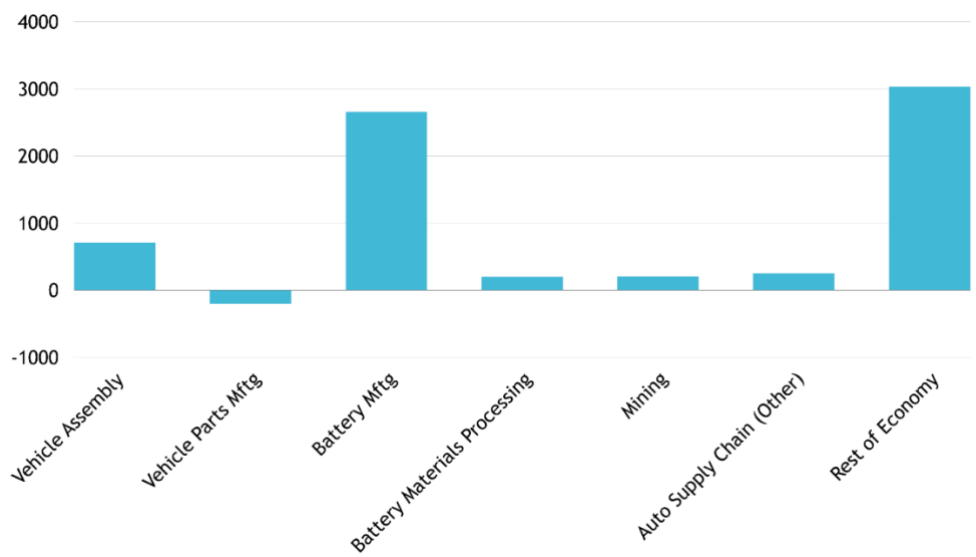
Figure 7. Total impact of ICEV-EV transition on employment - all industries, Quebec



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 remains unchanged 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 Quebec. 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 labour markets in Quebec for nine occupations. FOCAL II findings signal difficulties for recruiters during the peak periods as the transition unfolds. Changing employment is 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 participating in the transition face the biggest changes. Labour markets more distant from the investments, assembly plants, and key occupations face more limited impacts. Occupations that are working in the selected industries (listed in Appendix A) are included in this section.

Occupational impacts in Quebec are relatively large and concentrated in the electrical, electronics and chemical related occupations that will be recruiting to fill the new manufacturing capacity across the battery supply chain.

Recruitment Gaps

FOCAL has created a "recruitment gap" measure for each occupation and provincial/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. An increase 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, assumptions included in the base case scenario will affect 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 Quebec'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 nine occupations in Quebec 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 18, 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 engines and drive chains. By far the most important of these changes in Quebec is in the battery supply chain and, in particular, new chemical plants that are producing cathode, anode, graphite and related materials. This investment pattern makes occupational impacts in Quebec different from Ontario.

Direct impacts emerge at different time intervals, with new jobs in battery and related activity peaking in the 2031-2035 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 nine occupations.

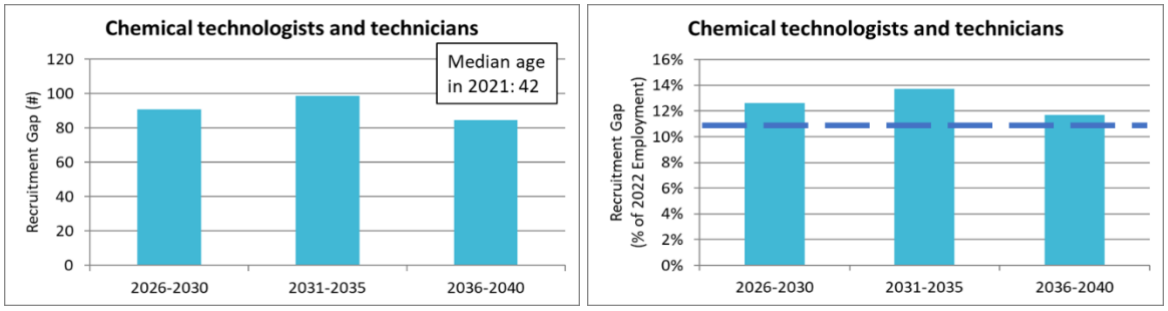
Quebec results highlight a key feature of the emerging transition in that province. The largest impacts are in the new battery production capacity and added capacity in chemical production across the supply chain.

To illustrate the distinctive pattern of recruitment gaps for the selected occupations, the right-hand panel in Figures 10 to 18 contains a horizontal bar at 11%. This is the average recruitment gap for all the selected occupations in the FOCAL II analysis within Quebec 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].

Chemical technologists and technicians (Figure 10): This is the first of several occupations where recruitment climbs to record high levels during the 2031-2035 interval – reflecting the peak in new production by new battery facilities and their chemical and mineral suppliers. This is a relatively small occupation, but it is a critical part of the overall chemical industry work force that must be recruited. Chemical technicians and technologists have an average age profile so that replacement demand will add to recruiting challenges.

