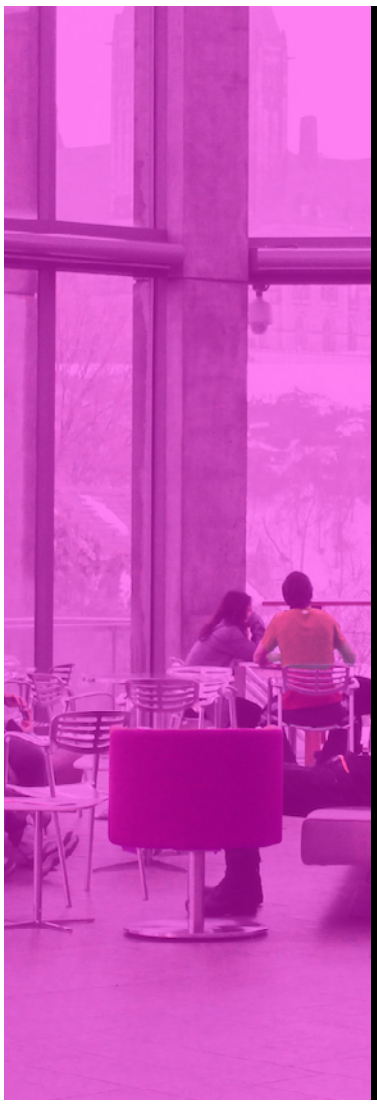
The Conference Board of Canada

In partnership with Future Skills Centre

# Green Occupation Pathways

## From Vulnerable Jobs to Rapid-Growth Careers

**Impact Paper** | February 2, 2022



Future Skills Centre

The Future Skills Centre – Centre des Compétences futures (FSC-CCF) is a forward-thinking centre for research and collaboration dedicated to preparing Canadians for employment success. We believe Canadians should feel confident about the skills they have to succeed in a changing workforce. As a pan-Canadian community, we are collaborating to rigorously identify, test, measure, and share innovative approaches to assessing and developing the skills Canadians need to thrive in the days and years ahead.

The Future Skills Centre was founded by a consortium whose members are Ryerson University, Blueprint, and The Conference Board of Canada.

If you would like to learn more about this report and other skills research from FSC, visit us at fsc-ccf.ca or contact info@fsc-ccf.ca.

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# Foreword

## Shift to a green economy will redefine the labour landscape in Canada

**A report from The Conference Board of Canada and the Future Skills Centre**

**January 2022**

The Future Skills Centre and The Conference Board of Canada are pleased to release this report on the pathways toward occupations driving a green economy. This work responds to a key element of our partnership—sharing insights and consolidating the best thinking from across the country about the future of work and how we need to shape future skills.

Climate change and the climate crisis have been garnering increasing attention in recent years, and many extreme weather events have highlighted the urgency to make changes to the way we live and work to safeguard the future of the planet. From floods in British Columbia to fisheries in Newfoundland and Labrador, we know that people's lives and livelihoods are dramatically affected by the changing climate.

This report therefore explores the pathways for workers in a more sustainable future, one in which workers can both survive and thrive in the changing economy. The paper predicts significant changes to Canadian and global labour markets that introduce some new careers while other jobs transition out.

It will be crucial for Canada to embrace a low-carbon future and foster a "green economy" in which new firms and sectors emerge to facilitate this transition. Redirecting investment and skills toward the development of cleaner industries and enterprises will strengthen the workforce and economy as more jobs and industries shift from the energy and extractive sectors.

This research aligns with the Future Skills Centre's focus on sharing knowledge and solutions to tackle emerging challenges regarding the future of work and workers in Canada. It also adds to the growing dialogue and conversation about a globally competitive, environmentally sustainable, and human-focused approach to green transitions in Canada. The issues raised here will be critical for ongoing dialogue, discussion, and investment as the country strives to both build a greener economy and support workers through sectoral transformation.

**Tricia Williams,** PhD
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# Key Findings

- Career pathways to rapid-growth occupations in the clean economy are open to all workers whose roles are at high risk of automation and who have limited career mobility. We refer to these vulnerable occupations as high-risk, low-mobility (HRLM) occupations.
- The number of available transitions varies considerably by each high-risk, low-mobility occupation and the ability and willingness of workers to retrain.
- Almost every vulnerable occupation has a transition pathway to the clean economy with one year of training. However, many occupations have only limited transition opportunities with six months or less of training.
- Barriers to transitioning go beyond training requirements. They include compensation issues, job security, workers' willingness to retrain, and the availability of useful and timely information on the labour market.
- The ability to transition is uneven across the provinces and territories. Some regions—including many in Atlantic Canada—will have fewer rapid-growth, clean economy jobs in the future.
- Given the scale of this issue, employers, governments, and other labour market stakeholders need to provide stronger support for developing at-risk or displaced workers' skills. Subsidized on-the-job training and education, age-targeted supports, and better labour market information can alleviate fears about switching careers.

# Introduction

## The nature of work in Canada is changing. So is our climate. Can we alleviate both needs?

One in five Canadian employees is working a job that is at considerable risk of automation. And for those employees, there are few or no options to transition into lower-risk occupations without undergoing significant retraining.[1] This amounts to 3.5 million people across 92 occupations. We refer to these vulnerable occupations as high-risk, low-mobility (HRLM) occupations.

Designing and implementing viable responses to automation requires a thorough understanding of the opportunities available to HRLM workers. Helping to transition these workers into high-growth sectors of the economy is ideal (e.g., technology, cannabis, services). But policy responses that integrate with other public priorities will be the most effective and efficient.

Focusing on the clean (or green) economy is timely, given the Canadian government's focus on climate change and integration of clean technologies to meet its targets set out in global environmental accords. The Pan-Canadian Framework, for example, established a goal to make "Canada a leader in the development and deployment of 'breakthrough' clean technologies."[2] As such, understanding the transition—from those segments of the Canadian economy that are vulnerable to automation to the fast-growing clean economy—addresses multiple labour market challenges.

1 Gresch, *Responding to Automation.*
2 Environment and Natural Resources, "Clean Technology, Innovation and Jobs."

The transition to the green economy will structurally impact labour markets in Canada and globally. As with other large-scale labour market shocks – such as the widespread adoption of information and communications technologies, industry 4.0, and aging populations – the green transition will create more job opportunities in the sector. It will also change the skills required and tasks performed in existing occupations.

Similarly, shifts in the relative demand for some jobs will likely require workers to change their careers as some jobs disappear and others appear.[3] If workers are to transition successfully, we need to understand which skills are necessary for these transitions. This is true for the clean economy and other fast-growing sectors.

The emerging green economy presents both challenges and opportunities for policy-makers. On the one hand, the increased adoption of automation-enabling technologies will likely accelerate employment declines in occupations involving routine tasks. On the other hand, green technologies and energy-efficient processes will transform many sectors of the economy, enabling greater value creation.

To make the most of the green transition, governments, employers, and other stakeholders need to understand how the skills composition of today's workforce will differ from one filled with more green jobs. Knowledge of the speed and cost of this transition is essential for human resource planning, provincial and federal policy-making, and for workers themselves to understand their future options.

## Objectives

This research has a twofold goal: to reduce employment in vulnerable, stagnating sections of the economy; and to ensure that fast-growing sectors have access to the labour they need. Specifically, we examine the feasibility and desirability of transitions from the HRLM occupations to a set of rapid-growth occupations in the clean economy. (See "What Is the Clean Economy?") We also estimate the costs associated with those transitions.

First, we identify green industries that are critical to transitioning to a clean economy. We then identify existing and emerging green occupations that are more important to green industries than the overall economy. Next, we determine the key differences between green and non-green occupations by leveraging a comprehensive inventory of skills, knowledge requirements, and wages. We also estimate the equivalence between years of training and skills gains that can inform retraining programs.

We focus on national and provincial/territorial levels, where most workforce training programs are designed and implemented. However, the results are also applicable to metropolitan areas. While transitioning workers from vulnerable to more resilient segments of the economy is important across Canada, regions with a relatively low ratio of green to vulnerable jobs may need to be more proactive in identifying alternative, high-growth occupation pathways.

3 Bowen and others, "Characterising Green Employment."

Lastly, through a survey of over 500 Canadian workers and in-depth interviews with industry associations, labour representatives, and other relevant experts, we examine the human factors in job transitions, such as worker attitudes and preferences. See Appendix A for a detailed discussion of our methodology.

Existing studies help us understand the size and performance of Canada's clean economy. Still, the studies are limited in informing policy development around the nature of work and the necessary occupations required to achieve the stated goal of making Canada a leader. As such, our analysis can serve as a springboard for relevant policy discussions and pave the way for understanding how HRLM workers can transition into other promising sectors of the economy.

## What Is the Clean Economy?

We define the clean economy as a combination of industrial and governmental activity that produces goods and services with an environmental benefit or adds value to such products through supply chain linkages. This definition involves describing the clean economy in terms of the industries and occupations that comprise it. Given the need to reduce our carbon emissions by developing and deploying clean technologies, we need to understand the labour force requirements to enable this transition.

