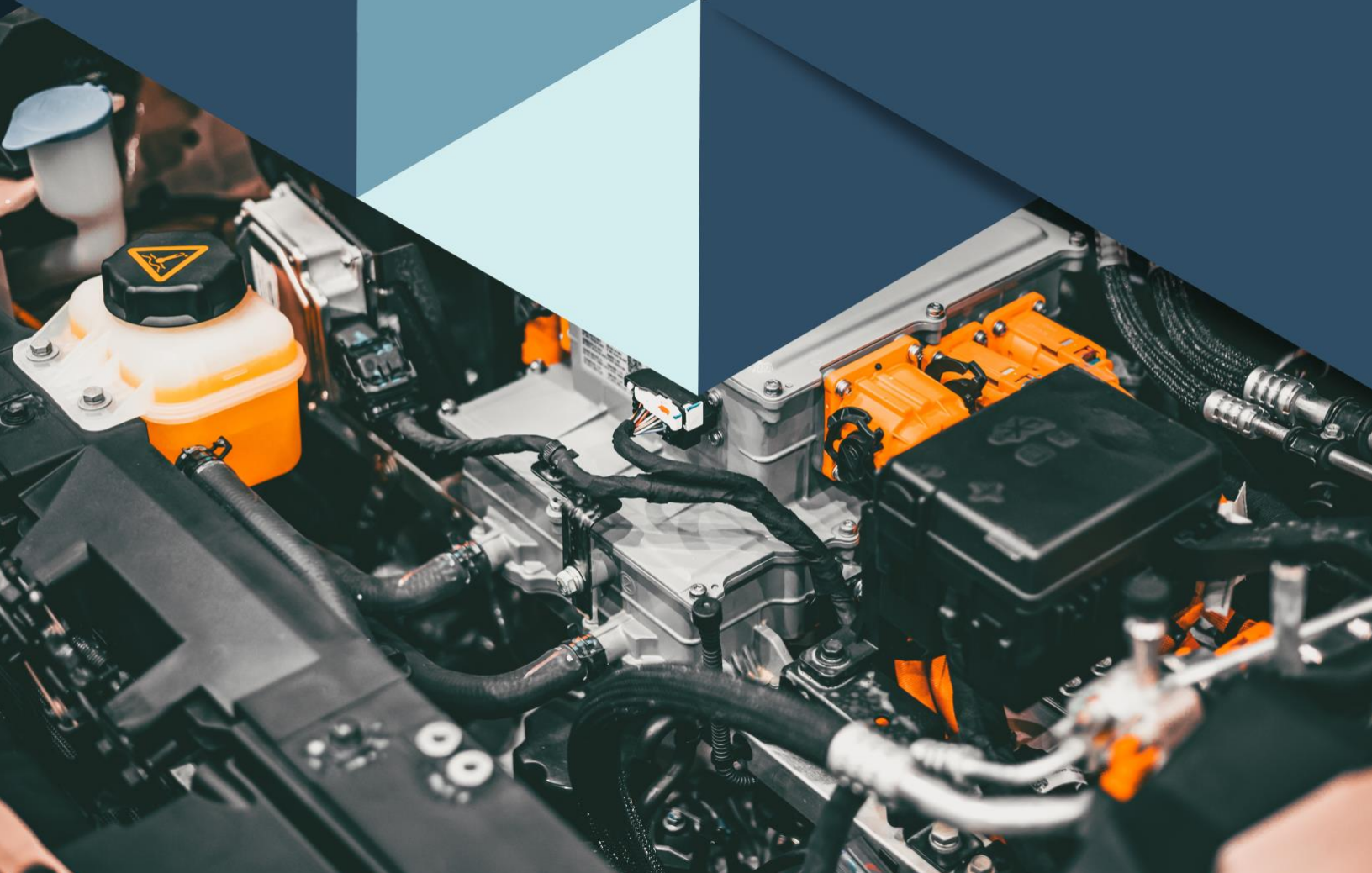
FOCAL Initiative

VEHICLE ELECTRIFICATION AND ITS IMPACT ON THE AUTOMOTIVE SERVICE, REPAIR, AND AFTERMARKET INDUSTRIES

MARCH 2024



About the FOCAL Initiative

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

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

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Introduction

Canada has expressed a firm commitment to reaching a carbon neutral future by 2050. Despite difficulties in reaching its climate targets in recent years, Canada's efforts have been focused on cutting emissions in multiple sectors and industries, along with investing in the production of low carbon emission technologies (Office of the Auditor General of Canda, 2021). A cornerstone of Canada's climate strategy is to reduce emissions resulting from the transportation sector, which account for 28% of all greenhouse gas emissions within the country (Statistics Canada, 2023). A key endeavor is focusing on shifting to zero-emission vehicles, requiring all new light-duty vehicles sold within Canada to be zero emission vehicles by 2035 (Government of Canda, 2022). Spurred by mandates, manufacturers are increasingly incorporating hybrid electric vehicles (HEVs) and battery electric vehicles (BEVs) into their product offerings, while eliminating internal combustion engine vehicle (ICEV) models. A study of the Canadian market found that three major barriers to consumer adoption of electric vehicles (EVs)[1] include high upfront costs, range anxiety and access to charging infrastructure. It notes that government incentives and the ability to observe and interact with EVs carried a positive impact on EV adoption, increasing the appeal to consumers (Singh & Walsh, 2021). Currently Canada has succeeded in deploying over 20,000 chargers at over 8,000 charging sites across the country, with a further 1.2 billion dollars committed to adding around 85,000 more chargers (Government of Canada, 2023). At the same time, ranges for EVs available in Canada have increased. In the six years from 2013 to 2019, average BEV ranges increased from 219 to 386 kilometers (Government of Canada, 2019). As improvements are made to battery technologies, EV ranges will continue to increase over time. Federal and provincial governments offer incentives on the purchase or lease of zero emission vehicles (ZEVs) to stimulate consumer demand of new technologies, with federal rebates of up to $5,000 and provincial rebates up to $7,500 (Tchir, 2023). As the major perceived barriers to EV adoption continue to be addressed, it is only a matter of time before the share of EVs on the road significantly increases.

The current share of HEVs and BEVs on the road constitute a small portion of overall registered passenger vehicles compared to ICEVs, but a steady growth in their adoption can be observed. Between 2017 and 2023, new motor vehicle registrations for EVs grew by over 630%, from around 43,000 vehicles in 2017, to over 320,000 in 2023. The share of new EVs registered in Canada out of the total new vehicles registered in Canada also increased from 2.2% in 2017 to 18.7% in 2023 (Statistics Canada, 2024). Investment announcements in EV and battery manufacturing, along with multiple automotive production forecasts all signal a transition in both production and adoption towards EVs. The automotive industry, being a centerpiece of the Canadian economy, thus finds itself in the midst of a historic transition.

