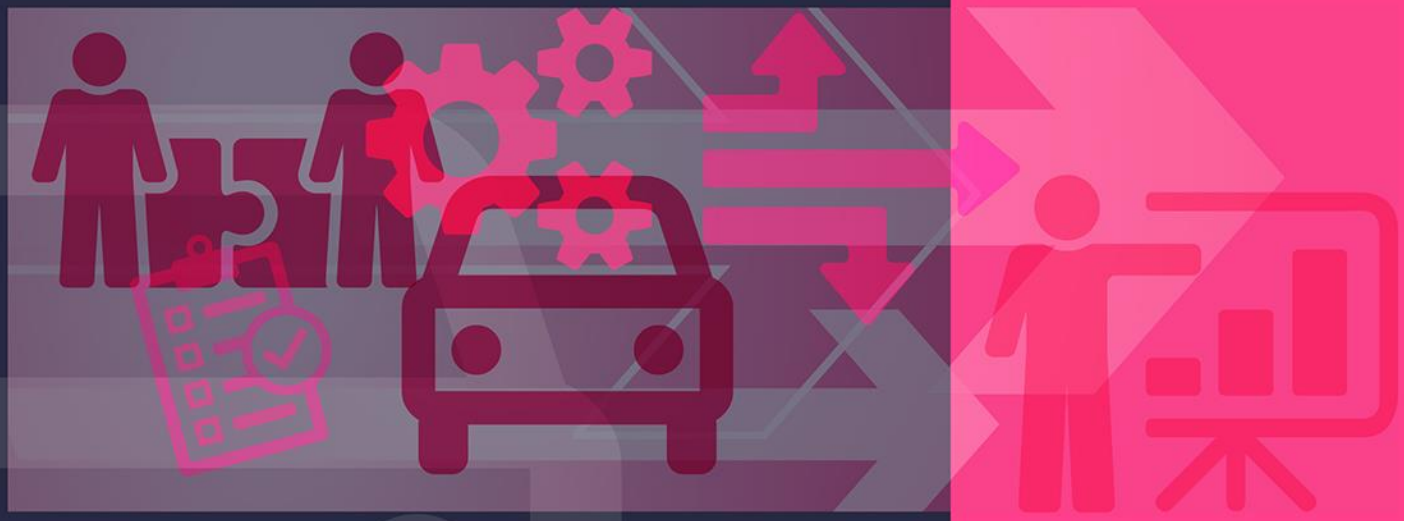
FOCAL Initiative
Future of Canadian Automotive Labourforce
Sur l'avenir de la main-d'œuvre de l'industrie automobile canadienne

LABOUR MARKET FORECAST

AUTOMOTIVE INDUSTRY LABOUR MARKET ANALYSIS

AUTOMOTIVE TECHNOLOGY LABOUR MARKET OUTLOOK



The project is a collaboration of the Canadian Skills Training and Employment Coalition, Prism Economics and Analysis, and the Automotive Policy Research Centre.

October, 2020

futureautolabourforce.ca

THIS PAPER was prepared for the Auto Labour Market Information (LMI) Project, now known as the *Future of Canadian Automotive Labourforce (FOCAL) Initiative.*

The goal of the project is to help stakeholders better understand the automotive labour market. The Project will create industry-validated, regional, occupational supply and demand analyses and forecasts and skill profiles for skilled trades and other key skilled occupations in the broader automotive sector including vehicle assemblers, parts manufacturers and technology companies that supply the industry. The project will also examine various labour market trends in the sector and facilitate discussions among stakeholders about how to address any forecasted skills shortages and other labour market challenges. The planned outcome of the project is enhanced regional labour market information that will support colleges, employers, policy makers and other stakeholders in taking practical steps to address skills shortages and other labour market challenges in the automotive sector.

This project is funded by the Government of Canada's Sectoral Initiatives Program. The opinions and interpretations in this publication are those of the author(s) and do not necessarily reflect those of the Government of Canada.

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October, 2020

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EXECUTIVE SUMMARY

Technology has long played a critical role in the development and production of motor vehicles by Canada's automotive industry. The importance of automotive technology has only grown in recent years as investments in new areas of innovation, such as autonomous vehicles and hydrogen fuel cells, promise to revolutionize traditional aspects of transportation. The value of labour market analysis for this component of the broader automotive manufacturing sector becomes clear in light of these trends.

This report provides a summary of current and future labour market conditions for 18 key occupations that are instrumental in the automotive technology space. Occupations fall into one of three broad categories: occupations related to engineering (including technologists and technicians), occupations related to computers and digital systems, and managerial occupations with a technical focus. Evidence from studies of labour mobility suggests highly-skilled workers, such as those sought after by automotive technology employers, are also highly mobile workers, with a willingness to move driven by a strong wage premium for their specialized abilities. For this reason, the outlooks featured in this report consider labour supply and demand at the national level.

Two sets of distinct national labour market outlooks are detailed, both covering the 2021 to 2030 period. In the general case, where all industries are considered, total employment among the occupations of interest is expected to reach 1.08 million workers by 2030. Total labour demand is projected at over 111,000 workers, while nearly 57,000 workers are expected to enter the workforce based on historic trends. Employers are thus expected to face a recruitment gap of nearly 55,000 workers between 2021 and 2030, the equivalent of hiring 6% of the workforce as of 2019.

