THE GREEN ECONOMY AND ITS IMPACT ON THE SKILLED TRADES IN CANADA

Future Skills Centre
Centre des Compétences futures

Canada

About the Canadian Apprenticeship Forum

The Canadian Apprenticeship Forum – Forum canadien sur l'apprentissage (CAF-FCA) is a national, not-for-profit organization working with stakeholders in all regions of Canada. We influence pan-Canadian apprenticeship strategies through research, discussion and collaboration. We share insights across trades, across sectors and across the country. We do this in order to promote apprenticeship as an effective model for training and education.

Our Board of Directors is comprised of representatives from business, labour, the jurisdictional apprenticeship authorities, education and equity-priority groups. Through our work, CAF-FCA has shed light on a number of key issues affecting apprenticeship, such as the perceived barriers to accessing and completing apprenticeship, and the business case for apprenticeship training. For more information visit the CAF-FCA website at caf-fca.org.

Table of Contents

List of Tables

List of Figures

Acronyms used in this report

BEV – Battery Electric Vehicles

CAF – Canadian Apprenticeship Forum

CCDA – Canadian Council of Directors of Apprenticeship

CBHCC – Canadian Board for Harmonized Construction Codes

CanREA – Canadian Renewable Energy Association

CER – Canada Energy Regulator

CAGBC – Canadian Green Building Council

EPA – United States Environmental Protection Agency

EV – Electric Vehicle (in this report, refers to HEVs, PHEVs, and BEVs)

FOCAL – Future of the Automotive Labourforce Initiative

HEV – Hybrid Electric Vehicle

GHG – Greenhouse Gases

ICEV – Internal Combustion Engine Vehicle

ILO – International Labour Organization

JP – Journeyperson

LEED – Leadership in Energy and Environmental Design

NECB – National Energy Code of Canada for Buildings

NBC – National Building Code of Canada

NOC – National Occupational Classification codes (Canada)

NRCan – Natural Resources Canada

NZE – Net-Zero Energy

NZEr – Net-Zero Energy Ready

OEM – Original Equipment Manufacturer

O*NET – U.S Department of Labour's Occupational Information Network

SOC – U.S. Standard Occupational Classification System

TDA – Training Delivery Agent

TVET – Technical and Vocational Education and Training

PHEVs – Plug-In Hybrid Electric Vehicles

UNEP – United Nations Environment Program

UNIDO – United Nations Industrial Development Organization

ZCB – Zero Carbon Building

Executive Summary

The transition to a greener economy promises long-term environmental benefits, anticipated to create both significant opportunities and challenges. One of the key concerns is the labour market implications during the ramp-up of clean technologies. This transition is accelerating the demand for existing and new competencies that, if in short supply, could impede the pace of transition and lead to mismatches in workforce capabilities.

This report assesses the demand for training in apprenticeship programs as the economy advances towards decarbonization. It also examines key green occupations that rely on certified tradespeople but lack formal apprenticeship programs. The objective of this report is to better understand the supply and demand dynamics of skilled trades that are critical to the green economy and to assess the readiness of Canada's workforce to support a low-carbon future.

Green jobs were identified using the U.S. Department of Labor's O*NET system, along with additional resources such as a literature review and relevant occupational forecasts from Canadian industry groups. Once identified, current labour market conditions for these trades were examined. This included analyzing the job vacancy-to-unemployment ratio to assess market tightness, as well as recent trends in apprentice registration and completion to assess supply. Prism Economics' CANTRAQ model was then used to estimate future demand for certified workers in green trades, alongside the projected supply of new journeypersons.

The report examines two decarbonization scenarios: a baseline scenario (current policy and market conditions) and a green scenario (stronger climate action to meet Canada's goal of net-zero emissions).

Green jobs – skilled trades demand

Decarbonization and the greening of the economy are expected to create significant demand for skilled trades in Canada. The sectors most involved in reducing GHGs in the net-zero transition include: construction, manufacturing, utilities and energy production, transportation, mining, and sustainable agriculture. Each of these sectors employs skilled tradespeople. As their skills often overlap with those in other sectors, this results in increased competition when it comes to hiring.

Across sectors there is a convergence of a set of skilled trades that are central to Canada's green economy transition. **These include electricians, HVAC technicians, industrial mechanics (millwrights)** and **welders**.

Related occupations that rely on the skills and qualifications of certified journeypersons will be essential in supporting this transition. These include **contractors and supervisors, residential and commercial installers and servicers** and **manufacturing managers**.

Green skills

New technologies for cleaner production and green operations are reshaping the work performed across many skilled trades. Research indicates that entirely new "green" trades have not emerged; rather, some established trades are evolving to include new tasks that require updated knowledge and skills as well as associated training. Labour market stakeholders will need to assess future labour market demand and training needs to ensure that their training programs are aligned with the evolving skills landscape.

Labour market outlook

Skilled trades employment is projected to grow through 2030 and beyond in both the baseline and green scenarios. However, growth accelerates significantly in the green scenario, driven primarily by federal and provincial incentives that stimulate investment in manufacturing, construction and energy projects.

To meet the demands of an accelerated greening economy scenario, Canada will need to train and certify more than **264,000** apprentices across the 26 trades analyzed in this report. This represents a 49% increase compared to the estimate in the baseline scenario. Construction electricians and refrigeration and A/C mechanics account for nearly half of the additional employment demand in the green scenario. Electricians are expected to be heavily impacted by decarbonization, driven by the demand for electrification that affects multiple sectors of the economy.

The analysis identifies several trades likely to experience future recruitment challenges for certified workers. These trades already face tight labour market conditions and are projected to fall short of meeting future demand under the accelerated green scenario.

Of the 26 green trades assessed, six are expected to face a high risk of recruitment challenges over the next decade, and another 11 are expected to face a moderate risk. While registration volumes may be sufficient for the remaining trades, the central issue is whether the certified workforce possesses the skills and knowledge needed to support the transition to a net-zero economy. Many green jobs require enhanced competencies. Without a highly skilled workforce, filling available roles may continue to be a challenge.

Addressing the skills gap for a net-zero future

A decline in new registrations over the outlook period could jeopardize Canada's ability to meet its climate target, specifically in those trades where tight labour markets already exist. By identifying priority areas for training and workforce development in the skilled trades, this report aims to support the move to a low-carbon economy by ensuring that Canada's labour force is well-equipped for this transition.

A collaborative model involving federal and provincial governments, industry partners, and training providers will be essential. Key actions include increasing apprentice intake in select trades, supporting completion and certification, and improving career advising, particularly in trades facing recruitment challenges.

Section 1: Introduction

In response to the growing concerns about the severe impacts of global warming, Canada has committed to ambitious climate change policies. As outlined in Canada's 2030 Emissions Reduction Plan, the federal government aims to significantly reduce greenhouse gas (GHG) emissions and achieve net-zero by 2050. To support this target, various industrial sectors are adapting their processes to minimize their carbon footprint.

This report focuses on the skilled trades occupations that are related to decarbonization efforts to reduce GHG emissions. As Canada transitions to a greener economy, the demand for skilled tradespeople is expected to both grow and evolve. The report examines the extent to which there is increasing demand for training in apprenticeship programs, as well as in specific green economy occupations that lack formal apprenticeship pathways but rely on certified trades professionals. The objective of this report is to better understand the supply and demand dynamics of skilled trades critical to the green economy and to assess the readiness of Canada's workforce to support a low-carbon future.

In this project, we addressed the following research questions:

1. How could potential decarbonization pathways in Canada affect the demand for skilled tradespeople?

2. What apprenticeable skilled trades occupations will be in greater demand as the economy advances towards decarbonization?

3. What other related skilled trade occupations (without an apprenticeship program) will be in greater demand?

4. How will changes in demand resulting from decarbonization affect training needs for apprenticeable skilled trades?

5. Which trades are at risk of falling behind future demand based on the current number of certified workers being produced in the trade?

Section 2: Methodology

O*NET green occupations project taxonomy

Green jobs were identified using the U.S. Department of Labor's Occupational Information Network (O*NET). This resource provides a comprehensive list of occupations identified as "green", that is, occupations impacted by the green economy. This methodology identifies three categories of green jobs:

1. **New and emerging** – These are entirely new jobs created by green technologies and require unique skills and tasks.

2. **Green enhanced skills** – These are existing jobs that now require new skills or methods due to the adoption of green technology.

3. **Green increased demand** – These are unchanged jobs that are now in higher demand because of the green economy.

Although the focus of this report is on **green increased demand** occupations, the implications of **new and emerging** and **green enhanced skills** on training were also considered. This three-element taxonomy was applied in assessing the skilled trades in Canada to identify the apprenticeable trades and related occupations flagged as "green", as well as the occupational category (increased demand, new and emerging, enhanced skills) tied to that occupation. O*NET data is structured by the U.S. System of Occupational Classification (SOC). To identify the corresponding Canadian apprenticeable programs for the green occupations flagged by O*NET, Prism utilized its own correspondence table and mapped the U.S. SOC codes to the Canadian National Occupational Classification (NOC) codes.

Literature review and environmental scan

A literature review was conducted of existing online policy reports, academic and grey literature[1] and employer/trainer resources to identify the key sectors impacted by greening and changes in technologies for both the apprenticeable trades and the related occupations that will be in demand and/or require new skills. This involved an examination of emerging clean technologies and those trades linked to associated knowledge areas. Additionally, a review of existing occupational or industry forecasts with green scenarios was conducted to inform the analysis.

Delimitation: Although the review focused on documents within the last 10 years, older relevant resources within the last 15-20 years were also utilized.

The literature review did not consider previous research related to how a green economy impacts different equity priority groups such as Indigenous Peoples, persons with disabilities and women.

