MNP

Electrification and Automation of the BC Automotive Aftermarket Service Sector: Labour Market Research

Prepared for the Automotive Retailers Association

Final Report

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Disclaimer

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List of Acronyms

Acronym	Definition
ADAS	Advanced Driver Assistance Systems
AR	Augmented Reality
ARA	Automotive Retailers Association
BC	British Columbia
BCIT	British Columbia Institute of Technology
BEV	Battery Electric Vehicle
D2C	Direct-to-Consumer
EPR	Extended Producer Responsibility
EV	Electric Vehicle
F&I	Finance and Insurance
FCEV	Fuel Cell Electric Vehicle
HEV	Hybrid-Electric Vehicle
ICTC	Information and Communications Technology Council
IT	Information Technology
ICE	Internal Combustion Engine
LiDAR	Light Detection and Ranging
NAICS	North American Industry Classification System
OEM	Original Equipment Manufacturer
OTA	Over-the-Air
PHEV	Plug-in Hybrid Electric Vehicle
PSI	Post-Secondary Institution
Sector	Automotive Aftermarket Service Sector
SME	Subject Matter Expert
US	United States
VR	Virtual Reality
ZEV	Zero-Emission Vehicle

Executive Summary

Background and Purpose

The automotive sector, including the aftermarket service sector (the Sector), is facing a wave of technological change including the increasing adoption of zero emission vehicles (ZEVs) and rise of automation. These technologies will impact the way in which vehicles are sold, maintained, repaired and recycled. All of which has implications for the way in which work in the aftermarket sector is completed. The current and future workforce will need to adapt to these new technologies and the Sector will need to consider their effects in areas such as training and development, future skill gaps and health and safety.

The Sector, led by the Automotive Retailers Association (ARA), engaged MNP to conduct research on the labour market impacts of the transition to ZEVs and automation technologies. A Project Governance Committee, comprised of representatives from the Sector in BC, the ARA, post-secondary institutions, regulatory authorities (e.g., SkilledTradesBC), and the BC Ministry of Energy, Mines and Low-Carbon Innovation, guided the research. The results of the study are intended to be used to support the Sector in adapting to new technologies.

Methodology

A combination of primary and secondary research was used to conduct this study. The primary research activities (i.e., semi-structured, virtual interviews) collected information on the impact of different technology, adoption timelines, factors affecting adoption timelines, changing skill requirements, anticipated changes to the training landscape, the emergence of new occupations and impacts on worker health and safety. Interviews were held with all eight sub-sectors, post-secondary institutions (PSIs), original equipment manufacturers (OEMs), regulatory bodies, insurance providers and car share services.

Validation focus groups were held to test the preliminary findings with industry prior to finalizing them. Modifications to the preliminary findings were made, where required based on feedback from these sessions.

Defining the Automotive Aftermarket Services Sector

For the purposes of this study, the automotive aftermarket sector has been defined to include the following eight sub-sectors:

- New Car Dealers
- Used Car Dealers
- Aftermarket Parts
- Towing and Recovery
- Mechanical Repair and Maintenance
- Collision Repair
- Auto Glass Repair
- Automotive Recyclers

Excluded from the scope was fleet planning and management services for businesses electrifying their fleets, as well as infrastructure development and deployment.

Key Findings

The key findings from this research are:

- Of the five technologies included in this study, **ZEV adoption is expected to have the most significant impact on the Sector**. While ZEVs bear a number of similarities to internal combustion engine (ICE) vehicles, they also differ in some elements related to repair and maintenance, towing and recycling. These differences create the requirement for new skills and the strengthening of existing ones.
- **The complexity of repair work is set to increase.** While ZEVs are expected to require less maintenance and advanced driver-assistance systems (ADAS) technologies are expected to reduce the number of collisions, the nature of repairs may be more complex and severe (in the case of collision repairs). ADAS technologies have a lot of sensors and components that need to be properly calibrated to function correctly. Batteries and fuel systems in ZEVs are complex and several safety considerations need to be accounted for in repairing them.
- **Adoption timelines remain unclear as there are a number of factors affecting adoption.** Approximately 50 percent of on-road vehicles are expected to be ZEVs by 2035 and approximately 60 percent by 2040. However, several factors may impact this adoption timeline, such as manufacturing capacity, the cost of the technology for both the consumer (e.g., ZEVs) and businesses (e.g., AI, robotics) and geographic location.
- **Minor changes to the Sector's overall workforce composition are forecasted.** While minor shifts in workforce compositions may be expected within sub-sectors, the overall workforce composition of the Sector is expected to be largely unaffected.
- **Automotive service and autobody and collision technicians, auto dismantlers and IT specialists** are the occupations anticipated to see the **greatest requirement for upskilling and reskilling**. Electrical, battery and technological skills such as software programming and computer diagnostics are the priority areas of training for these occupations. Other priority areas for the wider sector include data literacy and analytics and health and safety skills.
- **A mix of skills is expected to be required owing to the mix of vehicle fuels that will be in circulation in 2040.** A combination of mechanical and electrical skills will be required across the Sector. Although ZEVs are expected to require less maintenance, there will still be a need for maintenance and repair of brakes, suspension, heating, ventilation and air conditioning systems and electronic systems. Further, ICE vehicles are estimated to still comprise some 40 percent of the provincial vehicle fleet in 2040 and will need repair and maintenance.
- **Skill shortages may continue to emerge.** The current skill set of the workforce is not growing at the same speed as technological change creating a skill gap between that of the workers and what employers require. Skills related to battery removal, IT, electrical, software programming and data analytics were areas identified as most at risk of being in short supply.
- **The frequency of training is expected to increase.** On-going training is set to become a requirement for those working in the Sector. This is particularly true for automotive service technicians and autobody and collision technicians, whose roles are among those occupations

forecast to experience the greatest degree of change. (Please note that the need for ongoing training is distinct from the re-introduction of skilled trades certification (also known as mandatory certification) for these occupations). As such, a continuous learning mentality, albeit not a skill, was noted as a highly important requirement for current and future workers.

- **The costs associated with increased training and skill development will likely affect some businesses' viability, which may lead to consolidation and changes in service availability in some regions.** Approximately 70 percent of businesses in the Sector have fewer than 10 employees and 4 percent have more than 50. Smaller businesses may be less able to invest in training, skill development, and technology. This is particularly true in cases where facilities cannot pass their training costs on to their customers or among facilities that may not have the volume to justify investments in accessing repair information and training. As a result, facilities may consolidate or specialize in specific services or vehicle types. This may also reduce the availability of services in some regions of the province and/or change how services are provided in rural areas.
- **Skill specialization is forecast to increase.** There is some consensus that a trend towards skill specialization will emerge (e.g., the specialization of repair and maintenance for ZEVs and ICE vehicles). With it, new occupations are also set to appear. As new roles emerge and others evolve to become more specialized, training is also expected to become more specialized. This will have implications for the provision and design of training.
- **Car ownership models are beginning to change.** This has implications for the number of vehicles on the road. Specifically, the rate of growth of vehicles on the road will be lower than the projected growth in the driving age population due to anticipated changes in car ownership in urban areas. Changing ownership models also impact the frequency of repair and maintenance. Vehicles that are part of a car share system or fleet will likely require more frequent maintenance than personal vehicles due to higher usage rates and more demanding operating conditions.
- **How batteries are managed will have implications for the Sector and its workforce.** Currently, no system is in place to safely repurpose and recycle ZEV batteries. The development and implementation of an extended producer responsibility (EPR) program for ZEV batteries are identified in the Ministry of Environment and Climate Change Strategy's Extended Producer Responsibility Five Year Action Plan 2021-2026.[1] The design and delivery of the EPR program have the potential to create new occupations within the Sector and will impact training requirements for those dealing with vehicles for which the batteries are being removed and/or replaced.

[1] Government of BC. Advancing Recycling in B.C. Extended Producer Responsibility Five Year Action Plan 2021-2026. Retrieved from: https://www2.gov.bc.ca/assets/gov/environment/waste-management/recycling/recycle/extended_producer_five_year_action_plan.pdf

Recommendations

Recommendations for the Sector in adapting to new technologies and addressing skill development and training include:

- **Improve the Sector's image.** There is general agreement that negative perceptions are held about working in the Sector. This has implications when it comes to recruiting workers. However, there is an opportunity to improve the sector's image through marketing, education and engagement. In particular, targeted messaging emphasizing sustainability and environmental efforts (e.g., ZEVs, recycling programs, and reducing waste in production), showcasing the innovative work being done, including advancements in ADAS and AVs, and communicating how employees can play a role in shaping the future of transportation are several areas the Sector can highlight. For example, recyclers could rebrand their sub-sector as part of the green jobs movement. These messages have the potential to resonate strongly with youth audiences, in particular. Improving the Sector's image will require a concerted effort from sub-sector participants, government, PSIs, and other stakeholders. Engagement strategies with K-12 students, a provincial/national awareness and reputation campaign and leveraging existing career initiatives are just some options to execute this path forward.
- Businesses and workers should **prepare to dedicate more time and resources to training** as requirements for upskilling and reskilling are set to increase for most Sector occupations. Preparations for employers may include setting aside additional time for on-the-job training, establishing mentorships between younger and older staff members to aid knowledge transfer (in both directions), subsidizing training costs, accommodating time-off for external training and coordinating schedules to minimize disruption to business operations while staff are away for training. Employees should also be prepared to spend additional time in training, including travel time when virtual options are not available. Investment from government and PSIs will also be required to ensure the necessary training is available in the required geographic areas and at a sufficient frequency of delivery (see below).
- **Establish standards for training across the province.** Many occupations in the Sector will require higher levels of training or completely new skills due to innovation and technological advancements. However, to date, programming has struggled to keep pace with the rate of technological change leading to variation in both access to training and in relation to specific training content. Interviewees suggested establishing standards and associated certifications (e.g., micro-credentials) for training as it relates to teachings on new technologies and their implications for health and safety. This will require existing training to be updated and new training to be introduced. As part of this, PSIs, in consultation with the Sector, may be required to review and update programming more regularly than the current cadence (e.g., every 3-5 years).
- **Where applicable, introduce new programming and modalities that address specific Sector needs.** While existing programming modifications will address some of the future training requirements, new programming will still be required. Micro-credentials represent an increasingly popular modality for upskilling and providing professional development opportunities as they are often offered at a shorter length, lower cost and with flexible delivery options than traditional post-

secondary programs. In time, AR and VR will represent opportunities to train the workforce as well.

- **(Continued) Investment and support from government** to roll out the required infrastructure that is needed for this wave of technological advancements. Many investments, including expanding the public charging network, supporting existing multi-unit buildings to include charging stations, and developing new or updating existing regulations and policies to embrace newer ADAS features, will be required by government to help the province transition to ZEVs and automated technologies. Thinking specifically about skills and training development, investments will be required to update existing programming, design and introduce new programming, add additional instructors, provide flexible training options and availability in communities across the province and additional subsidization of training.
- **Identify opportunities for industry collaboration in the provision of training.** Most businesses in the Sector have fewer than 10 employees. The small nature of facilities creates challenges when it comes to investing in training and development. There may be opportunity for businesses to collaborate in the provision of training. For example, sharing the cost of bringing an instructor to a region to train technicians from a group of facilities rather than sending technicians out-of-town for training. If a number of facilities can work together to offer training, it could lower the cost for individual businesses and allow them to invest in training. Coordination of training opportunities could be done through the ARA.
- **Identify ways to ensure access to repair information.** Access to repair information and equipment, more commonly known as the 'Right to Repair,' was noted as one of the enduring challenges faced by the Sector. The cost of accessing OEM repair information is a barrier for aftermarket service providers and could lead to reductions in the availability of services and increases in the cost for consumers. The Sector should work with OEMs, regulatory bodies (e.g., SkilledTradesBC), PSIs and government to identify ways to facilitate access to information for training and the provision of repair and maintenance services to ensure continued availability of service for consumers.
- **Work with the Ministry of Environment and Climate Change Strategy to define the Sector's role in the management of ZEV batteries.** The recycling and repurposing of ZEV batteries will require training for those working with batteries at each stage of the lifecycle. It may also create new occupations in the Sector.

1. Introduction

Background and Purpose

The automotive sector, including the aftermarket service sector (the Sector), faces a wave of technological change, including the increasing adoption of zero emission vehicles (ZEVs) and the rise of automation. These technologies will impact how vehicles are sold, maintained, repaired and recycled. All of which has implications for the way in which work in the aftermarket sector is completed. The current and future workforce will need to adapt to these new technologies and the Sector will need to consider their effects in areas such as training and development, future skill gaps and health and safety.

The BC Sector, however, has limited information on the impacts these technologies are forecast to have on the provincial workforce. To help bridge this data gap, the Sector, led by the Automotive Retailers Association (ARA) and funded by the Sector Labour Market Partnerships, engaged MNP LLP (MNP) to conduct detailed research on the labour market impacts of the transition to ZEVs and automation technologies.

The ARA provided overall project management for the study while a Project Governance Committee, comprised of representatives from the BC automotive aftermarket service sector, post-secondary institutions (PSIs), regulatory authorities (e.g., SkiledTradesBC), and the BC Ministry of Energy, Mines and Low-Carbon Innovation, guided the research. The results of the study are intended to be used to support the Sector in adapting to new technologies.

Scope

The scope encompassed:

- Identifying the ZEV and automation technologies affecting the Sector.
- Quantifying the current size and scope of the automotive aftermarket sector.
- Developing projections of the size and composition of the workforce from 2022 to 2040.
- Identifying how technological advancements are affecting the required skills and training.
- Identifying how technological advancements are affecting current and emerging occupations.
- Identifying health and safety considerations related to technological advancements.
- Identifying a potential timeline for transitioning the workforce and factors influencing it.
- Developing recommendations for supporting the development of the workforce needed to support the Sector.

The scope of the assessment was limited to light duty passenger vehicles and businesses providing vehicle sales, maintenance, towing and recycling services. Excluded from the scope was fleet planning and management services for businesses electrifying their fleets, as well as infrastructure development and deployment.

Approach

In preparing this report, MNP carried out the following activities:

- Conducted a literature review and environmental scan to gather existing information and data.
- Developed research tools (i.e., tailored interview guides) and identified research contacts.
- Conducted key informant, contextual interviews with eight Project Governance Committee Members.
- Developed a methodology, using the findings of the preliminary research, to develop projections of the composition of the automotive workforce in BC over the period 2022 through 2040.
- Conducted 40 key informant interviews with the sector stakeholders.
- Collated and undertook qualitative and quantitative analysis of the gathered information.
- Developed projections of how the composition of the workforce will change.
- Assessed how the skill set and required training of the Sector will change.
- Conducted three focus groups with 32 participants to validate the findings and develop recommendations.
- Developed draft and final reports of the finding of the study.

Structure of the Report

The remaining sections of this report are organized as follows:

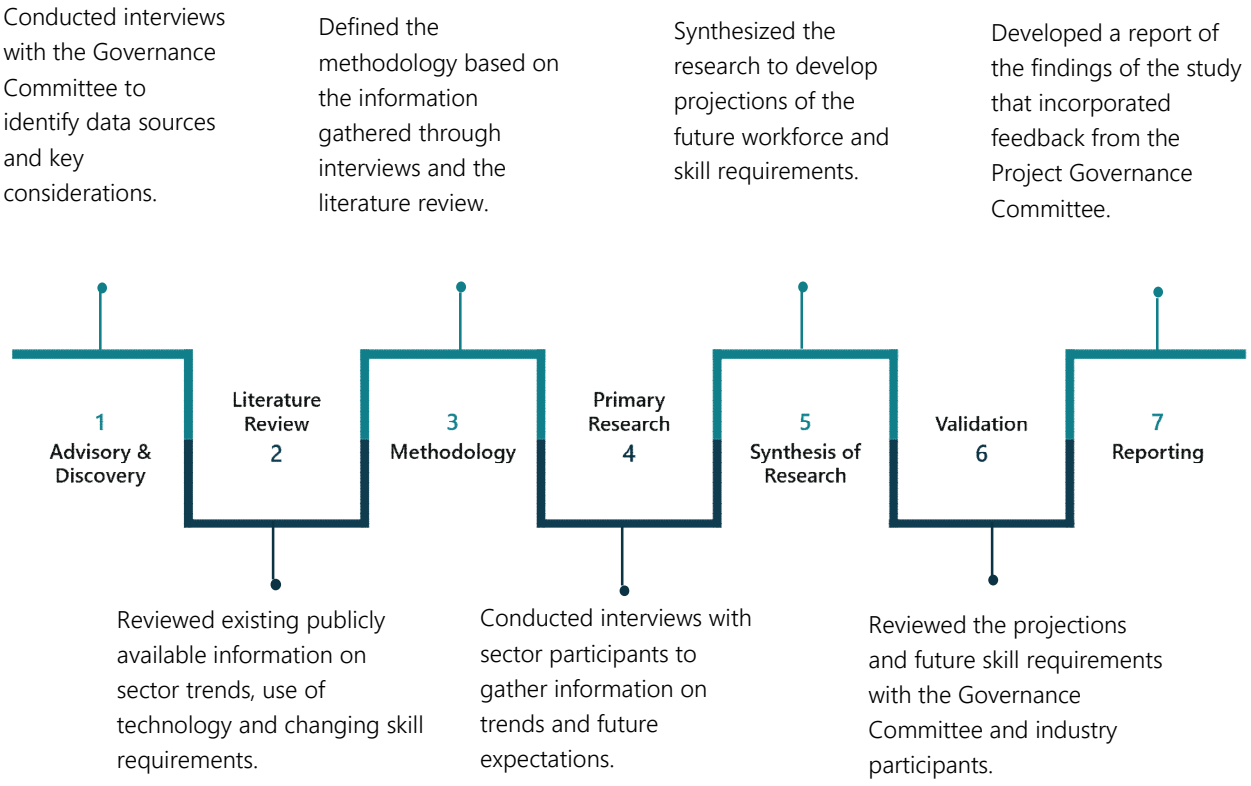
- Section 2 provides an overview of the methodology and data sources used in conducting the study.
- Section 3 contains an overview of the Sector in BC and trends impacting the composition of the workforce.
- Section 4 offers an outline of technologies influencing the Sector and factors affecting adoption pathways.
- Section 5 describes the key impacts of the technologies on the labour market including skills and training requirements.
- Section 6 contains a summary of findings and recommendations
- Appendices A through F provide supporting information on the primary data collection, works cited and project assumptions.

2. Methodology and Data Sources

Approach

Figure 1 outlines the approach used to conduct this study. After confirming the project scope, work plan and the in-scope sub-sectors with the Project Governance Committee, contextual key informant interviews with Project Governance Committee (Appendix B) members and a literature review were conducted to identify trends and emerging technologies in each sub-sector. The literature review also examined the operating environment, how changes in technology in the past have affected the workforce and relevant provincial strategies such as the BC Hydrogen Strategy and Clean BC. The information gathered through the contextual interviews and secondary research was used to identify data gaps and design the primary data collection tools (i.e., interview guides for each stakeholder group). Research contacts for each stakeholder group were identified in collaboration with the ARA and Project Governance Committee and 40 key informant interviews were conducted across sector representatives, post-secondary institutions, insurance providers and regulatory authorities. The primary and secondary research findings were then synthesized and used to develop projections of the workforce composition and future skills requirements. To validate the findings and review projections, three focus groups were conducted with a total of 32 sector representatives attending the online sessions. Thereafter, the final report was developed, outlining the effects of electrification and automation on the automotive aftermarket sector and providing recommendations for supporting the workforce.

Figure 1: Approach to Conducting the Study



Data Sources

The data used in the study included both quantitative and qualitative information gathered from primary and secondary sources. Both the primary and secondary research was conducted to gather information on how electrification and automation technologies are expected to impact the composition of the workforce, the skill and training requirements, as well as worker health and safety

Primary Research

The primary research activities for this study included:

- **Contextual key informant interviews with Project Governance Committee members.** To begin, the contextual key informant interviews were conducted with eight members of the Project Governance Committee to identify the key trends and emerging technologies that should be considered in the study. The interviews were conducted virtually and were held in August and September 2022.
- **Key informant interviews with sector stakeholders.** To obtain information on how skills requirements were likely to be affected by the transition to ZEVs and automation, 66 industry participants were invited to participate in an interview. Contacts for these interviews were identified in collaboration with Project Governance Committee. Information on and invitations to participate in interviews were sent by MNP. Up to four follow-up emails were sent to potential participants to increase participation and follow-up phone calls were made to some interviewees. A total of 40 stakeholders agreed to participate and interviews were conducted between November 2022 and January 2023.
- **Focus Groups with sector representatives.** Three focus groups were conducted with 32 sector representatives from different sub-sectors to review and validate the preliminary research findings. The sessions were conducted virtually using Mural, a collaboration platform, on February 2, February 3 and February 24, 2023. Communication materials and online registration tools were prepared and circulated in advance.

Appendix C details the number of invitations sent by sub-sector and the distribution of the interview participant's sub-sector.

Secondary Research

A review of relevant published information from government sources such as Statistics Canada, research organizations, industry groups and peer-reviewed journals was conducted. Our review focused on the following themes:

- Emerging technologies;
- Changing skill requirements and trends influencing skill requirements;
- Skill gaps and new occupations;
- Changing training requirements;
- Trends in technology that are impacting skill requirements and labour demand;
- Impact of past technologies on the workforce; and
- Experience in other jurisdictions.

Limitations

The findings presented in this report are subject to the following limitations:

- OEMs declined to participate in interviews. Those who provided a reason cited a desire to be contacted by government directly. As a result, we could not incorporate their perspectives on adoption timelines, future maintenance requirements for ZEVs or advances in automation and Advanced driver-assistance system (ADAS).
- This study was conducted between August 2022 and March 2023. At the time of writing, there was significant uncertainty about how and when different technologies would be adopted and the ability of car makers to meet government targets. The findings presented here are based on our assessment of the information available at the time and the likely adoption pathways. Actual adoption pathways, the mix of fuel types and the use of automation may differ from what was foreseeable at the time of this report
- This research involved comparing the adoption of technology in the Sector with other jurisdictions. However, as BC is one of the leading jurisdictions in vehicle electrification, there were limited learnings from other jurisdictions that could be drawn on.

3. Overview of the Sector in BC

Sector Definition

In BC, the Sector primarily consists of service-oriented businesses that deal with motor vehicle sales, maintenance, repair, and disposal. For the purposes of this study, the Sector has been defined to include the eight sub-sectors listed in Table 1. They are organized by their North American Industry Classification System (NAICS) code and the analysis that follows is based on these sub-sectors.

Table 1: Definition of the BC Automotive Aftermarket Service Sector by NAICS

Sub-Sector	NAICS Code[2],	Description
New Car Dealers	441110	New Car Dealers
Used Car Dealers	441120	Used Car Dealers
Aftermarket Parts	441310	Automotive Parts and Accessories Stores
Towing and Recovery	488410	Motor Vehicle Towing
Mechanical Repair	811111	Automotive Mechanical, Electrical Repair and Maintenance
Collision Repair	811121	Automotive Body, Paint and Interior Repair and Maintenance
Auto Glass Repair	811122	Automotive Glass Replacement Shops
Auto Recyclers	415310	Used Motor Vehicle Parts and Accessories Wholesaler-Distributors

Source: Statistics Canada, North American Industry Classification System (NAICS) Canada 2021

Number and Size of Employers

To estimate the number of businesses operating in the Sector, we used data from Statistics Canada's Business Counts. The data on business counts considers each of an employer's locations separately, meaning that an employer with 10 stores would be counted as 10 locations.[3] Additionally, the sector assignments are based on the primary business activity of the employer. Therefore, an employer that offers multiple services will be categorized in the sub-sector that corresponds to their primary business activity. As a result, the location counts by sub-sector may not reflect the total number of businesses providing services in the sector. For example, new car dealers will be counted in that sub-sector. However, they typically offer mechanical repair services. As a result, the number of businesses providing mechanical repair services is greater than indicated in the business counts. Other sub-sectors where the business

[2] NAICS codes are assigned based on the primary purpose of the location. For example, a business that is primarily engaged in retailing parts but has a small shop where repairs are performed will be assigned to Aftermarket Parts while a shop that is primarily engaged in mechanical repair but also sells parts will be assigned to Mechanical Repair

[3] Statistics Canada, Business Counts 2022.

counts may significantly underestimate the number of businesses providing services are indicated in the notes below the table.

