



ECO CANADA

Environmental Careers Organization



The Green Jobs Map

Tracking Employment through Canada's Green Economy

LABOUR MARKET RESEARCH STUDY

2012

Canada

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ECO CANADA

ECO Canada develops programs that help individuals build meaningful environmental careers, provides employers with resources to find and keep the best environmental practitioners, and informs educators and governments of employment trends to ensure the ongoing prosperity of Canada's growing environmental sector.



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EXECUTIVE SUMMARY



Examining the Green Transition through an Employment Lens

In popular discourse and major political circles, the green economy has proved to be an irresistible topic. Such allure stems from both the urgency of the problems currently threatening the health of our environment and economy, as well as the breadth of the solutions that the green economy can provide. Yet the same characteristics that make the green economy so popular are also those that can render it meaningless and ineffective. When the green economy means so many *different* things to so many people, there's the risk of never really arriving at a clear idea of what the green economy actually encompasses or which strategies can best support its growth.

It is this dilemma of transforming the ideals of the green economy into tangible results that informs the present study, *The Green Jobs Map*. In recognition of the fact that there are many roads that lead to the final destination of a successful green economy, this research zeros in on one path – employment – to develop a clearer sense of what green growth entails for policymakers, businesses and workers.

This focus on green employment outcomes is deeply necessary for a variety of reasons. For one, such an approach ensures that discussions of the green economy remain grounded in concrete and measurable issues, like green skills needs and employment demand. For another, the potential for the green economy to produce positive economic, environmental and social changes is fully reliant on effective workforce development. As noted in a recent report by the ILO and EU, "The success of implementing green policies is dependent on the availability of skilled people."¹ Thus, detailed and up-to-date information is needed on what Canada's emerging green economy means for job demand, competency requirements and training needs.

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If we are to promote a green economy we have to link it to employment opportunities.

GREEN ECONOMY EXPERT PANELIST

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To bridge this informational gap on jobs in the green economy, *The Green Jobs Map* focuses on three areas: the major contributing industries in the Canadian green economy, essential green competencies within these industries, and the requisite green skills and training that professionals need in order to work in these particular occupations. Ultimately, these insights inform a larger conversation about the evolution of the green economy, the current strategies that are needed to support the success of green industries, and the future prospects of environmental employment in Canada.

If there's one aspect of the green economy that is frequently misunderstood, it is the notion that green growth represents something entirely new and unprecedented. In fact, the green economy is better perceived as the culmination of a long-term increase in environmental awareness and enhanced civic influence over corporate and government decisions related to the environment. As the latest evolution of environmental activities and occupations that have actually been around for a while, the green economy is part of a larger enduring trend.

¹ International Labour Office and the European Union, *Anticipating skill needs for the low carbon economy? Difficult, but not impossible*, 2011.

In ECO Canada's previous report, *Defining the Green Economy*,² researchers found that a green economy impacts the labour force mainly through the adaptation or reallocation of jobs, with "existing workers having to learn new skills and/or broaden their pre-existing skill sets." Despite this preliminary look into the occupational changes linked to a green economy, there has been relatively little done to systematically classify required competencies and knowledge.

Over the course of *The Green Jobs Map*, it was apparent that the growing influence of the green economy has corresponded with greater integration of environmental information into strategic decision-making and business planning. The intellectual capital amassed over decades of environmental work in regulatory-driven contexts, such as expertise in human health and safety, environmental protection, and environmental remediation, is now being applied to an expanded range of areas.

Such a shift demonstrates not only how important environmental considerations are to numerous business functions, but also how more companies are starting to see the green transition as an opportunity, rather than a cost. In contrast to a past focus on the inconvenience or negative economic impact of environmental regulations linked to natural resource extraction, heavy industry or manufacturing, more businesses are now choosing to focus on the advantages they can gain through the green transition.

As a result, the general perception of environmental industries, demand for environmental knowledge, and applications of environmental work are changing:

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There are many reports warning of a looming skills gap in the green economy. It is advantageous to know the skills in demand in a green economy so we can ensure our workforce is capable. It helps both those new entrants to the green economy and employers to clearly define skill sets and competencies required to enter emerging sectors. It also helps post-secondary institutions to develop the proper skill sets for the labour market.

GREEN ECONOMY EXPERT PANELIST

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Popular Environmental Discourse: Drivers/Perceptions	Recent/Emerging Green Transition: Drivers/Perceptions
<ul style="list-style-type: none">• Regulatory requirements• Environment as a "cost"• Reactive to environmental impact – emphasis on cleaning up• Compliance-driven	<ul style="list-style-type: none">• Increases in efficiency, cost savings• Environment as an "opportunity"• Proactive planning, decision making• Widespread realization of benefits of investing in the environment

² ECO Canada, *Defining the Green Economy*, 2010.



Environmental employment spans a broad spectrum – it is a continuum of highly-skilled contributions from the very technical to the integration of environmental intellectual capital into existing business practices. As a starting point, it can be observed that jobs in sectors linked to a green economy can be classified into two categories.

The first group is made up of jobs that require environmental skills, knowledge, experience or competencies in order to produce products or services that have an environmental benefit. Examples of these jobs include industrial engineers who design production systems that require fewer resources or produce less waste, product designers who design products to be recycled, architects and land use planners who incorporate sustainability into designs, and environmental occupations such as air quality engineers, conservation officers, and environmental communications managers.

While workers in the second category perform economic activities that have an environmental benefit, they do not require environmental knowledge or skills in order to perform their work. These jobs include construction or trades workers that apply knowledge of standard construction techniques while completing green projects, mass transit vehicle operators who contribute to a more resource-efficient transportation system, but do not require any special environmental knowledge, manufacturing production workers at companies that produce environmental goods, or low-skilled agricultural workers employed at organic farms.

Most of the research on jobs linked to a green economy focuses on the combination of all jobs, both those requiring environmental skills or knowledge, and those that do not. Without the distinction between those jobs requiring special skills and knowledge, it is difficult for students, workers, and educational stakeholders to maintain a shared understanding of the education and training that helps to advance a green economy. Accordingly, this study focuses on those jobs that are linked to a green economy and also require environmental skills.

ECO Canada's occupational research demonstrates that environmental work tends to be founded first on formal disciplines (e.g. engineers, chemists, geologists, etc.), and secondly on multi-disciplinary work, or "discipline-plus," developed from experience and professional training. These competencies may be shared amongst many different formal occupations, but are specific to environmental work. "Discipline-plus" competencies are identified in ECO Canada's National Occupational Standards (NOS) for environmental employment. Using this occupational standards-based approach, ECO Canada developed a database of online job vacancy advertisements from a wide-range of national sources during the months of March through May 2012. The analysis involved a total of 835 job postings strongly linked to supporting a green economy.

This sample of job postings was collected conservatively, limiting the sample to only those jobs clearly linked to supporting a green economy through the application of environmental skills and knowledge. Jobs that don't reference environmental skills in the job description requirements – or jobs with scant or vague mention of environmental skills – are excluded. In addition, jobs that are clearly linked to a green economy, but that require few specialized skills, are excluded. Finally, any job that is not directly and clearly linked to supporting a green economy is also excluded.