Recruiting challenges are expected to be more severe within the broader automotive manufacturing sector, which includes vehicle assemblers and parts manufacturers as well as employers from throughout the automotive supply chain. Total employment among the occupations of interest is expected to surpass 25,000 workers within the broader automotive manufacturing sector by 2030. Total labour demand is projected at over 9,500 workers, while approximately 1,200 workers are expected to enter the workforce based on historic trends. Employers are thus expected to face a recruitment gap of 8,300 workers between 2021 and 2030, the equivalent of hiring 37% of the workforce as of 2019. Although the broader definition of the industry covers much of the economic activity related to automotive manufacturing it does not include employment from establishments such as academic research labs, government R&D and testing facilities, non-profit technology organizations, and other associated operations.

INTRODUCTION

In Spring 2020, the FOCAL (Future of Canadian Automotive Labourforce) Initiative project team prepared a series of regional labour market forecasts using a new and broader definition of Canada's automotive manufacturing sector. This definition was based on a two-pronged approach, which consisted of analyzing establishment-level data ("bottom up") and tracing industry production through the economy ("top down"). The broader automotive manufacturing sector includes producers in the supply chain that have previously been classified in non-automotive industries from one of four groupings:

1. Metals (e.g. iron and steel mills, foundries)
2. Non-Metal Materials (e.g. plastics, glass)
3. Computer and Electronics (e.g. semiconductors, navigational instruments)
4. Other (e.g. motor vehicle parts wholesalers, engineering services)

This report presents new national workforce estimates and labour market outlooks with a focus on key automotive technology occupations. It begins with a synopsis of key factors in the report's analysis, including descriptions of areas of automotive technology and the occupations of interest. Next, a review of scholarly articles provides evidence for the need to prepare labour market outlooks tailored to automotive technology. This is followed by two sets of national labour market forecasts for the occupations of interest. The report closes with a summary of major findings and a description of future work on this topic.

Each set of labour market forecasts consists of an employment outlook, as well as outlooks for labour demand (i.e. hiring requirement), labour supply (i.e. new entrants), and excess demand (i.e. recruitment gap) for the 18 occupations of interest. Please note that due to uncertainty surrounding COVID-19 business closures both employment outlooks exclude data for 2020 and 2021. The forecast period for all other outlooks covers the years from 2021 to 2030.

BACKGROUND

Canada's automotive manufacturing sector is a key driver of the national economy, making significant contributions to output (as measured by GDP) and employment. Its impact grows even larger by moving beyond the traditional view of the sector, which consists of only vehicle assembly and parts manufacturing. This broader definition of automotive manufacturing includes employment associated with metals, non-metals materials and a host of other sectors. Furthermore, it also includes a greater focus on automotive technology, such as companies that manufacture computers and electronic companies (e.g. semiconductors), as well as those that design and implement computer systems.

The above definition was used to develop labour market forecasts for Ontario, Quebec, and several major automotive manufacturing hubs across Canada. This report provides a different perspective to prior work by focusing on labour market forecasts for key automotive technology occupations. It includes two sets of national occupational labour market forecasts - the General Labour Market Outlook considers the full Canadian workforce while the Automotive Labour Market Outlook limits the analysis to Canada's broader automotive manufacturing sector. Furthermore, it expands the geographic dimension of the analysis to the national level in order to properly assess labour demand and supply for automotive technology's target workforce of highly-skilled and mobile workers. This report also discusses evidence for the link between highly-skilled workers and increased rates of labour mobility.

The structure and content of this report is based on the FOCAL Initiative's baseline labour market forecasts, which include outlooks for 49 occupations with significance to automotive manufacturing. Occupations were selected if employment exceeded 100 workers in at least one automotive region[1] and/or if they were considered technically-oriented. This report focuses exclusively on those previously identified technically-oriented occupations, which include:

[1] This project identified the following automotive regions: Eastern Ontario, Golden Horseshoe, Kitchener-Waterloo-Barrie, London/Stratford-Bruce Peninsula, Montréal, Vancouver, Windsor-Sarnia, Winnipeg

1. Engineering managers (NOC 0211)
2. Computer and information systems managers (NOC 0213)
3. Manufacturing managers (NOC 0911)
4. Mechanical engineers (NOC 2132)
5. Electrical and electronics engineers (NOC 2133)
6. Industrial and manufacturing engineers (NOC 2141)
7. Metallurgical and materials engineers (NOC 2142)
8. Computer engineers (except software engineers and designers) (NOC 2147)
9. Information systems analysts and consultants (NOC 2171)
10. Database analysts and data administrators (NOC 2172)
11. Software engineers and designers (NOC 2173)
12. Computer programmers and interactive media developers (NOC 2174)
13. Mechanical engineering technologists and technicians (NOC 2232)
14. Industrial engineering and manufacturing technologists and technicians (NOC 2233)
15. Electrical and electronics engineering technologists and technicians (NOC 2241)
16. Industrial instrument technicians and mechanics (NOC 2243)
17. Computer network technicians (NOC 2281)
18. Information systems testing technicians (NOC 2283)

These 18 occupations were highlighted because of the value their skillsets provide to technology-intensive activities related to automotive manufacturing. They can be grouped into one of three general categories: occupations related to engineering (including technologists and technicians), occupations related to computers and digital systems, and managerial occupations with a technical focus. A brief description of each occupation's roles and responsibilities, adapted from Statistics Canada's National Occupational Classification (NOC) guide, follows below:

Engineering managers (NOC 0211) – plan, organize, direct, control and evaluate engineering activities

Computer and information systems managers (NOC 0213) - plan, organize, direct, control and evaluate computer and telecommunications software, networks, and information systems

Manufacturing managers (NOC 0911) - plan, organize, direct, control and evaluate manufacturing activities

Mechanical engineers (NOC 2132) – research, design, develop, operate, evaluate, and maintain mechanical systems & machinery

Electrical and electronics engineers (NOC 2133) – design, plan, research, evaluate and test electrical & electronic equipment and systems