With the transition occurring over the next decades, changes in production, output and employment are expected. According to the FOCAL Initiative, the transition will lead to changes in

[1] In this report, the term electric vehicles (EVs) refers to hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), and battery electric vehicles (BEVs).

the employment and output of core automotive manufacturing industries (vehicle assembly and parts production), along with impacts extending all the way throughout the vehicle and battery manufacturing supply chains. A less understood relationship is how these changes in production and adoption will translate to various other auxiliary industries closely tied to the automotive and transportation sectors. More specifically, as EVs require repair and maintenance in the future, industries such as automotive maintenance, and the automotive aftermarket are expected to be potentially disrupted. Changes in maintenance requirements as a result of the different powertrain systems of EVs will carry implications to both the automotive service and repair, and the automotive aftermarket industries. This paper aims to explore the implications of EV adoption within the automotive service, repair and aftermarket industries. As the demands for components and services change, new technologies may potentially affect the activities of businesses by altering the products and processes which these businesses have operated on. The paper explores the potential disruption to businesses engaged in automotive repair and maintenance (NAICS 8111), parts dealing (NAICS 415) and manufacturers in industries providing support to them (NAICS 33631 and 33635).

Evolution within Automotive Technology

There are two main frontier technologies changing the design of vehicles and way people interact with them. The first is vehicle electrification, which is changing the powertrain structure of vehicles in a fundamental way, and the second is the integration of connected and autonomous technologies which changes how vehicles and their operators interact.
Power generation and propulsion within motor vehicles has largely been dominated by internal combustion engines (ICEs). Vehicle electrification is a major disruptor introducing changes to the industry, the product and the manufacturing processes, offering a cleaner and more efficient alternative. This shift towards EVs is driven by growing environmental concerns, stricter emission regulations, and advancements in battery technology that make EVs more viable. To significantly reduce the emissions of the transportation sector, and particularly those of light and heavy-duty vehicles, the majority of the automakers and governments have been putting forward plans to eventually phase out ICEs in favor of zero-emission vehicles.

Fully electric vehicles (BEVs) have fundamentally powertrain simpler systems than those of ICEVs and hybrid vehicles. The technical differences between ICEVs, BEVs and other hybrid vehicles have been previously detailed in multiple FOCAL reports including the “The Impact of EV Production on the Automotive Manufacturing Supply Chain: Sources, Methods and Findings” and “The Shift to EV Production in Canada’s Automotive Manufacturing Sector”. BEVs operate solely on electric power, drawing energy from onboard batteries that are recharged via an external power source. The simplicity of BEVs’ powertrain — primarily consisting of the electric motor, battery, and power electronics — eliminates many of the mechanical components found in ICEVs, such as the engine, fuel system, and exhaust.