In 2022, there were approximately 3,800 businesses in the Sector in BC (Table 2). Mechanical repair is the largest sub-sector, with just under 1,600 businesses (41 percent), while auto recyclers are the smallest sub-sector, with 61 (1 percent) businesses. Approximately, 70 percent of businesses have fewer than 10 employees and only 4 percent have more than 50. New car dealers tend to have more employees than other sub-sectors.

Table 2: Number of Automotive Aftermarket Service Businesses in BC by Number of Employees, June 2022

Sub-Sector	NAICS Code	Number of Locations	Number of Employees			
			Less Than 10	10 to 19	20 to 49	50+
New Car Dealers	441110	450	54	42	205	149
Used Car Dealers	441120	257	221	24	9	3
Aftermarket Parts	441310	417	243	57	115	2
Towing and Recovery	488410	172	128	20	21	3
Mechanical Repair	811111	1,585	1,394	157	32	2
Collision Repair	811121	742	530	170	38	4
Auto Glass Repair*	811122	210	196	13	N/A	1
Auto Recyclers**	415310	33	28	4	1	0
Total		**3,866**	**2,794**	**487**	**421**	**164**

Source: Statistics Canada, Business Counts, June 2022

Note: N/A indicates data is not available.

*Auto glass repair services are offered by Auto Glass Repair facilities, Collision Repair facilities, New Car Dealers and glass repair businesses that primarily provide industrial, residential and commercial glass replacement services.

**Auto recycling services are also provided by a number of Towing and Recovery operators and Mechanical Repair facilities.

Occupations

For the purposes of this report, the Sector's occupations have been organized into the following four occupational categories:[4]

- **Skilled trade occupations.** In the Sector, skilled trade occupations are responsible for the maintenance and repair of vehicles. They work across the eight different sub-sectors and each sub-sector employs a selection of trades depending on their needs. There are six skilled trade occupations in the Sector, all of which are Red Seal trades.
- **Other trades and technical occupations.** Workers in other trades and technical occupations typically support the day-to-day operations of the respective shops through the provision of technical services such as inventory management, delivery, driving, detailing and calibration of parts. These occupations usually do not require a formal certification. Examples of the occupations included in this category are inventory specialists, general shop labour and drivers. These roles may be employed by dealerships, auto-recyclers, towing companies, mechanical repair and body shops.
- **Sales and administrative occupations.** Examples of occupations included within this category are customer service representatives, licensed salespersons, estimators, finance, accounting and office support workers. Individuals in these roles usually engage with customers and provide advisory services in the Sector. Sales and administrative positions are present across all sub-sectors and usually require some industry-specific knowledge and experience.
- **Management occupations.** Most management occupations require industry experience and can vary from entry-level to senior positions. Their job duties vary depending on the business area but can include planning, directing and evaluating the operations of establishments, managing staff, and evaluating market trends. Some examples include controllers, sales managers and service managers.

[4] These four occupational categories are used to organize and present findings throughout the report.

Table 3 through Table 6 show the occupations typically found in each sub-sector. A description of each occupation in the tables is provided in Appendix D.

As shown in Table 3, four of the six skilled trade occupations are related to collision repair services, one is mechanical repair, and one is parts. Automotive Service Technicians are employed across sectors, while other trades tend to be found in one or two of the sub-sectors where the relevant services are provided.

Table 3: Skilled Trades Occupations by Sub-Sector

Sub-Sector (NAICS Code)	Parts-person (NOC 14401)	Automotive Service Technician (NOC 72410)	Autobody and Collision Technician (NOC 72411)	Automotive Glass Technician (NOC 72411)	Automotive Painter (NOC 72411)	Automotive refinishing Prep Technician (NOC 72411)
New Car Dealers (44111)	X	X	X	X	X	X
Used Car Dealers (44112)		X				
Aftermarket Parts (441310)	X					
Mechanical Repair (811111)	X	X				
Towing and recovery (488410)		X				
Collision Repair (811121)			X	X	X	X
Auto Glass Repair (811122)				X		
Auto Recyclers (415310)		X	X			

Table 4 shows the other trades and technical occupations and where they are typically employed. As illustrated, car dealerships, particularly new car dealers, hire a wider selection of occupations from this category compared to other sub-sectors. Collision and mechanical repair shops typically specialize in a limited range of services, therefore, a smaller selection of the occupations listed below are usually found at these places of work.

Table 4: Other Trades and Technical Occupations by Sub-Sector

Sub-Sector (NAICS Code)	Inventor/ Wareho-use Person (NOC 14401)	Lot Person (NOC 65329)	Auto Dismantler (NOC 73209)	Tow Truck Operator (NOC 73300)	Parts Delivery Driver (NOC 75201)	Detailer (NOC 75119)	Shop Helper (NOC 75119)	IT Specialist (NOC 21222)
New Car Dealers (44111)	X	X			X	X	X	X
Used Car Dealers (44112)		X				X	X	X
Aftermarket Parts (441310)	X				X		X	
Mechanical Repair (811111)	X	X					X	
Towing and recovery (488410)				X				
Collision Repair (811121)						X	X	
Auto Glass Repair (811122)						X	X	
Auto Recyclers (415310)	X		X					

Table 5 displays the sales and administrative occupations employed across the Sector. Although certain occupations are employed more widely across the sub-sectors, business office support workers and customer service representatives are found within all sub-sectors.

Table 5: Sales and Administration Occupations by Sub-Sector

Sub-Sector (NAICS Code)	Business Office (NOC 14100)	Warranty Clerk (NOC 14100)	Customer Service Rep (NOC 14101)	Tow Dispatcher (NOC 14404)	Licensed Automotive Salesperson (NOC 64100)	Service Advisor (NOC 64409)	Estimator (NOC 72410/ 72411)
New Car Dealers (44111)	X	X	X		X	X	X
Used Car Dealers (44112)	X		X		X		
Aftermarket Parts (441310)	X		X				
Mechanical Repair (811111)	X		X		X		
Towing and recovery (488410)	X		X	X			
Collision Repair (811121)	X		X				X
Auto Glass Repair (811122)	X		X				X
Auto Recyclers (415310)	X		X		X		

Table 6 shows the management occupations typically found in each sub-sector. The range of management positions varies depending on the sub-sector. Car dealerships, both new and used, require more management positions of differing responsibilities compared to other sub-sectors. In addition, all sub-sectors except for towing require a controller to oversee their operations.

Table 6: Management Occupations by Sub-sector

Sub-Sector (NAICS Code)	Controller (NOC 00012)	Finance Manager (NOC 10021)	Sales Manager (NOC 60020)	Fixed Operations Manager (NOC 60020)	Parts Manager (NOC 0621)	Leasing Agent (NOC 64100)	Service Manager (NOC 10029)
New Car Dealers (44111)	X	X	X	X	X	X	X
Used Car Dealers (44112)	X	X	X	X		X	
Aftermarket Parts (441310)	X				X		
Mechanical Repair (811111)	X						X
Towing and recovery (488410)							
Collision Repair (811121)	X						
Auto Glass Repair (811122)	X						
Auto Recyclers (415310)	X						

Workforce Estimates

To estimate the size of the workforce, we used information on business counts and employment trends by NAICS code from Statistics Canada and workforce estimates from a 2016 labour market study conducted by MNP. As of 2022, there were estimated to be approximately 43,000 people employed in the Sector in BC (Table 7). Between 2016 and 2022, employment within the Sector was estimated to have grown by approximately 6 percent. About 80 percent of the growth in employment was estimated to be in new car dealers. Aftermarket parts and repair services accounted for the remainder of the growth, while employment at used car dealers and towing and recovery remained relatively stable. Employment at auto recyclers declined.

Table 7: Employment by Sub-sector 2016 and 2022, Annual (Persons)

Sub-Sector	Total Workforce 2016	Total Workforce 2022	Percentage Change (2016 – 2022)
New Car Dealers	16,030	18,000	12%
Used Car Dealers	1,450	1,470	1%
Aftermarket Parts	2,360	2,500	6%
Towing and Recovery	1,670	1,670	0%
Mechanical Repair	11,300	11,500	2%
Collision Repair	6,600	6,750	2%
Auto Glass Repair	1,060	1,110	5%
Auto Recyclers	350	250	-29%
Total	**40,820**	**43,250**	**6%**

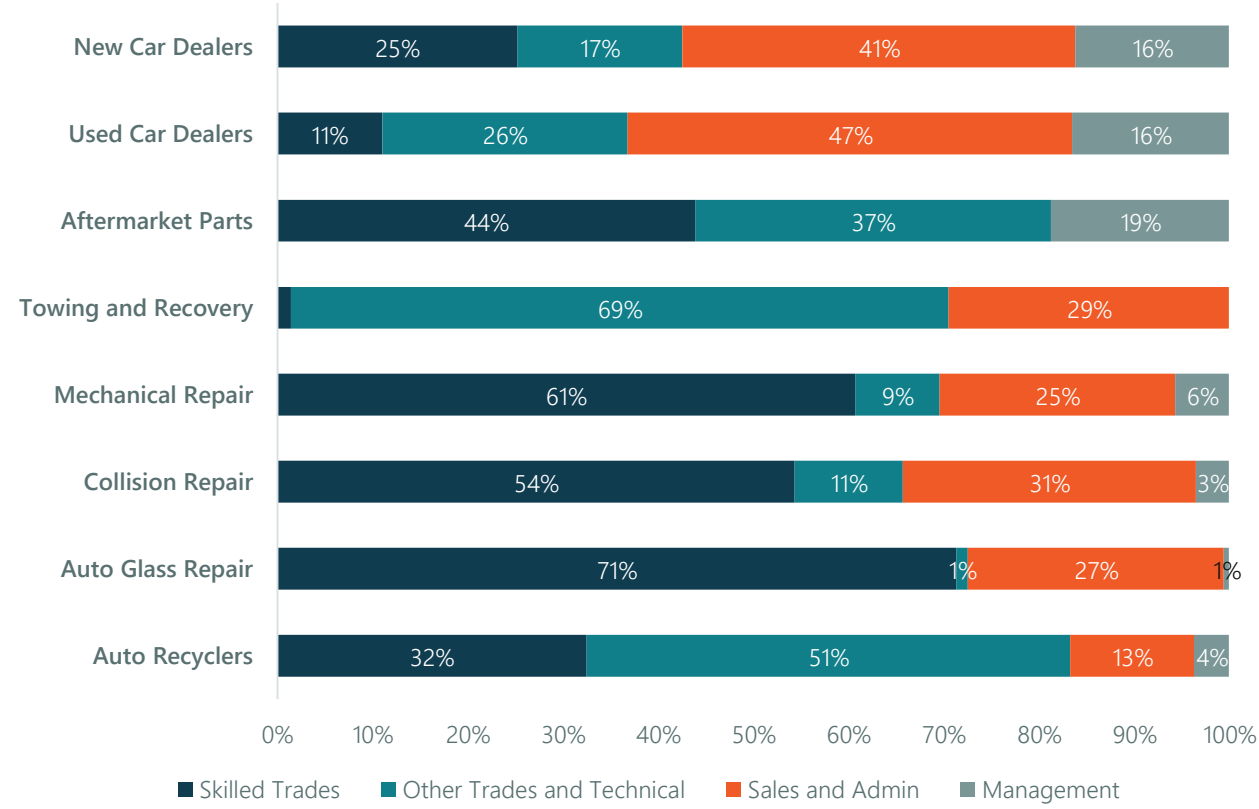
Source: MNP Estimates

Workforce Composition

Skilled trade occupations (including apprentices) were estimated to account for approximately 40 percent of the jobs in the Sector, sales and administration positions were estimated to account for 32 percent, other trades and technical occupations 18 percent and management occupations were estimated to account 10 percent of the jobs.

Figure 2 shows that the sub-sectors that primarily provide repair services (i.e., auto glass, collision repair, and mechanical repair) were estimated to employ a relatively higher share of skilled trades, whereas the sub-sectors primarily providing retail sales (i.e., new car dealers and used car dealers) were estimated to employ a relatively higher share of sales and administration positions. The workforce at towing and recovery and auto recycler businesses is dominated by other trades and technical positions.

Figure 2: Composition of Workforce by Sub-Sector – 2022



Source: MNP Estimates

Workforce Trends

Technology has been affecting the Sector for years, significantly impacting the workforce composition, changing skills requirements and the need for training. At present, the pace of technological advancement in the Sector has increased, and this is creating skill gaps within the workforce.

Some of the key workforce trends include:

- **An aging workforce.** In BC, approximately 27 percent of the Sector's workforce is 55 or older, while those just entering the labour force (e.g., aged 15 to 24) comprise 16 percent of the workforce.[5]
- **Labour shortages.** Labour shortages are emerging as many workers are approaching retirement age, and there are not enough new entrants to replace them.[6] According to WorkBC, automotive service technicians and mechanical repairers constitute one of the most in-demand trade occupations.[7]
- **Employment composition.** The nature of work for technicians in the Sector is changing. There is a greater emphasis on electronics and electrical systems in the repair of new vehicles. As a result, the skills necessary for employment in the Sector are transforming and new occupations are emerging (e.g., programming and battery technicians). At the same time, new technologies are increasing administrative requirements (e.g., IT support).
- **Training requirements.** As a result of changing skills requirements, there are implications for workforce training. There is significant consensus across the Sector that continuous training throughout a career will be necessary, as will an openness to life-long learning.
- **Demand for Information Technology (IT) Positions.** With the increased use of automation technologies and software, an increased demand for IT positions in the Sector, especially in car dealers, is expected.
- **Specialization and Outsourcing.** It is expected that in the future, there will be a trend toward the specialization of repair and maintenance shops for internal combustion engines (ICE) and ZEVs. However, as the cost of advanced technologies and equipment required for specialized repairs rises, some shops, particularly smaller ones, may not have the capacity to make such investments. Consequently, it is possible that a model may emerge in which specialized repair services could be outsourced to providers that offer these services to multiple shops, or the services themselves could be consolidated into larger operations.

[5] Statistics Canada, industry groups by class of worker including job permanency, labour force status, age and gender: Canada, provinces and territories, census metropolitan areas and census agglomerations with parts 2022.
[6] ARA. Retrieved from https://www.ara.bc.ca/the-automotive-industry-has-a-job-for-you/
[7] WorkSafeBC. Top Demand Trades. Retrieved from https://www.workbc.ca/research-labour-market/top-demand-trades

Key Findings

- Most businesses in the Sector are small, employing fewer than 10 people. New Car Dealers is the sub-sector that tends to have larger businesses with more employees. The size of a business has implications for the provision of training and skill development.
- Sector employment is estimated to have grown by approximately 7 percent between 2016 and 2022. Most of this growth occurred within dealerships, aftermarket parts and auto repair.
- The sub-sectors that primarily provide repair services were estimated to employ a relatively higher share of Skilled Trade workers whereas the sub-sectors primarily providing retail sales were employ a relatively higher share of Sales and Administration positions.
- There are a number of trends impacting the composition of the workforce. These include an aging workforce, labour shortages, changing skill requirements and specialization. These factors are expected to continue to shape the workforce in the future.

4. Technology Advancements and Pathways

Overview of the Technologies Impacting the Sector

The following section outlines five different technology types that are either already impacting the Sector or are forecast to impact the Sector before 2040. A brief description is provided for each technology, including commentary on the degree to which the technology type is already used across the Sector. This section concludes with Table 9, which indicates which sub-sectors are forecast to be impacted by a given technology.

Electrification Technology

ZEVs include all types of vehicles that use electricity or hydrogen to operate and can be changed with an external electrical source. In BC, this includes battery electric vehicles (BEVs), fuel-cell electric vehicles (FCEVs), extended range electric vehicles (EREVs) and plug-in hybrid electric vehicles (PHEVs) (Figure 3).

Figure 3: Definitions of ZEVs

BEV

Battery electric vehicle (powered 100% with electricity)

FCEV

Fuel-cell electric vehicle (powered 100% with hydrogen)

EREV

Extended range electric vehicle (has an electric motor and battery, but the battery is recharged with a combination of electricity and gas)

PHEV

Plug-in hybrid electric vehicle (has both an electric motor powered by electricity from a battery and a gas engine fueled by conventional gas)

The lifecycle of a ZEV is similar to the lifecycle of ICE vehicles and involves the same activities. Table 8 outlines the main similarities and differences between ZEVs and ICE vehicles.

Table 8: Similarities and Differences in Purchasing, Maintaining, Repairing and Recycling ZEVs and ICE Vehicles

	ZEVs Compared to ICE Vehicles Across the Aftermarket Lifecycle
Purchase 	New ICE vehicles are predominantly sold through car dealerships, while ZEVs are predominately sold either through a direct-to-consumer (D2C) model with OEMs or new car dealerships. Tesla, being the largest ZEV OEM in Canada and occupying approximately 45 percent of the Canadian ZEV market, sells its vehicles directly to consumers.[8] Used vehicles of both kinds may be purchased through car dealers or through private sales.
Maintenance and Repair 	ZEVs are serviced, maintained, and repaired at the same locations as ICE vehicles. However, regular maintenance differs in that BEVs and FCEVs generally have fewer moving parts than ICE vehicles. Consequently, BEVs and FCEVs may require less frequent maintenance and are less likely to experience mechanical failures. The routine maintenance and repair for PHEVs is similar to that of an ICE vehicle.
Towing and Recovery 	The same towing companies that handle ICE vehicles also tow ZEVs. As most ZEVs do not technically have a neutral gear, a flatbed truck or comparable transport vehicle is almost always needed for towing a ZEV.
Collision Repair 	Collision repairs for both ZEVs and ICE vehicles are done at collision repair shops. However, due to the differences in materials and components used in ZEVs compared to those in ICE vehicles, repair of ZEVs may require specialized training and equipment.
End-of-Life 	While many ZEVs have not yet reached their end-of-life due to their recent entry into the market, end-of-life will be handled by the same automotive dismantlers and recyclers that handle the end-of-life for ICE.

[8] S&P Global Mobility. (n.d.). (rep.). Canadian Automotive Insights (Ser. Q4 2022).

The CleanBC Roadmap to 2030 outlines targets for adopting ZEVs, starting with light-duty vehicles. By 2026, 26 percent of all new light-duty vehicles sold in BC will be ZEVs and by 2035, ZEVs will account for 100 percent of all new light-duty vehicle sales in BC.[9] The *ZEV Act* provides options to expand to other vehicle classes, including medium- and heavy-duty vehicles.[10] The Province of British Columbia is also making ZEV the default option for public sector fleets, with ZEVs accounting for 100 percent of light-duty vehicle acquisitions by 2027.[11]

In 2021, BC had the highest uptake rates of ZEVs in North America.[12] In the same year, light-duty ZEV sales represented 13 percent of all new light-duty vehicle sales in the province, bringing the total of light-duty ZEVs registered in BC to 79,587 as of December 2021.[13] While increasing, this still represents a small share (2.5 percent) of all passenger vehicles in BC. Of newly registered ZEVs in the province in 2021, BEVs were registered most often, while ZEVs with other fuel types (e.g., FCEVs) were registered the least.[14]

Transportation modes where direct electrification is not practical present promising pathways for increased fuel cell (e.g., hydrogen) adoption.[15] Both primary consultations and the literature indicate that the application of fuel cells (and hydrogen fuel cells) might be most applicable to longer range vehicles, while battery BEVs will be more suited to passenger cars.[16] Due to the weight and range constraints of battery-only options, hydrogen fuel cells are seen as the more efficient choice for heavier vehicles such as transit buses or trucks. At present, hydrogen-powered vehicles for private use are not commonplace[17] and there are limited number of refueling stations available.[18]

Investments are being made by the Province of British Columbia to develop the infrastructure required for the wider use of hydrogen-fueled vehicles. In 2021, and as part of CleanBC, the Province of British Columbia released its Hydrogen Strategy, which outlines its plan to accelerate the production and use of renewable and low-carbon hydrogen. The strategy includes piloting the use of hydrogen fuel cells in

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[9] The Government of British Columbia, CleanBC. (2021). Roadmap to 2030. Retrieved from https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_2030.pdf

[10] The Government of British Columbia, CleanBC. (2021). B.C Hydrogen Strategy. Retrieved from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/electricity/bc-hydro-review/bc_hydrogen_strategy_final.pdf

[11] The Government of British Columbia, CleanBC. (2021). Roadmap to 2030. Retrieved from https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_2030.pdf

[12] The Government of British Columbia, CleanBC. (2021). Zero-Emission Vehicle Update.https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/transportation/2021_zero_emission_vehicle_update.pdf

[13] Ibid.

[14] Statistics Canada, (2023, January 24). New Motor Vehicles Registrations, quarterly. Retrieved from https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2010002401

[15] The Government of British Columbia, CleanBC. (2021). B.C Hydrogen Strategy. Retrieved from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/electricity/bc-hydro-review/bc_hydrogen_strategy_final.pdf

[16] Canadian Hydrogen and Fuel Cell Association. Fuel cells – the sustainable power source. Retrieved from http://www.chfca.ca/fuel-cells-hydrogen/about-fuel-cells/

[17] Tchir J. (2022, August 21). Why aren't hydrogen-powered cars as popular as battery EVs? The Globe and Mail. https://www.theglobeandmail.com/drive/mobility/article-why-arent-hydrogen-powered-cars-as-popular-as-battery-evs/

[18] The Government of British Columbia, CleanBC. (2021). Zero-Emission Vehicle Update.https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/transportation/2021_zero_emission_vehicle_update.pdf

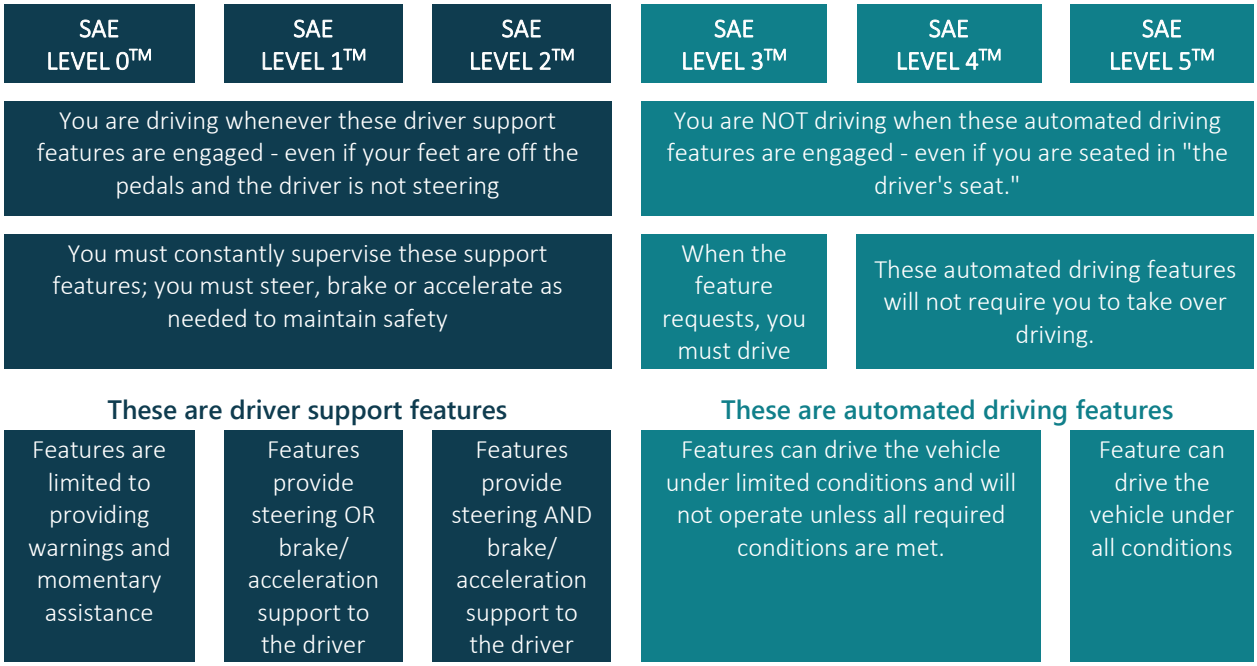
medium- and heavy-duty vehicles, marine, rail, aviation, off-road and other commercial transportation applications and allowing medium- and heavy-duty vehicle sales to generate credits under the ZEV Act.

The continued adoption of ZEVs impacts all aspects of the aftermarket sector from new car dealers to recycling. Primary consultations reveal that ZEVs and the electrification of the fleet is expected to impact mechanical repair and recyclers the most.