A review of existing taxonomies conducted at the outset of this study determined the industries, sectors, products and services that most researchers consider to be linked to a greener economy. References to green industries and sectors in these reports are grouped into eleven categories:

- Renewable and Green Energy Generation
- Energy Efficiency and Green Building
- Resource Conservation
- Alternative and Sustainable Transportation
- Environmental Protection
- Green Products Manufacturing
- Green Services
- Sustainability Planning & Urban Design
- Carbon and Climate Change Mitigation
- Green Retail
- Eco-Tourism

The multi-dimensional content analyses of green job descriptions provide a unique perspective on jobs in a green economy. While there is a great degree of overlap with demand for green competencies, employers in green sectors are most frequently seeking skills sets related to Corporate Environmental Program Planning and Implementation (32% of job vacancies) and Environmental Business, Technology & Product Development (31%).

Competency Areas in Demand for Jobs in a Green Economy



Note: Total does not equal 100%, since more than one competency could be listed per job posting.

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The career path framework is useful from the perspective of informing people who want to contribute to a green economy – what they need to find jobs that make a contribution.

GREEN ECONOMY EXPERT PANELIST

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This research provides a framework for understanding the competencies and occupations that are in demand for supporting a green economy for Canada. The transition to a green economy is clearly under way (evidenced in job demand), but it will likely continue to go through a state of evolution as new technologies give rise to new environmental products and services. The employment-based approach taken in this study is not intended to statically define jobs for a green economy, but rather to establish the important subjects for ongoing research that will help all workers to make career decisions that make a contribution to a green economy.

Environmental professionals undoubtedly play a crucial role in the green transition, especially in connecting environmental knowledge to strategic planning and business operations. These environmental integrators bridge the gap between the more technical or conventional approach to environmental work by interpreting and applying information to enable organizations to capitalize on the benefits of environmentally responsible pursuits and pass those benefits on to consumers.

The results of this study show that green careers are alive and well in areas like corporate environmental program planning and implementation, and environmental business, technology and product development. As more organizations pursue a green future, the demand for environmental professionals – the key to a successful and prosperous green transition – is remarkably strong.



Key Take-Away Points from *The Green Jobs Map*

The Green Jobs Map is intended to function exactly as its name implies. It is a practical resource for professionals, policy-makers, researchers and employers that charts the under-explored terrain of current employment opportunities in the Canadian green economy. Accordingly, *The Green Jobs Map* is focused on establishing detailed and relevant information on the major characteristics of green jobs, from the top sectors where these occupations can be found to the types of jobs available and the main requirements for working in these roles. This is a level of detail that involves going beyond simply counting the sheer number of green jobs. Instead, *The Green Jobs Map* determines what the key requirements are for these jobs and how both existing and future green workers can tailor their professional development to ensure that they are on the right track to employment success.

By tracing the unique characteristics of employment in Canada's green economy, *The Green Jobs Map* reveals clear pathways to rewarding and viable green careers. Out of the various insights included in this map of the green employment landscape, the following are the top three most essential features to keep in mind.

1.) Green employment demand is strongly driven by established environmental industries

The green economy is very much an extension and expansion of existing environmental work, and as a result, much of the employment linked to the green economy is associated with environmental industries and practices that have been around for a while.

When researchers reviewed the sample of job postings linked to the green economy, they found that 70% of these job vacancies were in the following sectors:

- Environmental Protection
- Resource Conservation
- Renewable and Green Energy
- Green Services
- Sustainability Planning & Urban Design
- Eco-tourism
- Energy Efficiency & Green Building

Amongst these sectors, the top two with the highest employment demand were in established sectors, such as environmental protection, which accounted for 38% of the job postings, and resource conservation, which had 21% of the job listings, as indicated in the table below.

Table 1
Job Vacancies by Green Sector, March-May 2012

GREEN ECONOMY SECTOR	SHARE OF JOB POSTINGS IDENTIFIED/ANALYZED
Environmental Protection	38%
Resource Conservation	21%
Renewable/Green Energy	11%
Green Services	10%
Sustainability Planning/Design/Urban Design	8%
Eco-Tourism	5%
Energy Efficiency & Green Building	4%
Alternative/Sustainable Transportation	2%
Carbon and Climate Change Mitigation	1%
Green Retail	1%
Green Manufacturing	0%
Total	100%

While the bulk of current employment opportunities in the green economy are still in well-established environmental sectors, there are indications that several emerging green industries may soon close this gap. Relatively new green sectors, such as renewable/green energy and green services, are clearly going through a phase of significant job growth, with these two specific sectors accounting for 11% and 10% respectively of the total number of green job openings.



2.) Green employers are looking for staff who can integrate environmental expertise into business planning and development

One of the most important findings from the study was the high value that many green companies placed on competencies associated with applying environmental knowledge to corporate planning and business development. While specialized and highly technical roles may still be important, a growing number of green companies were clearly looking for staff who could also bridge the gap between environmental expertise and business savvy.

Out of the pool of green job postings analyzed in this research, 32% of the jobs listed corporate environmental program planning and implementation as a required competency, while 31% of these listings mentioned a requirement for proficiency in environmental business, technology and product development.

The prevalence of these top two competencies also underscores a major transition amongst companies. Rather than merely react to an environment-related issue or comply with regulations, many businesses are taking a more proactive approach and clearly see environmental protection and sustainability as opportunities instead of costs.

3.) Careers in the green economy are both widespread and highly transferable

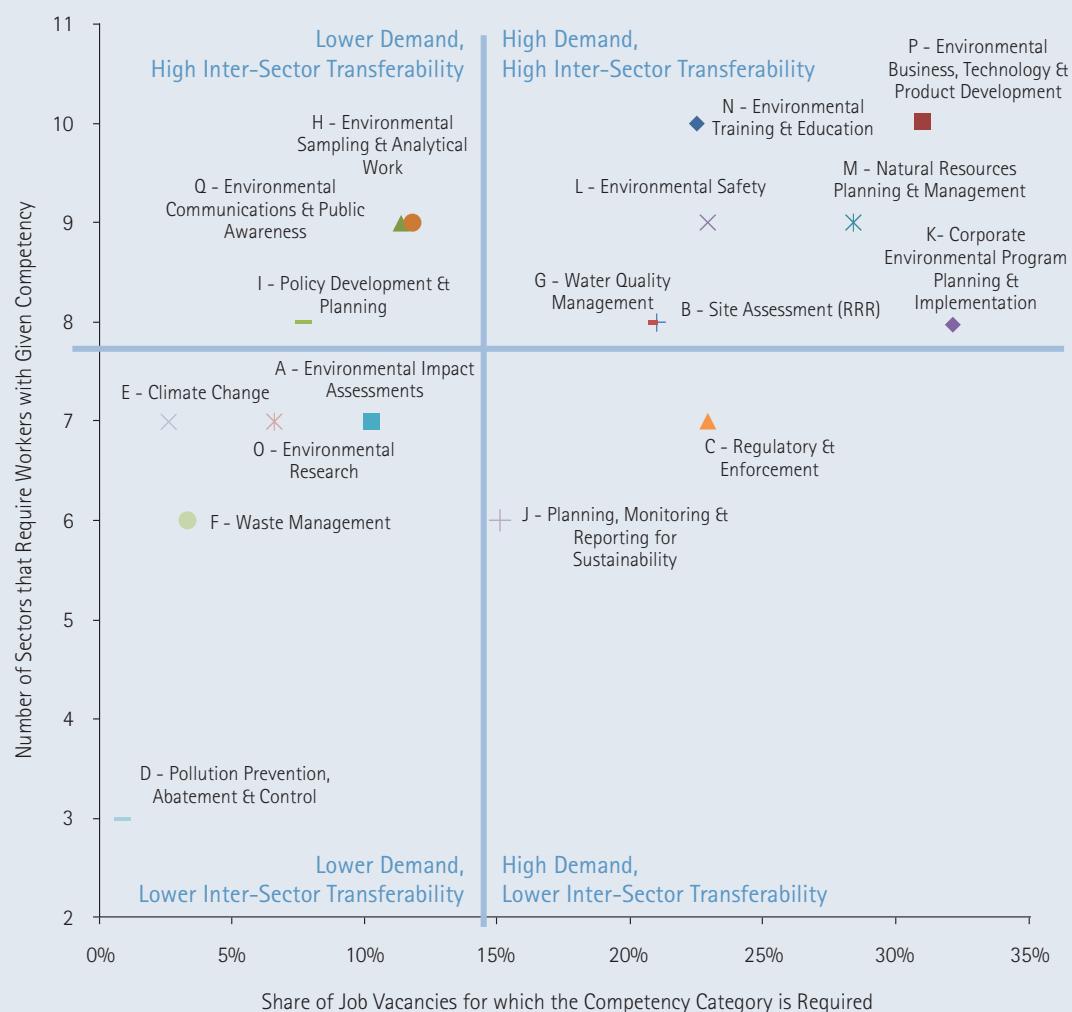
One of the most common assumptions about employment in the green economy is that these types of jobs are highly specialized and technical, with only narrow career options available. Yet as *The Green Jobs Map* demonstrates, many jobs linked to the green economy featured competencies that were in high demand across a variety of sectors. The following figure depicts the difference between green competencies according to the level of demand for each competency and the number of sectors in which the competency is required.