There are many industries relevant to the clean economy, encompassing a wide range of activities. This diversity reflects new industries emerging from existing business activities and the intertwined nature of producers and suppliers in a modern economy. As such, it is challenging to pinpoint all industries relevant to the clean economy.

We narrow our focus to industries centred on clean business activity to capture the majority of clean economic activity reliably. In addition, we use industry (NAICS) and occupation (NOC) codes to be as transparent, replicable, and internally consistent as possible.[4] With these criteria in mind, we group green industries into three major sectors: clean energy production, energy efficiency, and environmental management. See Appendix B for the full description of each.

The occupations we are most interested in are projected to grow rapidly or have many openings over the next 10 years. These are occupations that the U.S. Bureau of Labor Statistics has designated as having a "Bright Outlook."[5] Using our occupational forecast model, we project these occupations to grow 2.6 per cent higher than average between 2020 and 2030. Between 2020 and 2040, this climbs to 4.5 per cent.[6]

4 Statistics Canada, "North American Industry Classification System (NAICS)"; Employment and Social Development Canada, "Skill Level."

5 O*NET Resource Center, "Additional Initiatives."

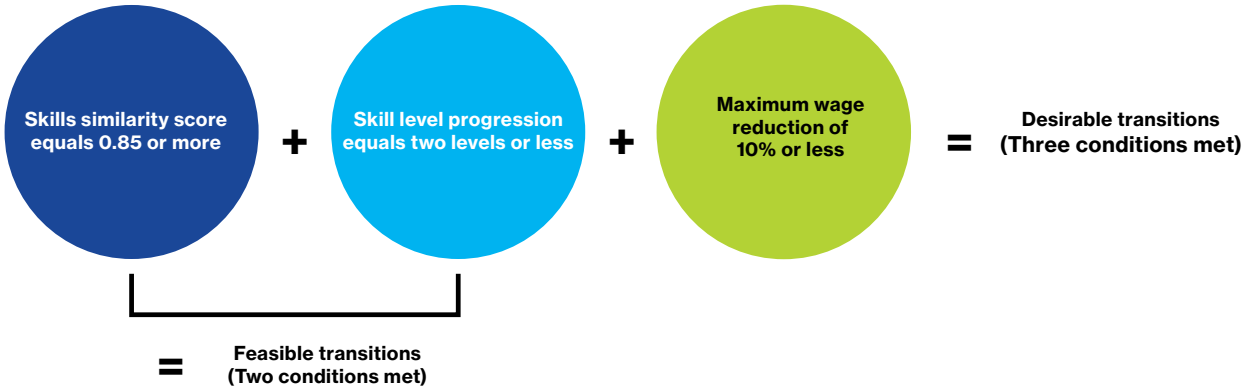
6 It is worth noting that there are four occupations designated as "Bright Outlook." But they are not projected to grow rapidly under our occupational forecast model. These are sheet metal workers, material handlers, structural metal and platework fabricators and fitters, and electrical power line and cable workers.

## Modelling Occupational Transitions

# In examining transitions from Canada's 92 HRLM occupations to the 16 rapid-growth occupations in the clean economy, there are 1,472 possible transitions.[7]

However, we must also consider the feasibility and desirability of each transition. As such, we examine three conditions: skills similarity, mobility between skill levels, and wage differences. (See Exhibit 1.)

**Exhibit 1**
**Three Conditions That Define Feasible and Desirable Occupational Transitions**




Source: The Conference Board of Canada.

7 See Gresch, *Responding to Automation,* for the list of HRLM occupations. See Appendix B, Table 5, for the list of rapid-growth occupations in the clean economy.

## Understanding Feasibility and Desirability

The transition model based on the three conditions, shown in Exhibit 1, enables us to investigate how education and training policies can facilitate transitions across occupations while maintaining workers in quality, growing jobs that maximize the use of their skill sets.

### Skills Similarity

Identifying similarities in the skills composition of green and non-green jobs can help determine the retraining needed to transition to the green economy. We classify the skills condition into two broad categories: cognitive skills and task-based skills. These elements aim to distinguish between general human capital (i.e., cognitive skills) and specific human capital (i.e., task-based skills and knowledge areas), both of which are necessary for the workplace.[8]

We estimate cognitive and task-based skill distances between a given pair of occupations using the cosine similarity score.[9] See Appendix A, Table 2, for data sources, their components and definitions, and the number of dimensions involved for each.

### Mobility Between Skill-Level Categories

Aside from the types of skills required, occupations also have skill-level categories that correspond to the amount of training or education typically required to fulfill them. Skill-level categories also reflect the experience required to enter the occupation and the complexity of the work responsibilities involved compared with other occupations. See Appendix A, Table 3, for a description of these categories.

Progression from a lower to a higher skill-level category is usually impossible without completing additional formal education or on-the-job training. Therefore, we allow progression from lower skill to higher skill-level categories in proportion to the training effort.

Specifically, we allow one level of progression for the moderate training effort and two levels of progression for the major training effort. The minor training effort is insufficient to make progression on the skill ladder. However, it is still necessary for transitioning to different occupations with the same skill level. This more or less corresponds with Employment and Social Development Canada's descriptions of the nature of education/training for the skill-level categories. Lastly, we exclude transitions to jobs with a skill group that is more than two levels above the current occupation, as well as transitions that involve excess skills.[10]

8 Bechichi and others, "Occupational Mobility, Skills and Training Needs."

9 Cosine similarity measures the angle between any two non-zero vectors. It is defined as the inner product space of the cosine of the angle between the two vectors. The values of cosine similarity are range from 0 and 1. See Rao, Hindle, and Gabler, *Modelling Job Transitions in Canada* for a detailed explanation.

10 We exclude transitions that involve excess skills (i.e., resulting from transitions from higher-skill to lower-skill jobs) because they are undesirable for workers and unproductive from a societal perspective.

**Education and training policies can facilitate transitions across occupations while maintaining workers in quality, growing jobs that maximize the use of their skill sets.**

## Wage Differences

Workers are unlikely to move to other occupations if transitions entail large wage drops. As such, we allow a maximum wage reduction of 10 per cent. This figure roughly corresponds to the average annual earnings loss of workers one year after displacement in five member countries of the Organisation for Economic Co-operation and Development (OECD), as estimated by the OECD.[11]

## How Training Translates to Improved Skills

Identifying feasible occupational transitions is methodologically challenging, as it requires determining the equivalence between years of training and skill gains. Unfortunately, there is a lack of empirical data translating a year of education or on-the-job training to skill improvements, especially regarding task-based skills. For this reason, we examine the distribution of skills shortages among the desirable occupational transitions identified by our three conditions. We also determine how much of the skills shortages each training scenario could reasonably address.[12] Specifically, we assume that:

- Six months of training can close the 25th percentile of a worker's skill shortages.
- One year of training can close the 50th percentile of a worker's skill shortages.
- Three years of training can close the 75th percentile of a worker's skill shortages.

See Appendix A, Table 4, for a more detailed breakdown between cognitive and task-based skills gains.

11 Organisation for Economic Co-operation and Development, *OECD Employment Outlook 2013*.

12 Bechichi and others, "Occupational Mobility, Skills and Training Needs."

## Career Pathways for Canadian Workers

# All HRLM occupations have potential transitions to high-growth occupations in the clean economy. However, the number of desirable transitions depends on the training that workers receive.

### Green Career Transitions Exist for Nearly All HRLM Workers With One Year of Training

With six months of training, 20.2 per cent of the theoretical 1,472 transition pathways can be realized. (See Table 1.) With one year of training, this number increases nearly threefold, to 57.7 per cent of all transitions. The additional six months of training enables workers to close larger skill gaps, move to occupations in upper skill levels, and more than double their options.

In the three-year training scenario, 79.5 per cent of the transition pathways can be realized. There are two potential reasons why moving from one to three years of training does not enable all transitions. First, it could be that the skill gaps are so large that two additional years of training are insufficient to close them. Second, the skill-level difference between the origin and destination occupations may be larger than two and, therefore, not feasible for transitions to occur. Either way, this suggests diminishing returns to investment in training after a certain threshold.

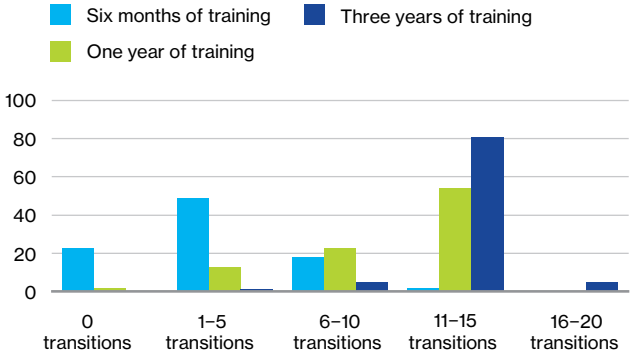
The number of transitions from HRLM to rapid-growth occupations varies considerably by HRLM occupation, reflecting the skill composition of different HRLM occupations. (See Chart 1.) As expected, the number of HRLM occupations with multiple transition options increases substantially with the amount of training.

There are only two HRLM occupations with more than 10 different green occupation pathways in the minor training scenario. But this climbs to 54 HRLM occupations in the moderate training scenario. Similarly, while there are 23 HRLM occupations without any green occupation pathways in the minor training scenario, this number decreases to two in the moderate training scenario.[13] This suggests that most of these vulnerable occupations would greatly benefit from up to a year of training. See Appendix C, Table 1, for a detailed table of results.

