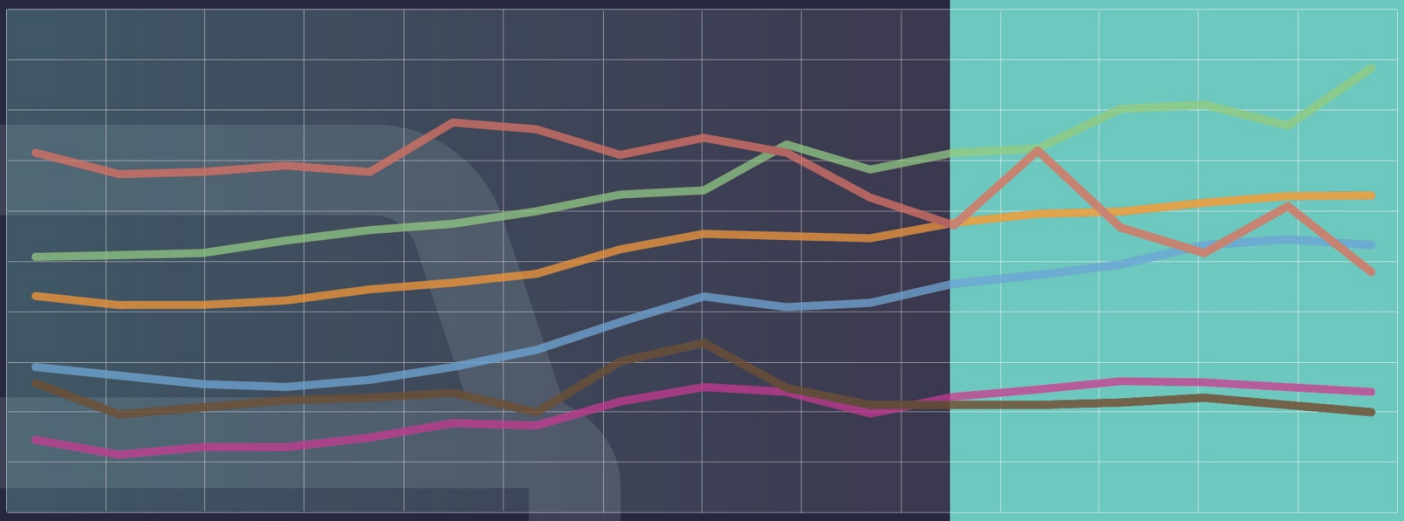
FOCAL Initiative
Future of Canadian Automotive Labourforce
Sur l'avenir de la main-d'œuvre de l'industrie automobile canadienne

TREND REPORT

AUTOMOTIVE INDUSTRY LABOUR MARKET ANALYSIS

REGIONAL AUTOMOTIVE TECHNOLOGY CLUSTERS: VANCOUVER CLUSTER



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

September, 2020

futureautolabourforce.ca

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

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

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

(FOCAL) Initiative, *futureautolabourforce.ca*

Canadian Skills Training and Employment Coalition, *cstec.ca*

Prism Economics and Analysis, *prismeconomics.com*

Automotive Policy Research Centre, *automotivepolicy.ca*

September, 2020

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

In this series of reports, we observe the contributions of Canada's six automotive technology clusters located in Vancouver, the Greater Toronto and Hamilton Area (GTHA), Kitchener-Waterloo-Cambridge (KWC), Windsor, Ottawa and the Greater Montreal Area (GMA). In doing so, we shed light on each regional cluster's domain of technological expertise, their distribution of employment and skills, and the factors that sustain their development. Moreover, we examine the pivotal role played by Canada's automotive technology clusters in the advancement of the country's broader automotive sector through their contribution to its manufacturing capability, development of new product technologies and enhancements to product quality.

This report focuses on the automotive technology cluster located in Vancouver, British Columbia. It examines the distribution of automotive technology companies and organizations in the region, highlighting the cluster's domains of technology focus. Furthermore, using the APRC's[1] comprehensive automotive database and through an establishment-level approach, it maps the regional distribution of employees and individuals that are engaged in advanced automotive technology manufacturing and research & development (R&D) activities. It sheds light on the concentration of labour and skills in specific technology fields within the cluster. Finally, through a survey of occupational profiles within selected companies, this report provides details on the occupations and skill streams that are in most demand in the local labour market.