Job posting data

A review of job postings was conducted to understand current green skills and jobs in demand. The impact of green economy activities and technologies is creating demand for new skills and related training. Job posting data was utilized to identify any employer-required certifications, new or emerging occupations, and where Red Seal certification was preferred.

Labour market analysis

Green jobs were identified based on a list developed by the U.S. Department of Labor's O*NET. Additional resources were also consulted, including the list of Green Occupations developed by Employment and Social Development Canada

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1 Grey literature refers to a wide variety of sources beyond traditional publishing, including reports, policy documents, newsletters, government materials.

(ESDC) and Occupational Forecasts published by industry groups.

The Prism Economics and Analysis CANTRAQ model (detailed below) was used to estimate the demand for certified workers in green trades and occupations, alongside the projected supply of new certified journeypersons, based on projections of apprenticeship registration and completion rates. The outlook examines two scenarios:

Baseline scenario: This assumes a steady-state adoption of green technologies, reflecting historical investment trends and moderate growth. It excludes accelerated adoption pathways, proactive policy interventions, or "what-if" scenarios. Demand assumptions are driven by ongoing investments in major green infrastructure projects, such as wind farms and small modular reactors (SMRs), as well as continued building maintenance activities.

Green scenario: This is an accelerated estimate that reflects the enactment of various policies implemented to meet Canada's target for net-zero emissions by 2050. These include energy efficiency building retrofits, the transition to EVs and a ramp-up in renewable energy technologies such as wind and solar power generation and associated battery storage.

The low numbers of equity priority groups in apprenticeships means the data sets are too small to report on. Statistics Canada does not make this data publicly available to researchers due to privacy concerns. In the labour market analysis, it was not possible to share the numbers of equity priority groups in each trade and how their employment may be impacted in a base or green scenario.

CANTRAQ, the Canadian system for tracking apprenticeship qualifications

CANTRAQ is a modelling system designed to address the drawbacks in existing planning and forecasting models, with a focus on the supply and demand for skilled trade qualifications.[1] In addition to an economic forecast and a demographic model, it includes an attrition model that estimates the flow of qualified tradespersons out of their home occupation and an estimate of the share of the occupational labour force that holds a certificate of qualification. The system also analyses historic trends in apprentice completion rates to support estimates of anticipated supply. Finally, it uses a mapping system to connect occupations (NOCs) with trade (apprenticeship) programs.

Industry validation

This report was validated for accuracy and relevance through a two-part process. A draft was first reviewed by a diverse panel of five experts in academia, policy, labour market information, and skilled trades. After incorporating their feedback and holding a final review meeting, the report was presented in a webinar format to a wider group of apprenticeship stakeholders. This final step allowed for broader feedback and ensured that our findings align with current industry needs.

Section 3: Findings of the Literature Review

Key Findings:

- The federal government's investment in climate action is the primary vehicle for achieving net-zero emissions by 2050. The commitment to this goal, supported by major climate investments and policies like the Canadian Net-Zero Emissions Accountability Act, directly increases demand for skilled tradespeople.

- The review found little evidence of entirely new occupations being created to support the green economy. Instead, existing jobs are seeing increased demand and modified job descriptions. The core educational and training requirements for these roles generally remain the same, although new skills are needed.

- The review identifies several key sectors where the demand for skilled trades is expected to grow due to greening activities, including:

  1. **Construction**: Driven by green builds and retrofits, impacting trades like electricians and HVAC mechanics.

  2. **Manufacturing**: Specifically automotive, for EV and battery production, requiring trades like welders, industrial mechanics and industrial electricians.

  3. **Renewable Energy**: With growth in wind and solar power, there's an increased need for technicians and electricians.

  4. **Transportation**: The maintenance of EVs requires electricians, as well as new skills for automotive service technicians.

  5. **Mining**: The push for critical minerals to support EV batteries will create demand for skilled workers in this sector, such as industrial mechanics, electricians, welders and heavy equipment operators.

- A critical challenge is ensuring the workforce is adequately upskilled and re-skilled, which necessitates a collaborative approach to training among government, industry, and educational institutions.

3.1 Defining green jobs and green skills

The green economy focuses on minimizing the environmental impact of human activities on nature, encompassing land, water, and air. In the policy literature arising from international governing organizations (UN, ILO, UNIDO, UNEP), green jobs are defined very broadly as jobs in the environmental sector and other industrial sectors involved in implementing greening activities.

Green jobs: These are jobs that directly contribute to the reduction of the human environmental footprint and the protection of the environment, including emissions reduction. While researchers have speculated on the creation of '**new occupations**', a review of the literature and job postings did not find evidence to support the idea that there will be significant creation of new occupations related to greening in the private and public spheres. Instead, some existing occupations are expected to see increased demand, such as research and development (scientists, engineers) and operations management and maintenance-related occupations (engineers, skilled trades).[2] As skills shift, companies may create new **job titles** to reflect the new skills required and may even rewrite job descriptions, but the basic educational, training and certification foundation remains the same. If there were a significant change in tasks, a new **occupation** would have to be created at a policy level in Canada's National Occupational Classification (NOC).

Green skills: The literature tends to define green skills broadly. The UNIDO definition of green skills is frequently used: "the knowledge, abilities, values and attitudes needed to live in, develop and support a sustainable and resource-efficient society."[3] This definition may be too generic and too broad to be of value to inform and quantify the impact of greening on occupational tasks and to define the technical skills needed for employers and educators/trainers wanting to upskill their workers. In this report, **green skills are defined as the knowledge and technical skills required to complete new tasks or preform tasks differently due to new inputs, processes, and/or outputs, with a direct outcome of reducing the human environmental footprint**.

The modifications in inputs (materials), processes (new technologies, equipment/machinery, practices), and outputs (products and services) in various sectors due to decarbonization and other pollution/waste reduction have a direct impact on workforce development. For the skilled trades, green skills will have a focus on technical or hard skills (as opposed to soft skills) that enable the adoption and use of resource-efficient, sustainable processes and technologies by workers. Technical or hard skills are specific, teachable skill sets that can be acquired through formal education, training programs, or on-the-job training. Hard skills are measurable or quantifiable, allowing for the assessment of learning through the ability to complete specific tasks.

3.2 Policy context for greening

Environmental legislation and policy in Canada have been evolving in response to international policies and commitments aimed at reducing the environmental footprint of humans, particularly in terms of carbon reduction. This means that Canada's stated obligations require action from all policy actors who affect GHGs – federal and provincial/territorial governments and industry. The federal government has committed over $120 billion to climate action and low-carbon economic development. A few of the key federal policies that impact greening are outlined below in Table 1.

Table 1: Key federal environmental policies and plans

Policy/Initiative	Purpose
Canadian Net-Zero Emissions Accountability Act, 2021 (Bill C-12)	The Act enshrines Canada's commitment to achieve net-zero GHG emissions by 2050. It requires five-year national emissions-reduction targets and establishes the 2030 GHG emissions target as Canada's Nationally Determined Contribution (NDC) under the Paris Agreement[4] emissions reductions of 40-45% below 2005 levels by 2030.
2030 Emissions Reduction Plan **A Healthy Environment and a Healthy Economy plan**	Roadmap to cut GHGs by 40 percent below 2005 levels by 2030, on the path to achieving net-zero emissions by 2050. Implemented the 2030 Emissions Reduction Plan.
Canada's National Housing Strategy, 2017 **Canada Housing Plan, 2024**	Long-term Housing plan with a goal of 3.9 million new homes by 2031, including 2 million net new homes added through federal initiatives. The current plan provides $115+ billion to fund new housing construction, repairs, community housing support, and programs targeting vulnerable populations. As of March 31, 2025 the NHS funding commitment was $65.8 billion with an end date of 2028.
Critical Minerals Strategy, December 2022	Critical Mineral Exploration Tax Credit (up to 30 percent of capital costs) and a $3.8 billion fund to support mining infrastructure and development projects.
One Canadian Economy Act, 2025 (Bill 5)	This Act combines two key initiatives: the Free Trade and Labour Mobility in Canada Act and the Building Canada Act. It addresses interprovincial trade barriers to streamline labour mobility across Canada and aims to fast-tracking major projects (infrastructure or industrial) deemed as being in the "national interest." It allows these projects to bypass or expedite certain regulatory processes, including environmental assessments. Potential projects may include pipelines, ports, highways, mines, and energy corridors.

Provincial policies, plans and projects

The provinces and territories also have green economy strategic plans, policies and projects at various stages of planning and implementation that involve the federal government, industry, labour and NGOs. Although the sectoral focus varies by province and industrial activity, most jurisdictions place renewable energy (on-shore and offshore wind, solar, sustainably sourced biomass) and clean energy (nuclear and small modular reactors, hydrogen) high on their agenda. Ontario and Quebec account for the majority of activity related to automotive manufacturing and the shift to electric battery power,[5] but supply chain activities such as mining can occur in various provinces.

Canada's green policy agenda is also influenced by legislation, standards, building codes (both provincial and national), municipal bylaws, and international frameworks/guidelines for specific sectors in decarbonizing. These shifts in policies, standards, funding supports, and the rollout of projects across Canada have significant implications for labour demand, specific skills, and training requirements. It is essential, however, to acknowledge the significant challenges posed by simultaneous demand for certified workers and specialized skills across multiple sectors, which can hinder project implementation and strain workforce capacity. A national human resource development strategy and system-level national and provincial workforce development plans are crucial to supporting the transition to a green economy.