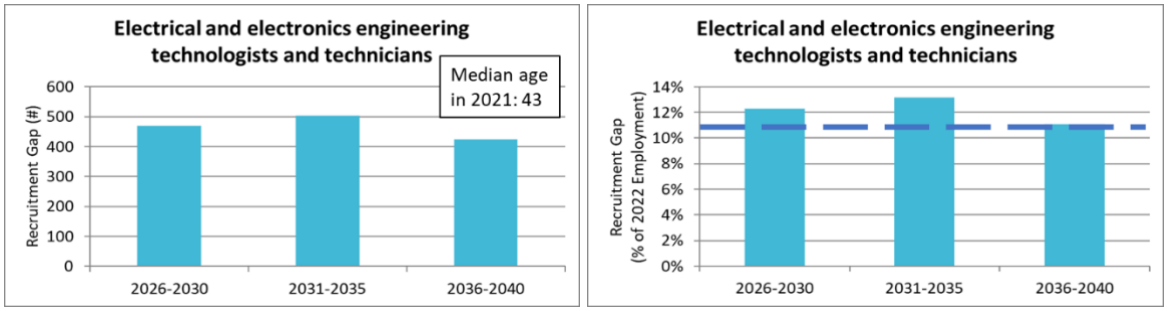
[9] See Appendix B for a complete list of occupations used in the analysis.
[10] Median ages are calculated using 2021 Census data for each occupation in selected industries (see Appendix A for list of industries). The median age for all occupations in the selected industries in Quebec is 42 years old in 2021.

Figure 10. Recruitment gap – chemical technologists and technicians



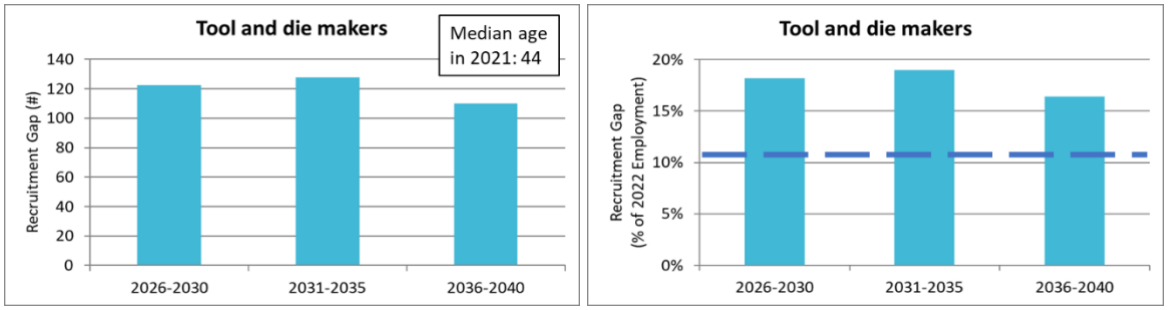
<u>*Electrical and electronics engineering technologists and technicians*</u> (Figure 11): This group of technicians and technologists (and the corresponding engineers) will be sought after in record numbers as the battery capacity reaches full production. While the peak gap is in 2031-2035 interval, the 2026-2030 interval also features similar recruiting intensity as new plants expand to full activity.

Figure 11. Recruitment gap – electrical and electronics engineering technologists and technicians



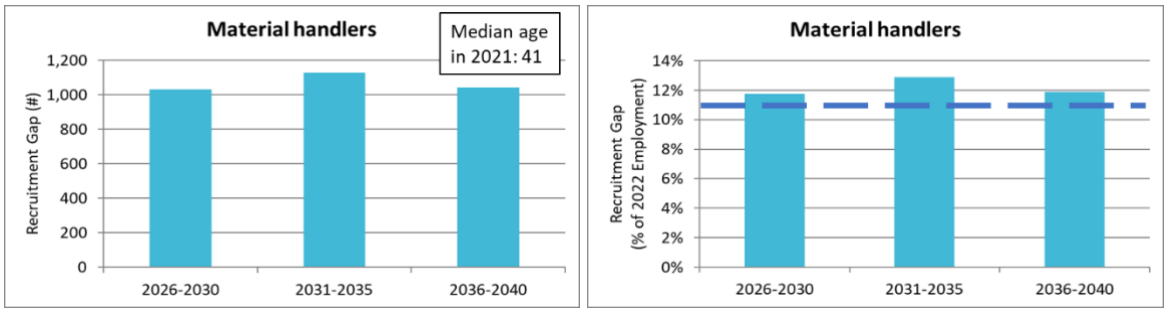
<u>*Tool and die makers*</u> (Figure 12): Skilled trades are in high demand in most industries and regions, and this is a case where the shortage will be aggravated by the ICEV – EV transition. Other trades (e.g. machinists, industrial electricians and millwrights) have a similar profile but tool and die makers have the highest gap. A relatively old age profile adds to the challenge.