Industrial and manufacturing engineers (NOC 2141) – conduct studies and develop & supervise programs to optimize the efficiency and productivity of equipment, materials, technology, and human resources

Metallurgical and materials engineers (NOC 2142) – conduct studies of the properties and characteristics of metals and other non-metallic materials; plan, design and develop

machinery & processes to concentrate, extract, and refine metals and other non-metallic materials

Computer engineers (except software engineers and designers) (NOC 2147) – research, plan, design, modify, evaluate, and integrate computer and telecommunications hardware & information and communication system networks

Information systems analysts and consultants (NOC 2171) – develop and implement information systems plans, policies, and procedures; provide advice on information systems issues

Database analysts and data administrators (NOC 2172) – design, develop and administer data management solutions; develop and implement data administration policy, standards, and models

Software engineers and designers (NOC 2173) – research, design, evaluate, integrate, and maintain software applications, technical environments, operating systems, information warehouses, and telecommunications software

Computer programmers and interactive media developers (NOC 2174) – write, modify, integrate, and test computer code for a variety of applications, software, and interactive media (e.g. computer games)

Mechanical engineering technologists and technicians (NOC 2232) – provide technical support and services in mechanical engineering fields

Industrial engineering and manufacturing technologists and technicians (NOC 2233) - provide technical support and services in the develop of production methods, facilities, and systems

Electrical and electronics engineering technologists and technicians (NOC 2241) - provide technical support and services in the design, development, testing, production, and operation of electrical & electronic equipment and systems

Industrial instrument technicians and mechanics (NOC 2243) – repair, maintain, calibrate, adjust, and install industrial measuring & controlling instrumentation

Computer network technicians (NOC 2281) – establish, operate, maintain, and co-ordinate the use of local and wide area networks, mainframe networks, and related computer equipment; operate and maintain internet and intranet websites & web-server hardware and software

Information systems testing technicians (NOC 2283) – execute test plans to evaluate the performance of software applications & information and telecommunications systems

Canada's automotive technology companies are involved in a wide array of technological innovation fields. Attempting to delineate the major technological trends found in automotive manufacturing products, processes, and R&D activities is an important step in understanding the labour needs of technology-oriented employers. The FOCAL Initiative project team, expanding on research by the Center for Automotive Research (CAR), has identified 10 major automotive technologies and trends[2]:

1. **Autonomous Vehicles** – technologies involved in achieving driving autonomy in vehicles
2. **Connected Vehicles** – technologies establishing communication between a vehicle and its surroundings
3. **Artificial Intelligence & Machine Learning** – technologies allowing machines to complete complex tasks and make predictions
4. **Materials & Lightweighting** – technologies to improve automotive frame materials and reduce vehicle weight
5. **Battery Electric & Hybrid Vehicles** – technologies involved in battery electric vehicles, hybrid vehicles and plug-in hybrid vehicles
6. **Hydrogen Fuel Cells** – technologies to power vehicles with electricity generated from compressed hydrogen and oxygen
7. **International Combustion Engine (ICE) Powertrain** – technologies to improve ICE functionality and efficiency
8. **Industry 4.0** – technologies to modernize manufacturing systems and improve production processes
9. **Vehicle Safety & Security** – technologies to prevent accidental vehicle failures and protect against malicious cyberattacks
10. **Other Software & Electronics** – technologies related to user interfaces, entertainment, and other advanced vehicle software and electronics

Although labour market concerns are relevant across the broader automotive manufacturing sector, they may be most acute in Canada's automotive technology clusters. Each cluster represents a regional concentration of businesses and institutions with a similar focus on one or more technological innovations related to automotive manufacturing. Tracking the occupations and skills that are currently in demand in automotive technology clusters, as well as those that are newly emerging, can provide valuable insights to hiring managers and policymakers. In addition to this report, the FOCAL Initiative project team has also prepared detailed profiles examining each of Canada's automotive technology clusters: Vancouver, the Greater Toronto and Hamilton Area, Kitchener-Cambridge-Waterloo, Windsor-Essex, Ottawa, and Montréal.[3]

[2] Detailed descriptions of these technologies are included in the FOCAL Initiative report "Identifying and Profiling Automotive Technology Clusters Across Canada"
[3] Cluster profiles will be published at https://www.futureautolabourforce.ca/trend-reports/

EVIDENCE OF LABOUR MOBILITY FOR HIGHLY-SKILLED WORKERS

Employers in the technology-focused component of the broader automotive manufacturing sector have a distinct occupational profile when compared to other employers in the industry. Typical automotive manufacturing employers focus on local labour supplies to fill vacancies when hiring production workers or skilled trades. However, automotive technology employers largely depend on highly-skilled workers to fill engineering and computer-related technical occupations. Recent evidence, discussed below, shows that this class of workers has greater geographic and sectoral mobility, indicating automotive technology employers face unique recruitment and retention challenges.

When examining the supply of labour in a region it is important to consider the type of occupation, as it will impact where labour for that occupation is sourced from. Lower-skilled labour is more likely to be sourced locally, while higher-skilled positions can attract talent from different regions. *"Why are Higher Skilled Workers More Mobile Geographically? The Role of Job Rents"* by Michael Amior examines the mechanisms driving greater geographic mobility for higher-skilled workers. To start, he reviews how higher-skilled workers having greater mobility has become a stylized fact in the field, stating "workers only move if the wage rents associated with a distant job offer exceed the cost of moving…for example, a better job may motivate a computer scientist to move from New York to Houston, but not somebody who cuts hair for a living." The author's dataset is taken from the U.S. survey of income and program participation, covering the period from 1996 to 2013. The author uses a structural model for his analysis and finds that "skilled work is necessarily more specialized, which naturally yields larger wage rents" and that these "wage rents are easily observed in the data." Wage rents impact geographic mobility for workers as there are costs to moving and lower-skilled workers are less likely to earn wages high enough to justify those costs. The author supplements his analysis by reviewing descriptive statistics. He compares cross-state migration rates segmented by education level and age group, finding that individuals with higher levels of education typically have higher migration than their less educated counterparts.