The second main driver of technological changes within cars are the more complex autonomous and connected systems integrated in vehicles, involving automated such as adaptive cruise

control, lane keeping assist, and autonomous emergency braking. These systems not only improve safety but also enhance the driving experience by reducing the workload on the driver. Furthermore, the integration of vehicle-to-everything (V2X) communication allows cars to interact with each other and with road infrastructure, enabling smoother traffic flow and reduced congestion. To support these advanced features, vehicles are now equipped with a multitude of sensors, including cameras, radar, and lidar, as well as sophisticated onboard computers capable of processing large amounts of data in real time.

The shift to vehicle electrification, along with the integration of autonomous, connected, and other vehicle technologies are contributing to a significant growth in the electronics, electrical and software markets within the automotive industry and its supply chain. Main drivers of demand are expected to be power electronics, sensors, and electronic control units (ECUs) which are required for vehicle electrification, as well as autonomous and connected vehicle systems (McKinsey & Company, 2023). Increased automation and electrification within vehicles is also leading to a growth in the use of ECUs and software required to operate, monitor and manage these systems (Burkacky, Deichmann , Guggenheimer, & Kellner, 2023). * Increased electronic and software content are both leading to changes in the automotive manufacturing industry, as well as in the automotive aftermarket, and the vehicle maintenance and service industries. The changes and impacts in the automotive aftermarket and maintenance industries are explored in the sections below.

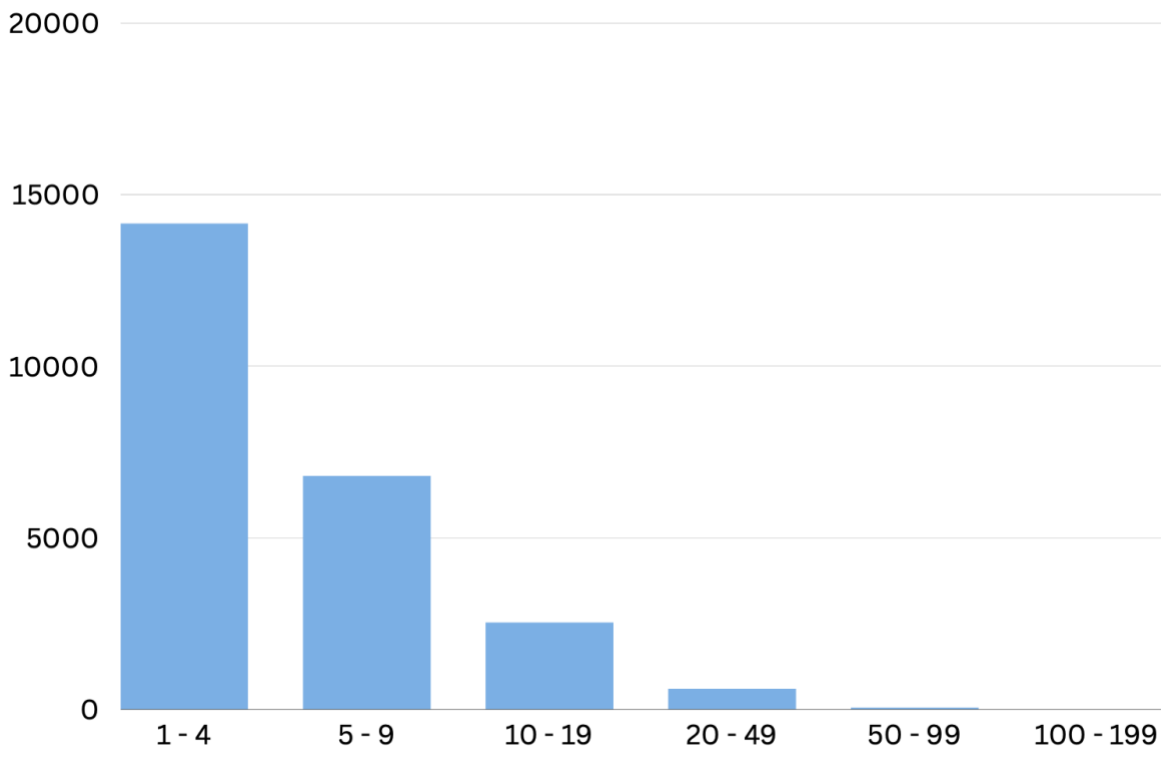
How New Technology is Shaping the Future of Automotive Service and Repair

The automotive repair and maintenance industry is a major part of the automotive industry and transportation sector, providing important after sale service of motor vehicles to consumers. It refers to the businesses primarily engaged in vehicle servicing, maintaining and repairing, and excludes large vehicle retailers and dealerships. In 2021, the sector was responsible for an economic output of almost $17 billion dollars according to Canada's 2021 Industry Input-Output tables. Over 24,000 businesses were responsible for employing over 106,500 workers in 2021, while a further 20,673 operated without any employees. The sector has experienced growth in employment, but the number of businesses in operation has marginally declined over 2021 and 2022 (may be attributed to COVID-19 disruptions in the industry), while job vacancies have climbed significantly, nearly doubling from 2020 to 2021, and increasing further into 2022, with vacancies in the 4th quarter at 11,310 (Statistics Canada, 2022) (Statistics Canada, 2022). This follows a growing trend of labour shortages in skilled trades occupations, which is particularly problematic in automotive repair since existing technicians may also struggle with servicing increasing complex new vehicle technologies in BEVs, PHEVs and HEVs.