As seen in the figure, the top competencies with high transferability across diverse green sectors included:

- Environmental Business, Technology and Product Development
- Environmental Training & Education
- Natural Resources Planning & Management
- Environmental Safety
- Environmental Communications and Public Awareness

Ultimately, green professionals who develop these high-demand and highly transferable green competencies are ensuring that they can have a rewarding and varied career in the environment, as opposed to simply having a job. These workers can expect a greater number of job opportunities, as well as a greater range of work contexts and activities.

Figure 1
Transferability and Demand for Environmental Competencies





PROJECT BACKGROUND

Emergence of a Green Economy

The notion of fostering a green economy has developed out of a rich historical context rooted in environmental protection, resource conservation, and sustainable development. Much of the recent interest in green growth draws on ideas about environmental management that have been building for decades, if not centuries, dating back to the earliest attempts to manage waste and sanitation. The notion of a green economy reverses a historical dichotomy of the "environment versus the economy," replacing the notion of competing interests with a recognition that there are many opportunities to establish new businesses and jobs that are linked to solutions that protect the environment. In the context of emerging clean technology to improve energy and resource efficiency and sustainability, a green economy can be understood as the latest evolution of environmental activities. It is part of a larger enduring trend.

Initial attempts to address environmental concerns in the late 19th to early 20th century often positioned the environment and the economy as having two diametrically opposed goals. Initiatives like the Conservation Movement made sense in the face of the erosion, climate change, and poor water quality caused by unregulated logging during the 1850s to mid-1900s. However, the notion of environmental protection did not receive widespread support because of its presumed conflict with economic progress. As Peterson Del Mar notes, "Conservation fared poorly when it appeared to threaten peoples' livelihoods."³

Through a series of high profile environmental disasters, the issues of environmental degradation and pollution moved up the social list of priorities from "nice to have" to urgent problems requiring immediate mitigation. Communities realized that they could no longer afford the steep human costs incurred by catastrophes like Love Canal or Three Mile Island. Subsequently, new legislation was enacted to support clean air, water and solid waste management and this coincided with the establishment of national and provincial environmental regulatory agencies to enforce laws and rehabilitate damaged eco-systems.



Following the World Commission on the Environment in 1987, environmental awareness took a new turn. In contrast to the previous approach of reacting to shocking environmental disasters, public attention shifted to long-term planning that coupled the importance of economic development with the need for effective environmental management. The Brundtland report's famous definition of sustainable development⁴ appealed to policymakers, industry leaders and concerned citizens alike. The concept of integrated environmental and economic development struck a happy medium among diverse stakeholders, but the sustainability movement was hampered by a number of issues. In order to satisfy numerous competing interests and arrive at a consensus, the concept of sustainability functioned as an abstract principle with much room for interpretation. The lack of a shared definition and consistent criteria for sustainable development not only made it difficult to link sustainability to practical outcomes, but also opened the door to superficial and inadequate attempts to meet sustainability objectives.

Out of this historical context, the green economy has emerged as the next opportunity to address environmental, economic and social concerns. Much of the present notion of green economic success draws on ideas about environmental management that have been building for some time. These include the need for a long-term, integrated approach to sustainable development and the importance of recognizing the protection of the environment as an opportunity instead of a cost.

³ David Peterson Del Mar, *Environmentalism*, Harlow: Pearson Education Ltd., 2006.

⁴ The Brundtland definition of sustainable development is, "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." *United Nations' World Commission on the Environment and the Economy, Report of the World Commission on Environment and Development: Our Common Future*, 1987.

What makes the concept of a green economy unique from its predecessors, however, is the remarkable currency it enjoys throughout mass media and political discourse. The green economy has become so popular for such a wide range of audiences that today, a basic Google search of the term "green economy" produces an incredible 5,600,000 results. Over the course of the research for this project, it was apparent that the popular perception of a green economy involves at least six key components. These include:

1. Economic prosperity based on sustainable development

A major driver behind the concept of a green economy is the notion that the environment and the economy do not have to be two mutually exclusive and contradictory objectives. Consequently, the shift to greener practices involves making environmentally-conscious decisions that still support long-term increases in profit and significant returns on investment.

2. New technologies, industries and areas of growth

This aspect of green is one of the most popular when people think of a green economy. As a growing number of governments, businesses and consumers commit to conserving resources and reducing environmental impact, innovative new technologies and industries have proliferated. From wind power to green roofs, the growth of a green economy relies on the ongoing development of creative solutions to environmental challenges.

3. Valuing natural capital and assets

One of the most powerful components of a green economy is the idea that natural resources have a value when left in their original state, and not only when they have been developed for industrial use. Thus, it has become increasingly important for businesses and policymakers to establish an economic value for natural assets, as well as to consider how environmental degradation presents a form of economic loss that must be counted against whatever profits are generated through the unmitigated use of natural resources.

4. Minimizing harmful environmental impact and increasing efficiency

This is the most essential part of what it means to be green. Businesses who claim to produce green products or use green processes must demonstrate how these products and processes generate less waste, minimize emissions, use resources more efficiently, reduce environmental risk and/or improve health and safety. Establishing consistent standards for these green activities is essential for avoiding green washing, in which organizations make superficial and inadequate attempts to demonstrate environmentally-responsible practices.

