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Electricity in Demand: Labour Market Insights

2023–2028

ABOUT ELECTRICITY HUMAN RESOURCES CANADA

EHRC is Canada's leading provider of trusted HR research intelligence for our national sector. Our primary role is to strengthen the ability of the Canadian electricity and renewable energy industry to meet current and future workforce needs.

EHRC develops the resources that inspire our next generation, and is the steward of forward-thinking initiatives that drive positive change as together we build Canada's low carbon economy. Our vision is to build a world-class electricity workforce. We will achieve this by growing our Canadian electricity labour force to be safety-focused, innovative and inclusive. Our mandate is to:

- Deliver critical business intelligence to inform labour market decision-making.
- Forge partnerships that enable the industry to adapt, upskill and innovate.
- Lead the industry in creating and sustaining a skilled and inclusive workforce.
- Inspire our future workforce to build a low carbon economy.

Ce rapport est également disponible en français sous le titre: L'électricité en demande: Perspectives du marché du travail 2023-2028. This report is also available in French.

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A MESSAGE FROM EHRC AND ONTARIO POWER GENERATION

Our sector employs more than 110,000 people across Canada who are responsible for the generation, transmission and distribution of electricity. Vast teams of skilled workers are there for Canadians 24/7 in communities nation-wide – keeping millions of homes and businesses powered up.

However, Canada's electricity sector is experiencing change on an unprecedented scale. Decarbonization and expansion of electrification initiatives are driving investments for clean, affordable and reliable energy to address climate change for a healthier planet. New technologies for smart homes and smart cities, electrical vehicle integration, small modular reactors (SMRs), and the increasing need for energy efficiency and energy storage are all factors that are reshaping how we generate, deliver, and use electricity.

As we work to reduce climate change emissions, there will be a tremendous impact on the labour market for Canada's electricity sector. This transformation will require workers with different skill sets and new knowledge – many more than are employed currently - as new priorities on clean growth and electrification change the human resources landscape.

The two key drivers of total workforce demand are retirements, followed closely by growth in the sector, which currently outpaces the broader Canadian economy. Currently in our sector the number of veteran workers outnumbers youth by a multiple of three to one. Further, with technology changes in the industry, layering digital on top of analog, and integrating more data for decision-making in a context of an increasingly destabilized geopolitical world – the role of information communications technology continues to grow and competition for these workers will be intense.

The lead time to create or adjust education and training courses is often significant. Indeed, it takes detailed knowledge of the current labour market context and training curricula grounded in competency requirements of industry to adequately adjust educational offerings on a regional, and national level. While historical occupations in the sector are well-established, new growth roles, particularly in renewable occupations, require better alignment with industry needs – and more capacity to turn out qualified applicants.

Realizing a net zero future will require a coordinated effort. It has never been more important for industry, labour, post-secondary, and policymakers to look at how we regulate, approve, build, operate and maintain our electricity system. This report focuses on the people who will ensure the continued reliability and stability of Canada's electricity sector while supporting environmental progress and sustainability in the 21st century.

Building on over twenty years of electricity sector research and human resource experience, EHRC and its valued partner Ontario Power Generation present a report entitled Electricity in Demand: Labour Market Insights 2023- 2028. This work provides a detailed look at the current state of the sector, the challenges it faces and potential solutions. It includes occupational specific projections for the next five years and total workforce requirements anticipated out to 2035 and 2050 so Canada can better understand, plan for and deliver an electricity system that is safe, reliable, cost-effective and carbon-neutral.

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Table of Contents

Figures

Tables

Acronyms

- **CIP** Classification of Instructional Programs
- **CO2** Carbon Dioxide Equivalent
- **COPS** Canadian Occupational Projection System
- **DEI** Diversity, Equity, and Inclusion
- **EHRC** Electricity Human Resources Canada
- **EVs** Electric Vehicles
- **GHG** Greenhouse Gas
- **GWh** Gigawatt Hour
- **ICT** Information and Communications Technology
- **LFS** Labour Force Survey
- **MWh** Megawatt Hour
- **NAICS** North American Industry Classification System
- **NOC** National Occupational Classification
- **PSIS** Postsecondary Student Information System
- **PV** Photovoltaic
- **RAIS** Registered Apprenticeship Information System
- **SMRs** Small Modular Reactors

Executive Summary

CANADA'S ELECTRICITY SECTOR IS A PILLAR OF ECONOMIC GROWTH, ENVIRONMENTAL SUSTAINABILITY, AND INDIVIDUAL WELL-BEING

A stable, reliable, and environmentally sustainable electricity system is crucial for Canada's economic and social well-being. It enables the production and delivery of goods and services, and supports its citizens' quality of life. Canadians rely on affordable and readily available electricity in their daily lives, making the electricity sector a vital resource. It not only powers homes, offices, and industries, but also drives innovation and environmental responsibility.

Furthermore, Canada's electricity sector significantly contributes to the country's economic prosperity and high standard of living by employing thousands of workers. Embracing hydropower and nuclear, wind, and solar energy, the sector works proactively to reduce greenhouse gas emissions, thereby bolstering Canada's reputation as a responsible global leader and attractive investment opportunity. The sector's activities and spirit of entrepreneurialism solidifies its position as a key pillar of the country's economic and social well-being, while supporting progress and sustainability in the 21st century.

In recent years the electricity sector has exhibited rapid growth, particularly in the renewable energy space

Over the past five years, Canada's electricity sector has experienced remarkable employment growth. Total employment in the sector increased by just over 12%, equivalent to an average annual growth rate of 2.3%. This growth significantly outpaced that of the broader Canadian job market, which grew by approximately 7% during the same period, equivalent to an average annual growth rate of 1.4%. Similar trends were exhibited across the various regions of Canada.

Employment gains were broad-based across the sector's four occupational groups—*Managers & supervisors, Engineers, technicians & technologists, Trades,* and *Information & communications technology (ICT)*—with *ICT* emerging as a key contributor, despite its relatively small share of sectoral employment (approximately 6% as of 2022). The robust growth registered across the four occupational groups underscores the strength and breadth of the sector's jobs, as well as the value of the skills and knowledge its workers possess.

In the past few years there has been a surge in online job postings by Canadian organizations active in the renewable energy space. The number of employment opportunities advertised related to wind and/or solar power has grown exponentially. For instance, job postings for Wind turbine technicians expanded by a remarkable 579% between 2018 and 2022. The number of job titles containing "EV" or "Electric vehicle" grew by 249%, while those pertaining to photovoltaics (PVs) rose by 259%. These figures underscore the sector's growing requirements for talent and specialized skills to support its ongoing development.

Canada's transition towards a sustainable energy future will create new opportunities and challenges

Various levels of government as well as the public and private sector are poised to make significant capital investments in the electricity sector to increase its ability to generate clean and affordable power. These investments align with the country's ambitious goals of achieving a net-zero electricity grid by 2035 and net-zero greenhouse gas emissions by 2050. Projections suggest that Canada's electricity consumption could more than double between 2021 and 2050. Such growth will necessitate a greater reliance on renewable resources, such as hydro, solar, and wind, and the declining use of fossil

fuels. In line with this transition, employer sentiment within the electricity sector is remarkably bright. The Electricity Human Resources Canada (EHRC) Employer Survey 2023 revealed that 87% of respondents perceive the business outlook for the sector over the next five years as being either "very strong" or "good".

Canada's journey towards net-zero emissions is the driving force behind the continued employment growth expected in the sector. By 2028, as Canada advances towards net zero, the number of job openings that arise due to expansion demand will be in the order of 12,000. This increase will largely be driven by significant growth in the number of projects and facilities that involve the generation of solar and/or wind power, which are typically more labour intensive than conventional sources of power, such as large hydro and coal-fired generation.

At the same time, the total number of retirements (or replacement demand) on the path to net zero expected in the electricity sector over the period from 2023 to 2028 is estimated to be approximately 15,700. Combined, the expansion demand and replacement demand are anticipated to result in a total of nearly 28,000 job openings in the sector. Even under a scenario where limited additional action to reduce GHG emissions is anticipated, total job openings will approach 17,000, but this will be driven primarily by replacement demand. Consequently, over the next five years and beyond, the occupational structure of the electricity sector's workforce, and the mix of skills it requires, will be transformed in all regions of Canada.

In looking beyond 2028, Canada's ambitions are to achieve a net-zero electricity grid by 2035 and net-zero emissions by 2050. If the prevailing estimates of employment patterns and retirement rates (generated by the short-term forecasting model) are extended out, an additional 130,000 job openings could materialize between 2028 and 2050 (36,000 of which would arise between the 2028–2035 time horizon). Over such lengthy time horizons, a countless number of factors will undoubtedly change and unfold in unpredictable ways, altering the electricity landscape. As such, these numbers are meant to provide an order of magnitude of the potential workforce requirements of reaching net zero.

Canada's electricity sector urgently needs a comprehensive human resource strategy to achieve its economic and environmental objectives

The scale of the challenges confronting the sector necessitate the development and execution of a comprehensive human resources strategy and action plan. Otherwise, Canada is unlikely to attain its climate goals and risks limiting its economic, societal, and environmental progress.

This report proposes a three-pronged strategy and action plan that focuses on (i) attracting and retaining workers to the sector (quantity of labour); (ii) safeguarding work quality and ensuring workers have the right training and skills (quality of labour); and (iii) matching workers with opportunities in the labour market (workforce partnerships).

PILLAR 1: ATTRACTING AND RETAINING TALENT

The sector currently faces recruitment and retention challenges in relation to critical occupations such as Electrical and electronics engineers, with close to one in three employers reporting recruitment difficulties. These problems are expected to be exacerbated: according to EHRC's Employer Survey, 83% of employers anticipate difficulties in attracting workers to the sector by 2028.

Moreover, nearly half of the sector's 34 core occupations are projected to face labour shortages at the economy-wide level. Each of the four groups of occupations considered in the analysis, albeit to different degrees, will be impacted: *Managers & supervisors, Engineers, technicians & technologists, Trades,* and *ICT*. Furthermore, the ability of the electricity sector to attract talent from other sectors of the economy is declining. The capture rate, which indicates the proportion of employment in an occupation that is accounted for by the electricity sector (relative to the occupation's economy-wide level of employment), is steadily decreasing. This trend will likely exacerbate the sector's labour shortages over time, especially in critical roles.

The data also underscore another concerning trend: a decline in the number of new apprenticeship registrations in trades relevant to the electricity sector. This downward trajectory—while partially driven by reduced enrolment rates during the pandemic—raises concerns that the pool of skilled tradespeople available to the sector will diminish over time.

Actions to address the quantity of labour in the sector should include:

- ***Making concerted efforts to extend the working lives of older workers through targeted initiatives such as flexible work arrangements.*** Like most sectors, the electricity sector is aging. The situation is particularly acute in the *Managers & supervisors* and *ICT* occupational groups, where workers are considerably older on average. Measures to retain more older workers could include, but are not limited to, improving work flexibility and other work accommodations, e.g., part-time arrangements and adjustments to work and pension rules that do not penalize older workers from extending their careers.

- ***Going beyond promotional efforts to improve gender diversity in work and education.*** In recent years, the sector has made progress in terms of increasing the proportion of its employees that are female. However, women still constitute only 16% of the workforce in core electricity occupations and only 5% among the *Trades* occupational group. Even for the electricity sector as a whole, women only account for 27% of total employment—a stark contrast to economy-wide employment, where women account for 48% of the total. Moreover, women remain under-represented in most fields of study relevant to the sector. Both employers (53%) and educational institutions (74%) have implemented policies to increase gender diversity. In both instances, efforts are narrowly focused on promotion, which on the surface have yielded only modest improvements. Other measures, such as wage subsidies (employers) and financial benefits and incentives (educators) are worth exploring and testing, especially in acute areas such as the *Trades*. Additionally, improving the diversity of educators and trainers can foster a more inclusive learning environment and help to attract a greater diversity of students.

- ***Building stronger partnerships to increase the proportion of Indigenous peoples, newcomers to Canada, persons with disabilities and racialized groups that are employed in the sector.*** Data from the 2021 census reveal that racialized groups and immigrants are largely under-represented in the sector, compared to the total economy. And while there have been improvements in each of these groups, they have been modest. As of 2021, the share of racialized groups and immigrants employed in core electricity occupations, at 22% and 19% respectively, was significantly lower than the economy-wide figures for the same set of occupations (33% and 32% respectively). Indigenous peoples account for only 5% of employment in the core electricity occupations, but this figure is favourable when compared to the corresponding figure for the same occupations across all sectors. In contrast, persons with disabilities account for 1% of employment in the electricity sector compared to approximately 15% in the wider economy. Further progress is needed to narrow the gap and improve diversity, equity, and inclusion (DEI) within the sector. Both employers and educators report having dedicated recruitment efforts for these population groups, but—as is the case with gender issues—they are overly focused on promotion. Greater efforts are needed to widen the scope of programs to improve diversity and attract workers to the sector. Part of that strategy should include improving outreach and engagements with these groups, notably by building stronger connections and partnerships with the organizations that represent them, an approach that is currently under-utilized.

- ***Introducing newcomer streams that target skill and labour shortages in the electricity sector.*** As Canada prepares to welcome nearly 1.5 million immigrants over the next three years, it will be important to enhance the selection criteria to reflect the acute labour and skill shortages that are expected to persist in the electricity sector over the coming years.
- ***Enriching career pathways for under-represented groups.*** The results of EHRC's Employer Survey reveal insights about the occupational segregation of many under-represented groups. For instance, most women are employed in *Other corporate professional occupations,* whereas nearly three in four Indigenous people work in the *Trades*. Creating career pathways for under-represented groups—supported by upskilling and reskilling—will help to improve DEI in the sector, with positive spillover effects on innovation and in other areas. Part of that strategy should entail promoting electricity careers and educational pathways, with emphasis on those under-represented groups, well before students reach the postsecondary level. For instance, EHRC's *Bright Futures Energy Camp* is a science camp for Indigenous youth ages 10–13 that aims to promote careers in the electricity sector, and EHRC's *Greening a Generation* is a project that encourages all Canadians, particularly youth, to consider pursuing a career in the electricity sector.
- ***Enhancing the capacity among education and training institutions.*** According to EHRC's Educational Institution Survey 2023, the demand for some electricity-related education and training programs exceeds program capacity, partially due to shortages of trainers. Ensuring that the sector has an adequate supply of workers will necessitate the resolution of these bottlenecks.

PILLAR 2: SAFEGUARDING WORK QUALITY AND ENSURING WORKERS HAVE THE RIGHT TRAINING AND SKILLS

The electricity sector has a high prevalence of full-time and permanent employment. Furthermore, its workforce boasts a high level of educational attainment, with over one-third holding bachelor's degrees or higher. Moreover, the sector generally offers competitive wages, surpassing average earnings in the wider economy. Finally, it distinguishes itself with high average tenure among its workforce, reflecting a strong commitment to employee retention.

However, it is important to acknowledge that there has been a gradual decline in job quality in the sector in recent years, with both temporary and part-time employment edging up and tenure moderately declining. Furthermore, wage growth in core electricity occupations has lagged the pace seen in the broader economy during the same period, signaling a slowdown in earnings growth.

And despite the highly qualified workforce, employers in the sector have identified a shortage of skilled workers as their most pressing constraint in the near term. Indeed, as the sector embraces new technologies and clean energy initiatives, investing in the workforce's knowledge, skills, and adaptability is of utmost importance.

Action to address the quality of labour within the sector should include:

→ ***Safeguarding work quality.*** It will be important for employers to continue to monitor job quality in the sector and prevent any further erosion. Additionally, the prevailing and comparably high work quality should be leveraged—along with other strategies—as a tool for recruitment. This will be key as competition for skilled workers intensifies in other sectors of the economy—a strategy best achieved through within-sector collaboration.

- ***Improving succession planning alongside increasing emphasis on mentoring.*** According to EHRC's Employer Survey 2023, only 58% of employers have succession policies (almost exclusively related to management) and 64% have mentoring programs. While encouraging older workers to delay retirement will alleviate labour pressures, increased recourse to succession planning and mentoring programs that facilitate the transfer of knowledge and expertise to less experienced employees will be needed to help address skill shortages. Policies and programs of this nature need to expand to cover the breadth of occupations in the electricity sector that are confronted with an older workforce and could form the basis for more broad-based measures to extend the careers of older workers.

- ***Enhancing foreign credential recognition in the sector.*** Improving and expediting the processes for recognizing and certifying the skills most relevant to the electricity sector will help employers more effectively tap into a diverse pool of skilled professionals and help address the shortage of talent in a rapidly evolving industry.

- ***Removing barriers to apprenticeships and enhanced work-integrated learning.*** Employers in the electricity sector face a number of barriers in taking on more apprentices and providing work-integrated learning (WIL) opportunities for postsecondary students. Internships, field placements, co-ops and other forms of WIL opportunities help students acquire practical work experience, improve their skills and determine their suitability for a career in a particular field. The primary barriers identified include time constraints and a lack of financial resources. EHRC, with programs like the *Empowering Futures Program*, Canada's student and first-year apprentice work placement initiative for the electricity industry, provides financial incentives of up to $10,000 to employers who create new WIL opportunities.

- ***Strengthening collaboration and coordination between educators and employers to ensure the provision of in-demand skills.*** While employers and educators report that there is generally good collaboration between them, there is considerable scope to better align the demand (employers) and provision (educators) of skills. According to EHRC's Educational Institution Survey 2023, 93% report that better industry connections are needed to improve training and education programs related to the electricity sector. For instance, although the share of energy generated from wind power is anticipated to grow the fastest among all energy sources, only a small proportion of new academic programs in the renewable energy space focus on this topic.

- ***Providing new training programs for the sector as a matter of urgency.*** Technologies such as electric vehicles, small modular reactors, energy storage, and those associated with renewable energy, are expected to become more prevalent in Canada. In response, educational institutions have introduced a range of new academic offerings in recent years, e.g., in relation to wind power or fusion energy. However, the lead time for new courses and academic programs can be long, i.e., one to two years (or more), and there are concerns regarding trainer shortages (improving diversity, as discussed above, could help here with other positive spillover effects). Given the urgent need to increase the amount and proportion of electricity generated from renewable sources, these bottlenecks will need to be addressed, and stronger collaboration with industry can help. In this context, EHRC's ongoing work on *National Occupational Standards* helps to provide meaningful benchmarks for emerging skills and competencies for occupations in the sector.

- ***Fostering continued R&D and innovation through greater collaboration between industry and academia.*** The development and deployment of new technologies will form an increasingly important part of the effort to foster a more efficient, productive and environmentally sustainable electricity system. To that end, governments, industry, academia, and other stakeholder groups must work more collaboratively to resolve the most pressing issues confronting the sector. One potential mechanism that could be particularly beneficial is a pan-Canadian Program Advisory Committee for the renewable energy sector. Committees of this nature bring together community and industry leaders to provide input into educational programs. It would go a long way in terms of tackling complex energy challenges and help to accelerate the development and deployment of new technologies.

PILLAR 3: BUILDING PARTNERSHIPS AND CONNECTING WORKERS WITH NEW AND EMERGING OPPORTUNITIES

As the electricity industry responds to changes in government policy, consumer preferences, technological innovations and competitive dynamics, there will inevitably be distributional implications for its labour force. For example, increasing the amount of electricity generated from renewable sources could create new employment opportunities in rural and remote areas, while reducing them elsewhere.

Given the stiff competition for talent that already exists within and beyond the electricity sector, it could be particularly challenging for employers in these areas to recruit enough adequately trained personnel to address emerging requirements. Workers are often reluctant to relocate from urban areas to smaller communities.

Action to address partnerships and connecting workers with new and emerging opportunities within the sector should include:

- ***Managing new working arrangements in the post-pandemic period.*** According to Statistics Canada, approximately one in five workers currently work most of their hours from home. With the onset of the pandemic, work preferences and the demand for hybrid working arrangements have grown, especially among younger and older cohorts. This shift has only intensified the competition to recruit and retain talent. This challenge is particularly acute for the electricity sector as some large utilities have restrictions on remote work due to security issues. Moreover, given the diverse nature of occupations that make up the electricity sector where many jobs cannot be performed remotely, this can cause tension among the existing workforce. A forthcoming report by EHRC will examine the issue of hybrid work arrangements in the electricity sector, including recent trends and potential policy solutions.

- ***Increasing the availability and quality of data on renewable occupations.*** As the transition to renewable energy intensifies, there will continue to be an urgent need to better understand the employment and education patterns of occupations in the renewable energy sector, such as Wind turbine technician, Smart grid specialist, or Solar PV installer/technician, among others. Currently, there are no official occupational codes—and thus no official statistics—for these growing and significant roles. The sector's ability to create an effective human resource strategy is contingent on that situation being resolved. EHRC is committed—through a forthcoming survey and report—to working with its partners to gather insights on renewable energy employment and to address knowledge gaps, but this collaboration can only complement the imperative for high-quality, official data on employment in this area.

- ***Improving data collection regarding DEI, while being mindful of privacy considerations.*** The EHRC Employer Survey 2023 revealed numerous gaps with respect to employment data for equity-seeking groups. Efforts to improve data collection in this area can shed light on employment patterns through the lens of DEI and help organizations foster a more inclusive work environment. These efforts, however, must be mindful of ensuring privacy and mitigate risks of data misuse, potentially by leveraging a trusted third-party organization like EHRC for data collection.

- ***Promoting sector-wide collaboration to alleviate within-sector competition for talent.*** Currently, the most common source of competition for labour (unchanged from the previous Employer Survey) is other utilities. Working together—rather than at cross purposes—should be the modus operandi for employers in the sector. Encouraging within-sector human resource strategies and promoting the sector as a workplace of choice would be mutually beneficial and could facilitate employee mobility between companies, occupations, and regions. For instance, considerable benefits and sizeable efficiency gains could be achieved if the sectors' employers worked collaboratively to identify and address common skill requirements. This could also reduce a firm's reluctance to invest in training for fear of employee turnover.

- ***Encouraging the development of region-specific training programs to align with emerging demand.*** As energy infrastructure becomes increasingly decentralized, it is critical to link the content and pathways of skills development to growing sectors within the region. In this respect, consideration should be given to developing local training and education programs that respond to the regional needs of the sector (that are complemented by measures to expand online programs, where relevant across the country to expand reach).

This would entail building capacity among education institutions in northern and rural parts of Canada, which can have positive spillover effects on diversity. Such an approach places the focus on accessing future talent at the local/regional level.

→ ***Including rural and remote energy-related projects as part of a broader regional development strategy.*** Efforts by governments and policy makers to spur economic diversification, in parallel to taking advantage of new opportunities in the electricity sector, will help to enhance the overall economic viability of the region. This will help to improve economic resilience and have positive spillover effects by attracting talent to the electricity sector in these rural and remote areas.

Achieving these action items in a meaningful and effective way will require the cooperation and collaboration of all stakeholders, including various levels of government, employers, educators, unions, and industry associations. Addressing the sector's human resources challenges in a unified way will not only improve efficiency, but will also foster a collective consciousness towards building an electricity sector that drives economic and social prosperity, as well as environmental sustainability.

1.0 Introduction

THE ELECTRICITY SECTOR IS FOUNDATIONAL TO ECONOMIC AND SOCIAL WELL-BEING IN CANADA

A country requires a cost-effective, stable, and reliable electricity system to maximize the output of its economy, the competitiveness of its industries, and to ensure a good quality of life for its citizens. For individuals and households in Canada, reliable electricity is a necessity of daily life. The people working in Canada's electricity sector are critical to meeting Canadians' basic needs and facilitating connections between family and friends, the world of work, and the broader community.

In the context of climate change, the electricity sector is a focal point of Canada's efforts to reduce greenhouse gas (GHG) emissions and reach its ambitious climate goals. Moreover, dependence on fossil fuels for electricity generation can make countries such as Canada vulnerable to price fluctuations, supply disruptions, and geopolitical tensions. In addition, the electricity sector contributes to economic growth and employment, stimulating local economies and creating jobs across the value chain. This is a particularly important consideration in Canada's rural and remote areas, where providing power is often logistically difficult and prohibitively costly.

These and other factors have propelled the rapid growth in recent years of the electricity sector and increased its importance as a building block for a more sustainable and resilient future.

Canada's electricity sector urgently needs a comprehensive and well-informed human resources strategy

The pace of change within the electricity sector has placed renewed—and heightened—attention on the importance of developing a comprehensive human resources strategy for the sector. Indeed, the demand for labour in the sector has accelerated and the emergence and persistence of labour shortages is dampening investment in critical areas.

And while these recent trends have been affected by several factors—such as the historically low unemployment rates in Canada that characterize the post-pandemic job market—the longer-term structural changes required to achieve Canada's climate goals will only intensify in the years to come. As the sector evolves and diversifies (notably regarding energy sources), the skill requirements of jobs are adjusting rapidly, highlighting the importance and urgency of revamping educational and training programming and curricula to respond to the sector's needs, while maintaining the existing training capacity.

In addition to the effects of climate change and related targets on the electricity sector, the simultaneous onset of other drivers such as demographic shifts and technological changes are transforming human resource requirements. A wave of retirements is taking place as members of the baby boomer generation approach the end of their careers. The fact that about one in five workers in the Canadian economy is 55 years of age or older—a figure that will only rise going forward—threatens to constrain the future availability of workers. An Electricity Human Resources Canada (EHRC) survey of employers in Canada's electricity sector, carried out in July 2023, indicates that the age structure of the workforce is extremely unbalanced. The ratio of people aged 55 or older to youth (those between 15 and 24 years of age) employed in the sector is nearly three-to-one. At the same time, the rapid onset of technological change within the sector has shifted the skill

composition of jobs, as well as the tasks that employees must perform, leading in many instances to employers reporting difficulties hiring individuals with the right skills. Indeed, in the EHRC survey, 13% of employers reported that their job applicants lacked the right mix of skills.

Moving forward, the ability of the electricity sector to attract, retain, and develop talent will be crucial to Canada achieving its economic, social, and environmental goals. This will require businesses, governments, educators, worker organizations, not-for-profits, civil society, and other stakeholders to collaborate more effectively.

The objectives of this report are threefold

Firstly, the report aims to shed light on the challenges, opportunities, trends, and key workforce issues confronting Canada's electricity sector. Secondly, it provides labour market information, intelligence, and outlooks that can enable stakeholders to make evidence-based workforce-related decisions. Thirdly, it identifies human resources solutions that can augment the electricity sector's ability to attract, retain, and develop the talent needed to support its goals and initiatives.

The overall objective of this report is to highlight emerging human resource issues affecting Canada's electricity sector and to set forth a road map and recommended strategies to harness its full potential and maximize its role in helping Canada build a competitive and resilient economy.

Sectoral and occupational lenses are used to help paint a robust picture of the electricity workforce

In the first instance, this report looks at employment in economic activities related to electricity. Its focus on specific sectors and industry groups provides a broad overview of employment, reflecting well over a hundred different occupations. The report also analyzes 34 core occupations that are integral to the sector's ongoing development.

Data and insights are drawn from multiple data sources

The issues, evidence, and solutions identified in this report are based on an analysis of data and research from multiple sources. For example, an environmental scan undertaken by EHRC examining key issues, policies, and trends affecting the sector provided significant insights to the overall analysis. Additionally, data from a variety of sources have been leveraged to shed light on different aspects of the electricity sector (Box 1).

To ensure that this report provides useful insights and data to stakeholders, EHRC carried out two quantitative and qualitative surveys of employers and education and training institutions. The surveys gathered input on the labour requirements and human resources management concerns of respondents in the electricity sector (the Employer Survey), as well as information regarding the current and future availability of talent (the Educational Institution Survey).

Box 1. Overview of Key Data Sources

- ***EHRC surveys:*** In July 2023, EHRC carried out two quantitative and qualitative surveys of employers and education and training institutions. The Employer Survey was completed by more than 70 organizations, representing every province and territory and more than $4 billion in total annual employee wages. The Educational Institutions Survey was completed by 20 institutions, representing a range of community and vocational colleges, technical institutes, union training centres, universities, and others central to the supply of workers in the sector.
- ***Labour Force Survey (LFS):*** Statistics Canada's monthly Labour Force Survey—covering approximately 56,000 households, representing 100,000 individuals—sheds light on trends and composition of key occupations in the Canadian electricity sector and indicates how employment in these occupations has changed over time.
- ***Census of Population:*** Conducted by Statistics Canada, the census provides a statistical portrait of Canada and its people. The most recent census was undertaken in 2021.
- ***Registered Apprenticeship Information System (RAIS):*** Statistics Canada's national database of program enrollments, training completions, and certificates obtained by apprentices in Canada.
- ***Postsecondary Student Information System (PSIS):*** A Statistics Canada database that annually tracks the numbers of graduates by relevant fields of study. Fields of study are classified according to the Classification of Instructional Programs (CIP).
- ***Vicinity Jobs:*** Using artificial intelligence and language processing and big data technologies, Vicinity Jobs provides real-time data on online jobs posting and their composition.

To complement the insights gathered from these institutional and enterprise-based surveys, data from Canada's monthly Labour Force Survey—an individual- or household-based survey instrument—published by Statistics Canada was used to shed light on trends in key occupations in the Canadian electricity sector and to better understand how employment levels in these occupations have changed over time.

Data from the 2021 census of Canada help to provide a more detailed socio-demographic profile of the country's electricity labour force. Online job posting data from Vicinity Jobs—a company that compiles information on Canada's local/regional labour markets—rounds out the portrait of the characteristics of jobs in the sector, with a focus on emerging and detailed job titles.

To more accurately portray the sector's supply of labour, the report also leverages data from Statistics Canada's Registered Apprenticeship Information System (RAIS) and Postsecondary Student Information System (PSIS). Potential employment in the sector is examined using scenarios that reflect various assumptions regarding macroeconomic conditions and changes in the composition of energy sources to reflect Canada's climate goals.

The report is organized in nine sections

Issues	01	Introduction
	02	Canada's electricity sector
Evidence	03	Employment trends
	04	Socio-demographic composition
	05	Characteristics of jobs
	06	Supply of labour
	07	Labour market outlook
Solutions	08	A call to action
	09	Way forward

2.0 Canada's Electricity Sector

This section provides a brief introduction to Canada's electricity sector and discusses the key drivers affecting the sector's workforce today and in the future.

2.1 OVERVIEW

The electricity sector encompasses and enables a wide range of activities

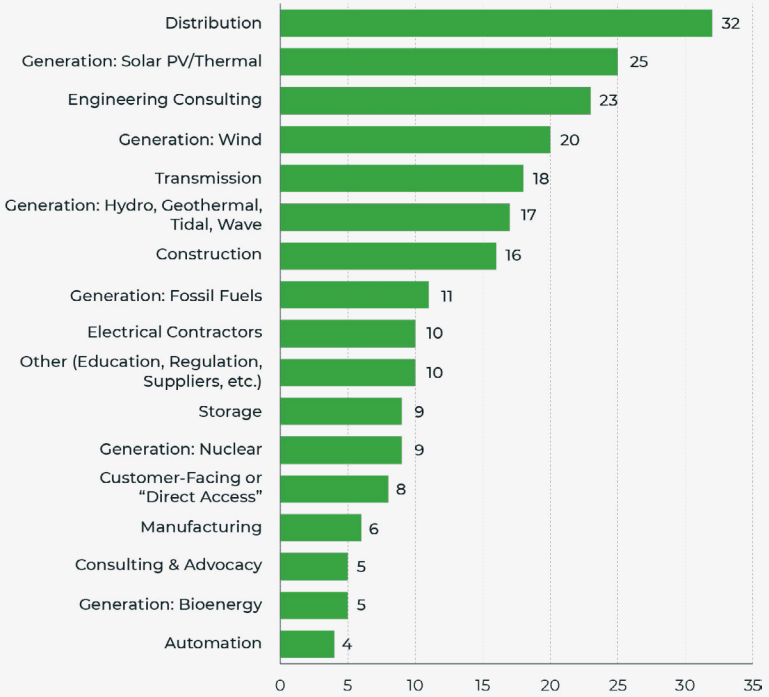
Each day, Canadian businesses depend on electricity to produce goods and services, while Canadians rely on electricity for light, home heating and cooling, and powering equipment and vehicles—not to mention countless other activities. Safe, reliable, and affordable electricity is, for the most part, an omnipresent feature of daily life in Canada. Intermittent power outages caused by extreme weather events are pointed reminders of the extent to which the routines of modern life are dependent on electricity.

The electricity industry can be broadly understood to be structured around three main activities:

- ***Generation*** is the production of electricity using various energy sources and technologies;
- ***Transmission*** involves conveying electricity over distances at high voltage to bring electricity from the power plants, where it is generated, closer to end-users; and
- ***Distribution*** is the process of connecting the end-users to electricity, typically through lower-voltage power distribution lines.

A wide range of activities are undertaken to support the sector in these three primary areas, as well as several major cross-cutting activities such as construction, manufacturing, engineering, and storage (Figure 1). In fact, a third of employers reported being engaged in multiple business activities. This figure is down from the 2017 Employer Survey (45%), suggestive of the fact that the number of specialized (and potentially smaller) businesses is growing in the electricity sector.

Figure 1. Breadth of activities undertaken by organizations in the electricity sector (as a % of organizations responding to survey), 2023



Source: *EHRC Employer Survey, 2023.*

Note: *Organizations are engaged in more than one activity and thus percentages do not sum to 100.*

The generation, transmission, and distribution of electricity primarily falls under provincial jurisdiction, while the federal government's role includes jurisdiction over aspects of nuclear power, electricity trade (i.e., exports and imports), international and interprovincial powerlines, investments in research and development, and support for commercialization of new technologies.[1] The federal government also plays an important role in supporting sectoral initiatives, including those that seek to identify and address emerging labour market issues.