In performing the profiling and occupation analysis, we refer to FOCAL's "Canada's Automotive Technology Clusters: Labour Market Characteristics and Regional Specializations" report. That report outlines the full spectrum of current trends shaping innovation in the automotive industry and provides details on the ten main domains of technological progress in the sector. Those ten automotive technology domains include: (1) Autonomous Vehicle (AV) Technologies, (2) Connected Vehicle Technologies, (3) Artificial Intelligence & Machine Learning (AI & ML), (4) Materials & Light Weighting, (5) Battery Electric & Hybrid Vehicle Technologies, (6) Hydrogen Fuel Cell (HFC) Technologies, (7) Internal Combustion Engine (ICE) Powertrain Technologies, (8) Production Technologies, (9) Vehicle Safety & Security and (10) Other Software & Electronics.

[1] APRC: Automotive Policy Research Centre

Additionally, FOCAL's report "Canada's Automotive Technology Clusters: Labour Market Characteristics and Regional Specializations" sets out the methodology that we used to identify and profile each cluster. The methodology report also provides details on the 18 automotive highly skilled occupations which are selected to examine the occupational distribution in the clusters.

BACKGROUND ON THE VANCOUVER TECHNOLOGY CLUSTER

The Greater Vancouver Area is widely considered to be Canada's primary hub for the design and development of Hydrogen Fuel Cell (HFC) technologies. As of 2018, the region hosted over 50 percent of all HFC facilities based in the country (CHFCA, 2018). The development of Vancouver's HFC industry can be traced to several factors, including the establishment of Ballard Power Systems in the region. Established in 1979, the company expanded throughout the 1990s after demonstrating the world's first fuel cell bus in Vancouver. In 2008, Ballard Power Systems partnered with Daimler AG and Ford Motor Company, forming the Automotive Fuel Cell Cooperation (AFCC). Although AFCC suspended its operations in 2018, Daimler AG remained in the region, later forming the Mercedes-Benz Canada Fuel Cell Division (MBFC). Further entrenching Ballard Power Systems status as an important anchor firm in the region is its contribution to the formation of numerous HFC spin-off companies (CHFCA, 2018). Studies conducted in the early 2000s counted as many as nine direct spin-offs from Ballard Power Systems (Molot & Mytelka, 2008). The company has also formed numerous collaborative R&D projects and contributed to the development of specialized labour skills and expertise in the region.

Government investments have also played an important role in the formation of Vancouver's automotive technology cluster. The cluster is supported by the National Research Council (NRC) Canada, which, as part of its Automotive and Surface Transportation Research Centre program, maintains one lab in the Vancouver region: the Fuel Cell Development and Testing lab. The NRC lab is located at the University of British Columbia (UBC) and provides fuel cell testing equipment and machinery to nearby companies. The cluster is also home to world-class academic institutions supporting the cleantech sector at the UBC's Clean Energy Research Centre (CERC), which performs a variety of research activities in clean energy and produces numerous highly qualified personnel for the sector.

The Vancouver automotive technology cluster is supported by several industry associations and non-governmental organizations. The Canadian Hydrogen and Fuel Cell Association (CHFCA) promotes the interests of the HFC industry via government and stakeholder relations outreach initiatives. Further advancing the cluster is the Foresight Cleantech Accelerator Centre, which showcases British Columbia's broader cleantech economy to global industries and markets. The cluster is also strengthened by the Canadian Urban Transit Research and Innovation Consortium (CUTRIC), which supports collaborative transit projects in the region between industry, academia and government.

VANCOUVER'S CLUSTER PROFILING AND OCCUPATIONAL ANALYSIS

Within the Greater Vancouver Area, a total of 32 automotive companies and organizations were identified. Among those organizations, 26 facilities were counted that design or develop the automotive technologies under study. Those 26 facilities and labs in the Vancouver cluster include: 23 companies, one academic research centre and two government R&D offices. Moreover, they contribute more than 1,900 employees and associated individuals to the Canadian automotive industry[2]. Below is a breakdown of the technologies, occupations and skills present in the Vancouver cluster.