5. Creating lasting social and ethical benefits

The development of the green economy represents a valuable opportunity to do things right, this time around. As a result, green has also come to be associated with corporate social responsibility and the triple bottom line (people, planet, profits) in which environmental and economic concerns share equal importance with fair and ethical social decisions. In this manner, the adoption of green practices often coincides with the development of fair trade, equitable living wages, and alternate forms of employee compensation that acknowledge the importance of work-life balance and a healthy lifestyle.

6. Increases environmental awareness and environmentally-responsible lifestyles

Going green does not start at the level of big businesses and governments – it starts with the choices of individual consumers and voters. Through spreading awareness of environmental issues and a marked increase in green marketing, green living has become a major, mainstream concept. A rapidly growing number of people are choosing to purchase green products, reduce waste in their homes, and support environmental policies. In turn, the combined impact of these decisions has shaped large-scale policy and business planning.

Within these six different factors, the concept of a greener economy manages to address many of the most pressing social, environmental and economic issues affecting communities around the world today. In this way, the green economy has become a powerful driver of positive, long-lasting change through the growth of new industries, major technological advancements, and improved employment prospects.

Defining a Green Economy: A Complex Task

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The United Nations Environment Programme (UNEP) defines a green economy as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcity. In its simplest expression, a green economy is low-carbon, resource efficient, and socially inclusive. In a green economy, growth in income and employment are driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services.⁵

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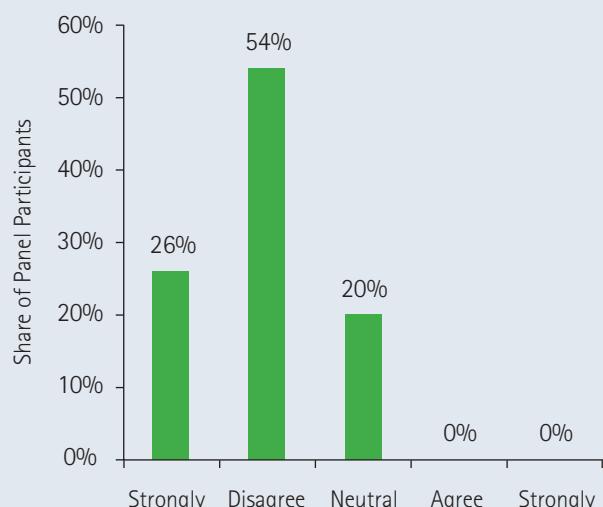
Much of the political and economic research on a greener economy is based on a definition that is similar to, or directly based upon, the UNEP definition quoted above. Indeed, a literature review of 33 studies reveals that most researchers define a green economy in similar ways and make reference to similar economic sectors or industries such as renewable and clean energy, energy efficiency, green building, resource conservation, alternative or sustainable transportation, and protection of the environment.

A survey of expert researchers and business leaders who are directly involved in transitioning the world to a greener economy reveals that 80 per cent of experts think that a greener economy is an idea that most people do not understand well.

Part of the difficulty of understanding the green economy is due to the impressive scope of business practices, regulations and policies, technologies, products, and ideas that it encompasses. As noted in a recent study, *A Green Economy for Canada: Consulting with Canadians*, "You can only win with this strategy – it takes into account people, innovation, and a lot of other aspects⁶." Simply put, a green economy means a lot of different things to a lot of different people.

Figure 2

To what extent do you agree with the following statement: "A green economy is a concept that is well-understood by most people."



Green Economy Expert Panel, n=35

⁵ United Nations' Environment Programme (UNEP), *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*, 2011.

⁶ Carolyn Webb and Thomas C. Esakin, *A Green Economy for Canada: Consulting with Canadians*, Canadian Institute for Environmental Law and Policy, 2011.

Measuring the Greening of the Economy: A Focus on Jobs

Measuring jobs linked to a green economy is challenging because industrial, occupational, and product classification systems do not consistently indicate whether a product, service, or process has an environmental benefit. Researchers measuring jobs in a green economy have addressed this challenge by establishing criteria and decision rules for determining the companies and industries they consider to be contributors to a greener economy. As a result, a set of green economy taxonomies have been developed that categorize the green industries and sectors linked to a green economy. These include areas such as natural resources conservation, waste management, environmental regulatory compliance, energy efficiency, resource efficiency, renewable energy, green building materials, and a large number of other categories.

Figure 3
Green Economy Sector Categories Mentioned in Secondary Report Taxonomies (number of reports making mention of the sub-sector)



*Green services are inclusive of business services, education, policy, R&D, communications, and financial services.
See Table 1 for a description of each sector.

Industries and Sectors in the Green Economy

A variety of taxonomies and classification systems have been devised to describe economic activities in a greener economy. There are ten industry-based taxonomies that were reviewed in this study to determine the industries, sectors, products and services that most researchers consider to be linked to the green economy. These taxonomies were identified in the following reports:

- *Green Jobs Definition* (US Bureau of Labor Statistics, 2011)
- *Sizing the Clean Economy* (the Brookings Institution-Battelle, 2011)
- *British Columbia's Green Economy: Securing the Workforce of Tomorrow* (Globe Group, 2010)
- *Greening the Economy: Transitioning to New Careers* (Toronto Workforce Innovation Group, Workforce Planning Board for York Region and Bradford West Gwillimbury, and the Peel-Halton Workforce Development Group, 2009)
- *The Clean Energy Economy* (Pew Charitable Trust, 2009)
- *Measuring the Green Economy* (US Department of Commerce, 2010)
- *Job Opportunities for the Green Economy* (Political Economy Research Institute, 2008)
- *Understanding a Green Economy - A Community College Perspective* (California Centers of Excellence, 2009)
- Canadian adaptation of the occupations identified by the California Centers of Excellence (Comparison made by HRSDC)
- *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication* (United Nations' Environment Programme, 2011)

An inventory of the green economic sectors that are described in each report's taxonomy reveals common themes.⁷ References to greener industries and sectors in these reports can be grouped into eleven broad sector categories described in Table 2. Appendix F outlines the sub-components of each of these green sectors identifying how they were referenced in each of the 10 reports listed above.

⁷ The exercise is not intended to create a new or separate green economy industry taxonomy. Rather, the inventory identifies the prevalence and collective emphasis that is placed on selected industries that are linked to a green economy.