One of the first attempts to provide strong causal evidence of a worker's skill level impacting geographic mobility was "*The impact of college education on geographic mobility: Identifying education using multiple components of Vietnam draft risk"* by Ofer Malamud and Abigail Wozniak. The authors' objective is to provide causal evidence for the positive correlation between education and labour mobility. The authors made use of microdata from the 1980 U.S. population census to compare migration rates for high school and college graduates. When examining how education effects mobility, one issue present is those who go to college self-select to do so, which may be related to other factors that also affect their mobility. The authors applied an instrumental variable approach to address this issue, using "variation in college attainment due to draft-avoidance behavior during the Vietnam War." In other words, men who otherwise would not have attended college did so to avoid the draft. Ultimately, the authors found that "the causal effect of an additional year of college on geographic mobility … range from 1.9 percentage points to 6.7 percentage points."

For Canadians, geographic mobility often manifests itself in highly-skilled workers pursuing job opportunities abroad, typically in the United States. This phenomenon is commonly referred

to as "brain drain". A 2018 academic study examined brain drain among Canadian graduates from STEM (Science, Technology, Engineering, Mathematics) programs at the Universities of Toronto, British Columbia, and Waterloo. The authors found evidence of brain drain as one-in-four STEM graduates in their sample opting to work outside Canada. Geographic mobility was particularly high for technology-focused programs, with two-thirds of software engineering students leaving Canada after graduating. Over 80% of those in the study's sample who chose to work abroad moved to the United States. They cited higher pay, firm reputation, and scope of work as the main reasons they chose to start their careers outside Canada.

In addition to geographic mobility, highly-skilled workers often have more opportunities to cross sectoral lines when seeking employment. A recent report from the Brookfield Institute titled *"Who Are Canada's Tech Workers?"* delves into the economic outcomes of workers in digital and high-tech occupations. The authors identified the industry groups that employ the largest number of tech workers in Canada. They found that while professional, scientific, and technical services employ the largest number of tech workers, there are significant numbers of these workers employed in manufacturing, public administration, finance, and other sectors. Along with the raw number of tech workers employed, the authors also looked at which industries employ the highest proportion of tech workers as a share of their total employment. They found that utilities and finance had relatively high concentrations of tech workers.

GENERAL LABOUR MARKET OUTLOOK

The labour market outlooks in this section were estimated based on projections of economic growth for 15 of Canada's largest sectors. A unique weighted average employment growth rate was calculated for each occupation using its Census distribution by sector. These growth rates were combined with historical employment data from the Labour Force Survey (LFS) to determine the employment trajectory for each occupation.

Employment

Canadian employment among the occupations of interest is projected to total an estimated 1.01 million workers in 2022 before rising to 1.08 million by 2030, the equivalent of just under 1.0% annual growth. By far the largest occupation is information systems analysts & consultants, which is projected to have employment of 241,000 workers in 2022 and over 257,000 workers by 2030. According to Statistics Canada, this occupation includes individuals who analyze systems requirements; develop and implement IT plans, policies, and procedures; and provide advice on a wide range of IT issues. Similarly, computer programmers & interactive media developers are expected to see employment grow from 172,000 to 182,500 during the forecast period. This occupation includes individuals who write, modify, integrate, and test computer code, either for software and data processing applications or for web-based and/or media applications. Other occupations with significant projected employment levels include manufacturing managers, computer and information systems managers, software engineers and designers, and computer network technicians.

TABLE 1. National Occupational Employment Outlook, All Industries, 2022-2030

Occupation	2022	2023	2024	2025	2026	2027	2028	2029	2030
Engineering managers	30,110	30,330	30,540	30,750	30,960	31,170	31,390	31,610	31,830
Computer and information systems managers	86,480	87,200	87,890	88,580	89,280	89,980	90,680	91,400	92,120
Manufacturing managers	90,190	91,000	91,810	92,630	93,460	94,300	95,140	95,990	96,850
Mechanical engineers	47,410	47,760	48,080	48,400	48,730	49,060	49,390	49,730	50,060
Electrical and electronics engineers	36,550	36,810	37,040	37,270	37,510	37,750	37,990	38,230	38,470
Industrial and manufacturing engineers	17,120	17,250	17,380	17,510	17,640	17,780	17,910	18,050	18,180
Metallurgical and materials engineers	4,400	4,440	4,460	4,490	4,520	4,550	4,580	4,610	4,640
Computer engineers (except software	30,690	30,940	31,180	31,420	31,660	31,910	32,150	32,400	32,650

engineers and designers)									
Information systems analysts and consultants	241,340	243,390	245,290	247,210	249,150	251,090	253,060	255,040	257,030
Database analysts and data administrators	40,820	41,190	41,550	41,900	42,260	42,620	42,990	43,360	43,730
Software engineers and designers	56,650	57,210	57,610	58,030	58,440	58,860	59,280	59,700	60,130
Computer programmers and interactive media developers	172,110	173,470	174,730	176,000	177,280	178,570	179,870	181,170	182,490
Mechanical engineering technologists and technicians	20,690	20,850	21,000	21,160	21,310	21,470	21,630	21,790	21,950
Industrial engineering and manufacturing technologists and technicians	23,040	23,240	23,430	23,630	23,830	24,020	24,220	24,430	24,630
Electrical and electronics engineering technologists and technicians	40,530	40,860	41,190	41,530	41,860	42,200	42,550	42,890	43,240
Industrial instrument technicians and mechanics	8,680	8,730	8,780	8,830	8,880	8,930	8,990	9,040	9,090
Computer network technicians	53,910	54,400	54,870	55,340	55,810	56,290	56,770	57,260	57,750
Information systems testing technicians	13,640	13,750	13,850	13,960	14,060	14,170	14,280	14,380	14,490
TOTAL	**1,014,370**	**1,022,810**	**1,030,700**	**1,038,650**	**1,046,660**	**1,054,730**	**1,062,870**	**1,071,070**	**1,079,330**