Distribution of Companies and Organizations

As presented in Figure 1, the Vancouver cluster is highly focused on manufacturing and developing hydrogen fuel cell technologies. A total of 15 companies and one government facility were found to be manufacturing and developing hydrogen fuel cell technologies. Besides Ballard and NRC's Fuel Cell Development and Testing facility, companies such as Core dPoint Technologies, OverDrive Fuel Cell Engineering Inc and AVL Fuel cell are active in manufacturing HFC stacks and modules and conducting R&D in the Vancouver region. Another four companies were identified to be manufacturing products or performing operations relating to battery-electric & hybrid vehicle technologies. Those included Nano One Materials, which develops and manufactures Black Cathode Materials for Lithium-Ion Batteries, and Delta-Q Technologies, which provides power electronics and embedded software for electric powertrain systems.

[2] In this report, 'employees' refers to employees of private companies, as well as professors, researchers and students working in university labs and other research partnerships.

Figure 1. Distribution of automotive-related technology companies and organizations in the Vancouver area by technology

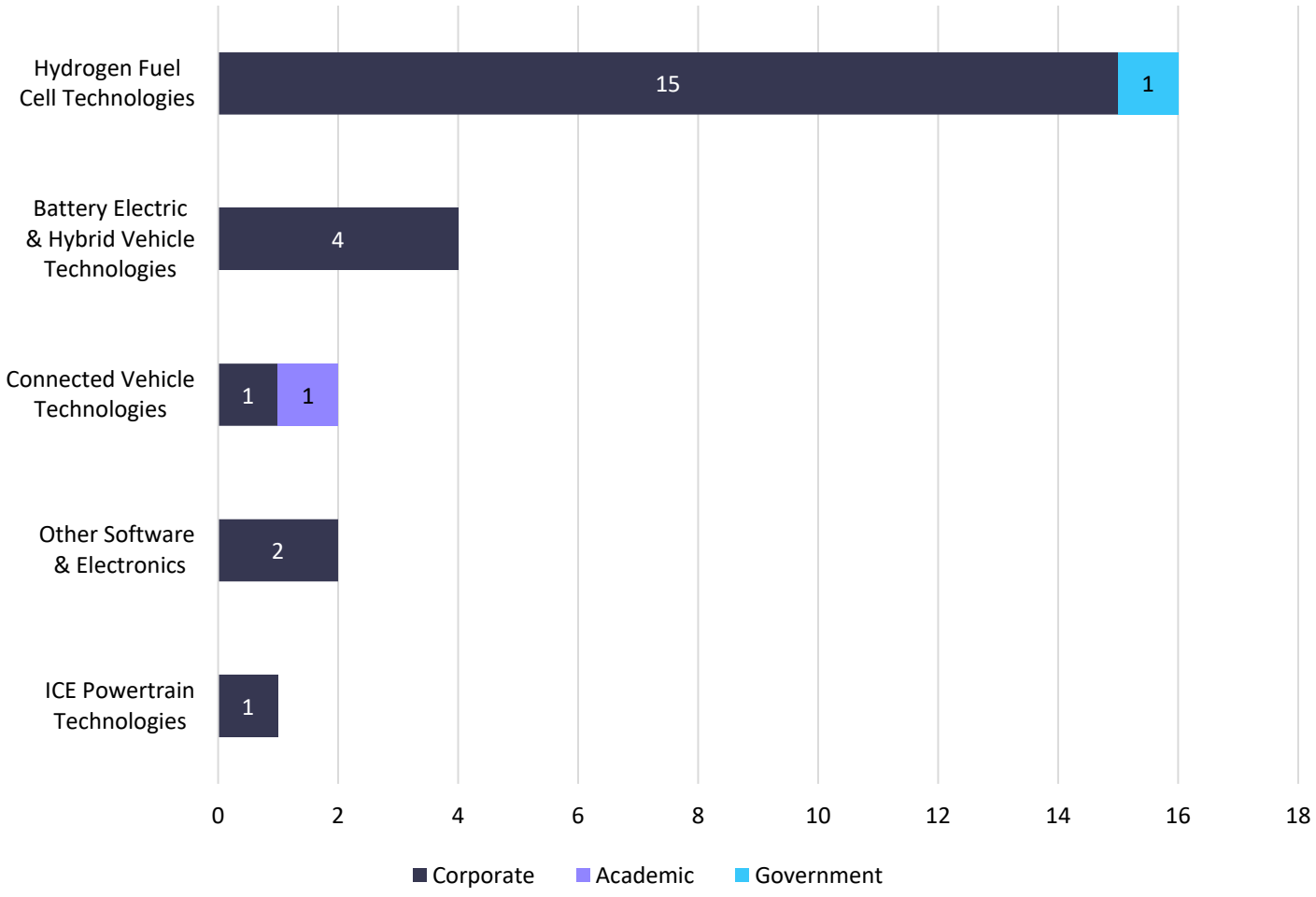


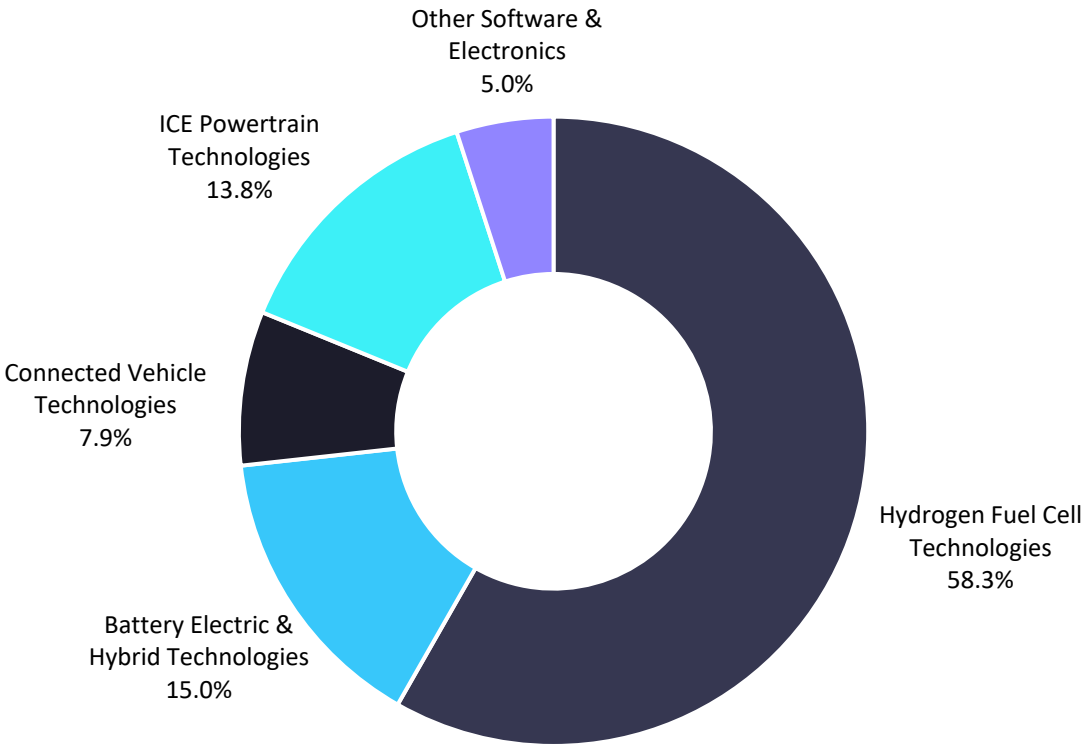
Figure 1 demonstrates that the companies and organizations that make up the Vancouver automotive technology cluster are primarily oriented towards developing alternative propulsion technologies. More than 75% of the 26 selected automotive technology organizations in the Vancouver region are engaged in the development of HFC and electric vehicle technologies. Fewer organizations are developing of other automotive technologies such as connected vehicle technologies, ICE powertrain technologies and other software and electronics.