**Chart 1**

**One Year of Training Enables Green Transitions for 99.7 Per Cent of HRLM Workers**

(number of HRLM occupations; number of desirable transitions)




Sources: The Conference Board of Canada; O*NET; Vicinity Jobs.

**Table 1**

**Transition Pathways Increase With More Training**

(number; percentage)

| | All Transition Pathways | Feasible Transition Pathways | | Desirable Transition Pathways | | |
|---|---|---|---|---|---|---|
| **Training scenario** | **All transition pathways** | **Number of transition pathways** | **Percentage of all transition pathways** | **Number of transition pathways** | **Percentage of feasible transition pathways** | **Percentage of all transition pathways** |
| Minor training (i.e., six months) | 1,472 | 397 | 27 | **298** | 75.1 | **20.2** |
| Moderate training (i.e., one year) | 1,472 | 964 | 65.5 | **849** | 88.1 | **57.7** |
| Major training (i.e., three years) | 1,472 | 1,287 | 87.4 | **1,170** | 90.9 | **79.5** |

Sources: The Conference Board of Canada; O*NET; Vicinity Jobs.

13 The two occupations are 8614 (mine labourers) and 8615 (oil and gas drilling, servicing, and related labourers). These occupations account for less than 10,000 workers in Canada.

## The Potential for High-Growth Transitions in the Clean Economy Is Lowest in Atlantic Canada

The projected distribution of HRLM—and rapid-growth, green occupations across the provinces and territories—highlights differences in the potential of feasible transitions. These differences indicate that the clean economy transition might be uneven if solely left to market forces.

Three Atlantic provinces (i.e., Newfoundland and Labrador, Prince Edward Island, Nova Scotia) have an especially high share of HRLM occupations and a low share of rapid-growth occupations in the clean economy. (See Table 2.) This Transition Potential Ratio represents the ease with which workers can transition from automation-vulnerable to fast-growing, green jobs. In other words, jurisdictions with low ratios will have relatively fewer rapid-growth occupations in the clean economy than HRLM occupations in the future. As a result, they will have fewer vulnerable-to-green-and-fast-growing occupational pathways.

Nationally, for example, we project that there will be 27 high-growth, green jobs for every 100 vulnerable jobs. Yet, in Prince Edward Island, there will only be 16 green jobs for every 100 vulnerable jobs. HRLM workers can transition to other rapid-growth occupations besides green ones. But, a low share of rapid-growth, clean economy occupations in those regions indicates that policy-makers must be proactive and deliberate in facilitating career transitions.

**Table 2**
**HRLM Transitions to Rapid-Growth Occupations Uneven Across Provinces and Territories**
(number; percentage)

| Province/Territory | HRLM Jobs, 2030 | | Rapid-Growth, Clean Economy Jobs, 2030 | | Transition Potential Ratio |
|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | |
| Ontario | 1,555,511 | 18.8 | 457,784 | 5.5 | 0.29 |
| Alberta | 481,988 | 18.1 | 134,703 | 5.1 | 0.28 |
| New Brunswick | 71,965 | 20.6 | 19,148 | 5.5 | 0.27 |
| Northwest Territories | 3,019 | 13.5 | 823 | 3.7 | 0.27 |
| Canada | 3,928,900 | 18.8 | 1,043,324 | 5.0 | 0.27 |
| Yukon | 3,827 | 14.6 | 994 | 3.8 | 0.26 |
| Nunavut | 2,321 | 14.9 | 599 | 3.9 | 0.26 |
| British Columbia | 508,985 | 18.5 | 128,271 | 4.7 | 0.25 |
| Quebec | 876,988 | 19.1 | 208,450 | 4.5 | 0.24 |
| Manitoba | 142,599 | 19.6 | 32,567 | 4.5 | 0.23 |
| Nova Scotia | 96,653 | 20.4 | 21,672 | 4.6 | 0.22 |
| Saskatchewan | 125,206 | 19.8 | 27,001 | 4.3 | 0.22 |
| Newfoundland and Labrador | 40,145 | 19.5 | 8,193 | 4.0 | 0.2 |
| Prince Edward Island | 19,693 | 23.2 | 3,118 | 3.7 | 0.16 |

Sources: The Conference Board of Canada; O*NET; Vicinity Jobs; Statistics Canada.

The potentially uneven transition from vulnerable to high-growth, clean economy occupations is evident in Chart 2. Notably, provinces with the lowest ratios also have the highest Automation Vulnerability Index (AVI) scores.[14] This is somewhat expected due to the correlation between the share of HRLM occupations and the AVI score. However, it reinforces that the labour forces of Newfoundland and Labrador, Prince Edward Island, Nova Scotia, and Saskatchewan are less resilient to automation and technological transformation than the rest of the country.

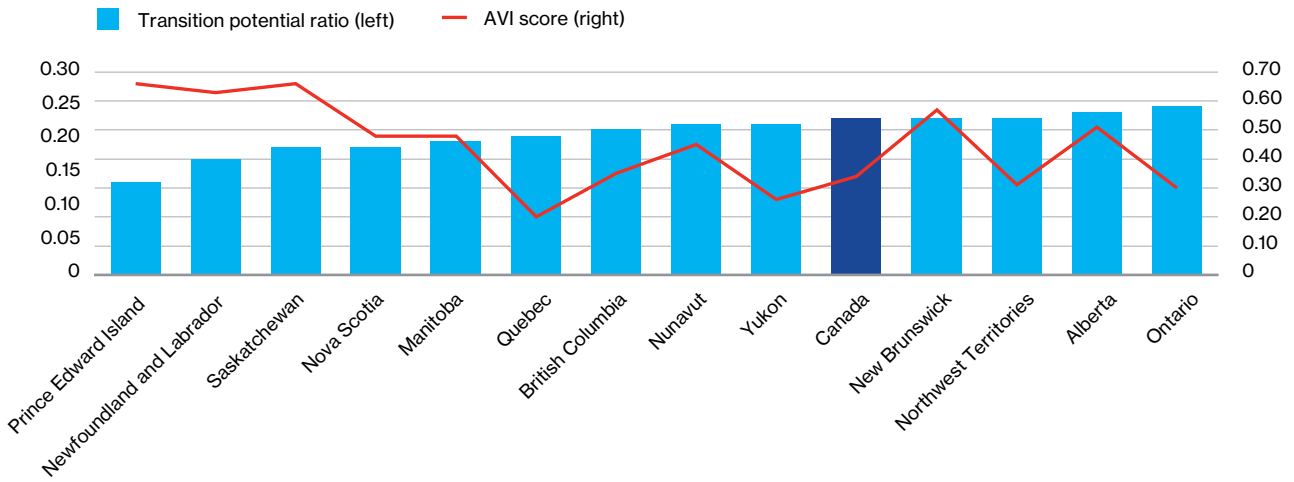
## The Cost to Transition Also Varies by Region

It is also important to highlight the different costs associated with each training scenario across the provinces and territories. Given budget constraints and sectoral priorities, a provincial or territorial government will likely support a training scenario that best fits its economic policy. The cost estimates provided in Table 3 are based on direct training costs and indirect opportunity costs. As well, they are averages of the previously identified desirable green occupation pathways.

**Chart 2**

**Atlantic Provinces Have Higher Automation Vulnerability and Lower Potential for Green Transitions**

(transition potential ratio; Automation Vulnerability Index score)




Sources: The Conference Board of Canada; O*NET; Vicinity Jobs.

14 See Sonmez, *Preparing Canada's Economies for Automation,* for more information on the Automation Vulnerability Index.

The differences in transition costs across regions are driven by different HRLM occupations and education costs in each jurisdiction. Alberta has the highest transition cost among the provinces, mainly due to the high employment income associated with existing HRLM occupations in that province. Thus, there is a high opportunity cost of retraining.[15] Conversely, Quebec has the lowest transition cost among the provinces, thanks to its low cost of education.[16]

See Appendix C for a breakdown of the direct (Table 2) and indirect (Table 3) costs associated with retraining.

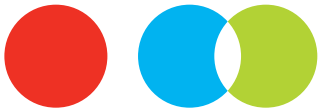


**Table 3**
**The Average Cost of Transition Varies by Training Scenario and Jurisdiction**
(C$)

| Province/Territory | Minor Training (i.e., Six Months) | Moderate Training (i.e., One Year) | Major Training (i.e., Three Years) | Average |
|---|---|---|---|---|
| Alberta | 35,768 | 68,450 | 201,771 | 101,996 |
| Saskatchewan | 32,847 | 62,548 | 184,511 | 93,302 |
| Prince Edward Island | 31,954 | 60,983 | 180,282 | 91,073 |
| Nunavut | 35,172 | 61,598 | 168,610 | 88,460 |
| Northwest Territories | 31,630 | 59,876 | 173,809 | 88,438 |
| British Columbia | 29,220 | 56,578 | 167,105 | 84,301 |
| Newfoundland and Labrador | 29,656 | 55,365 | 165,238 | 83,420 |
| Manitoba | 29,021 | 55,510 | 164,536 | 83,022 |
| New Brunswick | 28,513 | 54,952 | 163,006 | 82,157 |
| Canada | 28,158 | 54,075 | 159,788 | 80,674 |
| Ontario | 28,124 | 53,718 | 158,410 | 80,084 |
| Yukon | 28,435 | 53,980 | 157,162 | 79,859 |
| Nova Scotia | 27,737 | 53,093 | 157,522 | 79,450 |
| Quebec | 23,721 | 45,845 | 135,057 | 68,208 |

Note: Costs do not increase proportionally between training scenarios because each comprises different pathways (i.e., transition pairs), and each pathway is associated with a different cost.
Sources: The Conference Board of Canada; O*NET; Vicinity Jobs; Statistics Canada.