Figure 12. Recruitment gap - tool and die makers



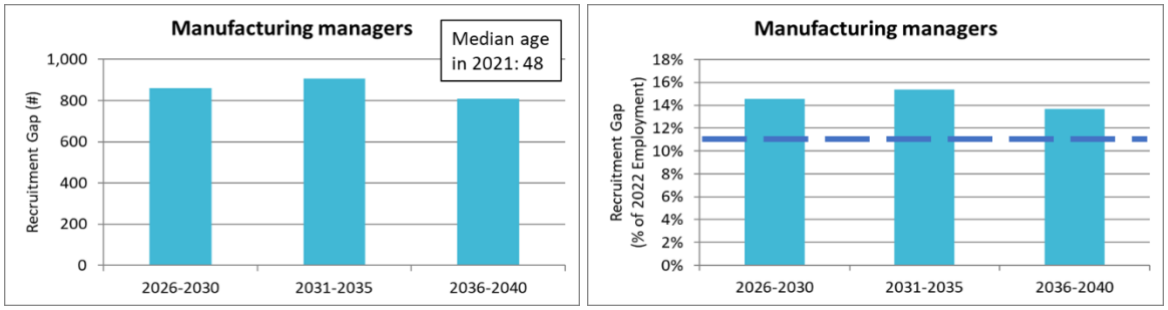
Material handlers (Figure 13): While there is no vehicle assembly in Eastern Ontario, this occupation emerges as a source of labour shortage. A closer examination reveals that assemblers are working in the parts industries and recruitment gaps are high as the transition is beginning. Here again market conditions in Eastern Ontario will be complicated by expansion demands for this occupation in other regions. This will be especially true in the 2031-2035 period. This occupation has 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 13. Recruitment gap – material handlers



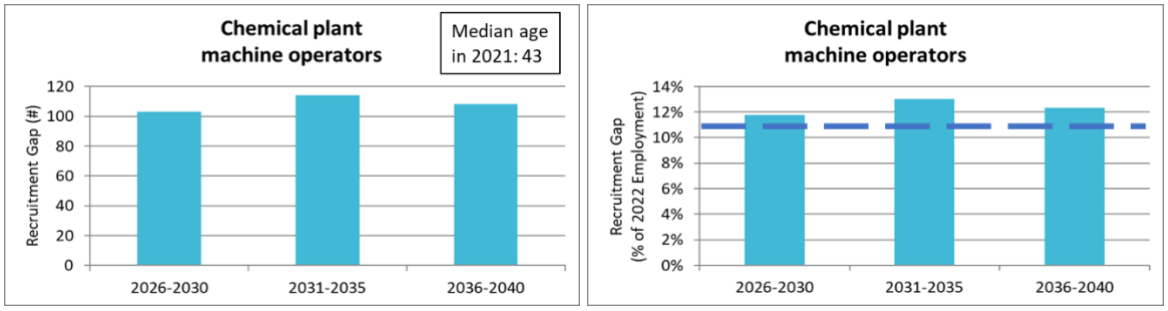
Manufacturing managers (Figure 14): This is the largest workforce and most widespread example of recruiting challenges for managers and supervisors. Recruiting challenges are already high currently and this is to some extent replacement demand.

Figure 14. Recruitment gap – manufacturing managers



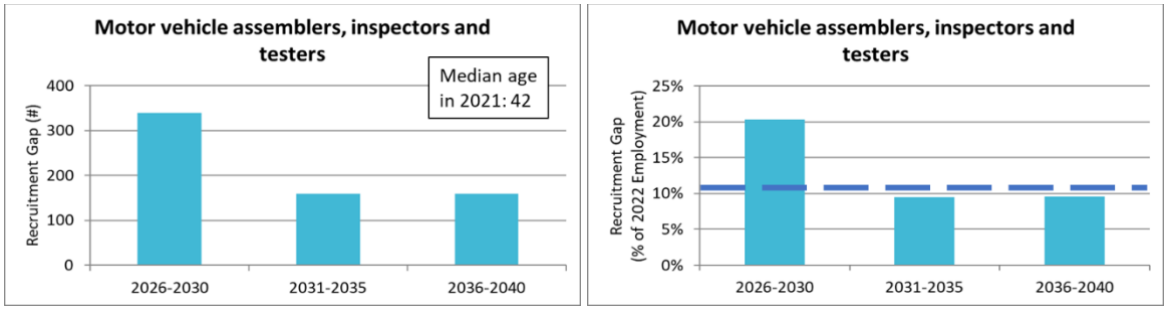
Chemical plant machine operators (Figure 15): This is a mid size and specialized workforce with moderate recruitment gaps prior to the transition. The age profile is average. These operators and the related technicians and supervisors are in short supply in some other regions but Quebec's success attracting new chemical facilities will create a large challenge.

Figure 15. Recruitment gap – chemical plant machine operators



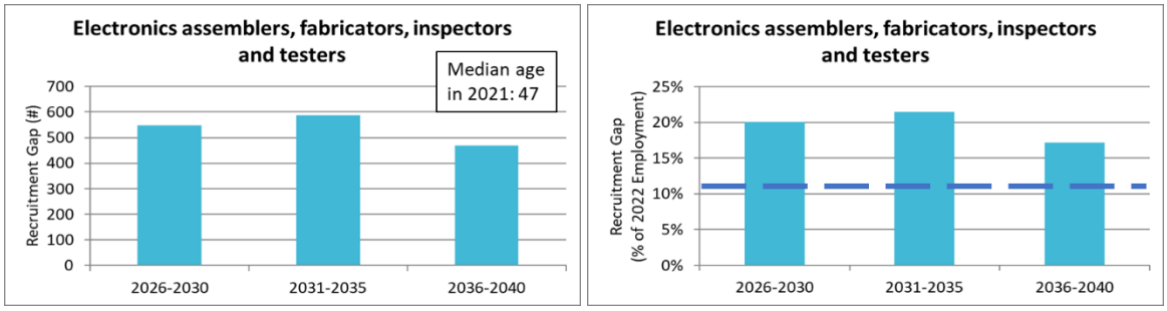
Motor vehicle assemblers, inspectors and testers (Figure 16)
This key workforce is being challenged as assembly shifts from ICE vehicles to electric. In the base case scenario, there is a moderate ramping up in electric vehicle assembly to 2030 and a flat profile over the final decade of the transition. Workers joining new BEV assembly need to be recruited and trained in the first five years.