ADAS/Autonomous Vehicles

ADAS features can be most easily understood using a continuum developed by the Society of Automotive Engineers (SAE)[19] (Figure 4). The continuum defines six levels of driving automation ranging from 0 (fully manual) to 5 (fully autonomous). Most vehicles in Canada are categorized between Level 1 and Level 2.[20]

Figure 4: The Six Levels of Driving Automation by SAE International



Note: The figure was created from SAE International's Updated SAE J3016 Visual Chart, https://www.sae.org/blog/sae-j3016-update

Although ADAS features have been around for some time (with the commercialization of cruise control in the 1950s),[21] the capacity for complete autonomy is still far removed. That said, the growth of ADAS

[19] Since its initial launch in 2014, SAE J3016 Recommended Practice: Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles, commonly referenced as the SAE Levels of Driving Automation™, has been the industry's most-cited source for driving automation. With a taxonomy for SAE's six levels of driving automation, SAE J3016 defines the SAE Levels from Level 0 (no driving automation) to Level 5 (full driving automation) in the context of motor vehicles and their operation on roadways.

[20] Tchir, J. (2022, November 30). No, you can't buy a self-driving car yet, but a lot of people seem to think you can. The Globe and Mail. Retrieved March 1, 2023, from https://www.theglobeandmail.com/drive/mobility/article-no-you-cant-buy-a-self-driving-car-yet-but-a-lot-of-people-seem-to/

[21] Wired. A brief history of autonomous vehicle technology. Retrieved from https://www.wired.com/brandlab/2016/03/a-brief-history-of-autonomous-vehicle-technology/

applications is increasing and has been growing more quickly since 2015.[22] This is partly due to the increasing availability of sensors, computing power and the smaller size of computers. Today, 93 percent of new vehicles are equipped with at least one ADAS feature.[23]

ADAS technologies are forecast to continue to grow as both traditional automakers and new entrants (e.g., Tesla and Google's parent company) are investing sizeable resources in an attempt to become the leaders in autonomous driving. Regulation, government support and social acceptance will all play key roles in how ADAS features, and AVs unfold. Such technologies are forecast to affect the repair sector the most, with knowledge implications and training implications for those providing sales, maintenance and repair.

Artificial Intelligence

As noted, the impact of AI on the Sector is expected to augment the workforce. Artificial intelligence (AI) and the application of AI have the potential to be immensely powerful, generally and specifically within the Sector. As with robotics, AI technologies are expected to augment labour.

At present, the full effect of AI on aftermarket service has yet to be determined as the technology is still in its infancy and adoption levels are low. An area where AI is starting to be adopted is in sale and repair of vehicles. For example, AI and photo/virtual-based estimates are being deployed by insurers with increasing regularity. Such technologies promise improvements in efficiencies, consistency and timelines. However, their initial rollout, as reported by body-shop owners, has led to incorrect estimates, longer processing times due to haggling over incorrect estimates and incomplete repairs.[24] This dynamic is not uncommon when a labour augmenting technology is introduced. For example, when Apple Maps was first introduced in 2012, it encountered challenges related to inaccuracies, incomplete data and poor functionality.[25] Apple has made a number of revisions to improve the service offering and, as of December 2020, has hundreds of millions of users,[26] this still trails the more than one billion users Google Maps has.[27]

Opportunities to integrate AI into the sales process include personalizing sales efforts to up- and cross-sell customers, personalized and dynamic pricing, predictive aftersales and service offers and

[22] MNP primary research findings.

[23] J.D. Power. (2020, May 1). Advanced Driver Assistance Systems Continue to Cause Confusion. Retrieved from https://canada.jdpower.com/resources/advanced-driver-assistance-systems-continue-cause-confusion

[24] Marshall A. (2021, April 13). AI comes to car repair, and body shop owners aren't happy. Wired. Retrieved from https://www.wired.com/story/ai-car-repair-shop-owners-not-happy/

[25] Gasse J.L. (2012, October 21). Apple's $30bn maps mistake. The Guardian. Retrieved from https://www.theguardian.com/technology/blog/2012/oct/01/apple-30-billion-maps-mistake

[26] Apple website. (2020, December 10). Apple delivers all-new Apple maps across Canada. Retrieved from https://www.apple.com/ca/newsroom/2020/12/apple-delivers-all-new-apple-maps-across-canada/

[27] O'Beirne J. (2021, July). How many people use Google maps compared to Apple maps? Retrieved from https://www.justinobeirne.com/how-many-people-use-google-maps-compared-to-apple-maps

programmatic advertising.[28] For example, car dealers are using software applications such as AutoAlert[29] and Drive AI[30] to leverage existing customer data and provide reasonable purchase offers using advanced predictive analytics. In addition, chatbots and virtual assistants can help stores assist customers with tasks such as scheduling service or sales appointments and answering product questions.

The examples provided here give a flavour for how this technology is beginning to impact the Sector and suggest that as the technology evolves it will be used for additional applications related to diagnostics and research. New applications are also likely to be identified and applied in the Sector.

Robotics

While robotics have the potential to affect the Sector, primary research findings reveal that, at present, it does not have a large presence in any sub-sector and is expected to impact the Sector to a lesser degree than other technologies over the time period covered by this study.

One area where there has been some adoption of robotics is in process automation. Some dealers have incorporated unmanned inspection systems which can perform tire and alignment inspections at a drive-through speed. Hunter Quick Check® is one such system that has been adopted by some dealerships in the Lower Mainland.[31]

The use of robotics has also been incorporated in the following automotive manufacturing tasks: spot and arc welding; painting, sealing, and coating; part transfer; materials removal; polishing; machine tending; and quality inspection.[32] As these robots become more intelligent and the cost of these robots is significantly reduced, similar tasks that are carried out in the Sector may also be automated.

When robotics is adopted more widely in the Sector, it is expected to augment labour as opposed to replace labour. Technologies that augment labour typically provide workers with new tools to complete tasks more efficiently[33] as opposed to replacing them entirely.

Virtual Reality/Augmented Reality

Virtual Reality (VR) refers to the use of computer technology to create a simulated environment that users can interact with in a lifelike way, whereas Augmented Reality (AR) is a technology that overlays digital

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[28] Grühn B., Kässer M., Köstring J.C., Padhi A., Tschiesner A. (2019, February 14). Winning tomorrow's car buyers using artificial intelligence in marketing and sales. McKinsey & Company. Retrieved from https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/winning-tomorrows-car-buyers-using-artificial-intelligence-in-marketing-and-sales

[29] AutoAlert is a software platform that provides automotive dealerships with data analytics and customer engagement solutions to help improve customer retention and drive sales growth.

[30] Drive AI is a software platform offered by Absolute Results. Drive AI helps automotive dealerships turn their service customers into incremental sales leads by creating compelling and relevant offers with its AI engine.

[31] Hunger Quick check® is an unmanned inspection system by Hunter Engineering Company. The system is normally installed at the service drive to enable quick tire and alignment inspection. Vehicles driving through the system will also receive a report that indicates any misalignment and an analysis of the tire tread depth and wear.

[32] Top 10 Applications of Robotics in the Automotive Industry. (2021, December 19). Analytics Insight. Retrieved from https://www.analyticsinsight.net/top-10-applications-of-robotics-in-the-automotive-industry/

[33] Moencks M., Roth E., Bohne T., Basso M., Betti F. (January 2022). Augmented Workforce: Empowering People, Transforming Manufacturing. World Economic Forum. Retrieved from https://www3.weforum.org/docs/WEF_Augmented_Workforce_2022.pdf

information on top of the real world. VR and AR are two related but distinct technologies that are used to create immersive digital experiences.[34] These technologies are still in the early phase of adoption within the Sector.

VR and AR have applications for the entire end-to-end process for automobiles, including the aftermarket sector. Both VR and AR are expected to impact the areas of maintenance and sales and in the provision of training for repair and towing. In relation to routine maintenance, these technologies have the capacity to aid the vehicle owner to scan a barcode showing on the dashboard when a check-light is flashing and get a precise answer as to what went wrong. This is achieved with the help of AR, which enables augmenting real-world experience with the application of graphics and data.

AR can also be used as apps or virtual assistants that aid basic troubleshooting and repair. VR and AR give rise to the potential for virtual showrooms, integrating realistic 3D visualizations of the vehicle and enabling clients to interact through both physical and virtual mock-ups. Using AR and VR makes the process of customization more straightforward and has the potential for quicker sales conversions. VR can simulate hazardous or dangerous environments for safety training and provide a realistic and immersive environment for technical skills training. AR can offer an enhanced and interactive training experience.

Others

Other technologies noted throughout the consultations include mobility as a service, over-the-air updates, digital vehicle inspections, big data and mobile charging solutions.

As noted in the AI section, the full application of some of the technologies discussed here has yet to be fully mapped out. As technological advancements are happening quickly and changing the aftermarket sector regularly, there may be future technologies or future applications of the technologies listed here that cannot be determined at this moment in time.

[34] Augmented reality (AR) vs virtual reality (VR). Splunk. (n.d.). Retrieved February 28, 2023, from https://www.splunk.com/en_us/data-insider/what-are-augmented-reality-and-virtual-reality.html

Table 9 summarizes how the technologies outlined above are expected to impact the Sector through 2040.

Table 9: Technology Types Expected to Impact the Sector through 2040

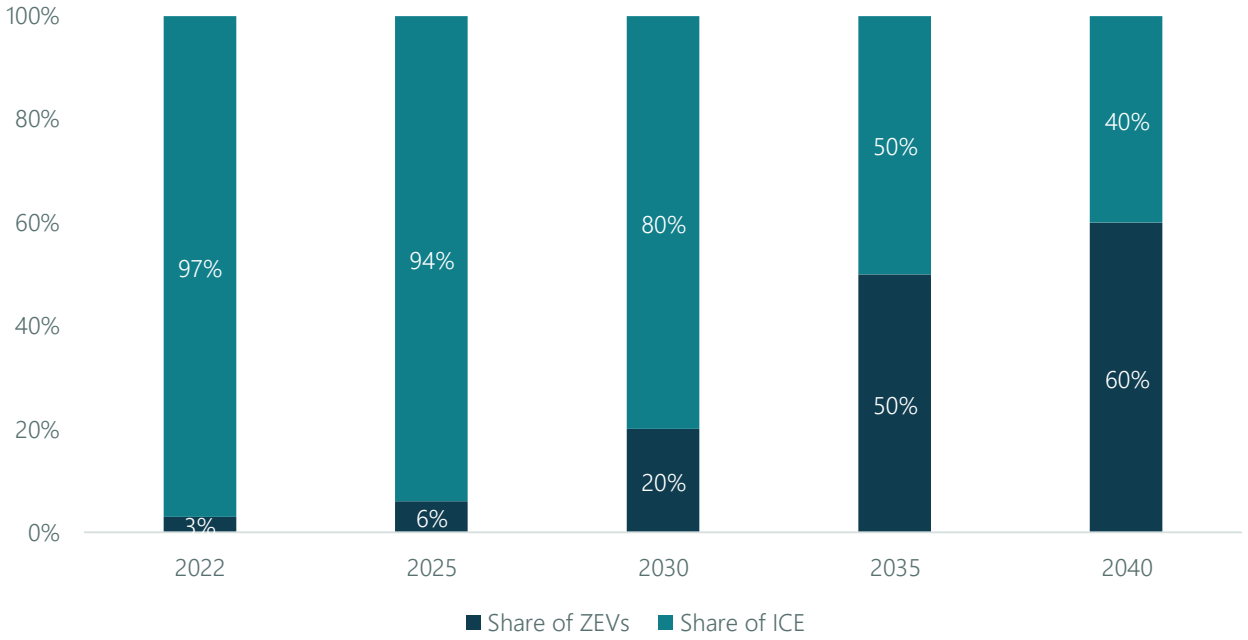
Technology Type	Area of Impact	Sales	Routine Maintenance	Repair	Towing and Recovery	End of Life
Electrification (i.e., ZEVs)	Light-duty vehicles for BEVs and heavy-duty vehicles, commercial vehicles and fleets for FCEVs	X (knowledge)	X	X	limited	X
ADAS/AVs	Light-, medium- and heavy-duty vehicles	X (knowledge)		X	X (reduction in call volume)	X (training)
Robotics	Paint and maintenance		limited	X	limited	
AI	Service delivery	X		X	X	
AR/VR	Service delivery	X	X	X (training)	X (training)	

Timeline for Transitioning Today's Workforce

Technology Adoption pathways

Figure 5 shows the projected composition of BC's on-road vehicle fleet through 2040 based on meeting the targets for the sale of new light-duty vehicles outlined in the CleanBC Roadmap to 2030. Approximately 20 percent of the on-road vehicle fleet was projected to be ZEV by 2030 and 60 percent was projected to be ZEV by 2040. This suggests that the workforce will need to be able to provide service to both ICE vehicles and ZEVs, with the need for service to ZEVs growing quickly between 2025 and 2035. Adoption is expected to be faster in urban areas. Slower growth in more rural areas is attributed to the need for people to drive longer distances (thus, range is a more significant consideration), limited access to charging stations and limited access to maintenance, among other things.

Figure 5: Changes in Composition of On-Road Vehicle Fleet Between 2022 and 2040



By 2030, all new vehicle sales are expected to be equipped with ADAS features that meet the requirements of at least SAE Level 2 Driving Automation in Canada. This translates into approximately 100 percent of the on-road vehicle fleet being equipped with some ADAS features by 2040.

Technology Adoption Factors

Several factors are expected to affect the adoption timelines. These include (but are not limited to):

Cost

One of the most significant factors affecting technology adoption is the cost of the technologies themselves. For example, while BEVs cost less to charge and maintain than their ICE counterparts, the price of a BEV is generally higher due in part to the cost of the battery pack. However, the automotive industry is actively working to reduce the cost of battery packs to make them more affordable and accessible to a wider range of consumers.

Similarly, the high cost associated with developing and testing autonomous driving software is a significant barrier to the adoption of AVs. The development and training of AI that enables autonomous driving and the testing and validating of these systems are extremely costly. For example, Ford and Volkswagen are shutting down Argo AI after investing more than USD$3 billion into the autonomous driving company and are still unable to predict the timeline to achieve full self-driving.[35] Some systems also use expensive sensors such as light detection and ranging (LiDAR), which have dropped significantly in price. For example, around 2017, top-quality LiDAR sensors typically cost around US$75,000. However, the development of new technologies and the emergence of competitors such as Luminar and Innoviz

[35] Marshall, A. (2022, October 28). Ford abandons the self-driving road to nowhere. Wired. Retrieved February 22, 2023, from https://www.wired.com/story/ford-abandons-the-self-driving-road-to-nowhere/

have enabled the production of LiDAR sensors at a much lower cost, with prices now dipping below US$1,000.[36]

Cost is also a significant factor determining the adoption of AR and VR in automotive training. The implementation of AR/VR training programs require an initial investment in hardware and software, as well as ongoing program updates and maintenance. However, once established and can be offered at scale, AR/VR training can be more cost-effective than in-person training sessions, which are both time-consuming and expensive.[37] With in-person training, participants have to travel to the session(s) and take time off work.[38] Therefore, VR/AR training may be a more appealing alternative if offered at a lower price point and can provide similar or better results than in-person training.

Infrastructure and Technological Limitations

Range anxiety, longer charging times, limited access to charging infrastructure and access to maintenance services can hinder ZEV adoption. While installations of public charging station have increased in BC, the longer charging duration compared to refueling of ICE vehicles makes them less convenient, especially for long-distance travel. At-home charging is the most affordable and convenient option, but some apartment buildings have limited charging stations due to issues such as limited space, lack of electrical infrastructure and the need for permission from the building owner or strata council.[39]

Autonomous driving technologies are facing major barriers due to infrastructure and technological limitations. Although some vehicles on the road today are already equipped with the necessary sensors and computing power to achieve self-driving, the complexity of the AI required by AVs to face various real-world situations is the main technical barrier. The use of sensors and on-road infrastructure can help accelerate the adoption of AVs by addressing some of the technical challenges, but deployment at scale may be slowed by logistical and regulatory challenges. Furthermore, infrastructure-based sensors can create a dependence on the quality and consistency of the infrastructure itself, which can be difficult to guarantee in practice.

Geographic Location

Geographic location can have a significant impact on the adoption of ZEVs. Data indicate that while urban areas account for 80.6 percent of total vehicle registration volume in Canada, they account for a larger 85.6 percent of all ZEV registrations. In BC specifically, ICBC's Vehicle Population data shows that approximately 94 percent of the ZEVs registered in BC are concentrated in urban areas, with a population

[36] Abuelsamid, S. (2023, February 22). Mercedes-Benz expands lidar production deal with Luminar. Forbes. Retrieved February 22, 2023, from https://www.forbes.com/sites/samabuelsamid/2023/02/22/mercedes-benz-expands-lidar-production-deal-with-luminar/

[37] McClintock, S. (2022, December 6). Top 7 questions to determine if virtual reality training is right for you. eLearning Industry. Retrieved March 6, 2023, from https://elearningindustry.com/top-questions-to-determine-if-virtual-reality-training-is-right-for-you

[38] Xie, B., Liu, H., Alghofaili, R., Zhang, Y., Jiang, Y., Lobo, F. D., Li, C., Li, W., Huang, H., Akdere, M., Mousas, C., & Yu, L.-F. (2021). A review on Virtual reality skill training applications. Frontiers in Virtual Reality, 2. https://doi.org/10.3389/frvir.2021.645153

[39] Farías, A. valentina. (n.d.). (rep.). ELECTRIC VEHICLE CHARGING IN MULTI-UNIT RESIDENTIAL BUILDINGS.

of at least 10,000.[40]

Access to charging infrastructure can vary greatly depending on the geographical region. Urban areas tend to have more public charging stations and are typically more conducive to shorter driving distances, which makes BEVs more practical for city dwellers.

BC experiences a diverse range of weather patterns depending on the region. Northern, Interior, and Rocky Mountain areas typically experience long and cold winters. Extreme, cold weather negatively affects the driving range of BEVs as it reduces the battery efficiency and increases the demand on the battery running the heating, ventilation, and air conditioning system.[41] This makes ZEVs less attractive in these areas.

Development Speed and Manufacturing Capacity

Limited vehicle options reduce consumer choices and make it difficult for some people to find a ZEV that meets their needs and preferences, negatively affecting adoption.[42] As of March 2023, there are still no ZEV offerings in the mid-size pickup truck category. However, as most automakers are speeding up the development of ZEVs, they will introduce a wider range of models, giving consumers more choices.

The limited ZEV manufacturing capacity and the supply shortage of key battery materials such as lithium, cobalt, nickel, copper, and rare earth metals can hinder OEMs' production, which in turn affects adoption rates. The manufacturing constraint has resulted in a situation where the current demand of ZEVs in Canada exceeds the available supply. As per a survey conducted by Toronto Star among Toronto dealerships, excluding Tesla, the average wait time for a ZEV purchase after placing a factory order is currently approximately 11 months.[43] In BC, it is common for waitlists to extend up to a year or longer.[44]

According to the proposed legislation from Environment and Climate Change Canada drafted for the Canadian market and the United States (US) Presidential Administration's target for ZEV sales in the US market, automakers in North America must produce about 10 million new ZEVs per year between 2030 and 2035 to meet the target. To achieve this goal, more than half of the current automotive manufacturing capacity in North America, based on the pre-COVID production levels, would need to be converted to ZEV production.[45]

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[40] Insurance Company of British Columbia. (2022, November 28). Vehicle Population – Electric Vehicles [Data set]. https://public.tableau.com/app/profile/icbc/viz/VehiclePopulation-ElectricVehicles/2017-2021ElectricVehicles

[41] Pratt, D. (2021, December 19). Cold temperatures affect an electric vehicle's driving range. Consumer Reports. Retrieved March 6, 2023, from https://www.consumerreports.org/hybrids-evs/how-much-do-cold-temperatures-affect-an-evs-driving-range-a5751769461/

[42] International Energy Agency. (2021, April). Global EV Outlook 2021. IEA. Retrieved February 27, 2023, from https://www.iea.org/reports/global-ev-outlook-2021

[43] Oved, M. C. (2022, October 29). Want an EV in Toronto? star investigation finds shockingly long waits compared to anywhere else in Canada. thestar.com. Retrieved March 1, 2023, from https://www.thestar.com/news/canada/2022/10/29/want-to-buy-an-electric-vehicle-in-toronto-good-luck-star-investigation-finds-wait-times-of-up-to-a-year.html

[44] Want an ev? be patient, or consider used. Want an EV? Be patient, or consider used. (n.d.). Retrieved March 1, 2023, from https://www.bchydro.com/news/conservation/2023/buying-electric-vehicles.html

[45] Estimate is based on pre-COVID production capacity of 16 million vehicles annually.

Supply Chain Reliability

The global chip shortage as a result of Covid-19 lockdowns and geopolitical tensions demonstrated the importance of supply chain reliability. Due to the shortage of automotive-grade semiconductors, many OEMs have been forced to reduce production. ZEVs are more reliant on semiconductors than ICE vehicles since they depend on electronic systems and computers to control many of their functions. Supply chain challenges are expected to be short-term impacts, with three-quarters of chip executives (76 percent) expecting the global semiconductor supply chain challenge to be resolved by 2024.[46]

While chip availability may improve in the near future, the reliable supply of raw materials for ZEV batteries is a significant concern for OEMs. In response, manufacturers have signed multi-year supply agreements with various raw material suppliers to ensure a consistent and stable supply chain.[47]

Government Policies, Regulations and Subsidies

Government policies and subsidies are key factors in promoting the adoption of ZEVs. The price of most ZEVs is still much higher than that of their comparable ICE counterparts, despite the total cost of ownership for a ZEV becoming cheaper based on a study by Clean Energy Canada which assumes eight years of ownership and 20,000 kilometers of driving (annually).[48] By offering financial incentives, tax credits, or rebates, governments can make ZEVs more affordable for consumers and reduce the upfront cost of the purchase. Government policies and subsidies can also help support the development of ZEV infrastructure, such as charging stations, which further encourage the adoption of ZEVs.

Regulations are also a factor in the adoption of ADAS features and the improvement of autonomous driving capabilities. In Canada, certain ADAS features, such as automatic emergency braking and forward collision warning, have been made mandatory in the Motor Vehicle Safety Regulations (MVSR) for all new light-duty vehicles sold in Canada, as of September 1, 2022. Additionally, lane departure warning, lane-keeping assistance, automatic high beams and rear-view camera systems have been set out to be part of the safety standards for all new passenger cars sold in Canada. These features are the building blocks of Level 0 to Level 2 Driving Automation defined by SAE. (See footnote number 19 on page 20 for an explanation of these levels.)

Battery Recycling

At present, BC does not have a provincewide program for repurposing and recycling ZEV batteries. An extended producer responsibility (EPR) program for ZEV batteries is in development.* How this program is delivered will affect training requirements for those working with batteries and may create new occupations in the Sector. Unlike many other products covered by EPR programs, ZEV batteries have the potential to be repurposed, as well as recycled.

*Ministry of the Environment and Climate Change Strategy. Advancing Recycling in BC Extended Producer Responsibility Five-Year Action Plan 2021-2026

[46] Alam, S. F., Chu, T., & Haggerty, M. (2023). (rep.). (S. Grant, Ed.) The Pulse of the Semiconductor Industry: Balancing resilience with innovation. Accenture PLC.

[47] Ramey, J. (2022, April 14). GM signs multi-year deal for cobalt from Glencore. Autoweek. Retrieved February 27, 2023, from https://www.autoweek.com/news/green-cars/a39725582/gm-glencore-cobalt-mining-ultium-australia/

[48] Woynillowicz, D., Dyer, S., & Kitchin, R. (2022). The True Cost. Clean Energy Canada.

The establishment of effective policies and regulations is also essential for improving the capabilities of AV technology. While simulations and controlled environments can provide valuable insights, real-world testing is crucial due to the importance of real-world driving scenarios. However, the lack of clarity and consistency in regulations in some regions can hinder the testing and development of AV technology. For example, the case of the 2018 fatal crash involving an AV operated by Uber in Tempe, Arizona, highlighted the need for clearer regulations and increased safety standards for autonomous vehicles. The incident led to increased scrutiny of AV technologies and was seen as a setback for the automotive industry.[49] At the time of writing (March 2023), there are no specific regulations governing the use of AVs on public roads in BC, and the Insurance Corporation of BC does not provide insurance for AVs.[50]

Forecasts of Labour Market Composition, 2022 - 2040

The following section outlines changes in workforce compositions by major occupational groups for each sub-sector in the Sector. More detail on distribution by occupation and growth assumptions used for each occupation can be found in Appendix E.