Hiring Requirements

Hiring requirements represent the demand for labour across employers in the economy and consists of two components:

1. Replacement demand – labour demand driven by the need to replace workers exiting the workforce due to retirement or death
2. Expansion demand – labour demand driven by output growth in the economy

The outlook for replacement demand is driven by national projections of mortality rates and annual changes in labour force participation rates by age-year. The outlook for expansion demand is a product of industry growth and is reflected in the year to year changes in employment seen in Table 1.

Total hiring requirement among the occupations of interest is projected to total over 111,000 workers between 2021 and 2030. This level of labour demand is equal to 11% of the total workforce within these occupations as of 2019. Hiring requirements are also projected to be largely balanced between the 2021-2025 and 2026-2030 periods. Notably, expansion demand is expected to decline between the periods as macroeconomic outlooks project slower industry growth over the latter half of the decade. In contrast, replacement demand is expected to increase due to demographic shifts. Hiring requirements by occupation follow similar trends. The largest hiring requirements are, unsurprisingly, found among occupations with the highest levels of employment.

TABLE 2. National Occupational Hiring Requirement Outlook, All Industries, 2021-2030

Occupation	2021-2025	2026-2030	2021-2030	Share of 2019 Emp.
Engineering managers	1,660	1,600	3,260	11%
Computer and information systems managers	5,060	4,820	9,880	12%
Manufacturing managers	5,760	5,920	11,680	13%
Mechanical engineers	2,400	2,290	4,690	10%
Electrical and electronics engineers	1,840	1,730	3,570	10%
Industrial and manufacturing engineers	920	900	1,820	11%
Metallurgical and materials engineers	230	210	440	10%
Computer engineers (except software engineers and designers)	1,700	1,610	3,320	11%
Information systems analysts and consultants	13,860	13,010	26,860	11%
Database analysts and data administrators	2,480	2,380	4,860	12%
Software engineers and designers	3,330	2,680	6,010	11%
Computer programmers and interactive media developers	8,920	8,240	17,170	10%
Mechanical engineering technologists and technicians	1,080	1,070	2,150	11%
Industrial engineering and manufacturing technologists and technicians	1,310	1,320	2,630	12%
Electrical and electronics engineering technologists and technicians	2,280	2,310	4,590	12%
Industrial instrument technicians and mechanics	400	380	790	9%
Computer network technicians	3,160	3,040	6,210	12%
Information systems testing technicians	730	680	1,410	11%
Engineering managers	1,660	1,600	3,260	11%
Computer and information systems managers	5,060	4,820	9,880	12%
Manufacturing managers	5,760	5,920	11,680	13%
Mechanical engineers	2,400	2,290	4,690	10%
Electrical and electronics engineers	1,840	1,730	3,570	10%
TOTAL	**57,130**	**54,190**	**111,320**	**11%**

New Entrants

In order to meet hiring requirements, employers must be able to recruit new entrants to the workforce. New entrants are defined as individuals between the ages of 15 and 30 who are entering the workforce for the first time. The forecasts of new entrants seen in Table 3 are based on historic rates of entry, projections of labour force participation by age-year, and projections of the workforce by age-year and occupation.

Nearly 57,000 new workers are expected to begin working in one of the occupations of interest during the forecast period. This represents 6% of the total workforce for these occupations as of 2019. Projected new entrants as a share of 2019 employment ranges from 5% to 10% for most occupations. These shares are notably lower for managerial occupations, which rely the least on new entrants due to the experience typically required for these positions

TABLE 3. National Occupational New Entrants Outlook, All Industries, 2021-2030

Occupation	2021-2025	2026-2030	2021-2030	Share of 2019 Emp.
Engineering managers	400	410	810	3%
Computer and information systems managers	1,000	1,040	2,040	2%
Manufacturing managers	1,030	1,070	2,090	2%
Mechanical engineers	1,680	1,740	3,420	7%
Electrical and electronics engineers	1,040	1,080	2,120	6%
Industrial and manufacturing engineers	530	550	1,080	6%
Metallurgical and materials engineers	160	160	320	7%
Computer engineers (except software engineers and designers)	620	640	1,260	4%
Information systems analysts and consultants	5,010	5,200	10,210	4%
Database analysts and data administrators	950	1,000	1,950	5%
Software engineers and designers	2,150	2,240	4,390	8%
Computer programmers and interactive media developers	7,400	7,660	15,060	9%
Mechanical engineering technologists and technicians	960	1,000	1,960	10%
Industrial engineering and manufacturing technologists and technicians	750	780	1,530	7%
Electrical and electronics engineering technologists and technicians	1,550	1,620	3,170	8%
Industrial instrument technicians and mechanics	360	370	740	9%
Computer network technicians	1,680	1,750	3,430	7%
Information systems testing technicians	630	660	1,290	10%
Engineering managers	400	410	810	3%
Computer and information systems managers	1,000	1,040	2,040	2%
Manufacturing managers	1,030	1,070	2,090	2%
Mechanical engineers	1,680	1,740	3,420	7%
Electrical and electronics engineers	1,040	1,080	2,120	6%
TOTAL	**27,910**	**28,970**	**56,880**	**6%**

Recruitment Gaps

Recruitment gaps represent the excess labour demand from employers once new entrants into each occupation have been taken into account. The total recruitment gap across all occupations of interest is projected to total just under 55,000 workers, or 6% of total 2019 employment, during the forecast period. Recruitment gaps as a proportion of 2019 employment are highest among occupations with fewer projected new entrants, such as manufacturing managers. They are lowest among occupations that can expect a strong influx of new workers, such as computer programmers and interactive media developers. Recruitment gaps could be significantly higher if these occupations fail to recruit new entrants at historic levels.