3.3 Skilled trades demand by sector

This section focuses on the industrial sectors that are central to the greening economy. Changes in industrial expansion will lead to an increase in skilled tradespeople in specific occupations and sectors. The review is focused on green technologies and processes that may lead to increased demand for apprenticeable trades and related occupations. The sectors most involved in reducing GHGs in the net-zero transition include: construction, manufacturing, renewable energy, transportation, mining, and sustainable agriculture.[6] Each of these sectors employs skilled tradespeople. Some trades are in demand across multiple sectors. The section below addresses the impact of greening and net-zero activities on technology, processes, and potential job demand by industrial sector. New skill requirements for apprenticeable trades emerging from decarbonization are also examined in the scope of this review.

The literature review examines the greening economy and the demand for labour at the sectoral level. The labour market outlook in Section 4 accounts for the aggregate demand and supply of skilled trades labour based on various projects across Canada.

3.3.1 Construction, buildings and maintenance – the CBM sector

The CBM sector encompasses new buildings (residential, commercial and institutional), heavy and civil engineering construction (roads, bridges and utilities), specialty trade contractor work (plumbing, electrical, HVAC, etc.), and the maintenance and renovation of existing structures. A life cycle approach to greening in the CBM sector considers the overall environmental impact of buildings, from the extraction of raw materials to the disposal of waste at the end of their life. These include the product stage, construction stage, use stage and end-of-life stage. According to the Canadian Board for Harmonized Construction Codes (CBHCC), GHG emissions from the sector, including the supply chain, consist of:

- embodied GHG emissions in construction materials and processes throughout the life cycle of a building or infrastructure project
- emissions from building energy operations and use – material extraction, manufacture, transportation, construction, replacement, refurbishment, demolition, removal.

For this report and outlook, the product stage (supply chain) and end-of-life stage (recycling) are not in scope. The focus is on the 'construction' and 'use' stages of decarbonization.

Key greening issues in this sector

Emissions: According to the federal government, "over 85% of building sector emissions come from space and water heating, due to the use of fossil fuel equipment, such as natural gas furnaces, and extra energy demand to heat and cool buildings with insufficient envelope performance. Remaining emissions come from electricity used to power appliances, lighting, and auxiliary equipment."[7]

Strategies to reduce GHGs and overall human environmental footprint:

(i) Green builds

- Key features of a green building include:
- meets Leadership in Energy and Environmental Design (LEED) standards
- clean electricity
- installation and maintenance of on-site power generation (e.g., solar, wind, hydrogen)
- energy storage, especially in multi-tenant or multi-residential buildings
- use of zero-emission construction equipment and fuels
- use of alternative material design.

(ii) Retrofits

Retrofitting the aging building stock is critical to reducing emissions. A central focus is improving the building envelope, which includes:

- adding or upgrading insulation of walls, roofs, and floors to reduce heat transfer. This may include the use of closed-cell foam insulation for added thermal performance
- replacing space and water heating systems, such as fossil-fuel or less efficient electric baseboard heaters, with heat pumps or other emerging technologies. More extensive upgrades may also require ductwork replacement [8]
- addressing air infiltration by sealing gaps and cracks to prevent energy loss
- upgrading windows and doors with energy-efficient models
- installing reflective roofing to keep a building cooler in summer
- Conducting energy audits to identify areas for improvement and optimize the building envelope
- Maintenance of ventilation systems.

(iii) Green roofs

A green roof is one component of a net-zero building or home. Green roofs/rooftop gardens in metropolitan areas improve air quality, moderate the urban heat island effect and also provide habitats for wildlife. [9] **Green roof installers** will include **landscape horticulturists and construction workers (labourers)** who will need to expand their existing skill set to this specialized area.

Standards: New standards are important drivers of change in occupational skills and technologies across multiple sectors. CBHCC's _National Model Codes_ promote the design and construction of new buildings to meet net-zero energy-ready standards by 2030, along with codes for fire, plumbing, and farm building. A net-zero energy ready (NZEr) building is designed, modelled and constructed the same way as an NZE building but does not yet have on-site or off-site renewable energy components in place. CAGBC's _Zero Carbon Building Standards_ serve as a tool for low-carbon design and operational performance in buildings. British Columbia has the highest standard for building. The province's _BC Energy Step Code_ is a performance-based building standard designed to progressively increase the energy efficiency of new construction, ultimately aiming for all new buildings to be NZEr by 2032, with requirements for improvements in energy performance beyond the baseline BC Building Code.

Efficiency Canada outlines key aspects of net-zero energy "readiness" buildings:

- improved air sealing
- increased insulation levels
- high-performance windows and doors to reduce thermal demand
- appropriately sized space and water heating equipment
- green roofs.

Box 1: Skilled trades and related occupations in construction, buildings and maintenance affected by greening

To reduce emissions across the construction and use stages of a building's life cycle, decarbonization strategies must address both new construction and the existing building stock. Green construction and retrofits require specialized expertise in energy-efficient building techniques, technologies/equipment, and sustainable materials. Workers will need to identify and understand new equipment and their profile for the utilization of energy and CO_2 emissions. **Supervisors** will be responsible for overseeing green building projects and the use of eco-friendly materials and technologies. **Welders** will be needed for the construction of clean energy projects such as wind turbines and solar farms, and green infrastructure.

Electricians and/or workers with electrical training will be needed to install, maintain, and repair EV charging stations in residential and commercial buildings. They will also be required for the installation and maintenance of solar panels in energy-efficient buildings. **Plumbers and pipefitters** will have to install water-saving systems and retrofit old infrastructure using greywater systems, low-flow fixtures, and implement sustainable water management practices. **HVAC Technicians** will have to upgrade and maintain electric heating, ventilation, and air conditioning systems. The EV transition also requires construction or expansion of mines for materials essential for battery manufacturing, which involves several trades, including **drillers and blasters** and **heavy equipment operators**.

3.3.2 Manufacturing sector

Canada manufactures a wide range of products. Various industries within the manufacturing sector have been implementing strategies to reduce their GHG emissions. These efforts are focused on both the manufacturing processes and the final manufactured product itself. Two key areas where these strategies are being applied are the **automotive manufacturing sector**, with a focus on zero-emission vehicle production, and the **production and processing of synthetic and alternative fuels**.

Automotive manufacturing sector – zero-emission vehicle production

The automotive industry has been at the forefront of decarbonization efforts, specifically in product decarbonization. A federal mandate introduced in 2023 requires all new cars, SUVs and light trucks sold in Canada by 2030 to be 'zero-emission'. Between 2017 and 2023, new motor vehicle registrations for EVs grew by over 630%, from around 43,000 vehicles in 2017 to more than 320,000 in 2023. Of the total new vehicles registered in Canada, the share of new EVs increased from 2.2% in 2017 to 18.7% in 2023.[10]

Electric Vehicle Manufacturing involves three main activities: EV battery manufacturing, OEM assembly, and production of motor vehicle parts. Expanding EV adoption and developing a full end-to-end EV manufacturing sector will create job opportunities across the supply chain.

Key areas include:

- Battery manufacturing and recycling
- EV manufacturing, including assembly and parts production
- Charging infrastructure: construction, installation and maintenance
- Software and systems engineering (IT sector)
- Mining and processing of critical minerals (Mining sector).

Skilled trades will be essential in both upstream and downstream activities, supporting growth and/or innovation in manufacturing, construction, technology, and resource extraction. At the same time, decarbonization can also lead to job losses in assembly, the parts production supply chain, and the aftermarket sector, as building and servicing ICEVs requires more labour. [11]

Two aspects of EV production that affect the demand for labour are consumer demand in Canada for EVs (in terms of price, battery life, trust, and taste) and U.S. exports. Most of the vehicles manufactured in Canada are exported to the United States. The U.S. tariffs have disrupted the automotive manufacturing sector's ecosystem and have slowed or even stopped the construction of EV and battery manufacturing facilities, leading to idling of plants and resulting in layoffs[12]. While policy actors in the automotive sector remain optimistic about the long-term growth to meet government targets,

shifting policy priorities and trade uncertainty may delay Canada's EV transition and hinder its ability to meet climate change goals.

Box 2: Skilled trades and related occupations in the manufacturing sector affected by greening

> If Canada is successful in transitioning to EV manufacturing and attracting battery investment, the need for skilled trades professionals to support EV manufacturing and technology development in Canada is expected grow significantly by 2040. Skilled trades anticipated to see the largest employment gains in the EV transition include **machinists** and **machining and tooling inspectors, tool and die makers, welders and related machine operators, electricians** (except industrial and power system), **Industrial electricians** and **manufacturing managers**, who may need to have a journeyperson qualification.[13]

Synthetic & alternative fuel production and processing

Natural Resources Canada (NRCan) suggests that clean fuels could supply over 60% of Canada's national energy demand by 2050, particularly in sectors that are challenging to electrify, such as aviation, heavy industry and freight transport.[14] Synthetic fuels (synfuels) and alternative fuels are non-petroleum-based fuels manufactured from renewable or alternative sources. These sustainable biofuels are produced from biomass sources, such as agricultural crops and algae, renewable diesel, hydrogen and synfuels, which are made from captured CO_2. The biofuel market in Europe is expanding, driven by supportive government policies.[15] Canada has been slower to adopt this technology. NRCan reports that synthetic and alternative (clean) fuels manufacturing comprises only 5% of Canada's total energy supply.[16]

Box 3: Skilled trades and related occupations in synthetic and alternative fuel affected by greening

> If synthetic fuels expand in the Canadian market, this production will require skilled workers, including **technicians** and **electricians**. There is already evidence of this shift, with some post-secondary institutions now offering training for registered apprentices and certified workers in select trades to prepare them for the evolving energy landscape.[17]

3.3.3 Renewable/Clean energy sector

Generation and use of clean/renewable energy sources, as well as clean energy infrastructure, include offshore and onshore wind and solar power generation, electrical vehicle integration as part of the smart grid, and use of small modular reactors (SMRs). Battery storage facilities are central to expanding clean energy generation.