15 For instance, pulp mill machine operators in Alberta earned $87,985 in 2015, while the median employment income for the same occupation in Canada was $73,443.

16 The cost of post-secondary education per student in Quebec was $12,737, while the national average was $17,862.

## Human Factors in Job Transitions

# Although transitions must be feasible and desirable, other important considerations exist. For example, which relevant worker views might help or hinder transitions to the clean economy?

Similarly, what impact do these considerations have on decisions to transition? Ultimately, individual perspectives are critical to understanding the factors potentially preventing vulnerable workers from taking advantage of the available transition pathways to clean economy careers.

### Fear About Transitions

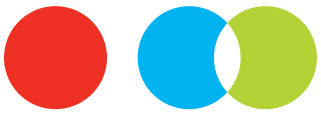
Interviewees mentioned fear as a critical factor that could keep workers from transitioning. This could be the fear of leaving a secure job. It could also be the worry of not knowing what a green job entails, especially when the clean economy has been politically polarized at times. Another common fear is being left behind if workers cannot learn the skills necessary to feel competent in a new occupation. This is especially true for those in the middle of their careers or closer to retirement.

These fears stem from the fact that workers can become attached to, and gain a sense of identity and self-worth from their current jobs. Workers often want to feel like they can add value and make a difference. Similarly, they can develop a strong sense of belonging that they must abandon when transitioning to a new job. This can also help explain why it can be challenging for workers to pivot to completely different occupations and industries.

One way to alleviate these fears is to help workers feel competent in their new job. If they are confident that they can add value in their new occupation, they will likely be more comfortable making the transition. This means ensuring that they have received the appropriate training to contribute at an elevated level and produce meaningful accomplishments. If workers feel like they are adding value, they will likely regain that sense of self-worth and identity.

## Compensation Is Top of Mind

Unsurprisingly, survey respondents ranked compensation as the most important reason for staying at or leaving their current job. (See Table 4.) However, nearly three-quarters of respondents also ranked an identity-related factor (i.e., enjoyment) and competency in their top three reasons. Thus, while examining skillsets and wage differentials narrows our focus, it does not tell the whole story.



## Job Security Plays a Greater Role in Transitioning to the Clean Economy

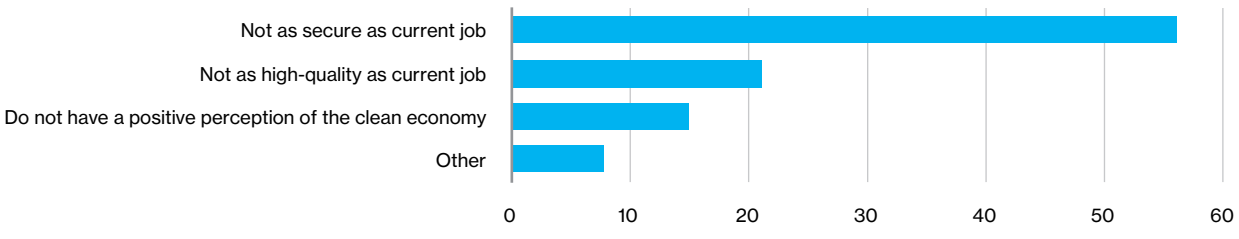
When asked about transitions to the clean economy specifically, most workers ranked job security as the most important factor. (See Chart 3.) If workers have no guarantee that the position into which they are moving has good benefits and long-term viability, they are unlikely to make the switch. This is especially true for occupations in the natural resource sector that are well-paid, have excellent benefits, and are often unionized.

**Table 4**
**Compensation, Enjoyment, and Competency Are the Top Reasons to Stay—or Leave**

| Average rank | Reason |
|---|---|
| 1 | My current occupation pays well (does not pay well). |
| 2 | I like (dislike) my current field/occupation. |
| 3 | I'm good (bad) at my current occupation. |
| 4 | I'm uncertain (certain) I have the skills to succeed in a different occupation. |
| 5 | I would have worse (better) job security in a new field/occupation. |
| 6 | Other |

Source: The Conference Board of Canada.

**Chart 3**
**Job Security Is the Most Important Factor When Transitioning**
**Q:** What is the primary reason that might deter you from an occupation in the clean economy?
(percentage of respondents; n = 497)




Sources: The Conference Board of Canada; O*NET; Vicinity Jobs.

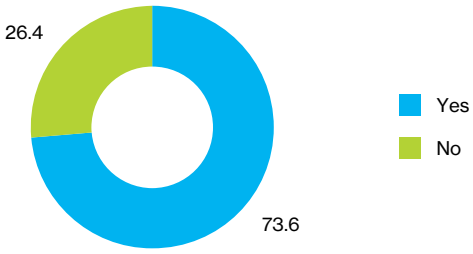
**If workers have no guarantee that the position into which they are moving has good benefits and long-term viability, they are unlikely to make the switch.**

In our conversations with various groups representing and advocating for workers, it became apparent that workers want high-quality, long-lasting jobs that give them a sense of pride. Any perceived hesitancy toward the clean economy is not necessarily directed at the clean economy itself. But it results from a fear of whether these new jobs would offer the same level of security as workers' existing jobs. When asked whether they would be willing to transition into the clean economy, nearly three-fourths of surveyed workers responded positively. (See Chart 4.)

**Chart 4**

**Most Workers Willing to Work in the Clean Economy**

**Q:** Would you consider transitioning to a clean economy occupation?
(percentage of respondents; n = 518)




Source: The Conference Board of Canada.

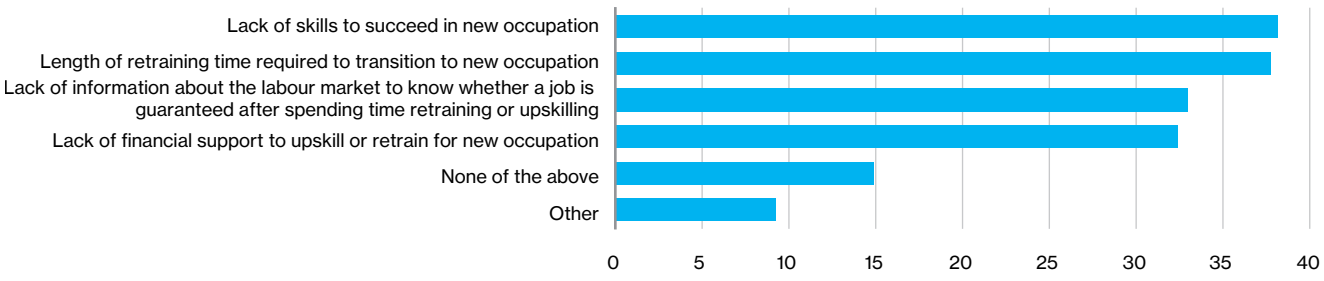
## Perceived Barriers to Transitions

Beyond personal preferences and psychological deterrents, we are also concerned with other challenges that might impede workers from transitioning to rapid-growth occupations in the clean economy. When asked to select which barriers prevented respondents from transitioning, the results were nearly evenly split between lack of skills, length of retraining, and lack of information and financial support. (See Chart 5.) Notably, 85.1 per cent of respondents reported at least one perceived barrier to transitioning.

**Chart 5**

**Lack of Skills and Retraining Time Are Top Barriers to Switching Jobs**

**Q:** What are some barriers preventing you from transitioning to a different occupation? (Please select all that apply.)
(percentage of respondents; n = 518)

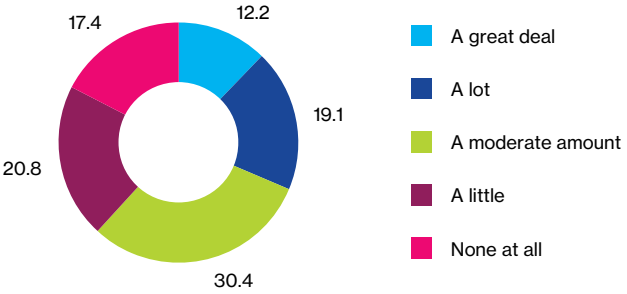



Source: The Conference Board of Canada.

## Unequal Access to Retraining

The top barrier preventing HRLM workers from transitioning to the clean economy is a perceived lack of skills. Nearly two in five workers believe that they do not have the necessary skills to succeed in a new occupation. A similar portion said that their employers had offered little to no training or up-skilling to help them adjust to a transforming role. (See Chart 6.)