TABLE 4. National Occupational Recruitment Gap Outlook, All Industries, 2021-2030

Occupation	2021-2025	2026-2030	2021-2030	Share of 2019 Emp.
Engineering managers	1,260	1,180	2,450	8%
Computer and information systems managers	4,060	3,780	7,840	9%
Manufacturing managers	4,730	4,850	9,580	11%
Mechanical engineers	710	550	1,260	3%
Electrical and electronics engineers	790	650	1,450	4%
Industrial and manufacturing engineers	390	350	740	4%
Metallurgical and materials engineers	70	50	130	3%
Computer engineers (except software engineers and designers)	1,080	970	2,050	7%
Information systems analysts and consultants	8,850	7,800	16,650	7%
Database analysts and data administrators	1,530	1,380	2,910	7%
Software engineers and designers	1,170	450	1,620	3%
Computer programmers and interactive media developers	1,530	580	2,110	1%
Mechanical engineering technologists and technicians	120	60	190	1%
Industrial engineering and manufacturing technologists and technicians	560	540	1,100	5%
Electrical and electronics engineering technologists and technicians	730	690	1,430	4%
Industrial instrument technicians and mechanics	40	10	50	1%
Computer network technicians	1,480	1,300	2,780	5%
Information systems testing technicians	100	20	120	1%
Engineering managers	1,260	1,180	2,450	8%
Computer and information systems managers	4,060	3,780	7,840	9%
Manufacturing managers	4,730	4,850	9,580	11%
Mechanical engineers	710	550	1,260	3%
Electrical and electronics engineers	790	650	1,450	4%
TOTAL	**29,220**	**25,220**	**54,440**	**6%**

BROADER AUTOMOTIVE MANUFACTURING SECTOR LABOUR MARKET OUTLOOK

While the previous outlooks considered labour market conditions of the occupations of interest across all industries, this section limits the analysis to industries which are part of the broader automotive manufacturing sector. This includes core automotive industries (i.e. vehicle assembly and parts manufacturing) and more than thirty associated industries which sell a portion of their output to core industries[4]. Although this broader definition covers much of the economic activity related to automotive manufacturing, there are still facets of the automotive technology labour market that were not captured in this analysis. The broader definition also includes core automotive employers who may not dedicate labour resources to developing or implementing new technologies.

The labour market outlooks in this section were derived from a labour market forecast model for Canada's broader automotive manufacturing sector. The outlook is based on forecasts of total motor vehicle production, including both light and commercial vehicles. These forecasts cover domestic vehicle production, which is expected to fall to 1.72 million units in 2022 before rebounding to a peak of 1.89 million in 2025 and ultimately plateauing in the range of 1.85 million units between 2026 and 2030. Vehicle production from Canada's primary automotive trade partners, the United States and Mexico, is also considered as a driver of export levels. Lastly, a growth adjustment factor was added to the outlooks for this report to account for automotive technology's strong growth potential.

Employment

Total broader automotive manufacturing sector employment among the occupations of interest is projected to total approximately 22,400 workers nationally in 2022 and surpass 25,000 by 2030. This is equivalent to 1.5% average annual growth over the forecast period. The largest occupations are manufacturing managers, which account for approximately 28% of total employment, and mechanical engineers, which account for an additional 18%.

TABLE 5. National Occupational Employment Outlook, Broader automotive manufacturing sector, 2022-2030

Occupation	2022	2023	2024	2025	2026	2027	2028	2029	2030
Engineering managers	830	870	880	900	900	910	920	930	940
Computer and information systems managers	430	450	450	460	460	470	470	480	480
Manufacturing managers	6,220	6,500	6,560	6,710	6,720	6,790	6,860	6,940	7,020

[4] The core and associated automotive industries are outlined in FOCAL's labour market forecast reports, which can be found at https://www.futureautolabourforce.ca/labour-market-forecasts/

Mechanical engineers	4,120	4,300	4,340	4,450	4,450	4,490	4,540	4,600	4,650
Electrical and electronics engineers	1,660	1,740	1,750	1,790	1,790	1,810	1,830	1,850	1,880
Industrial and manufacturing engineers	1,810	1,890	1,910	1,960	1,960	1,980	2,000	2,020	2,050
Metallurgical and materials engineers	140	150	150	160	160	160	160	160	160
Computer engineers (except software engineers and designers)	330	350	350	360	360	360	360	370	370
Information systems analysts and consultants	820	850	860	880	880	890	900	910	920
Database analysts and data administrators	140	150	150	150	150	150	150	160	160
Software engineers and designers	560	590	590	610	610	610	620	630	630
Computer programmers and interactive media developers	670	700	710	720	720	730	740	750	760
Mechanical engineering technologists and technicians	1,320	1,380	1,390	1,430	1,430	1,440	1,460	1,480	1,490
Industrial engineering and manufacturing technologists and technicians	1,390	1,460	1,470	1,500	1,510	1,520	1,540	1,560	1,570
Electrical and electronics engineering technologists and technicians	1,330	1,390	1,400	1,440	1,440	1,450	1,470	1,480	1,500
Industrial instrument technicians and mechanics	150	160	160	170	170	170	170	170	170
Computer network technicians	410	430	430	440	440	450	450	460	460
Information systems testing technicians	50	60	60	60	60	60	60	60	60
TOTAL	**22,380**	**23,420**	**23,610**	**24,190**	**24,210**	**24,440**	**24,700**	**25,010**	**25,270**