Between 2019 and 2024, Canada's total wind, solar and storage installed capacity grew 46%. **Wind** energy accounts for only 6% of electricity generation, but demand for it is expected to increase.[18] **Solar** is growing but still represents just 1% of total generation.[19] The Canadian Energy Regulator (CER) notes that wind is the second-largest source of renewable electricity after hydroelectric. Solar and wind power generation involves a life cycle that covers several stages: development, construction and installation, operations and maintenance, and repowering and decommissioning.[20]

A **smart grid** is a modernized electrical grid that uses digital technology and two-way communication to monitor, manage, and optimize the production, distribution, and consumption of electricity. Smart grids are crucial for achieving Canada's climate goals and meeting the growing demand for electricity.[21] Home energy systems and vehicle-to-home technology for EVs play a role in how homes receive and manage electricity as part of the smart grid. Utilities and electric vehicle charging companies can use the energy stored in the large batteries of electric SUVs and pickup trucks by accessing them through the owners' home charging stations.

Battery storage or battery energy storage systems (BESS) are devices that enable energy from renewable sources (such as solar and wind) to be stored and released in response to increased electricity demand, thereby increasing efficiency for energy storage and use.

Energy efficiency involves managing the efficient **usage** of all forms of energy (electric, gas, thermal, etc.) to reduce energy consumption and energy loss. This puts new demands on employers and workers. As operations in various sectors across the economy shift to meet environmental standards, workers will need to understand any new tasks impacted. The CBM sector (see Section 3.3.1) is largely involved in energy efficiency as part of its green transition.

A focus on clean/renewable energy generation and storage, and energy efficiency has implications for labour demand, shifts in skills requirements and training.

Box 4: Skilled trades and related occupations in renewable/ clean energy generation affected by greening

Skilled workers in the green energy sector include **wind turbine technicians, solar power technicians**, and **electricians**. Electricians are responsible for installing and maintaining electrical systems in wind farms, including substations and grid connections. Solar photovoltaic technicians install, maintain and repair solar panels in residential and commercial settings. They are often certified electricians or individuals with some electrical training who have upskilled through additional courses. While wind and solar technicians may hold Red Seal certification, this is not always required.

3.3.4 Transportation services

Transportation accounts for 25% of Canada's GHGs, with almost half of that share of emissions coming from light-duty cars and trucks. [22] Transportation of people and goods by **sea, air or land** can "go green" through the use of low-emission fuels and vehicles. Fleets in the public service, the broader public sector and the private sector can be switched to low-emission vehicles (cars, buses, rails, ships, planes). Battery and hydrogen powered engines, as well as hybrid engines, in ships are still in their early stages of development. The focus has therefore been on decarbonizing the automotive manufacturing sector (discussed above) and transportation services. The latter involves the two subsectors discussed below.

Vehicle service, repair, and aftermarket industries

While routine maintenance compared to ICEVs may decrease, there is a forecasted increase in the service time needs (i.e., time spent servicing) of EV powertrain parts, thermal parts and tires. EVs require less maintenance work than ICEVs, but "servicing EVs requires specialized capabilities, as the tasks involved are more complex." FOCAL notes that the maximum lifetime for batteries is estimated to be 15 years, or when a battery falls to below 80% of its original maximum capacity. Current battery technology makes servicing battery packs difficult, expensive, and time-consuming, except when technicians have adequate experience, tools, and certification.[23] The cost of service and repair will impact aftermarket industries as routine and major maintenance become infrequent and less necessary for EVs.

EV transitions also have an impact on the servicing and maintenance of buses and trucks. As large companies and different levels of government switch their fleets, this will impact training needs. Light-duty vehicle manufacturing may transition to electrification faster than heavy land, air and sea freight vehicles. The size of the required batteries is an impediment. Employers (dealerships, fleet owners) will need to train maintenance staff to work on EV powertrains and purchase high-voltage tools and safety equipment.[24]

EV charging infrastructure in residential and non-residential buildings and spaces

Installation and maintenance of EV charging infrastructure can be accounted for as part of green jobs in transportation services. These installations involve businesses, road networks and residential buildings but are related to transportation.

Box 5: Skilled trades in transportation services affected by greening

> The electrification of transportation, including EV charging stations and smart grid systems, will require **electricians and/or individuals with some electrical training.** Investment in infrastructure to support this transition will increase the demand for electrical knowledge and skills.

3.3.5 Mining and mineral resources sector

Mining is one of Canada's oldest industries, with mines in most provinces and territories.[25] The industry encompasses the extraction of minerals, milling, and developing mineral properties. Mineral resource development involves pre-exploration, exploration, mine complex development, mine production, and closure (decommissioning of the mine, processing plant, and any other parts of the complex).[26] In addition, environmental restoration of the site is done to address hazards to the environment and people. Community engagement is key throughout this cycle for inclusive economic development.

Mining is set to expand in Canada in response to government policy at the federal and provincial levels related to critical minerals (lithium, cobalt, nickel, copper and rare earth elements). Critical minerals such as nickel and graphite are already produced by Canada, but mining expansion is planned for other elements. Sectors that rely on mining products downstream in the supply chain include agriculture, manufacturing (electric vehicles and their batteries), electronics (semiconductors), clean technologies, and energy (wind turbines, solar panels). EV production requires lithium, nickel, cobalt, and graphite materials for the production of lithium-ion (Li-ion) batteries. Ontario, Quebec, British Columbia, and Newfoundland & Labrador are ramping up mining activity, which has labour implications, including for skilled tradespeople.

The APRC notes, "In addition to the complexities of measuring employment in the EV-critical mineral mining sector, Canada's mining industry is confronting a significant labour shortage, particularly in skilled trades." [27] The shift to EVs for cars and fleets for commercial transportation is a big driver for the development of mining critical minerals in Canada.

Box 6: Skilled trades in mineral mining affected by greening

> Tradespeople will be needed for exploration, development, production (maintenance and operations of mining facilities), and environmental restoration.
>
> Key skilled trades involved in these processes include **industrial mechanics (millwrights), electricians, heavy equipment operators** (e.g., excavators and bulldozers, loaders, and cranes), **welders, boilermakers and labourers.**

3.4 New and emerging occupations

Provinces may designate new skilled trades if they feel there are enough differences in tasks to warrant the classification of a new trade. So far, existing skilled trades, particularly Red Seal, remain foundational, with new skills being added for green tasks. In addition, some employers advertise green jobs that require some, but not all, of the skills of a certified skilled trade. The demand for journeypersons - someone who has completed their apprenticeship training and certification, therefore, should not be overestimated.

People in non-trade technical jobs are also upskilling with green skills to work in the green economy. New jobs or jobs with new titles that may require skilled trades training, for example, include sustainable construction manager, electric vehicle (EV) technician, green retrofit specialist, critical minerals technician and hydrogen fuel cell technician. Lack of data to determine if there are emerging green occupations that require formal recognition through the NOC system or designation of new trades by the Red Seal Secretariat or provincial apprenticeship bodies continues to be a challenge. A enhanced systemic collection of skills and training data is needed.

3.5 Green skills in apprenticeable trades and related occupations

While existing trades may see increased demand, new technical (hard) skills will be required for some of these trades.

Green skill categories

Based on research by Sia Partners, the following green skill categories were suggested:[28]

- Renewable energy engineering
- Sustainability management
- Energy management
- Environmental compliance: understanding environmental regulations, conducting audits and reporting to regulatory authorities
- Waste management & recycling
- EVs & sustainable transportation
- Sustainable agriculture practices
- Environmental science
- Water & wastewater management.

At some point, skilled tradespeople will need to learn skills in one or more of these categories, depending on the sector in which they work.

Skilled trades with green skills

The research suggests that the following apprenticeable trades require some new knowledge and skills related to the greening of the sector:[29]

- Automotive service technician
- Truck and transport mechanic
- Refrigeration and air conditioning mechanics
- Oil heat system technician
- Landscape horticulturist
- Machinists
- Steamfitters/pipefitters
- Plumbers
- Roofers
- Sheet metal workers

This list is not exhaustive and could involve more trades. As technology evolves to meet decarbonization goals, several related occupations that rely on certified workers may require additional skills. These include transport truck drivers, construction inspectors, construction managers, home building and renovation managers, training and development specialists (JPs as trainers/educators), industrial engineering and manufacturing technologists and technicians, aircraft assemblers and aircraft assembly inspectors, and electrical and electronics engineering technologists and technicians.

Training and education needs

Employers and TDAs, and policymakers for apprenticeship/Red Seal programs need to consider additional knowledge and the new skills required, including:

- changes in technology (including AI) and manufacturers' specifications
- new national guidelines, building codes and standards, and municipal guidelines/bylaws
- international agreements
- green literacy - Canada's Sustainable Development Goals (SDG) obligations and the importance of one's work in addressing environmental impacts and climate change
- specific soft skills - communication, time management, teamwork and collaboration, risk analysis.

These subjects apply not only to skilled trades apprenticeship training but also to workplace training in other occupations, as well as to high school and post-secondary education, including college and university programs.

Shifts in training needs in selected trades

Workers in apprenticeable skilled trades will be impacted in varying degrees by greening. As fossil fuel demand declines (for example, coal), workers will r**equire re-skilling** for the clean energy sector. Existing workers in apprenticeable trades will require **upskilling** as old technologies are replaced in different sectors. Upskilling of existing workers will require an understanding of the skills needed for individual trades and a closer job evaluation by employers (and unions) based on their operations, products/services, and resources used, to facilitate customized training. For apprenticeable tradespeople, most learning is done onsite, which makes it easier to upskill tradespeople.