Distribution of Employment and Skills

Within the Vancouver automotive technology cluster, we found that 1,050 employees are directly or indirectly involved in manufacturing and development activities relating to HFC

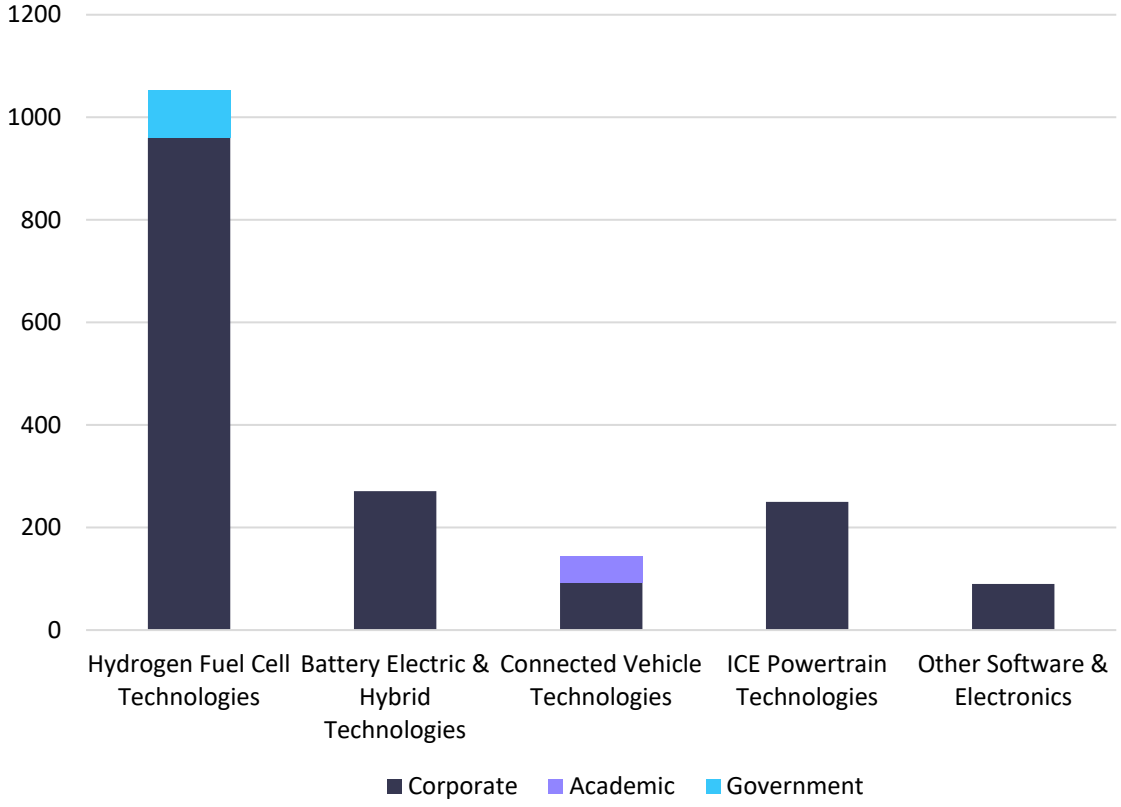
technologies. That figure represents 58% of the total 1,900 employees and associated individuals that we identified in the cluster. The majority of the employment under HFC technologies can be attributed to Ballard Power Systems and Greenlight Innovation, which combined have close to 450 employees, 200 of which are engaged in manufacturing testing and assembly equipment for hydrogen fuel cells.

Figure 2. Distribution of employees and individuals (by percentage) associated with automotive activities by technology



Further to HFC employment, battery-electric and hybrid technologies employment represented 15% of the total 1,900 employees and associated individuals in the region. One of the leading employers under this category is E-One Moli Energy (Canada) Limited, which performs R&D on lithium-ion rechargeable batteries and their manufacturing methods. ICE powertrain technologies represented 13.8% of the total employees under consideration. The remaining 13% of new automotive technology employment in the region was found in connected vehicle technologies and other software & electronics.

Figure 3. Distribution of employees and associated individuals associated with automotive