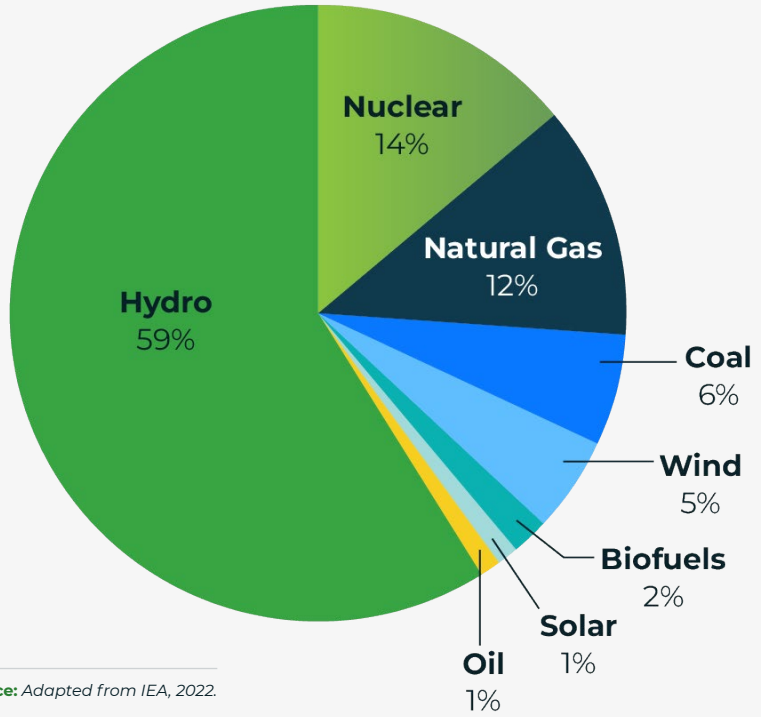
The structure of the sector has changed over time

In recent decades, most provinces have experienced a shift from vertically integrated electric utilities (such as provincial Crown corporations responsible for multiple activities) to the unbundling of generation, transmission, and distribution activities.[2] In some provinces, increased market liberalization has allowed the private sector to take a more prominent role in generation.

Electricity is generated from a variety of energy sources

Electricity can be generated from many sources, including hydro, coal, uranium (nuclear), natural gas, petroleum, and non-hydro renewable sources. Currently, Canada's electricity is largely generated via hydroelectricity (59%), followed by nuclear (14%) (Figure 2). Overall, as of 2021 approximately two-thirds of Canada's electricity was generated from renewable sources, including hydro, solar, wind, and non-emitting fuels. Wind power is Canada's second-largest source of renewable energy after hydro, accounting for 5% of the country's electricity generation in 2021.

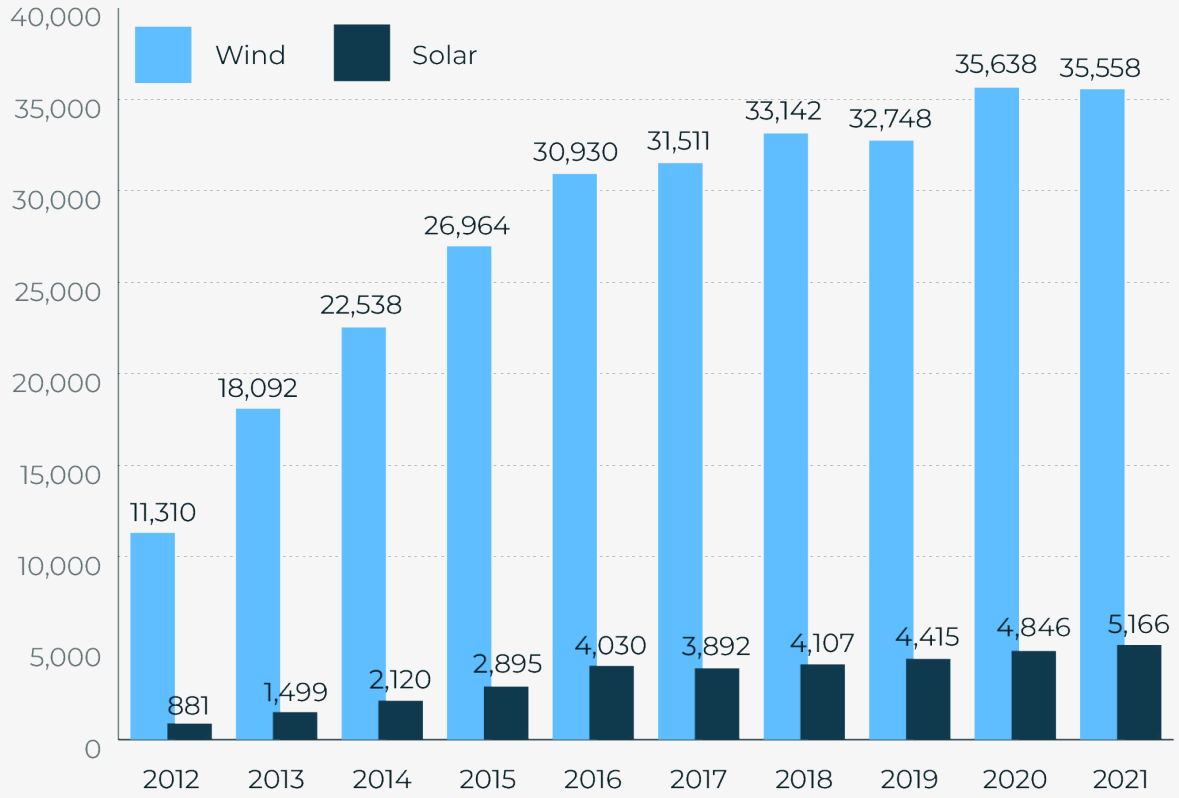
Figure 2. Canada's electricity generation by energy source (%), 2021



Source: *Adapted from IEA, 2022.*

In recent years, the amount of electricity generated from wind and solar sources has increased (Figure 3), and the number of renewable energy projects in Canada, both existing and proposed, continues to grow.[3] However, renewable sources such as solar, wind, and biomass-geothermal still only account for a fraction of the overall electricity generated in Canada—something that will have to change dramatically as the country embarks on the path towards net-zero emissions (see also Section 7).

Figure 3. Electricity generation from wind and solar (GWh), Canada, 2012–2021



Source: *Adapted from IEA, 2022.*

Canada annually exports around 10% of the electricity it generates, all of which is destined for the United States. Canada typically imports 2% of its electricity from the United States each year.[4] This arrangement allows for a high degree of reliability and resilience, particularly in the event of seasonal or unplanned changes in supply and demand in either country. Moreover, because electricity imported from Canada tends to be much cleaner than that produced in the United States, the latter country is better able to achieve its own climate change objectives.

Per capita consumption of electricity in Canada is high by international standards

Several factors affect the amount of electricity consumed in a country, including weather, incomes and purchasing power, and the energy-intensity of its industries. In 2020, Canada, the world's 39th most populous country, was the fourth-largest consumer of electricity on a per-capita basis.[5] This is largely because Canada, although one of the world's coldest (and developed) countries, experiences hot summers, during which the use of air conditioners significantly contributes to aggregate electricity consumption. Canada also has several large electricity-intensive industries, e.g., manufacturing and transportation, and its power is relatively more affordable than that of other countries. This tends to increase the amount of electricity used.

The onset of the global COVID-19 pandemic in 2020 triggered shifts in consumers' energy use. As the downtown cores of Canadian cities hollowed out and a sizable proportion of the workforce pivoted to working from home, both the consumption of electricity, and its allocation across peak and off-peak periods changed.

Canada's electricity usage is expected to increase in the medium-to-long term as efforts to decarbonize the economy gain momentum and Canada pursues GHG reductions and net-zero targets with greater vigour (see discussion of decarbonization and electrification below). This will lower Canada's reliance on the most GHG-intensive fuels (i.e., coal, oil, and natural gas) to generate electricity.

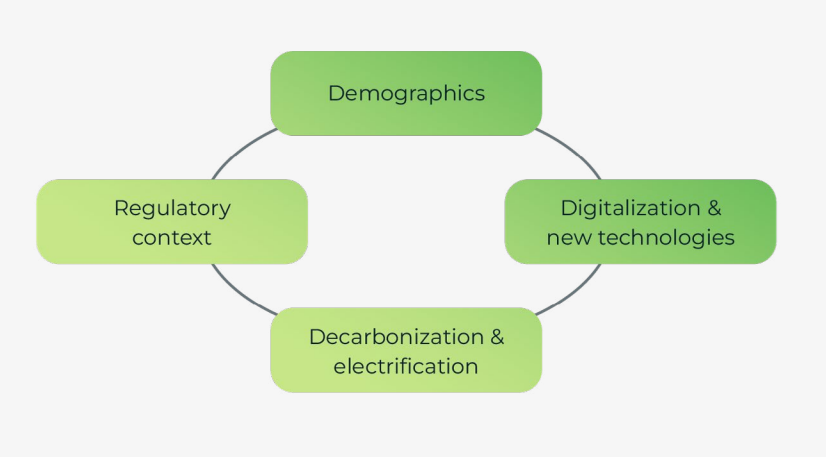
2.2 KEY DRIVERS OF CHANGE

Canada's electricity workforce is affected by the broader political and economic forces of change

The onset and persistence of Russia's war in Ukraine has led to, among other things, supply chain disruptions and price volatility. This has created instability in the energy sector, and uncertainty that impacts global markets.

At the same time, 2022 and 2023 have been characterized by a certain degree of macroeconomic uncertainty and resource nationalism. Rising interest rates and persistent inflation have created caution and some postponement of investment, including in the electricity sector, and overarching concerns about the possibility of a global recession, with spillover effects on the Canadian economy.

In addition to the prevailing macroeconomic environment, megatrends affecting Canada's economy and society are demographic change, technological change, and climate change. Canada's electricity workforce is particularly influenced by demographic changes, digitalization, and decarbonization and electrification, along with an evolving regulatory context. The impact of these forces will likely continue through the medium and longer term, given the multi-faceted and interrelated nature of these drivers.



Against the backdrop of Canada's aging population, immigration is driving growth of the overall population

Canada's population is aging. Almost one in six people are 65 years of age or older. A wave of retirements is taking place as members of the baby boomer generation approach the end of their careers. By 2035, Canada's worker-to-retiree ratio is expected to be two-to-one— a significant shift from the seven-to-one ratio that prevailed 50 years ago.[6] Canada's electricity workforce reflects the broader national-level aging trend, with 17% of workers aged 55 and over. This demographic reality means that the sector will need to attract large numbers of new workers in the coming years just to sustain—let alone grow—its workforce.

At the same time, Canada's population is growing. In June 2023, Canada's population surpassed 40 million people.[7] It is expected to continue to grow as immigrants arrive in greater numbers in the coming years.[8] Population growth, coupled with the greater use of electronic appliances and equipment, and electric vehicles, will continue to drive increased demand for electricity going forward.

Immigration not only increases the demand for electricity, it also expands the supply of workers in the labour market. International immigration currently accounts for almost 100% of Canada's labour force growth. Attracting newcomers to Canada to jobs in the electricity sector will be a crucial ingredient in future recruitment strategies. Other groups that are currently under-represented in the sector's workforce—such as women, Indigenous people, and persons with disabilities—are also untapped potential pools of talent for the electricity workforce.

New technologies are emerging, and digitalization is accelerating

Several technologies are impacting Canada's electricity sector workforce, including electric vehicles (EVs) and heat pumps. A prerequisite for the continued growth and uptake of these technologies is a skilled workforce able to perform installations and servicing, and ensure reliable operation of the grid, given the anticipated increase in the demand for electricity.

Other technological innovations that are increasingly playing a role in the electricity sector include batteries to store electricity for later use; hydrogen fuel cells; and small modular reactors (SMRs).

SMRs are designed to be more portable, flexible, and easier to build than conventional large-scale nuclear power plants. Their small size (usually less than 300 MW) makes them less expensive to produce and easier to deploy. Their modular design allows for deployment in large established grids, small grids, remote off-grid communities, and as an energy source for resource projects. SMRs' other advantages include their relatively low capital costs and enhanced safety features, and their ability to serve as a backup power source. They can also be shut down and restarted quickly, which makes them more responsive to fluctuations in electricity demand.

Although they largely remain in the development stage, the federal government believes that the deployment of SMRs could ultimately reap large benefits for Canada. It considers them a source of safe, clean, and affordable energy that can help to facilitate a resilient, low-carbon future. Their potential benefits include: (i) contributing towards the achievement of Canada's climate change commitments; (ii) supporting job creation and economic growth; and (iii) sustaining and expanding Canada's leadership in research and innovation.

Canada has mapped out three areas for SMR application: (i) on-grid power generation in provinces phasing out coal as a

fuel source; ii) on- and off-grid combined heat and power for heavy or medium industries; and (iii) off-grid power, district, and desalination in remote communities.

New Brunswick, Ontario, Saskatchewan, and Alberta have signed a memorandum of understanding to collaborate in the development of an SMR industry. Zero-carbon energy from SMRs is a key pillar of Ontario Power Generation's Climate Change Plan. It is building Canada's first SMR, with $970 million in support from the Canada Infrastructure Bank. New Brunswick is considering developing an SMR cluster, which could potentially create several hundred high-paying jobs over the next 15 years. Prince Edward Island has also expressed an interest in deploying SMRs on its territory.

In the longer term, there is potential for electricity to be generated from nuclear fusion, which does not produce long-lived radioactive waste, in contrast to nuclear fission (however, practical fusion power generation is not yet a reality).

There is also the cross-cutting trend of digitalization, which can be described as the growing application of information and communication technology (ICT) across the economy.[9] Increasing digitalization has been marked by advances in data (i.e., increasing volumes of data due to declining costs of sensors and storage), analytics (i.e., rapid progress in the use of data and computing capabilities to produce useful information and insights), and connectivity (i.e., increased exchange of data between humans, devices, and machines via digital networks).[10]

The use of digital technology in the electricity sector is not a new development; for instance, power utilities used digital technology in the 1970s to manage and operate the grid.[11] Today, more than 80% of the electrical grid utilizes smart meters, with smart grids becoming more prevalent and having the potential to transform the grid with peer-to-peer electricity trading systems. However, the acceleration of digitalization will create many new opportunities, challenges, and unknowns for the sector's workforce. The growing use of digital technologies is affecting employers, workers, and the labour market.[12] Businesses are grappling with the adoption of new technologies to stay competitive, while workers face the imperative to adapt and upgrade their skills to thrive in a world of work that is increasingly digital. The global COVID-19 pandemic accelerated the use of digital technology in workplaces around the world, including in Canada.

Overall, it has been suggested that Canada lags other countries in terms of nurturing, developing, and using digital talent.[13] For Canada's electricity sector, a key challenge is ensuring that the workforce has the knowledge, skills, and tools needed as industry practices evolve in the face of emerging technologies and increased digitalization. The sector will have to remain competitive in attracting and retaining talent, as competition for workers both within and beyond the sector intensifies. This is a key issue that merits attention, given the potential risks that cybersecurity breaches entail for the electricity sector, e.g., widespread blackouts, economic losses, and national security threats, and its service providers, who may incur substantial reputational damage.

Decarbonization and electrification

The effects of climate change, including extreme weather events that have in some cases resulted in widespread power outages, are being felt across the country. Canada has ratified the Paris Agreement, the international treaty aimed at fighting climate change. It seeks to limit the global average temperature rise to well below 2°C and pursue efforts to limit the increase to 1.5°C. The Paris Agreement is based on "nationally determined contributions," i.e., countries determine what contributions they should make to achieve the aims of the treaty.

The Government of Canada's *2030 Emissions Reduction Plan*, released in 2022, outlines various ways to decrease emissions to achieve Canada's target of emissions 40–45% below 2005 levels by 2030.[14] It identifies economy-wide programs and investments, as well as measures for specific industries, including electricity, oil and gas, transportation, agriculture, and buildings. Many of the initiatives in the reduction plan extend past 2030, since Canada has also committed to concurrently work towards net-zero GHG emissions by 2050. Net-zero refers to a state where GHG emissions caused by humans are balanced by actions to remove them from the atmosphere, through measures such as carbon sequestration and carbon offset programs (e.g., planting trees).[15] For the electricity sector in particular, the aim is to achieve a net-zero electricity system by 2035.

The Canada Energy Regulator has undertaken economic and energy modelling to explore alternative scenarios to achieve net-zero status by 2050. The scenarios assume that, during the projection period, technologies such as EVs and electric heat pumps will become much more prevalent, and that electricity use will double. Indeed, there is an urgent need to turn away from carbon-emitting energy and use cleaner sources of electricity as a primary power source to reduce the impact of climate change.[16]

As such, decarbonization and electrification go together and are linked to the uptake of technologies by Canadian households. Canada already has a relatively clean power grid by international standards, with 81% of generation coming from low- or non-emitting sources. However, it will be necessary to replace the remaining 19% with clean generation to achieve net-zero status.[17] Decarbonization of Canada's electricity sector will require sizable investments to develop (and retrofit) non- and lower-emitting electricity sources such as wind, geothermal, and tidal power, as well as SMRs and electricity storage.[18]

Regulatory context

In the context of Canada's efforts to reduce the impact of climate change, the regulatory environment for Canada's electricity sector is rapidly evolving. Federal and provincial/

territorial governments have recently announced several regulations, investments, and initiatives that apply to the electricity sector.

The federal government introduced *Clean Electricity Regulations* in August 2023; the regulations are considered an integral part of *Canada's 2030 Emissions Reduction Plan* to establish performance standards to reduce GHG emissions from electricity generated from fossil fuel starting in 2035. Also in August 2023, Canada's Minister of Energy and Natural Resources released *Powering Canada Forward*, which delineates the federal government's plans to decarbonize Canada's electricity grids by 2035, while ensuring its continued affordability and reliability. *Canada's Sustainable Jobs Plan*, introduced in February 2023, outlines the federal government's strategy for creating and maintaining jobs in the energy sector. It largely involves fostering conditions that support the re-deployment of workers within and outside the sector to net-zero jobs, and making the sector attractive as an employer to those entering the labour force. The federal government is developing a *Clean Electricity Strategy*, which will be released in 2024.

Federal investments to support clean energy initiatives include the *Clean Technology Investment Tax Credit* introduced in 2022, which allows for a 30% refundable tax credit for investments in equipment and property that support low-emitting energy generation and storage (including geothermal equipment, as an extension to the credit announced in Budget 2023). The federal government's March 2023 budget included several announcements regarding clean electricity. *A Clean Electricity Focus for the Canada Infrastructure Bank* envisages investing $10 billion in two of the bank's priority areas (clean power and green infrastructure). Budget 2023 also introduced the *Clean Electricity Tax Credit*, a 15% refundable tax credit for eligible investments in clean electricity. Qualifying investments include those in non-emitting electricity generation systems (e.g., solar, wind, nuclear), abated natural gas-fired electricity generation, stationary electricity storage systems that do not use fossil fuels in operation (batteries), and equipment to transmit electricity between provinces and territories.

Recent announcements regarding clean electricity have also been made at the provincial level. In June 2023, BC Hydro announced plans for a call for new sources of renewable, emission-free electricity. BC has also committed to providing $140 million to the *BC Indigenous Clean Energy Initiative*, which will support Indigenous-led clean energy products. In July 2023, the Ontario government released *Powering Ontario's Growth*, a plan designed to meet its long-term demand for zero-emissions electricity. It aims to advance nuclear power through the creation of three SMRs and pre-development work for new large-scale nuclear power generation. The plan also provides for the deployment of additional long-term zero-emission electricity resources, such as wind, solar, hydroelectric, batteries, and biogas.

In various energy-related fora, representatives of Nova Scotia Power, the New Brunswick Power Corporation, Hydro-Québec, and the Canada Infrastructure Bank have discussed the Atlantic Loop project, which would bring hydroelectricity generated in Quebec and Labrador into New Brunswick and Nova Scotia via upgraded and expanded transmission links. The project would enable New Brunswick and Nova Scotia to transition from coal-fired power plants to clean sources of electricity.

In August 2023, Alberta's Minister of Affordability and Utilities announced that all approvals of new renewable energy projects will be deferred until February 2024 to allow for the review of policies and procedures that could adversely impact their development.

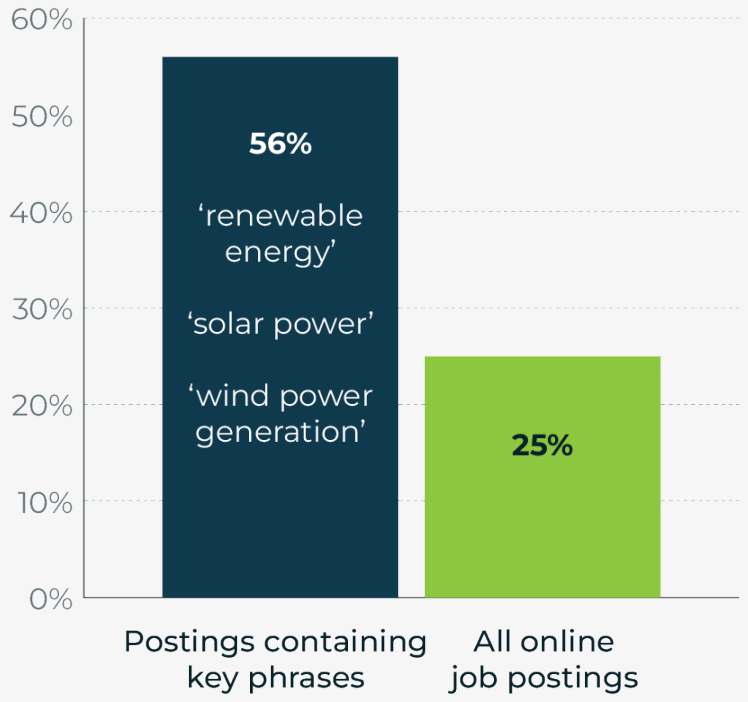
2.3 HUMAN RESOURCES ARE CRITICAL

Uptake of new technologies, implementation of clean energy initiatives, and progress towards Canada's climate change targets require a skilled and adaptable workforce

Decarbonization of the electricity sector and the electrification of other sectors, such as transportation, hinges on having an electricity workforce that is adequate in size and sufficiently trained. The installation and maintenance of the infrastructure required for electric vehicles, for instance, requires specialized skills and expertise. The increasing demand for workers with these specialized skills is already evident: between 2018 and 2022, the number of online job postings containing the key phrases 'renewable energy,' 'solar power,' and/or 'wind power generation' increased by 56% (Figure 4).

The fulfillment of the significant federal and provincial commitments that have been made regarding emissions reductions (including those of the Paris agreement) and clean energy targets will be jeopardized if Canada's electricity and renewables sector does not have enough workers with the right mix of skills.

Figure 4. **Percentage increase in number of online job postings, 2018–2022**



Source: *Vicinity Jobs.*

Key takeaways:

- The impacts of population growth, an aging workforce, growing demand for electricity, increased proliferation of digital technology, the imperative to decarbonize and electrify the Canadian economy, as well as macroeconomic uncertainty, are key issues affecting Canada's electricity sector workforce.
- Strengthening the connectivity of the electricity grid within and across regions is necessary to improve its stability and reliability, and ensure progress towards net-zero emissions.
- Canada has ambitious targets to reduce GHG emissions and achieve a net-zero electricity system within 12 years. The regulatory context is evolving rapidly, albeit in some instances in ways that are inconsistent with achieving net-zero status.
- A pan-Canadian human resources strategy for the electricity sector is imperative for Canada's ability to respond to the emerging economic and environmental pressures and to ensure continued prosperity for Canadians now and into the future.

3.0 Employment Trends

This section provides a portrait of the electricity sector's workforce and describes patterns of growth in core occupations and groups of occupations, including across geographic regions.

3.1 PORTRAIT OF THE SECTOR

Core occupations constitute more than half of all jobs

In this report, the electricity sector is defined as occupations within the North American Industry Classification System (NAICS) 2211 – Electric power generation, transmission, and distribution industry group. This industry group (or "sector," in common parlance) encompasses hundreds of different occupations involved in the generation, transmission, and distribution of electricity. It includes a diverse set of direct activities, e.g., from a Civil engineer involved in the design of a new power generation facility to an Electrical power line and cable worker responsible for constructing, maintaining, and repairing overhead and underground electrical power transmission and distribution systems.

This report particularly focuses on 34 occupations —based on the official National Occupational Classification (NOC) system—that are core to the sector's activities (Appendix A). Each occupation can be grouped into a higher-level occupational category: *Managers & supervisors, Engineers & engineering technologists, Trades,* and *Information & communications technology (ICT)*.[19] Box 2 contains an overview of the key terminology used throughout this report.

While in some instances there are data limitations, every effort has been made to provide employment-level information for the 34 core occupations within the economic activities →

Box 2. Key employment and sectoral terminology

- ***Electricity sector:*** The electricity sector, subsequently referred to as "the sector," refers to occupations or activities within the industry group NAICS 2211 – Electric power generation, transmission, and distribution.
- ***Core electricity occupations:*** Refers to 34 occupations that are central to electricity employment in Canada. See Appendix B for the full list and description of these occupations. In several instances in this report, employment levels and related indicators for the 34 core occupations are compared with their counterparts in the same occupations at the economy-wide level.
- ***Other occupations (within NAICS 2211):*** These are the hundreds of other occupations that constitute total employment in NAICS 2211, excluding the 34 core electricity occupations.
- ***Occupational groups:*** Each of the 34 core electricity occupations are organized by broad type, notably *Managers & supervisors, Engineers, technicians & technologists, Trades,* and *Information & communications technology.*

of interest, i.e., employment in these NOCs by Electric power generation, transmission, and distribution (NAICS 2211 industry group).[20]

In this context, it is important to bear in mind that several critical jobs within the electricity sector do not have distinct NOC codes. Although data for these job titles are collected, they typically fall under the NOC that is most relevant to the job in question. This is particularly the case for renewable energy jobs such as Solar panel installers and/or Wind turbine installers/technicians, which do not correspond to an official NOC.[21] Other data sources, e.g., online job posting data from Vicinity Jobs, is leveraged to capture insights on these job titles (see below).

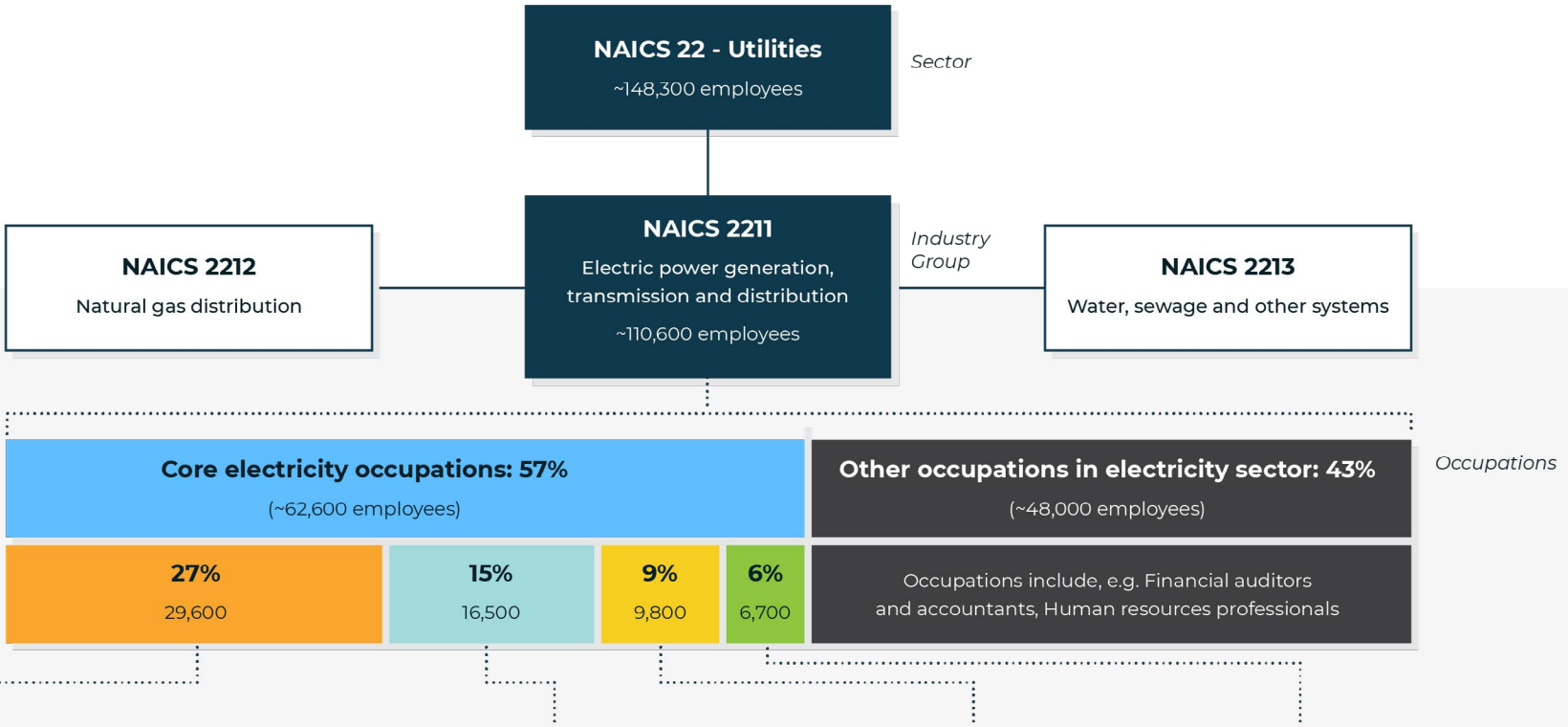
As of 2022, just over 110,600 individuals were employed in the sector across a wide range of occupations.[22] Collectively, the 34 core electricity occupations constitute approximately 62,600 workers, or more than half (approximately 57%) of total employment in the sector. The *Trades* group of occupations accounts for approximately 27% of the 110,600 workers, followed by *Engineers, technicians & technologists* at 15%, *Managers & supervisors* at 9%, and *ICT* at 6% (Figure 5). The remaining category (Other occupations) accounts for approximately 43% and covers hundreds of additional occupations, including those in the fields of business, finance, and administration.

Not surprisingly, the specific occupations within each occupational group represent vastly different proportions of sector-wide employment

The following four occupational groups encompass a wide range of occupations and activities.[23] In particular, based on 2022 Labour Force Survey statistics:

- ***Managers & supervisors:*** Four occupations are included in this group. They range from Utilities managers, which comprise 7.8% of total sector employment, to Construction managers, which represent 0.1% of the total.
- ***Engineers, technicians & technologists:*** This group encompasses nine specific occupations. Their employment shares range from 5.2% for Electrical and electronics engineers to less than 0.1% for Industrial and manufacturing engineers.
- ***Trades:*** This is the largest group by volume, covering thirteen trade-related occupations. The top occupation in terms of employment is Electrical powerline and cable workers, which accounts for 11.1% of the sector's total. The smallest occupation, Residential and commercial installers and servicers, accounts for less than 0.1% of employment.
- ***ICT:*** Eight occupations comprise this core group, ranging in relative magnitude from approximately 2.7% for Information systems specialists to less than 0.1% for Data scientists.

Figure 5. **Composition of employment in Canada's electricity sector, 2022**



Trades

- Boilermakers
- Construction millwrights and industrial mechanics
- Contractors and supervisors, pipefitting trades
- Electrical mechanics
- Electrical powerline and cable workers
- Electricians (except industrial and power system)
- Industrial electricians
- Industrial instrument technicians and mechanics
- Power engineers and power systems operators
- Power system electricians
- Public works maintenance equip. operators and related workers
- Residential and commercial installers and services
- Welders and related machine operators

Engineers, technicians & technologists

- Civil engineers
- Civil engineering technologists and technicians
- Electrical and electronics engineers
- Electrical and electronics engineering technologists and technicians
- Industrial and manufacturing engineers
- Industrial engineering and manufacturing technologists and technicians
- Mechanical engineers
- Mechanical engineering technologists and technicians
- Non-destructive testers and inspectors

Managers & supervisors

- Construction managers
- Contractors and supervisors, electrical traders and telecommunications occupations
- Engineering managers
- Utilities managers

Information & communications technology

- Computer network and web technicians
- Computer systems developers and programmers
- Cybersecurity specialists
- Database analysts and data administrators
- Data scientists
- Information systems specialists
- Software developers and programmers
- Software engineers and designers

Source: *Statistics Canada, Labour Force Survey, 2022.*

Composition of employment across the four occupational groups is relatively consistent across regions

Examining the distribution of employment across the four occupational groups reveals relative consistency across the regions (Table 1).[24] The regional employment shares are like those for Canada as a whole, with a few notable exceptions:

- ***Atlantic Canada:*** The shares of *ICT* personnel (1.4%) and *Managers & supervisors* (5.5%) in the region's sector is relatively lower than it is at the national level. *Engineers, technicians & technologists* have a 12% share, while *Trades* jobs account for 36.8%.
- ***Quebec:*** There are higher shares of employment in the *ICT* (11.4%) and *Managers & supervisors* occupations (10.7%) than is the case at the national level. However, the proportion of *Trades* jobs (17.4%) is less than the corresponding national figure.
- ***Ontario:*** The shares are broadly similar to national averages, although with a slightly smaller share of both *Managers & supervisors* and *ICT* (4%) and a greater share of *Trades* (30.9%)—not unlike Atlantic Canada, but to a lesser degree.
- ***Prairies:*** They have a slightly higher share of *Managers & supervisors* (11.8%) occupations than exists at the national level.
- ***British Columbia:*** Relative to the national average, the share of *Engineers, technicians & technologists* (26.5%) is considerably higher, whereas the share of employment in *Trades* (22.5%) and *Other* occupations is slightly lower.