Here are three examples of skilled trades in the green transition:

Example 1: Refrigeration and air conditioning mechanic

A Refrigeration and Air Conditioning Mechanic must upskill to understand energy-efficient systems and smart technologies, which require advanced skills. They will have to learn the skills required for installing and maintaining eco-friendly refrigerants, smart thermostats, and green building certifications. They will have to understand heat pumps and installation.

Example 2: Automotive service technician

Automotive service technician skill requirements have been shifting under the Red Seal program to reflect changes in the industry and new skills that are needed. To ensure that automotive service technicians can operate in the EV sector, they must be properly trained and equipped to perform changing work tasks. For instance, the two primary documented electrical hazards associated with working on battery technology include arc flash and electric shock risk. Extensive training in electrical theory and safety is paramount to the safety of service workers engaging in EV repair work. The automotive manufacturing sector will also become heavily software-driven and electrified, and this will require different types of skills. Training on new EV and related infrastructure technologies will also be required for electricians.

Some colleges offer EV technician certificates, which complement the existing skill set of a qualified automotive technician. A **ZEV (Zero-Emission Vehicle) Technician** is an **automotive technician** who focuses on servicing, diagnosing, and repairing electric vehicles (EVs), plug-in hybrids, and hydrogen fuel cell vehicles. These technicians now require additional training to work with high-voltage electrical systems, battery packs' electric drive trains and regenerative braking, advanced safety protocols for working with high-voltage components, understanding power electronic devices such as inverters and converters, EV diagnostics and charging infrastructure and diagnostics.[30]

Example 3: Wind power technician or wind turbine technician

Wind turbine technicians perform maintenance and troubleshoot electrical and mechanical systems. Workers will need to install and maintain clean technologies and fuels for energy production, such as solar panels and wind turbines. CanREA has developed Wind Turbine Technician Core Competencies with Canadian wind power facility operators, wind turbine manufacturers, colleges/trainers and other stakeholders. These competencies include general skills, safety, electrical, mechanical and operational. CanREA suggests that college choices for someone looking to work as a wind power technician should include a renewable program or a trade with mechanical or electrical training (e.g., millwright, machinist, industrial electrician) and electronics which provide a solid foundation for working in renewable energy technician jobs.

Labour market stakeholder roles in training

To equip the workforce for the transition to a green economy, apprenticeship educators/trainers will need to adjust their curriculum to incorporate new skills for the emerging tasks required in a job. As green technology advances, provincial governments may also need to evaluate whether the shift in new skills warrants the need for designation of new occupations, which could require new or supplementary training programs, although this is less likely.

In previous research, job postings have been used to assess demand for green skills, but j**ob postings may underestimate the need for green skills** since human resources managers may still be operating with old job descriptions.[31] The labour market stakeholders (employers/unions/industry associations) in each trade need to be proactive in assessing the extent of training needs. They will need to establish timelines for the creation or alteration of trades. They will need to provide the necessary upskilling/re-skilling as demand for apprentices and journeypersons ramps up in each sector. Meeting the demand for tradespeople in specific trades will also require enough qualified JPs to mentor and supervise apprentices on the job, along with instructors/trainers at colleges and other TDAs.

Training can take various forms, including:

- Revised curricula in existing apprenticeship programs delivered by colleges, unions, joint employer-labour programs and other TDAs

- Creating modules that target specific skill sets for workers already qualified/certified, delivered by TDAs (colleges, unions) for upskilling

- Providing in-house training by employers for specialized tasks and work on specialized equipment not found elsewhere.

Some of this work is already underway in preparing the workforce for the green economy. In sectors such as construction, automotive repair and solar and wind power generation, training programs are being offered by a range of technical and vocational education and training (TVET) providers, including colleges and NGOs.

Colleges have introduced EV technician training to support the shift to zero-emission transportation. For instance, Invest WindsorEssex provides battery boost training for automotive technicians and people who can work as product and process technicians in the EV supply chain. [32] Associations/entities in green energy and green electricity have also been working on training curricula and needs.

There is growing recognition that climate literacy is an essential component of the green transition in the skilled trades.[33] This includes understanding how the work being performed in a specific trade impacts the environment and emphasizing the tradespersons' potential contribution to meeting Canada's climate goals. This knowledge empowers tradespeople to work cohesively on projects to reduce

Canada's climate footprint, going beyond the technical skills to understand why addressing climate change matters. The Canada Green Building Council (CAGBC) and other entities have been actively developing training programs or modules focused on low-carbon and green-building concepts within the construction sector. Skillplan has developed modules in collaboration with the Canadian Building Trades Unions (CBTU), as the latter moves to integrate climate literacy into the unionized construction trades education and training system.[34] Collaborations among NGOs and business entities are also underway on green skills.[35]

Despite this progress, there is an opportunity for a more organized human resources development approach to meet the increased demand for skilled trades and green skills in the trades. This would involve collaboration among federal and provincial governments, industry stakeholders, and training providers to ensure:

- training investment is allocated to the appropriate sectors and skilled trades based on labour market demand

- training is consistent in quality across providers

- training meets employer needs and recognized standards.

A collaborative model, engaging both training and industry partners, would help ensure the curricula and skill content align with employer needs, ultimately increasing the employability of new workers.

To meet the growing demand for labour in the green economy, it will be essential to focus on four specific things:

1. apprentice intake

2. promotion of apprenticeship program completion and certification

3. strengthening career advising – especially promoting trades where recruitment challenges are most acute

4. ensuring the curriculum reflects the green skills needed within the skilled trades.

The findings of this literature review inform section 4 of this report: **Labour Market Outlook Findings.**

Section 4: Labour Market Outlook Findings

Building on the review of existing literature outlined in Section 3, this section examines the labour market outlook for skilled trades affected by decarbonization. It draws on a range of sector-specific forecasts and labour force indicators to assess demand trends, certification gaps, and pressures facing Canada's apprenticeship training system.

Key Findings:

- The transition to a green economy in Canada is expected to create significant and widespread demand for skilled trades workers across multiple sectors, including building, manufacturing, and renewable energy.

- Electricians emerge as the most in-demand occupation, with critical roles in building retrofits, EV manufacturing, and the expansion of renewable energy infrastructure.

- Canada will need to train and certify more than 264,000 apprentices in the 26 trades assessed in this report under the green scenario.

- The analysis identifies a high risk of future supply gaps for several trades, including glazier, industrial electrician, labourer, power system electrician, machinist and refrigeration and A/C mechanic, due to a combination of existing labour market tightness and rising demand in the green economy.
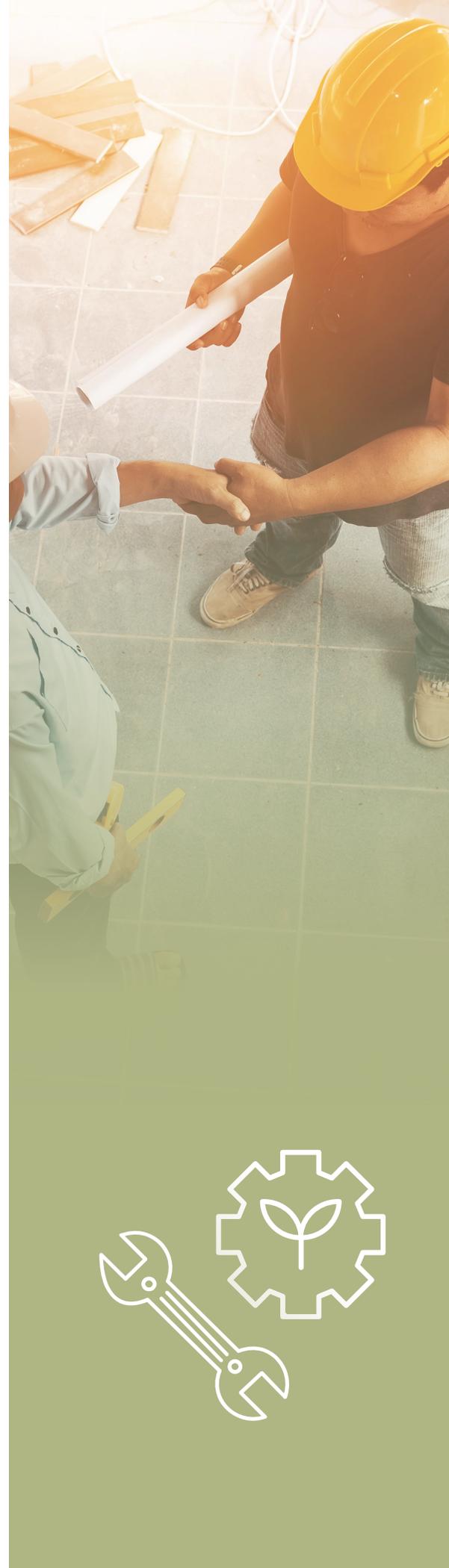
4.1 Occupational and industry green economy forecasts

Decarbonization is expected to create significant demand for skilled trades in Canada. Several reports have examined the labour market impacts of transitioning to clean energy technologies, highlighting the occupations most affected.

Building sector: energy, efficiency and building retrofits

The Delphi Group, in collaboration with the Canada Green Building Council, conducted a Green Retrofit Economy study. The study provides insights into the demand for key occupations, focusing on non-residential and high-rise residential building types. The analysis identified electricians and **HVAC-related trades (plumbers, gasfitters, steamfitters, pipefitters and air conditioning mechanics)** as experiencing the highest demand. Contractors and **supervisors** were also flagged as a major occupation in implementing retrofit measures.