Forecast Assumptions

The workforce requirement forecasts between 2022 and 2040 are based on the following assumptions:

- The rate of growth of vehicles on the road will be lower than the projected growth in the driving age population due to anticipated changes in car ownership. [51] This was assumed to reduce growth in vehicles relative to the driving age population by one percentage point.
- The increasing prevalence of ADAS will reduce the frequency of collisions. It is estimated that between 2022 and 2040, the number of collisions would decrease by approximately 8 percent. However, the severity of repair may increase. The net impact will be a modest reduction in total repair hours by approximately 3 percent.

Regional Differences

The geographic location of employers will impact the timeframe over which they will need to adapt to the forecasted changes. As noted earlier in the report (page 24), the roll out of these technologies is expected to happen faster in urban areas. As a result, employers located in urban areas may need to adapt more quickly and to a greater extent than rural based facilities.

Geography may also affect the type of ZEVs. In rural areas, PHEV or FCEV may be more common than in urban areas due to driving distances and infrastructure.

[49] Smiley, L. (2022, March 8). 'I'm the operator': The aftermath of a self-driving tragedy. Wired. Retrieved February 28, 2023, from https://www.wired.com/story/uber-self-driving-car-fatal-crash/

[50] Autonomous Vehicle Laws in Canada: Provincial &Territorial Regulatory Review. BLG. (2023). Retrieved February 28, 2023, from https://www.blg.com/en/insights/2023/ri/autonomous-vehicle-laws-in-canada-provincial-and-territorial-regulatory-review

[51] Zhou F., Zheng Z., Whitehead J., Perrons R., Washington S. & Page L. (2020). *Examining the impact of car-sharing on private vehicle ownership. Transportation Research Part A: Policy and Practice*. 138. 322-341. 10.1016/j.tra.2020.06.003. https://www.researchgate.net/publication/342363079_Examining_the_impact_of_car-sharing_on_private_vehicle_ownership

- ZEVs will require fewer mechanical repairs, such as oil and filter changes. However, the nature of the repairs and maintenance may be more complex. Overall fewer work hours may be required for ZEVs. The decrease in repair hours due to this is likely to outweigh the increase in repairs required due to growth in number of vehicles as the share of ZEVs increases over time. Overall, the total repair hours are expected to decrease slightly beginning in 2030.
- The number of trade apprentices being trained will grow to replace the retiring workforce.
- Land constraints in urban areas will make it difficult for expansion in the number of shops requiring light industrial zoning (e.g., collision and mechanical repair shops). Consequently, there was no growth assumed in the number of businesses in the sector.

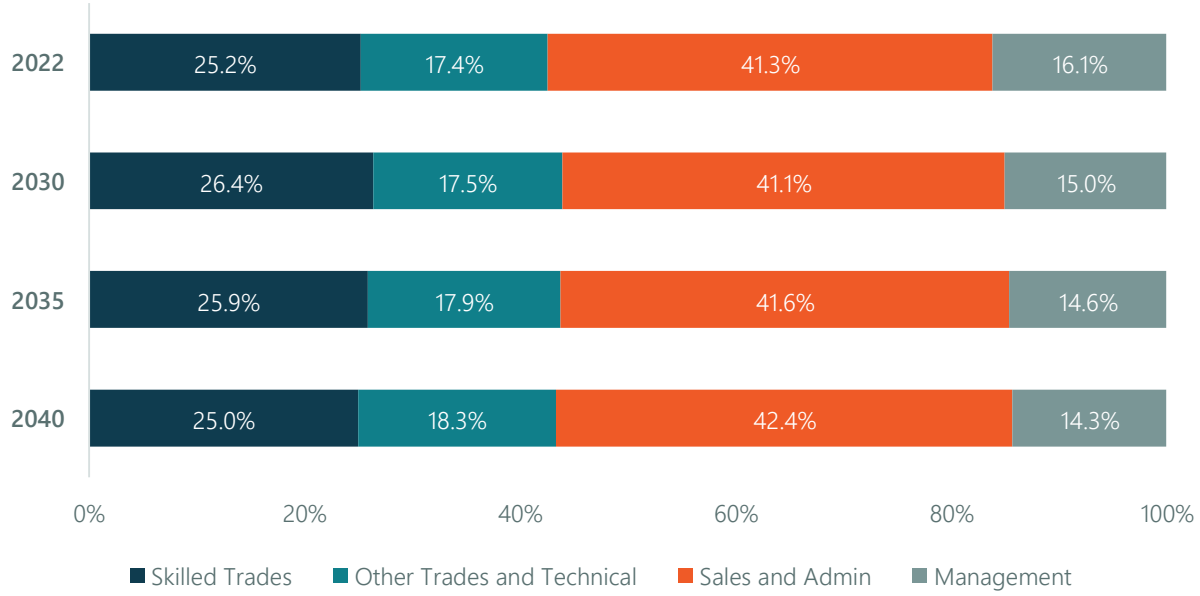
New Car Dealers

There are several factors that may affect the demand for various occupations within the sub-sector. The number of sales staff, including licensed automotive salespeople and customer service representatives, depend on anticipated growth in vehicle sales, however, growth in the number of positions may slow due to growth in online sales and OEMs' shift towards a D2C model. Technological advancements and the use of software would mean additional technical personnel, such as IT specialists, may be required, while fewer administration and management personnel may be required due to automation.

A higher number of technicians may be required as a result of increases in the share of repairs that are performed by new car dealers due to proprietary software and technologies on newer vehicles. However, the demand for technicians will also be impacted by decreased repair hours.

As shown in Figure 6, the net impact on workforce composition was estimated to be a slight increase in the share of skilled trades and other trades and technical positions, and a decrease in the share of management positions. The share of sales and administration positions was estimated to remain relatively stable. The overall size of the workforce is expected to grow modestly between 2022 and 2040 (by about 0.3 percent annually).

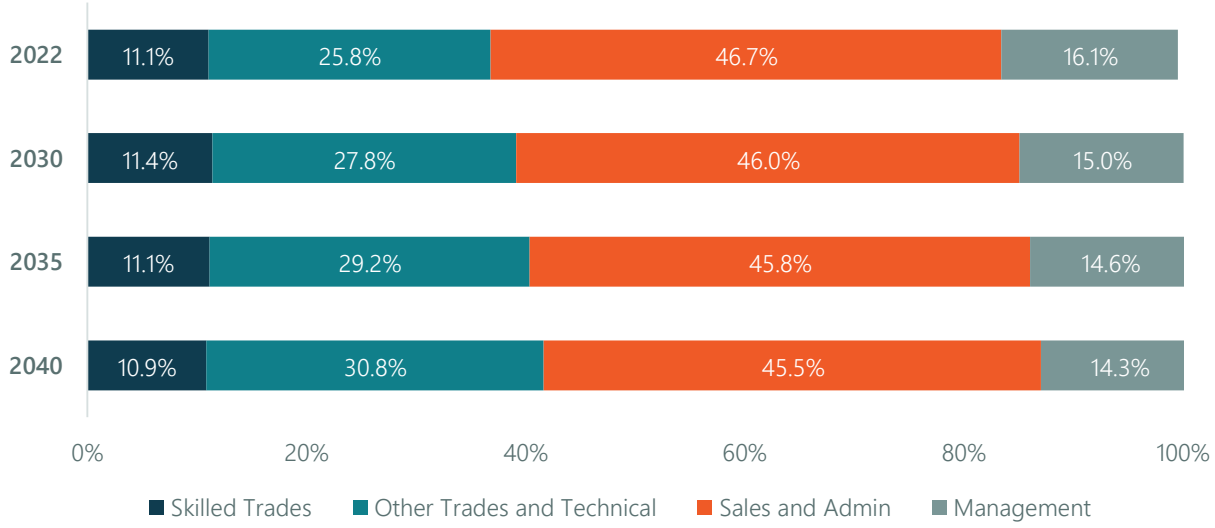
Figure 6: Change in Composition of Workforce Between 2022 and 2040 – New Car Dealers



Used Car Dealers

Similar to new car dealers, the shift towards online sales and digital marketing may reduce the need for sales personnel. The net impact, however, also depends on projected growth in vehicle sales. Fewer administration and management personnel may be required, whereas more technical roles may be created due to automation and technological advancements. The overall impact on the sub-sector may be an increase in the share of other trades and technical occupations and a slight decrease in the share of all other occupations (Figure 7). The overall size is expected to remain stable between 2022 and 2040.

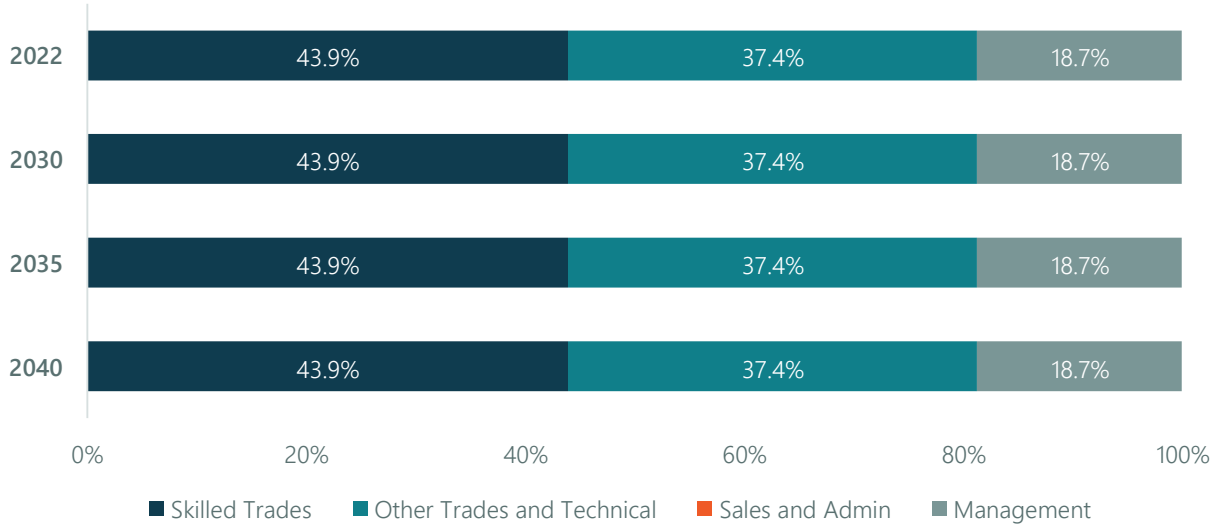
Figure 7: Change in Composition of Workforce Between 2022 and 2040 – Used Car Dealers



Aftermarket Parts

The overall workforce composition of the sub-sector is likely to be unaffected by the trends in the Sector. The size of the workforce is also expected to remain stable. Changes in skill requirements and knowledge of the workforce are expected (Figure 8).

Figure 8: Change in Composition of Workforce Between 2022 and 2040 – Aftermarket Parts

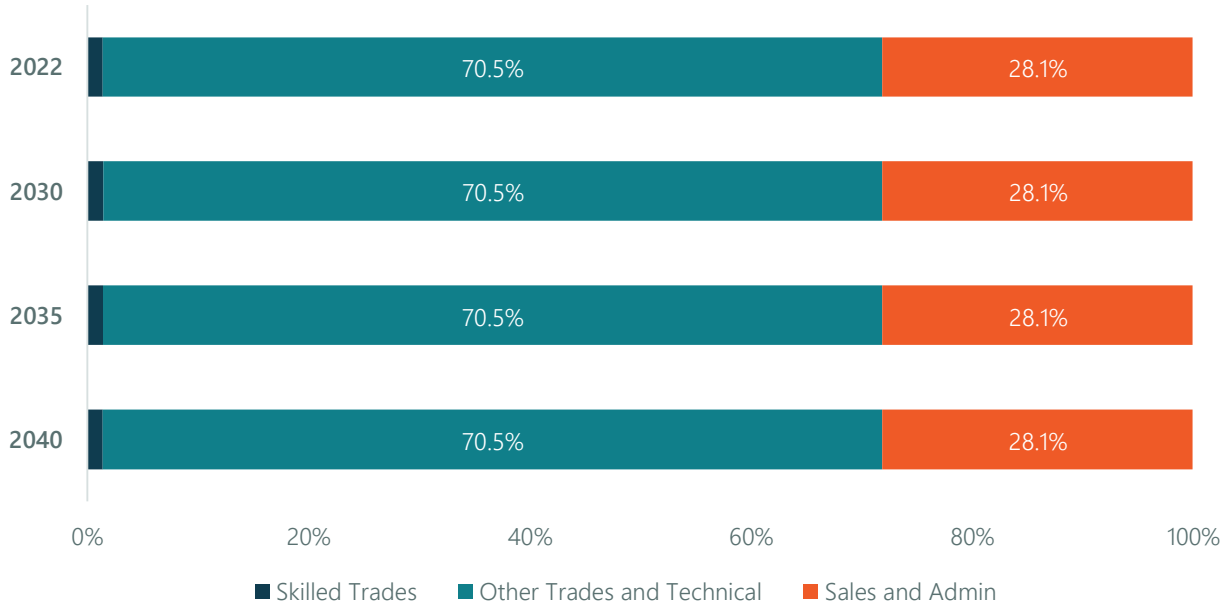


Towing and Recovery

The number of breakdowns and accidents is expected to decrease in the future. This coupled with technological advances automating more tasks, may mean fewer tow truck operators and admin positions are expected to be needed.

As shown in Figure 9, the composition of the workforce within the sector is likely to remain stable; however, overall employment within the sector may decrease with consolidation expected in the sub-sector.

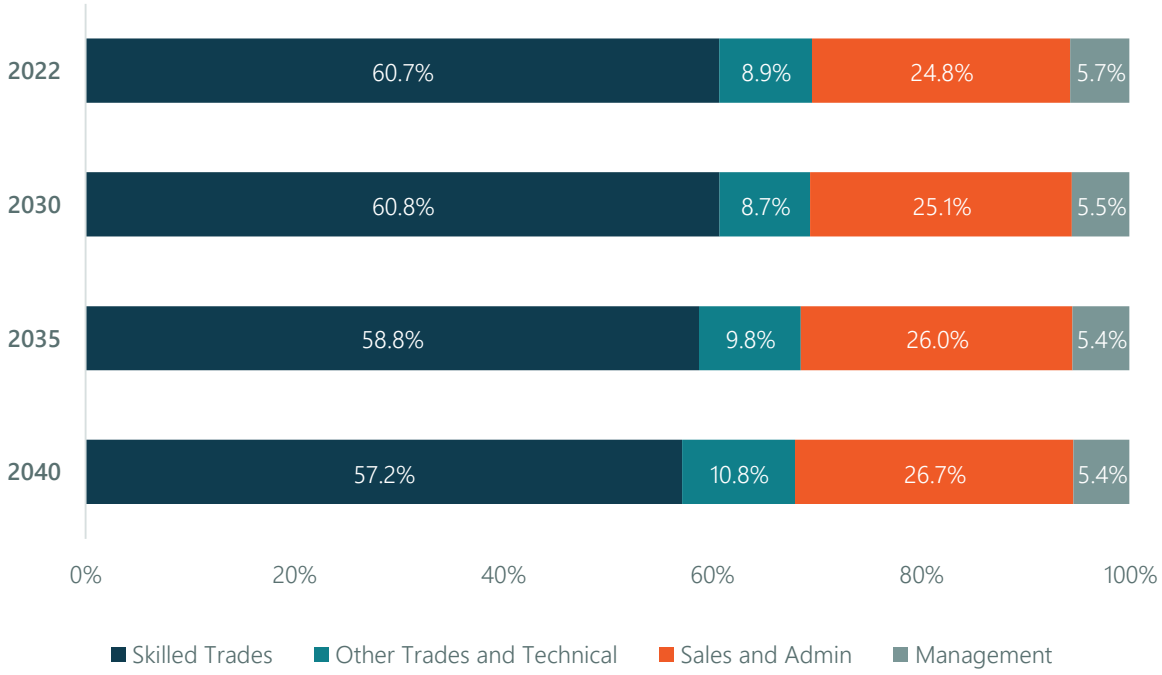
Figure 9: Change in Composition of Workforce Between 2022 and 2040 – Towing and Recovery



Mechanical Repair and Maintenance

The overall size of the workforce is expected to grow slightly between 2022 and 2040 (by about 0.3 percent annually), and the workforce composition is expected to change slightly. Fewer repair hours (as a result of ZEVs comprising an increasingly larger portion of the vehicle fleet and them needing less maintenance than ICE vehicles) would decrease the demand for automotive service technicians. The demand for technicians working in mechanical repair shops may further decrease as an increasing share of repairs may be performed by new car dealers due to the proprietary software and technology on vehicles. Decreases in demand for skilled trades and increases in demand for administrative and customer representative staff as well as additional technical staff, such as IT system specialists, would mean a shift in composition from skilled trades to sales and administrative staff and other trades and technical staff. Demand for management occupations will be determined by the number of businesses. Therefore, the share of management occupations may remain relatively stable or decrease slightly. Figure 10 shows changes in the workforce composition of the mechanical repair and maintenance sub-sector.

Figure 10: Change in Composition of Workforce Between 2022 and 2040 – Mechanical Repair and Maintenance

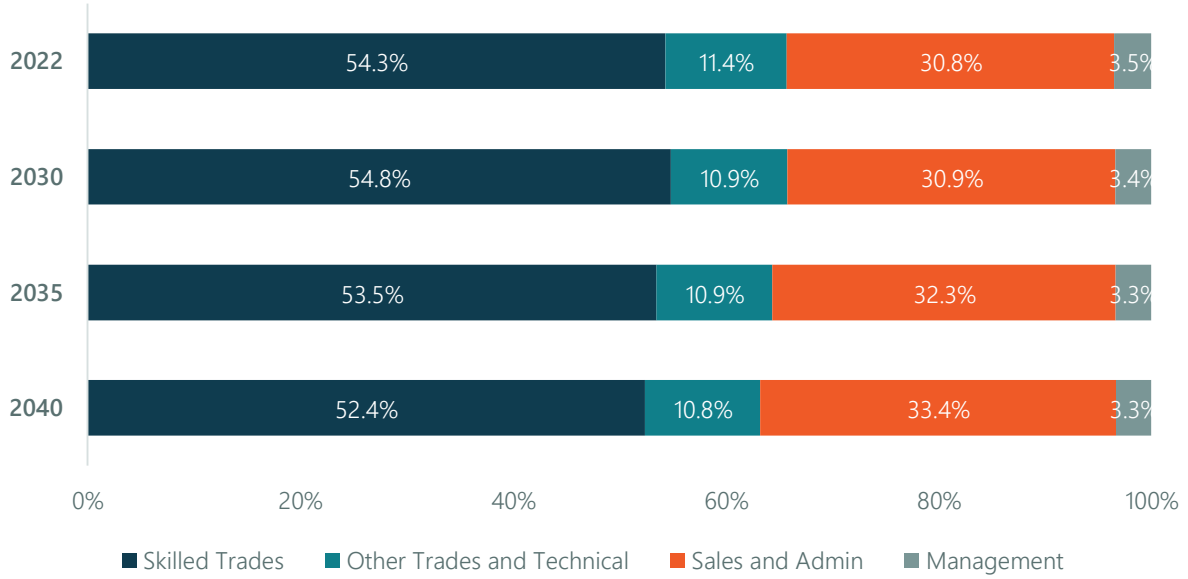


Collision Repair

Fewer collisions due to ADAS are expected to result in fewer repair hours. As a result, fewer autobody and collision technicians, automotive painters and glass technicians are expected to be required. The increased use of sensors and other ADAS technologies will impact the skill level required by technicians and will likely give rise to new specializations amongst technicians (e.g., ADAS/Diagnostic technicians). The demand for painters and glass technicians may be further affected as there may be potential for the use of robotics in these areas. Technological advances and more complex vehicles will also produce more administrative work and so the demand for occupations such as administrative clerks, estimators and service advisors is expected to increase.

These trends are likely to result in the composition of the workforce shifting slightly, with the share of skilled trades decreasing and the share of administrative positions increasing. The proportion of other trades and technical occupations as well as management positions depend on growth in the number of businesses. Under the assumption of no growth in the number of businesses, the demand for these occupations is likely to remain stable. Figure 11 shows changes in the composition of the workforce composition of the collision repair sub-sector.

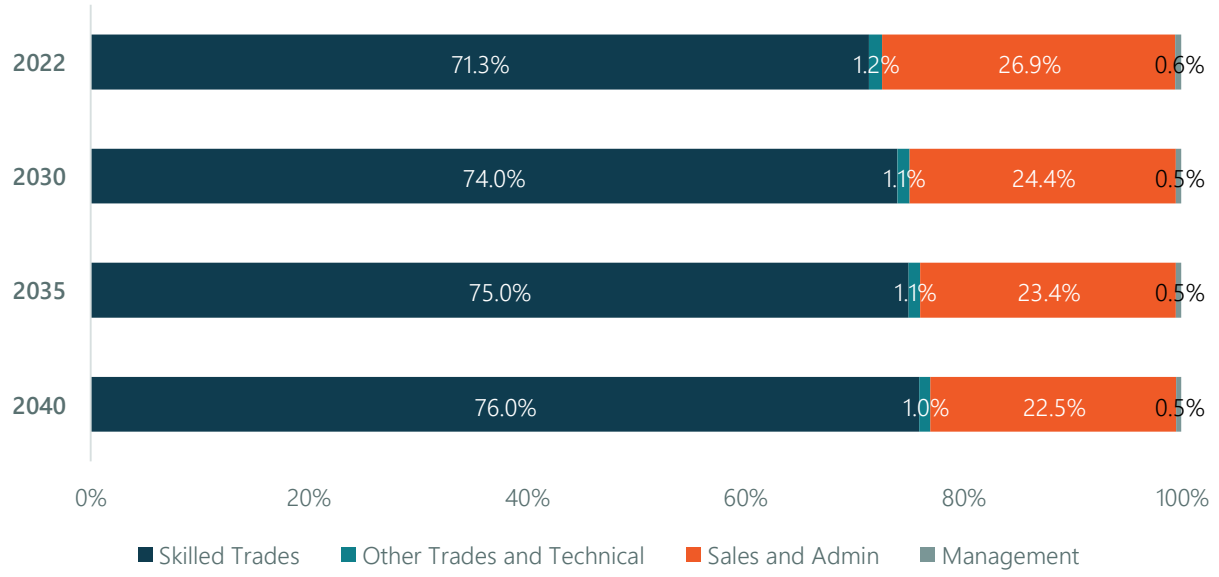
Figure 11: Change in Composition of Workforce Between 2022 and 2040 – Collision Repair



Auto Glass Repair

This sub-sector is expected to be relatively unaffected by the projected changes in vehicle fleet composition. The key trend that is likely to impact the workforce composition of this sub-sector is the modest increase in on-road vehicles which is expected to result in needing an increasing number of automotive glass technicians and apprentices. This would result in the share of skilled trades increasing and the share of all other occupations decreasing (Figure 12). The increase in ADAS and the need to calibrate these systems as part of the repair will affect the skill requirements for technicians. It is important to note that the adoption of robotics could affect the increase in demand for automotive glass technicians.