**Chart 6**
**Employers Are Helping Their Employees Upskill to Varying Degrees**
**Q:** To what extent has your employer offered any training or upskilling to help you adjust to a transforming role?
(percentage of respondents; n = 546)




Source: The Conference Board of Canada.

This number climbs as high as 55.6 per cent for workers aged 55 and over (compared with only 25.4 per cent for workers aged 34 and under). And our interviews revealed that employers are unlikely to take a chance on transitioning workers unless they are confident the employees have most of the necessary skills and experience. This may mean that employers may need to invest in the training themselves to address their skill shortages.

Similarly, our discussions with labour advocacy groups revealed inequitable access to up-skilling and training opportunities in most workplaces. For example, employees with elevated levels of tertiary education tend to gain access to the lion's share of continuous education opportunities. Meanwhile, workers vulnerable to automation and who are likely to have low educational attainment and fundamental skills deficits, often cannot access these opportunities.

## Retraining Takes Time

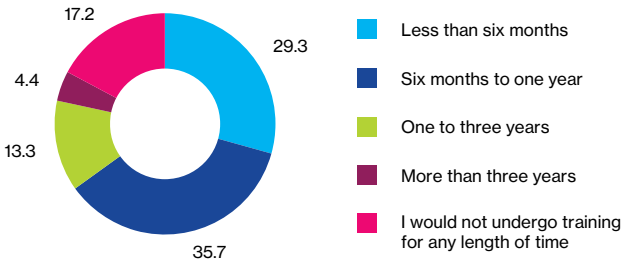
Retraining is a key component of our transition model. Depending on which occupation they are transitioning from, HRLM workers must spend between six months and three years to access fast-growing, green careers. Cashiers, for example, have no available green transition opportunities with six months of training. As the time spent training increases, however, more pathways become available.

Workers are generally willing to put in the required time. However, a significant portion is unwilling to train for six months or more. (See Chart 7.) This is concerning, given that 23 HRLM occupations have zero green transitions with six months of retraining. This equates to 35.2 per cent of HRLM employment in 2020 or 1.2 million workers.

**Chart 7**

**Almost Half of Respondents Said They Would Be Unwilling to Retrain for Six Months or More**

**Q:** For how long would you undergo retraining to transition to an occupation expected to increase in demand (and is less vulnerable to automation)? (percentage of respondents; n = 518)




Source: The Conference Board of Canada.

Assuming workers can afford to retrain, one potential reason is that they are uncertain of the job prospects that await them after retraining. This challenge is compounded if retraining requires workers to take time off work and forego income. If workers are not at risk of displacement or unemployment, they have even less incentive to do so. Similarly, they may not have enough information to justify spending the time.

Unsurprisingly, older workers who are further along in their careers prefer spending shorter amounts of time retraining. For example, only 14.0 per cent of respondents aged 34 and under said they would not undergo training for any length of time compared with the 22.1 per cent aged 55 and over. Similarly, 25.7 per cent of respondents aged 34 and under said they'd train for less than six months compared with 32.6 per cent aged 55 and over.

Interestingly, only 2.9 per cent of respondents, aged 35 to 44 (the lowest of the age cohorts) said they'd be willing to undergo three years or more of training. This is likely because they're in the middle of their careers and have substantial financial commitments, such as mortgages and children, which makes it more difficult to leave their current job.

## Lack of Labour Market Information and Guidance

Without labour market information and other resources, workers may find it challenging to navigate the labour market and get a sense of which occupations are in demand and primed to grow in the present and near future. One key aspect of labour market information is the timeliness of data: existing tools tend to rely on historical data instead of real-time data. Another is the quality of information. Many tools examine transitions based on job titles or educational qualifications, but these unnecessarily limit options, especially for mid-career and older workers.

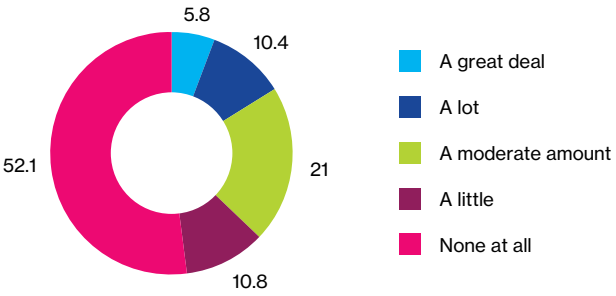
Transition opportunities, based on skills similarity and skill level, leverage the transferrable skills of these workers and enable them to find more meaningful opportunities. The Conference Board of Canada has developed an easy-to-use, online tool to address this gap.[17] If workers do not have access to essential information about clean economy occupations, they are unlikely to invest in the skills they would need to transition to them. More generally, if they don't have access to resources, it may exacerbate Canadian unemployment. (See Chart 8.)

17 See OpportuNext at http://www.opportunext.ca/ for more information.

**Chart 8**

**Most Workers Said They Had Little to No Access to Resources After Unemployment**

**Q:** If you have ever been unemployed due to an automation-enabling technology, did you have access to resources to help you identify your next course of action (e.g., labour market information, training, and/or reskilling opportunities)?
(percentage of respondents; n = 539)




Source: The Conference Board of Canada.

## Lack of Financial Support

While the length of retraining time was a major barrier for those who could afford to retrain, the cost of the training itself is another. (See Chart 9.) Other reasons include family commitments that leave workers with less available time and older workers choosing early retirement rather than enrollment in formal training.

According to interviewees, many employers do not invest in formal training and development for their employees, and there are few government subsidies and grants for this purpose. Similarly, many skills and training funds are reserved for workers who qualify for employment insurance, meaning that workers must wait until they are displaced before they can access them. More programs like the Department of Finance's Canada Training Benefit could help alleviate the cost and time constraints of retraining while reducing frictional and structural unemployment.[18]

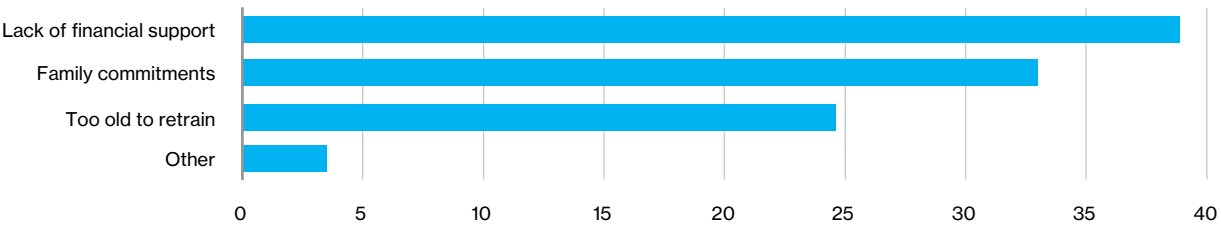
## Skills for the Clean Economy

Employers, educational institutions, and others frequently mentioned the importance of transferrable skills and social and emotional skills for the clean economy. These skills are the least likely to be replaced by technology, as they allow workers to adapt to an ever-changing labour market. They include skills such as communication, creativity, critical thinking, collaboration, adaptability, and resiliency.[19]

**Chart 9**

**Workers Cite Lack of Financial Support as the Main Deterrent to Training**

**Q:** What is the primary reason that might deter you from undergoing training?
(percentage of respondents; n = 509)




Sources: The Conference Board of Canada; O*NET; Vicinity Jobs.

18 Department of Finance Canada, "Budget 2019: The Canada Training Benefit."
19 Giammarco, Higham, and McKean, *The Future Is Social and Emotional.*

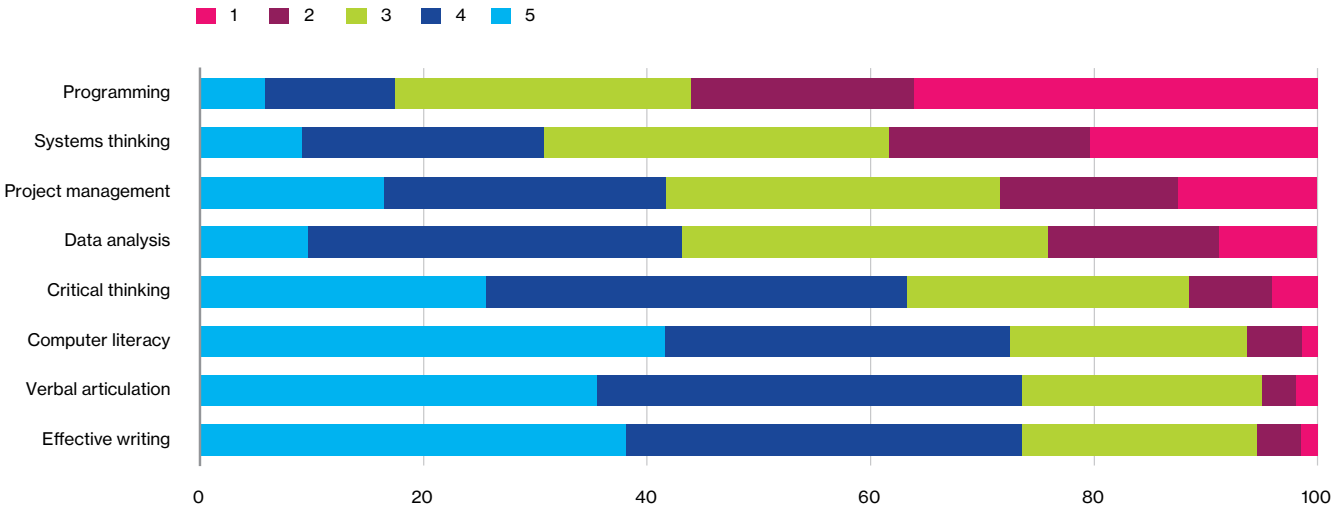
In previous research that examined HRLM industries and occupations, interviewees also suggested that these social and emotional skills will be in greater demand.[20] This is encouraging, as HRLM workers who can cultivate these skills in their existing roles will have greater success transitioning.