Table 2
Sectors Commonly Referenced by Researchers Studying Green Economic Activity

SECTOR	DESCRIPTION
1. Renewable and Green Energy Generation	This sector encompasses four subsectors: (1) Renewable power and heat generation, (2) Production of biofuels and biogas, (3) Other forms of greener energy; and (4) Renewable energy services. Renewable power generation includes hydropower, ocean and wave energy, solar energy (both solar thermal and photovoltaic solar power), wind energy and geo-exchange or earth energy. The biofuels subsector includes activities linked to production of bioenergy, biofuels, landfill gas, and municipal solid-waste-to-fuel activities. Other forms of greener energy include cogeneration of power, hydrogen power, and nuclear energy. Renewable energy services include the professional, technical, and scientific services that support a renewable energy sector.
2. Energy Efficiency and Green Building	The energy efficiency sector includes (1) green building activities and (2) other energy efficiency technologies and applications. The green building subsector includes architectural and construction services to build more energy and resource-efficient buildings or retrofit existing buildings to improve their resource efficiency. It also includes building inspection and audit for resource and energy efficiency, deconstruction of inefficient systems or structures, resource-efficient landscaping, the use of energy-saving building materials, installation of energy-efficient HVAC and building control systems, energy-efficient lighting, resource-conserving water systems, and other professional energy services. Beyond green building services, the energy efficiency sector includes energy-saving consumer products and appliances, energy consulting, software and services, and fuel cell technologies.
3. Resource Conservation	The resource conservation sector encompasses fisheries and wildlife management, and natural resource management. The natural resource management subsector encompasses organic and sustainable agriculture, sustainable forestry, land management, water and soil conservation, storm water management, water-efficient products for natural resource management, and other forms of resource conservation.
4. Alternative and Sustainable Transportation	This sector includes two different subsectors: (1) vehicles and (2) transportation systems planning. The vehicles subsector includes electric vehicles, hybrid vehicles, alternative fuel vehicles, and fuel cell vehicles. It also encompasses repair and maintenance of these vehicles and fueling stations for these vehicles (e.g. stations supplying natural gas, hydrogen, electric power, etc.). The transportation systems planning subsector includes mass transit systems, transportation systems planning, and transportation logistics with reduced environmental impact such as traffic monitoring software or truck fleet tracking systems.
5. Environmental Protection	The sector encompasses seven subsectors with an environmental protection function: (1) Air quality, (2) Water quality, (3) Site assessment and reclamation, (4) Waste management, (5) Professional environmental services, (6) Pollution control, and (7) Environmental health and safety. The air quality subsector includes air purification technologies, air testing, and other services related to monitoring and improving air quality. The water quality subsector encompasses water testing, water purification technologies, and waste water treatment. The waste management subsector includes both waste treatment and recycling.

Table 2
Sectors Commonly Referenced by Researchers Studying Green Economic Activity
(continued)

SECTOR	DESCRIPTION
6. Green Products Manufacturing	This sector includes the production of goods that have an environmental benefit. Subsectors include green building materials, biomaterials, bioplastics, biochemicals, and biorubber products, green consumer products (including electrical equipment, appliances and components), environmental monitoring and control products, recycled-content products, eco-friendly packaging and green product process management. Some companies produce green paper products, green petroleum and coal products, and machinery used in protection of the environment or more efficient resource usage.
7. Green Services	Green services is a broad sector that encompasses several sub-sectors including (1) Environmental education and training, (2) Environmental communications and public awareness, (3) Policy and legislation, (4) Research and development, (5) Financial services including carbon finance and investment, financial services and venture capital for green businesses and energy trading, and (6) Business services including the use of ICT to lower environmental impact.
8. Sustainability Planning & Urban Design	This sector encompasses all activities related to planning for a sustainable urban environment.
9. Carbon and Climate Change Mitigation	This sector includes carbon capture and storage as well as activities that are related to mitigating the effects of climate change.
10. Green Retail	The green retail sector encompasses businesses that sell environmentally-friendly products as well as those who employ sales consultants to help customers make more environmentally-conscious purchasing decisions.
11. Eco-Tourism	This sector encompasses the services that are consumed by tourists as they visit fragile, pristine, undisturbed natural areas in a low-impact manner as to preserve the ecological system. Responsible eco-tourism includes all programs and activities that minimize the negative aspects of conventional tourism on the environment and enhance the cultural integrity of local people.

“

...having a real impact on a greener economy
can't be restricted to just a few sectors.

GREEN ECONOMY EXPERT PANELIST

”



Skilled Jobs that Support a Green Economy

The UNEP and Brookings-Battelle definitions of a green economy acknowledge that the competencies workers apply are enabling factors that support the emergence of a green economy. Unfortunately, information on the competencies and knowledge required in a green economy is limited, as is information on the occupations that enable the realization of a greener economy. In order for workers to choose careers linked to a green economy, better information is needed to understand career paths in a green economy, along with the competencies, knowledge, and experience that are required for these careers.

In ECO Canada's previous report, *Defining the Green Economy*,⁸ researchers found that a green economy impacts the labour force mainly through jobs being "adapted or reallocated, with existing workers having to learn new skills and/or broaden their pre-existing skill sets."

As a starting point, jobs in sectors linked to a green economy can be classified into two categories:

- (1) Jobs that require environmental competencies, knowledge, or experience in order to produce products or services that have an environmental benefit, and
- (2) Jobs that do not require environmental skills, knowledge, or competencies.

Examples of jobs in the first category include:

- Industrial engineers who design production systems with less waste or requiring less resources,
- Product designers who design products to be recycled,
- Architects and land use planners who incorporate sustainability into designs, and
- Environmental occupations such as air quality engineers, conservation officers, environmental communications managers, hazardous materials specialists, marine biologists, and many other occupations that require environmental knowledge and skills.

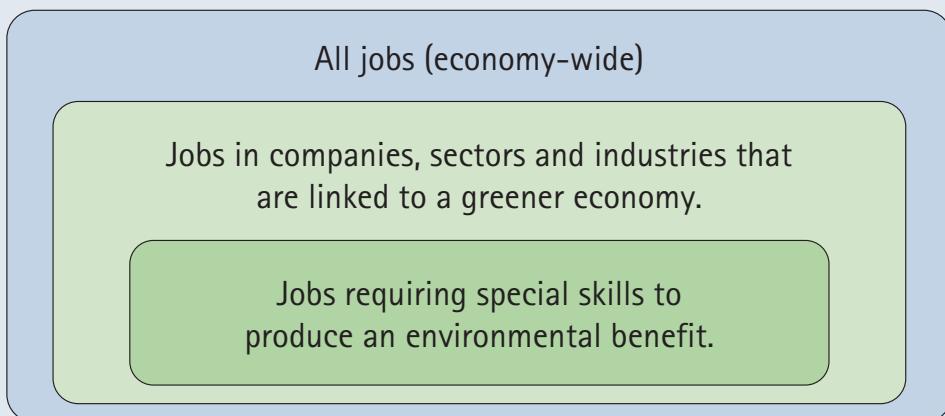
Examples of jobs in the second category include:

- Construction trades workers that apply knowledge of standard construction techniques while constructing a green building,
- Mass transit vehicle operators who contribute to a more resource-efficient transportation system, but do not require any special environmental knowledge,
- Manufacturing production workers at companies that produce environmental goods,
- Low-skilled agricultural workers employed at organic farms.

While workers in the second category perform economic activities that have an environmental benefit, they do not require environmental knowledge or skills in order to perform their work.

⁸ ECO Canada, *Defining the Green Economy*, 2010.

Figure 4
Jobs with Environmental Skills that are Linked to a Green Economy



Much of the existing research on employment in the green economy focuses on a combination of all jobs, including those that require specialized environmental competencies, and those that do not. In contrast, this study focuses on jobs in the green economy that require environmental expertise, since more information is needed on the unique environmental competencies and knowledge that are required for green careers. Additionally, this information provides a better understanding of the educational and training programs that are needed to support employment in the green economy.

Synopsis of the Research Approach

The research is based on an analysis of approximately 10,000 job vacancy advertisements that were posted online for jobs across Canada during the months of March through to May of 2012. Over 800 job vacancies were identified that make reference to environmental skills within the description of the requirements for the job. A set of computer-based algorithms were developed to analyze the text in each job advertisement to identify and classify the environmental skills that are referenced in the job description. Using this content analysis technique, the research team measured the demand for 17 categories of environmental skills and knowledge.