Figure 16. Recruitment gap - motor vehicle assemblers, inspectors and testers



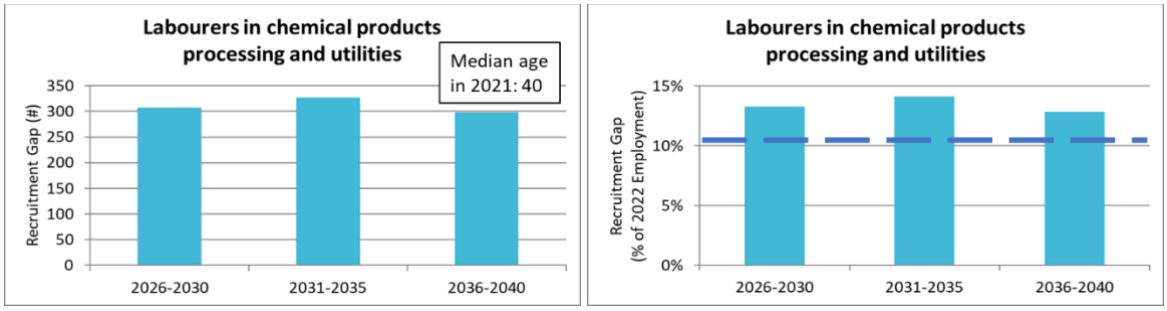
Electronics assemblers, fabricators, inspectors and testers (Figure 17)
This occupation is a relatively large workforce at the start of the transition and there are shortages in the labour market even as the transition begins. This is to some extent a function of the older age profile and ongoing retirements. Note that the recruitment gap tops 20% in 2031-2036 and this is the highest among all the occupations in 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 17. Recruitment gap - electronics assemblers, fabricators, inspectors and testers



<u>*Labourers in chemical products processing and utilities*</u> (Figure 18)
Workers recruited here join the operators, technicians and supervisors in the chemical industry noted above. Taken together recruiting the four chemical occupations noted here is a special labour market concern. Most of this new workforce are joining new production facilities that are part of an entirely new supply chain linked to mining and mineral processing. Meeting these demands may require new training and skills development programs.

Figure 18. Recruitment gap - labourers in chemical products processing 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 management and supervision, engineering, skilled trades and assemblers in battery production and the supply chain. Results for these occupations signal widespread labour shortages.

Province-wide 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.

There is a shift from industrial and mechanical to electrical engineering, as well as technicians and technologists, across the transition. 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 facilities close down and eliminate jobs in internal combustion engine, transmissions and exhaust systems.

New investments in electrical, electronics and related chemicals and mineral production concentrate recruiting challenges among supervisors, technicians, operators and labourers. It may be the case that new processes and technologies will impact the skills and training needed across this workforce and there may be a case for programs to prepare the new workforce.

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 [11]. 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.

Conclusions and Implications

The ICEV-EV transition, in the base case scenario, will create major disruptions in labour markets for several specific occupations in Quebec. 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

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.

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 internal combustion 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.

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 resource risks are not new to manufacturing in the province, 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 partially adapted electric vehicle industry. Other FOCAL II scenarios show more dramatic success as 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, vehicle assembly is Canada's second most important export industry and circumstances described here confirm Quebec's emergence as a new and global force.

Appendices

Appendix A – Industries Analyzed in the Labour Market Impact Model
Appendix B – Occupations Analyzed in the Labour Market Impact Model
Appendix C – Methodology Notes
Appendix D – Detailed Results
Appendix E – Skills Transferability Matrix (STM) Example

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 (Quebec)

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.

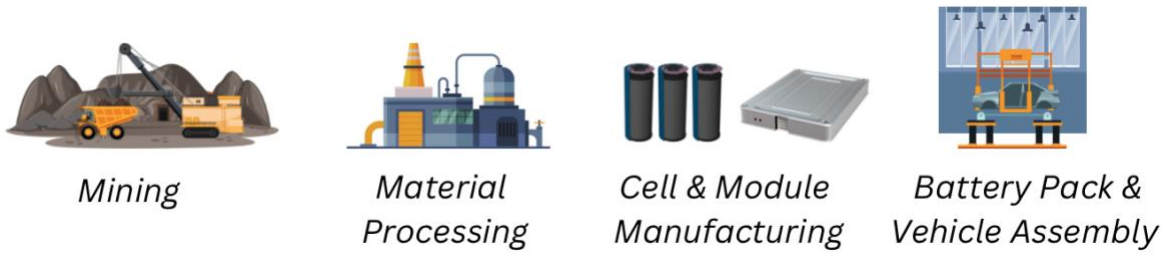
1. New EV production
2. Economic impacts across the supply chain
3. Labour market impacts by region and occupation

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 19. 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 49 selected industries in seven 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 Quebec 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 Quebec 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 Quebec'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.