While specific technical skills will vary, workers with a solid foundation of social and emotional skills will have more capacity to learn the requisite "hard" skills on the job. These include computer literacy, data analysis, programming, machine learning, and skilled trades. According to Chart 10, workers are well-positioned in this regard.

**Chart 10**

**Most Workers Assess Themselves Highly on Social and Emotional Skills**

**Q:** Please rate your proficiency in each of the following skills from 1 to 5.
(percentage breakdown of respondents by skills proficiency rating; n = 515)




Source: The Conference Board of Canada.

20 Thomson and Gresch, *Responding to Automation.*

## Conclusion

# The transition to green energy production and more energy-efficient practices is just one way new technologies and environmental imperatives are already restructuring economies worldwide.

For low-skilled workers, in particular, the shock of the COVID-19 pandemic created even more uncertainty in the labour market and accelerated the arrival of the future of work. As such, we are at a defining moment in terms of our ability to shape the course of generations of people and their work.

As the pace of technology adoption increases, skills gaps will continue to grow as the desired mix of skills changes within and across occupations in the years to come. The World Economic Forum reports that around 40 per cent of workers will require re-skilling of six months or less by 2025.[21] Similarly, around 94 per cent of business leaders report that they expect employees to pick up new skills on the job—a sharp uptake from approximately 65 per cent in 2018.[22] Our research suggests that six months may be insufficient for a considerable number of career transitions—a year may be more appropriate in many cases.

One year of training to re-skill and up-skill HRLM workers is both achievable and desirable. However, given the scale of the issue, the public sector needs to provide stronger support. The fast-changing nature of skills requirements necessitates a systematic understanding of skills composition. And, by understanding the skills similarities between different jobs, we can estimate the retraining efforts required to enable transitions between them.

21 World Economic Forum, *The Future of Jobs Report 2020*.
22 Ibid.

Importantly, governments, employers, and other labour market stakeholders must consider the various human factors affecting career transitions. These include the compensation and job security of new jobs, the availability of useful and timely labour market information, and the willingness of workers to retrain. Policy-makers will need to implement training policies and programs that incentivize workers to push past the real and perceived barriers they face in transitioning to occupations with high growth prospects, particularly in the clean economy.

Because of the nature of rapidly growing sectors of the economy, we must continue to study the evolution of existing occupations and the growth of emerging ones. Employers, policy-makers, and educational partners will need to modify the content of training and educational programs to meet new workplace demands as technologies and business practices introduce novel skill requirements. However, transitioning the labour force to where the economy will need it in the future is perhaps more feasible than many previously imagined.

# Appendix A
# Methodology

This impact paper examines the feasibility of transitioning workers from occupations susceptible to automation to rapidly growing ones—particularly in the clean economy. We define this shift as a transition from high-risk, low-mobility (HRLM) occupations to rapid-growth, clean-economy occupations. In particular, we seek to identify:

- the extent of skills gaps, and task and knowledge area differences between HRLM and rapid-growth, clean economy occupations in Canada;
- the time and monetary costs of skills development and training for a transition between any given HRLM occupation and rapid-growth occupation in the clean economy;
- regional variation, if any, in these transitions;
- workers' views of potential transitions and the barriers that could impede them.

## Interviews

We interviewed 27 individuals from organizations across Canada. Examples of the types of organizations interviewed include private companies working in the clean economy, industry associations, not-for-profits, think tanks, environmental advocacy groups, educational institutions (colleges, polytechnics, and universities), unions, and other labour advocacy groups.

We used a purposive sample for the interview component of the project, reaching out to subject matter experts in the occupational transition and clean economy space, and organizations that are actively involved in the clean economy. We then used a snowball sampling strategy to select the remaining participants based on recommendations from our interviewees.

Interviews were semi-structured and based on four primary themes: the state of the clean economy in Canada; changes to current and future occupations; new and emerging skills; and transition strategies.

Each participant was interviewed for 30–60 minutes over Microsoft Teams. The interviews were recorded with each participant's permission. We then undertook a thematic analysis of the interviews. The interviews also helped finalize the survey questionnaire for workers in HRLM occupations to capture their views and experiences regarding occupational transitions.

## Survey

The survey was administered online using SurveyMonkey Audience from March 9–10, 2021. It sought to assess worker views on 19 questions related to occupational transitions and the clean economy. We collected 546 responses from workers in a variety of organizations and industries across Canada. (See Table 1.)

## Appendix A, Table 1
## Demographic Information of Survey Respondents

| Organization size | Percentage of respondents |
|---|---|
| 1 to 99 | 28.9 |
| 100 to 499 | 22.2 |
| 500 to 2,499 | 18.9 |
| 2,500 or more | 30 |
| **Organization type** | |
| Private sector corporation | 60.4 |
| Government department/agency | 19.6 |
| Hospital/university/college/school board | 10.6 |
| Not-for-profit organization | 6.2 |
| Crown corporation | 3.1 |
| **Industry** | |
| Educational services | 11 |
| Finance and insurance | 10.6 |
| Manufacturing | 9.7 |
| Health care and social assistance | 9.2 |
| Construction | 8.8 |
| Unsure | 8.4 |
| Professional, scientific, and technical services | 7.7 |
| Retail trade | 6.6 |
| Public administration | 6.6 |
| Other services (except public administration) | 5.3 |
| Accommodation and food services | 3.1 |
| Transportation and warehousing | 2.6 |
| Administrative and support, waste management, and remediation services | 2.2 |
| Agriculture, forestry, fishing, and hunting | 1.6 |
| Arts, entertainment, and recreation | 1.6 |
| Utilities | 1.3 |
| Wholesale trade | 1.1 |
| Mining, quarrying, and oil and gas extraction | 0.7 |
| Information and cultural industries | 0.7 |
| Management of companies and enterprises | 0.7 |
| Real estate, rental, and leasing | 0.4 |

(continued ...)

| Age | |
|---|---|
| Under 18 | 0.7 |
| 18 to 24 | 6.2 |
| 55 to 64 | 17.4 |
| 25 to 34 | 19.2 |
| 35 to 44 | 25.8 |
| 45 to 54 | 29.9 |
| 65 and older | 0.7 |
| **Gender** | |
| Woman | 55.5 |
| Man | 43 |
| Non-binary | 0.7 |

Source: The Conference Board of Canada.

## Skills Similarity

We estimate cognitive and task-based skill distances between a given pair of occupations using the cosine similarity score. Cosine similarity measures the angle between any two non-zero vectors. It is defined as the inner product space of the cosine of the angle between the two vectors. The values of cosine similarity range from 0 and 1.[23]

The transition similarity scores are based on two different skills data sources: O*NET and Vicinity Jobs. (See Table 2.) We weighted each source to reflect the richness of the data. We gave more weight to O*NET (0.6) than Vicinity Jobs (0.4) because O*NET provides more varied information to the transition process (i.e., knowledge, skills, abilities; work activities; and education, training, and experience). Vicinity Jobs provides information about two broad categories (i.e., skills, and education and experience).

### Appendix A, Table 2
### Data Inputs Are Used in the Calculation of the Similarity Score

| Source | Input | Dimensions | Definition |
|---|---|---|---|
| O*NET | Knowledge | 33 | Organized sets of principles and facts applying in general domains. |
| | Skills | 35 | Developed capacities that facilitate learning or the more rapid acquisition of knowledge. |
| | Abilities | 52 | Enduring attributes of the individual that influence performance. |
| | Work activities | 41 | General types of job behaviours occurring on multiple jobs. |
| | Education, training, and experience | 41 | The frequency of categories for education, training, and experience of each occupation. |
| Vicinity Jobs | General/soft skills | 52 | General/soft skills that apply to most occupations. |
| | Specialized skills | 147 | Specialized skills apply to specific jobs. |
| | Tool and equipment and technology | 4,099 | Equipment, tools, and technological skills entail knowledge of information and communication technologies and heavy machinery. |
| | Experience | 2 | The experience requirements for the stated occupation. |
| | Education | 7 | The education requirements for the stated occupation. |

Sources: O*NET; Vicinity Jobs.

23 See Rao, Hindle, and Gabler, *Modelling Job Transitions in Canada*.

## Skill-Level Categories

We assign 4-digit NOC occupations to skill levels identified by Economic and Social Development Canada. (See Table 3.)