Table 1. Employment shares in the electricity sector by occupational group and region (%), 2022

	Atlantic Canada	Quebec	Ontario	Prairies	British Columbia	Canada
Managers & supervisors	5.5	10.7	6.6	11.8	10.9	8.9
Engineers, technicians & technologists	12.0	14.2	13.3	15.0	26.5	14.9
Trades	36.8	17.4	30.9	26.9	22.5	26.8
ICT	1.4	11.4	4.0	5.1	7.9	6.0
Other	44.2	46.3	45.2	41.3	32.2	43.4
Electricity sector total	***100***	***100***	***100***	***100***	***100***	***100***

Source: *Statistics Canada, Labour Force Survey, 2022.*

3.2 EMPLOYMENT GROWTH IN CORE ELECTRICITY OCCUPATIONS

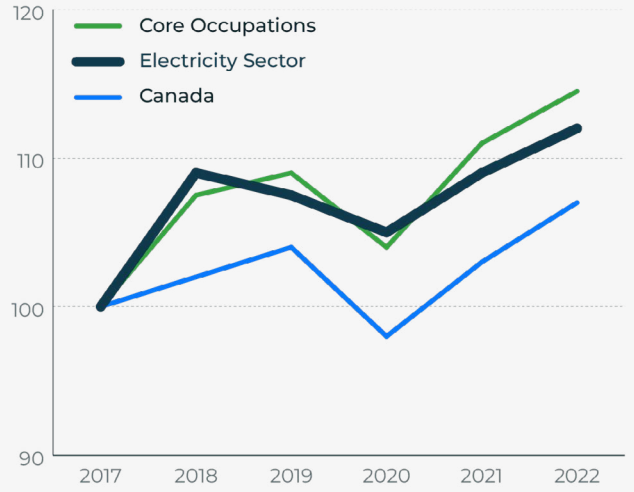
Since 2017, there has been rapid growth in employment within the electricity sector, outpacing job growth in the rest of the economy

Over the past five years, total employment in Canada grew a little more than 7%, or approximately 1.4% per year, which is relatively robust, given the magnitude of job losses that took place during the pandemic (Figure 6). In comparison, employment in the electricity sector (i.e., NAICS 2211) increased by just over 12% over the same period, or 2.3% per year on average. Moreover, the level of employment in core electricity occupations grew more than twice that of the corresponding figure for the Canadian economy, i.e., more than 14% over the five-year period, or 2.7% per year.

Job growth has been widespread across Canada, particularly among the core electricity occupations

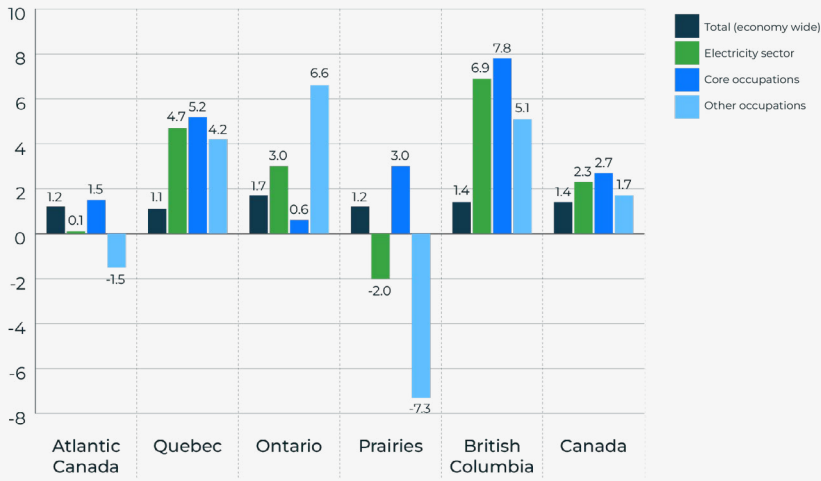
A similar picture emerges when developments across different regions are examined (Figure 7). Firstly, in most instances (except Atlantic Canada and the Prairies), employment growth in the electricity sector outpaced that of the rest of the economy. Secondly, average annual employment growth over the past five years in the core occupations outstripped job →

Figure 6. **Evolution of employment growth in Canada's electricity sector (Index: 2017=100), 2017–2022**



Source: *Statistics Canada, Labour Force Survey.*

Figure 7. **Average annual employment growth in Canada's electricity sector (%), 2017–2022**



Source: *Statistics Canada, Labour Force Survey.*

growth in other electricity occupations and the rest of the economy, with the lone exception being Ontario.

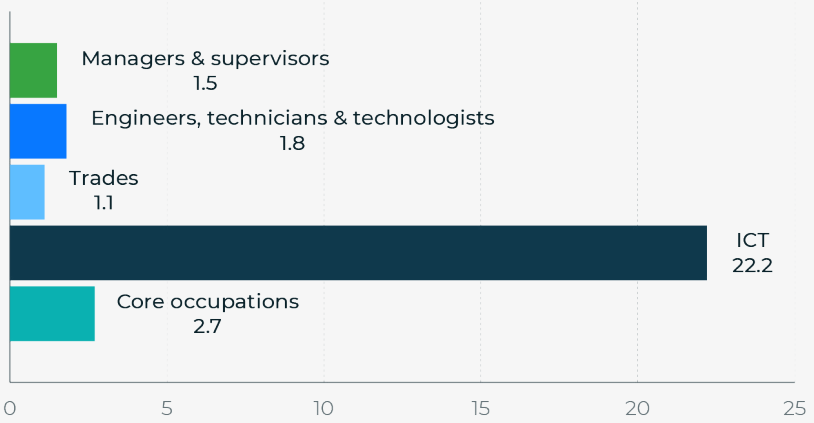
Across regions, several different patterns can be observed:

- ***Atlantic Canada:*** only moderate growth in the electricity sector overall (0.1% per year), but strong growth in the core electricity occupations, with declines in other electricity sector occupations.
- ***Quebec:*** robust growth across the board in all electricity-related occupations. Growth among the core occupations within the sector far outpaced the overall job gains in the province.
- ***Ontario:*** electricity sector-wide job gains (3.0% per year) nearly double the growth in economy-wide employment (1.7% per year), but unlike other regions, growth was particularly strong (6.6% per year) among the other electricity-related occupations.
- ***Prairies:*** the lone region where electricity-related employment fell. It declined by an average of 2.0% per year over the five-year span. However, among the core electricity occupations, average annual employment growth at 3% was comparably strong, with other electricity-related employment falling 7.3% per year since 2017.
- ***British Columbia:*** robust job creation across the board with respect to core and other electricity occupations. Apart from other occupations, average annual job growth far outpaced gains in the rest of the country.

Across the four occupational groups, there has been considerable variation in employment gains

Average annual employment gains varied across the electricity sector's four core occupational groups. As shown in Figure 8, since 2017 job gains in the sector were particularly strong in *ICT* (22.2% per year). *Engineers, technicians & technologists* occupations grew by 1.8% per year (see also Box 3). Employment increased more moderately for both *Trades* (1.1%) and *Managers & supervisors* (1.5%).

Figure 8. Average annual employment growth in core occupations in the electricity sector, by occupational group (compound annual % change), 2017–2022



Source: *Statistics Canada, Labour Force Survey.*

Box 3. Recent trends in engineers compared to engineering technologists and technicians

Within the occupational group *Engineers, technicians & technologists*, there are nine specific occupations, including three dedicated to engineers (that typically require postsecondary degree) and six dedicated to engineering technologists and technicians (that typically require a college diploma or apprenticeship training). Given the distinct training requirements of these two subgroups, Table 2 shows the breakdown between them over time. It highlights that within the occupational group, as of 2022, engineers account for approximately 10,800 (65%) workers compared to 5,700 (35%) for technologists and technicians, with little change in the distribution since 2017.

Table 2. Distribution of Employment within Engineers and Engineering Technologists Occupational Group, 2017 and 2022

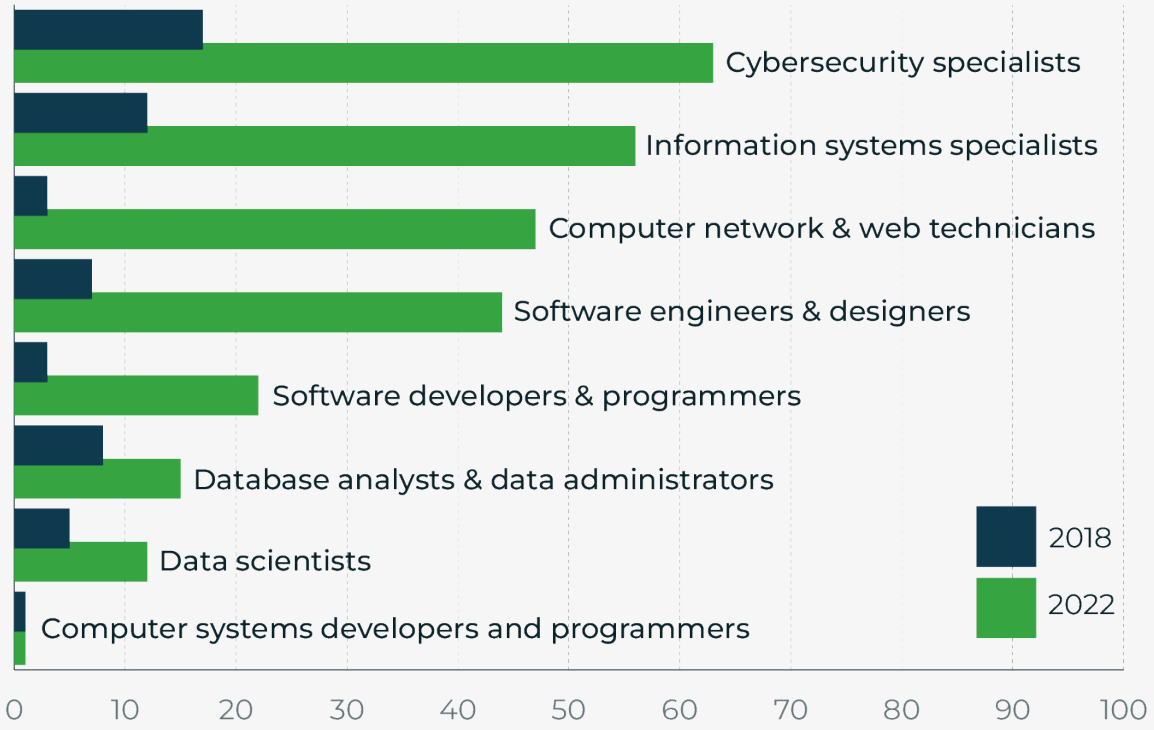
	2017		2022	
	#	Share	#	Share
Engineers	9,600	64%	10,800	65%
Engineering technologists and technicians	5,500	36%	5,700	35%
Engineers, technicians & technologists	***15,100***	***100%***	***16,500***	***100%***

Source: *Statistics Canada*

ICT workers are increasingly sought by hydro employers

Another sign of the growing role of *ICT* occupations in the electricity sector is the fact that among hydro employers, there was a 364% increase in the number of job postings for *ICT* occupations between 2018 and 2022—albeit starting from a relatively low level in 2018 (Figure 9). Meanwhile, the total number of job postings by hydro employers increased 60%.

Figure 9. Number of job postings by hydro employers for *ICT* occupations, 2018 and 2022



Source: *Vicinity Jobs.*

Notes: *Hydro employers includes Hydro Québec, BC Hydro, Hydro One Networks Inc., Manitoba Hydro, Newfoundland and Labrador Hydro, Toronto Hydro, Newfoundland Labrador Hydro, Hydro Ottawa, and Peace River Hydro Partners.*

3.3 CRITICAL OCCUPATIONS IN DEMAND

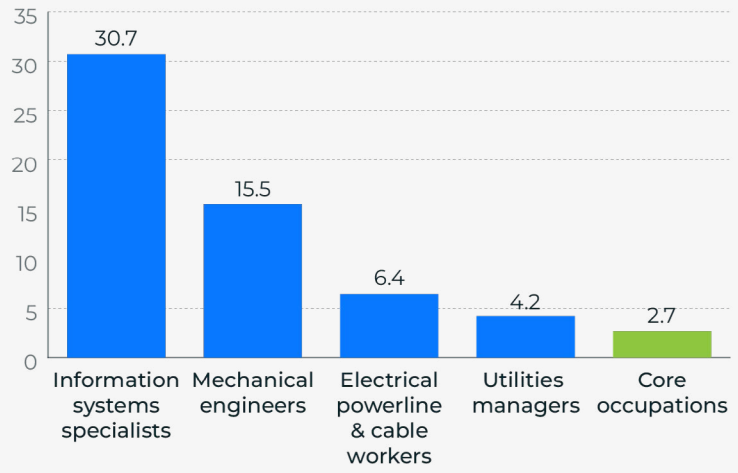
Employment in several large core occupations has grown rapidly

Each of the occupational groups have exhibited robust employment growth in some of their largest occupations (Figure 10). For instance, within *ICT,* the largest occupation is Information systems specialist (see Section 3.1) and since 2017, employment has grown on average more than 30% per year. Similarly, in the case of *Electrical powerline and cable workers* and *Utilities managers*, both of which are the largest occupations within their respective groups, employment has grown at an annual pace (6.4% and 4.2%) that far outstrips that of the other core occupations within the electricity sector (2.7%). Similarly, within the occupational group of *Engineers, technicians & technologists*, the employment of *Mechanical engineers* increased at an annual pace of more than 15% since 2017. Together, these four specific occupations account for more than 40% of employment in the core electricity occupations.

Employers are having difficulty recruiting workers to fill many of these and other occupations

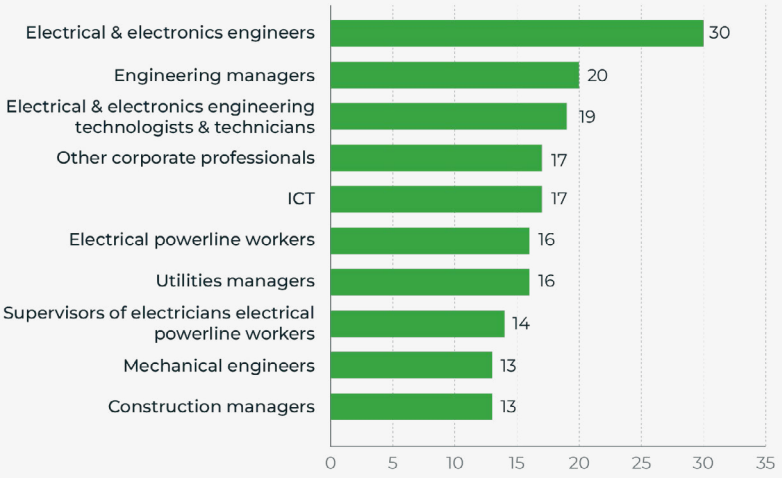
Against the backdrop of strong employment growth, employers in the electricity sector face significant →

Figure 10. Employment growth in key core occupations (compound annual average, %), 2017–2022



Source: *Statistics Canada, Labour Force Survey.*

Figure 11. Top 10 occupations for which it is difficult to attract or recruit (% of employers), 2023



Source: *EHRC Employer Survey, 2023.*

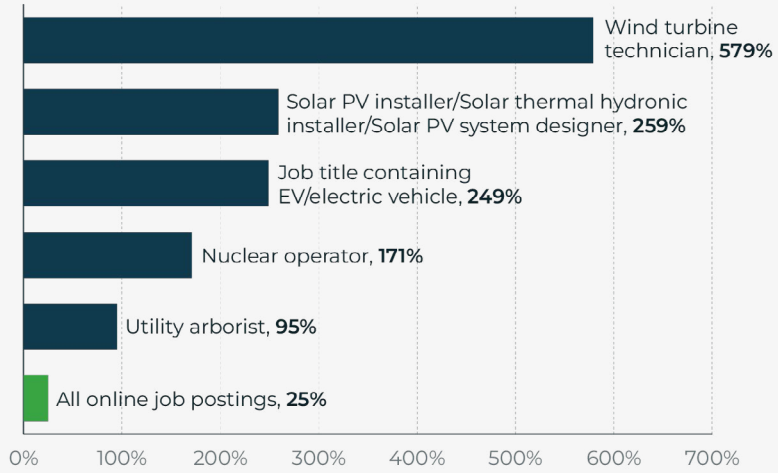
challenges recruiting and attracting workers for several occupations (Figure 11). Many engineering-related occupations are among the most difficult to recruit for. Close to one in three employers surveyed by EHRC reported that it was difficult to hire Electrical and electronics engineers. Other occupations appearing in the top 10, in terms of recruitment difficulties, include ICT workers, other corporate professionals, Electrical powerline workers and Utilities managers. Compounding the challenge is the fact that employers also report difficulties retaining staff for eight of these occupations.[25]

Postings for job titles related to renewable energy have increased in recent years

Official statistics and frameworks such as the NOC system are unable to capture detailed information on some specific job titles. This is especially the case for those that have recently emerged and have not yet been fully categorized according to occupational classifications. In this context, detailed job titles from online job posting can provide meaningful insights to supplement official statistics.

Data from Vicinity Jobs for the period 2018–2022 shows that the overall number of online job postings increased by 25%.[26] Over the same period, postings for some key job titles related to renewable energy grew even more (Figure 12). Postings for Wind turbine technicians grew considerably, with the volume increasing 579% between 2018 and 2022. The number of job titles containing 'EV' or 'electric vehicle' grew by 249%, while job titles related to photovoltaics (PVs) expanded by 259%.

Figure 12. Increase in number of online job postings for custom electricity job titles (%), 2018–2022



Source: *Vicinity Jobs.*

Many organizations are turning to outsourcing

Among the employers recently surveyed by EHRC, close to half (40%) report resorting to outsourcing for a wide range of activities, including construction, operations and inspection, and maintenance and repair, among others. This is a significant increase compared to EHRC's Employer Survey 2017, which indicated that just over a quarter (27%) of employers routinely or frequently use contractors and consultants. The incidence of outsourcing is prevalent across the four occupational groups, with *Engineers, technicians & technologists* and *Trades* seeing the highest rate of outsourcing. In addition, one in three employers report that outsourcing is likely to increase over the next five years, with nearly half stating that they expect it to remain at current levels (only 13% expect a decline in outsourcing). While the leading reason that employers turn to outsourcing is the temporary nature of a project (28%), 15% state that it is because of the difficulties associated with recruiting staff.

Key takeaways:

- Over the past five years, job growth in the electricity sector has far outpaced that of the rest of the economy. Moreover, employment gains in the core set of occupations have been particularly strong. This is true, by and large, across the regions.
- Across the four groups of occupations, employment gains have been strong, with growth in ICT helping to drive overall growth, despite its comparably small share of overall employment in the electricity sector.
- At the same time, the largest occupations within each of the occupational groups have witnessed significant employment gains since 2017.
- Employers report difficulties recruiting and retaining employees in several occupations critical to the electricity sector.
- Online job postings in the renewable energy sector, notably those involving wind and solar power, have seen exponential growth.
- Close to half of employers outsource to fill a wide range of their HR needs—a significant increase compared to 2017, when only 27% relied on external contractors. Only 13% of them anticipate that outsourcing will decline over the next five years.

4.0 Socio-Demographic Composition

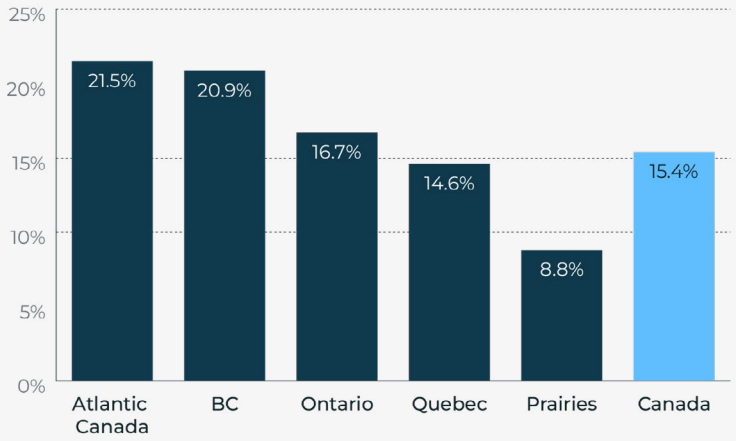
This section examines the socio-demographic composition of Canada's electricity sector workforce. It considers the age, gender, and diversity of employment in core electricity occupations. It characterizes recent years' trends and indicates how core electricity occupations compare with the same occupations in the rest of the economy.

4.1 AGE

Population aging in the electricity sector is affecting most regions

Each of the regions have sizable shares of workers aged 55 years and over. In Atlantic Canada and British Columbia, more than one in five workers fall in this age category. Quebec and the Prairies, in contrast, have the lowest proportion of such workers (Figure 13).

Figure 13. Share of older workers (age 55+) in core electricity sector occupations by region (%), 2022



Source: *Statistics Canada, Labour Force Survey, 2022.*

Except for the *Trades*, employees in the electricity sector tend to be older than their counterparts in the rest of the economy.

Most employees are aged 25–54 in all occupational groups in both the electricity sector and the economy as a whole (Table 3). Given that the core electricity occupations typically require at least some postsecondary education (see Section 5 and Appendix B), it is perhaps not surprising that individuals between the ages of 15–24 comprise the smallest proportion of the workforce (6% among the core electricity occupations).

While the share of workers aged 55 years and over in the core electricity occupations is on par with the corresponding economy-wide figure, on average, there are noticeable differences by occupational group (Table 3). The *Trades* group's share of workers aged 55 and over is smaller by comparison, and by a considerable margin. Workers in the *ICT* occupational group within the electricity sector are older, i.e., nearly one in three (29%) workers are at least 55 years of age, whereas the corresponding figure across all sectors is 12%. Similarly, for *Managers & supervisors*, close to one in four (24%) are aged 55 and over (compared to 18% in all economic sectors). Among *Engineers, technicians & technologists*, the shares are comparable, although workers are slightly older in the electricity sector (19% are 55 and over compared to 18% in all economic sectors).

Table 3. Profile of employment in core occupations of the electricity sector, by occupational group and age range (%), 2022

Core electricity occupations in NAICS 2211	Age 15–24	Age 25–54	Age 55+
Managers & supervisors	2	74	24
Engineers, technicians & technologists	9	72	19
Trades	6	86	7
ICT	3	67	29
Total electricity core occupations	***6***	***79***	***15***
Total electricity sector	***5***	***78***	***17***

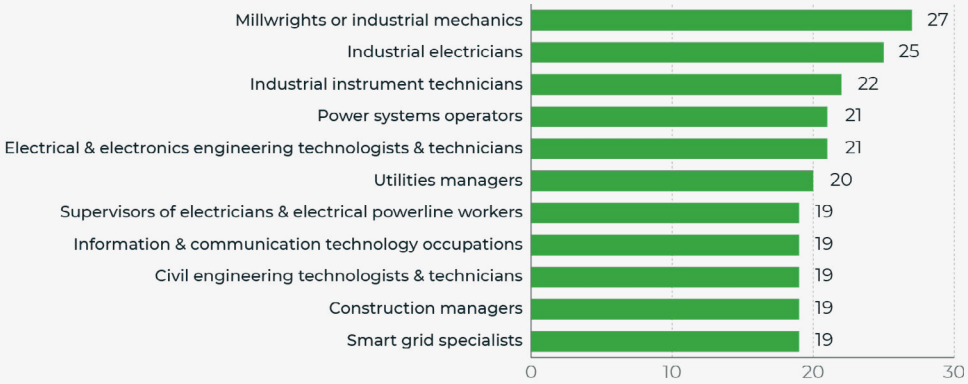
Core electricity occupations in all NAICS	Age 15–24	Age 25–54	Age 55+
Managers & supervisors	1	81	18
Engineers, technicians & technologists	9	73	18
Trades	12	70	17
ICT	7	80	12
Total	***8***	***76***	***15***

Source: *Statistics Canada, Labour Force Survey.*

A number of occupations have a disproportionate share of workers aged 55 and over

There is also some heterogeneity within the occupational groups. EHRC's Employer Survey shows that in several occupations, the proportion of workers aged 55 years and over is much higher than the corresponding figure for the electricity sector overall (Figure 14). In particular, a number of occupations have close to 20% or more of workers aged 55 and over, ranging from Millwrights or industrial mechanics to Smart grid specialists.

Figure 14. Share of older workers (age 55+) in the electricity sector by occupation (%), 2023



Source: *EHRC Employer Survey, 2023.*

4.2 GENDER[27]

The sector continues to be male-dominated, although by a smaller extent than in previous years

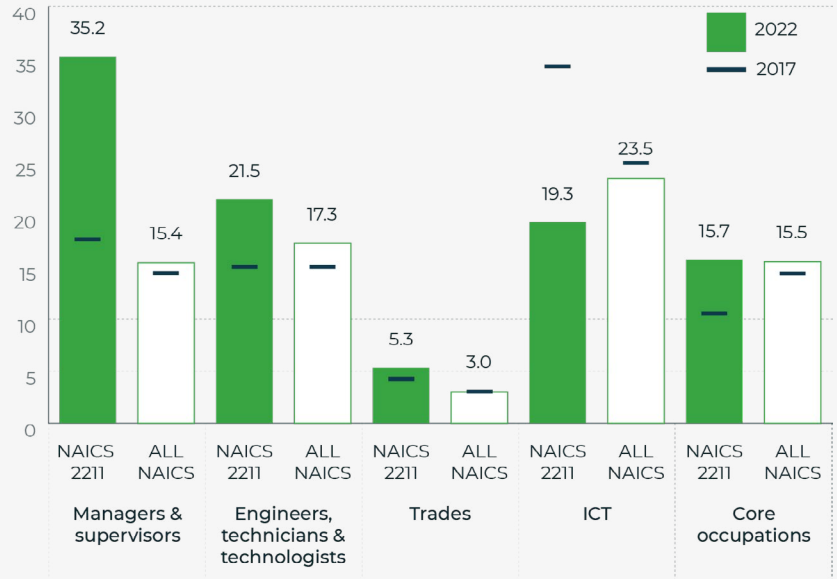
In core electricity occupations, only 16% of employees are female (Figure 15), a lower share than for the electricity sector as a whole, at 27%. The gender composition of employment in core electricity occupations is similar to the corresponding figure for the same occupations at the economy-wide level. This, however, is in stark contrast to the situation at the economy-wide level, where women hold 48% of all jobs.

Since 2017 the sector has made strong gains in gender diversity compared to the rest of the economy. In fact, the share of female employment in core electricity occupations has grown by five percentage points, compared to less than two percentage points elsewhere.

There are, however, distinct differences across occupational groups:

- ***Managers & supervisors:*** This is the occupational group with the highest proportion of female employment (one in three). Its share of women is also more than double that of the same occupational group across the entire economy.
- ***Engineers, technicians & technologists:*** More than one in five employed in the group are female, up considerably (nearly seven percentage points) from 2017 and higher than the economy-wide share.
- ***Trades:*** At only 5%, and little changed since 2017, few women are employed in the core electricity *Trades* occupations—but this is slightly higher than the economy-wide share for these *Trades* occupations.
- ***ICT:*** Levels of female employment are comparable to other sectors, but have significantly declined over the past five years.

Figure 15. Share of female employment in core electricity occupations by occupational group (%), 2017 and 2022



Source: *Statistics Canada, Labour Force Survey.*

Note: *Unless otherwise states, for comparison purposes, figures for All NAICS refer to the same occupations as in NAICS 2211. See Appendix B for the full list and description of these occupations.*

4.3 DIVERSITY, EQUITY AND INCLUSION: DATA FROM CENSUS OF POPULATION

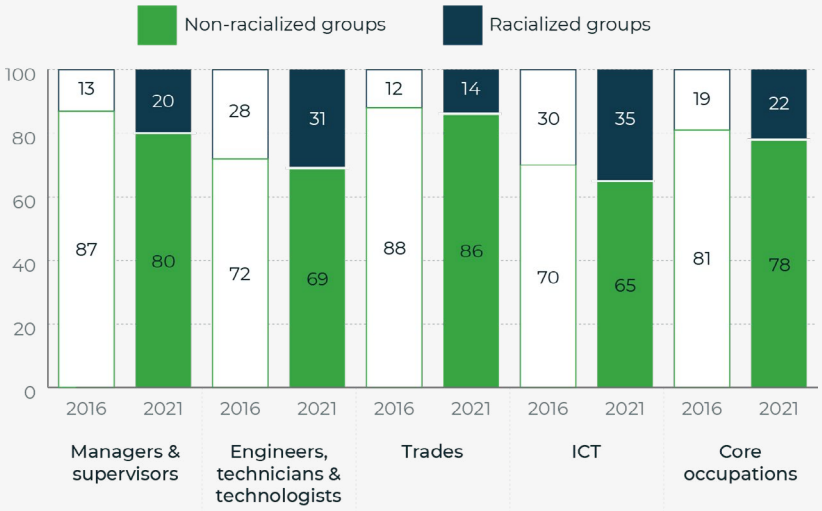
Efforts to increase Diversity, equity, and inclusion (DEI) are pivotal to the success of the electricity sector's human resources strategy. The sector, like others, benefits significantly from a diverse workforce, as it brings a wider array of perspectives, ideas, and innovative solutions than would otherwise exist. Moreover, efforts to promote a more diverse workforce can help address key labour and skills shortages. This sub-section examines the electricity sector's workforce and compares it to others by examining employment levels across various DEI lenses, using data from the *Census of Population*.

Racialized groups make up a small portion of the electricity workforce

Among the electricity sector's core occupations, the proportion of racialized groups was just under 22% (Figure 16) in 2021. Meanwhile, for the core occupations economy-wide, racialized groups constitute 33% (for all occupations, racialized groups represent approximately 30% of total employment). These figures are comparable to the share of racialized groups in the electricity sector as a whole (22%).

Among the occupational groups, *ICT* has the highest share of racialized groups within the electricity sector, at close to 35%. Since 2016, when the share of racialized groups in core electricity occupations was nearly 19%, there have been modest improvements. Indeed, all occupational groups have witnessed improvements since 2016. The *Trades*, however, have the lowest proportion of visible minority individuals (just under 14% in core electricity occupations in NAICS 2211), with little improvement over the past five years. *Managers & supervisors* have seen the largest gain, i.e., a seven-percentage point increase since 2016.

Figure 16. Share of employment by occupational group and racialized groups (%), 2016 and 2021



Source: *Statistics Canada, Census of Population, 2016 and 2021.*

Note: *Racialized groups are persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour.*

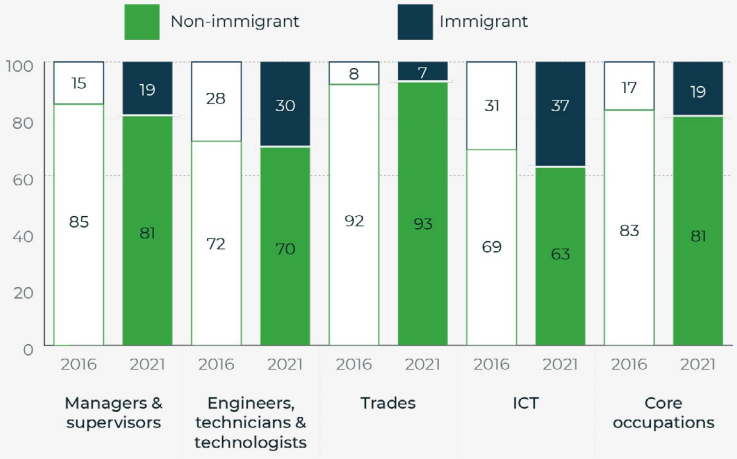
Immigrants are also under-represented in the electricity sector, but there have been important gains, with the exception of the *Trades*

Figure 17 shows that the proportion of immigrants employed in core occupations was just under 19% in 2021 (18% for the total electricity sector). In comparison, for these occupations economy-wide, immigrants comprise 32% of employment (for all occupations, immigrants represent approximately 26% of total employment). There have been limited improvements in the share of immigrants in the core electricity occupations since 2016 (less than two percentage points). This is due almost entirely to the fact that the share of immigrants among the *Trades* group of occupations (at approximately 7%) declined slightly over the period, whereas the other occupational groups registered increases. At the same time, with the onset of the pandemic the number of immigrants arriving to Canada fell sharply in 2020, the year preceding the Census (see also Figure 24 in Section 7).

Indigenous employment within the electricity sector is heavily concentrated in the *Trades*

The proportion of people working in core electricity occupations who are Indigenous —5% in 2021—rose modestly since 2016 (Figure 18). This is higher than the share of Indigenous people in these occupations economy-wide, at just over 2.7% in 2021 (for all occupations, Indigenous people represent approximately 4% of total employment). Most of the increase is a result of growth in the *Trades*' share. Among *ICT* occupations, the share has fallen since 2016, albeit only by 0.1 of a percentage point.