Figure 12: Change in Composition of Workforce Between 2022 and 2040 – Auto Glass Repair

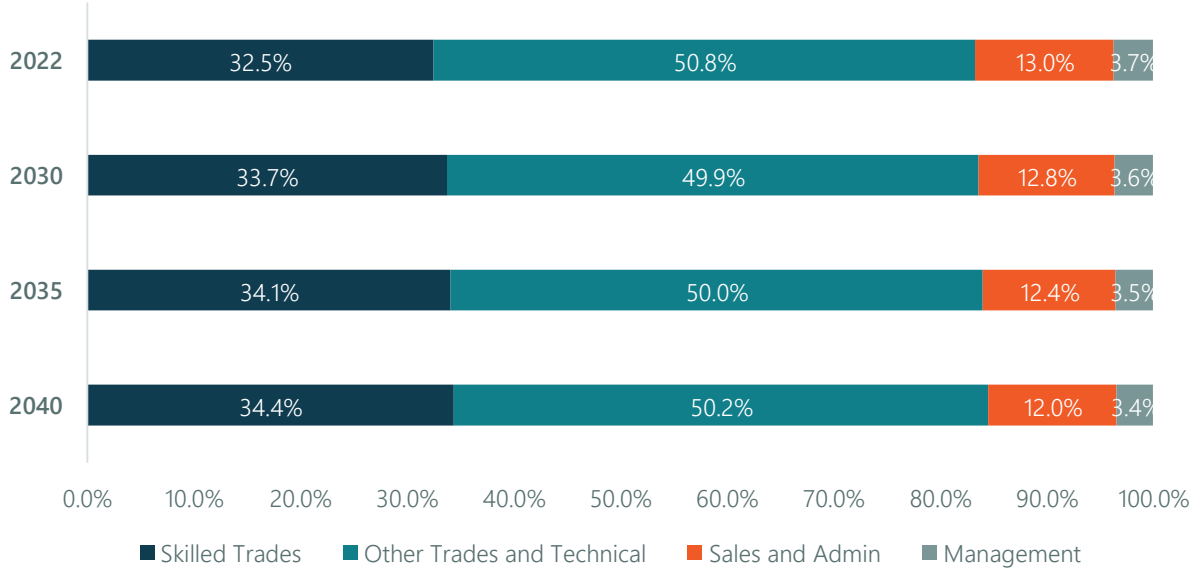


Auto Recyclers

The number of businesses in this sub-sector has been declining. With consolidation expected in the sub-sector and increased automation of inventory and sales processes, reduced demand for most occupations is expected.[52] There may also be changes in the types of activities performed by the sub-sector as well as the skills required. A greater emphasis on quality control is expected as additional testing of parts may be required. The sector may also experience a shift towards recycling materials as opposed to parts re-use. Further, technological advancements may create a need for technical positions such as IT professionals.

As shown in Figure 13, the overall impact on the sub-sector may be a decrease in the share of sales, administration and management positions and a slight increase in the share of skilled trades and other trades and technical occupations. The overall size of the workforce within the sub-sector is expected to decrease.

Figure 13: Change in Composition of Workforce Between 2022 and 2040 – Auto Recycling



[52] The volume of work performed by auto recyclers may increase in the short-term as the number of write-offs is expected to rise due to the high cost of repairs. This dynamic may last until the cost of repairs decrease as technologies become more common.

Key Findings

- Within the Sector, the adoption levels of the five technologies explored in this study vary. ZEVs and ADAS technologies are furthest along in their adoption, albeit they are still at early stages.
- Of the five technologies, transitioning to ZEVs is expected to have the largest impact on the Sector with mechanical repair and recyclers making a particular note of this during primary research consultations.
- ZEVs and ICE vehicles have both similarities and differences when it comes to purchasing, maintaining, repairing and recycling them. The greatest differences are the less frequent maintenance and the specialized knowledge and training needed for ZEVs.
- If rolled out as targeted in the CleanBC Roadmap, approximately 50 percent the vehicles on road are expected to be ZEVs by 2035 and approximately 60 percent by 2040.
- There are several factors impacting the adoption timelines for the five technologies examined in this study. The most pressing of which include manufacturing capacity, the cost of the technology for both the consumer (e.g., ZEVs) and businesses (e.g., AI) and geographic location.
- The overall workforce composition of the Sector is likely to remain relatively stable. However, minor shifts in compositions within sub-sectors particularly new and used car dealers and mechanical and collision repair shops may be expected as a result of technological advancements.

5. Impacts of Technology Advancements

Findings, as they relate to the impacts of technological advancements on skill requirements, training and development, recruitment and retention and health and safety, are explored in this section of the report.

Impact on Skills

Skill Requirements

The skills required to work in the Sector are many, varied, and continually evolving. Technological advancements are leading this evolution, with an emphasis on electrical capabilities and technology fluency emerging. The workforce will be required to upskill and even reskill to ensure they have the necessary skills to work with the latest technologies. Employers require workers that can operate and supervise the changing technologies used in repair, maintenance, and collision repair shops.

Changes to specific skills are presented across the following pages. To understand these changing skills, a skills mapping was conducted. The skills mapping was organized by the four main occupational categories used in this study and employed the following taxonomy (Table 10) in defining the main skills categories. Appendix F defines each skill used in the skills mapping.

Table 10: Skills Taxonomy

Skill Category	Definition
Technical Skills	Abilities to design, set up, operate, and correct malfunctions involving the use of machines or technological systems.
Technological Skills	Abilities to interact and complete tasks using computer-based technologies and other associated technologies.
Cognitive Skills	Abilities to learn and then apply that knowledge to solving problems.

Note: MNP developed this based on the *Employment and Social Development Canada Skills and Competencies Taxonomy* and the *McKinsey DELTA Framework*.

Both existing and emerging skills have been included in the skills mapping tables (Table 11, Table 12, Table 13 and Table 14).

Skilled Trade Occupations

Of the three skill categories listed above, technical skills have been the foundation for skilled trade occupations in the Sector. While these roles do require a certain level of cognitive ability, they have generally been less reliant on technological proficiency. The changes to these skills are explored below.

Among the skilled trade occupations, automotive service and autobody and collision technicians are expected to see the greatest change in skill set (Table 11) For example, high-voltage powertrains and systems that were introduced in the 2010s have created a demand for technicians with specialized

electrical skills.[53] The increased use of hydrogen fuel cells will also require electric skills from technicians as many hydrogen fuel cell systems use advanced electronics to control and monitor the system. Meanwhile, the increasing use of wireless data communications and advanced communication protocols today has introduced new connectivity and cybersecurity challenges for technicians working on newer vehicles. Technicians will need to acquire more advanced technical and technological skills to diagnose, repair, and maintain these complex systems. This includes knowledge of the latest communication protocols, as well as cybersecurity best practices to protect sensitive data and prevent potential threats. As future vehicles are expected to contain more layers of device electrification and additional high-speed data networks, technicians will be required to continuously hone their skill set.

Cognitive Skill Requirements

Advanced research skills in conjunction with document use and problem-solving skills were specific cognitive skills noted by interviewees as critical for technicians in the short-term at a minimum. The growing complexity of vehicles coupled with changing access to repair information were the reasons provided as to why these skills will be especially important.

In the longer-term, AI may assist with the research process.

As the Sector demands increasing electrical and technological skills from its technicians, the degree to which they will need their mechanical skills is expected to lessen, somewhat. For example, with BEVs, there are fewer moving parts which will reduce the need for mechanical repairs. However, technicians may still need to replace individual cells or modules within the battery pack, replace bearings or seals of electric motors and maintain and repair hydraulic brake systems, suspension components and HVAC systems. For PHEVs, which include a gas engine, a battery pack and an electric motor, technicians will need to be able to provide service for both technologies. Therefore, a mix of electrical, mechanical and technological skills will be needed. It is possible that specialized roles emerge as skill sets evolve. Dedicated positions such as an EV specialist may arise. Strengthening technological skills (e.g., data literacy, data analysis, programming, etc.) is expected to be the main change for parts-personnel. As the Sector transitions to ZEVs, parts departments will need to service vehicles powered by a variety of powertrain technologies, including battery, hybrid, plugin-hybrid, fuel cell and ICE. This increased variety of powertrain options will require an even larger variety of parts to be stocked and managed. Therefore, it is essential for parts advisors and managers to understand data and predict demand to ensure lean inventory practices. Additionally, parts personnel will need to adapt to provide customers with faster turnaround times and reduce wait times as the consumer experience becomes increasingly important. The changes listed here for parts personnel are similar to what will be expected for inventory/warehouse personnel (Table 12) given similarities in work.

Of the skilled trade occupations, painters and refinishing prep technicians are forecast to experience the least change to their skill set. Where changes are forecast, they relate to the role robotics might play in labour augmentation. For example, in the future, there may be robotics that assist with vehicle painting.

[53] Aptiv. Evolution of Vehicle Architecture. Retrieved from https://www.aptiv.com

Table 11: Changing Skill Requirements for Skilled Trade Occupations

Legend

↑ Upskilling is anticipated ○ No change in skill is anticipated ↓ A reduction in skill is anticipated

Skills	Parts-person	Automotive Service Technician	Autobody and Collision Technician	Automotive Glass Technician	Automotive Painter	Automotive Refinishing Technician
Technical Skills						
Mechanical		↓	↓	○		
Machine Use		○	○	○	○	○
Electrical		↑	↑	↑		
Battery Testing and Repair		↑	↑			
Battery Storage and Shipping	↑	↑	↑			
Battery Removal		↑	↑			
Technological Skills						
Computer Diagnostic		↑	↑	↑		
Software (Spreadsheet, CRM)	↑	↑	↑			
Cybersecurity	↑	↑	↑			
Wireless Data Communication		↑	↑			
Machine Learning		↑				
Data Literacy	↑	↑	↑	↑		
Telematics		↑	↑			
Software Programming	↑	↑	↑	↑		
Robotics				↑	↑	↑
Data Analytics and Interpretation	↑	↑	↑			
Digital Design and Marketing						
Cognitive Skills						
Customer Service	○	○	○	○		
Numeracy	○	○	○			

Skills	Parts-person	Automotive Service Technician	Autobody and Collision Technician	Automotive Glass Technician	Automotive Painter	Automotive Refinishing Technician
Attention to Detail	↑	↑	↑	↑	↑	↑
Problem Solving		↑	↑	○		
Communication	○	○	○	○	○	○
Advanced Document Use	↑	↑	↑	↑		
Advanced Research Skills	↑		↑	↑		
Health and Safety	↑	↑	↑	↑	↑	↑

Other Trades and Technical Occupations

Similar to skilled trades, other trades and technical occupations currently place a higher emphasis on technical skills than cognitive or technological skills, with the exception of IT specialists, who require a higher level of technological proficiency. The changes to these skill categories, including the rise of electric and technological skills, are explored below.

> As more and more personal data is collected by and stored in vehicles, dismantlers will need to become well versed in cybersecurity best practices. Parts are already being disposed of that have data privacy concerns.
>
> - *Tier 1 Supplier*

With advancements in automotive technology, other trades and technical occupations, outlined in Table 12, will play an important role in supporting the day-to-day operations of the Sector. While these roles do not directly involve the maintenance or repair of vehicles, the individuals working in these positions must keep their technical skills and expertise up-to-date.

Auto dismantlers will need to strengthen the greatest number of skills among other trades and technical occupations. For instance, auto dismantlers often work with newer ZEVs that are damaged and no longer roadworthy. They need to be trained and sufficiently skilled to disconnect the battery and make sure the high-voltage system is safe to work on. The dismantlers will also need to inspect the battery for any signs of damage or wear and assess its overall condition as well as test electronics in parts. Similar skills will be required of tow truck operators as they are often dealing with vehicles shortly after any initial damage is incurred. Skills concerning battery storage will also be required. Once a battery is damaged, there is an increased risk that it may catch fire. This is an important consideration for towing businesses, especially when they have to store damaged vehicles on their lot. Such considerations also have implications for the skill set of lot personnel. Single- and multi-use fire blankets for vehicles are emerging on the market but can be expensive. Leaving additional space between parked vehicles is another reported method being used to help isolate and contain any fires should they occur. Such strategies will form part of the evolving health and safety skills for these occupations. As the engineering of towing robots advances, with versions designed to provide towing services in tight spots and towing of exotic cars, tow truck operators will require specialized knowledge to program and operate these machines and troubleshoot any technical

issues that may arise.

An example of such a robot currently used in North America is the Eastract machine, which uses robotic arms and advanced sensors to autonomously lift and tow disabled vehicles.[54] As the towing sub-sector adopts these new technologies, it is essential that operators are trained to work alongside them effectively to provide reliable and safe towing services.

Auto detailers will need to improve their knowledge of the electrical components present in electric vehicles. Although the high-voltage electrification components in EVs are well protected, it is best to use caution when cleaning around these components. Wear and tear can still pose a threat. As a result, detailers will need more electrical knowledge and greater awareness of safety protocols with respect to high-voltage systems.

Some towers are servicing regions further and further from their main base. There are two main reasons for this.

The first is that the towing sub-sector is consolidating (mainly due to an aging workforce and high barriers to entry), so there are fewer companies covering the same geographic area.

The second is that repair, maintenance and collision services for the newest vehicles are typically available in select locations (usually in urban centres). This means that Vancouver might be the closest service location for a new vehicle that is in Prince George.

Continued skill development of the workforce coupled with over-the-air (OTA) updates/remote diagnosis and solutioning are some avenues to minimizing such long towing journeys.

- *MNP Primary Research Findings*

[54] Carroll, P. (2021, March 1). Eastract North America announces the Import & Sale of the unique TowTract and cartract vehicle carrier equipment. EIN Presswire. Retrieved March 2, 2023, from https://www.einpresswire.com/article/536121259/eastract-north-america-announces-the-import-sale-of-the-unique-towtract-and-cartract-vehicle-carrier-equipment

Table 12: Changing Skill Requirements for Other Trades and Technical Occupations

Legend

↑ Upskilling is anticipated ○ No change in skill is anticipated ↓ A reduction in skill is anticipated

Skills	Inventory/ Warehouse Person	Lot Person	Auto Dismantler	Tow Truck Operator	Parts Delivery Driver	Detailer	Shop Helper	IT Specialist
Technical Skills								
Mechanical			○					
Machine Use			○	○	○	○	○	
Electrical		↑	↑	↑		↑		
Battery Testing and Repair			↑					
Battery Storage and Shipping	↑	↑	↑	↑				
Battery Removal			↑					
Technological Skills								
Computer Diagnostic		↑	↑	↑				
Software (Spreadsheet, CRM)	↑	↑	↑	↑			↑	↑
Cybersecurity			↑					↑
Wireless Data Communication			↑					↑
Machine Learning								↑
Data Literacy	↑		↑	↑			↑	↑
Telematics				↑				↑
Software Programming	↑							↑
Robotics						↑	↑	↑
Data Analytics and Interpretation	↑		↑				↑	↑

Skills	Inventory/ Warehouse Person	Lot Person	Auto Dismantler	Tow Truck Operator	Parts Delivery Driver	Detailer	Shop Helper	IT Specialist
Digital Design and Marketing								
Cognitive Skills								
Customer Service	○		○	○	○	○	○	
Numeracy	○		○		○		○	↑
Attention to Detail	↑	↑	↑	↑	↑	↑	↑	↑
Problem Solving			○					↑
Communication	○		○	○	○	○	○	↑
Advanced Document Use	↑		↑	↑				↑
Advanced Research Skills	↑		↑	↑				↑
Health and Safety	↑	↑	↑	↑	↑	↑	↑	↑

Sales and Administration Occupations

The occupation outlined in Table 13 are largely centered around customer interaction and delivering consultative services (cognitive skills) within the Sector. The changing skills among this category of occupations mainly relate to developing technological and strengthening cognitive skills with little by way of technical skills. Knowledge of the changing technology (e.g., electric and battery storage) will be important, however. Further, the occupations within this category are forecast to experience a similar level of upskilling across the same skill types (i.e., no one occupation will require vastly more upskilling than another).

The adoption of the direct-to-consumer (D2C) model by OEMs could impact a number of occupations in this category, particularly those in selling roles. With a portion of sales forecasted to take place directly with the OEMs, sales personnel will need to adapt to having potentially fewer customers visiting their dealerships (in-person or online) to purchase vehicles, particularly among EV buyers.[55] There is some suggestion that sales representatives may evolve to become delivery agents rather than true salespeople in the face of this change to business models.

[55] Hailes, D. (2023, January 18). Cox Automotive's car buyer journey study shows growing frustration with car buying process. Cox Automotive Inc. Retrieved February 28, 2023, from https://www.coxautoinc.com/news/2022-car-buyer-journey-study/

Sales staff will also need to be trained in the nuances of ZEV and battery maintenance, providing information on refueling infrastructure (including where to find it), ADAS features and other new technologies in order to provide value to their customers.

Deep product feature knowledge will be particularly important as many consumers begin their vehicle purchase journey doing their own research, meaning when they eventually engage with sales personnel, they are looking to learn additional information that is not readily available online through their own research. This also means that the transaction may focus more on fulfillment than the sale itself. Sales personnel may shift to providing customers with the hands-on training they need to fully understand all technology in the car. The knowledge required for sales staff may be so significant that some predict it will result in a new role known as a product genius or product and customer service expert.

> Sales personnel will also need to advance their digital design and marketing skills which is growing in importance as a portion of sales move online.
>
> - New Car Dealer

The business office, also known as the finance and insurance (F&I) department, plays a crucial role in providing a range of tangible and intangible add-on products related to vehicle financing, leasing, and insurance. In the era of ZEVs and software-defined vehicles, where vehicles like Tesla's generate terabytes of data every day, it will be increasingly important for the business office to be able to interpret this data and advise customers on products that best suit their individual needs. By analyzing the driving data and using it to inform recommendations, the business office can provide more tailored and personalized service to customers, helping them to make more informed decisions about their vehicle financing and insurance options.

The role of repair and collision estimators requires a combination of both analytical and customer service skills to be successful. Looking ahead, estimators will need to strengthen their analytical skills in particular. The plethora of new technologies incorporated in newer vehicles will require estimators to analyze data from various sources to diagnose repair issues effectively. Since collision estimators also interact with insurance providers, the ability to use software tools to maintain data and records accurately is important to ensure compliance with the standards and procedures.

As tow truck fleets move towards electrification, telematics will become an increasingly crucial tool for dispatchers. Whether the preferred power source is hydrogen or batteries, the longer charging time and limited hydrogen infrastructure will require the trucks to be more efficiently managed. The dispatchers will be more dependent on telematics technologies to monitor fuel levels, optimize the routes and schedule charging and refueling stops for these battery or hydrogen fuel-cell powered trucks.

Table 13: Changing Skill Requirements for Sales and Administration Occupations

Legend

↑ Upskilling is anticipated ○ No change in skill is anticipated ↓ A reduction in skill is anticipated

Skills	Business Office	Warranty Clerk	Customer Service Rep	Tow Dispatcher	Licensed Automotive Salesperson	Service Advisor	Estimator
Technical Skills							
Mechanical						○	
Machine Use							
Electrical							
Battery Testing and Repair							
Battery Storage and Shipping							
Battery Removal							
Technological Skills							
Computer Diagnostic				↑			
Software (Spreadsheet, CRM)	↑	↑	↑	↑	↑	↑	↑
Cybersecurity							
Wireless Data Communications							
Machine Learning							↑
Data Literacy	↑	↑	↑	↑	↑	↑	↑
Telematics				↑		↑	
Software Programming							
Robotics							
Data Analytics and Interpretation	↑	↑	↑	↑	↑	↑	↑
Digital Design and Marketing					↑		

Skills	Business Office	Warranty Clerk	Customer Service Rep	Tow Dispatcher	Licensed Automotive Salesperson	Service Advisor	Estimator
Cognitive Skills							
Customer Service	↑	↑	↑	○	↑	↑	↑
Numeracy	○	○	○	○	○	○	○
Attention to Detail	↑	↑	↑	↑	↑	↑	↑
Problem Solving			○	○	↑	↑	↑
Communication	○	○	○	○	○	○	○
Advanced Document Use	↑	↑			↑	↑	↑
Advanced Research Skills	↑	↑			↑	↑	↑
Health and Safety	↑	↑	↑	↑	↑	↑	

Management Occupations

The management occupations included in this study are centered on cognitive skills. However, the rapid pace of technological advancement in the Sector is creating new opportunities and challenges. Managers need to be able to identify these emerging trends, understand them and prepare their businesses to adapt to them (Table 14).

Within management occupations, the roles of fixed operations managers and service managers are expected to undergo the greatest degree of change when it comes to skills development. It is the strengthening of technical skills, particularly battery related skills, that separates them from other managers. The degree to which they will need to use their mechanical skills is forecast to drop, somewhat, owing to the changing fleet composition (i.e., an increasing number of ZEVs on the road). Customer service will be a continued area of focus for management. As customers are becoming increasingly tech-savvy, and they expect a high level of expertise and knowledge from their automotive advisors, and managers need to be able to support and guide their teams to achieve these requirements. For example, fixed operations managers need to constantly make decisions about how to allocate both human capital and physical capital. With both ICE and ZEVs becoming software-heavy, these vehicles generate a wealth of data that can be used to optimize service and maintenance operations, and fixed operations managers need to be able to understand the interpret this data in order to make informed decisions.

> Used car sales managers used to appraise cars which took a lot of effort as it involved calling other used car dealers to apprise or understand the market. Now they have a system/platform to automatically give you a value.
>
> - *Used Car Dealer*

In a retail context, leasing agents are primarily responsible for increasing lease penetration and customer retention for the stores. Leasing typically involves a shorter turnover time frame and provides franchised

dealerships with an additional opportunity to retain customers by signing them into a new lease contract. As the market is expected to be fueled with a range of powertrain options in the coming years, leasing agents must possess strong analytical and data interpretation skills to offer clients appropriate vehicle and payment options to meet their needs. This is particularly relevant for traditional OEMs, as their EV production is gradually increasing to meet demand. Leasing agents play a critical role in developing leasing strategies that not only offer clients optimal options but also give OEMs sufficient time to build their EV lineups without losing clients to other brands.

Continued upkeep of health and safety knowledge and procedures will be required for all management occupations as it will be for all occupations in the Sector.

Table 14: Changing Skill Requirements for Management Occupations

Legend

↑ Upskilling is anticipated ○ No change in skill is anticipated ↓ A reduction in skill is anticipated

Skills	Controller	Finance Manager	Sales Manager	Fixed Operations Manager	Parts Manager	Leasing Agent	Service Manager
Technical Skills							
Mechanical				↓	○		↓
Machine Use				○			○
Electrical				○			○
Battery Testing and Repair							↑
Battery Storage and Shipping				↑	↑		↑
Battery Removal				↑			↑
Technological Skills							
Computer Diagnostic				↑			↑
Software (Spreadsheet, CRM)	↑	↑	↑	↑	↑	↑	↑
Cybersecurity							↑
Wireless Data Communications							
Machine Learning	↑						
Data Literacy	↑	↑	↑	↑	↑	↑	↑
Telematics				↑			↑
Software Programming							

Skills	Controller	Finance Manager	Sales Manager	Fixed Operations Manager	Parts Manager	Leasing Agent	Service Manager
Robotics							
Data Analytics and Interpretation	↑	↑	↑	↑	↑	↑	↑
Digital Design and Marketing			↑			↑	↑
Cognitive Skills							
Customer Service		↑	↑	↑	↑	↑	↑
Numeracy	○	○	○	○	○	○	○
Attention to Detail	↑	↑	↑	↑	↑	↑	↑
Problem Solving	○		○	○		↑	○
Communication	○	○	○	○	○	○	○
Advanced Document Use	↑	↑	↑	↑		↑	
Advanced Research Skills	↑	↑	↑	↑		↑	
Health and Safety	↑	↑	↑	↑	↑	↑	↑

Key Findings

- Within skilled trade occupations, automotive service and autobody and collision repair technicians are expected to see the greatest change in skills. The main areas of upskilling include electrical, battery and technological skills such as software programming and computer diagnostics.
- A combination of mechanical and electrical skills will be required across these positions and others as ZEVs still need mechanical maintenance and repair but also because by 2040 ICE vehicles are estimated to comprise 40 percent of the provincial vehicle fleet.
- Auto dismantlers and IT specialists will need to strengthen the greatest number of skills among other trades and technical occupations. Developing electrical, battery and technological skills is where auto dismantlers will need to develop new skills, while IT specialists will need to strengthen technological and cognitive skills.
- Data literacy and analytics as well as cognitive skills are the areas where sales and administration occupations will be required to focus their training. Within this occupational category no one occupation will require vastly more upskilling than another.
- Within management occupations, the roles of fixed operations managers and service managers are expected to undergo the greatest degree of change when it comes to skills development. It is the strengthening of technical skills, particularly battery related skills, that separates them.
- There is some consensus that a trend towards skill specialization will emerge (e.g., the specialization of repair and maintenance for ZEVs and ICE vehicles).
- Continued upkeep of health and safety knowledge and procedures will be required for all occupations in the Sector particularly those working directly with high-voltage batteries.