### Appendix A, Table 3
**Economic and Social Development Canada Skill Level Categories**

| Level | Description |
|---|---|
| 0 | Management jobs. |
| A | Professional jobs that usually require a degree from a university. |
| B | Technical jobs and skilled trades that usually require a college diploma or training as an apprentice. |
| C | Intermediate jobs that usually require high school and/or job-specific training. |

Source: Economic and Social Development Canada.

## Skills Gains

The values in Table 4 correspond to the bottom, median, and top quartiles of the distribution of skills shortages among occupational transitions that do not involve skills excesses. A score of 1 refers to a perfect similarity between origin and destination occupations in our model (i.e., 100 per cent similarity).

Hence, 0.12 means that the cognitive skill set of an employee is 12 percentage points more similar to the cognitive skill sets associated with the occupation to which he or she is wishing to transition (upon completing six months of training).

Similarly, 0.23 means that the task-based skill set of an employee is 23 percentage points more similar to the task-based skill sets associated with the occupation to which he or she wants to transition (after six months of training).

Lastly, 0.16 is the combination of cognitive and task-based skills gains for the six months of training. In other words, after six months of training, the overall skill set of an employee becomes 16 percentage points more similar to the overall skill sets associated with the occupation to which they want to transition. The same logic applies to the longer training scenarios in our transition model.

### Appendix A, Table 4
**Skills Gain Increase With More Training**

| | Minor Training (i.e., Six Months) | Moderate Training (i.e., One Year) | Major Training (i.e., Three Years) |
|---|---|---|---|
| **Quartile** | **25th** | **50th** | **75th** |
| Cognitive upskilling | 0.12 | 0.19 | 0.24 |
| Task up- or re-skilling | 0.23 | 0.31 | 0.37 |
| **Weighted average** | **0.16** | **0.24** | **0.29** |

Note: Weighted average = (cognitive up-skilling, quartile-based * 0.6) + (task up- or re-skilling, quartile-based * 0.4)
Sources: The Conference Board of Canada; Organisation for Economic Co-operation and Development.

# Appendix B
# The Clean Economy

## Industries in the Clean Economy Are Diverse

### Clean Energy Production

These are activities related to the production, transmission, and distribution of clean energy. For example, a company that operates a solar electric power generation facility or wind farm falls under this category. Eighteen industries comprise the energy production sector of the clean economy. (See Table 1.)

**Appendix B, Table 1**
**Industries in the Clean Energy Production Sector**

| NAICS Code | NAICS Title |
|---|---|
| 221111 | Hydroelectric power generation |
| 221113 | Nuclear electric power generation |
| 221114 | Solar electric power generation |
| 221115 | Wind electric power generation |
| 221116 | Geothermal electric power generation |
| 221117 | Biomass electric power generation |
| 221118 | Other electric power generation |
| 221121 | Electric bulk power transmission and control |
| 221122 | Electric power distribution |
| 221330 | Steam and air-conditioning supply |
| 332410 | Power boiler and heat exchanger manufacturing |
| 333611 | Turbine and turbine generator set units manufacturing |
| 335311 | Power, distribution, and specialty transformer manufacturing |
| 335911 | Storage battery manufacturing |
| 335931 | Current-carrying wiring device manufacturing |
| 237130 | Power and communication line and related structures construction |
| 237990 | Other heavy and civil engineering construction |
| 238210 | Electrical contractors and other wiring installation contractors |

Source: Statistics Canada.

### Energy Efficiency

These activities increase energy efficiency via the manufacturing of energy-saving products, the construction of energy-efficient buildings, and the provision of services that reduce end-use energy consumption. For example, a company that manufactures air-conditioning, heating, or commercial and industrial refrigeration equipment falls under this category. Forty-six industries comprise the energy efficiency sector of the clean economy. (See Table 2.)

### Environmental Management

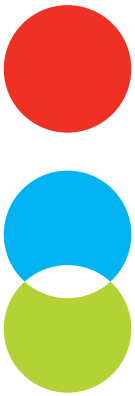
These activities focus on environmental management issues as well as the conservation and regulation of natural resources. For example, a consulting company that provides advice and assistance to businesses and other organizations on environmental issues—such as the control of environmental contamination from pollutants, toxic substances, and hazardous materials—falls under this category. Seventeen industries comprise the clean environmental management sector of the clean economy. (See Table 3.)

## No Official Definition of "Green"

An analysis of task content shows that green jobs vary in "greenness," with very few jobs consisting exclusively of green tasks. This analysis suggests that we should consider the term "green" a continuum rather than a binary characteristic.[24]

Some green occupations are nascent and driven by new technological applications. Others evolve from green economic activity in an existing part of the economy. We can describe this "greening" of occupations by the extent to which green technologies and economic activity:[25]

- increase the demand for existing occupations;
- shape the work and worker requirements needed for occupational performance;
- generate unique worker requirements.



24 Bowen and others, "Characterising Green Employment."
25 Dierdorff and others, *Greening of the World of Work*.

## Appendix B, Table 2
## Industries in the Energy Efficiency Sector

| NAICS Code | NAICS Title |
|---|---|
| 327993 | Mineral wool manufacturing |
| 332321 | Metal window and door manufacturing |
| 332322 | Sheet metal work manufacturing |
| 333415 | Air-conditioning and warm air heating equipment, and commercial and industrial refrigeration equipment manufacturing |
| 336111 | Automobile manufacturing |
| 336112 | Light truck and utility vehicle manufacturing |
| 336120 | Heavy-duty truck manufacturing |
| 336211 | Motor vehicle body manufacturing |
| 336310 | Motor vehicle gasoline engine and engine parts manufacturing |
| 336320 | Motor vehicle electrical and electronic equipment manufacturing |
| 336330 | Motor vehicle steering and suspension components (except spring) manufacturing |
| 336340 | Motor vehicle brake system manufacturing |
| 336350 | Motor vehicle transmission and power train parts manufacturing |
| 336360 | Motor vehicle seating and interior trim manufacturing |
| 336370 | Motor vehicle metal stamping |
| 336390 | Other motor vehicle parts manufacturing |
| 334512 | Automatic environmental control manufacturing for residential, commercial, and appliance use |
| 334513 | Instruments and related products manufacturing for measuring, displaying, and controlling industrial process variables |
| 334515 | Instrument manufacturing for measuring and testing electricity and electrical signals |
| 336510 | Railroad rolling stock manufacturing |
| 335110 | Electric lamp bulb and part manufacturing |
| 335121 | Residential electric lighting fixture manufacturing |
| 335122 | Commercial, industrial, and institutional electric lighting fixture manufacturing |
| 335210 | Small electrical appliance manufacturing |
| 335221 | Household cooking appliance manufacturing |
| 335222 | Household refrigerator and home freezer manufacturing |
| 333413 | Industrial and commercial fan and blower and air purification equipment manufacturing |
| 333414 | Heating equipment (except warm air furnaces) manufacturing |
| 334413 | Semiconductor and related device manufacturing |
| 335312 | Motor and generator manufacturing |
| 335999 | All other miscellaneous electrical equipment and component manufacturing |
| 236115 | New single-family housing construction (except for-sale builders) |
| 236116 | New multi-family housing construction (except for-sale builders) |
| 236117 | New housing for-sale builders |
| 236118 | Residential remodelers |
| 236210 | Industrial building construction |
| 236220 | Commercial and institutional building construction |
| 237210 | Land subdivision |
| 238350 | Finish carpentry contractors |
| 238220 | Plumbing, heating, and air-conditioning contractors |
| 238160 | Roofing contractors |
| 238990 | All other specialty trade contractors |
| 541310 | Architectural services |
| 541340 | Drafting services |
| 541320 | Landscape architectural services |
| 541350 | Building inspection services |

Source: Statistics Canada.

## Appendix B, Table 3
### Industries in the Environment Management Sector

| NAICS Code | NAICS Title |
|---|---|
| 541620 | Environmental consulting services |
| 562111 | Solid waste collection |
| 562112 | Hazardous waste collection |
| 562119 | Other waste collection |
| 562211 | Hazardous waste treatment and disposal |
| 562212 | Solid waste landfill |
| 562213 | Solid waste combustors and incinerators |
| 562219 | Other nonhazardous waste treatment and disposal |
| 562910 | Remediation services |
| 562920 | Materials recovery facilities |
| 562998 | All other miscellaneous waste management services |
| 813312 | Environment, conservation, and wildlife organizations |
| 924110 | Administration of air and water resource and solid waste management programs |
| 924120 | Administration of conservation programs |
| 925120 | Administration of urban planning and community and rural development |
| 926120 | Regulation and administration of transportation programs |
| 926130 | Regulation and administration of communications, electric, gas, and other utilities |

Source: Statistics Canada.

We identify three green occupational categories: green increased demand, green enhanced skills, and green new and emerging. (See Table 4.) We expect the green transition will affect the green increased demand occupations more heavily in the short term. However, as more workers acquire the knowledge and skills needed to transition, green enhanced skills and new and emerging occupations will play a larger role in the medium to long term.

Even with these occupation categories, it is still difficult to classify and quantify employment in green occupations. The green increased demand category highlights this challenge, as an occupation may be considered green in one industry but not in another. By examining the relative concentration of occupations in each clean economy industry, we can understand which occupations are “greener” based on their relative importance in each of the green industries.