Based on occupational research conducted by ECO Canada, environmental work tends to be founded first on formal disciplines (e.g. engineers, chemists, geologists, etc.), and secondly on multi-disciplinary work, or "discipline-plus," developed from experience and professional training. These competencies may be shared amongst many different formal occupations, but are specific to environmental work. "Discipline-plus" competencies are identified in ECO Canada's National Occupational Standards (NOS) for environmental employment.

The NOS are based on extensive research performed by ECO Canada on an ongoing basis. The competencies that are required of workers in environmental occupations are identified in the NOS dictionary which defines 308 technical competencies along with 42 transferable competencies (350 competency statements in total).

- **Technical competencies** are statements that describe the demonstrated ability to perform a task (i.e. a series of activities that together produce a measurable result) to the satisfaction of the employer or otherwise established norms.
- **Transferable competencies** are statements that describe a behaviour or "soft skill" that may contribute to the successful performance of various technical tasks in the area of practice.

ECO Canada uses the 308 technical competencies and 42 transferable competencies to create occupational profiles for each area of practice. These occupational profiles demonstrate the level at which competencies must be performed by environmental professionals to work proficiently in their area of practice. The 308 technical statements are grouped into 17 technical categories (A-Q) that represent different types of environmental skill areas. Likewise, the 42 transferable competencies are grouped into eight transferable categories (1-8).

Content analysis algorithms are used in the research to analyze each sentence contained within each job description and determine the degree of match between the skills that are required for the job and the competencies that are listed in the NOS dictionary.

Figure 5
NOS Skills in Current Jobs - Determining the Relationship

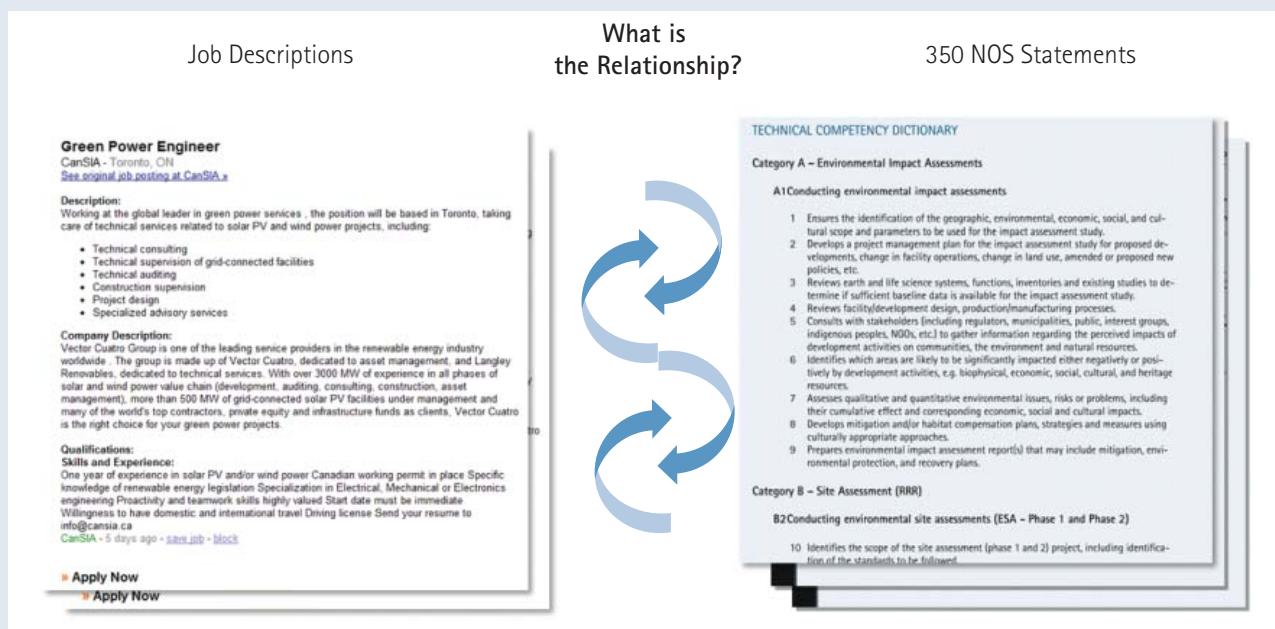
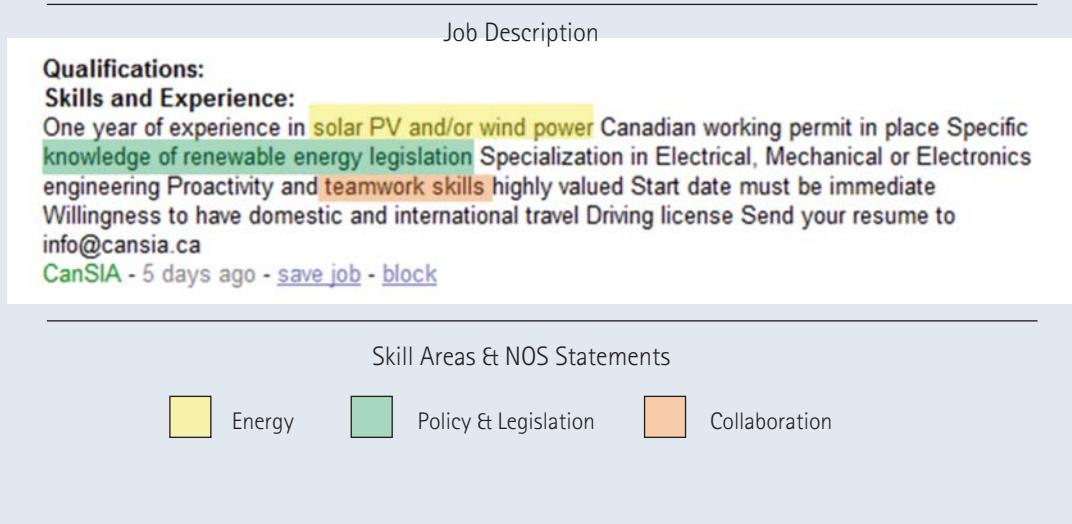


Figure 6
Example: NOS Statement Categories References in a Job Description





Two content analyses were performed: An analysis that associated NOS statements with sentences in each job description, and an analysis of all sentences in all job descriptions in order to identify clusters of associated concepts and themes. Figure 6 contains a simplified example in which three skills categories are identified: (1) energy (2) policy/legislation and (3) collaboration. Policy and legislation skills are identified in the NOS technical competencies, while collaboration and teamwork represent transferable NOS competencies, and energy-related knowledge is identified as a separate skill that is common to many jobs, but not referenced specifically in the NOS.

The aggregate of all jobs requiring environmental skills was analyzed in total to identify the prevalence of demand for each category of skills and then further analyzed to understand the particular occupations for which employers are currently seeking workers with skills in those categories. A comprehensive list of the technical competency statements is featured in Appendix E.