Comparing the employment outlooks found in Table 5 to those of the overall Canadian economy (as seen in Table 1) reveals varying levels of representation by occupation in the broader automotive manufacturing sector. Table 6 presents average employment by occupation during the forecast period in both the broader automotive manufacturing sector and the general case, with occupations ordered by the share of general employment found in the broader automotive manufacturing sector. The most well-represented technical occupations in the broader automotive manufacturing sector are primarily related to engineering; projected broader automotive employment is equal to 11% of the general employment outlook for industrial & manufacturing engineers and 9% for mechanical engineers. Manufacturing managers (7%) and mechanical engineering technologists & technicians (7%) are also among the best represented occupations. Conversely, occupations related to computer and digital systems are underrepresented, as no occupation in this category accounts for more than 1% of the general employment outlook.

TABLE 6. Average Employment by Occupation, Descending Order by Broader automotive manufacturing sector Share of Total Employment, 2022-2030

Occupation	Broader automotive manufacturing sector	Total	Broader automotive manufacturing sector Share of Total
Industrial and manufacturing engineers	1,950	17,650	11%
Mechanical engineers	4,440	48,740	9%
Manufacturing managers	6,700	93,490	7%
Mechanical engineering technologists and technicians	1420	21,320	7%
Industrial engineering and manufacturing technologists and technicians	1500	23,830	6%
Electrical and electronics engineers	1,790	37,510	5%
Metallurgical and materials engineers	160	4,520	4%
Electrical and electronics engineering technologists and technicians	1430	41,870	3%
Engineering managers	900	30,970	3%
Industrial instrument technicians and mechanics	170	8,880	2%
Computer engineers (except software engineers and designers)	360	31,670	1%
Software engineers and designers	610	58,430	1%
Computer network technicians	440	55,820	1%
Computer and information systems managers	460	89,290	1%
Information systems testing technicians	60	14,060	<1%
Computer programmers and interactive media developers	720	177,300	<1%
Database analysts and data administrators	150	42,270	<1%
Information systems analysts and consultants	880	249,180	<1%

Overall, employment among these key occupations in the broader automotive manufacturing sector represents just 3% of total projected employment in the total national workforce. This

result is due in part to the methodology used to define the broader automotive manufacturing sector, which relies on tracking inter-industry economic transactions. Automotive technology-related activities that do not generate significant output to core automotive industries would not translate to employment using this methodology. This includes employment from establishments such as academic research labs, government R&D and testing facilities, non-profit technology organizations, and other similar operations. The FOCAL Initiative project team conducted a study of Canada's six automotive technology clusters that provides in-depth analysis of the companies and workers that are excluded from this report. The study, which will be disseminated in a series of cluster profiles, identified nearly 300 automotive technology companies and labs with over 29,000 employees and researchers nationally.

Hiring Requirements

Hiring requirements here represent the demand for labour across employers within the broader automotive manufacturing sector. It covers the needs of all employers among core automotive industries, but only the portion of employment dependent on core industries for employers in associated industries. Total hiring requirement among the occupations of interest is expected to total approximately 9,500 workers between 2021 and 2030. 55% of the hiring requirement will be accrued during the 2021-2025 period as rising vehicle production and parts exports drive industry growth. In contrast, hiring requirement during the 2026-2030 period will be driven primarily by retirements due to the broader automotive manufacturing sector's relatively older workforce.

Hiring requirements as a proportion of each occupation's estimated 2019 employment are much larger within the broader automotive manufacturing sector than in the general case (as seen in Table 2). The higher proportions here reflect the growing importance of automotive technology in the coming years. Hiring requirements surpass 60% of 2019 employment for some technical occupations, such as computer and information systems managers or database analysts and administrators. Recruiting and retaining qualified workers to fill these positions will be critical to the industry's success over the next decade.

TABLE 7. National Occupational Hiring Requirement Outlook, Broader automotive manufacturing sector, 2021-2030

Occupation	2021-2025	2026-2030	2021-2030	Share of 2019 Emp.
Engineering managers	160	130	290	35%
Computer and information systems managers	140	130	270	65%
Manufacturing managers	1,330	1,060	2,390	39%
Mechanical engineers	1,020	850	1,870	46%
Electrical and electronics engineers	330	250	580	35%
Industrial and manufacturing engineers	310	230	540	30%
Metallurgical and materials engineers	20	20	40	26%
Computer engineers (except software engineers and designers)	90	80	170	51%
Information systems analysts and consultants	250	220	470	58%
Database analysts and data administrators	50	50	100	69%
Software engineers and designers	130	110	240	43%

Computer programmers and interactive media developers	130	100	240	36%
Mechanical engineering technologists and technicians	300	240	540	41%
Industrial engineering and manufacturing technologists and technicians	430	370	800	58%
Electrical and electronics engineering technologists and technicians	420	370	790	60%
Industrial instrument technicians and mechanics	30	20	60	37%
Computer network technicians	60	40	100	26%
Information systems testing technicians	10	10	20	47%
Engineering managers	160	130	290	35%
Computer and information systems managers	140	130	270	65%
Manufacturing managers	1,330	1,060	2,390	39%
Mechanical engineers	1,020	850	1,870	46%
Electrical and electronics engineers	330	250	580	35%
TOTAL	**5,210**	**4,280**	**9,510**	**43%**

New Entrants

New entrants to the occupations of interest are expected to total just 1,200 workers within the broader automotive manufacturing sector between 2021 and 2030. As in the general case, few new entrants are projected for managerial occupations. New entrants as a share of 2019 employment range from 5% to 10% for most other occupations. This is a conservative projection that is based on historic levels of entry, meaning employers in the broader automotive manufacturing sector who prioritize recruitment for these occupations can surpass expectations. However, it should also be noted that these employers will face significant competition for new entrants from other sectors as demands for highly-skilled workers continue to rise across the economic landscape. Moreover, job opportunities outside Canada for new STEM graduates will place additional recruitment pressure on domestic employers.