Table 1. Overview of the Automotive Repair and Maintenance Industry (NAICS 8111) in 2021.

Automotive Repair and Maintenance (NAICS 8111)	
Industry Output (2021) (x 1,000)	$16,990,800
Number of Employees in Industry	106,500
Number of Employing Businesses	24,179
Number of Non-Employing Businesses	20,673

Figure 1. Distribution of number of businesses by employment within the Automotive Repair and Maintenance Industry (NAICS 8111) (2021).



The relative mechanical simplicity of BEVs compared to ICEVs can be assumed to have an impact on businesses operating in the automotive repair and maintenance industry. A study on family focused BEVs in the Canadian market revealed maintenance costs savings of 47% compared to ICEVs in the same segment over a vehicle's lifetime. This translates to a national average annual savings of $931. Many of the commonly replaced components in motor vehicles (most of which are mechanical moving parts) were also not present in BEVs (Logtenberg, Pawley, & Saxifrage, 2018). The lower maintenance requirements for BEVs may imply less revenue or output for businesses within the automotive repair and maintenance industry. The extent of the impact of these changes on employment and the overall output of the industry is yet to be explored in future research.

Furthermore, the most expensive components in BEVs, the battery, have exceedingly long-life spans. The maximum lifetime for batteries is estimated to be 15 years, or when a battery falls to below 80% of its original maximum capacity. The construction of battery packs and current technology make servicing battery packs exceedingly difficult, expensive, and time-consuming. Consequently, they are generally considered unserviceable, except by technicians who have the adequate experience, tools, and certification (Deng,, Bae, Denlinger, & Miller, 2020). For service and repair businesses, this translates to decreased annual revenues as routine and major maintenance become infrequent and less necessary.

The fast pace of technology transitions within the automotive industry has also created uncertainty in the regulatory environment surrounding service and maintenance. The passing of amendments to the copyright act were a step forward in guaranteeing Canadians better access to repair services across sectors (Automotive Industria Association of Canada, 2023). In the automotive sector, the Canadian Automotive Service Information Standards (CASIS) agreement is the defining factor providing original equipment manufacturer (OEM) information to independent repair specialists (Canadain Vehicle Manufacturers' Association, n.d.). However, as a voluntary agreement, not all automakers participate in sharing their information for diagnostic and repair purposes. Current key arguments made against legislation granting access to this data for independent repair purposes is that it would make it difficult for vehicle manufacturers to protect proprietary knowledge from competitors and may open them to liability issues in the event of poor repair work resulting in accidents (Vermes, 2022). Due to how interwoven the mechanics and software of modern cars are, incorrect repairs could lead to erratic behavior, such as impaired braking performance or unanticipated acceleration.

The decreased need for servicing on BEVs, and for some components of HEV and PHEV, along with the uncertainty surrounding the current repair and maintenance industry can leave some businesses unwilling to invest resources in acquiring the necessary talent, training, and infrastructure for the service of more advanced vehicles. A Reuters article on EV servicing in Europe reported costs for training and equipment at just over $40,000 (Carey, Lienert , & Piovaccari, 2023). An overwhelming majority of repair shops within Canada are small businesses operating without, or with less than 4 employees, and steep upfront costs may price some businesses out of servicing EVs.

For technicians willing to make the investment, BEV, HEV and PHEV components may present an opportunity. The global market for EVs, advanced electronic components, driver's aids, and infotainment electronics is expected to grow by 25% by 2030 (McKinsey & Company, 2023). While routine maintenance compared to ICEVs may decrease, there is a forecasted increase in the service time needs (i.e., time spent servicing) of EV powertrain parts, thermal parts and tires. The complexity of service tasks on EVs may necessitate longer billable work hours or increases in hourly rates to compensate for the nature of work. As advanced driver assistance systems (ADAS) become more complex and common, the length and difficulty of the calibration processes may increase (Fischer, Kramer, Maurer, & Mickelson, 2021). In order to ensure that automotive service technicians are able to capitalize on these opportunities, they must be properly trained and equipped to perform these evolving work tasks.