Similarly, BuildForce Canada developed a green building scenario focusing on labour demand in the residential sector. This forecast focuses specifically on the workforce required to phase out fossil-fuel based heating systems, notably through the installation of heat pumps and broader energy-efficiency retrofits. The analysis found that **trade helpers and labourers** would account for the largest share of new employment due to their broad involvement across residential projects. Substantial employment increases were also expected for **refrigeration and A/C mechanics, carpenters** and **electricians**. Related occupations heavily impacted by greening activity included **contractors and supervisors** and **residential and commercial installers and servicers**.

Manufacturing sector: electric vehicle transition

Canada's move toward electrified transportation is reshaping labour demand in the vehicle manufacturing sector.

The Future of Canadian Automotive Labourforce (FOCAL) analyzed the labour market impact of Canada's transition to Electric Vehicles (EVs). The skilled trades projected to experience the largest employment impacts from this transition include **millwrights and industrial mechanics, industrial electricians, welders** and **machinists**. In addition, **manufacturing managers** will play a key role in supporting this transition.

Renewable/clean energy generation sector: power and utility expansion

The transition to renewable energy sources such as wind and solar will also reshape demand across several skilled trades.

The Electricity Human Resources Council assessed the labour demand required to support Canada's growing renewable energy sector, highlighting a significant need for skilled workers, particularly **Red Seal electricians** and **powerline technicians**.

Cross-sector findings and key occupations

Although labour market forecasts vary by sector, there is strong convergence around a set of skilled trades that are central to Canada's transition to a green economy. Consistently, electricians emerge as one of the most in-demand occupations required in the transition to net-zero in construction, industrial and utility contexts. **HVAC-related trades** are also identified as critical for decarbonizing both residential and commercial buildings. **Industrial mechanics (millwrights)**, **machinists**, and **welders** are projected to play a major role in the transformation of manufacturing and transportation systems. **Trades helpers and labourers** are also expected to be high demand, especially in retrofit-heavy industries where general labour is involved at every stage of a project.

While the reports summarized above have examined the **occupational** impacts of decarbonization within specific industries, this report focuses on the demand for **qualifications** across sectors. It focuses on **the demand for certified skilled trades workers and where training system pressures may emerge**. The outlook assesses anticipated demand across multiple green trades by examining certification requirements, historical trade completion rates, and recent registration trends.

4.2 Defining 'green' skilled trades and related occupations

This section outlines the green skilled trades (trades that are in demand or will be in demand based on the greening economy) that form the basis of the labour market outlook presented in this report. These trades were identified using O*NET data, supplemented by the literature review and a review of relevant occupational forecasts from Canadian Industry groups.[36]

Table 2 outlines the 26 green apprenticeable trades included in this analysis, along with the industries where increased demand for workers in these trades is expected. The table also highlights related occupations that are expected to see increased demand. While these related occupations are not tied to formal apprenticeship programs, they often rely on the skills and qualifications of certified journeypersons.

Table 2: Green trades and related occupations

	Industry			
Apprenticeable Trades	**Construction**	**Manufacturing**	**Renewable Energy & Utilities**	**Transportation**
Welder	✓	✓	✓	
Electricians	✓	✓	✓	
Plumber	✓			
Steamfitters/pipefitter	✓			
Refrigeration and A/C mechanic	✓		✓	
Insulator (heat and frost)	✓			
Sheet metal worker	✓			
Ironworker	✓	✓		
Metal fabricator (fitter)	✓	✓	✓	
Roofer	✓		✓	
Heavy equipment operator	✓	✓	✓	
Concrete finisher	✓			
Construction craft worker (labourers)	✓			
Sprinkler fitter	✓			
Carpenters	✓		✓	
Machinists		✓		
Industrial electrician		✓	✓	
Industrial mechanic (millwright)		✓	✓	
Instrumentation and control technician		✓	✓	
Powerline technician			✓	
Boilermaker			✓	
Automotive service technician		✓		✓
Power system electrician			✓	
Glazier	✓			
Bricklayer	✓			
Painter and decorator	✓			

Related Occupations	Industry			
	Construction	Manufacturing	Renewable Energy & Utilities	Transportation
Manufacturing manager		✓	✓	
Construction manager	✓			
Residential and commercial installer and servicer	✓		✓	
Other repairers and servicers			✓	
Home and building renovation manager	✓			
Contractors and supervisors	✓	✓	✓	
Construction estimator	✓			
Construction inspector	✓			

Source: U.S. Department of Labor's O*NET, Prism Economics and Analysis

4.3 Supply of skilled tradespeople: current conditions and future outlook

Current labour market indicators and trends in apprenticeship registrations and completions are key to assessing the supply of certified skilled trades workers in Canada. The analysis that follows highlights pressure points in the system and potential gaps that may emerge as demand for green trades continues to grow.

Current labour market tightness

The unemployment-to-job vacancy ratio is an indicator of labour market tightness, providing insights into the balance between labour demand and supply for specific occupations. A low ratio suggests a tight labour market (more vacancies than unemployed workers), while a high ratio indicates a looser labour market with more unemployed workers than available jobs. As of 2024, there were 1.5 unemployed people for each job opening, reflecting a moderate tightness in the labour market for green trades. For several other trades, the ratio was notably lower, at <1 person per job vacancy. These trades included: automotive service technicians, construction millwrights and industrial mechanics, heating, refrigeration and A/C mechanics, industrial electricians, industrial instrument technicians and mechanics, machinists, plumbers, power system electricians and metal fabricators. This highlights a particularly constrained supply for select trades that are impacted by the green transition, as illustrated in Figure 1.

*Figure 1: Unemployment-to-job vacancy ratio, selected green trades, 2024*
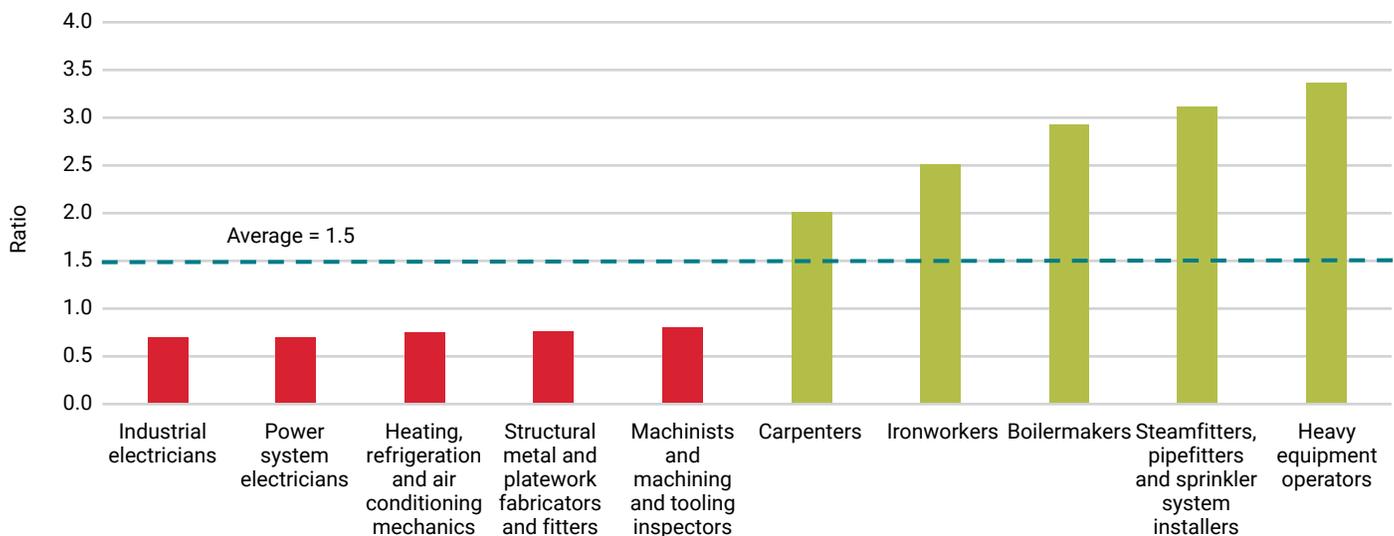
Source: Statistics Canada, Labour Force Survey, Job Vacancy and Wage Survey, Custom Tabulation.

Apprenticeship registrations and completions

Apprenticeship training is the main pipeline for skilled trades professionals in Canada. In recent years, apprenticeship programs have seen significant expansion. In 2023, national new registrations in green trades reached a record high, increasing by 18% from the previous year (see Figure 2). This momentum is likely attributed to government funding and initiatives that have increased the number of new apprentices entering the skilled trades.

Apprentice retention remains a strong focus. While completion levels have remained relatively flat post-pandemic, recent growth in new apprenticeship registrations is expected to result in higher completions over the outlook, provided these completion rates remain close to historical averages.

Figure 2: Number of new registrants and completions, green trades, Canada (excluding territories)
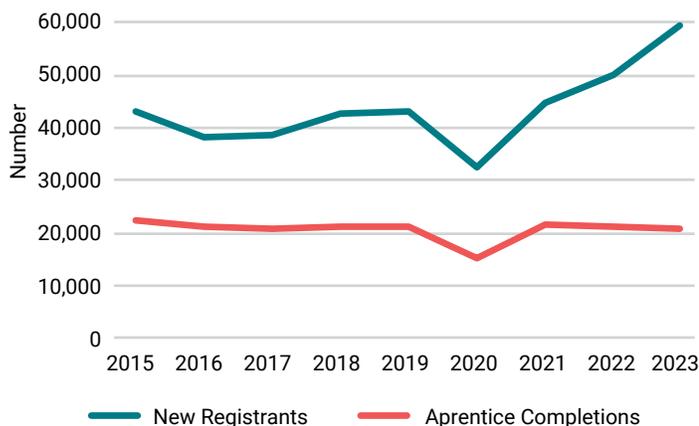

Source: Statistics Canada, Registered Apprenticeship Information System, Custom Tabulation

In 2021, roughly 6% of Canada's workforce held a Certification of Qualification (CofQ), regardless of whether it was their highest level of education. However, historical comparisons are only available for those whose highest level of educational attainment is a CofQ. Census data from 2011, 2016 and 2021 show a gradual decline in the share of the workforce with a certification of qualification as their highest form of educational attainment (see Figure 3).