[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.

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 (Quebec)

Expansion Demand	2026-30	2031-35	2036-40	2025-40
11200 Human resources professionals	20	10	-10	20
13201 Production and transportation logistics coordinators	40	10	-10	40
14400 Shippers and receivers	40	20	-10	40
14402 Production logistics workers	10	10	0	10
20010 Engineering managers	30	20	-10	40
20012 Computer and information systems managers	20	20	-10	30
21101 Chemists	20	10	-10	20
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	-10	20
21223 Database analysts and data administrators	0	0	0	0
21230 Computer systems developers and programmers	20	10	0	20
21231 Software engineers and designers	10	0	0	10
21232 Software developers and programmers	0	0	0	0
21233 Web designers	0	0	0	0
21234 Web developers and programmers	10	10	0	10
21301 Mechanical engineers	120	50	-40	130
21310 Electrical and electronics engineers	60	40	-20	70
21311 Computer engineers (except software engineers and designers)	0	0	0	0
21320 Chemical engineers	10	10	-10	10
21321 Industrial and manufacturing engineers	20	10	-10	20
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	10	10	-10	20
22220 Computer network and web technicians	10	10	0	20
22222 Information systems testing technicians	0	0	0	0
22301 Mechanical engineering technologists and technicians	60	20	-20	60
22302 Industrial engineering and manufacturing technologists and technicians	50	30	-20	60
22310 Electrical and electronics engineering technologists and technicians	80	50	-30	90
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	10	0	10
72020 Contractors and supervisors, mechanic trades	10	0	0	10
72100 Machinists and machining and tooling inspectors	50	20	-20	50
72101 Tool and die makers	20	10	-10	20
72106 Welders and related machine operators	110	30	-20	110
72200 Electricians (except industrial and power system)	20	10	-10	20
72201 Industrial electricians	20	10	-10	20
72400 Construction millwrights and industrial mechanics	70	30	-30	80
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	50	0	0	40
73300 Transport truck drivers	30	10	-10	20
73400 Heavy equipment operators	30	10	-10	20
75101 Material handlers	100	60	-40	110
82020 Supervisors, mining and quarrying	10	0	0	10
83100 Underground production and development miners	20	0	-10	20
84100 Underground mine service and support workers	10	0	0	10
90010 Manufacturing managers	120	60	-40	130
92021 Supervisors, electronics and electrical products manufacturing	20	10	-10	20

Expansion Demand	2026-30	2031-35	2036-40	2025-40
92023 Supervisors, other mechanical and metal products manufacturing	0	0	0	0
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	20	20	-10	30
94100 Machine operators, mineral and metal processing	20	10	-10	20
94101 Foundry workers	10	10	-10	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	10	0	0	10
94110 Chemical plant machine operators	10	0	0	10
94111 Plastics processing machine operators	10	10	-10	10
94200 Motor vehicle assemblers, inspectors and testers	200	-10	-10	150
94201 Electronics assemblers, fabricators, inspectors and testers	100	70	-50	120
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	20	10	-10	30
94204 Mechanical assemblers and inspectors	80	0	0	60
94212 Plastic products assemblers, finishers and inspectors	0	0	0	0
94213 Industrial painters, coaters and metal finishing process operators	40	10	-10	40
95100 Labourers in mineral and metal processing	10	10	0	10
95102 Labourers in chemical products processing and utilities	40	20	-10	40
95109 Other labourers in processing, manufacturing and utilities	50	30	-20	60

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 (Quebec)

Replacement Demand	2026-30	2031-35	2036-40	2025-40
11200 Human resources professionals	280	310	310	900
13201 Production and transportation logistics coordinators	110	120	120	340
14400 Shippers and receivers	510	580	580	1,680
14402 Production logistics workers	10	10	10	20
20010 Engineering managers	220	250	250	730
20012 Computer and information systems managers	700	790	790	2,280
21101 Chemists	60	70	70	210
21211 Data scientists	10	10	10	30
21220 Cybersecurity specialists	60	70	70	200
21221 Business systems specialists	110	120	120	350
21222 Information systems specialists	1,260	1,410	1,410	4,090
21223 Database analysts and data administrators	120	140	140	390
21230 Computer systems developers and programmers	420	460	460	1,340
21231 Software engineers and designers	320	360	360	1,050
21232 Software developers and programmers	330	370	370	1,070
21233 Web designers	50	60	60	170
21234 Web developers and programmers	190	210	210	620
21301 Mechanical engineers	350	400	400	1,140
21310 Electrical and electronics engineers	400	450	450	1,300
21311 Computer engineers (except software engineers and designers)	190	220	220	630
21320 Chemical engineers	40	50	50	130
21321 Industrial and manufacturing engineers	120	130	130	380
21322 Metallurgical and materials engineers	10	10	10	40
21330 Mining Engineers	10	10	10	40
22100 Chemical technologists and technicians	90	100	100	280
22220 Computer network and web technicians	290	320	320	930
22222 Information systems testing technicians	30	40	40	110
22301 Mechanical engineering technologists and technicians	180	200	200	590
22302 Industrial engineering and manufacturing technologists and technicians	120	130	130	380
22310 Electrical and electronics engineering technologists and technicians	440	500	500	1,440
22312 Industrial instrument technicians and mechanics	50	50	50	160