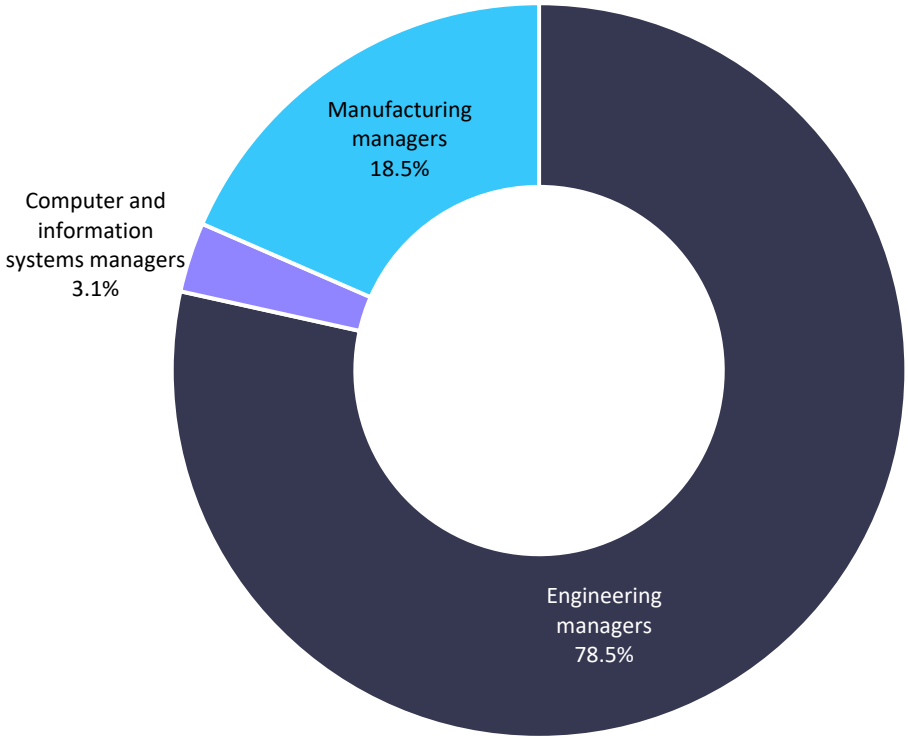


To complete the occupational distribution analysis, we reviewed a total of 920 profiles out of the 1,433 employees in Vancouver's 23 automotive technology companies. Of the 920 profiles that we identified, a total of 630 employee profiles were found to be relevant to the 18 occupations selected for this study. Our analysis revealed a strong presence and demand for skills and occupations under the Mechanical, Electrical and Industrial Engineering and Technician occupations compared to other engineering and technical fields. Demand for those skills and occupations can be attributed to the relative maturity of HFC technologies compared with other technological progress areas in the automotive industry.

Management Occupations

For the three management occupations, our occupational analysis revealed a strong presence of “Engineering Managers” at 78.5% among the 23 companies considered under this study. 18.5% of the management profiles we surveyed were “Manufacturing Managers,” and only 3.1% of the profiles were “Computer and information systems managers.”

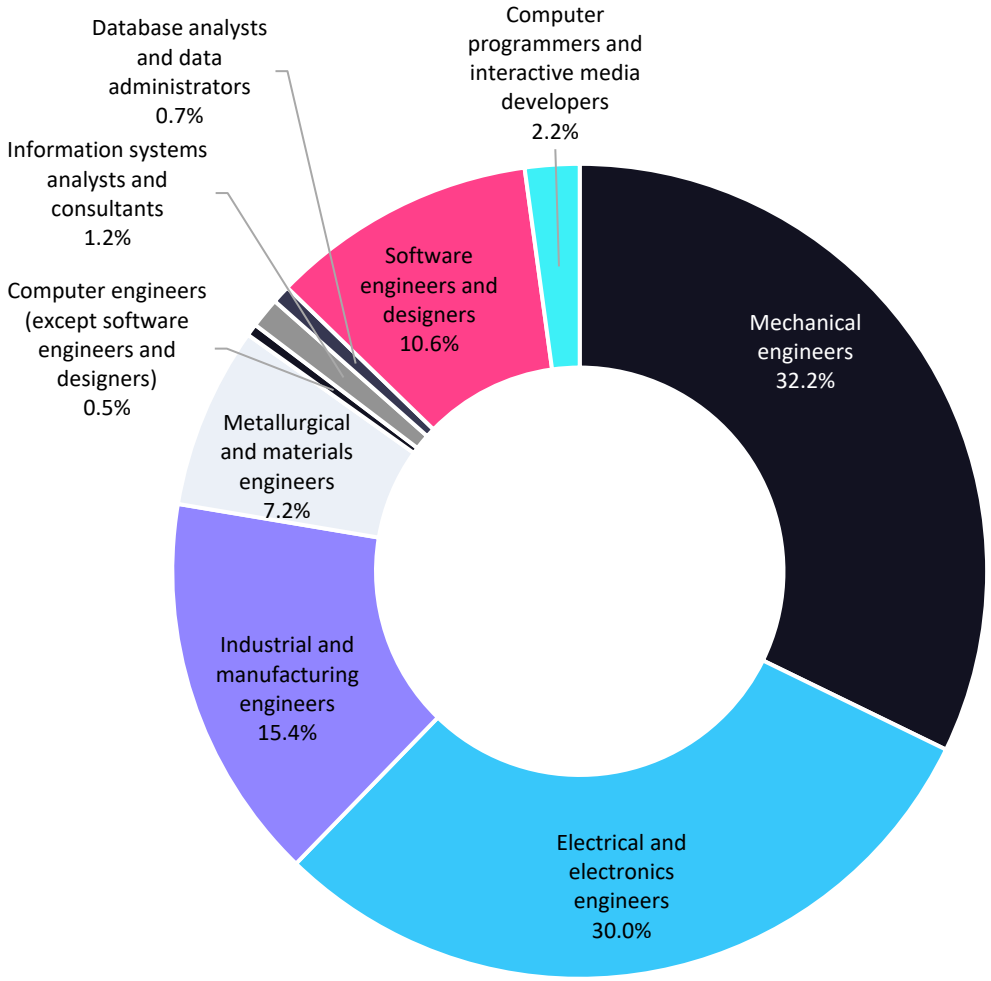
Figure 4. Occupational distribution for management occupations in the automotive technology companies of Vancouver