Education, Certification and Upskilling

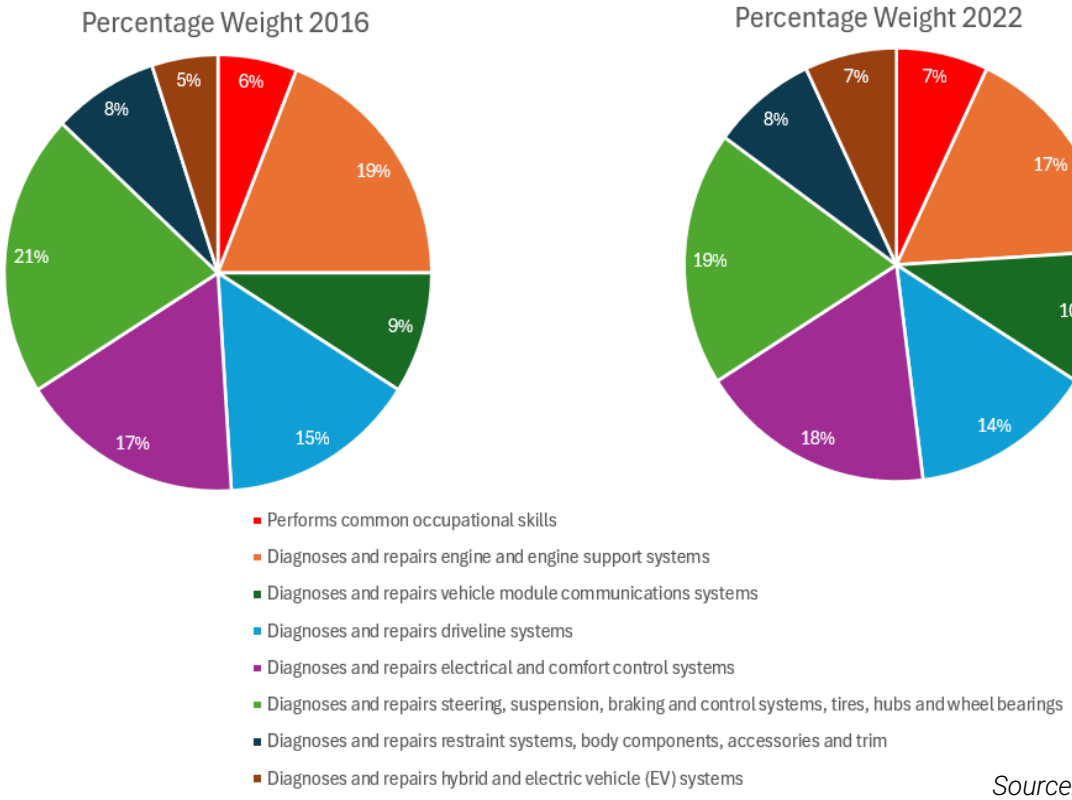
To better weather the short- and long-term volatility of a vehicle electrification transition and ensure automotive service technicians can benefit from new opportunities in the sector, sufficient access to programs for education are required. Existing technicians who have experience servicing ICEVs must also have access to upskilling programs to acquire new skills to service

PHEVs, HEVs, and BEVs. A lack of trained professionals can prevent Canadians from accessing much needed repair and maintenance services and poses a health and safety risk to vehicle operators.

High voltage components and chemical batteries are also a unique source of risk compared to ICEVs. If batteries experience mechanical, thermal or electrical damage, there is an increased risk of battery fire (Zhang, Zhang, Sun, & Wang, 2018). Preexisting damage to high-voltage components pose a health and safety risk to service technicians. Little systemic research exists on the risks posed to recovery, roadside assistance and workshop workers in regard to electric vehicle safety, but the main two documented electrical hazards when working with battery technology include arc flash and electric shock risk (Linja-aho, 2020). Extensive training in electrical theory and safety is paramount to the safety of service workers engaging in EV repair work.

The highest standard for skilled trade work in Canada, the Red Seal, is a certification attached to a provincial or territorial trade certificate indicating that a tradesperson has demonstrated knowledge in their field that is required of the national standard (Red Seal, 2023). Automotive servicing is a trade which is regulated by the red seal program, and over time its requirements have changed to better reflect the skills required of certified technicians.

Figure 2. Red Seal examination weightings 2016 vs. 2022.



Source: Red Seal

Two examples of programs offered are from St. Clair College, and Fanshawe College, where the program is slated to begin in fall of 2024. The second category of programs are micro-credential courses aimed at providing existing red seal automotive service technicians or 3rd or 4th year apprentices with more theory and experience in dealing with electrical and electronic systems found in EVs. These programs are typically conducted over the course of several weeks with instruction times in the tens of hours. The final type of instruction offered is certificate programs conducted over several months that aim to train existing certified automotive service technicians thoroughly on the high voltage and communication systems found in EVs. In addition to colleges, private businesses have begun offering their own apprenticeships, upskilling and certificate programs. The table below serves to summarize key learning objectives, technology and theory covered across a sample of programs, to better understand in demand skills and requirements for EV servicing in the automotive repair and maintenance sector.

Table 2. Curriculum Structure for Automotive Service Technicians EV Training Program.