Skill Gaps

The current skill set of the provincial workforce is not growing at the same speed as technological change, according to most interviewees, creating a skill gap between that of the workers and what employers require. This dynamic is particularly pronounced for the aftermarket parts sub-sector, new car dealers, mechanical repair and collision repair. Auto Recyclers were the one sub-sector that did not report currently experiencing a significant skill gap. There is limited available literature on the exact nature of potential future skill gaps, though there is consensus that skill gaps are emerging.

Table 15 shows the skills expected to be in short supply according to the primary consultations conducted as part of this study. For the most part, the identified skill gaps are related to the changing nature of the work for technicians and the need for more technological skills.

Table 15: Skills that are Anticipated to be in Short Supply

Anticipated Skill Shortages		
Battery Removal	Software Programming	Electrical
Data Analytics and Interpretation	IT	

Source: MNP primary research

Other Requirements

In addition to the upskilling and reskilling that will be required of workers in the Sector, there are a number of other factors that will be required by these workers. These include:

- **Continuous learning.** Given the speed of technological advances and the uncertainty around the level of change, continuing education, training and lifelong learning will become increasingly essential for the labour force. This requirement will also have implications for the provision of training and will likely require increased investment in innovative initiatives by schools, universities, private-sector and public-sector training institutes, and employers' and workers' organizations. Effective lifelong learning will require good foundational skills for both young, mid-career and older workers. Core skills, such as optimal management of one's own learning, social and interpersonal relations and communication, will be prerequisites for a successful learning career.[56] The need for constant learning and training was one the study's most recurring themes and was articulated by each sub-sector.
- **Increased knowledge.** In order to keep pace with the advancing technologies, workers across the Sector will be required to increase their knowledge base. By way of illustration, sales personnel will need to possess very strong features knowledge, including safety components. This will be important both in terms of selling a vehicle and identifying opportunities for up or cross-selling, as well as to avoid liability in the event safety components were ill-explained. Another example is related to mechanical and collision technicians, who will be required to possess at least some level of knowledge with respect to battery chemistry.
- **Management and leadership.** An aptitude for management and leadership was noted by interviewees as an additional requirement, particularly for those transitioning from a technician background into management. Additional training and upskilling in these areas were considered important.

New Occupations

There are expectations that new occupations (e.g., battery technician) will emerge in response to the new technologies. There are also forecasts that established occupations from other fields (e.g., cybersecurity analyst, digital advertiser) will enter the Sector. Finally, there are occupations that have existed in certain sub-sectors that are now expected to be presented in new sub-sectors (e.g., IT specialists have been employed at dealers for a number of years, but this role is now expected to branch into other sub-sectors such as collision repair and auto recyclers.

Table 16 outlines the new occupations that are emerging in the Sector as of 2022, while Table 17 highlights the new roles that are forecast to appear in the coming years (up to 2040). A number of specialized roles are detailed below, which is a reflection of the growing bank of skills and knowledge individuals need to possess. The specialization of some roles will have implications for the provision of training, including whether traditional qualifications (e.g., Red Seal) will be replaced or augmented with specialized qualifications.

[56] Rainie L., Anderson J. (2017, May 3). The Future of Jobs and Jobs Training. Retrieved from https://www.pewresearch.org/internet/2017/05/03/the-future-of-jobs-and-jobs-training/

Table 16: New Occupations Emerging as of 2022

Position	Position Description	Aftermarket Lifecycle Stage these Positions Relate to	Existing Occupation in Other Sectors	New Occupation
IT Specialist	Manages and maintains the technology infrastructure, including the database and file systems used in modern collision centres.	Collision Repair	X	
Data Analyst	Collects and analyzes data related to a spectrum of activities, including sales trends, customer behaviour, and inventory management.	New and Used Car Dealers	X	
EV Technician	Specializes in servicing and repairing electric and hybrid electric vehicles.	Collision Repair, Mechanical Repair		X
Digital Advertiser	Guides customers through the complex array of digital and technological features available in software-defined vehicles.	New and Used Car Dealers	X	
Product Genius	Helps customers learn about the features and benefits of new cars and improve customer experience.	New Car Dealers	X	
Battery Technician	Specializes in the maintenance and repair of all types of batteries used in ZEVs and hybrid vehicles and may also include the remanufacturing of batteries.	Mechanical Repair		X
Diagnostic Technician	Specializes in diagnosing and troubleshooting complex issues using specialized diagnostic tools and equipment.	Collision Repair, Mechanical Repair, New Car Dealers		X
ADAS Technician	Specializes in service and repair ADAS components found in modern vehicles and has a deep understanding of the complex electronic and computer systems that power these components.	Aftermarket Parts, Auto Glass Repair, Collision Repair, Mechanical Repair, New Car Dealers		X
Data Forensics	Specializes in analyzing and interpreting data related to the safety and performance of vehicles.	Regulatory Body	X	

Table 17: New Occupations Emerging in the Future (up to 2040)

Position	Position Description	Aftermarket Lifecycle Stage these Positions Relate to	Existing Occupation (in other sectors)	New Occupation
IT Specialist	Manages and maintains the technology infrastructure used in the recycling business.	Auto Recyclers	X	
Data Analyst	Collects and analyzes data related to a spectrum of activities, including sales trends, customer behaviour, and inventory management.	All Sub-sectors	X	
Remote, Digital Diagnostic Support	Remotely connects to vehicles to diagnose and troubleshoot issues with specialized software and diagnostic tools.	New Car Dealers		X
Electric Motor Rebuilder	Repairs and rebuilds the electric motors used in electric vehicles or other applications.	Mechanical Repair		X
Cybersecurity Analyst	Analyzes and identifies potential cybersecurity threats and vulnerabilities in the software-defined vehicles.	Mechanical Repair	X	
Charging Specialist	Provides on-site charging solutions/services for ZEVs that have run out of power or are stranded on the road. A roadside assistant in the era of EVs.	Towing and Recovery		X

Key Findings

- According to interviewees skill gaps are emerging with respect to battery removal, IT, electrical, software programming, management and data analytics and interpretation.
- In addition to honing certain skills, the workforce will need to adopt a continuous learning mentality if they are to keep pace with the rate of technological change.
- New occupations are expected to emerge now and into the future (up to 2040) a result of technological advancements.
- Some of these will be new occupations (e.g., battery technician and changing specialists) while others will be occupations that are present in other industries moving into the Sector (e.g., IT specialist and cybersecurity analyst).

Learnings from Other Jurisdictions

A number of jurisdictions, including Quebec, California, Norway, South Korea, Japan, China and New Zealand were examined as part of this study. While a number of these jurisdictions, namely Norway and China, have higher ZEV adoption rates than BC, most jurisdictions are still trying to understand the impact the transition to ZEVs will have on their workforce and how they will equip their workforces with the required skills.

Norway

A 2022 study, exploring the evolving vocational training requirements in Sweden, Norway and Estonia, found that in Norway 'there are currently no national regulations related to work on electric vehicles.' Schools in Sweden, Norway and Estonia commissioned the study to identify training needs and opportunities for collaboration with respect to training technicians to work on electric vehicles.*

Quebec

Propulsion Quebec, the cluster for electric and smart transportation, in conjunction with the Information and Communications Technology Council (ICTC) examined some of the labour dynamics associated with Quebec's emerging EV industry. The study noted that the ability to optimize vehicle repair and maintenance through data and analytics and the introduction of the Internet of Things monitoring of vehicles would give rise to a reduction in over-maintenance and 'no-fault-found events.' It also generally noted that many existing workers will see skill shifts, leading to the need for workforce development solutions, training, reskilling, and upskilling. How Quebec planned to undertake the require workforce development was not detailed.**

New Zealand

While New Zealand has not set a date for when the sale of new ICE vehicles will cease, the ZEV sector is still advancing. One key informant interviewee noted that as recently as 2015, certifications and training standards in New Zealand were largely absent from the training landscape. In the years since, the industry, in collaboration with some of the manufacturers, have *"really accelerated the provision of training."* Initially, younger workers and those interested in ZEVs were predominantly enrolling in the training. Now (2023), there is much broader uptake of the training courses.***

** Ärlemalm P., Stig M., Börstell J., Vikvald K. T., Kivi M., Michael M., Larsson H., Rosmo R., Paaskivi A., Winther P., Sipinen K., Skånøy, P.M. (2022). Training materials, equipment, and teacher training in VET for e-vehicles. Transportforetagen.*

*** Cutean, A., Davidson, R., Felder, M., Hale, E., Oschinski, M., Watson, M., Xiao. (2022, January). Recharging Quebec's Transportation Sector Information and Communications Technology Council (ICTC).*

**** MNP primary research*

Impact on Training and Development

The demand for new and evolving skills in the sector is giving rise to a changing training landscape. Changes as they relate to who provides training, training requirements, the frequency of training, challenges to the provision of training and the re-introduction of certified skilled trades programming in BC are explored below.

Providers of Training

Technological advancements are impacting who delivers training to the Sector. Currently, training is provided by a number of different organizations, including established (i.e., PSIs) and emerging (i.e., PSI and OEM partnerships) entities. A list of these providers, including their role and expectations as to how it will change in the future is outlined below.

- **Public and private post-secondary institutions.** Public and private training providers are those that have completed SkilledTradesBC designation review process and are authorized to offer SkilledTradesBC-approved industry training programs. These post-secondary institutions provide a mix of foundational programs[57] and apprenticeship programs for Red Seal accreditation. They also offer one-time specialty industry training as workers need to keep their knowledge and skills up-to-date, particularly the further removed they are from their original training (i.e., foundational or apprenticeship programs)

  To a lesser but growing extent, PSIs are providing training in association with OEMs. There is a growing trend of OEMs partnering with different PSIs to provide training. The nature of these partnerships involves the manufacturers contracting PSI instructors to teach dealer technicians about the OEM's specific technology and models. In some cases, manufacturing specific apprenticeships are beginning to emerge.

  In addition to established PSIs, training after the Red Seal level is also provided by OEMs and third party providers (as detailed below).
- **OEM training**. OEMs normally provide training to their franchised dealer networks. OEM-led training, including training designed for both variable and fixed operation personnel, is mostly released during the introduction stage of the new models. Training provided by OEMs can be taken by those with or without a Red Seal qualification. However, some training specifically targets qualified technicians and is designed as such. Workers at independent shops can also avail of some, but not all, OEM-led training.

  As vehicles are becoming software-defined, OEMs will increasingly use OTA updates to release new features, bug fixes, performance improvements and security updates to their vehicles.[58] These updates will enable new features and introduce complexity to vehicles, potentially necessitating adjustments to the repair procedures for technicians and knowledge updates for sales and F&I

[57] Foundation programs are entry-level training programs for people with little or no experience in the field.

[58] Herlt, A., Rochlitz, H., Küchler, S., Kellner, M., & Jana, P. (2022, October 24). Smartphones on wheels: New rules for automotive-product development. McKinsey & Company. Retrieved February 27, 2023, from https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/smartphones-on-wheels-new-rules-for-automotive-product-development

personnel.

OEM certification requirements are increasing for some brands. For example, Audi requires their technicians to fly to their facility for training provided directly by them. This creates a challenge for workers to acquire and maintain their skill sets and yet there is a growing expectation that staff will need these qualifications as parts of the Sector specialize.

As mentioned, OEMs also partner with PSIs or independent training centers to provide mechanic training, and some OEMs offer certifications for technicians to become manufacturer-certified mechanics. For example, OEMs such as Toyota, Honda/Acura, General Motors and Ford have partnered with the British Columbia Institute of Technology (BCIT) to provide foundation training to students for careers within their respective networks. Recently Tesla's START program established a new partnership with BCIT with a focus on ZEVs. As repairs and fixes are advancing towards OTA updates, it is expected that the OEMs will continue expanding training partnerships to ensure support is available for their products. At the same time, they are expected to retain control over the management of the software component.

- **Third party providers.** Third party providers such as I-CAR, the ARA's Training Centre of Excellence and Automotive Service Excellence offer training courses to those with or without a Red Seal qualification and to those working at either an independent facility or franchised dealer. Training can be provided through virtual platforms, just-in-time, or in-person. Each of the providers tends to be sub-sector specific. I-CAR, for example, focuses on training for collision repair. Collision centers are rarely brand-specific and OEMs' dealer networks are not required to have body services; thus, I-CAR also provides training with OEM-specific information.

The Right to Repair

Access to OEM information and equipment, more commonly known as the 'Right to Repair,' was noted as an enduring challenge faced by the Sector.

Repair information can be accessed through subscription services. The cost of these subscriptions was noted as a significant barrier, with some OEMs charging $30,000 per year for mechanical repair information. This can create a barrier for the aftermarket in providing repair services due to the volumes needed to justify the purchase of a subscription for a specific type of vehicle. For mechanical repairs, it can also raise the cost of repair for consumers.

Collision repair facilities also increasingly need OEM certification to remain competitive in the market. This involves sending technicians for relevant training and investing in tools and equipment. Unlike mechanical repair, collision repair facilities have limited ability to adjust their rates in response to cost increases, as repair rates are generally set by the Insurance Corporation of BC.

Another challenge relates to who can provide training and thus certification (including Red Seal certification). Training providers, particularly those that are qualification-granting, can be unable to train and certify students in the absence of certain OEM information.

Although not a formal medium, both primary and secondary data indicate that the internet is frequently used as an on-the-job resource for research and information sharing.[59] Some interviewees mentioned that by utilizing online resources, they can quickly and efficiently gather information, which can effectively help them diagnose and resolve problems. Additionally, the internet provides an opportunity for them to stay up-to-date with the latest advancements in repair technologies and techniques.

Training Requirements

As new technologies continue to enter the Sector, placing changing demands on the skill set of the workforce, the training system will need to adapt to prepare individuals for the changing labour market. Specifically, the following components will be required:

Training Designed to Address Sector Needs

The future training system and curriculum will need to teach the skills that the Sector requires. Specifically, the skills outlined in the skills mapping tables (Table 11 through Table 14) and the skill shortages outlined in Table 15 are what the Sector is forecast to require. To ensure the workforce possess these skills, current programming will need modifying and new programming will be required. Priority training areas emerging from the skills mapping include:

- Electric skills. Training for electric skills is becoming increasingly important as the Sector adopts ZEVs, which rely heavily on electrical systems and components. While broad knowledge of the transition to electrification will be important for many occupations in the Sector, those occupations most in need of deep electrical training include automotive service technicians, autobody and collision technicians, glass technicians, dismantlers, detailers and tow truck operators.
- Battery related skills. This includes the testing, storing, shipping and removal of batteries. Training for each of these areas will be important for the same occupations listed above (electric skills) as well as for parts-persons and inventory/warehouse personnel.
- Computer diagnostic skills. Widespread training in computer diagnostics among technicians, towers, dispatchers, dismantlers and lot personnel will be critical to ensure the Sector can work with the software in vehicles.
- Data literary, analysis and interpretation skills. Proficiency in these skills is set to become a foundational requirement for most occupations in the Sector and so training programs will need to incorporate the teaching of these skills.
- Health and safety skills. This type of training is typically required for all employees, regardless of position. Safety training may include instruction in workplace safety, hazard identification and mitigation, emergency response, and other safety topics.

As new roles emerge and others evolve to become more specialized, training is expected to become more specialized as well. This will have implications for the provision and design of training.

[59] Red Seal Program website. Automotive Service Technician Red Seal Occupation Standard. Retrieved from https://www.red-seal.ca/eng/trades/autoservtech/2016rs.4s_.4v.2rv.3.2w.shtml

Increased Training

To keep pace with the rate of forecasted technological change, the frequency of training is expected to increase for all four occupational categories. Training is set to become a constant occurrence for those working in the Sector. This is particularly true for automotive service technicians and autobody and collision technicians whose roles are forecast to experience the highest level of change. Please note that the increase in training frequency described here is distinct from Skilled Trade Certification (see text box on Skilled Trade Certification on the next page).

The costs associated with increased training and skill development are likely to affect the viability of some businesses. This is particularly true in cases where facilities are unable to pass their training costs on to their customers (e.g., when prices are set by a governing organization) or among smaller facilities that may not have the resources or volume to invest in the required training and development.

A number of interviewees reported that they and/or their staff now take annual training, which represents an increase from historical patterns, which was more akin to every couple of years. Sector stakeholders, including government and PSIs, will need to ensure training opportunities are available at regular intervals if the workforce is to stay on top of their skill development. As the frequency of learning increases, training previously considered advanced is now becoming the minimum requirement. For example, for skilled trade occupations, a Red Seal qualification is the minimum requirement. The concept of attaining one's ticket (i.e., Red Seal) and supplementing that core training with 'endorsements' throughout a career was projected as the likely future state by interviewees.

A Mix of Training Delivery

Recent IT advances offer new and potentially more widely accessible ways to access education. This was observed during the Covid-19 pandemic when most PSIs transitioned to online instruction. Post Covid, a hybrid delivery model is emerging as the learning modality of choice as it allows for practical course elements to be delivered in-person while theoretical components can avail of online formats. Some interviewees noted that AR and VR might have potential applications for future training delivery but lacked specific details on how this may materialize. Examples are available in the literature and include a 2020 announcement by Ford to partner with Bosch to utilize Bosch's VR technology to train dealership technicians on the new Mustang Mach-E[60] Pre-dating that, Porsche began utilizing AR Smart Glasses to improve technical services at Porsche dealerships in the US as early as 2017. It has seen its usage tripled since the onset of the Covid-19 pandemic.[61] Leveraging technology to provide and deliver training can

[60] Ford Media Center. (2020, February 14). How Ford, Bosch Are using Virtual Reality to Train Technicians On All-Electric Mustang Mach-E. Retrieved from https://media.ford.com/content/fordmedia/fna/us/en/news/2020/02/14/ford-bosch-virtual-reality-technician-training-mustang-mach-e.html

[61] Porsche Cars North America Newsroom (2020, April 29). Augmented Reality Usage Triples in Porsche Workshops Amid COVID-19. Retrieved from https://newsroom.porsche.com/en_US/technology/porsche-tech-live-look-augmented-reality-usage-covid-19-20702.html

help overcome some well documented challenges when it comes to access training. Such challenges include the often-expensive nature of training and geographic access, particularly for those living in remote communities.

An Evolving Credentialing System

Given the demand for continuous training, micro-credentials are expected to play a role (the extent of which has yet to be determined) in the training environment now and into the future. Specifically, micro-credentials are expected to support professional development for skilled trade occupations once they have completed their Red Seal certification. Micro-credentials could also be used for upskilling in relevant areas (e.g., battery removal and handling) for other occupations in the Sector.

An example of courses emerging in this space includes the Electric Vehicle Technology and Service program introduced by BCIT in 2020. The course prepares automotive service technicians to safely diagnose, service and repair high-voltage electric vehicles. The course is also open to third and fourth year apprentices and comprises a 6-hour online self-paced safety module that must be completed before an intensive 30-hour classroom/shop training period.

As micro-credentials are often offered at a shorter length, lower cost and with flexible delivery options, they can increase access to post-secondary education for a range of learners who may not be able to or do not wish to enroll in longer post-secondary programs. Key to micro-credential development will be partnership and collaboration with Sector participants, training institutions and OEMs, to ensure the competencies learners gain are relevant and recognized for employment.

Skilled Trades Certification

The Province of BC is re-introducing skilled trades certification (also known as mandatory certification). This means that in order to work in a particular trade, a worker must be a registered apprentice or a certified journeyperson. The government is employing a phased approach to mandatory certification, beginning with a total of 10 trades, including the following trades employed in the Sector:

- Automotive Service Technician
- Autobody and Collision Technician

The transition to skilled trade certification for these trades will begin in 2024.*

Skilled trades certification presents both an opportunity and a challenge. Having a standard certification will ensure a base of level of skills; however, the changing nature of technology means that some form of professional development requirements beyond a Red Seal certification may need to be introduced to ensure those repairing vehicles have the required skillset.

*Ministry of Advanced Education and Skills Training. (2021, June). Skilled Trades Certification in British Columbia. Retrieved from https://engage.gov.bc.ca/app/uploads/sites/672/2021/06/Business-Case-Skilled-Trades-Certification.pdf

Building on the idea of an evolving credentialing system, self-directed learning is expected to continue to expand. As previously mentioned, many workers are already taking to the internet to guide their research and troubleshoot their problems. While this can work for troubleshooting and filling specific knowledge gaps, instructor-led training is still expected to be required.

Challenges to the Provision of Training

Barriers Faced by PSIs

PSIs noted a number of challenges when it came to the provision of training. These included:

- Budgetary pressures. Several training providers noted that while provincial funding to their organizations has remained unchanged over a number of years, the cost of providing training has steadily increased (i.e., trades training requires a significant quantity of materials and equipment) over the same timeframe. This means that training providers have had to absorb cost increases in order to continue to deliver trades training programs.
- Time pressures. Although most PSIs conduct regular (i.e., every three to five years) program reviews in consultation with the Sector, PSIs face challenges in updating and adapting course material quickly enough to reflect new technologies. As the rate of technological change accelerates, PSIs have a hard time keeping pace. This often means that training lags behind Sector needs.
- Additional teaching material. The rate of technological change and the introduction of new technologies is also impacting the volume of material required to be taught. Instructors can be faced with lengthening the program time or exploring more topics but in less depth.

Key Findings

- Access to information needed to repair vehicles was noted as one of the enduring challenges faced by the Sector.
- Priority training areas include electrical skills, battery skills, computer diagnostic skills, data literacy, analysis and interpretation skills and health and safety skills.
- The frequency of training is expected to increase for all four occupational categories.
- Micro-credentials are expected to play a role in the training environment now and into the future.
- Budgetary and time pressures as well as additional content that needs to be incorporated into curricula were the leading challenges noted by PSIs.
- Apprenticeship training will need to keep pace with and incorporate technological trends (including electrification) into its requirements.

Impact on Recruitment and Retention

This study found that employers in the Sector continue[62] to experience recruiting difficulties. The impact technology is expected to have on recruitment and retention was mixed among stakeholders. Approximately half of those interviewed, viewed the increased use of technology in the Sector as a pull factor, while the balance perceived the challenges presented by the proliferation of technology to be more pronounced than the opportunities. The possibility for older workers to opt into early retirement in

[62] MNP. (2016, November 29). Automotive Sector Labour Market Information Report.

place of upskilling was noted as, at least, a short-term obstacle. In terms of recruitment, some put forward that the constant need to train and retrain may make it harder to attract workers in the first place. Other interviewees took the view that technological advancements will attract more people into the Sector, including people with different backgrounds and skills and those interested in technology.

Impact on Worker Health and Safety

There are a number of worker health and safety risks and measures to be considered as the Sector transitions to ZEVs and AVs.

The biggest risk reported by interviewees relates to the high-voltage produced by ZEVs. Workers can be injured by contact with the electricity from compromised lithium-ion batteries. Damaged high-voltage electrical systems can also energize other components of a BEV, posing a risk to workers of electric shock, electrical burns, or even electrocution. A damaged high-voltage battery can short circuit, catch fire, and explode. This type of fire can be difficult to extinguish, and the damaged battery can reignite a long time after the fire is initially put out. Whether they burn and create fumes, or crack and leak, damaged batteries release toxic substances. Table 18 summarizes the main ways damaged batteries are hazardous to those selling, repairing, towing, dismantling and recycling ZEVs.

Table 18: Health and Safety Risks to Workers in Dealing with a Damaged EV Battery[63]

Risk	Impact on Worker
Uncontrolled release of energy	Damaged high-voltage electrical systems can energize other components of a BEV, posing a risk of electric shock, or even electrocution, and electrical burns.
Fire and explosion	Damaged batteries can short-circuit and catch fire, and even explode. Li-ion batteries burn hotter and faster than other fuel sources and can reignite after the fire is extinguished. Electrolyte leaked from these batteries is also flammable.
Fumes or leaks of toxic substances	Fumes from burning li-ion battery (containing, for example, CO_2, CO, NO, NO_2, HCl, HCN, hydrocarbons, and HF) may cause irritation, illness, or death. Skin contact with leaked electrolytes and HF can cause irritation or burns.