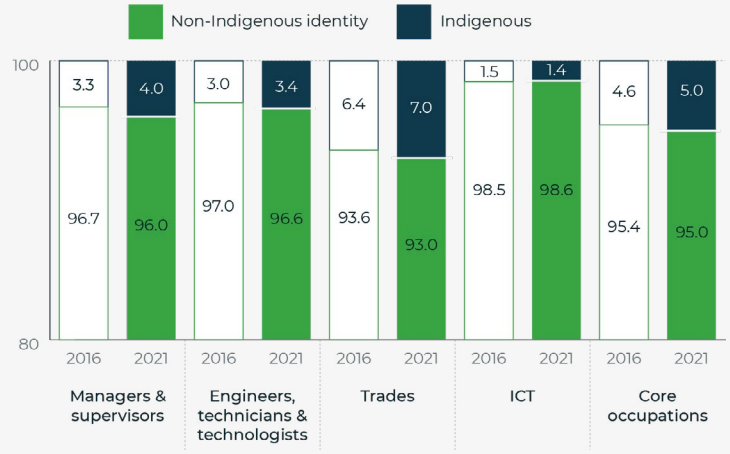
Figure 17. Share of employment by occupational group and immigration status (%), 2016 and 2021



Source: *Statistics Canada, Census of Population, 2016 and 2021.*

Note: *Immigrant status also includes non-permanent residents.*

Figure 18. Share of employment by occupational groups and Indigenous identity status (%), 2016 and 2021



Source: *Statistics Canada, Census of Population , 2016 and 2021.*

Note: *Indigenous identity refers to whether the person identified as Indigenous peoples of Canada.*

Persons with disabilities continue to constitute a small portion of the electricity workforce, with little change since 2017

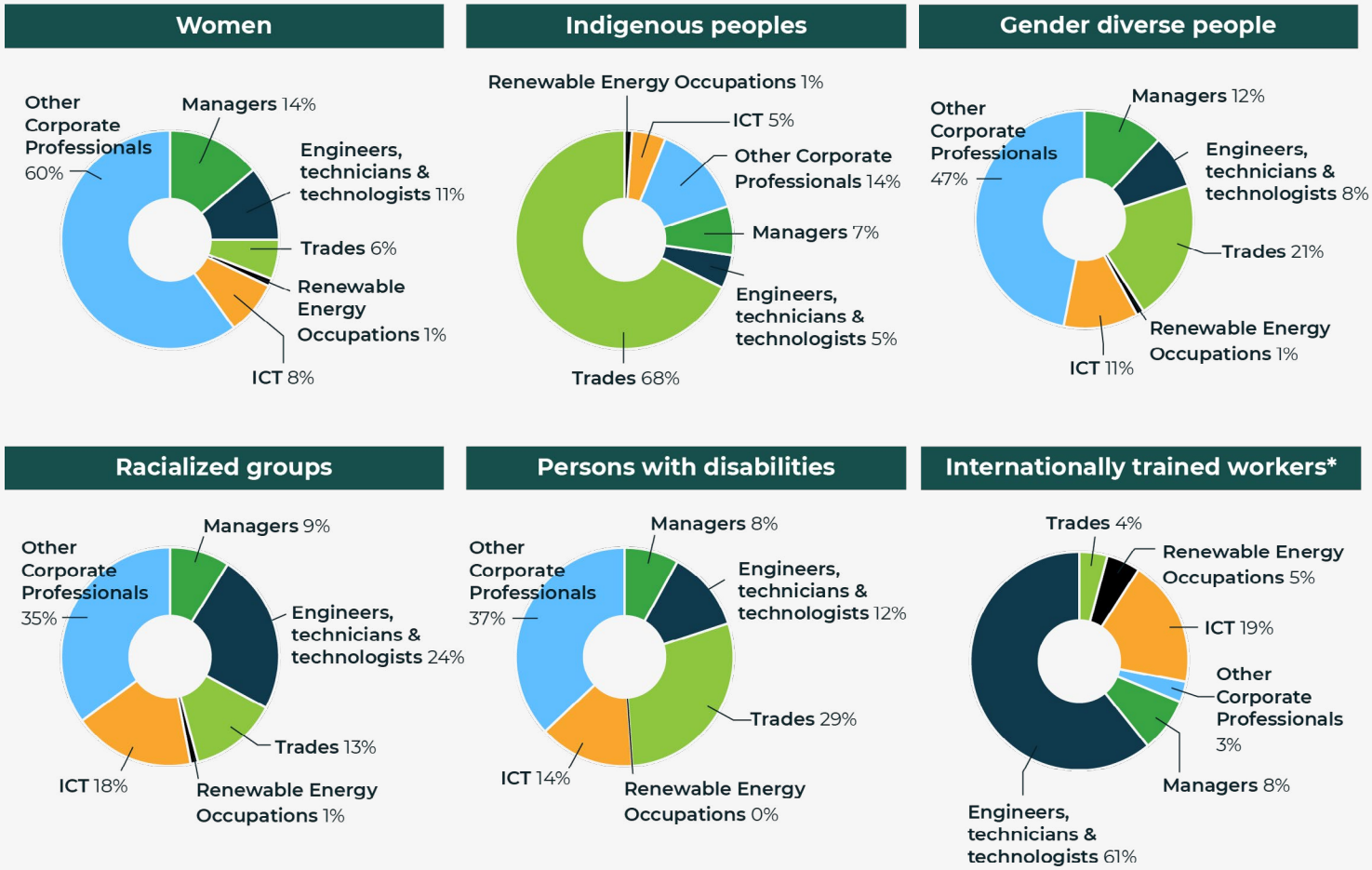
In 2017, the results of EHRC's Employer Survey indicated that persons with disabilities represented approximately 1% of the electricity sector's employment. According to the EHRC survey of employers undertaken in 2023, this figure remains at 1%. In contrast, the 2017 Canadian Survey on Disability from Statistics Canada indicates that 15.6% of employed Canadians aged 25 to 64 had a disability.

Diversity across occupational groups

The results of EHRC's Employer Survey 2023 indicate that the diversity of electricity-sector employees varies considerably across occupational groups varies (Figure 19):

- ***Women:*** More than half are employed as *Other corporate professionals*, with the next largest occupational group being *Managers*.
- ***Indigenous people:*** Largely concentrated within the *Trades*, i.e., more than two-thirds (68%), with the remaining employees spread across the other occupational groups.
- ***Racialized groups:*** Almost one in four are employed as *Engineers* (24%) while a large share is in *Other corporate professionals* (35%).
- ***Persons with disabilities:*** Mostly employed in the *Trades* and *Other corporate professionals*; combined, these two categories represent over two-thirds of employment among this group.
- ***Gender diverse people:*** Primarily employed within *Other corporate professionals*, followed by *Trades* and *Managers*.
- ***Internationally trained workers:*** Employers reported that the largest proportion (61%) worked in *Engineering* occupations, followed by *ICT* (19%).

Figure 19. **Distribution of diversity populations across occupational groups**



Source: *EHRC Employer Survey, 2023.*

Note: *The category 'Internationally trained workers' includes immigrants, refugees, international students, and Canadians who trained or worked outside of the country.*

Key takeaways:

- Population aging continues to affect the sector, although the extent varies by occupational group and specific occupation. Of particular concern is the share of workers aged 55 years and over in the *ICT* and *Managers & supervisors* occupational groups.
- In recent years, there have been gains in the share of female employment in the electricity sector (except for the *ICT* group of occupations).
- Women, however, continue to constitute only 16% of employment in the core electricity occupations (compared to 27% for the sector as a whole, and 48% among total employment in Canada). The problem is particularly acute in the *Trades*, although the proportion of women in all four core occupational groups is low.
- In terms of DEI, census 2021 results reveal that racialized groups, immigrants, and Indigenous people constitute an important element of the electricity sector's core workforce.
- Since 2016, although the employment shares of most of these groups have risen, by and large their proportion of electricity sector employment is substantially lower than it is in the broader economy.
- According to EHRC's Employer Survey, except for racialized groups, most of the population subgroups are relatively concentrated in certain occupational groups. For instance, almost half of women are employed as *Other corporate professionals* and most Indigenous peoples work in *Trades* occupations.

5.0 Characteristics of Jobs

This section analyzes employment dimensions, such as work quality, educational attainment and tenure, to shed light on the characteristics of jobs in the sector.

5.1 CONTRACTUAL STATUS OF WORKERS

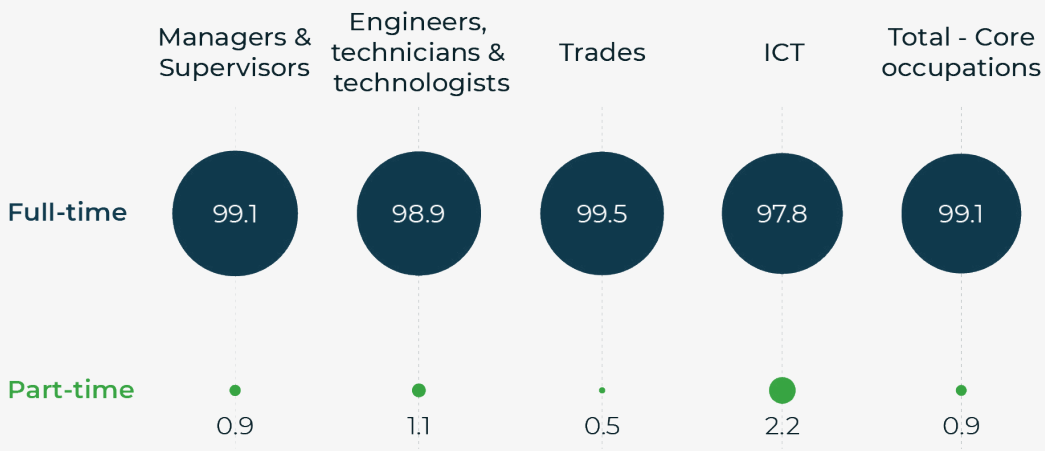
Most jobs in core electricity occupations are full time

The rate of full-time employment in the four occupational groups considered is quite high (99%), and less than 1% of employment is part time (defined as less than 35 hours per week on average), as shown in Figure 20. This is substantially higher than the economy-wide average for 2022, at 17% part-time employment.

The relatively high levels of full-time employment are broadly consistent across the four occupational groups, likely due in part to the nature of the jobs they entail. However, compared to 2017, part-time employment has increased considerably, albeit starting from very low levels.

Men and women have about the same volume of part-time employment. But given the comparably small share of women employed in core electricity occupations (see Section 4), their share of part-time employment is higher (2.6% among women, compared to less than 1% among men).

Figure 20. Employment in Canada's electricity sector by occupational group and full-time and part-time status (%), 2022



Source: *Statistics Canada, Labour Force Survey.*

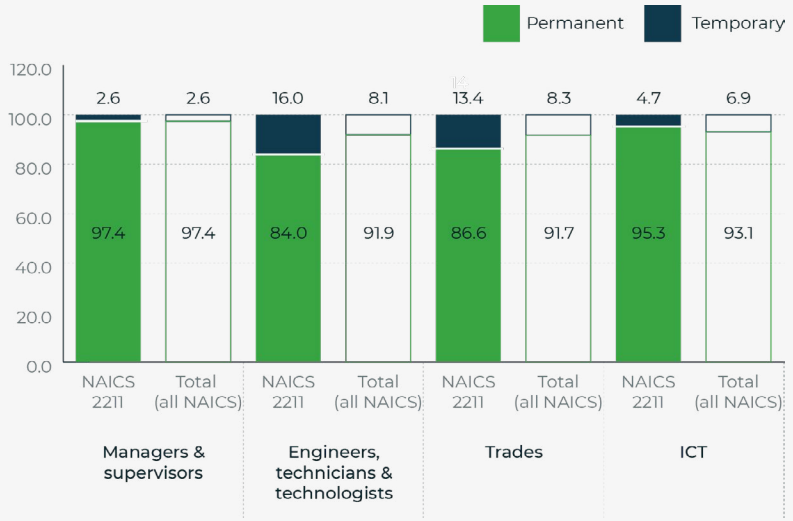
Temporary employment is more common in the electricity sector than in the economy as a whole, and is growing

In core electricity occupations, 88.5% of jobs are permanent, whereas 11.5% are temporary. This is a good indicator of the sector's work quality, since temporary employment, like part-time work, typically provides fewer benefits and coverage than permanent employment.

However, these same occupations in the economy as a whole are 92.9% permanent status and 7.1% temporary. As such, the core electricity occupations have a slightly higher share of temporary employment (by four percentage points). The difference is particularly notable among *Engineers, technicians & technologists* and *Trades* (Figure 21). *Managers & supervisors* in the electricity sector have the same prevalence of temporary employment as they do in the rest of the economy, while the rate of temporary employment among *ICT* occupations is even slightly lower.

Like part-time employment, the share of temporary work in core electricity occupations is on the rise—growing by roughly three percentage points since 2017. This stands in stark contrast to the situation in the rest of the economy, where those same occupations have seen a moderate decline in temporary employment. The pattern is consistent with the increased reliance on contractors and outsourcing to undertake projects of a temporary nature, as discussed in Section 3.

Figure 21. Shares of employment by contractual status, for core occupations by occupational group (%), 2022



Source: *Statistics Canada, Labour Force Survey.*

Note: *A temporary job has a predetermined end date or will end as soon as a specific project is completed.*

5.2 EDUCATIONAL ATTAINMENT, WAGES, AND TENURE

Jobs in core occupations tend to be held by people with relatively high levels of educational attainment

In 2022 more than one-third of those employed in core electricity occupations had a bachelor's degree or above (Table 4). The corresponding figure for *Engineers, technicians & technologists* is nearly two in three. Taken together, less than 6% of those employed in core electricity occupations have attained a secondary school diploma, or less. The figures are also up compared to 2017, consistent with overall increases in educational attainment across the rest of the economy.

Taking a closer look at each of the occupational groups and comparing employment in the same occupations across the total economy is revealing. While for *Engineers, technicians & technologists* the figures are similar across sectors, individuals employed in *ICT* occupations within the electricity sector have, on average, less postsecondary education (by a gap of more than 10 percentage points) than those in the economy-at-large. For *Managers & supervisors* and those employed in *Trades*, the opposite is true: both have a much higher share of employees holding a bachelor's degree or above. Among *Trades*, the figure is close to double, i.e., more than 15% hold a bachelor's degree, compared to just under 8% for the same occupations in other sectors.

Table 4. **Educational attainment of employees in core electricity occupations, by occupational group (%), sector, 2022**

Occupational group	Sector	Bachelor's degree or above	Some postsecondary education	Secondary school or less
Managers & supervisors	*NAICS 2211*	50.6	45.7	3.6
	All NAICS	43.2	44.5	12.3
Engineers, technicians & technologists	*NAICS 2211*	63.0	33.6	3.4
	All NAICS	62.3	31.5	6.1
Trades	*NAICS 2211*	15.4	75.3	9.3
	All NAICS	7.9	68.6	23.5
ICT	*NAICS 2211*	54.8	43.9	1.2
	All NAICS	65.4	28.9	5.6
Total	*NAICS 2211*	***37.7***	***56.3***	***6.0***
	All NAICS	***45.5***	***42.8***	***11.7***

Source: *Statistics Canada, Labour Force Survey.*

Note: *Some postsecondary includes those individuals with a postsecondary or trades certificate or diploma.*

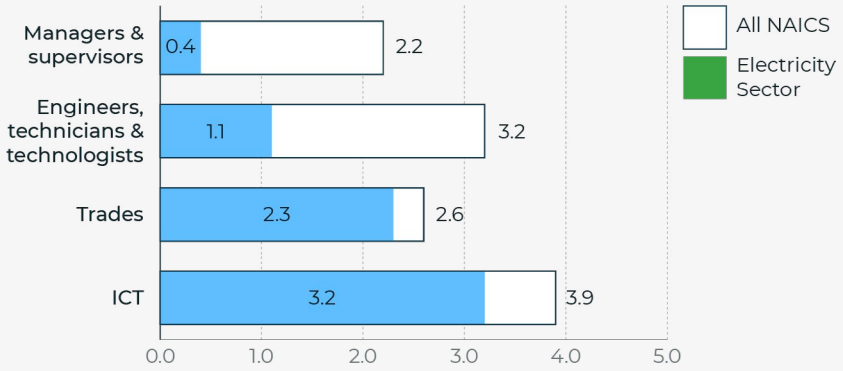
Although wages are relatively high in the sector, they are growing more slowly than in the rest of the economy

Against the backdrop of the relatively high job quality in the sector, i.e., high degree of permanent, full-time employment held by highly educated individuals, it is perhaps not surprising that across the four occupational groups, wages in the electricity sector tend to be higher on average than in the rest of the economy. However, over the past five years, such wages have been growing much more slowly than in the rest of the economy (Figure 22).

Tenure also tends to be higher, although declining over time

Average tenure (measured in months) is higher across the board in the sector's core occupations, than it is in the same occupations in the economy as a whole (Figure 23). However, with the exception of the *ICT* occupational group, between 2017 and 2022, in most cases tenure declined. According to the EHRC Employer Survey 2023, employee turnover in renewable energy-related occupations is nearly double that of other occupations.

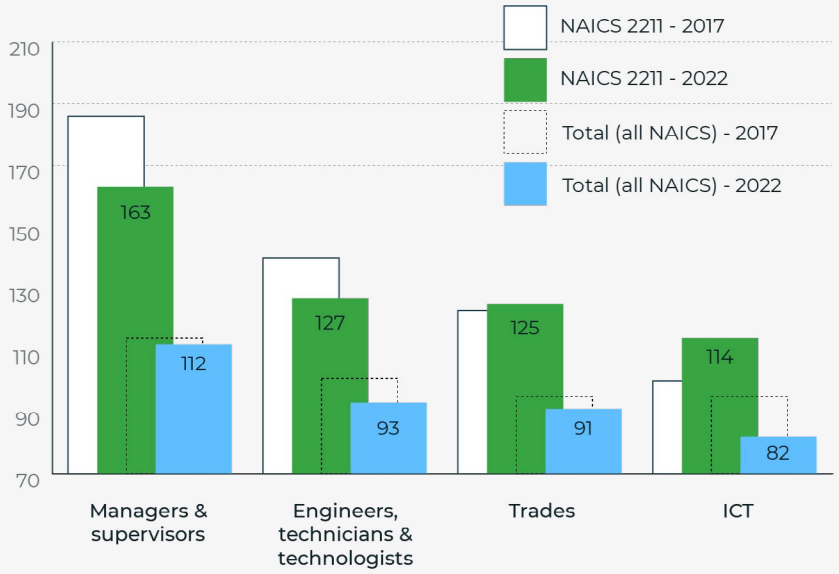
Figure 22. Wage growth in Canada's electricity sector compared to economy-wide wage growth (compound annual % change), 2017–2022



Source: *Statistics Canada, Labour Force Survey.*

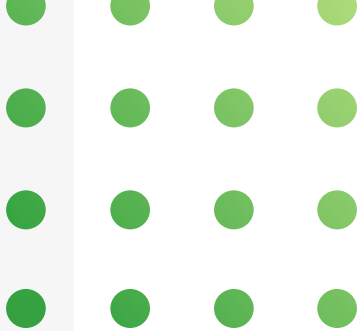
Note: *Average hourly wages based on usual hours worked.*

Figure 23. Average tenure in months for core electricity occupations, by occupational group and sector, 2017–2022



Source: *Statistics Canada, Labour Force Survey.*

This may reflect the broader trend of tenure decline in the Canadian economy, which is partly the result of population aging and turnover (i.e., as older cohorts of workers with longer tenure leave, younger workers with lower tenure enter, which has a downward impact on average tenure).



Key takeaways:

- The quality of jobs in Canada's electricity sector is comparably high, characterized by elevated shares of full-time and permanent employment and competitive wages, and driven in part by a highly qualified workforce.
- However, despite its relatively strong standing, the past five years have seen moderate declines in job quality, as the incidence of temporary and part-time employment has risen. Additionally, since 2017 wages in the electricity sector's core occupations have risen less than for those same occupations in the economy as a whole.
- High average tenure in the core occupations indicates that employee retention rates are quite high. Here too, although figures are moderately declining, they are consistent with patterns in the rest of the economy. Falling average tenure is also partly a function of an aging workforce, as workers with longer tenure on average exit the sector and younger workers with shorter tenure enter.

6.0 Supply of Labour

This section provides data on key sources of labour supply to Canada's electricity sector. It analyzes graduate trends from postsecondary instructional programs and apprenticeship registrations in key fields of study and trades relevant to the sector. Data are drawn from Statistics Canada's Canadian Occupational Projection System (COPS), the Postsecondary Student Information System (PSIS), and the Registered Apprenticeship Information System (RAIS).[28]

6.1 SOURCES OF LABOUR SUPPLY

Relatively high numbers of immigrants continue to enter Canada and represent a major source of labour supply

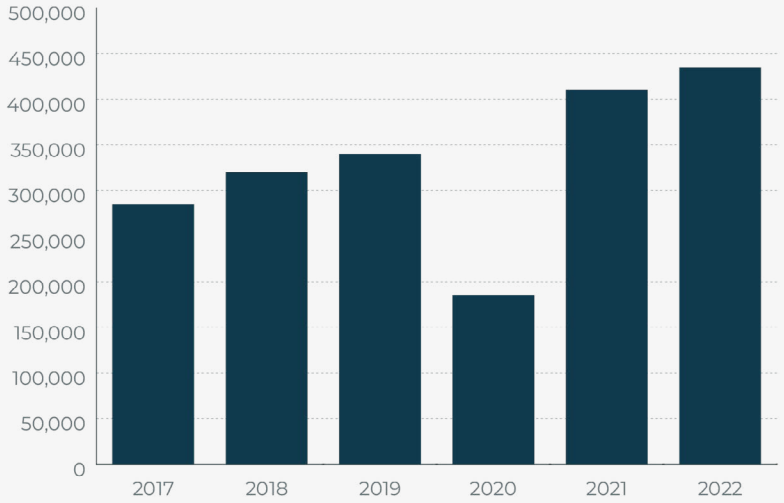
Broadly speaking, the future supply of labour to the electricity sector can come from a combination of (i) recruiting more workers from other sectors of the economy, (ii) improving labour market attachment and recruitment of under-represented groups; and (iii) attracting new entrants to the labour market.

With respect to the former, the primary sources of new entrants to the labour force come from a combination of:

- ***School leavers:*** individuals who leave full-time education and training programs to join the workforce; and
- ***New immigrants:*** individuals who enter Canada each year as permanent residents.[29]

Between 2017 and 2022, the annual level of immigration increased by more than 50%, averaging 329,500 new permanent residents per year. The onset of the COVID-19 pandemic in 2020 ushered in restrictions on the arrivals of newcomers to Canada, and as such, fewer new permanent and temporary residents entered during that year (Figure 24).

Figure 24. Number of new permanent residents admitted to Canada, 2017–2022



Source: *IRCC, 2023.*

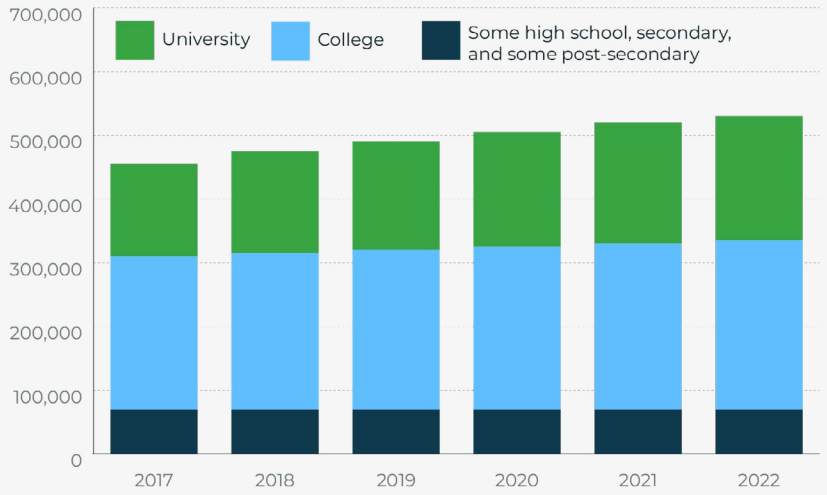
Immigration, Refugees and Citizenship Canada has established progressively higher targets for newcomers to Canada going forward, with 465,000 immigrant arrivals targeted in 2023, rising to 485,000 in 2024, and 500,000 in 2025.[30]

New immigrants account for the vast majority of growth in Canada's overall labour force. However, not all new permanent residents join the labour market upon entering Canada, since the total number of new permanent residents includes children, as well as adults who may or may not join the labour force. Between 2012 and 2021, the annual number of new immigrants effectively joining the Canadian labour market averaged 136,000.[31]

Educational attainment continues to rise among school leavers

School leavers are the other major source of new entrants to the labour market. Their educational attainment continues to rise, consistent with the evidence presented in Subsection 5.2. In 2022 nearly 87% of school leavers had either college- or university-level education, up by 2.5 percentage points since 2017 (and driven entirely by gains in university).

Figure 25. Distribution of school leavers by education level, 2017–2022



Source: *ESDC COPS 2022.*

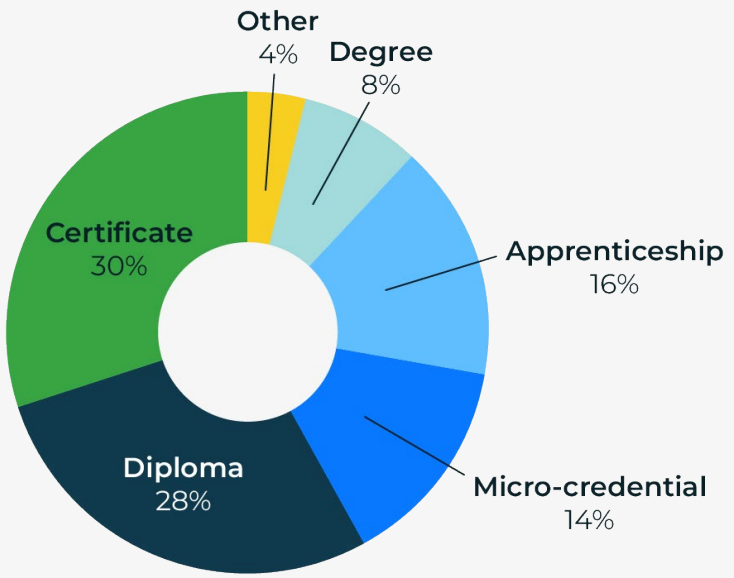
6.2 CURRENT EDUCATION AND TRAINING LANDSCAPE WITH RESPECT TO THE ELECTRICITY SECTOR

Many educational institutions in Canada are involved in educating and training the future workforce for the electricity sector. In EHRC's Educational Institution Survey 2023, more than 25 educational institutions shared their views on various issues. The respondents represent a wide range of institutional types, including college, private career college, vocational/community colleges, union college/training centre, technical institutes, and universities among others.

Among educators, there is a widespread recognition of the importance of offering education and training programs to equip students to work in the electricity sector

The vast majority (88%) of institutions that participated in the EHRC Educational Institution Survey 2023 offer educational programs related to the electricity sector. They confer a variety of credentials, including degrees, diplomas, certificates, micro-credentials and apprenticeships. Respondents indicated that many electricity-related academic programs are over-subscribed. More than half (58%) stated that applicant demand exceeds the number of spots available.

Figure 26. Type of credentials conferred within electricity and/or renewable energy programs (%), 2023



Source: *EHRC, Educational Institution Survey, 2023.*

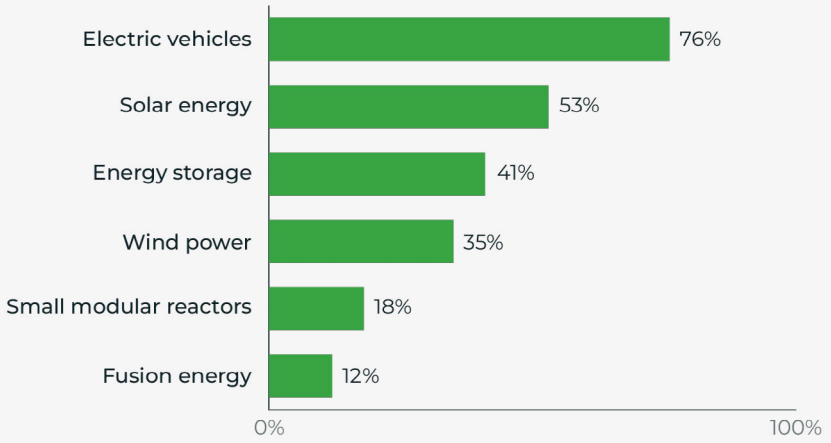
Note: *The category of Apprenticeship includes pre-apprenticeship training.*

There are signs of significant increases in training and education programs related to renewables and clean electricity

Respondents to the Educational Institution Survey also noted that new programs have recently been developed, or are currently in development, that impart information on renewable energy, low-emission sources of electricity generation, and/or new technology.

Given the breadth of occupations that are core to the electricity sector, the potential supply of labour to Canada's electricity sector extends well beyond these dedicated programs. It comprises individuals with diverse educational backgrounds who have honed their expertise through various learning channels. Two main streams are (i) workers who have completed a combination of on-the-job apprenticeships and classroom-based trades training, and (ii) postsecondary instructional programs. Each of these play a vital role in cultivating the talent that the sector relies upon. The next two subsections elaborate on recent trends with respect to postsecondary graduation and apprenticeship enrolment.

Figure 27. Introduction of new educational programs (% of respondents), 2023



Source: *EHRC, Educational Institution Survey 2023.*

Note: *Percentages of respondents who stated they are developing, or have developed, a new program in one of these areas. Percentages do not sum to 100 as respondents could indicate more than one response.*

6.3 POSTSECONDARY GRADUATES

Workers in core electricity occupations have backgrounds in a wide range of fields of study

Graduates from Canadian public postsecondary institutions are an important source of supply of human resources to the electricity sector. Data from the 2021 census of Canada was analyzed to determine the most common fields of study completed by those working in core occupations within the economy as a whole. For each core occupation, the top three fields of study were identified, according to the Classification of Instructional Programs (CIP) codes for the highest certificate, diploma, or degree held by individuals in those occupations. The detailed results for each occupation are presented in Appendix D (Table 12).

Figure 28 presents the consolidated list of the top fields of study for core occupations, highlighting how some fields are important for more than one occupational group. For example, Electrical, electronics, and communications engineering are among the most common programs for all four occupational groups, highlighting that this field of study is a key source of labour for core electricity sector occupations.

Graduates from these instructional programs are an important source of human resources for the electricity sector

As discussed earlier in this report, there is a conceptual difference between "occupation" and "industry," recognizing that there are inevitably many different types of jobs (inside and outside the electricity sector) that one can work in, given expertise in a particular area. (e.g., one Civil engineer might work in the electricity sector, whereas another Civil engineer might work in the construction sector). Similarly, a graduate from a given field of study, such as Civil engineering, is typically not limited to working in a single occupation (i.e., they may not necessarily have the job title "Civil engineer"). Nonetheless, the list of the most common fields of study for core electricity occupations suggests an important source of potential future human resources for the sector.

The number of graduates in these key fields of study can provide insights into the future supply of potential workers to the electricity sector. The Postsecondary Student Information System (PSIS)[32] tracks the numbers of graduates by fields of study over time. Fields of study are classified according to the CIP, which enables linkages to census data on occupations by field of study.