Replacement Demand	2026-30	2031-35	2036-40	2025-40
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	130	150	150	420
72020 Contractors and supervisors, mechanic trades	40	40	40	130
72100 Machinists and machining and tooling inspectors	640	720	720	2,070
72101 Tool and die makers	110	130	130	360
72106 Welders and related machine operators	580	650	650	1,880
72200 Electricians (except industrial and power system)	10	20	20	50
72201 Industrial electricians	60	70	70	210
72400 Construction millwrights and industrial mechanics	390	440	440	1,260
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	150	170	170	490
73300 Transport truck drivers	710	780	780	2,270
73400 Heavy equipment operators	180	200	200	580
75101 Material handlers	1,100	1,240	1,240	3,580
82020 Supervisors, mining and quarrying	40	40	40	120
83100 Underground production and development miners	60	70	70	200
84100 Underground mine service and support workers	30	40	40	110
90010 Manufacturing managers	770	870	880	2,520
92021 Supervisors, electronics and electrical products manufacturing	20	20	20	70
92023 Supervisors, other mechanical and metal products manufacturing	10	10	10	20
92024 Supervisors, other products manufacturing and assembly	30	30	30	80
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	20	30	30	80
94100 Machine operators, mineral and metal processing	240	280	280	810
94101 Foundry workers	100	110	110	310
94104 Inspectors and testers, mineral and metal processing	20	20	20	70

Replacement Demand	2026-30	2031-35	2036-40	2025-40
94105 Metalworking and forging machine operators	220	250	250	720
94106 Machining tool operators	130	140	140	410
94110 Chemical plant machine operators	100	120	120	340
94111 Plastics processing machine operators	530	590	590	1,700
94200 Motor vehicle assemblers, inspectors and testers	170	200	200	560
94201 Electronics assemblers, fabricators, inspectors and testers	470	540	540	1,550
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	40	50	50	140
94204 Mechanical assemblers and inspectors	60	70	70	200
94212 Plastic products assemblers, finishers and inspectors	150	170	170	490
94213 Industrial painters, coaters and metal finishing process operators	140	150	150	450
95100 Labourers in mineral and metal processing	50	60	60	180
95102 Labourers in chemical products processing and utilities	310	350	350	1,020
95109 Other labourers in processing, manufacturing and utilities	370	420	420	1,210

New Entrants

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

Table 7. New entrants – detailed results (Quebec)

New Entrants	2026-30	2031-35	2036-40	2025-40
11200 Human resources professionals	50	50	50	160
13201 Production and transportation logistics coordinators	30	30	30	100
14400 Shippers and receivers	90	90	80	280
14402 Production logistics workers	10	10	10	20
20010 Engineering managers	20	20	20	50
20012 Computer and information systems managers	50	40	40	140
21101 Chemists	10	10	10	40
21211 Data scientists	20	20	20	50
21220 Cybersecurity specialists	10	10	10	40

New Entrants	2026-30	2031-35	2036-40	2025-40
21221 Business systems specialists	20	20	20	60
21222 Information systems specialists	140	130	120	420
21223 Database analysts and data administrators	20	20	20	60
21230 Computer systems developers and programmers	160	150	140	490
21231 Software engineers and designers	110	110	100	340
21232 Software developers and programmers	220	210	200	670
21233 Web designers	30	30	30	90
21234 Web developers and programmers	210	200	190	650
21301 Mechanical engineers	110	110	100	330
21310 Electrical and electronics engineers	70	70	60	220
21311 Computer engineers (except software engineers and designers)	20	20	20	70
21320 Chemical engineers	20	20	20	50
21321 Industrial and manufacturing engineers	30	30	30	100
21322 Metallurgical and materials engineers	0	0	0	10
21330 Mining Engineers	10	10	0	20
22100 Chemical technologists and technicians	10	10	10	30
22220 Computer network and web technicians	90	90	80	290
22222 Information systems testing technicians	70	70	60	220
22301 Mechanical engineering technologists and technicians	50	50	40	150
22302 Industrial engineering and manufacturing technologists and technicians	20	20	20	70
22310 Electrical and electronics engineering technologists and technicians	50	50	40	150
22312 Industrial instrument technicians and mechanics	10	10	10	20
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	20	10	10	50
72020 Contractors and supervisors, mechanic trades	10	10	10	40
72100 Machinists and machining and tooling inspectors	70	70	70	230
72101 Tool and die makers	10	10	10	30
72106 Welders and related machine operators	120	120	110	370
72200 Electricians (except industrial and power system)	10	10	10	30