As vehicles evolve, OEMs have specific recommendations and may have certifications for working on these types of vehicles to prevent vehicle damage and ensure worker safety.[64]

There are similar risks associated with hydrogen fuel cells. These include fires and explosions, freeze burn, electrocution and arc flash hazards. Hydrogen used in fuel cells is a highly flammable, odorless gas, meaning it can be hard to detect if there is a hydrogen leak. This adds a layer of complexity to an already risky situation for workers.[65] The safe storage of hydrogen gas will also be required. Interviewees

[63] WorkSafe BC. Batteries (EV). Retrieved from https://www.worksafebc.com/en/health-safety/hazards-exposures/batteries-ev

[64] Red Seal Program website. Auto Body and Collision Technician Red Seal Occupational Standard. Retrieved from https://www.red-seal.ca/eng/trades/mvbrmetalpaint/2019rs.4s_.4v.2rv.3.2w.shtml

[65] United Stated Department of Labor. Occupational Safety and Health Administration. Retrieved from https://www.osha.gov/green-jobs/hydrogen

suggested that a certification program be introduced for technicians to safely work on ZEV and their various fuel options.

The main health and safety risks of AI, VR and AR relate to their proper use.[66] Without adequate training, these technologies could be used incorrectly, which cause physical harm to workers if they are not operated as intended. For example, AR and VR users will need to ensure they have sufficient space when using devices, they are aware of their surroundings, that their devices are clean (if they are shared), and ensuring the software stays up-to-date to minimize cyber attacks.

Changing Business Models

Traditional business models across the automotive sector are undergoing changes. These include:

- **D2C.** Many OEMs are investing in their online sales platforms, allowing customers to research and purchase vehicles directly from the manufacturer. Some OEMs have also experimented with new sales models, such as subscription-based services, where customers pay a monthly fee for access to a fleet of vehicles. While the shift toward D2C sales is still in its early stages, some automakers have made significant strides in this direction. For example, Tesla has always sold its vehicles directly to consumers through its website and company-owned stores, bypassing the traditional dealership model entirely. Additionally, companies like Volvo and Porsche have launched online sales platforms that allow customers to purchase vehicles directly from the manufacturer. The expansion of OEM D2C sales has implications for the volume of transactions for new car dealers and possibly for the number of repairs completed as well. OEMs will likely continue to rely on their dealership networks for the foreseeable future, while also exploring new D2C sales channels as their franchises can provide a level of personalized service and support that is difficult for manufacturers to replicate at scale and they also offer services beyond just making a sales transaction, such as the test driving experience and, maintenance and repair.
- **Online sales for new and used car dealerships.** In response to changing consumer preferences, dealerships are also investing in their online sales platforms. A growing proportion of dealership sales are now happening through digital channels. For example, CarMax, the largest used car dealer network in North America, has expanded its online retail sales to account for approximately 9% of its business. This allows the consumers to purchase or finance the vehicles online and receive the delivery either at home or through its express pickup option.[67] Dealerships are also using digital channels to generate leads and provide customer support. This has implications for the number of sales staff needed at a given dealership and also for the skill set of those staff members. The expectation is that fewer sales staff will be needed as online sales grow while the staff selling through digital channels will need to be as technologically knowledgeable as their customers. As dealerships migrate to online sales, they will need to ensure they remain compliant with the requirements of the Vehicle Sales Authority of BC, the provincial vehicle sales regulator.
- **Mobility as a Service (MaaS).** The MaaS model is gaining popularity in urban areas around the

[66] MNP primary research findings.
[67] CarMax, Inc. (2022). Annual Report Fiscal Year 2022. https://s27.q4cdn.com/743947716/files/doc_financials/2022/ar/KMX-FY22-Annual-Report.pdf

world. Some MaaS providers offer their own fleet of vehicles, which customers can access through an online platform. Evo Car Share, operated by the British Columbia Automobile Association, and Modo are the most prominent companies (at the time of writing (March 2023)) in BC to offer fleets to their customers. The vehicles in these fleets are likely to require more frequent maintenance than personal vehicles due to higher usage rates and more demanding operating conditions. The repair and maintenance of these vehicles would also be categorized as fleet maintenance which has a number of implications. Fleet maintenance and repair are typically performed in-house or through contracts with specific companies. If an increasing number of vehicles are being provided through fleets, there may be less work done at small independent shops. As well as implications for repair and maintenance, the rollout of ZEV across these fleets will require strategies for charging so that vehicles are readily available. The Sector is still assessing how it will address this issue.

OEMs and dealerships are introducing a similar offering under a subscription model, which includes allowing customers to pay a monthly or yearly fee for access to a vehicle rather than owing one. Further, some OEMs have begun implementing a new service called features-on-demand in certain regions. This service enables customers to subscribe to additional features that have been originally blocked by software. BMW's ConnectedDrive store is one such example. In certain regions, BMW owners are able to unlock certain features by purchasing or subscribing to them through the ConnectedDrive store. This adds an additional layer of complication when it comes to repairing these vehicles, since OEMs will have the technical capability to require that these features be only serviced or repaired at an OEM-certified facility or franchised dealership.

Key Findings

- The impact technology is expected to have on recruitment and retention is unclear. For some, the increased use of technology was seen as a pull factor particularly for those interested in technology. For others, it may act as a push factor especially for older workers who may not want to invest in upskilling.
- D2C models employed by OEMs, the rise of MaaS and the increased use of online sales platforms by dealers are the changing business models used in the Sector. This has implications for the aftermarket in terms of how and where products and services will be provided.
- Changing business models may also change the nature of work for those working in sales and services in dealerships.

6. Recommendations

The Sector is facing a wave of technological change including the increasing adoption of ZEVs and rise of automation. This has significant implications for the skills required of the workforce. There are also expected to be changes in how products and services are delivered due to changes in business models.

Key Findings

The key findings from this research are:

- Of the five technologies included in this study, **ZEV adoption is expected to have the most significant impact on the Sector**. While ZEVs bear a number of similarities to ICE vehicles, they also differ in some elements related to repair and maintenance, towing and recycling. These differences create the requirement for new skills and the strengthening of existing ones.
- **The complexity of repair work is set to increase.** While ZEVs are expected to require less maintenance and ADAS technologies are expected to reduce the number of collisions, the nature of repairs may be more complex and severe (in the case of collision repairs). ADAS technologies have a lot of sensors and components that need to be properly calibrated to function correctly. Batteries and fuel systems in ZEVs are complex and several safety considerations need to be accounted for in repairing them.
- **Adoption timelines remain unclear as there are a number of factors affecting adoption.** Approximately 50 percent of on-road vehicles are expected to be ZEVs by 2035 and approximately 60 percent by 2040. However, several factors may impact this adoption timeline, such as manufacturing capacity, the cost of the technology for both the consumer (e.g., ZEVs) and businesses (e.g., AI, robotics) and geographic location.
- **Minor changes to the Sector's overall workforce composition are forecasted.** While minor shifts in workforce compositions may be expected within sub-sectors, the overall workforce composition of the Sector is expected to be largely unaffected.
- **Automotive service and autobody and collision technicians, auto dismantlers and IT specialists** are the occupations anticipated to see the **greatest requirement for upskilling and reskilling**. Electrical, battery and technological skills such as software programming and computer diagnostics are the priority areas of training for these occupations. Other priority areas for the wider sector include data literacy and analytics and health and safety skills.
- **A mix of skills is expected to be required owing to the mix of vehicle fuels that will be in circulation in 2040.** A combination of mechanical and electrical skills will be required across the Sector. Although ZEVs are expected to require less maintenance, there will still be a need for maintenance and repair of brakes, suspension, HVAC systems and electronic systems. Further, ICE vehicles are estimated to still comprise some 40 percent of the provincial vehicle fleet in 2040 and will need repair and maintenance.

- **Skill shortages may continue to emerge.** The current skill set of the workforce is not growing at the same speed as technological change creating a skill gap between that of the workers and what employers require. Skills related to battery removal, IT, electrical, software programming and data analytics were areas identified as most at risk of being in short supply.
- **The frequency of training is expected to increase.** On-going training is set to become a requirement for those working in the Sector. This is particularly true for automotive service technicians and autobody and collision technicians, whose roles are among those occupations forecast to experience the greatest degree of change. (Please note that the need for ongoing training is distinct from the re-introduction of skilled trades certification (also known as mandatory certification) for these occupations). As such, a continuous learning mentality, albeit not a skill, was noted as a highly important requirement for current and future workers.
- **The costs associated with increased training and skill development will likely affect some businesses' viability, which may lead to consolidation and changes in service availability in some regions.** Approximately 70 percent of businesses in the Sector have fewer than 10 employees and 4 percent have more than 50. Smaller businesses may be less able to invest in training, skill development, and technology. This is particularly true in cases where facilities cannot pass their training costs on to their customers or among facilities that may not have the volume to justify investments in accessing repair information and training. As a result, facilities may consolidate or specialize in specific services or vehicle types. This may also reduce the availability of services in some regions of the province and/or change how services are provided in rural areas.
- **Skill specialization is forecast to increase.** There is some consensus that a trend towards skill specialization will emerge (e.g., the specialization of repair and maintenance for ZEVs and ICE vehicles). With it, new occupations are also set to appear. As new roles emerge and others evolve to become more specialized, training is also expected to become more specialized. This will have implications for the provision and design of training.
- **Car ownership models are beginning to change.** This has implications for the number of vehicles on the road. Specifically, the rate of growth of vehicles on the road will be lower than the projected growth in the driving age population due to anticipated changes in car ownership in urban areas. Changing ownership models also impact the frequency of repair and maintenance. Vehicles that are part of a car share system or fleet will likely require more frequent maintenance than personal vehicles due to higher usage rates and more demanding operating conditions.
- **How batteries are managed will have implications for the Sector and its workforce.** Currently, no system is in place to safely repurpose and recycle ZEV batteries. The development and implementation of an EPR program for ZEV batteries are identified in the Ministry of Environment and Climate Change Strategy's Extended Producer Responsibility Five Year Action Plan 2021-2026.[68] The design and delivery of the EPR program have the potential to create new occupations within the Sector and will impact training requirements for those dealing with vehicles for which

[68] Government of BC. Advancing Recycling in B.C. Extended Producer Responsibility Five Year Action Plan 2021-2026. Retrieved from: https://www2.gov.bc.ca/assets/gov/environment/waste-management/recycling/recycle/extended_producer_five_year_action_plan.pdf

the batteries are being removed and/or replaced.

Recommendations

Recommendations for the Sector in adapting to new technologies and addressing skill development and training include:

- **Improve the Sector's image.** There is general agreement that negative perceptions are held about working in the Sector. This has implications when it comes to recruiting workers. However, there is an opportunity to improve the sector's image through marketing, education and engagement. In particular, targeted messaging emphasizing sustainability and environmental efforts (e.g., ZEVs, recycling programs, and reducing waste in production), showcasing the innovative work being done, including advancements in ADAS and AVs, and communicating how employees can play a role in shaping the future of transportation are several areas the Sector can highlight. For example, recyclers could rebrand their sub-sector as part of the green jobs movement. These messages have the potential to resonate strongly with youth audiences, in particular. Improving the Sector's image will require a concerted effort from sub-sector participants, government, PSIs, and other stakeholders. Engagement strategies with K-12 students, a provincial/national awareness and reputation campaign and leveraging existing career initiatives are just some options to execute this path forward.
- Businesses and workers should **prepare to dedicate more time and resources to training** as requirements for upskilling and reskilling are set to increase for most Sector occupations. Preparations for employers may include setting aside additional time for on-the-job training, establishing mentorships between younger and older staff members to aid knowledge transfer (in both directions), subsidizing training costs, accommodating time-off for external training and coordinating schedules to minimize disruption to business operations while staff are away for training. Employees should also be prepared to spend additional time in training, including travel time when virtual options are not available. Investment from government and PSIs will also be required to ensure the necessary training is available in the required geographic areas and at a sufficient frequency of delivery (see below).
- **Establish standards for training across the province.** Many occupations in the Sector will require higher levels of training or completely new skills due to innovation and technological advancements. However, to date, programming has struggled to keep pace with the rate of technological change leading to variation in both access to training and in relation to specific training content. Interviewees suggested establishing standards and associated certifications (e.g., micro-credentials) for training as it relates to teachings on new technologies and their implications for health and safety. This will require existing training to be updated and new training to be introduced. As part of this, PSIs, in consultation with the Sector, may be required to review and update programming more regularly than the current cadence (e.g., every 3-5 years).
- **Where applicable, introduce new programming and modalities that address specific Sector needs.** While existing programming modifications will address some of the future training requirements, new programming will still be required. Micro-credentials represent an increasingly popular modality for upskilling and providing professional development opportunities as they are

often offered at a shorter length, lower cost and with flexible delivery options than traditional post-secondary programs. In time, AR and VR will represent opportunities to train the workforce as well.

- **(Continued) Investment and support from government** to roll out the required infrastructure that is needed for this wave of technological advancements. Many investments, including expanding the public charging network, supporting existing multi-unit buildings to include charging stations, and developing new or updating existing regulations and policies to embrace newer ADAS features, will be required by government to help the province transition to ZEVs and automated technologies. Thinking specifically about skills and training development, investments will be required to update existing programming, design and introduce new programming, add additional instructors, provide flexible training options and availability in communities across the province and additional subsidization of training.
- **Identify opportunities for industry collaboration in the provision of training.** Most businesses in the Sector have fewer than 10 employees. The small nature of facilities creates challenges when it comes to investing in training and development. There may be opportunity for businesses to collaborate in the provision of training. For example, sharing the cost of bringing an instructor to a region to train technicians from a group of facilities rather than sending technicians out-of-town for training. If a number of facilities can work together to offer training, it could lower the cost for individual businesses and allow them to invest in training. Coordination of training opportunities could be done through the ARA.
- **Identify ways to ensure access to repair information.** Access to repair information and equipment, more commonly known as the 'Right to Repair,' was noted as one of the enduring challenges faced by the Sector. The cost of accessing OEM repair information is a barrier for aftermarket service providers and could lead to reductions in the availability of services and increases in the cost for consumers. The Sector should work with OEMs, regulatory bodies (e.g., SkilledTradesBC), PSIs and government to identify ways to facilitate access to information for training and the provision of repair and maintenance services to ensure continued availability of service for consumers.
- **Work with the Ministry of Environment and Climate Change Strategy to define the Sector's role in the management of ZEV batteries.** The recycling and repurposing of ZEV batteries will require training for those working with batteries at each stage of the lifecycle. It may also create new occupations in the Sector.

Appendix A – Legal Matters

This report is provided for information purposes and is intended for general guidance only. It should not be regarded as comprehensive or a substitute for personalized business or investment advice. We have relied upon the completeness, accuracy and fair presentation of all information and data obtained from secondary sources and through primary research activities. The accuracy and reliability of the findings and opinions expressed in the presentation are conditional upon the completeness, accuracy and fair presentation of the information underlying them. As a result, we caution readers not to rely upon any findings or opinions expressed for business or investment purposes and disclaim any liability to any party who relies upon them as such.

Additionally, the findings and opinions expressed in the presentation constitute judgments as of the date of the report and are subject to change without notice. MNP is under no obligation to advise of any change brought to its attention which would alter those findings or opinions.

Finally, our analysis is based on factors that rely on past events and approximations developed by government statistical agencies. These factors and approximations give expectation of current and future events. However, current and future events are not guaranteed to follow past events and results may vary, even significantly.

Appendix B – Steering Committee

Organization	Position	Contact
Sector Labour Market Partnership Program	Ex-officio	Matthew Boddy
Automotive Retailers Association	Project Manager and Subject Matter Expert (SME)	Ken Hendricks
Ministry of Energy, Mines and Low Carbon Innovation, Senior Policy Analyst	Ex-officio	Ryan Citron
Automotive Retailers Association, President and CEO	SME	Adrian Scovell
Automotive Retailers Association, Senior Advisor	SME and Support Staff	David Ribeiro
Automotive Retailers Association, Senior Advisor	SME and Support Staff	Dejla Sabanac
SkilledTradesBC Industry Relations	SME and Ex-officio	Craig Woods
British Columbia Institute of Technology	SME and Post-Secondary Representative	Mubasher Faruki
Precision Auto, Owner	SME and Industry Representative	Scott Waddle
Open Road Auto Group, Quality Assurance Manager	SME and Industry Representative	Aaron Au
Lift Auto Group, VP	SME and Industry Representative	John Martinolich

Appendix C – Primary Data Collection

Interviews

Invitations and Sample Design

The target sample design by region for key informant interviews is shown in the table below.

Stakeholder Group	Provincial Organizations	Lower Mainland	Vancouver Island	Interior	Northern BC	Outside BC	Target Total
1. Sub-Sectors							
Aftermarkets Parts		2	1				2
Automotive Recyclers		1	1	1			3
Auto Glass Repair		1	1				2
Collision Repair		3	2	1	1		7
Mechanical Repair and Maintenance		3	3	1	1		8
New Car Dealers		4	2	1			7
Used Car Dealers		1	1	1		1	4
Towing		2	1	1	1		5
2. Post-Secondary – Public		1	1	1	1		4
3. Post-Secondary – Private		2		1			3
4. Original Equipment Manufacturers/ Tier 1 Suppliers						3	3
5. Other Organizations							
Insurance Providers, including ICBC	1					1	2
Car Share Providers, including BCAA	1					1	2
Regulatory (MVSA, WorkSafe)	2					1	3
SkilledTradesBC	1						1
Total	**5**	**19**	**13**	**8**	**4**	**7**	**56**

Invitations to participate in the key informant interviews were sent to 64 industry stakeholders. The invitation list was compiled in conjunction with the ARA and the Project Governance Committee and through public sources.

Interviewees

The table below shows the distribution of interview participants by stakeholder group and region.

Stakeholder Group	Provincial Organizations	Lower Mainland	Vancouver Island	Interior	Northern BC	Outside BC	Invited	Completed
1. Sub-Sectors								
Aftermarkets Parts		1					2	1
Automotive Recyclers		1	1	1			4	3
Auto Glass Repair							3	0
Collision Repair		3	1	1		2	7	7
Mechanical Repair and Maintenance		4	2				9	6
New Car Dealers		5					7	5
Used Car Dealers		1	1			1	4	3
Towing		2					3	2
2. Post-Secondary – Public		1		1	1		6	3
3. Post-Secondary – Private				1			5	1
4. Original Equipment Manufacturers/ Tier 1 Suppliers						3	8	3
5. Other Organizations								
Insurance Providers, including ICBC	1					1	2	2
Car Share Providers, including BCAA	1					1	2	1
Regulatory (MVSA, WorkSafe)	2					2	4	4
SkilledTradesBC	1						1	1
Total	**5**	**19**	**13**	**8**	**4**	**7**	**66**	**42**

Focus Groups

The table below shows the distribution of focus groups participants by stakeholder group and region.

Stakeholder Group	Provincial Organizations	Lower Mainland	Vancouver Island	Interior	Northern BC	Outside BC	Total
1. Sub-Sectors							
Aftermarkets Parts		2					2
Automotive Recyclers		2	1	1			4
Auto Glass Repair							
Collision Repair		3	1	1		2	7
Mechanical Repair and Maintenance		1	2				3
New Car Dealers		1					1
Used Car Dealers		2	1				3
Towing						2	2
2. Post-Secondary – Public		2			1		3
3. Post-Secondary – Private		1					1
4. Original Equipment Manufacturers/ Tier 1 Suppliers			1			2	3
5. Other Organizations							
Car Share Providers, including BCAA	1						1
Regulatory (MVSA, WorkSafe)	2						2
Total	**3**	**14**	**6**	**2**	**1**	**6**	**32**

Appendix D – Occupation Descriptions

The occupation descriptions contained in this appendix are based on National Occupation Classification System Codes for each occupation.

Skilled Trade Occupations

Occupation	NOC Code	Position Description
Parts-person (including apprentices)	14401	A parts-person rents, sells or leases tools, parts, vehicles and equipment to customers. They are employed by Aftermarket Parts retailers, wholesalers and New Car Dealers. They may also work in Auto Recyclers and Mechanical Repair shops.
Automotive Service Technician (including apprentices)	72410	Automotive Service Technicians examine, test and repair the parts and systems on cars and light trucks. Their work also involves reassembling and testing repaired items against manufacturers' standards and performing preventative maintenance such as wheel alignments, oil changes and tune ups. They are employed by Mechanical Repair shops, New Car Dealers and Auto Recyclers.
Motor Vehicle Body Repairers (includes Autobody and Autobody and Autobody and Autobody and Collision Technician, Automotive Glass Technician, Automotive Painter, Automotive Refinishing Prep Technician and apprentices)	72411	Motor vehicle body repairers repair and replace damaged vehicle body parts and interior finishing, repaint body surfaces and may replace automotive glass. They may be employed in Auto Glass Repair shops, Collision Repair shops, New Car Dealers, automobile appraisal centres and Auto Recyclers.

Other Trades and Technical Occupations

Occupation	NOC Code	Position Description
Inventory/Warehouse Person	14401	Inventory and Warehouse employees in the Sector compile and maintain records of quantity, type and value of material, equipment, merchandise, or supplies. They may be employed at Aftermarket Parts retailers, New Car Dealers, and Auto Recyclers.
Lot Person	65329	Lot employees are responsible for managing and caring for the cars in a car lot. Attendants work at different kinds of lots, including at New Car Dealers and Used Car Dealers.
Auto Dismantler	73209	Auto Dismantlers carefully take a vehicle apart and place salvageable parts into an inventory to be sold or used in future auto repairs. They are employed by Auto Recyclers.
Tow Truck Operator	73300	Tow Truck Operators offer a variety of vehicle-related repair and hauling services to non-commercial and commercial vehicle drivers, police, municipalities and even other tow truckers. They may be employed by Towing and Recovery companies and other businesses in the Sector.
Parts Delivery Driver	75201	Delivery and courier service drivers drive automobiles, vans and light trucks to pick up and deliver auto parts. They are mainly employed by Aftermarket Parts retailers but may also be employed by New Car Dealers, Mechanical Repair shops, and elsewhere in the Sector.
Detailer	75119	Detailers clean, wash and wax vehicles such as passenger cars, trucks, vans and trailers. They may be employed by New Car Dealers, Used Car Dealers, Collison Repair shops and Auto Glass Repair shops.
Shop Helper	75119	This unit group includes trade helpers and labourers who assist skilled tradespersons and perform laboring activities in the maintenance and repair of vehicles. They are employed throughout the Sector.
IT Specialist	21222	IT specialists in the Sector manage and maintain the technology infrastructure used in the company, including hardware, software, and networking systems. They provide technical support to staff and ensure that the systems are secure, reliable, and up to date with the required industry standards. They also work with other management positions in the company to ensure that the databases are meeting business needs and supporting effective decision-making.

Sales and Administration Occupations

Occupation	NOC Code	Position Description
Business Office (includes general administrators that are not customer facing and that perform multiple functions such as bookkeeping, payroll, human resources etc.)	14100	General office support workers prepare correspondence, reports, statements and other material, operate office equipment, answer telephones, verify, record and process forms and documents such as contracts and requisitions and perform general clerical duties according to established procedures. They are employed throughout the Sector.
Warranty Clerk	14100	Warranty Clerks organize, process and review warranty claims made by the customers and ensure that their employers are paid for all product maintenance parts or replacements covered under a warranty. They are usually employed by New Car Dealers or Aftermarket Parts retailers.
Customer Service Representative (includes receptionists and front desk staff and customer facing staff not otherwise specified)	14101	Customer Service Representatives are responsible for greeting customers arriving at the front desks / greeting areas, directing visitors to appropriate people or services, answering and forwarding telephone calls, taking messages, scheduling appointments and performing other clerical duties. They are employed throughout the automotive sector.
Licensed Automotive Salesperson	64100	Licensed Automotive Salespeople sell or lease a range of vehicles including commercial vehicles, motorcycles, power sport, and personal vehicles to customers. They are employed by New Car Dealers, Used Car Dealers and other businesses that sell vehicles.
Service Advisor	64409	Service Advisors supervise and co-ordinate the activities of Customer Service Representatives in the Automotive Sector. They are employed throughout the Sector by businesses offering repair services.
Estimator	72410/72411	Estimators inspect vehicles to determine the level of damage, and cost of repairs. Estimators may be employed by New Car Dealers, Used Car Dealers, Collison Repair Shops and Auto Glass Repair shops.
Tow Dispatcher	14404	Tow Dispatchers operate radios and other telecommunication equipment to support tow truck operators.