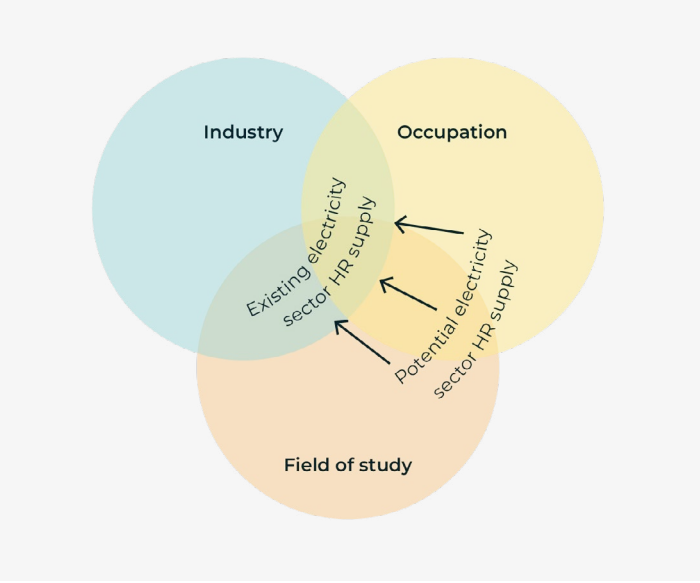
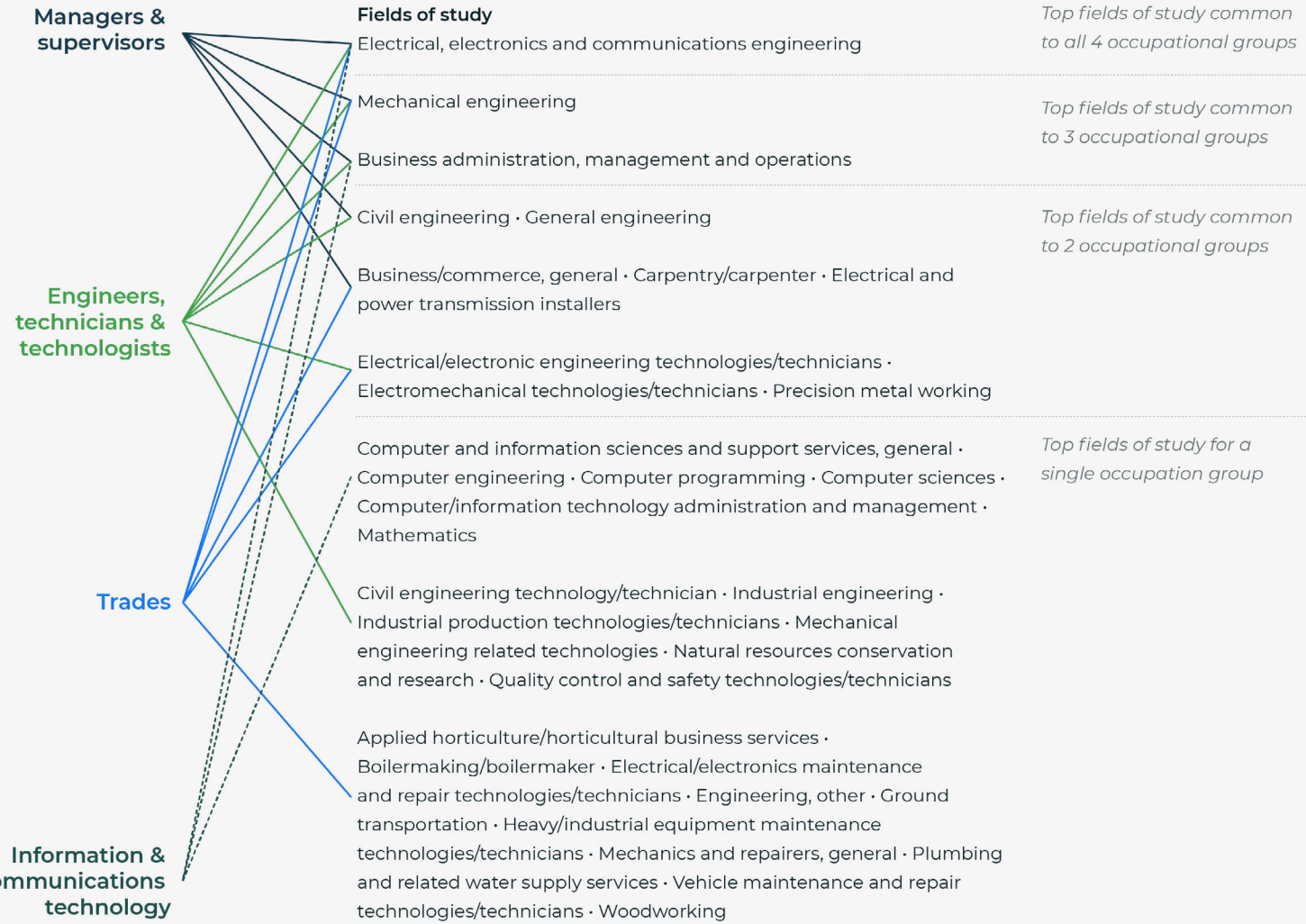


Figure 28. Top fields of study for core electricity sector occupations



Source: *Calculations based on census of Canada, 2021. Occupation by major field of study (detailed, 4-digit): Canada. Table: 98–10–0403–01.*

Note: *Data reflect those working in core occupations for the economy as a whole.*

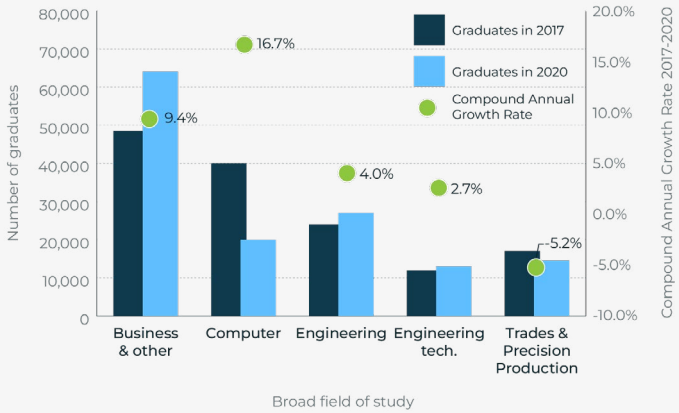
Overall growth in the number of graduates in the top fields of study for core electricity occupations has outpaced the growth of graduates in other fields, albeit with some variation

PSIS data for the most common fields of study for core occupations are presented below. Figure 29 groups the number of graduates according to broad categories of educational programs and Figure 30 presents the picture by detailed field of study. While there are annual fluctuations in the number of postsecondary graduates, in 2020 (the most recent year for which PSIS data is available) the number of graduates in the most common fields of study for core occupations (considered as a whole) increased by 21%, with approximately 24,000 more graduates than in 2017. In comparison, the growth in the number of graduates for all fields of postsecondary study (i.e., not just the electricity-relevant fields) was 8.6% over the same period (a compound annual growth rate of 2.8%).

Despite strong overall growth, there is much variation across electricity-relevant fields of study in terms of the magnitude of changes and the volume of graduates. In some cases, there is evidence of weak growth or even declining numbers of graduates.

→ Business programs have experienced large increases in the volume of graduates. In addition, based on the compound annual growth rate, 'Business, commerce, general' is one of the fields with the highest growth.

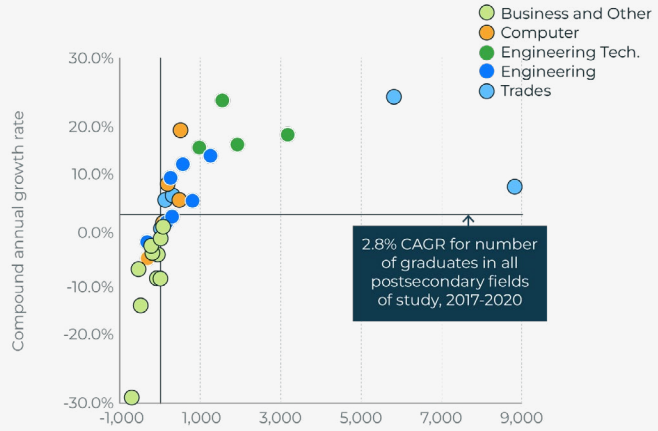
Figure 29. Change in number of graduates in top fields of study for core occupations, grouped by broad fields of study, Canada, 2017 and 2020



Source: *Statistics Canada. Postsecondary Student Information System (PSIS). Table: 37–10–0235–01. Postsecondary graduates, by detailed field of study, institution, and program and student characteristics.*

Note: *"Business and other" includes CIP codes 52.01, 52.02, 3.01, 27.01, 1.06; "Computer" includes CIP codes 11.01, 11.02, 11.07, 11.10; "Engineering" includes 14.01, 14.08, 14.09, 14.10, 14.19, 14.35, 14.99; "Engineering tech." includes 15.02, 15.03, 15.04, 15.06, 15.07, 15.08; "Trades and Precision Production" includes 46.02, 46.03, 46.05, 47.00, 47.01, 47.03, 47.06, 48.07, 48.08, 48.05, 49.02.*

Figure 30. Change in the number of graduates in top fields of study for core occupations, Canada, 2017 and 2020



Source: *Statistics Canada. Postsecondary Student Information System (PSIS). Table: 37–10–0235–01. Postsecondary graduates, by detailed field of study, institution, and program and student characteristics.*

Note: *Categories in the legend refer to the broad field of study.*

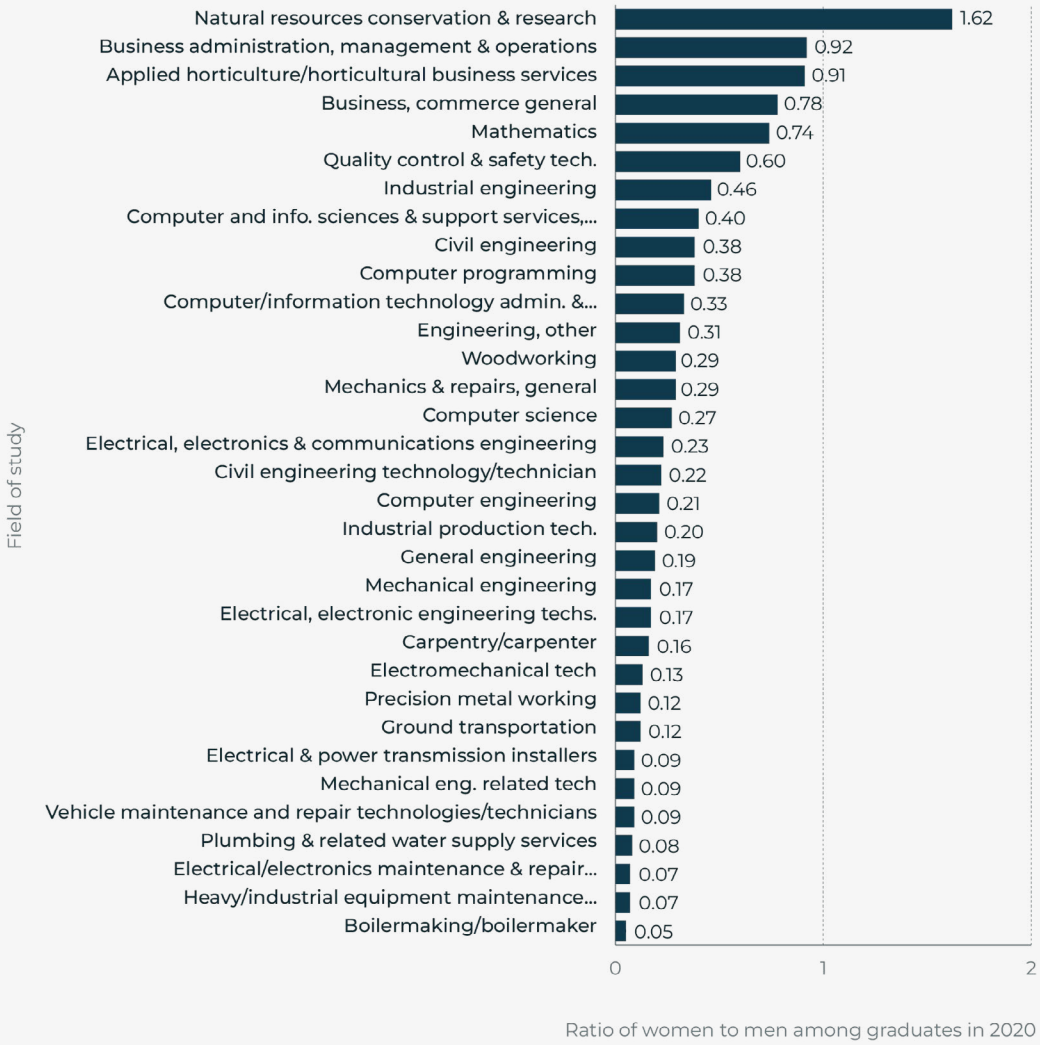
- The computer and information sciences fields exhibited the greatest compound annual growth -- between 14% and 23% --, although it produced fewer graduates than business programs.
- Engineering fields of study have also seen an increase in the number of graduates, albeit a more modest increase than for business and computer fields. However, the number of graduates in Civil engineering and Electrical, electronic and communications engineering have grown less than 2.8% (the Canadian average for all fields of study).
- Some engineering technologies and engineering-related fields have experienced growth above the Canadian average of 2.8%, while others are below. In some cases (e.g., Civil engineering technology/technician), the number of graduates has declined in recent years.
- Trades and precision production fields of study have seen a decline in the number of graduates. Training in skilled trades commonly occurs through a combination of classroom-based training, as well as on-the-job training in the form of apprenticeships (trends in trades apprenticeships are further discussed in Section 6.4).

It is important to note that the onset of the global pandemic in 2020 prompted rapid shifts in the delivery formats of learning and training programs, with classes moving online in many cases. This is likely having an enduring impact on the Canadian educational landscape, including attitudes towards in-class mandatory training and the importance of offering flexible learning modalities. According to the 2023 EHRC Educational Institution Survey, about a third (29%) of respondents indicated that their institution offered online learning for electricity-related programs.

Women remain under-represented in many fields of study

With the exception of Natural resources conservation and research, which is the third-most common field of study for the Civil engineering technologist/technician occupation, the number of male graduates exceeded the number of female graduates in every field of study in 2020. The gaps between men and women are narrowest in business-related programs and Applied horticulture.

Figure 31. Ratio of females to males among graduates of top electricity-related fields of study, 2020



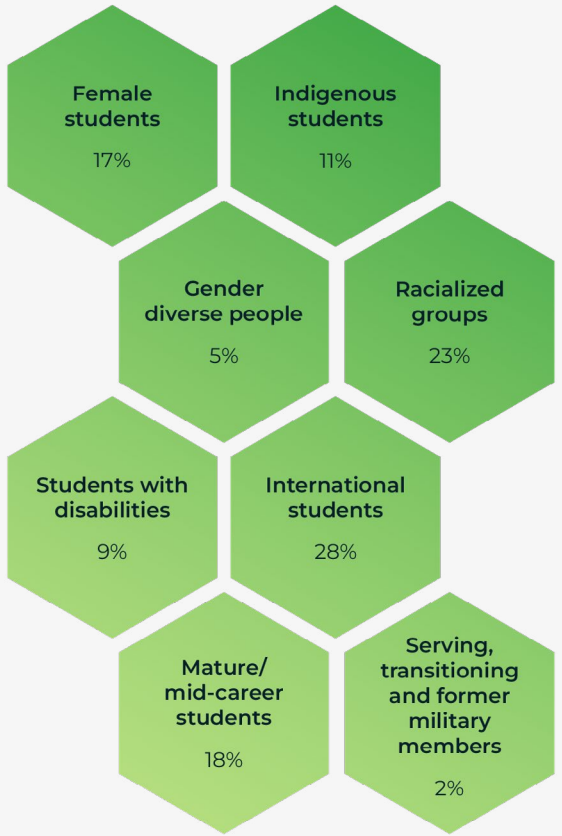
Source: *Statistics Canada. Postsecondary Student Information System (PSIS). Table: 37–10–0235–01. Postsecondary graduates, by detailed field of study, institution, and program and student characteristics.*

Beyond gender, the diversity of students in electricity-related training and education programs is an area for improvement

Based on responses to the 2023 Educational Institution Survey, there are students within electricity-related training and education programs from a variety of different population groups, but there is scope to foster greater inclusion and participation to increase the diversity of the student body and the potential future workforce for the sector.

Indeed, two-thirds of educational institutions report that they already have dedicated outreach strategies in place to recruit typically under-represented groups. Approximately 74% of respondents to the 2023 Educational Institution Survey have an outreach strategy for female students, with a similar share (79%) reporting an outreach strategy for Indigenous students. The most common type of outreach strategy used by educational institutions is targeted promotion, with financial benefits/assistance as another common form of outreach.

Figure 32. Average shares of student groups in electricity-related training and education programs (%), 2023



Source: *EHRC, Educational Institution Survey, 2023.*

6.4 REGISTERED APPRENTICESHIPS

Trades and apprenticeships in Canada are regulated by provinces and territories

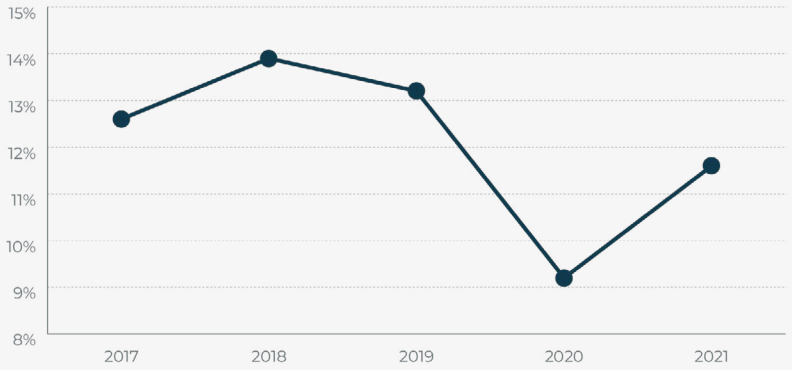
In addition to postsecondary instructional programs, classroom-based and on-the-job training in the form of apprenticeships for skilled trades is an important source of supply of talent for the electricity sector. Provinces and territories in Canada are responsible for apprenticeship training and trade certifications within their jurisdictions. Designated trades are governed by regulations introduced under the various provincial and territorial apprenticeship acts, which often cover registration and training requirements and identify compulsory trades. Compulsory trades are those which can only be performed by a certificate holder for that trade or by an apprentice working pursuant to a registered training agreement. Some trades have common standards to assess the skills of tradespeople across Canada (and thus facilitate labour mobility) via the Red Seal Program. For example, Industrial electrician is a Red Seal trade in 10 provinces and territories. A Red Seal tradesperson can move to and work in other provinces without having to pass additional examinations.

The number of apprentices that register for in-class and/or on-the-job training in both Red Seal and non-Red Seal trades is tracked by apprenticeship branches at the provincial and territorial level. Information is compiled on an annual basis and is made available in the Registered Apprenticeship Information System (RAIS). The result is a national database of program enrollments, training completions, and certificates obtained by apprentices in Canada.[33]

The overall apprenticeship completion rate fell sharply in 2020, with some rebound in 2021

The completion rate for apprentices is the annual number of apprenticeship and trade qualifier certificates awarded, divided by the total number of registered apprentices. Between 2017 and 2021, the annual completion rate for apprenticeships overall was 12.1% on average (Figure 33). However, this period includes the height of the pandemic in 2020, when the completion rate sank to just 9.3%. In 2021, the completion rate rebounded somewhat to 11.6% (but was still lower than pre-pandemic).

Figure 33. Annual apprenticeship completion rate



Source: *Statistics Canada, Table 37–10–0219–01 & Table 37–10–0220–01.*

Table 5 indicates the number of certificates awarded (not including trade qualifiers) from 2017 to 2021 for selected electricity-related major trades groups. The number of certificates awarded for welders decreased significantly (-43%) since 2017; meanwhile, Millwright certifications also declined, but by just 7%. On the other hand, certifications of Electricians saw a slight increase (2%), and Stationary engineers and power plant operator certifications increased by 10% (recognizing that this trade has a relatively small number of certifications compared to the others).

A wide range of subtrades are relevant to the electricity sector

As introduced in Section 3, 13 occupations grouped under the occupational group of *Trades* are core to the electricity sector. Of these 13 occupations,[34] 11 have corresponding apprenticeship registration information available in the RAIS data.[35] In many cases there are several subtrades within RAIS that are associated with a single occupation/NOC code. Appendix E identifies the NOC codes and the corresponding subtrade names and codes from the RAIS database for the *Trades* occupations.

Table 5. Apprenticeship certifications for selected major trade groups, Canada, 2017–2021

	2017	2018	2019	2020	2021	% change 2017-2021
Electricians	7,038	7,725	7,392	5,025	7,191	***2%***
Millwrights	1,584	1,596	1,533	993	1,476	***-7%***
Welders	2,091	1,770	1,455	873	1,182	***-43%***
Stationary engineers and power plant operators	204	180	243	189	225	***10%***

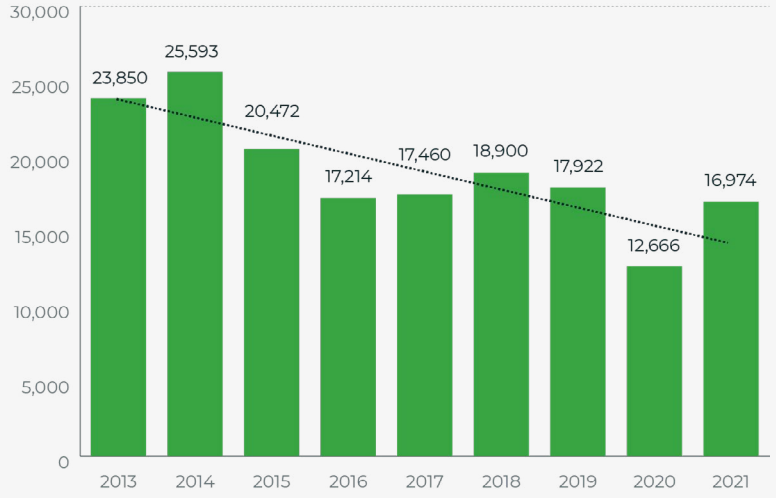
Source: *Statistics Canada, Table 37-10-0220-01.*

The number of new apprenticeship registrations in the *Trades* is declining

Figure 34 shows the volume of new registrations of apprenticeships for trades that are key to the electricity sector (considered collectively). This includes registered apprentices working across all sectors of the economy, since the RAIS data does not identify which sector an apprentice works in.

While there have been fluctuations over time, recent years have seen a decline in the number of new registrations of apprentices in trades relevant to the electricity sector.[36] In 2020, when the global COVID-19 pandemic first arose, the number of registrations fell 29% compared to the previous year. As is the case with completions, some recovery occurred in 2021, however, the number of new registrations remains lower than during the years immediately before the pandemic. If the prevailing trend continues, there is a risk that the future pool of skilled trades that the electricity sector relies upon could shrink.

Figure 34. Number of new registrations, key trades for electricity sector, Canada, 2013–2021



Source: *Registered Apprenticeship Information System (RAIS), 2021 RAIS release.*

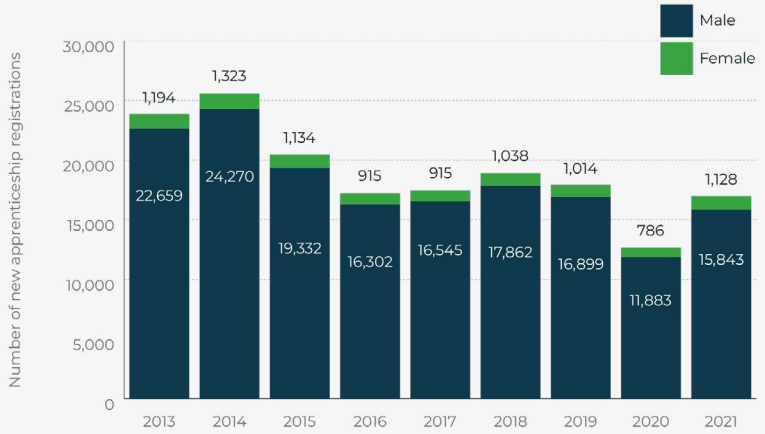
Note: *See Appendix E for the list of trades considered central to the electricity sector.*

Females comprise only a small proportion of new apprenticeship registrations

As is the case with postsecondary fields of study relevant to electricity occupations, females are under-represented among new registrations for apprenticeships in relevant trades. In 2021, only 6.6% of new apprenticeship registrations were from females. In comparison, among all new apprenticeship registrations in 2021 (i.e., not just the trades of particular interest to the electricity sector), females comprised 11.9% of new registrations. This likely reflects the higher share of females in other trades, such as hairstylists and estheticians (87% female among new registrations in 2021) and food service (42% female among new registrations in 2021).

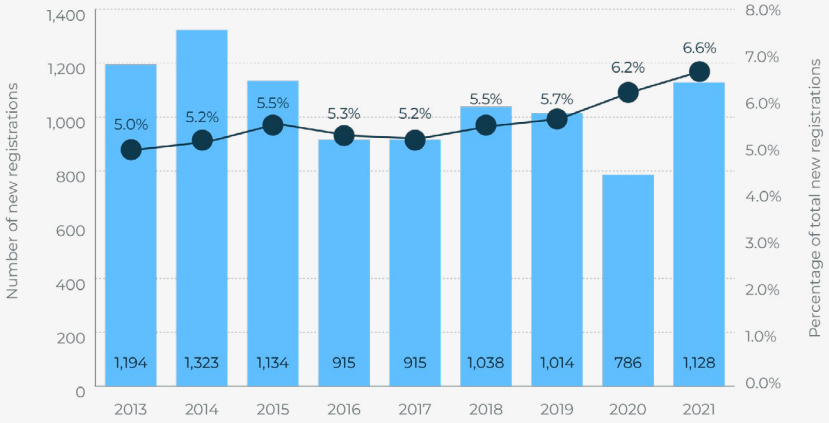
The share of females among new registrations in electricity-relevant trades has increased modestly over the last nine years, from 5.0% in 2013 to 6.6% in 2021 (Figure 36). However, this has occurred against the overall decline in the number of new registrations, and as such, largely reflects a decline among males, rather than a substantive increase in the number of new female apprenticeship registrations.

Figure 35. Number of males and females among new registrations for electricity-relevant trade apprenticeships, 2013–2021



Source: *Registered Apprenticeship Information System (RAIS), 2021 RAIS release.*

Figure 36. Number of females and percentage of females among new registrations for electricity-related apprenticeships, 2013–2021



Source: *Registered Apprenticeship Information System (RAIS), 2021 RAIS release.*

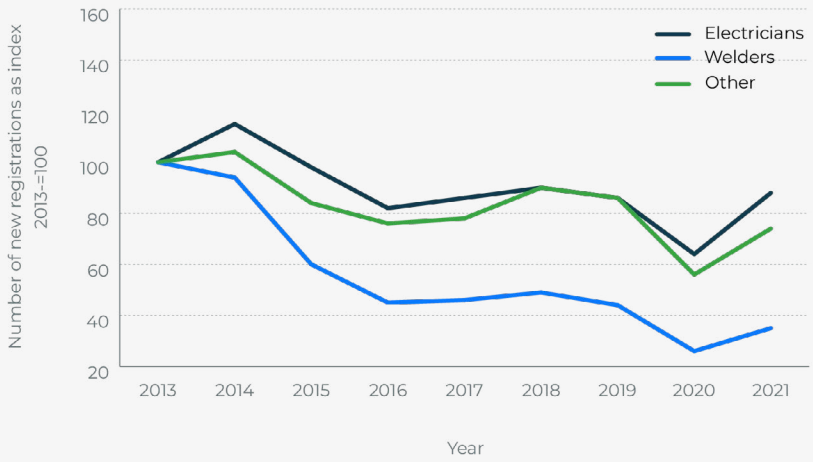
New registrations for electricians have declined, but less than the reductions seen in other trades

In 2013, electricians[37] comprised approximately one-half (53%) of the new apprenticeship registrations in electricity-relevant trades. This share has increased over time, reaching 65% in 2021, reflecting the fact that the number of new apprenticeship registrations in other trades has declined more significantly than that of electricians. Figure 37 shows that this overall decline may have been driven in part by the decline in the number of new apprenticeship registrations in the welder major trade group (which comprised 25% of new registrations among electricity-relevant trades in 2013, and only 13% in 2021).[38]

Employers continue to face barriers to taking on more apprentices

While efforts to attract workers, notably women, to the trades is an issue of particular concern, it is important to acknowledge that employers often face challenges in bringing apprentices into their workplaces. According to the EHRC Employer Survey, the top barriers facing employers are time constraints and insufficient financial resources. In particular, employers report that the duration of on-the-job apprenticeship training is often too short to be of significant value. The second most frequently noted barrier was the financial costs associated with bringing on board apprentices.

Figure 37. New apprenticeship registrations by major trade group, electricity-relevant trades



Source: *Registered Apprenticeship Information System (RAIS), 2021 RAIS release.*

Note: *See Appendix B for the list of trades and sub-trades associated with core electricity occupations.*

Key takeaways:

- Levels of immigration have increased in recent years, and while not all new permanent residents necessarily enter the labour market, immigrants make a significant contribution to the growth of Canada's overall labour force.
- School leavers will continue to constitute the largest share of new entrants to the labour market going forward, and educational attainment continues to rise among this group.
- Growth in the number of postsecondary graduates in the top fields of study for core occupations has outpaced the growth in the overall number of postsecondary graduates. These graduates represent an important source of potential future human resources for the sector. However, they are also likely sought after by employers in other sectors.
- The computer and information sciences fields of study exhibited the strongest growth in the number of graduates in percentage terms. This could be indicative of the digital transformation that is taking place in the sector and economy more generally.
- Women remain under-represented in most fields of study, with gender-based gaps narrowest in business-related fields.
- More than half of educational institutions surveyed say that the number of applicants to electricity-related programs exceeds the number of available spaces.
- Educational institutions have outreach strategies in place for traditionally under-represented groups, but there is scope to foster greater enrolment of diverse groups in the electricity sector.
- The annual apprenticeship completion rate in 2021 was below pre-pandemic levels. There has been a decline in the number of new registrations of apprentices in trades relevant to the electricity sector; the future pool of skilled trades that the electricity sector relies upon could shrink if the prevailing trend continues.
- Time and financial barriers impede the ability of employers to adopt work-integrated learning strategies and to take on more apprentices.

7.0 Labour Market Outlook

This section outlines the labour market outlook for Canada's electricity sector. It draws on a variety of data sources to describe how employment in the sector is anticipated to unfold in the coming years, notably in a scenario where Canada makes strides towards reaching net-zero. It assesses the relevant occupations, based on how challenging it is expected to be to meet their future labour requirements.

7.1 CONTEXTUALIZING THE OUTLOOK TO 2028

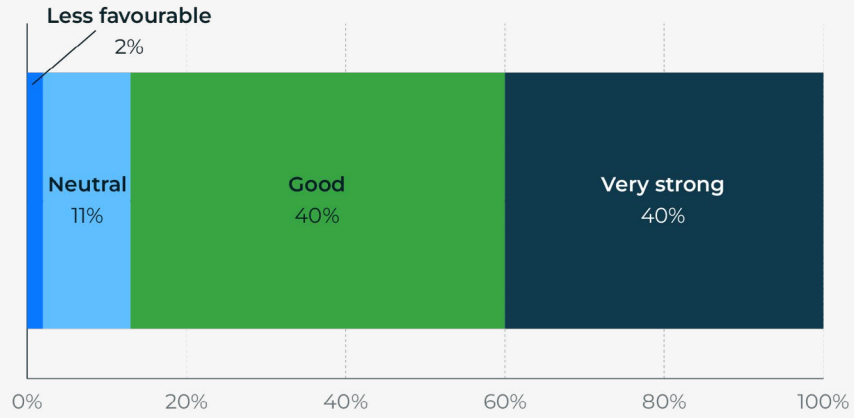
In the future, significant capital investments in clean electricity are planned

The demand for electricity in Canada is expected to increase in the future. This is in part due to expected population growth, but also stems from the projected greater use of technologies such as electric vehicles and heat pumps, which will become more prevalent as Canada pursues the goal of net-zero GHG emissions by 2050. High levels of investment in renewable energy projects have already been signalled as part of Canada's efforts to decarbonize its economy and achieve a net-zero electricity grid by 2035, and utility companies are expected to increase capital spending over the medium term.[39] Canada's electricity exports to the United States are expected to remain strong over the medium term, as signaled by an agreement recently reached with Hydro-Québec to supply hydro power to New York City over a 25-year period. Access to a stable supply of electricity will also be critical to support the future growth of Canada's other industries.

Employer sentiment regarding the business outlook for the sector is bright

This sense of dynamism is reflected in the results of the EHRC Employer Survey 2023, with 87% of respondents characterizing the business outlook for the sector over the next five years as being either "very strong" or "good" (Figure 38).

Figure 38. Electricity sector employer responses to the question, What is your business outlook for the sector over the next 5 years?



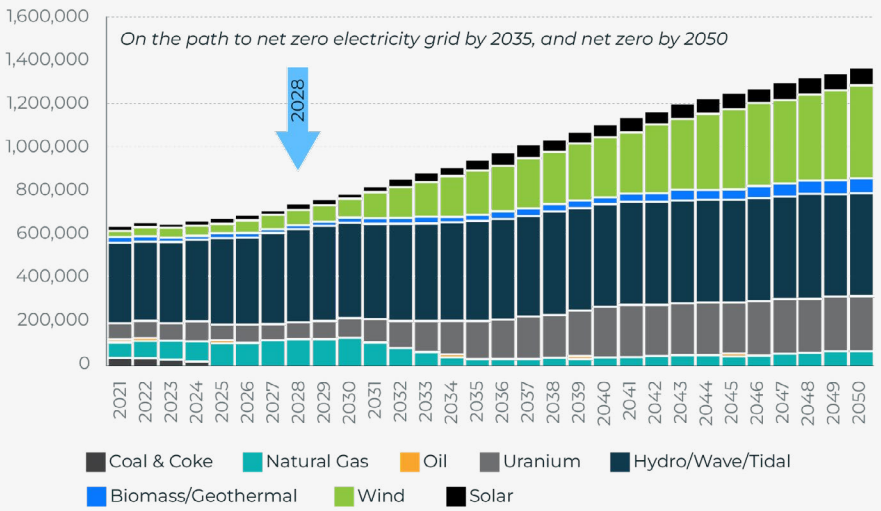
Source: *EHRC Employer Survey, 2023*

Underlying this sense of optimism is a dramatic shift in the sector's role in Canada's pursuit of net-zero. As discussed in Section 2.0, Canada is party to the Paris Agreement, aimed at keeping global average temperature from rising to dangerous levels that could cause irreversible environmental damage. Canada has committed to achieving a net-zero electricity grid by 2035, and net-zero GHG emissions by 2050. Net-zero refers to a state where human-caused GHG emissions are balanced by human-caused removals of GHGs from the atmosphere through various proactive measures.[40]

Given the wide-ranging impacts of climate change, achieving net-zero is important from an economic, societal, and environmental perspective. On the heels of an unprecedented forest fire season during summer 2023, which saw thousands of people evacuated from their homes and off-the-charts poor air quality in communities across the country, many Canadians are acutely aware of the risk posed by extreme weather events and the urgent need to reduce GHG emissions to limit the impacts of climate change.