TABLE 8. National Occupational New Entrants Outlook, Broader automotive manufacturing sector, 2021-2030

Occupation	2021-2025	2026-2030	2021-2030	Share of 2019 Emp.
Engineering managers	<10	<10	10	1%
Computer and information systems managers	<10	<10	<10	N/A
Manufacturing managers	60	60	120	2%
Mechanical engineers	160	180	340	8%
Electrical and electronics engineers	50	50	110	6%
Industrial and manufacturing engineers	40	40	90	5%
Metallurgical and materials engineers	<10	<10	10	4%
Computer engineers (except software engineers and designers)	10	10	20	5%
Information systems analysts and consultants	20	20	30	4%
Database analysts and data administrators	<10	<10	<10	N/A
Software engineers and designers	20	20	40	7%

Computer programmers and interactive media developers	30	30	50	8%
Mechanical engineering technologists and technicians	70	80	150	11%
Industrial engineering and manufacturing technologists and technicians	50	50	90	7%
Electrical and electronics engineering technologists and technicians	50	50	100	7%
Industrial instrument technicians and mechanics	10	10	10	9%
Computer network technicians	10	10	20	4%
Information systems testing technicians	<10	<10	10	10%
Engineering managers	<10	<10	10	1%
Computer and information systems managers	<10	<10	<10	N/A
Manufacturing managers	60	60	120	2%
Mechanical engineers	160	180	340	8%
Electrical and electronics engineers	50	50	110	6%
TOTAL	**580**	**610**	**1,200**	**5%**

Recruitment Gaps

Employers in the broader automotive manufacturing sector are expected to face a recruitment gap of 8,300 workers for the occupations of interest during the forecast period. Nearly half of the total recruitment gap is accounted for by the two largest occupations, manufacturing managers and mechanical engineers. Other occupations, such as information systems testing technicians, have relatively small projected recruitment gaps, in some cases fewer than 100 workers. Recruitment gaps represent much larger proportions of each occupation's estimated 2019 employment here than in the general case. Even after accounting for new entrants, employers in the broader automotive manufacturing sector will need to recruit between 30% and 60% of their current workforce over the next decade to meet labour demands for most occupations. This result reinforces the growing importance of automotive technology and the impact of competition for highly-skilled workers. The top occupations in terms of projected recruitment gap share are database analysts & data administrators (69%) and computer & information systems managers (64%). Additionally, projected recruitment gaps exceed half of 2019 employment for information systems analysts & consultants (53%), electrical & electronics technologists/technicians (52%), and industrial engineering & manufacturing technologists/technicians (51%).

TABLE 9. National Occupational Recruitment Gap Outlook, Broader automotive manufacturing sector, 2021-2030

Occupation	2021-2025	2026-2030	2021-2030	Share of 2019 Emp.
Engineering managers	160	120	280	34%
Computer and information systems managers	140	130	270	64%
Manufacturing managers	1,270	990	2,270	37%
Mechanical engineers	860	670	1,530	37%
Electrical and electronics engineers	280	200	470	29%
Industrial and manufacturing engineers	270	180	450	25%

Metallurgical and materials engineers	20	10	30	22%
Computer engineers (except software engineers and designers)	80	70	150	46%
Information systems analysts and consultants	230	200	430	53%
Database analysts and data administrators	50	50	100	69%
Software engineers and designers	110	90	200	36%
Computer programmers and interactive media developers	110	80	180	27%
Mechanical engineering technologists and technicians	230	170	400	30%
Industrial engineering and manufacturing technologists and technicians	380	320	700	51%
Electrical and electronics engineering technologists and technicians	370	320	690	52%
Industrial instrument technicians and mechanics	20	20	40	27%
Computer network technicians	50	30	90	21%
Information systems testing technicians	10	10	20	37%
Engineering managers	160	120	280	34%
Computer and information systems managers	140	130	270	64%
Manufacturing managers	1,270	990	2,270	37%
Mechanical engineers	860	670	1,530	37%
Electrical and electronics engineers	280	200	470	29%
TOTAL	**4,640**	**3,660**	**8,300**	**37%**

CONCLUSION

The labour market outlooks featured in this report clearly illustrate the demand for highly-skilled workers to fill technical positions, both in the general workforce and within the broader automotive manufacturing sector specifically. The outlooks also show the potential for automotive technology employers to face significant challenges in recruiting and retaining highly-skilled workers. Mitigating these challenges will be essential to maintain the broader automotive manufacturing sector's continued success over the next decade and beyond.

Going forward, the FOCAL Initiative project team plans to continue analyzing labour market conditions in the broader automotive manufacturing sector from a technology-oriented perspective. A new set of national labour market forecasts will be published in 2021 that consider how labour demand and supply would be impacted by an acceleration in production technology investments (i.e. Industry 4.0) by employers in the broader automotive manufacturing sector.

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