## Appendix B, Table 4
## The Three Clean Economy Occupation Categories

| | Green increased demand | Green enhanced skills | Green new and emerging |
|---|---|---|---|
| Change in overall demand/supply | Increase in the employment demand for an existing occupation. | Increase or no increase in the employment demand for an existing occupation. | Entirely novel or "born" from an existing occupation. |
| Changes in skill sets | No significant changes in the work and worker requirements of the occupation. | Significant change to the work and worker requirements of an existing occupation. | Unique work and worker requirements necessary, resulting in the generation of a new occupation. |
| Example | Increased demand for electrical power line installers and repairers related to energy efficiency and infrastructure upgrades. | Increased knowledge requirements of energy-efficient materials and construction, as well as skills associated with integrating green technology into the aesthetic design of buildings. | Wind turbine service technician who installs, inspects, maintains, operates, and repairs wind turbines. |

Sources: The Conference Board of Canada; Dierdorff and others, "Greening of the World of Work."

This approach identifies occupations within each clean economy sector based on a concentration quotient (CQ). The CQ measures the relative importance of any given occupation to each clean economy sector compared with the overall economy. The CQ formula is:

$$CQ = \frac{\text{Occupation's share of sectoral employment}}{\text{Occupation's share of national employment}}$$

Values greater than 1 indicate that a given occupation is more important to the clean economy than the overall economy. Values less than 1 indicate that a given occupation is less important to the clean economy than the overall economy. Values equal to 1 indicate that a given occupation is equally important to the clean economy and the overall economy.[26]

Table 5 describes the final list of rapid-growth, clean economy occupations.

26 We performed this analysis using U.S. labour market data due to the availability of industrial employment at the detailed level (i.e., 6-digit NAICS).

## Appendix B, Table 5
## The Three Clean Economy Occupation Categories

| NOC | Title | SOC | Title | Green category |
|---|---|---|---|---|
| 125 | Other business services managers | 13-1199.01 | Energy auditors | New and emerging |
| 714 | Facility operation and maintenance managers | 11-1021.00 | General and operations managers | Enhanced skills |
| 1112 | Financial and investment analysts | 41-3099.01 | Energy brokers | New and emerging |
| 1121 | Human resources professionals | 131151 | Training and development specialists | Enhanced skills |
| 2141 | Industrial and manufacturing engineers | 172112 | Industrial engineers | Increased demand |
| 2243 | Industrial instrument technicians and mechanics | 499081 | Wind turbine service technicians | New and emerging |
| 2263 | Inspectors in public and environmental health, and occupational health and safety | 195102 | Occupational health and safety technicians | Enhanced skills |
| 6552 | Other customer and information services representatives | 434051 | Customer service representatives | Increased demand |
| 7205 | Contractors and supervisors, other construction trades, installers, repairers and servicers | 47-1011.03 | Solar energy installation managers | New and emerging |
| 7233 | Sheet metal workers; boilermakers; structural metal and platework fabricators and fitters & ironworkers | 472211 | Sheet metal workers | Enhanced skills |
| 7235 | Structural metal and platework fabricators and fitters | 472221 | Structural iron and steel workers | Increased demand |
| 7244 | Electrical power line and cable workers | 499051 | Electrical power-line installers and repairers | Increased demand |
| 7313 | Refrigeration and air conditioning mechanics; machine fitters; elevator constructors and mechanics | 499021 | Heating, air conditioning, and refrigeration mechanics and installers | Enhanced skills |
| 7441 | Residential and commercial installers and servicers | 499071 | Maintenance and repair workers, general | Enhanced skills |
| | | 472231 | Solar photovoltaic installers | New & emerging |
| | | 47-4099.02 | Solar thermal installers and technicians | New & emerging |
| | | 47-4099.03 | Weatherization installers and technicians | New & emerging |
| 7452 | Material handlers | 537062 | Laborers and freight, stock, and material movers, hand | Increased demand |
| 2255 | Technical occupations in geomatics and meteorology | 15-1199.05 | Geographic information systems technicians | New & emerging |
| | | 15-1199.04 | Geospatial information scientists and technologists | New & emerging |
| | | 19-4099.02 | Precision agriculture technicians | New & emerging |
| | | 19-4099.03 | Remote sensing technicians | New & emerging |

Note: NOCs 6552 and 7233 are also classified as HRLM occupations. NOC 6552 is a green increased demand occupation that will experience relatively high growth (i.e., higher than the average of the total economy). Workers in this occupation will be able to transition to green industries without additional training because work requirements will remain mostly the same. NOC 7233 is a green enhanced skill occupation for which work requirements will be substantially different in the future.
Sources: The Conference Board of Canada; Statistics Canada; O*NET.

# Appendix C
# Detailed Results

## Appendix C, Table 1
**The Number of Occupations by the Number of Desirable Transitions**

| Minor Training (i.e., Six Months) | | Moderate Training (i.e., One Year) | | Major Training (i.e., Three Years) | |
|---|---|---|---|---|---|
| **HRLM occupations** | **Desirable transitions** | **HRLM occupations** | **Desirable transitions** | **HRLM occupations** | **Desirable transitions** |
| 23 | **0** | 2 | **0** | 1 | **4** |
| 3 | **1** | 11 | **3** | 1 | **7** |
| 4 | **2** | 2 | **4** | 2 | **8** |
| 41 | **3** | 2 | **7** | 1 | **9** |
| 1 | **4** | 10 | **8** | 1 | **10** |
| 4 | **6** | 6 | **9** | 21 | **11** |
| 5 | **7** | 5 | **10** | 8 | **12** |
| 5 | **8** | 47 | **11** | 41 | **14** |
| 1 | **9** | 2 | **12** | 11 | **13** |
| 3 | **10** | 4 | **14** | 5 | **16** |
| 2 | **11** | 1 | **13** | | |
| **Average** | **6** | **Average** | **8** | **Average** | **10** |

Sources: The Conference Board of Canada; O*NET; Vicinity Jobs.

## Appendix C, Table 2

### Average Direct Training Cost of Transition Varies by Effort and Jurisdiction

(C$)

| Province/Territory | Minor Training (i.e., Six Months) | Moderate Training (i.e., One Year) | Major Training (i.e., Three Years) | Average |
|---|---|---|---|---|
| Prince Edward Island | 13,820 | 27,468 | 82,730 | 41,339 |
| Alberta | 12,189 | 24,224 | 73,006 | 36,473 |
| New Brunswick | 11,485 | 22,812 | 68,773 | 34,356 |
| Saskatchewan | 11,322 | 22,480 | 67,768 | 33,857 |
| Manitoba | 10,189 | 20,248 | 61,024 | 30,487 |
| Nova Scotia | 9,708 | 19,295 | 58,150 | 29,051 |
| Northwest Territories | 9,146 | 18,402 | 55,254 | 27,601 |
| Newfoundland and Labrador | 8,950 | 17,771 | 53,574 | 26,765 |
| British Columbia | 8,943 | 17,775 | 53,570 | 26,763 |
| Ontario | 8,777 | 17,445 | 52,573 | 26,265 |
| Nunavut | 8,721 | 17,442 | 52,326 | 26,163 |
| Canada | 8,688 | 17,269 | 52,043 | 26,000 |
| Yukon | 7,687 | 15,329 | 46,215 | 23,077 |
| Quebec | 6,195 | 12,314 | 37,111 | 18,540 |

Note: Costs do not increase proportionally between training scenarios because each comprises different pathways (i.e., transition pairs), and each pathway is associated with a different cost.
Sources: The Conference Board of Canada; O*NET; Vicinity Jobs; Statistics Canada.

## Appendix C, Table 3

### Average Indirect Training Cost of Transition Varies by Effort and Jurisdiction

(C$)

| Province/Territory | Minor Training (i.e., Six Months) | Moderate Training (i.e., One Year) | Major Training (i.e., Three Years) | Average |
|---|---|---|---|---|
| Alberta | 23,578 | 44,226 | 128,765 | 65,523 |
| Nunavut | 26,451 | 44,156 | 116,284 | 62,297 |
| Northwest Territories | 22,483 | 41,475 | 118,555 | 60,838 |
| Saskatchewan | 21,525 | 40,068 | 116,743 | 59,445 |
| British Columbia | 20,277 | 38,802 | 113,535 | 57,538 |
| Newfoundland and Labrador | 21,198 | 37,595 | 111,664 | 56,819 |
| Yukon | 20,748 | 38,651 | 110,947 | 56,782 |
| Canada | 19,469 | 36,806 | 107,746 | 54,674 |
| Ontario | 19,347 | 36,273 | 105,836 | 53,819 |
| Manitoba | 18,832 | 35,262 | 103,512 | 52,535 |
| Nova Scotia | 18,029 | 33,797 | 99,372 | 50,399 |
| Prince Edward Island | 18,134 | 33,515 | 97,552 | 49,734 |
| Quebec | 17,526 | 33,531 | 97,946 | 49,668 |
| New Brunswick | 17,029 | 32,140 | 94,233 | 47,800 |

Note: Costs do not increase proportionally between training scenarios because each comprises different pathways (i.e., transition pairs), and each pathway is associated with a different cost.
Sources: The Conference Board of Canada; O*NET; Vicinity Jobs; Statistics Canada.

# Appendix D
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