Several factors may be contributing to this trend. One possibility is that more individuals are pursuing post-secondary education before considering careers in the skilled trades. Additionally, many apprentices do not complete their training and leave the program before reaching certification, while others continue working in trades-related roles without writing or passing the CofQ examination. The shrinking proportion of certified workers poses a challenge to maintaining a qualified trades workforce at a time when demand is set to grow significantly due to Canada's transition to a green economy.

Figure 3: Share of workforce with CofQ, highest level of education attainment in 2011, 2016 and 2021
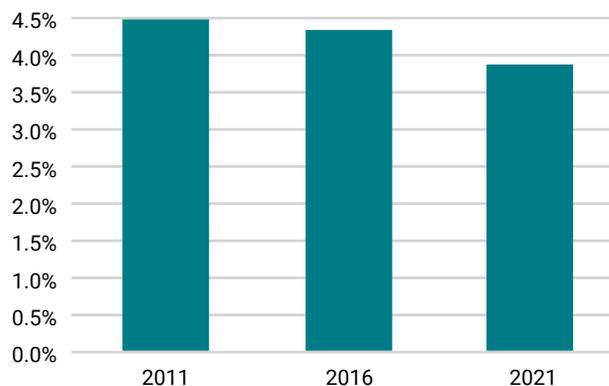
Source: Statistics Canada, 2011, 2016, 2021 Census, Custom Tabulation

4.4 Forecast of demand and supply

This section presents a forward-looking assessment of Canada's ability to meet emerging demand for certified skilled trades workers in the green economy. It includes:

- baseline projections of certification requirements across 26 green trades over a ten-year period (2025–2034) that compare anticipated demand to expected supply based on current completion trends.

- a green scenario to estimate additional workforce needs resulting from an accelerated pace of decarbonization.

When combined, these projections provide insight into where gaps may emerge and which trades are most at risk of falling short of future labour requirements.

Baseline scenario

Over the 2025-2034 outlook period, it is projected that more than 177,000 apprentices will need to be trained and certified across the 26 trades examined in this report to meet labour market demand.

Roughly one-quarter of this demand stems from net new employment growth; the remainder reflects replacement needs due to retirements and other labour force exits. Not surprisingly, demand is not evenly distributed across trades. When measured as a share of current (2024) employment, the trades expected to experience the greatest relative employment impact include: automotive service technician, construction electrician, insulator (heat and frost), and refrigeration and air conditioning mechanic.

Table 3 summarizes the projected certification requirements alongside expected completions for each trade between 2025 and 2034. These estimates are based on current average completion rates and assume they remain stable over the outlook period.

The analysis suggests that several green trades may be at risk of falling short of certification targets, potentially leading to a shrinking pool of certified workers. Trades facing the greatest potential shortfalls under the base scenario include boilermaker, construction craft worker and machinist.

Table 3: Certification requirements and anticipated supply, green trades, Canada

| Trade	Employment Demand – Apprenticeable Trade	Replacement Demand – Apprenticeable Trade	Related Occupation Demand	Total Demand	Anticipated Completions
Automotive service technician	1,575	2,338	1,244	5,157	8,649
Boilermaker	686	2,315	311	3,312	1,949
Bricklayer	492	1,398	481	2,371	2,877
Carpenter	3,161	13,298	13,052	29,511	52,839
Concrete finisher	-108	248	747	887	1,699
Construction craft worker	998	1,882	86	2,966	1,654
Construction electrician	8,196	14,306	21,967	44,469	77,618
Glazier	262	623	639	1,524	2,196
Heavy equipment operator	-74	1,317	1,930	3,173	5,182
Industrial electrician	885	2,779	1,538	5,202	5,960
Industrial mechanic (Millwright)	925	9,082	2,122	12,129	19,507
Instrumentation and control technician	211	1,225	305	1,741	2,605
Insulator (heat and frost)	418	716	752	1,886	1,876
Ironworker	7	814	228	1,049	2,542
Machinist	779	3,415	1,369	5,563	2,236
Metal fabricator (Fitter)	-93	444	313	664	1,426
Painter and decorator	395	1,158	695	2,248	4,391
Plumber	4,435	6,118	5,001	15,554	28,946
Power system electrician	30	51	10	91	108
Powerline technician	452	1,288	1,429	3,169	4,816
Refrigeration and air conditioning mechanic	2,331	3,398	2,599	8,328	15,046
Roofer	484	992	553	2,029	2,810
Sheet metal worker	915	1,998	1,568	4,481	11,054
Sprinkler fitter	348	760	310	1,418	4,634
Steamfitter/Pipefitter	738	2,462	1,501	4,701	11,207
Welder	2,609	7,414	3,830	13,853	12,236

Source: Statistics Canada, Prism Economics and Analysis

Green scenario

Canada will need to train and certify more than **264,000** apprentices in the 26 trades assessed in this report under the green scenario. This represents a 49% increase from the base scenario. Figure 4 illustrates the forecasted employment levels under each scenario. Employment is set to continue to grow in both the base and green scenarios, but at a more rapid pace for the latter.

Under an accelerated green scenario, several trades are disproportionately responsible for additional employment stemming from decarbonization. Construction electrician and refrigeration and A/C mechanic account for nearly half of the additional employment demand. Additional trades driving employment include: carpenter, plumber and industrial electrician. Electricians are anticipated to be heavily impacted by decarbonization, resulting from the demand for electrification that affects multiple sectors of the economy.

Figure 4: Certified employment of green trades, green scenario and base scenario
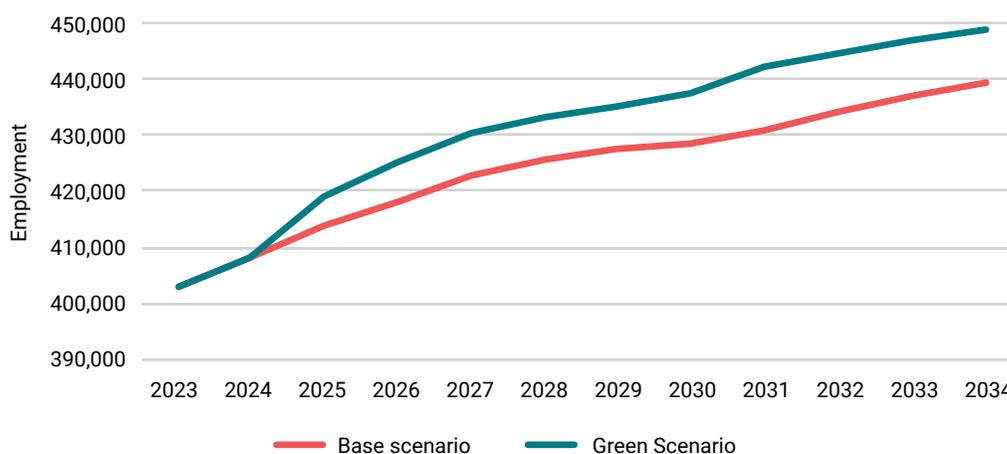
Source: Statistics Canada, Prism Economics and Analysis

Table 4 presents a risk assessment that combines three factors: first, the current labour market tightness (as measured by the unemployment-to-job vacancy ratio), second, the projected balance between certified worker supply and demand under a baseline scenario, and finally, the anticipated gap under an accelerated green scenario. The overall risk rating reflects how these components interact, with trades considered most at risk if they are already experiencing tight labour market conditions and are also projected to have insufficient certified worker supply to meet future demand in either scenario. Refer to Appendix A for more information on the colour-coded indicators in the table.

The results point to several trades that face a high risk of future supply gaps: **glazier, industrial electrician, labourers (construction craft worker), power system electrician, machinist and refrigeration and A/C mechanic**. These trades exhibit both low unemployment-to-job ratios and elevated demand in the green scenario. In these trades, the existing labour market tightness is compounded by rising certification requirements which are responsive to decarbonization efforts. This suggests that significant strain may emerge without increased focus on training and efforts to improve retention rates.

A larger group of trades falls into the moderate risk category. These trades include: **boilermaker, construction electrician, insulator (heat and frost)**, **industrial mechanics (millwrights)**, among others. Here, demand is expected to rise, but the supply gap is less acute. In this category, trades may have sufficient intake to meet increased green demand, but tight labour conditions may make it difficult to find skilled workers when they are needed. Although some of these trades may not face critical challenges immediately, they represent areas where proactive measures could help to prevent longer-term imbalances.

Trades at low risk generally have more balanced labour markets or have an apprenticeship intake that is sufficient to meet green demands. These trades include: **carpenters, sheet metal workers,** and **steamfitters/pipefitters**, among others. In these occupations, current supply appears to be better aligned with anticipated demand, although as the green economy evolves, continued monitoring will be important.