A recent scenarios-based report from the Canada Energy Regulator, entitled *Canada's Energy Future 2023* (*CEF 2023*, see also Box 4), stresses that *"how we produce and use energy in a net zero world will be dramatically different than it is today."* It underscores two major implications for the future of Canada's electricity sector. Firstly, it suggests that the amount of electricity consumed could more than double by 2050, compared to 2021, under-net-zero scenarios. Everyday functions that currently use fossil fuels—such as for fueling vehicles and heating buildings—would need to be replaced by technologies that use electricity, such as electric vehicles and heat pumps, among others. *"Electricity,"* the *CEF 2023* report emphasizes, *"becomes the cornerstone of the net zero energy system."* The second key implication of a net-zero future is that the composition of the sources of energy used to generate electricity transition away from fossil fuels and towards renewable sources such as solar, wind, and biomass-geothermal (Figure 39).

Figure 39. Sources of energy for electricity generation (GWh), 2021–2050, *Canada's Energy Future 2023*, Canada Net-Zero scenario



Source: *Canada Energy Regulator. Canada's Energy Future Data Appendices.*

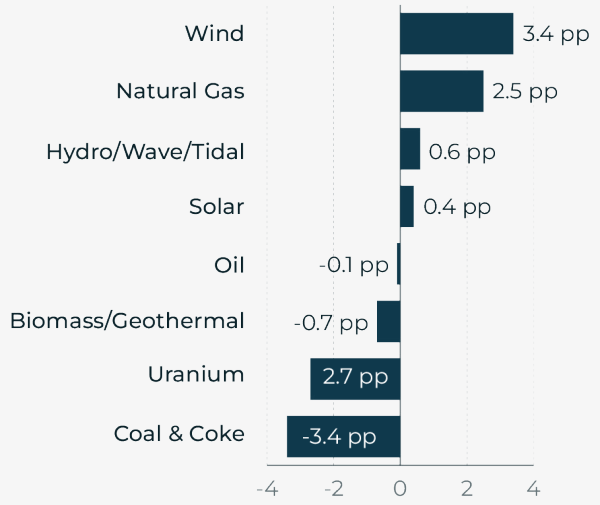
The net-zero scenarios within *CEF 2023* entail overall electricity use increasing in Canada, as well as the decarbonization of electricity production. Figure 40 shows the percentage point change in the shares of electricity that could be generated by alternative energy sources on the path to net-zero in the medium and long term. In the medium term, wind and solar would start playing a greater role in electricity generation. However, natural gas could also take on greater prominence as a transitional measure, based on its lower emissions compared to other fossil fuels such as coal.

The next five years will be critical on the path to net-zero. Although Canada's current energy mix for generating electricity already has a high share of renewables by international standards (largely due to the prominence of hydro), achieving net-zero will entail continued progress in phasing out electricity generation from fossil fuels and increasing generation from renewable sources. Although the year 2050 may seem far in the future, the time horizon of 2035 for achieving a net-zero electricity grid is just 12 years away—so by 2028, Canada should be well on its way.

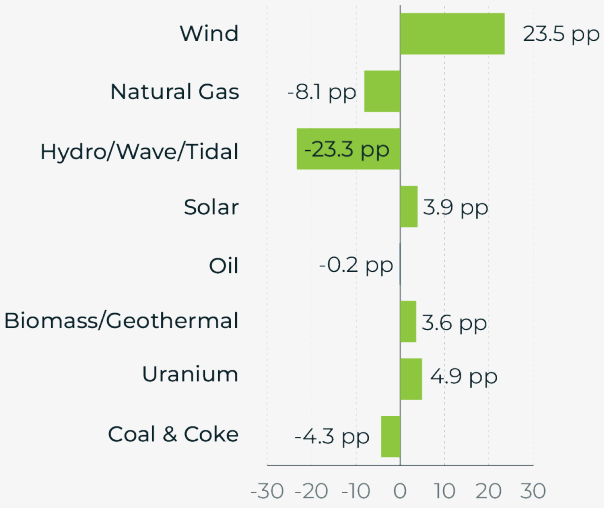
Indeed, as illustrated in Figure 40, the next five years are a critical transition period, laying the groundwork for the even more pronounced shifts in the sources of electricity generation that are expected by 2050 to achieve net-zero.

Figure 40. Percentage point (pp) change in shares of electricity generated by source relative to 2022 – *CEF 2023* Canada Net-Zero scenario

Panel A. Shares in 2028 relative to 2022 (pp)



Panel B. Shares in 2050 relative to 2022 (pp)



Source: *Canada Energy Regulator, 2023. Canada's Energy Future Data Appendices.*

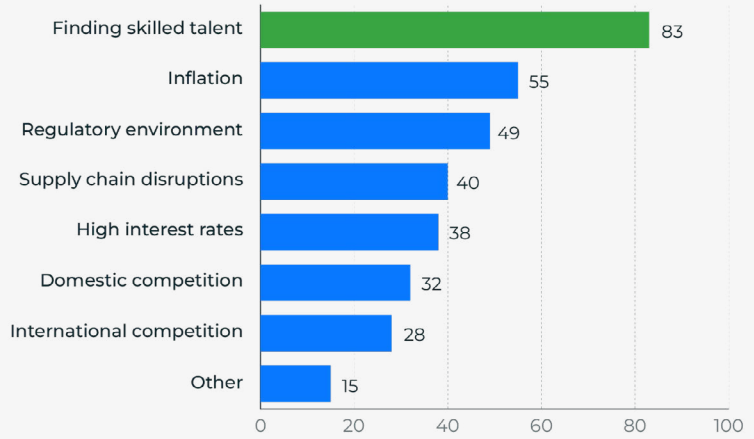
7.2 EMPLOYMENT FORECAST SCENARIOS

Finding skilled talent has been identified as the most pressing constraint for the sector over the next five years

Over the next five years, employers in Canada's electricity sector cite talent as the foremost challenge; this issue far outstrips other major concerns such as inflation, the regulatory environment, and elevated interest rates (Figure 41). Based on EHRC's Employer Survey 2023, 83% of employers indicated that finding skilled talent was a pressing issue constraining their outlook over the next five years.

Against this backdrop, and leveraging the assumptions and data underpinning the long-term scenarios from the Canada Energy Regulator's *Canada's Energy Future 2023* (Box 4), a forecast model has been developed to shed light on the potential employment implications for the electricity sector over the medium term. It considers two *CEF 2023* scenarios: "Canada Net-Zero" and "Current Measures".

Figure 41. Most pressing issues constraining your outlook over the next 5 years (% of employers), 2023



Source: *EHRC Employer Survey, 2023.*

Note: *Figures do not sum to 100 as respondents could provide more than one answer.*

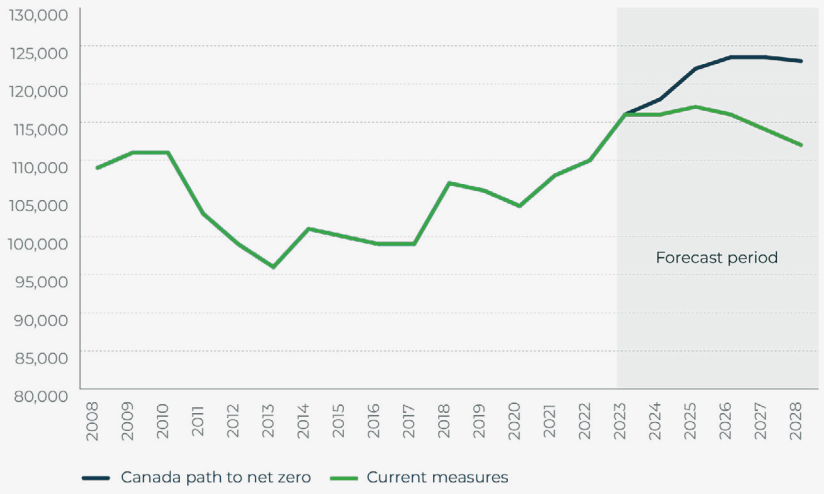
Box 4. *Canada's Energy Future 2023* (*CEF 2023*) and EHRC's forecast model

- *Canada's Energy Future 2023* is a report published by the Canada Energy Regulator. The *CEF 2023* report presents scenarios to explore how Canada's energy futures might unfold over the long term. The scenarios are not predictions or recommendations—rather, they are a tool to help policy makers and Canadians visualize what net-zero could look like.
- Three scenarios are presented: "Global Net-Zero," "Canada Net-Zero," and "Current Measures". The "Global Net-Zero" and "Canada Net-Zero" scenarios both assume a predetermined end point—i.e., that Canada will achieve net-zero GHG emissions by 2050. The main difference between these two scenarios is the presumed pace of action outside of Canada to reduce GHG emissions. Both net-zero scenarios assume that the electricity system decarbonizes by 2035 and achieves net-negative GHG emissions thereafter.
- The "Current Measures" scenario does not assume that Canada achieves net-zero by 2050; rather, it assumes limited additional action to reduce GHG emissions beyond the measures that are already in place (i.e., enacted prior to March 2023).
- EHRC's forecast model (v1.0) was developed against this backdrop. It has four main inputs drawn from the *CEF 2023* report, notably (i) total electricity generated; (ii) the share of electricity generated from renewable sources (hydro, wind, solar, biomass, and geothermal), (iii) gross domestic product (GDP), and (iv) population (see Appendix F regarding the modelling approach).

Employment is set to continue to grow

As is highlighted in Section 3.0 and shown in Figure 42, employment in Canada's electricity sector has grown rapidly in recent years. In fact, in 2022 it reached 110,600, a level not seen since 2009. Employment is set to continue to grow in both the net-zero and current measures scenarios—but more so in the former scenario, since generating electricity from renewable sources is typically more labour intensive (whereas in the current measures scenario, employment initially grows but then decelerates) than that produced with fossil fuels.

Figure 42. Historical and forecasted level of employment in the electricity sector, 2008–2028



Source: *EHRC, 2023.*

Note: *Employment in the total electricity sector, i.e. NAICS 2211.*

Table 6. Forecast levels of employment in the electricity sector (NAICS 2211), 2023–2028

	2022 (actual)	2023	2024	2025	2026	2027	2028
Path to net-zero scenario	110,600	116,071	117,964	122,443	123,382	123,264	122,830
Current measures scenario	110,600	115,983	116,278	117,182	115,842	114,216	112,491

Source: *EHRC, 2023.*

Note: *Total employment in the electricity sector, i.e. NAICS 2211.*

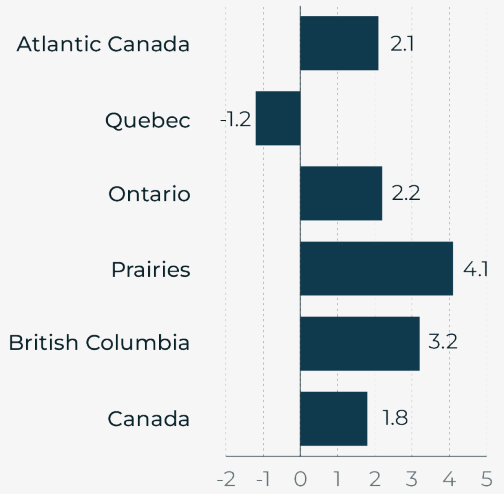
Most regions would see employment gains in a path to net-zero scenario

In a path to net-zero scenario, Figure 43 highlights that all regions are expected to see employment gains, with the exception of Quebec where the vast majority of electricity is already generated via renewable sources (i.e., hydro). Strong employment growth in Atlantic Canada, Ontario, and the Prairies is anticipated, driven in part by the sizeable expected growth in renewable energy sources (other than hydro) that underly the net-zero scenario.

Among occupational groups, *Trades* and *ICT* are expected to see the strongest growth

The *ICT* group of occupations accounts for a relatively small share of the core electricity occupations. But on the heels of strong employment gains in recent years, its employment is set to grow at the fastest annual pace over the next five years. Both the *Trades* and *Engineers, technicians & technologists* groups are expected to grow at a robust average annual pace to 2028, whereas it is anticipated that employment among *Managers & supervisors* will fall below current levels.

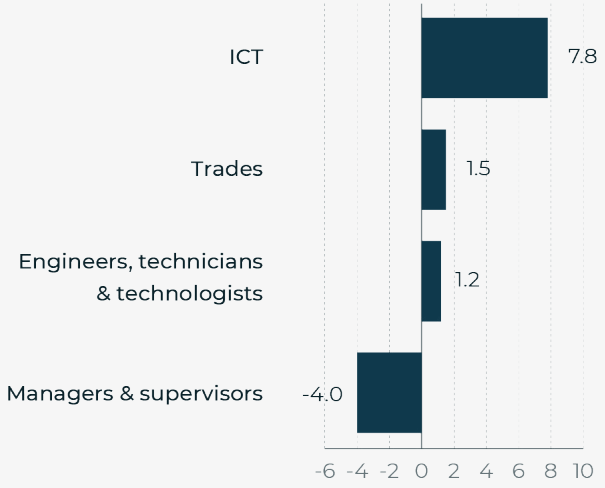
Figure 43. **Anticipated growth in employment in the electricity sector by region (%, compound annual rate), 2022–2028**



Source: *EHRC, 2023.*

Note: *Path to net-zero scenario.*

Figure 44. **Anticipated growth among core electricity occupations by groups (%, compound annual rate), 2023-2028**



Source: *EHRC, 2023*

The outlook among the top occupations is mixed

Anticipating growth at the occupational level is particularly challenging, given the range of factors that could affect how employment levels unfold. However, results from the forecast model and employer survey both suggest that the employment outlooks for the largest core occupations in the sector are largely positive (Table 7). With a few exceptions, the outlook presented in the forecast model, and the views expressed by respondents to EHRC's Employer Survey are consistent. Both sources point to a positive outlook for Mechanical engineers, Electrical and electronics engineering technologists and technicians, and Electrical powerline and cable workers (in 2022, these three occupations collectively accounted for nearly one-third of employment in the core electricity occupations). The employers surveyed also had positive outlooks for Electrical and electronics engineers and Power system electricians.

Official data on specific job titles outside the National Occupational Classification (NOC) system, especially those involving the renewable energy sector, is scarce. However, the results of EHRC's Employer Survey 2023 suggest that the demand for Wind turbine technicians/installers, Solar PV/Thermal technicians/installers, Smart grid specialists and Utility arborists is expected to increase. Conversely, the outlook for the top occupations in the *Managers & supervisors* group is negative.

Table 7. Employment outlook for key occupations by source

		2017-2022 change	2023-2028	
			EHRC Model	EHRC Survey
Managers & supervisors	Utilities managers	↑	↓	↓
	Contractors and supervisors, electrical trades and telecommunications occupations	↓	↓	↓
Engineers, technicians & technologists	Electrical and electronics engineers	↓	↓	↑
	Mechanical engineers	↑	↑	↑
	Electrical and electronics engineering technologists and technicians	↑	↑	↑
Trades	Electrical powerline and cable workers	↑	↑	↑
	Power engineers and power systems operators	↑	← →	↓
	Power system electricians	↓	↓	↑
ICT	Information systems specialists	↑	↓	..
	Software developers and programmers	↑	↑	..
Renewable energy and other	Wind turbine technicians/installers	..	..	↑
	Solar PV/Thermal technicians/installers	..	..	↑
	Smart grid specialists	..	..	↑
	Utility arborists	..	..	↑

Source: *EHRC, 2023.*

Note: *The symbol ".." indicates "not available". The renewable energy and other job titles do not correspond to official NOCs and therefore were not included in either the historical growth or the outlook with respect to the model. The EHRC Employer Survey did not specifically ask about the outlook for Information systems specialists and Software developers and programmers.*

7.3 ANTICIPATED LABOUR IMBALANCES

To ensure that organizations in the electricity sector have enough capable employees to achieve their business objectives, as well as Canada's clean energy goals, it is crucial to assess—to the extent possible—areas where labour shortages are anticipated to be most severe. There are a few key considerations in this regard.

Firstly, the analysis presented in the previous subsection focused on the level of employment expected in the electricity sector based on expansion demand, i.e., the anticipated change in employment due to macroeconomic growth/contraction (and other parameters such as population changes, the volume of electricity generated, and the energy mix). In addition to expansion demand, the electricity sector will also have to fill job openings that result from retirements, i.e., replacement demand.[41]

Secondly, it is important to distinguish between changing employment levels and recruitment difficulties. For example, even if the expected number of Utilities managers is expected to decline and the outlook for that occupation is comparably weak or negative, there could nevertheless still be challenges in filling those positions. Conversely, simply because the employment level in a particular occupation is expected to grow, it may nevertheless still have an adequate or even excess supply of future workers, and thus employers may not find it difficult to respond to growing demand. As such, in order to assess the extent to which labour market imbalances are expected to occur at the occupation (or group) level, it is necessary to determine its anticipated demand and supply of workers.

Thirdly, and related, labour imbalances are difficult to forecast at the intersection of occupation and sector. It bears repeating that in most cases, the connection between a student's field of study and the specific occupation and sub-sector in which they eventually work is tenuous. Moreover, the vast majority of occupations in the electricity space exist in other sectors (the exceptions are occupations like Power system electricians and Electrical powerline and cable workers, the majority of which are employed in the electricity sector). As such, information on occupation-based labour market imbalances at the economy-wide level are highly relevant. A particularly important source leveraged in this analysis is the Canadian Occupational Projection System (Box 5).

Box 5. Canadian Occupational Projection System (COPS)

Employment and Social Development Canada (ESDC) produces the Canadian Occupational Projection System (COPS), which is a suite of models that project the demand and supply of labour. Its projections reflect assumptions concerning demographic, technological, fiscal, and other factors that are likely to impact the labour force, output, and the structure of the economy in the coming years. The model also considers the number of students expected to emerge from the educational system, given historical enrolments and graduate and dropout rates. COPS projections cover a 10-year horizon; it is not meant to forecast short-term fluctuations or year-to-year changes. The latest projections cover the period from 2022 to 2031.

Projections are provided for 293 occupations across all sectors of the economy at the national level. Some occupations with small levels of employment are combined with other occupations performing similar tasks. For each occupation, one of three outlook statuses are identified—surplus, balance, or shortage—with surplus or shortage indicating a potential labour market imbalance. Detailed explanations of the methodology of COPS are available from ESDC (*here*) and also from the Labour Market Information Council (*here*).

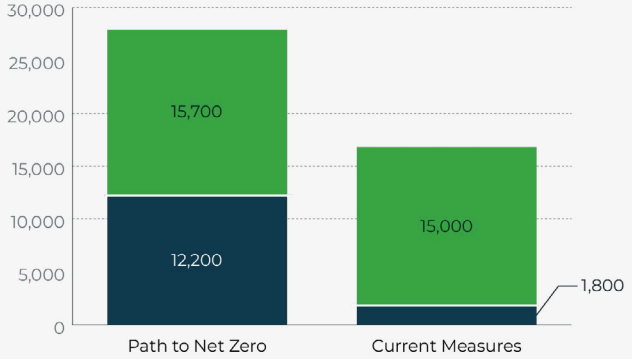
Replacement demand due to retirements is expected to be significant

As indicated above, from 2023 to 2028, employment in the electricity sector is anticipated to grow by over 12,000 jobs, as Canada charts its path towards net-zero. The additional jobs associated with this expansion demand, however, are surpassed by the number of job openings that are expected to arise from replacement demand (Figure 45, panel A). The total number of retirements expected in the electricity sector is estimated to be approximately 15,700 over the period from 2023 to 2028. Combined, the expansion demand and replacement demand are anticipated to result in a total of nearly 28,000 job openings in the sector. Under the current measures scenario, nearly 17,000 job openings are anticipated, the vast majority of which stem from replacement demand.

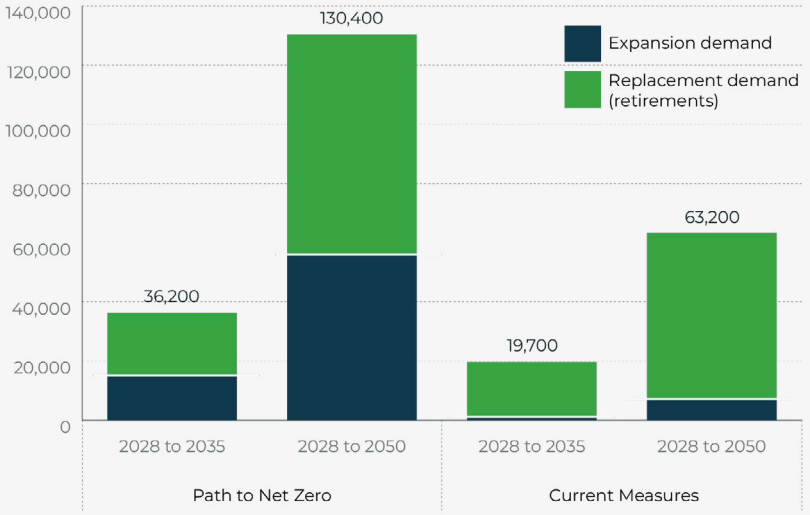
In looking beyond 2028, if the prevailing estimates of employment patterns and retirement rates generated by the 2023–2028 forecasting model persist, under the net-zero scenario, an additional 130,000 job openings could materialize between 2028 and 2050 (36,000 of which would arise between the 2028–2035 time horizon) (Figure 45, panel B). Over such lengthy time horizons, a countless number of factors will undoubtedly change and unfold in unpredictable ways, significantly altering the electricity landscape. As such, these numbers are meant to provide an order of magnitude of the potential workforce requirements of reaching net zero.

Figure 45. Composition of demand for workers in the electricity sector (NAICS 2211) under different scenarios

Panel A. Short-term forecasting model 2023-2028



Panel B. Long-term extrapolation method 2028-2050



Source: *EHRC estimates based on Labour Force Survey, ESDC COPS 2022, and EHRC model 2023.*

Notes: *Expansion demand refers to the anticipated employment growth that occurs in the path to net-zero scenario. Replacement demand is estimated using occupation-specific retirement rates, weighted by each occupation's share of employment in the electricity sector in 2022. These estimates do not reflect openings that could result from the death or emigration of employees.*

The distribution of expansion and replacement demand varies across occupational groups, as does the potential supply of workers to fill these job openings

Between 2023 and 2028, the relative size of replacement and expansion demand varies by occupational group (Figure 46). The extent of labour imbalances (i.e., disequilibrium) expected in the four occupational groups was determined by comparing the expected demand for labour with the potential supply of labour, based on the projected number of school leavers[42] and the occupational mobility rate (i.e., job changers[43]). The anticipated number of school leavers and job changers reflect prevailing patterns and forecasts for each occupational group within the electricity sector.

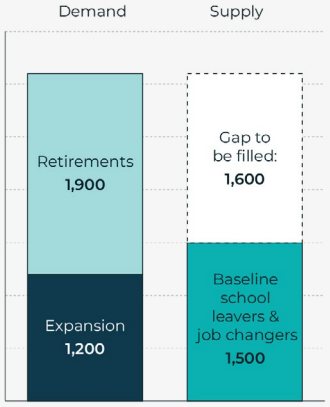
The difference between the total demand and potential supply of labour within each occupational group over the 2023–2028 period is referred to as the "gap" (i.e., excess demand or excess supply) in job openings.[44] Excess demand would need to be filled through other sources of labour supply.

Analyses of projected developments in each occupational group yields the following results:

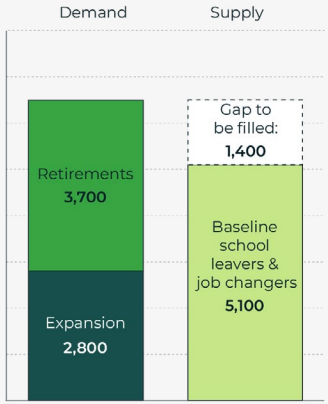
- ***Engineers, technicians & technologists:*** Replacement demand is quite strong among this group, and when combined with expansion demand, yields a gap of 1,600, given the comparably small baseline levels of school leavers and job changers expected in this occupational group.
- ***Trades:*** With expansion and replacement demand exceeding the supply of labour that occurs given the anticipated number of school leavers and job changers, a gap of 1,400 results.
- ***ICT:*** Robust expansion demand far exceeds the limited number of school leavers and job changers. Together with the modest replacement demand expected to arise from retirements, the labour supply gap could stand at 3,800 over the forecast period.
- ***Managers & supervisors:*** Despite expected retirements in the order of 1,200, expansion demand is projected to decline over the forecast period. This suggests that the high levels of school leavers and job changers anticipated would more than offset the sector's labour requirements.

Figure 46. Composition of demand and supply of workers in the electricity sector by occupational group, 2023–2028

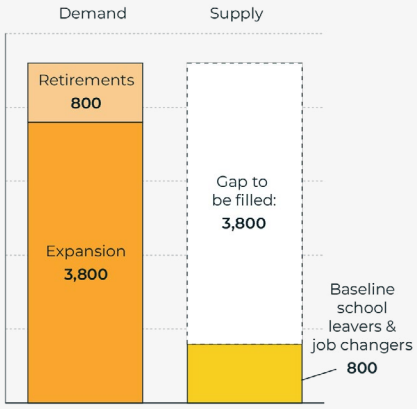
Panel A. *Engineers, technicians & technologists*



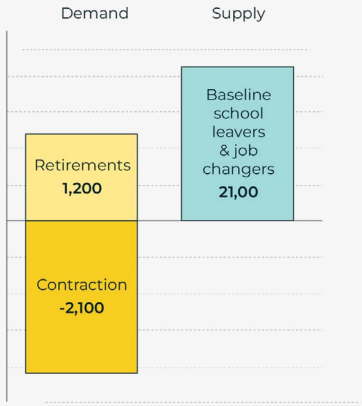
Panel B. *Trades*



Panel C. *ICT*



Panel D. *Managers & supervisors*



Source: *EHRC estimates based on Labour Force Survey, ESDC COPS 2022, and EHRC model 2023.*

Notes: *Expansion demand refers to the anticipated employment growth in the path to net-zero scenario. Replacement demand is calculated using occupation-specific retirement rates, weighted to the share of the occupation in the occupational group. These calculations exclude any openings that occur as a result of the death or emigration of employees.*

Over the medium term, it is expected that close to half of the core occupations will experience employee shortages at the national level. Consequently, it may be challenging for the electricity sector to recruit for these in-demand jobs

To supplement the outlook of future labour market conditions at the occupational group level and provide insights at the occupation-specific level, three variables are analyzed below, notably:

i. whether there is a shortage, surplus, or balance expected at the economy-wide level for core electricity occupations, based on the Canadian Occupational Projection System (Box 5);

ii. the electricity sector's capture rate for the occupation, i.e., among economy-wide employment in that occupation (or occupational grouping), the percentage the electricity sector accounts for. In other words, how much of total employment in that occupation (or grouping) is represented by the electricity sector. This is an indicator of the electricity sector's ability to attract talent, especially in those occupations that cut across sectors; and

iii. the degree of difficulty in recruiting workers to the electricity sector over the next five years, by occupational group, as reported by employers participating in EHRC's Employer Survey.

Among the 34 core electricity occupations, none are expected to experience a surplus of labour during the projection period on an economy-wide basis. Indeed, close to half (15) are expected to experience economy-wide shortages, while the remaining occupations are expected to be in balance (Table 8). However, even among the occupations that are expected to have balanced conditions, the analysis of the capture rates suggests that the sector accounts for a declining share of the total employment in these groups of occupations (in other words, that an increasing share of individuals in those occupations are working in other sectors). The anticipated recruitment challenges are also reflected in the results of EHRC's Employer Survey. Only a limited number of respondents indicated that there would be "no difficulty" in recruiting over the next 5 years. A closer look at these findings reveals the following:

→ ***Managers & supervisors:*** Of the four occupations within this occupational group, only Engineering managers are anticipated to be in short supply on an economy-wide basis. Additionally, the share of employers reporting "high/extreme" difficulty in recruiting positions among this group is lower than that of the three other occupational groups. This is broadly consistent with the analysis in the previous subsection suggesting that the number of school leavers and job changers available will likely be adequate to meet future demand.

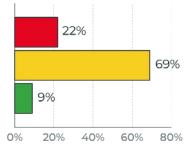
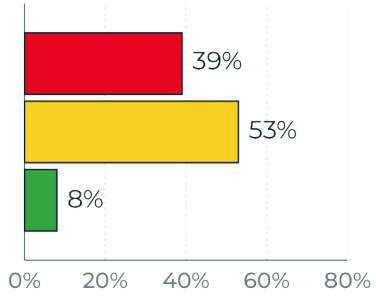
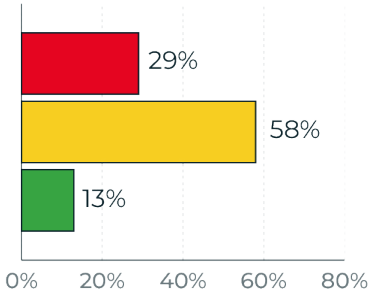
- ***Engineers, technicians & technologists:*** Three occupations (Civil engineers, Electrical and electronics engineers, and Industrial and manufacturing engineers) are expected to face shortages. While the remaining occupations are expected to be in balance, it is important to note that the share of employers reporting "high/extreme" difficulty in hiring for this occupational group is the highest (39%). And while the capture rate (6%) for this occupational group is the highest among the four considered in this report, it has been declining over time. Indeed, as shown above, it is anticipated that expansion and replacement demand will exceed the pool of school leavers and job changers.

- ***Trades:*** Employers in the electricity sector also report elevated degrees of difficulty recruiting for trades occupations, with 29% reporting "high/extreme" difficulty and an additional 58% indicating that there is "some/moderate" difficulty. The capture rate, at 5.9%, is declining. Among the specific occupations, Construction millwrights, Industrial mechanics, Electricians (except industrial and power system), Residential and commercial installers and servicers, and Welders are anticipated to be in short supply over the coming years. Of particular note in this respect is that the Residential and commercial installers official NOC code covers some jobs that are specific to renewable energy, such as Solar PV/Thermal technicians/installers and Smart grid specialists.

  Additionally, for nine of these trade-related occupations (Boilermakers, Construction managers, Construction millwrights and industrial mechanics, Contractors and supervisors, Electricians, Electrical powerline and cable workers, Industrial instrument technicians and mechanics, Residential and commercial installers and services, and Welders and related machine operators), the construction sector is an important source of employment. According to BuildForce Canada, an organization which assists the construction industry in its management of workforce requirements, within non-residential construction none of these occupations are anticipated to be in surplus over the 2023–2028 period, although the degree of imbalance varies by region, year and occupation.

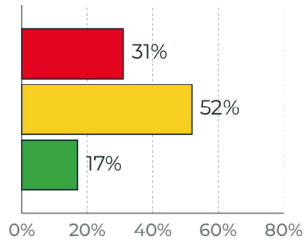
- ***ICT:*** All *ICT* occupations, with the exception of Computer network and web technicians, are expected to face labour shortages. For employers in the electricity sector, this is the group of occupations with the second-largest share of "high/extreme" difficulty in recruiting workers, at 31%. Of potential concern is the relatively low capture rate of 0.9%. Not surprisingly, this is the occupational group for which electricity sector employers face the most competition for talent from outside the sector.