Automotive Service Technicians EV Programs	
Coursework and Theory	**Learning Objectives**
• Basic Electricity • Direct Current Circuits • Alternating Current Circuits • Power Electronics • Advanced Driver Assistance Systems • Autonomous Vehicles • AC/DC Motors and Controllers • Communication and Control Systems • Sensors and Actuators • Regenerative Braking Systems • Thermal Management Systems • Electric Vehicle Battery Technology	• Apply high voltage safety procedures • Distinguish different categories of high voltage vehicles • Service high-voltage powertrain systems • Service high-voltage battery charging systems • Compare high-voltage vehicle transmission type • Identify types of high-voltage temperature management systems • Explore distinctive maintenance procedures for high-voltage vehicles • Identify connection procedures for categories of high-voltage vehicles • Diagnose vehicle networking and computer systems • Understand and master basic concepts of electricity • Become familiar with diagnostic tools used on vehicles with electric motors • Understand electrical diagrams

The changes occurring to the nature of work for automotive service technicians highlight the emergence of a unique phenomenon within the automotive sector. As new technology is introduced to motor vehicles, the necessary skills required by service technicians are starting to shift. While other parts of the automotive industry are required to alter their product offering and train staff to be familiar with new products, automotive service technicians working with HEVs, PHEV and BEVs are applying overhauled processes in their daily work because of new challenges to servicing cars that are heavily software driven and electrified. This places a large burden on one part of the sector to experience a skills shift, compared to the rest of it. Though this may be an immediate barrier to automotive service technicians, for those that can access training and

invest in the required tools and infrastructure to perform maintenance work on vehicles including new technologies as early adapters, it may prove to be an excellent opportunity.

How Technology Shifts are Disrupting Aftermarket Vehicle Parts Support

Wholesalers for motor vehicles parts and accessories play an important role in providing access to aftermarket vehicle support. Providing access to parts and accessories to independent repair shops, businesses and vehicle owners, the total output of the industry in 2021 neared $18 billion, among which goods and service were provided directly to businesses engaged in automotive repair and maintenance (I/O Tables 2021). As a relatively small part of the automotive sector, there are 6,848 businesses operating, with 3,856 employing businesses (Statistics Canada, 2024). In 2021, the industry employed over 60,500 workers.

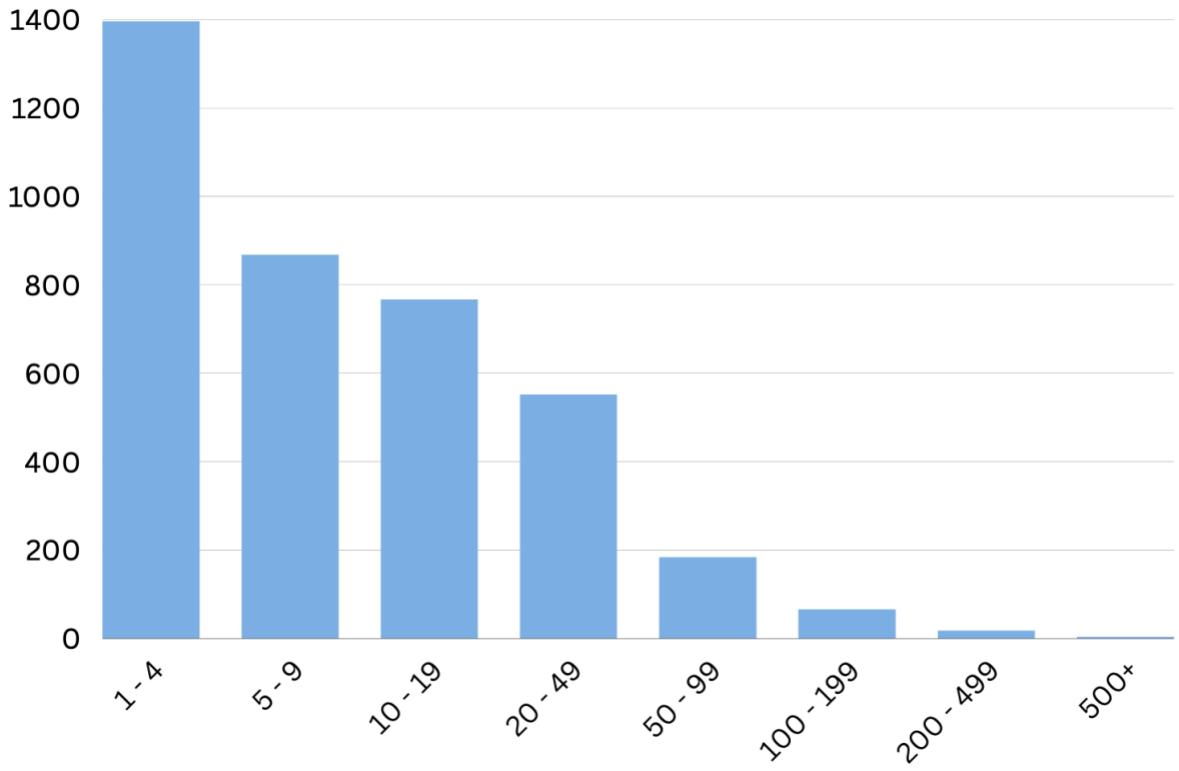
Table 3. Overview of the Motor Vehicle and Motor Vehicle Parts and Accessories Mechant Wholesalers Industry (NAICS 415) in 2021.