Engineering Occupations

"Mechanical engineers" and "Electrical and electronics engineers" comprised 32.2% and 30% of the engineering-related profiles in the Vancouver cluster. "Mechanical engineers" play a crucial role in the design and development of fuel cells and battery modules, as they have relevant skills in thermal and mechanical systems, as well as power-producing devices. "Electrical and electronics engineers" also possess the skills and expertise to design electric circuits for fuel cell modules, battery-electric systems, and power connections.

Figure 5. Occupational distribution for engineering occupations in the automotive technology companies of Vancouver

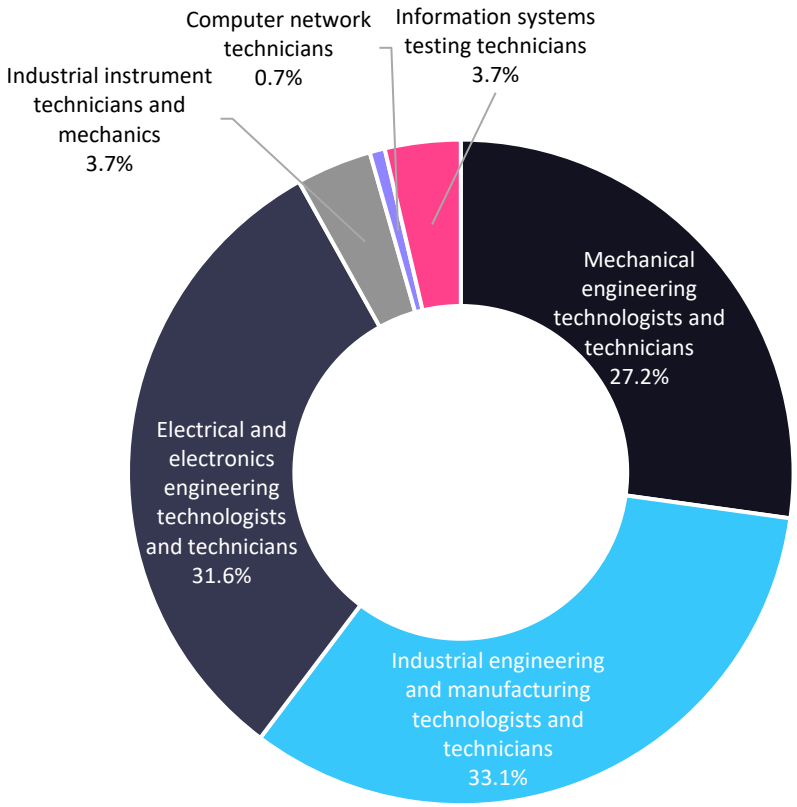


The distribution of other engineering occupations included 15.4% for "Industrial and manufacturing engineers". "Industrial and manufacturing engineers" are typically responsible for developing and scaling up production processes for fuel cell and electric powertrain parts. "Materials Engineers," represented 7.2% of the sample. They are generally involved in the development of fuel cells in the cluster and bring understanding of the characteristics of membrane and layer components of fuel cell stacks. Finally, "Software engineers and designers" were found to make up just 10.6% of the surveyed sample. The vast majority of software engineers were concentrated in companies developing connected vehicle technologies and other software & electronics.

Engineering Technologists and Technicians Occupations

Our analysis of the technicians and technologists occupations revealed similar trends to those identified earlier. “Electrical and electronics engineering technologists and technicians” and “Mechanical engineering technologists and technicians” comprised 31.6% and 27.2% of our sample, respectively (Figure 6). However, unlike the occupational distribution in the engineering occupations, “Industrial engineering and manufacturing technologists and technicians” represented the highest portion of the surveyed profiles at 33.1%. The majority of the “Industrial engineering and manufacturing technologists and technicians” can be found at Ballard Power Systems and are responsible for developing and coordinating the production process.

Figure 6. Occupational distribution for engineering technologist and technician occupations in the automotive technology companies of Vancouver



HIGHLIGHTS AND CONCLUDING REMARKS ON THE VANCOUVER CLUSTER

The Greater Vancouver Area's status as an important hub for fuel cell technology development in Canada is well established in our results. As displayed in Figures 2 and 3, the vast majority of Vancouver's new automotive technology workers are engaged in developing fuel cell technologies. Moreover, our results revealed that numerous companies and organizations play an active role in establishing Vancouver's capabilities in the design, development, and manufacturing associated with HFC technologies.