Table 8. Labour market imbalances by occupation and occupational grouping

Occupational group	Capture rate: Current and trend	% of electricity employers reporting difficulty to recruit position type in the next 5 years	Occupation	Recent labour market conditions 2019-2021	Outlook to 2031
Managers & supervisors	5.2% ↓		Construction managers	Balance	Balance
			Contractors and supervisors, electrical trades, and telecommunications	Balance	Balance
			Engineering managers	Shortage	Shortage
			Utilities managers	Balance	Balance
Engineers, technicians & technologists	6.0% ↓		Civil engineers	Shortage	Shortage
			Civil engineering technologists and technicians	Balance	Balance
			Electrical and electronics engineers	Shortage	Shortage
			Electrical and electronics engineering technologists and technicians	Balance	Balance
			Industrial and manufacturing engineers	Shortage	Shortage
			Industrial engineering and manufacturing technologists and technicians	Balance	Balance
			Mechanical engineers	Balance	Balance
			Mechanical engineering technologists and technicians	Balance	Balance
			Non-destructive testers and inspectors	Balance	Balance
Trades	5.9% ↓		Boilermakers[1]	Balance	Balance
			Construction millwrights and industrial mechanics	Shortage	Shortage
			Contractors and supervisors, pipefitting trades	Balance	Balance
			Electrical mechanics	Shortage	Balance
			Electrical powerline and cable workers	Balance	Balance
			Electricians (except industrial and power system)	Balance	Shortage
			Industrial electricians	Balance	Balance
			Industrial instrument technicians and mechanics	Balance	Balance
			Power engineers and power systems operators[2]	Balance	Balance
			Power system electricians[3]	Balance	Balance
			Public works maintenance equipment operators and related workers	Balance	Balance
			Residential and commercial installers and servicers	Shortage	Shortage
			Welders and related machine operators	Shortage	Shortage

Continued →

High/Extreme Difficulty · Some/Moderate Difficulty · No Difficulty

Occupational group	Capture rate: Current and trend	% of electricity employers reporting difficulty to recruit position type in the next 5 years	Occupation	Recent labour market conditions 2019-2021	Outlook to 2031
Information & communications technology	0.9% ← →		Computer network and web technicians	Balance	Balance
			Computer systems developers and programmers	Shortage	Shortage
			Cybersecurity specialists[4]	Shortage	Shortage
			Data scientists[4]	Shortage	Shortage
			Database analysts and data administrators	Shortage	Shortage
			Information systems specialists[4]	Shortage	Shortage
			Software developers and programmers[5]	Shortage	Shortage
			Software engineers and designers	Shortage	Shortage

Source: *EHRC Employer Survey 2023; Canada Occupational Projection System (COPS) 2022; Statistics Canada, Labour Force Survey.*

Notes: *Capture rate direction is calculated by comparing the average during the period 2017–2022 to 2000–2016. The outlook horizon for the COPS labour market imbalances is to 2031*

[1] *Included in Sheet metal workers; Boilermakers; Structural metal and platework fabricators and fitters & Ironworkers in COPS.*

[2] *Included in Utilities Equipment Operators and Controllers in COPS.*

[3] *Included in Industrial electricians in COPS.*

[4] *Included in Information systems analysts and consultants in COPS.*

[5] *Included in Computer systems developers and programmers in COPS.*

A multi-pronged approach to address labour market imbalances in the electricity sector is needed

To best address the anticipated labour market imbalances, the electricity sector will need to develop and implement an inclusive and multi-pronged approach to recruit and retain talent. While drawing school leavers to the sector along with some job changers will—as discussed above—constitute a foundational element of the sector's future workforce, more will need to be done to (i) attract a greater number of school leavers (and others) to the sector; (ii) incentivize older workers to delay retirement; and (iii) increase the representation of women, racialized groups, immigrants and persons with disabilities. This would include:

→ ***Improving the appeal of the sector as a potential employer to school leavers.*** In most instances, they constitute the majority of potential labour supply going forward (the exception being *Managers & supervisors*). And given that most core occupations in the electricity space exist in other sectors of the economy, measures are needed to further improve the attractiveness of the sector to students and eventual school leavers beyond the baseline figures presented above. Measures to support this could include:

- exposing students to the many career possibilities the sector has to offer, e.g. through EHRC's *Bright Futures Energy Camp*, a science camp for Indigenous youth ages 10–13 that aims to promote careers in the electricity sector by engaging young people in hands-on Science, Technology, Engineering and Math.
- expanding the capacity of new and existing postsecondary programs to welcome more students to the sector.
- providing students and apprentices with opportunities to work in the electricity sector through expanded work-integrated learning opportunities, such as EHRC's *Empowering Futures Program*, which provides student and first-year apprentice work placement initiatives for the electricity industry.
- introducing industry-wide promotional campaigns to promote the sector as a workplace of choice. This will have potentially positive spillover effects in terms of attracting other workers, not just students and apprentices, to the electricity sector.

→ ***Encouraging older workers to extend their careers.*** With more than 15,000 workers in the electricity sector expected to retire over the next five years, measures to encourage older workers to delay their retirement and remain attached to the electricity workforce must form the basis of an overall approach to addressing labour pressures. And while a range of factors influence

one's retirement decision, from personal preference to individual finances, clearly, modest steps to reduce the retirement rate would bring substantial benefits. Measures to support this could include:

- providing more flexible work arrangements, where relevant, that provide mature workers with incentives to delay retirement or draw older workers to the sector looking for a second (or third) career.
- ensuring that pension rules do not discourage older workers from combining work and pension income that could incentivize them to stay working longer.

→ ***Addressing female under-representation.*** In the electricity sector, women still represent only 16% among the core occupations and 27% of the workforce overall (compared to 48% economy wide). Simply raising the share of women among the core occupations to the electricity-sector average, i.e., an increase of 11 percentage points, would translate into an additional 7,000 workers. The situation is particularly challenging in the *Trades*, where women account for only 5% of employment. Measures could include:

- addressing the various forms of discrimination that exist in the workplace more proactively, especially in what is a traditionally male-dominated sector.
- testing and evaluating new approaches, beyond promotional campaigns, to improve the representation of women in education and training and within the workplace.
- enhancing occupational mobility for women. Most women in the electricity sector are employed in *Other corporate professional occupations*. Providing training and related support to help women access other job opportunities within the electricity sector could help address occupational segregation. This is also an issue with respect to Indigenous peoples, who are concentrated among the *Trades* group of occupations.

→ ***Improving representativeness of racialized groups, immigrants and persons with disabilities.*** For both immigrants and racialized groups, their share of employment in core electricity occupations are considerably lower than that of the same occupations in all sectors, i.e., 11 percentage points for racialized groups and 13 percentage points for immigrants (bearing in mind that these groups may overlap to some degree and also include women). Simply closing one of these gaps would add nearly 1,000 workers to the sector by 2028. Similarly, persons with disabilities represent only 1% of the electricity workforce compared to 15% among total Canadian employment (see also Section 4). In addition to the measures discussed above in relation to women, some of which can be leveraged and tailored to issues confronting racialized groups, persons with disabilities and

immigrants, there is a need for increased collaboration and partnerships with organizations that represent these population groups. Finally, against the backdrop of significant planned increases in immigration, it is worth assessing the feasibility of developing immigrant streams dedicated to skill- and labour-related shortages in the electricity sector.

Key takeaways:

- Significant capital investments in clean electricity are planned and employer sentiment regarding the business outlook for the sector is optimistic.
- In the EHRC Employer Survey 2023, 87% of respondents characterized the business outlook for the sector over the next five years as being either “very strong” or “good”.
- Employment growth is expected to continue to exhibit an upward trajectory, with demand especially strong in a scenario in which Canada makes strides towards attaining net-zero status by 2050.
- Shifts in the energy mix that occur as Canada increases its electricity generation capacity on the path to net-zero will have important employment implications at both the regional and occupational group level.
- At least 80% of electricity sector employers expect to have “some/moderate” or “high/extreme” difficulties recruiting workers between 2023 and 2028.
- For the electricity sector, expansion demand and replacement demand are set to reach a combined total of over 27,000 between 2023 and 2028. Core occupations will account for just under half of that figure.
- Within the occupational groups, with the exception of *Managers & supervisors*, the anticipated number of school leavers and job changers will be insufficient to meet future requirements. Other sources of labour supply will be needed to fill these gaps.
- Among the core electricity occupations, nearly half of the 34 occupations are predicted to face labour shortages at the economy-wide level. Such shortages are expected across all four occupational groups.
- Finding skilled talent has been identified as the most pressing constraint for the electricity sector over the next five years. A multi-pronged strategy to attract more workers to the sector, including students, older workers, women, racialized groups, Indigenous peoples, and immigrants, is needed to address these gaps.

8.0 A Call to Action

DRAMATIC SHIFTS IN THE ELECTRICITY SECTOR ARE AFFECTING ITS LABOUR REQUIREMENTS

Canada's efforts to reduce GHG emissions and achieve net-zero in the overall economy by 2050, and in the electricity grid by 2035, will likely lead to a substantial increase in the amount of electricity needed. It will also necessitate shifts in the mix of energy used to generate electricity, notably a significant increase in renewables and other non-carbon-emitting sources.

Consequently, as Canada continues on the path towards net-zero, and the electricity sector's demand for talent intensifies, the level of employment and occupational structure of its workforce will evolve.

Employers' most pressing issue over the next five years will likely be accessing skilled talent. Labour shortages, which already exist in some occupations and regions, are likely to worsen and employers will be forced to compete more intensively for workers with their counterparts in other sectors of the economy.

Ensuring an adequate number of workers in the sector will not fully address the problem. The dramatic shifts in how electricity is generated across the various regions of Canada will affect the skills needed to perform the tasks and functions associated with the sector's wide range of jobs. Therefore, it will be equally crucial to ensure that workers have the training and skills required to leverage new and emerging technologies. There will also be important within-sector and regional workforce adjustments that will necessitate enhanced planning. For instance, several large electricity-related projects will arise in rural and remote areas, where workers will be required on-site to build and/or maintain facilities. This is particularly the case for wind and solar projects. In other cases, workers in higher carbon-emitting segments of the energy sector and other sectors will need to find new employment opportunities – all of which will require greater efforts to connect workers and opportunities through enhanced partnerships.

A comprehensive human resource strategy should address quantity, quality, and partnership aspects of the workforce

The scale of the challenges suggests that the sector urgently requires an effective and comprehensive human resource strategy. Without such a strategy and action plan, Canada is unlikely to attain its climate goals, and risks impeding its economic, social, and environmental progress.

It is appropriate to view the labour market challenges and opportunities confronting the electricity sector through the framework of quantity, quality, and partnerships:

- ***Quantity:*** The amount of employment, i.e., attracting and retaining workers in the sector, especially those from traditionally under-represented groups.
- ***Quality:*** Job quality, i.e., ensuring skills of existing employees can evolve alongside emerging trends and technologies in a changing world of work, and educating and training new potential talent.
- ***Partnerships:*** Matching human resources with where they are needed most on a geographical and occupational basis.

With the aim of contributing to an action plan for electricity human resources, Table 9 links key observations noted throughout the previous sections of this report to potential strategies to address labour market challenges and opportunities in the sector, using the above-noted framework. The action items are intended to be mutually reinforcing, i.e., efforts to improve quality will have spillover effects on quantity and partnerships. As such, some of the recommended actions in a category may also support those in another category.

Table 9. Towards an action plan for human resources in the electricity sector

Quantity	Quality	Partnerships
Key observations → Employment growth in the sector has been strong in recent years and it is expected to increase more rapidly in the future. → Employment in the sector remains predominately male; Indigenous peoples, newcomers, persons with disabilities and racialized groups remain under-represented compared to economy-wide averages. → Women remain under-represented in most fields of study related to the sector. → Labour shortages are already pervasive in the electricity sector. They are expected to worsen due to its aging workforce and growing competition for talent, both within and outside the sector. → Registration in apprenticeships for skilled trades is declining. However, demand for some electricity-related education and training programs exceeds program capacity. → New educational programs require substantial lead time (possibly 2–3 years) for start-up, due to the need to secure funding, equipment, facilities and instructors – and promote them to potential applicants.	**Key observations** → Job quality is relatively high. Part-time and temporary work accounts for a relatively low proportion of the work carried out in the sector. → There are some signs, however, that temporary and part-time work are on the rise. → Many workers have skills that are highly sought in other sectors of the economy; this is particularly the case among *ICT* occupations. → Employee turnover is high among renewable energy jobs. → Technologies such as electric vehicles, heat pumps, and others associated with renewable energy are expected to become increasingly widespread. → A substantial proportion of employers outsource their talent requirements and they are expected to do so more frequently going forward. → Employers have identified finding skilled talent as their foremost concern over the next five years. → The pace of digitalization is continuing to intensify.	**Key observations** → A greater reliance on electricity generated from renewable sources will prompt considerable workforce adjustments at the regional level, in some cases opening up opportunities in rural areas and reducing opportunities elsewhere. → There are considerable gaps in the official data available on renewable energy occupations. → The data pertaining to diversity, equity, and inclusion in the electricity sector is inadequate. → Some prospective workers may be reluctant to move to smaller communities, given the limited availability of other employment opportunities. → The competition for talent within the electricity sector is high.
Potential strategies → Enhance efforts to increase the pipeline of workers to the sector, including augmenting the capacity of existing academic programs alongside the development of new ones. ■ ● ◢ → Educational institutions and employers need to move beyond promotional efforts to more targeted and effective strategies to increase the diversity of workers in the sector. ● ◢ → Increase collaboration and partnerships with organizations and associations representing Indigenous peoples, newcomers, persons with disabilities and racialized groups. ■ ● ◢ → Helping workers stay employed longer through flexible work arrangements, improved work/pension rules, and promotional campaigns, among others, could help to alleviate labour market imbalances. ■ ◢ → Dedicate immigration streams to skill-related shortages in the sector. ■ → Promote the sector as a workplace of choice, e.g., industry-wide promotional campaigns. ◢ ϟ → Foster greater collaboration to improve the link between the supply of and demand for labour, as well as the relevance of academic programs, e.g., through the development of joint programs between employers and educators, and colleges and universities, facilitated by intermediaries like EHRC. ● ◢ ϟ	**Potential strategies** → Prevent erosion of job quality (i.e., wages, contract status) and leverage the quality of jobs in renewed efforts to attract new workers to the sector. ◢ → Encourage older workers to remain in the workforce longer through succession planning (not just in management positions) to help transmit their accumulated expertise and institutional knowledge to newer employees. ◢ → Establish new academic programs and/or boost capacity within existing programs to deliver skills aimed at emerging technologies and renewable energy occupations. ■ ● → Increase opportunities for work-integrated learning to reduce the traditional time lag between education/training and contributions through paid work. Recognize the barriers that SMEs face with respect to work-integrated learning and have intermediaries like EHRC help them address financial and capacity constraints. ● ◢ ϟ → Enhance collaboration between industry and academia to foster R&D and innovation. Work with technology-specific third parties/agencies to develop new programs that meet industry needs. ● ◢ ϟ → Improve foreign credential recognition for newcomers with electricity-sector skills and qualifications. ■ → Upskill to ensure workers currently in the sector have the digital skills required to thrive in the future world of work. ● ◢	**Potential strategies** → Promote sector-wide collaboration to avoid counterproductive within-sector competition for talent. ◢ → Gather better and more frequent insights on diversity, equity, and inclusion. ◢ ϟ → Introduce official occupations related to renewable energy and undertake add-on surveys to the labour force survey, as needed. ■ → Facilitate labour mobility between companies (e.g., through joint projects), occupations (e.g., career laddering), and regions (e.g., incentives for interprovincial mobility). ■ ● ◢ → Integrate rural and remote energy-related projects into broader regional development strategies. ■ → Work with governments at the federal/provincial/territorial levels to create incentives to boost investments in infrastructure, training, lifelong learning, and other measures to expand and diversify electricity generation. ■ ● ◢ ϟ → Encourage the development of regionally specific training programs to align with emerging demand. ●

Roles and responsibilities: ■ Policymakers ◢ Employers ○ Educators ϟ EHRC

KEY RECOMMENDATIONS:

EHRC and industry have put forth a series of potential strategies to support an action plan for human resources development and growth in the electricity sector. There are 6 key recommendations that are currently deemed both critical and time sensitive:

1. Updated Labour Market Intelligence (LMI) and National Occupation Classification (NOC) Codes

Quality and timely labour market intelligence is critical to support business workforce needs, identify skills gaps, and ensure training and education programs are preparing career seekers and workers for the jobs of the future. To support future iterations of LMI it is essential that the National Occupation Classification System (NOCs) be updated to capture emerging renewable energy occupations and ensure accurate workforce projections, as well as labour mobility between occupations and regions. For instance, although power line and cable workers have completed a different apprenticeship program than residential electricians, they share common skills and knowledge. With some on the job training, these 'family members' can easily learn the specific skills required for the job.

NOC codes must be developed for the following renewable occupations: Wind turbine technician, Smart grid specialist, and Solar PV installer/technician. Currently, there are no official occupational codes—and thus no official statistics—for these growing and significant roles. That deficiency will need to be resolved if Canada is to shape an effective human resource strategy for the electricity sector and the path towards net-zero. There is also a need to invest in further NOC research specific to emergent roles in the electricity industry such as non-licensed nuclear operators, and smart grid specialist. EHRC is committed—through a forthcoming survey and report—to working with its partners to gather insights on renewable energy employment and to address knowledge gaps, but this collaboration should not replace the imperative for high-quality, official data on employment in this area.

2. Clear(er) and Well-publicized Career Pathways

Students, jobseekers and workers of all ages are constantly making choices about their careers—researching career interests and goals, and planning an education and training pathway to achieve those goals. Linking LMI and the pathways to the competency framework for the sector with tailored access for jobseekers, workers, employers, and educators will support transitions into the sector and within the sector. This would include a more informed transition for those who are re-evaluating career paths and engaging in re-training as

industry skill needs evolve, or who may be training/upskilling as a result of unemployment or sunsetting careers in other sectors.

At the same time there is a significant opportunity to engage youth as early as possible (throughout the K-12 education system) to peak their interest, curiosity, and awareness of the various occupations and career options within the electricity sector, and help them understand how a career in Canada's energy sector can be a path to supporting Canada's commitment to climate change action. Examples here could include the introduction of high school cooperative education experiences, and specific supports for those in rural and remote communities who are already facing geographic barriers to entry.

Lastly, better career paths should also align with a more unbiased approach to presenting youth with options for entering the workforce. For too long, the skilled trades have been deemed 'lesser than,' and as such, all technical roles within the electricity sector should be presented as equally important. A clear focus on apprenticeship registration through to completion, especially from equity deserving groups will be critical to long-term success as the skilled trades workforce is critical to the build-out requirements of a net-zero future.

The pathways approach should be supported by a significant investment in publicity and marketing to promote this as a sector of choice in action against climate change.

3. Building an Equitable, Diverse and Inclusive Workforce

EHRC is already mobilizing the industry to take action on DEI commitments through the Leadership Accord on Diversity, Equity and Inclusion, however the EHRC Employer Survey 2023 revealed a number of persistent gaps with respect to the collection of employment data for equity-seeking groups. Many organizations are still not gathering data at all, or it is limited to gender. Efforts to improve data collection in this area will help shed light on important gaps in DEI and help them foster a more inclusive work environment. The industry should be seeking to achieve alignment with the representation of equity-seeking groups in the broader Canadian labour market. The benefits of diverse workforces have been well-documented – but the sector is lagging in this area.

The only growing domestic supply of talent is within the Indigenous population. As such, better emphasis on skills development and support through K-12 and post-secondary education for Indigenous people going beyond the skills trades should be emphasized for the sector. This further presents an opportunity to train and retain people who live in rural and remote communities, further contributing to local economic development initiatives as Canada focuses on 'off-diesel' initiatives.

The gender gap in the sector remains persistent, especially in the core technical occupations. Efforts to attract, recruit and especially retain women and 2SLGBTQ+ individuals in engineering, skilled trades and other technical roles should be prioritized over the coming years – innovation here will be required to overcome persistent gender imbalances that are perpetuated by systemic issues in the sector.

Persons with disabilities remain significantly under-represented in the sector as compared to the broader labour market. Greater support to foster inclusive workspaces that are more flexible to the unique needs of people with disabilities, who economy-wide are persistently un- and under-employed, presents an opportunity for the sector to fill critical labour shortages in new ways.

As Black and racialized people in Canada make up a larger proportion of the population, more can be done to attract, recruit and retain people to the sector to align with the broader Canadian economy.

4. Immigration - Not the Status Quo

International immigration currently accounts for almost 100% of Canada's labour force growth. Attracting newcomers to Canada to jobs in the electricity sector will be a crucial ingredient in future recruitment strategies. In addition to the disconnect between incoming newcomers to Canada (skills vs jobs) there exists a range of barriers to employment, including language skills. Strategies and programs targeting permanent immigrants, including initiatives that integrate new arrivals into the community will be key to capture a significant cohort to work in the electricity sector. Further, while the data suggests there has been some headway made with regard to the integration of newcomer engineers into the sector, significant barriers are evident, based on their representation in the skilled trades and ICT roles. Greater focus on bridging programs and prior learning assessments (PLAR) to streamline foreign credential recognition (FCR) in these areas will be critical as immigration is the next largest supply of potential workers – especially as Canada utilizes express entry immigration programs, which tend to focus on immigrants with higher potential for economic integration.

Lastly, aligning with the national occupational classification data needs above, NOCs associated with specific electricity jobs which have emerged as in-demand over the course of the past five years (such as renewables), is imperative. The NOC framework is used to assess labour market impact assessments (LMIA) and if employers don't have an appropriate code to map their LMIA to, there is a much higher risk that it will not be approved – exacerbating the challenge of finding skilled workers in these roles and bringing them in from other countries.

5. Change Management

As the sector embraces new technologies and clean energy initiatives, organizations have to move quickly to implement new processes and/or initiatives to improve performance, reliability and affordability. Investing in the workforce's knowledge, skills, and adaptability is and will continue to be imperative to the long-term success of the sector, especially with the rapid pace of change.

In addition, the full impacts of the pandemic are still being felt. Jobseekers and current employees both have very different expectations of the workplace post-pandemic. Employers will need to consider this impact within the employment lifecycle to safeguard their ability to engage their workforce. Research has shown that new generations entering the workforce are looking for a workplace that mirrors their own values. In addition to economic essentials such as good salaries, job stability, and work-life balance, they are also looking for meaningful work. Considerations will need to include hybrid work models, privacy, productivity and mental health, as well as how to support both managers and employees in a hybrid and changing workplace environment.

6. Upskilling, Reskilling and Lifelong Learning

As the industry moves at an ever-quickening pace of change driven by technology, policy, public expectations and increased adverse weather events, there is a realization that not all upskilling and reskilling will take the form of traditional two to four year training programs, whether delivered through formal education institutions or internally. Workers – and their employers - need to see training that is fast, efficient and financially prudent. For workers who have completed primary technical training, it may look like more work-integrated learning where there is time set aside for in-class learning and then applied training on the job site. As such, employers will need to work with educators and trainers to develop courses and curricula that provide current employees with access to a range of technical or professional skills that have been designed to be accessible, time sensitive and technologically apt (e.g., modular course design, remote and asynchronous learning).

Further, in order to improve the potential for labour mobility from one employer to another, or one geographic region to another, and thus maximize labour market efficiency, there is a need to recognize additional learning through microcredentials that are grounded in a competency-based approach to learning and competency acquisition. EHRC has previously conducted research that indicates that microcredentials are best delivered by post-secondary institutions with the credibility of their training programs to support the credential, but through programs that are grounded in industry competency models. These microcredentials can then be laddered over time to verify competency as technologies and/or workplace competency needs shift and require additional training.

9.0 Way Forward

SINCE 2017, CANADA'S ELECTRICITY SECTOR HAS EXHIBITED RAPID CHANGE, LARGELY BECAUSE A STEADILY GROWING PROPORTION OF ITS GENERATION IS FUELED BY RENEWABLE SOURCES.

Although these developments have precipitated new economic, business, technological, and environmental opportunities, in addition to greater sector-specific levels of employment, they also present complex challenges. In particular, the sector will have to adapt to evolving developments associated with Canada's pursuit of net-zero emission status, in the context of federal/provincial/territorial regulatory environment(s) that may not always fully align with this goal.

There is considerable uncertainty surrounding the electricity sector's outlook. Therefore, it will be imperative to monitor it on an ongoing basis.

In this regard, EHRC is committed to providing evidence-based recommendations to address its human resources challenges and proposing solutions to policy makers, industry actors, and other stakeholders, when warranted. We will continue to update and refine the forecast model on a regular basis to reflect the sector's changing dynamics, as well as economy-wide developments. To that end, we will also provide regular employment-related updates to stakeholders, to help them make well-informed workforce planning decisions.

Finally, we commit to working with government, industry, labour, and educational partners to help elaborate and deliver on the human resources strategy and action plan proposed in this report. Our ultimate aim is to ensure the continued reliability and stability of Canada's electricity sector, while supporting environmental progress and sustainability in the 21st century.

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Appendices

A.

List of Study Participants

EMPLOYERS

- ABB Inc.
- ABH Engineering Inc.
- Acciona Energy Canada Global
- Advanced Mobility Products Inc.
- Advisian (worley group)
- AESO
- Alectra Inc.
- AltaLink
- Angler Solutions Inc.
- AP Renewables
- ARC Canada
- ARC Engineering Inc.
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- Battery Advancement
- BC Hydro
- BluEarth Renewables Inc.
- Bluewater Power
- Borealis Wind
- Borrum Energy Solutions
- Bourque Industrial Ltd
- Bronte Construction
- Bruce Power
- Burlington Hydro Inc.
- Business Transition
- Consulting Group Inc.
- CAFES Ottawa
- Canada Métal Nord Amérique
- Canadian Union of Skilled Workers
- CanREA
- Canada Nuclear Association
- Capital Power
- Capstone Infrastructure
- CIMA+
- Curtiss-Wright Nuclear
- Decentralized Energy Canada
- Discover Battery
- Electrical Contractors Association of Ontario (ECAO)
- ECCC
- EDF Renouvelables
- Edgecom Energy
- eDraft Automation Drafting Inc.
- EECOL Electric
- Elexicon Energy Inc.
- EnerServ
- Enerza Inc
- Enfinite
- ENMAX Corporation
- ENWIN Utilities Ltd.
- EPCOR Utilities Inc.
- ESA
- Essex Powerlines Corp
- Evolugen
- Exactus Energy
- Execon
- EXO Insights Corp
- e-Zinc
- Fortis Alberta
- FortisBC
- Fresh Valley Farms
- G&W Canada Corporation
- Get Energy
- Global First Power LTD
- GOLDBECK SOLAR Canada Corp.
- Gowling WLG (Canada) LLP
- GrandBridge Energy Inc. (formerly Energy+ and Brantford Power)
- Graybar Canada
- Graybar CANADA
- Green Learning Canada Foundation
- Growler Energy
- Halton Hills Hydro
- Hatch

- Heartland Generation
- Hubbell Canada ULC
- Hydro One Inc.
- Hydro Ottawa Holding Inc.
- Hydro-Quebec
- Innergex
- InnPower
- IntellectuLogy Solutions Inc.
- International Brotherhood of Electrical Workers
- Independent Electricity System Operator
- Kaihen
- KCP Energy
- Kepler Communications
- Kinectrics Inc.
- K-line
- Kruger Energy
- London Hydro
- Manitoba Hydro
- Marine Renewables
- miEnergy
- Moltex Energy Canada Inc.
- Nova Scotia Power
- New Brunswick Power
- New Brunswick Multicultural Council Inc.
- New Dawn Energy Solutions
- Newfoundland Power Inc.
- Newfoundland Hydro
- Northwest Territories Power Corporation
- Nova Scotia Power Inc.
- NRCan
- NRStor Inc.
- O Trade
- Ontario Energy Board
- Ontario Power Generation
- Opsis, gestion d'infrastructures Inc.
- ORPC
- Power Workers' Union
- Primary Engineering and Construction Corporation
- Rayleigh Solar Tech Inc.
- Redrock Power Systems/ VDot Cleantech
- Resource Innovations
- RGC Energy Inc.
- Rotor Mechanical Services Ltd
- Saint John Energy
- SaskPower
- Schneider Electric
- Shell Canada Limited
- Sky Fire Energy
- Solvest Inc.
- Spar Power Technologies Inc.
- Spark Power
- SunGrid Solutions
- Synergy North Corporation
- The Corporation of The City of Nelson
- Thinkwell Shift
- Toronto Hydro Electric-System Limited
- TransAlta
- UgoWork
- Utilities Kingston
- Vitesco Technologies Canada, Inc.
- Waterford Energy Services Inc.
- WaterPower Canada
- Warren Shapiro
- Wicks Electric Inc.
- WorkForce Strategies International Inc.
- Workforce Warriors Inc.
- Yukon Energy Corporation

EDUCATORS

- Algonquin College
- Assiniboine Community College
- British Columbia Institute of Technology (BCIT)
- Cambrian College
- Cégep de l'Outaouais
- Collège Communautaire du NB
- College of the North Atlantic
- Electrical Industry Training Centre's of Alberta
- Electrical Joint Training Committee
- George Brown College
- Georgian College
- Humber College
- Kwantlen Polytechnic University
- Loyalist College
- McMaster University
- New Brunswick Community College
- Northern College
- Nova Scotia Community College
- Renfrew County District School Board
- Royal Roads University
- Saint John Energy
- Southern Alberta Institute of Technology
- Saskatchewan Indian Institute of Technologies
- St. Clair College
- Thompson Rivers University
- University of Waterloo
- University of Windsor
- YMCA Hamilton

B.

Sectoral and Occupational Coverage

SECTORS

The *North American Industry Classification System* (NAICS) is a standardized system used in the United States, Canada, and Mexico to classify and organize businesses and industries based on their primary economic activities. The system encompasses a hierarchical structure that sets out numerical codes and groups these economic activities according to:

- ***level 1:*** sectors (two-digit codes, e.g., 22 – Utilities);
- ***level 2:*** subsectors (three-digit codes, e.g., 221 – Utilities);
- ***level 3:*** industry groups (four-digit codes, e.g., 2211 – Electric power generation, transmission, and distribution);
- ***level 4:*** industries (five-digit codes, 22111 – Electric power generation);
- ***level 5:*** Canadian industries (six-digit codes, e.g., 221113 – Nuclear electric power generation).

Employment data according to NAICS is collected using various sources, including the Labour Force Survey, census, and online job postings. NAICS-based employment data do not reflect specific types of jobs or occupations within a sector or industry. For instance, according to the 2021 census, 143,805 people were working in Utilities (NAICS 22) in Canada. This includes all occupations (typically hundreds) within the sector, ranging from accountants to zone maintenance technicians.

The level of granular information available differs by data source, although employment data is not typically available beyond level 3, i.e., by industry groups (and even less so when cross-tabulated with occupations).

While individuals working in the electricity sector are engaged across a number of different sectoral activities, this report will, depending on the data source and availability of information present information at the sector level for Utilities (22) and where feasible and data permits, for the following detailed industry group: NAICS 2211 –- Electric power generation, transmission, and distribution (Table 10).

Table 10. Overview of the electricity sector

NAICS code	NAICS title	Description
22	Utilities	This sector comprises establishments primarily engaged in operating electric, gas, and water utilities. These establishments generate, transmit, control, and distribute electric power; distribute natural gas; treat and distribute water; operate sewer systems and sewage treatment facilities; and provide related services, generally through a permanent infrastructure of lines, pipes, and treatment and processing facilities.
2211	Electric power generation, transmission, and distribution	This industry group comprises establishments primarily engaged in the generation of bulk electric power, transmission from generating facilities to distribution centres, and/or distribution to end users.

OCCUPATIONS

The *National Occupational Classification* (NOC) is the official systematic classification structure for occupations in Canada. Occupations are grouped by the type of job duties and requirements, with information on employment levels by NOC available from a variety of sources, similar to NAICS. The first level of the 2021 NOC hierarchy consists of 10 broad occupational groups and corresponds to the first digit of the NOC code. Following the broad groups, occupations are filtered into 45 major groups, 89 sub-major groups, 162 minor groups, and 516 unit groups.

The 2021 NOC codes are now five digits instead of the previous 2016 NOC codes, which were four digits. In the 2016 NOC, the code 2171 referred to information system analysts and consultants, but as of 2021, the occupation was split into three new occupation codes: data scientists (21211), cybersecurity specialists (21220), and information systems specialists (21222). Similarly, the 2016 NOC code, 2174 (computer programmers and interactive media developers) was split into two new 2021 occupation codes: computer systems developers and programmers (21230) and software developers and programmers (21232).

And while, as discussed above, the electricity sector involves hundreds of occupations, this report considers 34 core occupations of interest (Table 11). In particular, it focuses on individuals employed in occupations within the electricity sector, i.e., in Electric power generation, transmission (2211). In the absence of more granular occupational data at the industry group level, employment in these 34 occupations within the broader sector of Utilities (22) will be examined.