Motor Vehicle and Motor Vehicle Parts and Accessories Merchant Wholesalers (NAICS 415)	
Industry Output (2021) (x 1,000)	$17,950,000
Number of Employees in Industry	60,500
Number of Employing Businesses	3,856
Number of Non-Employing Businesses	2,992

Wholesalers for motor vehicle parts are likely to be exposed to the same general trends affecting the automotive sector in the electrification and autonomy transition, and are going to be required to adjust their inventory and purchases to better suit the needs of end users moving forward. ICEV-specific parts, such as motor oils and fluids, spark plugs, and engine and transmission components will experience a decline in sales in the long term, as they constitute a decreasing portion of vehicles on the road and are eventually phased out. Shared components between ICEVs and BEVs have a less discernable trend (KPMG, 2022). Market share for vehicle accessories is anticipated to decline as they may interfere with the functionalities of autonomous systems. Moreover, both electric vehicles (EVs) and autonomous vehicles inherently offer fewer options for customization, further reducing the demand for aftermarket accessories. Among the components best set to benefit from new technologies are driver assistance sensors, electrified powertrain components and tires (Kempf, Christof, Hörner, & Hofmann, 2021). Tires in particular

may see up to 20% more wear and tear due to the increased weight and torque output of EVs, and are expected to be among the most replaced components (Rogalski, Navales, & Delclaux, 2023). Increased weight also increases the burden on chassis components like suspension and driveline parts, but brakes are excluded due to the positive effects of regenerative braking on brake longevity (Kempf, Christof, Hörner, & Hofmann, 2021). ADAS is present in almost 40% of cars available for sale, and has a strong effect on the demand for certain cosmetic and body components. ADAS has the potential to severely reduce the risk of crashing, and as a result, reduce the need for replacement parts such as fenders, doors, hoods, paint, windshields, and other components. Offsetting the downward effect on revenues is increased part complexity on newer vehicles, resulting in higher prices per component (KPMG, 2022).

Figure 3. Distribution of number of businesses by employment within the Motor Vehicle and Motor Vehicle Parts and Accessories Mechant Wholesalers Industry (NAICS 415) (2021).



The increase of electronic components on shelves is unlikely to pose a new challenge for storage, as most mechanical components follow similar storage requirements. In general, both mechanical and electronic parts need to be stored in moisture-free, temperature-controlled environments absent of UV light. Special care should be taken to avoid mechanical damage due to mishandling or improper storage. Specific parts will usually be paired with a manufacturer's manual, containing instructions on each part's ideal storage conditions.

For wholesalers, the largest disruptor will be indirect, resulting from shifts in the industry landscape and supply chain. Traditionally supply channels in the automotive sectors see manufacturers providing parts to distributors, who in turn provide parts to wholesalers that then provide goods to individuals and installation businesses. Distributors may also choose to directly engage with end consumers (TRW Automotive, 2019). Globally, several trends have emerged which change this dynamic. There is an increase in the amount of merger and acquisition activity in the aftermarket space, with a few large wholesalers dominating the majority market share. At the same time, OEMs have begun to invest in their own aftermarket businesses to capture more value, while online retail has allowed customers to directly access parts from OEMs, distributors, and other wholesalers that they would otherwise lack access to. This may result in shrinking margins for some market players (Breitschwerdt, Cornet, Kempf, Michor, & Schmidt, 2017). For smaller businesses in wholesale, it may prove difficult to compete on a cost basis with larger enterprises that can leverage scale and acquire products in bulk, and already have established logistics channels to distribute goods. Direct access to consumers over e-commerce may also pose a threat to wholesale businesses deriving revenues from physical sales. Smaller businesses can however leverage these trends themselves, establishing online presences to access new clients and merging their businesses with other distributors or integrating with repair shops to generate new opportunities. In the future, this is likely to result in less total businesses in operation, with a less clear effect on total employment in the sector.

Overall, autonomous, and electrified vehicles do not pose a significant threat to wholesalers and parts dealers within the automotive sector. While there may be some short-term volatility in gaining familiarity with new components and waiting for a market for them to establish, wholesalers have the flexibility to change their product offerings over time without significant disruptions to their businesses. The main disruptor within aftermarket part support is the changing industry landscape with mergers and acquisitions creating aftermarket giants that capture large amounts of the market and may be difficult to compete with.