Table 4: Risk assessment of green trades: labour market tightness and projected supply-demand gaps (base and green scenarios)

Trade	Unemployment-to-job ratio	Base Scenario	Green Scenario	Risk
Automotive service technician	🔴	🟢	🟢	Moderate
Boilermaker	🟢	🔴	🔴	Moderate
Bricklayer	🟡	🟡	🟡	Moderate
Carpenter	🟢	🟢	🟡	Low
Concrete finisher	🟡	🟢	🟢	Low
Construction craft worker	🟡	🔴	🔴	High
Construction electrician	🟡	🟢	🟡	Moderate
Glazier	🟡	🟢	🔴	High
Heavy equipment operator	🟢	🟢	🟢	Low
Industrial electrician	🔴	🟡	🔴	High
Industrial mechanic (millwright)	🔴	🟢	🟢	Moderate
Instrumentation and control technician	🔴	🟢	🟢	Moderate
Insulator (heat and frost)	🟢	🟡	🔴	Moderate
Ironworker	🟢	🟢	🟡	Low
Machinist	🔴	🔴	🔴	High
Metal fabricator (fitter)	🔴	🟢	🟢	Moderate
Painter and Decorator	🟡	🟢	🟢	Low
Plumber	🔴	🟢	🟡	Moderate
Power system electrician	🔴	🟡	🔴	High
Powerline technician	🟡	🟢	🟢	Low
Refrigeration and air conditioning mechanic	🔴	🟢	🔴	High
Roofer	🟡	🟢	🟡	Moderate
Sheet metal worker	🟡	🟢	🟢	Low
Sprinkler fitter	🟢	🟢	🟢	Low
Steamfitter/pipefitter	🟢	🟢	🟡	Low
Welder	🟡	🟡	🟡	Moderate

Source: Statistics Canada, Prism Economics and Analysis

The green scenario presented in this report should be interpreted as a lower-band estimate of potential demand for certified skilled trades workers. While it captures the increased labour requirements driven by decarbonization in key sectors, such as buildings and renewable energy, it does not account for several areas of the green economy that are likely to generate additional demand. Notably, the scenario excludes the aftermarket sector for electric vehicles (EVs) and the installation and servicing of EV charging infrastructure.

The scenario assumes that apprenticeship registration levels remain consistent with current trends. Should registrations decline in the coming years, the available supply of certified workers, particularly in the latter half of the decade, may fall short of demand, exacerbating existing recruitment challenges in critical green trades. In addition, there may be labour market tightness at a provincial level that is not captured in a national analysis.

The timing and pace of decarbonization, electrification and EV adoption remains fluid, influenced by market conditions, regulatory developments, and consumer uptake. For these reasons, this scenario should not be viewed as a precise job forecast. This analysis is based on an assessment of available data in the context of many quickly evolving variables related to the green economy. It interprets the potential magnitude and direction of decarbonization's impact on skilled trades demand and highlights where pressure points are likely to emerge within Canada's apprenticeship training and certification system.

Section 5: Implications and Future Directions

Canada's transition to a net-zero economy is already reshaping the demand for skilled trades in sectors central to decarbonization, including construction, renewable energy, transportation and manufacturing. The growing demand for certified trades professionals, particularly in occupations such as electricians and HVAC technicians, requires aligning apprenticeship and training systems with emerging green economy needs. With more than 264,000 newly certified workers required by 2034 under the green scenario, and multiple trades expected to face high or moderate risk of recruitment challenges, workforce readiness will be critical to advancing Canada's national climate targets.

To meet this challenge, stakeholders across the labour market must collaborate to modernize current training systems, to expand capacity in trades currently undersupplying the market, and to equip the workforce with the new competencies that are required by green technologies and practices. Proactive planning and sustained investment in apprenticeship pathways, certification programs, and upskilling initiatives will be essential to closing these anticipated gaps. This report underscores the importance of a coordinated response to ensure that Canada's skilled trades workforce can support a low-carbon future and the overall green transition of industrial sectors.

The following areas are key considerations for future research to build on the findings of this report:

Policy and planning

Future research should explore specific governance models to drive coordinated action and harmonized training standards and curricula. This might include establishing a National Green Skills Council or creating shared frameworks for curriculum updates, training investments and workforce planning. Further analysis could also focus on developing strategies for upskilling and reskilling workers in occupations that may be phased out and sectors losing jobs to meet skilled trades demand.

Workforce development and inclusive greening

As demand for green trades grows, there's a critical opportunity to attract and support underrepresented groups, including women, Indigenous Peoples, newcomers, and racialized workers. Future studies could develop strategies to enhance recruitment and retention in high-demand trades. Additionally, research is needed to ensure that economic growth from green economy investments is inclusive, particularly for Indigenous peoples and local communities where projects are situated. This research should focus on how governments and their partners can provide effective labour market training and ensure equitable access to new jobs.

Education and training systems

Future reports could examine the capacity and agility of Canada's training and education systems. This includes:

- Assessing the training seat capacity by trade and region, and the availability of employer sponsorships

- Exploring the role of short-cycle upskilling to quickly fill urgent labour gaps and a framework for ensuring this training is high quality

- Investigating how industry-education partnerships can better align curricula with emerging green technologies and how to integrate green skills competencies and climate literacy more rapidly into programs.

Regional and data-driven insights

The national-level scenario presented here can be enhanced by more targeted, **regional analyses**. Furthermore, a sensitivity analysis on apprenticeship registration and completion rates would help policymakers anticipate potential supply gaps, especially if current trends shift.

The circular economy and greening

Future research could expand the scope to examine the demand for skilled trades through a broader lens of the circular economy. This means going beyond **decarbonization and air emissions** to include **land and water pollution**. Activities aligned with the principles of the circular economy aim to minimize waste and resource use by keeping materials and products in use for as long as possible through repair, refurbishment, remanufacturing, and recycling. This type of policy lens will impact industries and labour markets in a more holistic way, allowing for better planning of labour market changes and active labour market program interventions for tradespeople and related occupations.

Increasing climate literacy among apprentices and journeypersons

Apprentices need to understand the impact of climate change and the potential of their work to lower the carbon footprint. If apprentices believe addressing climate change is important, they are much more likely to care about whether their work is done properly and gain satisfaction from the valuable contribution they are making to protecting the environment. Higher numbers of youth and Indigenous Peoples may be attracted to the trades as a career if they feel it is a way they can contribute to more sustainable economic practices.

Appendix

The following tables outline the parameters of the risk assessment, representing the labour market conditions and how well projected apprenticeship completions align with future demand for each trade.

Unemployment-to-job vacancy ratio

This indicator shows how tight the labour market is. A lower ratio means fewer unemployed workers are available for open jobs.

Color	Description
● Red	Ratio is **less than 1** – more job vacancies than unemployed workers. A very tight labour market.
● Yellow	Ratio is **between 1 and 2** – slightly more unemployed workers than job openings. A moderately tight market.
● Green	Ratio is **greater than 2** – more unemployed workers than vacancies. Labour market is more balanced or loose.

Base scenario & green scenario

This indicator compares the projected number of new journeyperson completions with expected demand under two different scenarios.

Color	Description
● Red	*Projected Completions Lag Demand —* Completions are **more than 25% below** projected demand.
● Yellow	*Projected Completions Align with Demand* — Completions are **within ±25%** of projected demand.
● Green	*Projected Completions Meet or Exceed Demand* — Completions are **more than 25% above** projected demand.

Risk rating

The final risk rating reflects the combination of current labour market conditions and the alignment of training completions with future demand.

Risk Level	Description
Low	Strong alignment between supply and demand for certified workers. Balanced labour market.
Moderate	Some pressure points. Proactive planning can help prevent recruitment challenges for certified workers.
High	Considerable risk of recruiting challenges due to tight markets and/ or low training completions relative to demand.

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Endnotes

1   For more information, see the _CANTRAQ system_.

2   Vona, F., Vona, F., M. Giovanni, D. Popp, D. Consoli (2015 May 22). Green Skills. VOXEU, Centre for Economic Policy Research (CEPR).

3   See UNIDO, _What are green skills?_

4   For more information on the Paris Agreement see _United Nations Climate Change_

5   See the _FOCAL data dashboard_ for more information on employment breaks-down for Ontario, Quebec, regional clusters and Canada.

6   This report does not include an analysis of the sustainable agricultural sector. The only Red Seal trade that is exclusive to the sector is agricultural technician.

7   Environment and Climate Change Canada (2022). _2030 Emissions Reduction Plan, Canada's Next Steps for Clean Air and a Strong Economy_

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11 See FOCAL (V) (2024). _The Shift to EV Production in Canada's Automotive-Manufacturing Sector Assessing the Economic and Labour Market Impacts_ which presents 3 scenarios for EV transitions, with associated job creation and job losses.

12 While cancellations and delays of EV facilities and battery plants have occurred due to tariffs, a confluence of other factors such as low consumer interest in the U.S., high interest rates and inflation have impacted corporate decisions, despite government incentives. As 80% of Canadian vehicles are exported to the U.S., consumer demand is the most important driver for business decisions. Prices will also need to drop to create demand in BEVs.

13 FOCAL (IV) (2024). _ICEV to EV Workforce Transition Labour Market Forecast_.

14 The generation of green electricity is included in this statistic. This is discussed further under section 3.3.3: Renewable/Clean energy sector.

15 Ram, V.; Salkuti, S.R. (2023). _An Overview of Major Synthetic Fuels_. Energies, 16(6), 2834.

16 See _Clean Fuels – Fueling the Future_

17 See _RBC Polytech Micro-training_

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34 See _Canadian Building Trades Unions – Building it green_

35 For example, Youth Employment Services (YES) offers a free Green Skills introductory module (_Green Skills Passport_ created by EY and Microsoft)

36 Gasfitter and driller/blaster, while identified as green trades through our review, were excluded from the analysis due to insufficient data to model supply/demand estimates.