Table 11. Occupational overview of the electricity sector

NOC 2021 Code	NOC 2021 Title	Description	Occupational Group	Similar Job Titles	Top Skills & Abilities	
					Top 3 Skills	Top 3 Abilities
20010	*Engineering managers*	Engineering managers plan, organize, direct, control & evaluate the activities of an engineering department, service, or firm.	**Managers & Supervisors**	→ Electrical engineering manager → Engineering manager → Production engineering manager	→ Coordinating → Critical thinking → Decision making	→ Fluency of ideas → Mathematical reasoning → Numerical ability
21211	*Data scientists*	Data scientists use advanced analytics technologies, including machine learning & predictive modelling, to support the identification of trends, gather information from unstructured data sources & provide automated recommendations.	**ICT Occupations**	→ Data architect/scientist → Machine learning engineer/specialist → Quantitative analyst	→ Digital literacy → Numeracy → Systems analysis	→ Categorization flexibility → Deductive reasoning → Fluency of ideas
21220	*Cybersecurity specialists*	Cybersecurity specialists develop, plan, recommend, implement, improve, & monitor security measures to protect an organization's computer networks, connected devices & information to prevent unauthorized access, use, disclosure, disruption, modification, or destruction of the information or of the systems on which the information resides.	**ICT Occupations**	→ Cybersecurity analyst → Informatics security analyst/consultant → IT security specialist → Systems security analyst	→ Critical thinking → Decision making → Digital literacy	→ Deductive reasoning → Fluency of ideas → Inductive reasoning
21222	*Information systems specialists*	Information systems specialists analyze, test, & assess systems requirements, develop, & implement information systems development plans, policies, & procedures, & provide advice on a wide range of information systems issues.	**ICT Occupations**	→ Computer systems analyst → Information systems quality assurance (QA) analyst → IT & Informatics consultant → Systems auditor/consultant	→ Evaluation → Troubleshooting → Critical thinking	→ Fluency of ideas → Categorization flexibility → Deductive reasoning
21223	*Database analysts & data administrators*	Database analysts design, develop & administer data management solutions. Data administrators develop & implement data administration policy, standards, & models.	**ICT Occupations**	→ Data administrator → Data custodian → Data warehouse analyst → Database analyst	→ Critical thinking → Decision making → Digital literacy	→ Deductive reasoning → Fluency of ideas → Inductive reasoning
21230	*Computer systems developers & programmers*	Computer systems developers & programmers write, modify, integrate, & test computer code for software applications, data processing applications, operating systems-level software, & communications software.	**ICT Occupations**	→ Computer programmer → Operating systems programmer → Programmer analyst → Scientific programmer → Systems programmer	→ Digital literacy → Digital production → Troubleshooting	→ Fluency of ideas → Information ordering → Categorization flexibility

Continued →

21231	*Software engineers & designers*	Software engineers & designers research, design, evaluate, integrate, & maintain software applications, technical environments, operating systems, embedded software, information warehouses & telecommunications software.	**ICT Occupations**	→ Application & software architects → Cloud infrastructure, operations, & software engineer → Software engineer/ designer/project manager	→ Digital literacy → Digital production → Evaluation	→ Categorization flexibility → Fluency of ideas → Deductive reasoning
21232	*Software developers & programmers*	Software developers & programmers design, write, & test code for new systems & software to ensure efficiency. They create the foundations for operative systems & run diagnostic programs to certify effectiveness.	**ICT Occupations**	→ Application programmer → Computer game developer → Multimedia developer → Software development project manager/ programmer	→ Digital literacy → Digital production → Evaluation	→ Fluency of ideas → Information ordering → Mathematical reasoning
21300	*Civil engineers*	Civil engineers plan, design, develop & manage projects for the construction or repair of buildings, earth structures, powerhouses, roads, airports, railways, rapid transit facilities, bridges, tunnels, canals, dams, ports & coastal installations & systems related to highway & transportation services, water distribution & sanitation. They may also specialize in foundation analysis, building & structural inspection, surveying, geomatics, & municipal planning.	**Engineers**	→ Bridge, highway, structural, traffic, transportation, & surveying engineers → Civil engineer → Construction & project engineers → Environmental, geodetic, geomatics, & hydraulics engineer → Municipal, public works, sanitation, & water management engineers	→ Critical thinking → Decision making → Evaluation	→ Categorization flexibility → Deductive reasoning → Fluency of ideas
21301	*Mechanical engineers*	Mechanical engineers research, design & develop machinery & systems for heating, ventilating & air conditioning, power generation, transportation, processing, & manufacturing. They also perform duties related to the evaluation, installation, operation, & maintenance of mechanical systems.	**Engineers**	→ Acoustics, piping, robotics, nuclear, & thermal design engineers → Automotive, mechanical, tool, mechanical maintenance, & fluid mechanic engineers → Energy conservation, HVAC, power generation engineers	→ Critical thinking → Decision making → Evaluation	→ Categorization flexibility → Deductive reasoning → Fluency of ideas
21310	*Electrical & electronics engineers*	Electrical & electronics engineers design, plan, research, evaluate & test electrical & electronic equipment & systems .	**Engineers**	→ Electrical design, electrical, electrical network, electrical process control, electrical systems planning, & electrical distribution planning engineers	→ Critical thinking → Decision making → Numeracy	→ Categorization flexibility → Deductive reasoning → Fluency of ideas

Continued →

21321	*Industrial & manufacturing engineers*	Industrial & manufacturing engineers conduct studies & develop & supervise programs to achieve the best use of equipment, human resources, technology, materials, & procedures to enhance efficiency & productivity.	**Engineers**	→ Computer integrated manufacturing engineer → Fire prevention, industrial, manufacturing, production, quality control, plant, safety, & work measurement engineers	→ Decision making → Evaluation → Monitoring	→ Categorization flexibility → Fluency of ideas → Information ordering
22220	*Computer network & web technicians*	Computer network technicians establish, operate, maintain, & coordinate the use of local & wide area networks (LANs & WANs), mainframe networks, hardware, software, & related computer equipment. Web technicians set up & maintain internet, extranet & intranet Web sites & Web-server hardware & software & monitor & optimize network connectivity & performance.	**ICT Occupations**	→ Computer network, website, LAN, web & network support technician → Data center operator → LAN, network, & network system administrator	→ Preventative maintenance → Troubleshooting → Equipment & tool selection	→ Fluency of ideas → Problem identification → Written comprehension
22230	*Non-destructive testers & inspectors*	Non-destructive testers & inspectors operate radiographic, ultrasonic, liquid penetrant, magnetic particle, eddy current & similar testing equipment to detect discontinuities in objects of various compositions & materials.	**Engineers**	→ Acoustic emission, eddy current, visual inspection, & ultrasonic testing technician → Industrial radiographer → Infrared thermographer → Pressure vessel tester	→ Quality control testing → Equipment & tool selection → Critical thinking	→ Multitasking → Near vision → Pattern identification
22300	*Civil engineering technologists & technicians*	Civil engineering technologists & technicians provide technical support & services to scientists, engineers, & other professionals, or may work independently in fields such as structural engineering, municipal engineering, construction design & supervision, highways & transportation engineering, water resources engineering, geotechnical engineering, & environmental protection.	**Engineering**	→ Bridge design, building materials, & highway technician → Civil engineering, construction, & foundation technologist → Construction specifications writer → Municipal engineering assistant → Soil technologist	→ Numeracy → Coordinating → Critical thinking	→ Mathematical reasoning → Near vision → Numerical ability
22301	*Mechanical engineering technologists & technicians*	Mechanical engineering technologists & technicians provide technical support & services or may work independently in mechanical engineering fields such as the design, development, maintenance & testing of machines, components, tools, heating & ventilating systems, geothermal power plants, power generation & power conversion plants, manufacturing plants & equipment.	**Engineering**	→ Aeronautical technologist → Heating, machine, mould & tool designers → HVAC technologist → Marine engineering technologist → Mechanical engineering technician/technologist	→ Equipment & tool selection → Operation monitoring of machinery & equipment → Preventative maintenance	→ Control of settings → Deductive reasoning → Depth perception

Continued →

22302	***Industrial engineering & manufacturing technologists & technicians***	Industrial engineering & manufacturing technologists & technicians may work independently or provide technical support & services in the development of production methods, facilities & systems, & the planning, estimating, measuring, & scheduling of work.	**Engineering**	→ Computer-assisted design/ manufacturing programmer → Industrial engineering technician → Loss prevention technologist → Manufacturing technologist → Plastics manufacturing technician	→ Equipment & tool selection → Evaluation → Instructing	→ Fluency of ideas → Mathematical reasoning → Near vision
22310	***Electrical & electronics engineering technologists & technicians***	Electrical & electronics engineering technologists & technicians may work independently or provide technical support & services in the design, development, testing, production & operation of electrical & electronic equipment & systems.	**Engineering**	→ Communications technologist → Electrical engineering technician → Electronics design & engineering technologist → Electronics manufacturing technologist	→ Equipment & tool selection → Troubleshooting → Evaluation	→ Colour perception → Information ordering → Mathematical reasoning
22312	***Industrial instrument technicians & mechanics***	Industrial instrument technicians & mechanics repair, maintain, calibrate, adjust, & install industrial measuring & controlling instrumentation.	**Engineering**	→ Industrial instrument mechanic → Industrial instrument technician → Process control equipment mechanic	→ Operation monitoring of machinery & equipment → Preventative maintenance → Repairing	→ Sound localization → Arm-hand steadiness → Control of settings
70010	***Construction managers***	Construction managers plan, organize, direct, control & evaluate the activities of a construction company or a construction department within a company, under the direction of a general manager or other senior manager.	**Managers & Supervisors**	→ Construction manager → General contractor → Housing, industrial, residential, & pipeline construction managers	→ Management of financial resources → Management of material resources → Management of personnel resources	→ Auditory attention → Far vision → Information ordering
72011	***Contractors & supervisors, electrical trades, & tele-communications occupations***	Contractors & supervisors in electrical trades & telecommunications occupations supervise & coordinate the activities of workers classified in the following unit groups: Electricians, Industrial electricians, Power system electricians, Electrical powerline & cable workers, Telecommunications line & cable installers & repairers & Telecommunications equipment installation & cable television service technicians.	**Managers & Supervisors**	→ Cable maintenance & repair supervisor → Cablevision technicians/electricians → Electrical contractor → Plant electrician supervisor → Powerline & cable workers → Power systems electricians	→ Repairing → Equipment & tool selection → Instructing	→ Information ordering → Perceptual speed → Sound localization
72012	***Contractors & supervisors, pipefitting trades***	Contractors & supervisors in pipefitting trades supervise & coordinate the activities of workers classified in the following unit groups: Plumbers, steamfitters, pipefitters & sprinkler system installers, & gas fitters.	**Trades**	→ Gas fitters → Pipefitters → Plumber	→ Instructing → Management of financial resources → Management of personnel resources	→ Depth perception → Spatial visualization → Auditory attention

Continued →

72103	***Boilermakers***	Boilermakers fabricate, assemble, erect, test, maintain & repair boilers, vessels, tanks, towers, heat exchangers & other heavy-metal structures.	**Trades**	→ Boiler fitter & installer → Boilermaker → Construction/ industrial boilermaker	→ Equipment & tool selection → Monitoring → Operation & control	→ Static strength → Arm-hand steadiness → Auditory attention
72106	***Welders & related machine operators***	Welders operate welding equipment to weld ferrous & non-ferrous metals. This unit group also includes machine operators who operate previously set up production welding, brazing & soldering equipment.	**Trades**	→ Aviation welding technician → Brazing machine operator → Soldering machine operator → Welder	→ Equipment & tool selection → Operation & control → Preventative maintenance	→ Arm-hand steadiness → Control of settings → Dynamic strength
72200	***Electricians (except industrial & power system)***	Electricians (except industrial & power system) lay out, assemble, install, test, troubleshoot & repair electrical wiring, fixtures, control devices & related equipment in buildings & other structures.	**Trades**	→ Construction electrician → Domestic & rural electrician → Electrician	→ Repairing → Setting up → Equipment & tool selection	→ Gross body equilibrium → Body flexibility → Dynamic strength
72201	***Industrial electricians***	Industrial electricians install, maintain, test, troubleshoot & repair industrial electrical equipment & associated electrical & electronic controls.	**Trades**	→ Industrial, marine, mine, plant, & shipyard electricians	→ Preventative maintenance → Repairing → Setting up	→ Gross body equilibrium → Body flexibility → Far vision
72202	***Power system electricians***	Power system electricians install, maintain, test & repair electrical power generation, transmission & distribution system equipment & apparatus.	**Trades**	→ Power electrician → Power station electrician → Power system electrician	→ Setting up → Preventative maintenance → Repairing	→ Static strength → Trunk strength → Arm-hand steadiness
72203	***Electrical powerline & cable workers***	Electrical powerline & cable workers construct, maintain & repair overhead & underground electrical power transmission & distribution systems.	**Trades**	→ Cable installer & splicer → Construction lineman/ woman → Powerline patroller, technician, & lineman/ woman	→ Preventative maintenance → Repairing → Troubleshooting	→ Gross body equilibrium → Stamina → Static strength
72400	***Construction millwrights & industrial mechanics***	Construction millwrights & industrial mechanics install, maintain, troubleshoot, overhaul & repair stationary industrial machinery & mechanical equipment. This unit group includes industrial textile machinery mechanics & repairers.	**Trades**	→ Industrial mechanic → Knitting machine mechanic → Millwright	→ Preventative maintenance → Repairing → Operation monitoring of machinery & equipment	→ Auditory attention → Body flexibility → Control of settings

Continued →

72422	***Electrical mechanics***	Electrical mechanics maintain, test, rebuild & repair electric motors, transformers, switchgear, & other electrical apparatus.	**Trades**	→ Electric motor systems technician → Electrical mechanic → Industrial motor winder-repairer → Transformer repairer	→ Equipment & tool selection → Operation monitoring of machinery & equipment → Preventative maintenance	→ Sound localization → Arm-hand steadiness → Auditory attention
73200	***Residential & commercial installers & servicers***	Residential & commercial installers & servicers install & service a wide variety of prefabricated products such as windows, doors, electrical appliances, water heaters, fences, play structures & septic & irrigation systems.	**Trades**	→ Solar Panel Installer → Solar heating technician → Solar heating equipment installers → Aluminum window installer → Electric appliance installer	→ Equipment & tool selection → Operation & control → Operation monitoring of machinery & equipment	→ Body flexibility → Dynamic strength → Gross body coordination
74205	***Public works maintenance equipment operators & related workers***	Public works maintenance equipment operators & related workers operate vehicles & equipment to maintain streets, highways & sewer systems & operate trucks to collect garbage & recyclable materials.	**Trades**	→ Utility arborist	→ Operation & control → Operation monitoring of machinery & equipment → Preventative maintenance	→ Control of settings → Depth perception → Gross body equilibrium
90011	***Utilities managers***	Utilities managers plan, organize, direct, control & evaluate the operations of utility companies or services of heating fuel distribution companies.	**Managers & Supervisors**	→ Director of waste management → Electric generating plant manager → Electric power plant manager → Sewage treatment plant manager → Water filtration plant manager	→ Management of financial resources → Management of material resources → Time management	→ Fluency of ideas → Mathematical reasoning → Memorizing
92100	***Power engineers & power systems operators***	Power engineers operate & maintain reactors, turbines, boilers, generators, stationary engines, & auxiliary equipment to generate electrical power. Power systems operators monitor & operate switchboards & related equipment in electrical control centers to control the distribution of electrical power in transmission networks.	**Trades**	→ Auxiliary plant operator → Building systems technician → Control room operator → Electrical power systems operator → Nuclear generating station field operator → Power engineer → Power plant operator	→ Operation monitoring of Machinery & Equipment → Troubleshooting → Operation & control	→ Selective attention → Auditory attention → Deductive attention

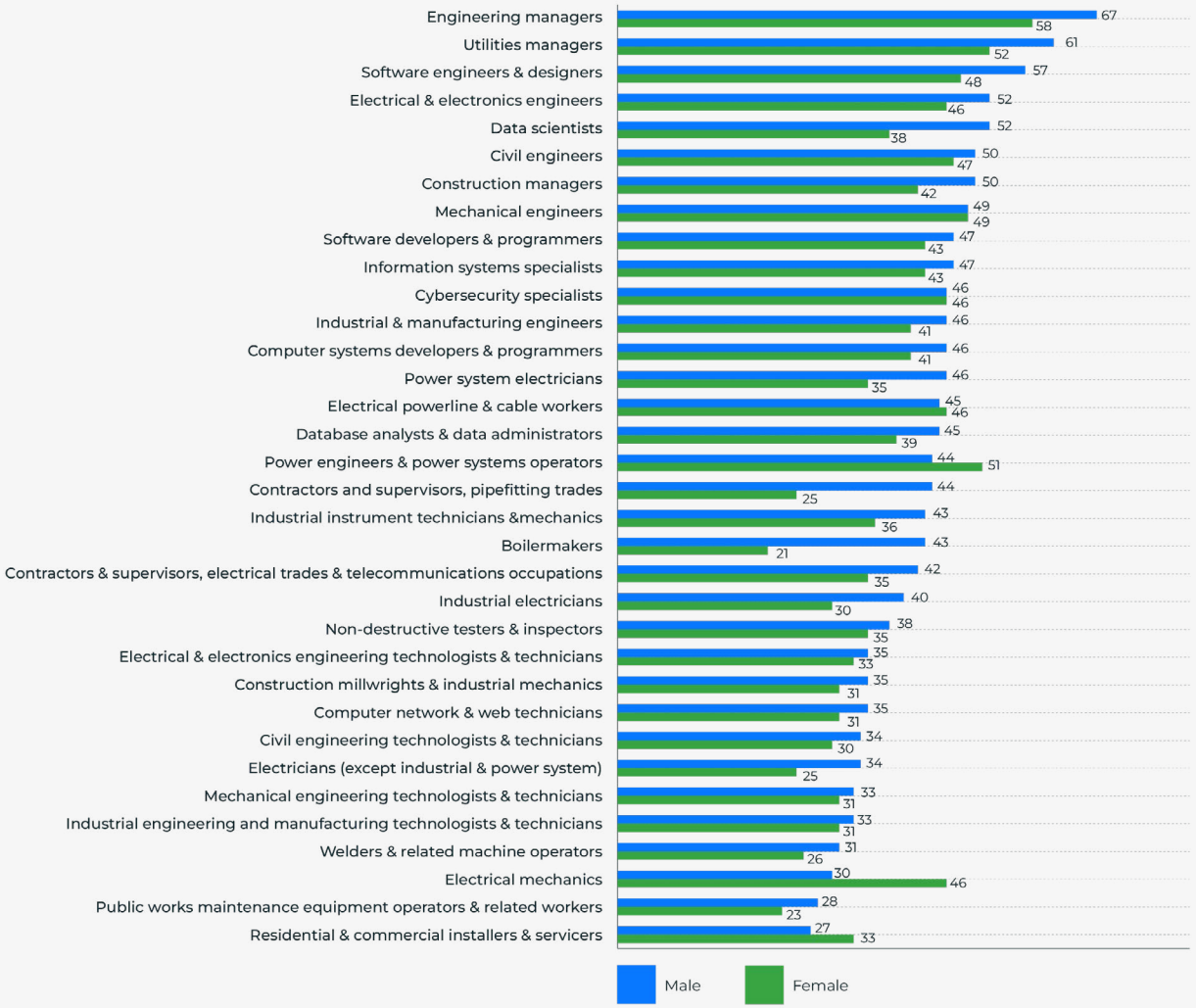
Source: *Government of Canada's National Occupation Classification (employment-related information) and Occupational and Skills Information System (skills and abilities-related information).*

Note: *The occupational groups presented in the table are an internal classification and do not correspond to an official classification per se. With respect to skills and ability, EHRC has developed a series of National Occupational Standards (NOS) for detailed jobs related to the sector. These standards are voluntary guidelines that have been developed to provide businesses, educators, trainers, and job seekers with practical guidance. They detail the competencies (i.e., skills and knowledge) required to perform a specific occupation safely, effectively and efficiently. For more information please visit: EHRC Industry Skills, NOS.*

Economy-Wide Wages and Gender Gaps

Figure 47 shows the economy-wide wages by detailed occupation and gender. In particular, of the 34 core occupations, men earn, on average, more than women in 30 of them.

Figure 47. Average hourly earnings by detailed occupation and gender, 2022



Source: *Statistics Canada, Labour Force Survey, 2022*

Top Fields of Study in the Electricity Sector

Table 12. Top three fields of study for each of the core electricity sector occupations

Field of Study		Managers & Supervisors Occupations			
		20010 Engineering managers	**70010** Construction managers	**72011** Contractors and supervisors, electrical trades and telecommunications	**90011** Utilities managers
52.01	Business, commerce general				2
52.02	Business admin, management and operations		3		1
46.02	Carpentry/carpenter		1		
14.08	Civil engineering		2		
46.03	Electrical and power transmission installers			1	
14.10	Electrical, electronics and comm. engineers	3		3	
15.03	Electrical, electronic engineering technicians			2	
14.01	General engineering	1			3
14.19	Mechanical engineering	2			
% of NOC with top 3 fields of study		*40%*	*16%*	*64%*	*19%*
% of NOC with no postsecondary		*0.2%*	*27%*	*11%*	*21%*

Field of Study		Information & Communications Technology Occupations							
		21211 Data scientists	**21220** Cybersecurity specialists	**21222** Information systems specialists	**21223** Database analysts and data administrators	**21230** Computer systems developers and programers	**21231** Software engineers and designers	**21232** Software developers and programmers	**22220** Computer network and web technicians
52.02	Business administration, management and operations			3	3				
11.01	Computer and info. sciences and support services, general	3	3	2	2	3		3	2
11.10	Computer/information technology admin. and management		2						3
14.09	Computer engineering						2	2	
11.02	Computer programming					2			
11.07	Computer science	1	1	1	1	1	1	1	1
14.10	Electrical, electronics and communications engineering						3		
27.01	Mathematics	2							
% of NOC with top 3 fields of study		*26%*	*40%*	*37%*	*27%*	*43%*	*48%*	*48%*	*35%*
% of NOC with no postsecondary		*5%*	*9%*	*8%*	*10%*	*10%*	*7%*	*10%*	*17%*

Continued →

Field of Study		Trades Occupations												
		22312 Industrial instrument technicians and mechanics	**72012** Contractors and supervisors, pipefitting trades	**72103** Boilermakers	**72106** Welders and related machine operators	**72200** Electricians (except industrial and power system)	**72201** Industrial electricians	**72202** Power system electricians	**72203** Electrical power line and cable workers	**72400** Construction millwrights and industrial mechanics	**72422** Electrical mechanics	**73200** Residential and commercial installers and servicers	**74205** Public works maintenance equipment operators and related workers	**92100** Power engineers and power systems operators
01.06	Applied horticulture/horticultural business services												2	
48.08	Boilermaking/boilermaker			1										
52.01	Business/commerce, general		2						3					
46.02	Carpentry/carpenter											1		
46.03	Electrical and power transmision installers	3				1	1	1	1					
14.10	Electrical, electronics and communications engineering					3	3							
15.03	Electrical/electronic engineering technologies/technicians	2				2	2	2	2		3			2
47.01	Electrical/electronics maintenance and repair technologies/technicians										2			
15.04	Electromechanical technologies/technicians	1						3			1			
15.17	Energy systems technologies/technicians													1
14.99	Engineering, other				3									
49.02	Ground transportation												1	
47.03	Heavy/industrial equipment maintenance technologies/technicians									1				
14.19	Mechanical engineering													3
47.00	Mechanics and repairers, general									3				
46.05	Plumbing and related water supply services		1	3										
48.05	Precision metal working		3	2	1					2		2		
47.06	Vehicle maintenance and repair technologies/technicians				2								3	
48.07	Woodworking											3		
% of NOC with top 3 fields of study		*62%*	*69%*	*72%*	*57%*	*70%*	*74%*	*76%*	*71%*	*54%*	*57%*	*7%*	*14%*	*38%*
% of NOC with no postsecondary		*8%*	*11%*	*11%*	*29%*	*15%*	*7%*	*6%*	*10%*	*20%*	*13%*	*65%*	*63%*	*27%*

Continued →

Field of Study		Engineers, Technicians & Technologists Occupations								
		21300 Civil engineers	**21301** Mechanical engineers	**21310** Electrical and electronics engineers	**21310** Industrial and manufacturing engineers	**21321** Non-destructive testers and inspectors	**22230** Civil engineering technologists and technicians	**22300** Mechanical engineering technicians	**22301** Industrial engineering manufacturing technicians	**22302** Electrical and electronics engineering technicians
52.02	Business admin., mgmt. and operations		3							
14.08	Civil engineering	1					2			
15.02	Civil engineering technolgoy/technician	3					1			
14.10	Electrical, electronics and comm. eng.			1						2
15.03	Electrical/electronic engineering technician			3						1
15.04	Electromechanical technician							2		3
14.01	General engineering	2	2	2	1					
14.35	Industrial engineering				3					
15.06	Industrial production technician					3			2	
14.19	Mechanical engineering		1		2			3	3	
15.08	Mechanical eng. related tech							1		
3.01	Natural resources conservation and research						3			
48.05	Precision metal working					2			1	
15.07	Quality control and safety tech.					1				
% of NOC with top 3 fields of study		*74%*	*80%*	*77%*	*52%*	*41%*	*44%*	*37%*	*17%*	*50%*
% of NOC with no postsecondary		*2%*	*2%*	*1%*	*2%*	*19%*	*12%*	*9%*	*20%*	*13%*

Source: *Calculations based on census of Canada, 2021. Occupation by major field of study (detailed, 4-digit): Canada. Table: 98–10–0403–01.*

Note: *Data reflect those working in core occupations for the economy as a whole. The numbers to the left of each field of study indicated are the Classification of Instructional Programs (CIP) codes. The numbers in the cells represent the ranking of fields of study for the highest degree held by persons with that occupation (i.e., "1" = most common field of study, "2" = second most common field of study, "3" = third most common field of study).*

Occupational Links to Registered Apprenticeship Information System

Core electricity trades, occupations, and corresponding sub-trades from the Registered Apprenticeship Information System (RAIS)

Core electricity trades		Associated RAIS database sub-trades	
2021 NOC (2016 NOC)	***Occupation name***	***RAIS sub-trade names***	***RAIS sub-trade codes***
72201 (7242)	Industrial electricians	Industrial Electrician Electrician (Street Railway Electrician Linesperson) Electrician Signal Maintenance	7242.01.00 7242.05.00 7242.07.00
72202 (7243)	Power system electrician	Power System Electrician	7243.01.00
72200 (7241)	Electricians (except industrial and power system)	Construction Electrician	7241.01.00
72203 (7244)	Electrical powerline and cable workers	Powerline Technician Construction Lineman Distribution Construction Lineman	7244.01.00 7244.01.01 7244.01.02
92100 (9241)	Power engineers and power systems operators	Power Engineer/Stationary Engineer (1st Class) Power System Operator Process Operator (Power) Switchboard Operator (Electrical Power)	9241.01.00 9241.01.02 9241.01.03 9241.01.04
22312 (2243)	Industrial instrument technicians and mechanics	Instrumentation and Control Technician Instrument Technician Relay and Instrument Technician	2243.01.00 2243.01.01 2243.01.02
72106 (7237)	Welders and related machine operators	Welder Welder (Assembly) Welder (High Pressure A) Pressure System Welder	7237.01.00 7237.01.02 7237.01.04 7237.01.05
72400 (7311)	Construction millwrights and industrial mechanics	Construction Millwright Industrial Mechanic Industrial Mechanic (Millwright) Pump Systems Installer Gas Turbine Repairer	7311.01.00 7311.02.05 7311.02.00 7311.06.00 7311.08.00
72103 (7234)	Boilermaker	Boiler and Related Equipment Assembler Boilermaker	7234.02.00 7234.01.00
72422 (7333)	Electrical mechanics	Electrical Control (Machine) Builder Electrical Mechanic (Electrical Utility)	7333.04.00 7333.02.00
74205 (2225)	Public works maintenance equipment operators and related workers	Utility Arborist	2225.04.01

Note: *RAIS data is not available in relation to Contractors and supervisors, pipefitting trades (NOC #72012) and Residential and commercial installers and servicers (NOC #73200)*

Forecasting Method

INTRODUCTION

This appendix presents the technical details of the forecasting process. This is the first iteration of EHRC's forecasting model, which aims to better understand the employment implications of changes in the electricity sector. This version of the model takes into consideration an initial subset of key parameters and forecasts employment out to 2028. As we develop and refine our model, additional parameters and dimensions will be added to improve our ability to anticipate how different scenarios will affect employment in the sector. Of course, there is a degree of uncertainty with any projection model.

Model specification and selection

The same procedure is applied to all the datasets, e.g., Canadian total employment in NAICS 2211, employment by region, occupations, etc.

First, we start by examining the statistical properties of the employment series. We run a Dicky=Fuller test to evaluate whether the series has a unit root. In all cases, the test statistic has a p-value lower than 0.1, which leads us to reject the hypothesis that the employment series have a unit root.

Second, we specify a linear regression model that will be used for the forecasts. We start with the general ARMAX(p,q) form

$$EMP_t = AR(p) + MA(q) + X_t + t + \varepsilon_t$$

Where EMP_t is the employment level in period t (year-month), AR(p) is an autoregressive component of order p, MA(q) a moving-average component of order q, X_t is a vector of explanatory variables, t is a year trend and ε_t is an error term with zero mean and a finite standard deviation.

We assume that employment is affected by the following variables: the logarithmic (log) transformation of GDP, log of population, the log of total electricity generated (GWh), and the share of electricity generated from renewable sources (hydro, wind, solar, biomass, and geothermal).

To determine p and q, we compare the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) of the following models: ARMAX(0,1), ARMAX(1,1) and ARMAX(1,0). We also explore more complicated structured with multiple lags. However, both AIC and BIC lean in favour of more parsimonious models. In most specifications, the ARMAX(1,0)

has the lowest AIC and BIC, which therefore suggest that the series can be best modelled as simple autoregressive processes of order 1.

Our forecasting model is thus:

$$EMP_t = \rho EMP_{t-1} + b_1 GDP_t + b_2 POP_t + b_3 ELEC_t + b_4 SHRENEW_t + t + \varepsilon_t$$

Definition of forecasting scenarios

We consider two scenarios based on *Canada's Energy Future 2023*. The first scenario is the path on which Canada would be up to 2028, if it were to reach net-zero emissions by 2050. The second scenario assumes no change to the current environmental measures and fixes the share of electricity generated from renewable sources to its latest value (June 2023).

Canada's Energy Future 2023 provides projections for GDP and POP, as well as ELEC in each of the two scenarios. Under both scenarios there is a strong expected increase in electricity, however, the net-zero scenario increases less rapidly in the first years, but then overtakes the current measure scenario over the last two years. With respect to GDP and population, *Canada's Energy Future 2023* higher GDP under Current measures than Net-zero; however, given the short time horizon, the population series are virtually identical.

End Notes

1 Natural Resources Canada, 2020.

2 Natural Resources Canada, 2020.

3 Canada Energy Regulator, 2021.

4 International Energy Agency (IEA), 2022.

5 Canada Energy Regulator, 2022.

6 Immigration, Refugees and Citizenship Canada (IRCC), 2022b.

7 Statistics Canada, 2023.

8 Immigration, Refugees and Citizenship Canada (IRCC), 2022.

9 International Energy Agency (IEA), 2017.

10 International Energy Agency (IEA), 2017.

11 International Energy Agency (IEA), 2017.

12 Brookfield Institute, 2022.

13 Brookfield Institute, 2022.

14 Environment and Climate Change Canada (ECCC), 2022.

15 Canada Energy Regulator, 2023.

16 Electricity Canada, 2023.

17 Canada Energy Regulator, 2023.

18 Environment and Climate Change Canada (ECCC), 2022.

19 Looking at economy-wide trends of these 34 occupations is of value because over the coming years, the ability of the electricity sector to attract and retain talent in these occupations will be central to Canada's ability to realize its fundamental climate and prosperity goals.

20 The term employment can often be interpreted to include individuals who are self-employed. This report, unless otherwise stated, excludes self-employed persons from its analysis and given that the share of self-employed individuals in NAICS 22 is 0, the term employment and employees are often used synonymously.

21 Data for solar panel installer and smart grid specialists is captured under the NOC for residential and commercial installers and servicers (NOC 73200), while wind turbine technicians are included in power engineers and power systems operators (NOC 92100).

22 In several instances, figures are rounded to the nearest hundred. Some minor discrepancies may occur when volumes are summed across different groups and dimensions.

23 See Appendix B for the full list of occupations in each of the groups.

24 It is notable that the distribution of employment in Canada's electricity and renewable energy sector is largely consistent with the distribution of total employment across the country. For instance, 39% of all electricity and renewable energy employment is accounted for by Ontario – this is similar to the province's share of total national employment.

25 Only Construction managers and Electrical & electronics engineering technologists & technicians do not also appear on the top 10 occupations most difficult to retain.

26 Online job postings are not the same as vacancies or employment levels and should not be interpreted as such. Online job postings, however, can provide near-real time insights on the level and composition of jobs and with a level localness and granularity not offered through traditional survey-based sources of information. For more details, please visit *Vicinity Jobs*.

27 Data on gender referenced in this section (and elsewhere) primarily come from Statistics Canada. According to Statistics Canada, "gender refers to the gender that a person internally feels ('gender identity' along the gender spectrum) and/or the gender a person publicly expresses ('gender expression') in their daily life, including at work, while shopping or accessing other services, in their housing environment or in the broader community. A person's current gender may differ from the sex a person was assigned at birth (male or female) and may differ from what is indicated on their current legal documents. A person's gender may change over time." For more information see, *Statistics Canada.*

28 The most recent year for which PSIS data is available is 2020; the most recent year for which RAIS data is available is 2021.

29 There are also persons who previously left the labour market and have rejoined, but these constitute a small share of new labour supply. See also *ESDC* for an elaboration on these issues.

30 Immigration, Refugees and Citizenship Canada (IRCC), 2022.

31 Employment and Social Development Canada (ESDC), 2022.

32 PSIS gathers detailed information on enrollments and graduates of Canadian public postsecondary institutions via a mandatory survey with national coverage.

33 The RAIS is not a sample survey; it is based on administrative records provided by the provincial and territorial jurisdictions.

34 Seven of these occupations are Red Seal trades.

35 Apprenticeship information is not available for contractors and supervisors, pipefitting trades (NOC #72012) and residential and commercial installers and servicers (NOC #73200).

36 Provinces and territories made operational and administrative changes that affected data collection for registered trades from 2013 onward. Consequently, the data presented is based on nine years of data, from 2013 to 2021 (the most recent year for which data is available).

37 Including the subtrades of Industrial electricians, Power system electricians, Construction electricians, Powerline technicians, Construction lineman, Distribution construction lineman, Electrician – street railway electrician linesperson, and Electrician signal maintenance.

38 This could potentially be linked to the decline in oil prices in 2014.

39 Employment and Social Development Canada, 2022.

40 Canada Energy Regulator, 2023.

41 There are sources of replacement demand that result from mortality or emigration that are not discussed here, but which typically make up a small percentage of overall replacement demand.

42 School leavers are full-time students between the ages of 15 and 34 leaving the school system as graduates or dropouts and are expected to join the labour market. The number of school leavers presented are the shares of school leavers by occupation that are anticipated to seek employment in the electricity sector. For the analysis presented, this is calculated taking—for each occupation of interest— the share of total school leavers based on employment levels in the electricity sector as a share of total employment.

43 Occupational mobility figures reflect the number of individuals—per occupation of interest—that are expected to look for employment having held a previous occupation. For the analysis presented, net occupational mobility is calculated taking—for each occupation of interest— the share of total job changers based on employment levels in the electricity sector as a share of total employment.

44 It is not recommended to take the sum of the anticipated supply of worker for each occupational group as an estimate for total supply to the sector as it assumes that surplus in one group (e.g., *Managers & supervisors*) could offset a deficit (e.g., *Trades*) in another.