The Impact of Technology Shifts on Manufacturers Supplying the Automotive Aftermarket

The main suppliers of automotive parts to motor vehicle manufacturers and parts distributors, motor vehicle parts manufacturers are the backbone of the automotive industry. This paper focuses solely on part of two subsectors, engine and engine parts manufacturing and transmission and powertrain manufacturing and how it interacts with aftermarket players in repair and part wholesale. Part of a larger vehicle parts manufacturing industry (NAICS 3363) employing 71,000 workers, engine and powertrain manufacturers sold $144 million worth of components and parts to repair and wholesale businesses in 2021 (Statistics Canada, 2024). (I/O Tables, Statistics Canada)

Electrified powertrains and autonomous functions in vehicles present a challenge to certain segments of parts manufacturers beyond the elimination of many components. The compatibility of EVs and autonomous components may impact third party and generic aftermarket parts

producers, as challenges may arise as a result of not using OEM parts in vehicles. Genuine or authorized parts are forecast to be the main drivers of demand by consumers (IMARC Group, 2023). This shift in consumer caused by software and hardware compatibility restrictions is likely to alter market shares among OEM parts producers, and producers of third-party or generic parts for ICEVs, HEVs, PHEVs and BEVs. Opportunities and growth still exist for aftermarket parts producers. A study conducted of independent repairs shops in the United States showed that mechanics are beginning to use more private-label aftermarket goods, as consumers squeezed by macroeconomic conditions are searching for low-cost alternatives to service their motor vehicles (Automotive Research, 2022). Furthermore, ICEVs are still expected to make up a significant share of vehicles by 2030, with a growing share of EVs on roads (Kempf, Christof, Hörner, & Hofmann, 2021). Medium- and heavy-duty vehicles are expected to have a much longer time horizon for their electrification transition, and will continue to require support from servicers and parts dealers beyond 2035. Significant innovation needs to be made to existing technology before it can meet the demands of freight transport (Transport Canada, 2022) (Government of Canda, 2022). ICEV part producers will continue to find revenue as support for aging ICEVs will be required, but over time, the industry will be squeezed as growth stagnates and opportunities dry up. This sets up a long-term future where businesses in the space providing parts for automotive repair and aftermarket wholesalers to service ICEVs begin to shift production into electrified powertrain parts, while engine parts producers and those without the capability to create powertrain parts compatible with EVs close their businesses or exit the automotive manufacturing sector. It becomes important then, for current producers to leverage production knowledge and established processes to secure alternative revenue sources and diversify their businesses.

Some ICEV part producers may be able to repurpose their production processes to produce goods for use in other equipment and machinery. An example of this is timing belts, which find use in automobiles and a wide range of machinery and equipment (Testbook, 2023). The success of this would be dependent on the part produced, and whether alternative uses or equivalents can be found in other equipment and machinery. This can allow businesses to pivot focuses or establish new revenue sources at lower costs than complete facility repurposing.

As EVs in operation begin to age, opportunities will emerge for parts manufacturers to embrace the untapped market of remanufacturing for electric powertrain components. Batteries are a particularly appealing component for remanufacture. It supports sustainability by reducing the need for new material mining, eliminates wasteful disposal of batteries and produces a circular economic effect. In 2021, only three facilities in North America were capable of remanufacturing batteries at scale, all of which were in the United States (Canadian Vehicle Manufacturers' Association, 2022). Remanufactured batteries may be an appealing option to wholesalers who seek to stock competitively priced goods for independent specialists to use in repairs. Depending on the model of the car, battery replacements outside of warranty can range from $9,000 to $27,500. Prices can also fluctuate depending on the availability and price of lithium to produce new batteries (Witt, 2024). Comparatively, remanufactured batteries for small urban EVs may

cost less than a quarter of the cost of a new battery, and could be sizeable portion of a potentially lucrative EV powertrain remanufacturing market by 2030 (Schartau & Indino , 2021).

Parts manufacturers are expected to bear the brunt of the volatility in the electrification and autonomy transition within the automotive sector. As many components are eliminated transitioning to EVs, business opportunities in parts manufacturing for ICEVs are expected to decrease. This will cause many unprepared businesses to close and employment in the sector to decrease for a period. For producers of parts for repair and aftermarket support of vehicles, alternative revenue sources and creativity and process innovation may help longevity and maintain profit margins as growth within the sector eventually stalls and reverses.

Conclusion

The electrification transition and autonomy are causing uncertainty and change on an unprecedented scale throughout the many parts of the automotive sector, while presenting unique opportunities and challenges. It is causing fundamental changes to the way service is provided for automobiles, the demand for components and the ability for parts manufacturers to continue supporting the rest of the sector. It has introduced ripple effects, changing the way the constituent parts of the sector interact with each other. If a parts manufacturer is unable to continue producing parts for ICEVs goes out of business, a wholesaler may be unable to stock those parts, and local repair shops may then be delayed or unable to provide important services to motor vehicle owners. The same process holds true for EVs. Lack of adequate skills required for service, lack of parts and suitable alternatives create an environment in which adoption stalls, and it is difficult for consumers to embrace new, more sustainable technologies. It is in the best interest of stakeholders of the Canadian automotive sector to adopt a holistic approach to better understand the long-term implications and scale of volatility posed by vehicle electrification and autonomy in the sector to ensure a smoother, confident transition.

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