Management Occupations

Occupation	NOC Code	Position Description
Controller	00012	Controllers will hold a significant leadership position within a participating Sector company. They are responsible for planning, organizing, directing, controlling, and evaluating the operations of their company /organization in relation to established objectives.
Finance Manager	10021	Finance Managers are responsible for overseeing the finance/credit departments in New Car Dealers and Used Car Dealers in the Sector. Their responsibilities include planning, organizing, directing, controlling and evaluating the activities of the department.
Sales Manager	60020	Sales Managers plan, organize, direct, control and evaluate the sales operations of establishments within the the Sector that sell merchandise or services on a retail or wholesale basis. They are employed throughout the Sector.
Fixed Operations Manager	60020	Fixed Operations Manager plan organize, direct, control and evaluate the operations of repair and maintenance shops/garages or dealership's repair departments. They supervise a team of technicians, or other staff in the repair department or organization and are responsible for managing workload, inventory, and client service.
Service Manager	10029	Service Managers plan, organize, direct and control service departments in New Car Dealers. They respond to customer inquiries and resolve problems.
Parts Manager	12013	Supervisors in this unit group supervise and co-ordinate the activities of partspersons (NOC 14401). They are employed by Aftermarket Parts retailers, wholesalers, New Car Dealers, and Auto Recyclers.
Leasing Agent	64100	Leasing Agents lease a range of vehicles including commercial, motorcycles, power sport vehicles, and personal vehicles to customers. They are employed by New Car Dealers.

Appendix E – Labour Market Forecasts

Growth Assumptions

Key Assumptions

The key assumptions that were used to estimate the labour demand projections are provided below:

- Apart from towing and recovery and auto recycling, the net growth in the number of locations for each subsector is assumed to equal zero percent annually from 2022 to 2040. For towing and recovery and auto recycling, the number of locations was assumed to decrease annually by 0.4 percent and 2 percent, respectively.
- Vehicle sales were expected to grow by 3 percent annually between 2022 and 2040.
- The on-road vehicle fleet is expected to grow by 0.9 percent annually between 2022 and 2040.
- The number of collision repairs as a percentage of on-road fleet is expected to be about 7.6 percent each year for vehicles not equipped with ADAS and about 4.9 percent for vehicles equipped with ADAS. This results in a decrease in collision repairs of about 8 percent in total between 2022 and 2040 (collision repairs increase between 2022 and 2028 and then decreased between 2029 and 2040).
- The number of glass repairs as a percentage of vehicles is expected to be about 3.9 percent each year (resulting in growth in the number of glass repairs of 0.9 percent annually).

There are a number of factors that affect the demand for labour in the Sector. These factors vary by occupation and sub-sector. The following table outlines the approach used to develop workforce projections for each occupation.

Job Type	Occupations	Job Growth Assumptions	Exceptions
Skilled Trades	• Autobody and Collision Repair Technician	Demand for Autobody and Collision Repair Technicians is driven by the number of hours of work required for vehicle repairs. Repairs on vehicles not equipped with ADAS were assumed to require an average of 10 hours and repairs on vehicles equipped with ADAS were assumed to require 11 hours of a technician's time (10 percent higher than vehicles not equipped with ADAS)	
	• Automotive Glass Technician	Growth in the number of Automotive Glass Technicians is based on the number of glass repairs.	
	• Automotive Painter	Demand for Automotive Painters based on the number of collision repairs assuming that each repair requires 6 hours of a painter's time.	
	• Automotive Refinishing Prep Technician	Demand for Automotive Refinishing Prep TechnicianS is driven by growth in the number of locations in each sub-sector.	
	• Automotive Service Technician	Demand for Automotive Service Technicians is based on the hours required for mechanical repairs. It was assumed that an ICE vehicle requires 15 hours of mechanical repairs in a year, whereas a ZEV would require between 10 to 12 hours.	
	• Partsperson	Demand for Partsperson is driven by growth in the number of locations in each sub-sector.	Demand for Partsperson at New Car Dealers is based on growth in the vehicle fleet.

Job Type	Occupations	Job Growth Assumptions	Exceptions
Apprentices	• Autobody and Collision Repair Technician Apprentice • Automotive Glass Technician Apprentice • Automotive Painter Apprentice • Automotive Service Technician Apprentice • Partsperson Apprentice	Demand for Apprentices is driven by the same factors that affect growth in technicians as well as age profile and share of the workforce retiring.	
Other Trades and Technical Positions	• Auto Dismantler • Detailer • Inventory/Warehouse People • Lot Person • Parts Delivery Driver • Shop Helper • Tow Truck Operator • Traffic Control/Flag People • IT Specialists/ Cybersecurity Analyst/Network Specialists	Demand for these positions is based on growth in the number of locations in each sub-sector.	Demand for Detailers and Inventory/Warehouse People at New Car Dealers is based on growth in the vehicle fleet. The number of IT positions at dealers is assumed to increase between 2022 to 2040 (from 0.25 jobs per establishment to 0.5 jobs per establishment) IT positions may also be required by Mechanical Repair shops and Recyclers by 2040 (approximately 0.25 to 0.5 positions per business)
Administration and Sales Positions	• Administrative Clerks • Estimator • Tow Dispatchers • Customer Service Representative • Service Advisors • Warranty Clerks	Demand for Warranty Clerk, Customer Service Representatives, Tow Dispatcher and Estimator is based on growth in the number of locations in each sub-sector. .	Demand for Administrative Clerks, Customer Service Representatives and Estimators was expected to increase at collision and mechanical repair shops owing to the increasing complex nature of the vehicles. Automation technology was assumed to decrease the need for administrative clerks at New and Used Car Dealers. One job required per business was assumed to decrease to 0.75 jobs

Job Type	Occupations	Job Growth Assumptions	Exceptions
	• Licensed Automotive Salespeople	Demand for Licensed Automotive Salesperson is based on growth in vehicle sales and an increase in the number of sales through online platforms. Based on this by 2040 there will be approximately 10 salespeople per dealer.	
Management Occupations	• Controller • Fixed Operations Manager • Parts Manager • Sales Manager • Service Manager • Leasing Agents • Finance Manager	Demand for Management Occupations was based on growth in the number of locations in each sub-sector.	Demand for Sales Manager and Leasing Agents at New Car Dealers is based on growth in the vehicle fleet. Automation technology was assumed to decrease the need for management positions at New and Used Car Dealers. One job required per business was assumed to decrease to 0.75 jobs.

Workforce Compositions by Occupation and Sub-Sector

New Car Dealers

Occupations	2022	2030	2035	2040
Skilled Trades	25.2%	26.8%	26.6%	26.0%
Automotive Autobody and Collision Repair Technician Apprentices	0.1%	0.1%	0.1%	0.1%
Automotive Autobody and Collision Repair Technicians (not including apprentices)	0.2%	0.2%	0.2%	0.2%
Automotive Glass Technicians (not including apprentices)	0.1%	0.1%	0.1%	0.1%
Automotive Painter Apprentices	0.1%	0.1%	0.1%	0.1%
Automotive Painters (not including apprentices)	0.1%	0.1%	0.1%	0.1%
Automotive Service Technician Apprentices	5.0%	6.0%	6.0%	5.9%
Automotive Service Technicians (not including apprentices)	14.4%	14.8%	14.5%	13.9%
Parts Salesperson (not including apprentices)	4.8%	5.0%	5.2%	5.3%
Parts Salesperson Apprentices	0.4%	0.4%	0.4%	0.4%
Other Trades and Technical	17.4%	17.2%	17.4%	17.7%
Detailers	5.0%	5.1%	5.3%	5.5%
Inventory / Warehouse People	0.4%	0.4%	0.4%	0.4%
Lot People	8.8%	8.4%	8.3%	8.2%
Parts Delivery Drivers	1.3%	1.3%	1.2%	1.2%
Shop Helpers	1.3%	1.2%	1.2%	1.2%
IT Specialist	0.6%	0.8%	1.0%	1.2%
Sales and Admin	41.3%	40.7%	40.9%	41.3%
Administrative clerks	6.7%	5.6%	5.1%	4.7%
Customer Service Representatives	7.2%	7.4%	7.6%	7.9%
Estimators	0.1%	0.1%	0.1%	0.1%
Licensed Automotive Salespeople	20.3%	20.7%	21.3%	21.8%
Service Advisors	6.2%	5.9%	5.9%	5.8%
Warranty Clerks	0.9%	1.0%	1.0%	1.0%
Management	16.1%	15.3%	15.1%	15.0%
Controllers	1.2%	1.0%	0.9%	0.8%
Finance Managers	4.7%	5.1%	5.4%	5.7%
Fixed Operations Managers	1.4%	1.2%	1.1%	1.0%
Leasing Agents	1.3%	1.3%	1.4%	1.5%
Parts Managers	1.4%	1.2%	1.1%	1.0%
Sales Manager	4.6%	4.2%	4.0%	3.9%
Service Managers	1.5%	1.3%	1.2%	1.1%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Used Car Dealers

Occupations	2022	2030	2035	2040
Skilled Trades	11.1%	11.4%	11.1%	10.9%
Automotive Service Technicians (not including apprentices)	5.6%	5.8%	5.7%	5.5%
Motorcycle / Power Equipment Mechanics (not including apprentices)	5.4%	5.6%	5.5%	5.3%
Other Trades and Technical	25.8%	27.8%	29.2%	30.8%
Detailers	13.7%	14.0%	14.2%	14.2%
Lot People	2.7%	2.8%	2.8%	2.8%
Shop Helpers	5.4%	5.5%	5.6%	5.6%
IT Specialist	3.9%	5.4%	6.7%	8.1%
Sales and Admin	46.7%	46.0%	45.8%	45.5%
Administrative clerks	24.8%	22.3%	20.8%	19.4%
Customer Service Representatives	5.4%	5.5%	5.6%	5.6%
Licensed Automotive Salespeople	13.7%	15.4%	16.5%	17.6%
Service Advisors	2.7%	2.8%	2.8%	2.8%
Management	16.5%	14.8%	13.8%	12.9%
Controllers	2.7%	2.4%	2.3%	2.1%
Sales Manager	13.8%	12.4%	11.6%	10.7%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

After Market Parts

Occupations	2022	2030	2035	2040
Skilled Trades	43.9%	43.9%	43.9%	43.9%
Parts Salespeople (not including apprentices)	42.6%	42.6%	42.6%	42.6%
Parts Salesperson Apprentices	1.3%	1.3%	1.3%	1.3%
Other Trades and Technical	37.4%	37.4%	37.4%	37.4%
Inventory / Warehouse People	12.6%	12.6%	12.6%	12.6%
Parts Delivery Drivers	24.8%	24.8%	24.8%	24.8%
Management	18.7%	18.7%	18.7%	18.7%
Parts Managers	6.2%	6.2%	6.2%	6.2%
Sales Manager	12.5%	12.5%	12.5%	12.5%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Towing and Recovery

Occupations	2022	2030	2035	2040
Skilled Trades	1.4%	1.4%	1.4%	1.4%
Automotive Service Technicians (not including apprentices)	1.4%	1.4%	1.4%	1.4%
Other Trades and Technical	70.5%	70.5%	70.5%	70.5%
Tow Truck Operators	65.9%	65.9%	65.9%	65.9%
Traffic Control / Flag People*	4.6%	4.6%	4.6%	4.6%
Sales and Admin	28.1%	28.1%	28.1%	28.1%
Administrative clerks	8.7%	8.7%	8.7%	8.7%
Customer Service Representatives	1.4%	1.4%	1.4%	1.4%
Tower Operators / Dispatchers	18.0%	18.0%	18.0%	18.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

*Please note that this occupation is not affected by technological advancements discussed in the report

Auto Glass Repair

Occupations	2022	2030	2035	2040
Skilled Trades	71.3%	73.9%	74.8%	75.6%
Automotive Glass Technician Apprentice	23.4%	27.0%	27.4%	27.7%
Automotive Glass Technicians (not including apprentices)	48.0%	46.9%	47.4%	48.0%
Other Trades and Technical	1.2%	1.1%	1.1%	1.0%
Detailers	0.3%	0.3%	0.2%	0.2%
Shop Helpers	0.9%	0.9%	0.8%	0.8%
Sales and Admin	26.9%	24.4%	23.6%	22.9%
Administrative clerks	14.7%	13.4%	12.9%	12.5%
Customer Service Representatives	9.6%	8.7%	8.5%	8.2%
Estimators	1.6%	1.5%	1.4%	1.4%
Service Advisors	0.9%	0.9%	0.8%	0.8%
Management	0.6%	0.5%	0.5%	0.5%
Controllers	0.3%	0.3%	0.2%	0.2%
Sales Manager	0.3%	0.3%	0.2%	0.2%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Mechanical Repair

Occupations	2022	2030	2035	2040
Skilled Trades	60.7%	60.8%	58.6%	56.8%
Automotive Autobody and Collision Repair Technician Apprentices	0.8%	1.0%	0.9%	0.9%
Automotive Autobody and Collision Repair Technicians (not including apprentices)	2.0%	2.0%	1.9%	1.9%
EV Technicians/Battery Technicians	0.8%	4.1%	10.0%	16.1%
Automotive Service Technician Apprentices	15.1%	16.4%	15.5%	14.8%
Automotive Service Technicians (not including apprentices)	0.8%	33.2%	26.1%	19.1%
Parts Salespeople (not including apprentices)	3.7%	3.6%	3.6%	3.5%
Parts Salesperson Apprentices	0.4%	0.5%	0.5%	0.5%
Other Trades and Technical	8.9%	8.7%	9.8%	11.0%
Detailers	2.8%	2.8%	2.7%	2.7%
Lot People	2.8%	2.7%	2.7%	2.7%
Shop Helpers	2.4%	2.4%	2.4%	2.3%
Tow Truck Operators	0.8%	0.8%	0.8%	0.8%
IT Specialist / Cybersecurity Analyst	0.0%	0.0%	1.3%	2.5%
Sales and Admin	24.8%	25.1%	26.1%	26.9%
Administrative clerks	10.6%	10.8%	11.4%	11.8%
Customer Service Representatives	2.8%	2.8%	2.7%	2.7%
Licensed Automotive Salespeople	1.6%	1.6%	1.6%	1.5%
Service Advisors	8.9%	9.2%	9.6%	10.0%
Tower Operators / Dispatchers	0.8%	0.8%	0.8%	0.8%
Management	5.7%	5.5%	5.5%	5.4%
Controllers	0.4%	0.4%	0.4%	0.4%
Finance Managers	0.4%	0.4%	0.4%	0.4%
Fixed Operations Managers	0.4%	0.4%	0.4%	0.4%
Parts Managers	0.4%	0.4%	0.4%	0.4%
Service Managers	4.0%	3.9%	3.9%	3.9%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Collision Repair

Occupations	2022	2030	2035	2040
Skilled Trades	54.3%	54.8%	53.4%	52.1%
Automotive Autobody and Collision Repair Technician Apprentices	7.0%	8.2%	8.0%	7.8%
Automotive Autobody and Collision Repair Technicians (not including apprentices)	23.2%	18.7%	13.6%	8.9%
Automotive Autobody and Collision Repair Technician – (Specializing in ZEVs/ADAS/Diagnostic Technician)	2.2%	6.0%	10.5%	14.6%
Automotive Glass Technicians (not including apprentices)	2.9%	3.0%	3.1%	3.2%
Automotive Painter Apprentices	2.9%	3.4%	3.2%	3.1%
Automotive Painters (not including apprentices)	13.3%	12.8%	12.2%	11.7%
Automotive Refinishing Prep Technicians	2.9%	2.8%	2.8%	2.8%
Other Trades and Technical	11.4%	10.9%	10.9%	10.9%
Detailers	8.9%	8.6%	8.6%	8.5%
Inventory / Warehouse People	0.6%	0.6%	0.6%	0.6%
Parts Delivery Drivers	0.2%	0.2%	0.2%	0.2%
Shop Helpers	1.6%	1.6%	1.6%	1.6%
Sales and Admin	30.8%	30.9%	32.4%	33.6%
Administrative clerks	12.2%	12.4%	13.1%	13.7%
Customer Service Representatives	6.1%	5.8%	5.8%	5.8%
Estimators	12.5%	12.7%	13.4%	14.1%
Management	3.5%	3.4%	3.3%	3.3%
Controllers	0.8%	0.8%	0.8%	0.8%
Fixed Operations Managers	1.4%	1.4%	1.4%	1.4%
Parts Managers	0.6%	0.6%	0.6%	0.6%
Sales Manager	0.2%	0.2%	0.2%	0.2%
Service Managers	0.4%	0.4%	0.4%	0.4%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Auto Recycling

Occupations	2022	2030	2035	2040
Skilled Trades	32.5%	33.1%	32.9%	32.9%
Automotive Autobody and Collision Repair Technicians (not including apprentices)	2.3%	2.7%	2.8%	3.0%
Automotive Service Technicians (not including apprentices)	2.5%	3.0%	2.6%	1.6%
Parts Salespeople (not including apprentices)	0.0%	0.0%	0.5%	1.7%
Parts Salesperson Apprentices	26.3%	26.0%	25.6%	25.2%
EV/Battery Technician	1.4%	1.4%	1.4%	1.4%
Other Trades and Technical	50.8%	50.4%	50.8%	51.1%
Auto Dismantlers / Parts Pullers	40.4%	40.0%	39.4%	38.8%
Inventory / Warehouse People	5.1%	5.0%	5.0%	4.9%
Parts Delivery Drivers	1.4%	1.4%	1.4%	1.4%
Tow Truck Operators	4.0%	3.9%	3.9%	3.8%
IT Specialist	0.0%	0.0%	1.3%	2.2%
Sales and Admin	13.0%	12.9%	12.7%	12.5%
Administrative clerks	9.3%	9.2%	9.1%	9.0%
Licensed Automotive Salespeople	2.3%	2.2%	2.2%	2.2%
Service Advisors	1.4%	1.4%	1.4%	1.4%
Management	3.7%	3.6%	3.6%	3.5%
Controllers	2.3%	2.2%	2.2%	2.2%
Service Managers	1.4%	1.4%	1.4%	1.4%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Appendix F – Skill Defintions

Skills	Definition
Technical	
Mechanical	The ability to diagnose, repair, and maintain the mechanical systems of vehicles. This includes skills related to performing routine maintenance such as oil changes, tire rotations, and brake inspections, as well as more complex repairs involving engine or transmission components
Machine Use	The ability to operate, maintain, and troubleshoot various machines and equipment used for servicing and repairing vehicles. This includes skills related to using hand and power tools, diagnostic equipment, and computerized systems to perform tasks such as engine or electric motor repair, brake service, suspension service, and electrical system diagnosis.
Electrical	The ability to diagnose, repair and maintain the electrical systems in vehicles. This includes the ability to read and interpret wiring diagrams, test electrical components, and use diagnostic tools and equipment to identify and fix electrical programs.
Battery Testing and Repair	The ability to diagnose, test, and fix issues with the high-voltage battery packs in an electrified vehicle. This includes the ability to use diagnostic tools and equipment to measure the voltage, current, and other parameters of the battery, as well as to perform repairs and maintenance tasks such as cell balancing, battery pack disassembly, and module replacement.
Battery Storage and Shipping	The abilities and knowledge required to handle, store and ship high-voltage battery packs used in BEVs This includes understanding the safety and environmental regulations related to battery storage and shipping and knowing how to safely handle and transport battery packs, as well as properly monitoring and maintaining battery health during storage and shipping.
Battery Removal	The knowledge and abilities required to safely remove and replace the high-voltage battery packs used in electrified vehicles, including understanding the safety procedures and protocols for working with high-voltage batteries, handling specialized tools and equipment needed for battery removal, and knowing how to properly disconnect and reconnect electrical components and wiring.
Technological	
Computer Diagnostic	The ability to use specialized software and equipment to diagnose and troubleshoot issues with computer systems in vehicles. This includes the ability to read and interpret diagnostic codes, use diagnostic tools to test various components and systems, and analyze data to identify and solve problems.

Skills	Definition
Software (Spreadsheet, CRM)	The ability to use specialized software programs to manage and track various aspects of dealership operations. This includes software for inventory management, customer relationship management (CRM), sales tracking, and service scheduling.
Cybersecurity	The knowledge and abilities required to identify and address potential cybersecurity vulnerabilities in vehicles that are increasingly reliant on software and connectivity features. This includes understanding the various ways in which software-defined vehicles may be vulnerable to cyber threats, such as hacking or malicious software, and knowing how to implement and maintain effective security measures to protect against this threat and identifying and responding to potential security threats in the course of vehicle service and maintenance.
Wireless Data Communications	In the era with software-defined vehicles and connected-cars, wireless data communications skills refer to the ability to diagnose and troubleshoot issues remotely using wireless communication systems and protocols, as well as identifying and resolving issues with cellular networks, Wi-Fi, Bluetooth, and other wireless technologies in the vehicle.
Machine Learning	The ability to apply machine learning algorithms and techniques to analyze data and identify patterns and insights that can be used to improve operational efficiency, customer experiences, customer loyalty, and business outcomes. These skills can be applied to predictive maintenance, inventory management, sales forecasting and personalized customer experiences in environments such as online vehicle shopping, issue diagnosis, and service appointment bookings, among others. .
Data Literacy	The ability to read, understand, interpret, and communicate insights from data. These skills may include expertise in areas such as data collection, cleaning, analysis, and visualization, as well as the ability to use data to inform decision-making and drive business outcomes.
Telematics	The ability to use and understand the technology and systems that allow for the exchange of information between a vehicle and the outside world. In the era with connected-cars, telematics includes skills related to the use and operation of software which provides a range of remote services to drivers of those vehicles. These services can include automatic crash response, roadside assistance, remote vehicle diagnostics, and turn-by-turn navigation, among others.
Software Programming	In the context of the Sector, software programming refers to the skills of writing, testing, and maintaining computer programs. This includes proficiency in developing scripts or programs that expand upon the standard features of enterprise applications like Customer Relationship Management (CRM) and Dealer Management Systems (DMS). Additionally, it involves the ability to create programs that perform various data analysis tasks and automations. For service-drive related functions, software programming may also involve upgrading or installing patches for software programs in a vehicle to ensure that they remain up-to-date and secure.

Skills	Definition
Robotics	The ability to use and maintain the robotic systems and equipment. This includes skills related to operating and programming robotic tools and equipment (software or hardware), performing regular maintenance and troubleshooting, and ensuring that the robots are used safely and efficiently.
Data Analytics and Interpretation	The ability to collect, analyze, and interpret large sets of data related to vehicle performance, usage, market values, and other factors. This includes skills related to using data analysis tools and techniques to identify trends, patterns, and insights within the data, as well as the ability to communicate those findings to others in a clear and meaningful way.
Digital Design and Marketing	The ability to create and implement digital marketing strategies and design digital assets that effectively promote and showcase vehicles and related products or services. This may include designing websites, social media posts, digital advertising campaigns, and other marketing materials, as well as utilizing digital marketing techniques such as Search Engine Optimization (SEO), email marketing, social media marketing, and others.
Cognitive	
Customer Service	The ability to provide exceptional service and support to customers who are purchasing, servicing, or repairing vehicles. This includes skills related to effective communication, problem-solving, and conflict resolution, as well as a deep understanding of the products and services offered by the automotive business.
Numeracy	The ability to understand and work with numbers, mathematical concepts, and data in order to effectively perform tasks related to calculating vehicle performance metrics, analyzing fuel efficiency and emissions, performing quality control checks, and understanding key performance indicators (KPIs).
Attention to Detail	Attention to Detail skills in the automotive aftermarket sector refers to the ability to notice and focus on the small details that are critical to making an impact on customer experience and business outcome.
Problem Solving	The ability to identify, analyze, and solve problems that arise in day-to-day operations effectively and efficiently. This includes skills related to troubleshooting customer complaints, resolving conflicts between employees, optimizing business processes, and finding ways to increase sales and profitability.
Communication	The ability to effectively communicate with customers, colleagues, and other stakeholders in a clear, concise, and professional manner.
Advanced Document Use	The ability to effectively create, manage, and utilize various types of business or repair documents and forms. This includes skills related to reviewing and interpreting legal and financial documents, completing transactional paperwork accurately and efficiently, and ensuring compliance with regulatory requirements.

Skills	Definition
Advanced Research Skills	The ability to conduct in-depth research, analyze information, and draw insights that can inform decision-making across various areas of the business. Service technicians may use advanced research skills to stay up-to-date with the latest technologies and techniques for vehicle maintenance and repair.
Health and Safety	The knowledge and abilities required to ensure a safe and healthy working environment for all staff and customers. This includes skills related to identifying and mitigating potential hazards, understanding, and complying with relevant regulations and guidelines, and promoting safe work practices.

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