TOP JOB GROWTH PROSPECTS FOR CAREERS IN THE GREEN ECONOMY

A review of secondary reports confirms that practically all segments of the green economy appear to be experiencing some level of employment growth. Despite limited data on the labour force linked to the green economy, there are indicators that demand for workers and new skills and knowledge will continue to increase for many sectors. In the reports reviewed, the top growth sectors included:

Renewable Energy: In 2006, the Delphi Group estimated employment in the green energy sector to be approximately 6,800 workers and by 2012 the sector is expected to have grown to 29,000 workers across Canada.⁹ By some measures it would appear that this estimate is conservative. The Globe Group estimates that the sector has grown to over 24,800 workers in 2008 in the Province of British Columbia alone.

Wind Power: Canada's wind energy industry added approximately 1,267 MW of new wind energy capacity in 2011, representing an investment of \$3.1 billion and creating 13,000 person-years of employment.¹⁰ According to CanWEA, 2012 is expected to be a record year for wind development in Canada with approximately 1,500 MW of new developments expected to come online.

Solar Industries: The 2009 *Labour Force Survey of the Canadian Solar Industry* estimated a full-time equivalent (FTE) labour force of approximately 1,524 workers in 2008 and expected the figure to double by 2011 with 3,069 FTE workers. Delphi and HRSDC anticipate the sector to employ approximately 5,300 by 2012 and 13,500 workers by 2017. CanSIA's long-term vision for the solar industry includes a Canadian solar industry that supports more than 35,000 jobs by 2025, with widespread deployment throughout Canada driven by the market competitiveness of the technology.

Bioenergy: The Canadian Bioenergy Association estimates that through production and non-production, as well as indirect employment, the bioenergy industry employed an estimated 9,527 workers in 2011. This is similar to the HRSDC/Delphi employment projection for the sector of 10,800 FTE workers in 2012, up from 2,500 FTE workers in 2006.

Hydrogen Fuel Cell: According to the Canadian Hydrogen and Fuel Cell Association, the Canadian fuel cell sector consists mainly of small and medium sized enterprises and research organizations across the country. The sector currently employs approximately 2,000 Canadians in "highly-skilled, clean-tech jobs."¹¹

Battery Technologies: In a 2010 study of careers in the green economy in British Columbia, the Globe Group reported that, "Jobs developing energy storage systems [batteries] are becoming increasingly important as the world changes to electricity options surrounding intermittent renewable energy sources." Activities related to energy storage prototype development and testing occurs in British Columbia in the categories of battery chemistry and materials, chargers and converters, and system control.¹²

⁹ HRSDC and Delphi Group, *Situational Analysis of the Canadian Renewable Energy Sector with a Focus on Human Resource Issues*, 2007.

¹⁰ CanWEA, *Industry Review*, 2011.

¹¹ CHFCA, "The Canadian Sector" at <http://www.chfca.ca/the-sector/the-canadian-sector/>

¹² Globe Group, *Careers for a Sustainable Future*, 2010.



Smart Grid: According to CanmetENERGY, there were 65 pilot projects and applications¹³ of smart grid technology in 2010 that were planned or being tested by local governments and power authorities.

Green Buildings: ECO Canada's *Building Operator Scoping Study*¹⁴ noted that, "BOMA Calgary has identified a shortage of qualified building operators in Alberta. There is a requirement for 1,700 building operators in Alberta's major cities. With a reported average age of 55 for existing building operators and a 10% retirement rate and 10% attrition rate, they anticipate a need for 340 new building operators annually (100 to 150 in Calgary alone). At present, approximately 100 new operators are entering the Alberta market annually." According to the Johnson Controls Institute for Energy Efficiency Indicator Survey 2011, Canadian building operators, executives, and owners have a strong interest in energy efficiency: 68 per cent of respondents reported that energy management is "extremely important" or "very important" to their organizations.

Green Architecture: Energy and water efficient green architectural design has seen strong growth over the past decade. At the end of the fourth quarter of 2010, there were 3,135 LEED project registrations and certifications, up dramatically from 98 projects in 2004.¹⁵ A comprehensive 2009 study by McGraw-Hill Construction found that new green/sustainable building projects increased five-fold between 2005 and 2008 in the United States, and the overall value of the green building market is expected to triple by 2013. The growth in these projects has attracted over 100,000 professionals globally to seek a LEED professional credential. As of December 2011, there were 6,837 LEED-certified professionals in Canada.¹⁶

Green Construction: According to the Construction Sector Council's (CSC) Construction Company Survey 2011¹⁷, more than three-quarters (78%) of construction companies stated that public and consumer demand for green building has increased substantially or somewhat over the past five years. Authors of the survey concluded that, "The construction industry is reaching the point where green building is extending beyond a niche market to an overall shift in building trends." Challenges identified by employers relate to a lack of understanding surrounding building green systems, a lack of courses and information available, conflicting information, and unclear certification systems as well as other problems. The report concluded though that, "Specific skill-oriented training is not needed [in the construction sector] as much as additional resources and information (e.g., workshops, on-site orientation), which will help to educate industry players and raise awareness about green building and on-site practices." The CSC employer survey noted that, "Construction industry workers need to have a cohesive, standardized understanding of what constitutes green building, particularly at the management level." Management occupations represent 10.1 per cent of the construction industry labour force.¹⁸ In 2006, there were a total of 108,500 workers in management occupations in the construction sector. Demand for construction managers is expected to continue to grow over the next decade and CSC's labour market demand forecast for 2020 estimates that demand for construction managers will grow by 1.5 per cent per year from 2006 through 2020.

¹³ See list at: http://198.103.48.154/fichier.php/codetec/En/2010-087/2010-087_Smart_Grid_EN.pdf.pdf

¹⁴ ECO Canada, Building Operator Scoping Study, 2011.

¹⁵ Source: CaGBC 2011 Report: http://www.cagbc.org/AM/PDF/AGM_CEO_Report_with_Governance_Presentation%20-%20May%2031_11_C.pdf

¹⁶ See GBCI Statistics

¹⁷ See Green Sustainable Building in Canada 2011, Construction Sector Council.

¹⁸ See Census of Canada, Topic-based tabulations, 2006

Figure 7
Employment in Urban Transit Systems, Canada, 2000-2010



Source: Labour Force Survey, Statistics Canada

Electric Vehicles: In 2008, Electric Mobility Canada completed its first Directory of Electric Mobility Resources in Canada, which identified 131 companies and organizations that are involved in the production, integration, distribution, research, and development of electrical vehicles and components. As of 2011, the list of companies and organizations involved in the industry has grown to over 315. R&D, piloting and commercialization of EV technology are some of the key areas of employment in the EV industry at present. According to the Electric Vehicle Technology Roadmap for Canada,¹⁹ the Canadian labour force offers a range of fundamental research expertise in electric mobility, specifically battery development, battery management systems, and materials science. As a world leader in fuel-cell technology, Canada has skilled personnel across a wide range of energy storage, power management, and control systems. AUTO21, a Network of Centres of Excellence, enhances Canada's position as a leader in automotive research and development and currently supports nearly 200 researchers across Canada working on 39 auto-related projects in a variety of areas.

Urban and Transportation Planning: According to the 2006 Census of Canada, there were over 8,000 urban and land use planners in Canada in 2006, up from 6,660 such workers in 2001.