New Entrants	2026-30	2031-35	2036-40	2025-40
72201 Industrial electricians	10	10	10	30
72400 Construction millwrights and industrial mechanics	50	50	50	160
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	30	30	30	100
73300 Transport truck drivers	40	30	30	110
73400 Heavy equipment operators	20	20	20	70
75101 Material handlers	170	170	160	530
82020 Supervisors, mining and quarrying	0	0	0	10
83100 Underground production and development miners	20	20	20	50
84100 Underground mine service and support workers	10	10	10	30
90010 Manufacturing managers	30	30	20	80
92021 Supervisors, electronics and electrical products manufacturing	0	0	0	10
92023 Supervisors, other mechanical and metal products manufacturing	0	0	0	10
92024 Supervisors, other products manufacturing and assembly	10	10	10	20
93100 Central control and process operators, mineral and metal processing	0	0	0	10
93101 Central control and process operators, petroleum, gas and chemical processing	10	10	10	20
94100 Machine operators, mineral and metal processing	50	50	40	150
94101 Foundry workers	20	20	20	60
94104 Inspectors and testers, mineral and metal processing	10	10	10	20
94105 Metalworking and forging machine operators	20	20	20	80
94106 Machining tool operators	20	20	20	80
94110 Chemical plant machine operators	10	10	10	30
94111 Plastics processing machine operators	70	70	60	210
94200 Motor vehicle assemblers, inspectors and testers	30	30	20	80
94201 Electronics assemblers, fabricators, inspectors and testers	30	30	20	80

New Entrants	2026-30	2031-35	2036-40	2025-40
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	10	10	10	20
94204 Mechanical assemblers and inspectors	10	10	10	30
94212 Plastic products assemblers, finishers and inspectors	20	20	20	60
94213 Industrial painters, coaters and metal finishing process operators	20	20	20	70
95100 Labourers in mineral and metal processing	10	10	10	50
95102 Labourers in chemical products processing and utilities	40	40	40	140
95109 Other labourers in processing, manufacturing and utilities	60	60	50	180

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 (Quebec)

Recruitment Gap (#)	2026-30	2031-35	2036-40
11200 Human resources professionals	250	260	260
13201 Production and transportation logistics coordinators	120	100	80
14400 Shippers and receivers	460	510	490
14402 Production logistics workers	10	10	<10
20010 Engineering managers	240	260	230
20012 Computer and information systems managers	680	760	740
21101 Chemists	70	70	50
21211 Data scientists	<10	<10	<10
21220 Cybersecurity specialists	50	60	60
21221 Business systems specialists	90	100	100
21222 Information systems specialists	1,140	1,290	1,280
21223 Database analysts and data administrators	110	120	120
21230 Computer systems developers and programmers	280	320	320
21231 Software engineers and designers	230	260	260
21232 Software developers and programmers	120	160	170
21233 Web designers	20	30	30
21234 Web developers and programmers	<10	20	20
21301 Mechanical engineers	360	340	260

Recruitment Gap (#)	2026-30	2031-35	2036-40
21310 Electrical and electronics engineers	390	420	360
21311 Computer engineers (except software engineers and designers)	170	200	200
21320 Chemical engineers	30	40	20
21321 Industrial and manufacturing engineers	110	110	100
21322 Metallurgical and materials engineers	10	10	10
21330 Mining Engineers	10	10	10
22100 Chemical technologists and technicians	90	100	80
22220 Computer network and web technicians	210	240	230
22222 Information systems testing technicians	<10	<10	<10
22301 Mechanical engineering technologists and technicians	190	180	140
22302 Industrial engineering and manufacturing technologists and technicians	140	140	90
22310 Electrical and electronics engineering technologists and technicians	470	500	420
22312 Industrial instrument technicians and mechanics	50	50	50
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	130	140	130
72020 Contractors and supervisors, mechanic trades	30	30	30
72100 Machinists and machining and tooling inspectors	610	670	630
72101 Tool and die makers	120	130	110
72106 Welders and related machine operators	570	560	520
72200 Electricians (except industrial and power system)	20	20	<10
72201 Industrial electricians	70	70	60
72400 Construction millwrights and industrial mechanics	410	420	370
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	170	130	130
73300 Transport truck drivers	700	760	740
73400 Heavy equipment operators	180	190	170
75101 Material handlers	1,030	1,130	1,040
82020 Supervisors, mining and quarrying	50	40	40
83100 Underground production and development miners	70	60	50
84100 Underground mine service and support workers	40	30	30
90010 Manufacturing managers	860	910	810
92021 Supervisors, electronics and electrical products manufacturing	30	30	10
92023 Supervisors, other mechanical and metal products manufacturing	10	10	10
92024 Supervisors, other products manufacturing and assembly	20	20	20

Recruitment Gap (#)	2026-30	2031-35	2036-40
93100 Central control and process operators, mineral and metal processing	<10	<10	<10
93101 Central control and process operators, petroleum, gas and chemical processing	40	40	10
94100 Machine operators, mineral and metal processing	220	250	230
94101 Foundry workers	90	100	90
94104 Inspectors and testers, mineral and metal processing	20	20	20
94105 Metalworking and forging machine operators	200	220	230
94106 Machining tool operators	110	120	110
94110 Chemical plant machine operators	100	110	110
94111 Plastics processing machine operators	470	520	520
94200 Motor vehicle assemblers, inspectors and testers	340	160	160
94201 Electronics assemblers, fabricators, inspectors and testers	550	590	470
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	60	60	30
94204 Mechanical assemblers and inspectors	130	60	50
94212 Plastic products assemblers, finishers and inspectors	140	150	150
94213 Industrial painters, coaters and metal finishing process operators	160	140	130
95100 Labourers in mineral and metal processing	50	50	40
95102 Labourers in chemical products processing and utilities	310	330	300
95109 Other labourers in processing, manufacturing and utilities	360	400	340