As we previously recognized, several factors contributed to the establishment of Vancouver's fuel cell technology cluster. One of the sectors founding members, Ballard Power Systems, remains a vital source of R&D expertise and skill development in the field. The company has also contributed to numerous spin-offs and start-ups in the Vancouver cluster. Other companies that contribute to the cluster include Green-light Innovations, AVL Fuel Cell Canada, Mercedes-Benz Canada Fuel Cell Division (MBFC) and Delta-Q Technologies; all of which are active in manufacturing, designing and developing hydrogen fuel cell and electric vehicle technologies. Besides those organizations, our results show that the vast majority of the automotive technology companies in the region's fuel cell cluster are SMEs. Such organizations tend to have a lower number of employees with advanced skills and are more prone to experiencing challenges performing R&D (CHFCA, 2018).

The Vancouver automotive technology cluster's specialization in fuel cell technologies was reflected in our analysis of the region's labour market. We found that 73.3% of the employees with automotive technology organizations in the area are engaged in the development of fuel cell and other alternative propulsion technologies (e.g., battery-electric and hybrid vehicles technologies). Furthermore, our occupation analysis revealed an abundance of skills and employment in three main occupation segments: (1) mechanical engineers, (2) electrical and industrial engineers, and (3) engineering technicians and technologists. Those occupational streams are essential to developing fuel cell modules and electric vehicle energy storage systems. In addition, we identified numerous "Metallurgical and materials engineers" in the region - individuals that have the necessary knowledge to design fuel cell membranes and their materials.

In sum, unlike several other Canadian automotive technology clusters that we examined in our reports, the cluster of firms and organizations in the Greater Vancouver Area are highly specialized. Despite some growth in the number of companies developing battery electric and hybrid vehicle solutions, its companies remain specialized in the development of hydrogen fuel cell technologies. That specialization drives regional demand for mechanical, electric and industrial engineers, and engineering technicians and technologists.

REFERENCES

Canadian Hydrogen and Fuel Cell Sector Profile. Retrieved from: *http://www.chfca.ca/wp-content/uploads/2019/10/CHFC-Sector-Profile-2018-Final-Report.pdf*

Molot, M. A., & Mytelka, L. First Mover Advantages in a Costly and Disruptive Technology The high-stakes fuel cell game. Retrieved from: *https://www.cpsa-acsp.ca/papers-2009/Molot-Mytelka.pdf.*