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 (Quebec)

Recruitment Gap (% of 2022 Base Year Employment)	2026-30	2031-35	2036-40
11200 Human resources professionals	9%	9%	9%
13201 Production and transportation logistics coordinators	6%	5%	4%

Recruitment Gap (% of 2022 Base Year Employment)	2026-30	2031-35	2036-40
14400 Shippers and receivers	10%	11%	11%
14402 Production logistics workers	4%	3%	<1%
20010 Engineering managers	11%	12%	10%
20012 Computer and information systems managers	9%	10%	10%
21101 Chemists	9%	9%	7%
21211 Data scientists	<1%	<1%	<1%
21220 Cybersecurity specialists	5%	6%	6%
21221 Business systems specialists	6%	7%	7%
21222 Information systems specialists	10%	11%	11%
21223 Database analysts and data administrators	8%	9%	9%
21230 Computer systems developers and programmers	4%	4%	4%
21231 Software engineers and designers	4%	4%	4%
21232 Software developers and programmers	1%	2%	2%
21233 Web designers	2%	2%	2%
21234 Web developers and programmers	<1%	<1%	<1%
21301 Mechanical engineers	7%	7%	5%
21310 Electrical and electronics engineers	10%	11%	9%
21311 Computer engineers (except software engineers and designers)	7%	8%	9%
21320 Chemical engineers	5%	5%	3%
21321 Industrial and manufacturing engineers	6%	6%	6%
21322 Metallurgical and materials engineers	3%	3%	3%
21330 Mining Engineers	4%	3%	3%
22100 Chemical technologists and technicians	13%	14%	12%
22220 Computer network and web technicians	4%	5%	4%
22222 Information systems testing technicians	<1%	<1%	<1%
22301 Mechanical engineering technologists and technicians	8%	7%	6%
22302 Industrial engineering and manufacturing technologists and technicians	9%	9%	6%
22310 Electrical and electronics engineering technologists and technicians	12%	13%	11%
22312 Industrial instrument technicians and mechanics	12%	13%	13%
72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	10%	10%	10%
72020 Contractors and supervisors, mechanic trades	4%	4%	4%
72100 Machinists and machining and tooling inspectors	10%	11%	10%
72101 Tool and die makers	18%	19%	16%
72106 Welders and related machine operators	9%	9%	8%
72200 Electricians (except industrial and power system)	6%	5%	1%

Recruitment Gap (% of 2022 Base Year Employment)	2026-30	2031-35	2036-40
72201 Industrial electricians	10%	10%	8%
72400 Construction millwrights and industrial mechanics	10%	10%	9%
72410 Automotive service technicians, truck and bus mechanics and mechanical repairers	9%	7%	8%
73300 Transport truck drivers	20%	22%	21%
73400 Heavy equipment operators	16%	17%	15%
75101 Material handlers	12%	13%	12%
82020 Supervisors, mining and quarrying	11%	9%	8%
83100 Underground production and development miners	8%	6%	5%
84100 Underground mine service and support workers	9%	8%	7%
90010 Manufacturing managers	15%	15%	14%
92021 Supervisors, electronics and electrical products manufacturing	11%	11%	4%
92023 Supervisors, other mechanical and metal products manufacturing	4%	3%	3%
92024 Supervisors, other products manufacturing and assembly	5%	6%	6%
93100 Central control and process operators, mineral and metal processing	<1%	<1%	<1%
93101 Central control and process operators, petroleum, gas and chemical processing	11%	11%	4%
94100 Machine operators, mineral and metal processing	6%	7%	7%
94101 Foundry workers	9%	10%	8%
94104 Inspectors and testers, mineral and metal processing	4%	4%	4%
94105 Metalworking and forging machine operators	12%	13%	13%
94106 Machining tool operators	7%	8%	7%
94110 Chemical plant machine operators	12%	13%	12%
94111 Plastics processing machine operators	12%	13%	13%
94200 Motor vehicle assemblers, inspectors and testers	20%	9%	10%
94201 Electronics assemblers, fabricators, inspectors and testers	20%	21%	17%
94203 Assemblers, fabricators and inspectors, industrial electrical motors and transformers	14%	15%	9%
94204 Mechanical assemblers and inspectors	23%	10%	10%
94212 Plastic products assemblers, finishers and inspectors	12%	14%	14%
94213 Industrial painters, coaters and metal finishing process operators	12%	11%	10%
95100 Labourers in mineral and metal processing	6%	7%	5%
95102 Labourers in chemical products processing and utilities	13%	14%	13%

Recruitment Gap (% of 2022 Base Year Employment)	2026-30	2031-35	2036-40
95109 Other labourers in processing, manufacturing and utilities	12%	13%	11%

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 20. 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%