Public Mass Transit: There were 57,100 workers employed at 106 conventional urban transit systems and 68 specialized urban transit systems in Canada in 2010. Over the five years between 2005 and 2010, employment in the sector has experienced relatively strong growth, increasing at a compound annual growth rate of 5.7 per cent per year. There were nearly 3,500 routes served by conventional transit systems in Canada in 2010 and the number of routes served has increased by 24 per cent from 2006 to 2010. If this growth trend continues, employment demand for transit workers is likely to continue to experience strong growth.

Environmental Protection, Resource Conservation and Environmental Sustainability: Jobs in environmental protection and resource conservation were identified as belonging to the green economy by several of the taxonomies reviewed. These areas include those subsectors for which ECO Canada has conducted extensive research. The number of workers and growth trends for each of these segments is summarized in Table 3.

¹⁹ See: Electric Vehicle Technology Roadmap:
http://canmetenergy.nrcan.gc.ca/sites/canmetenergy.nrcan.gc.ca/files/pdf/fichier/81890/ElectricVehicleTechnologyRoadmap_e.pdf

Table 3
Environmental Employment 2010, Selected Categories

SECTOR	ENVIRONMENTAL EMPLOYEES 2010	EMPLOYEE DEMAND GROWTH EXPECTATIONS (Per Environmental Trends Report 2010)
Environmental protection		
Air quality	66,628	Stable
Water quality	114,333	Flat to Stable
Site assessment and reclamation	137,940	Moderate to High
Waste management	188,377	Stable
Resource Management		
Natural resource management	49,582	Moderate to High
Eco-preservation / wildlife and fisheries management	41,831	Declining
Environmental Sustainability		
Environmental education and training	120,623	Stable
Research and development	48,684	Moderate to High
Policy and legislation	103,249	Stable
Environmental communication and public awareness	131,085	Stable

Source: ECO Canada, 2010. *Note: categories of employment are not mutually exclusive. A worker can be counted in one or more categories.



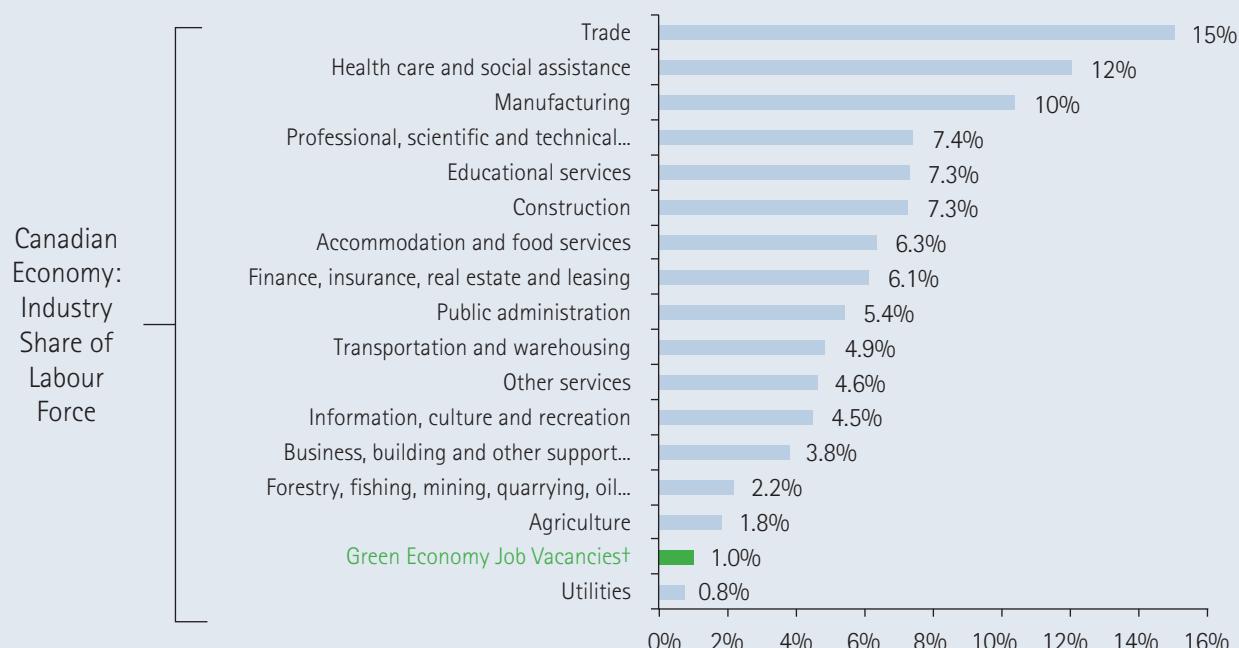
PROFILE OF JOBS-IN-DEMAND FOR A GREEN ECONOMY: CURRENT VACANCIES

Studies in the United States have estimated jobs linked to a green economy represent between 0.3 per cent and 2.0 per cent of total US employment, or as many as 2.7 million US workers.²⁰ In 2010, ECO Canada found that 4.0 per cent of workers in the Canadian labour force spend at least 50 per cent of their time on environmental tasks (682,000 workers), and these workers represent a significant portion of Canadian green economy jobs.²¹

Across Canada, during the months of March through May, 2012, a total of 835 job vacancy advertisements were found online which were strongly linked to supporting a green economy.

These vacancies were identified out of a pool of 83,451 online job postings that were collected from multiple online job aggregator websites. This sample of job postings has been limited to only those jobs that are clearly linked to supporting a green economy through the application of environmental skills and knowledge, as described in the job requirements written in job vacancy advertisements. Jobs that don't reference environmental skills – or jobs with scant or vague mention of environmental skills – are excluded. Since this conservative approach was used, it can be said that jobs linked to the green economy account for *at least* 1 per cent of recent job vacancies. When all forms of environmental employment are considered across sectors, this percentage is likely to be significantly higher.

Figure 8
Canadian Economy: Share of Labour Force by Industry vs.
Share of Job Vacancies Requiring Environmental Skills, March–May 2012



†Limited to job vacancies that clearly describe requirements for environmental skills.

²⁰ See Methodological Appendix, Sizing the Clean Economy; Brookings Institution – Battelle. http://www.brookings.edu/~/media/Series/resources/0713_clean_economy_appendix.pdf

²¹ ECO Canada, *Profile of Environmental Employment*, 2010. Note that 12.2% of Canadian workers spend at least some portion of their time performing environmental tasks.

Characteristics of Jobs Linked to a Green Economy

Years of Experience Required. Many of the jobs linked to a green economy are available to workers who have progressed significantly into their career. Nearly half of job vacancies (44 per cent) require between five and ten years of experience and 38 per cent of job vacancies require at least two to four years experience. Only 14 per cent require one year of experience or less, while four per cent require over ten years of experience.

Table 4

Number of Years of Experience Required for Jobs Linked to a Green Economy, March-May 2012

YEARS	MINIMUM LENGTH OF EXPERIENCE REQUIRED	SHARE OF SAMPLE OF JOB POSTINGS
0-1	One year or less	14%
2-4	Two to four years	38%
5-10	Five to ten years	44%
Over 10	Over ten years	4%
Total		100%

N = 409, Note: 51% of the sample of job vacancies do not indicate the minimum length of experience the employer expects of job candidates.

Level of Required Education. Post-Secondary education is required for the majority (98 per cent) of job openings linked to a green economy. A large portion of jobs linked to a green economy require a Bachelor's degree (72 per cent). About 1 in 5 job openings require some post-secondary education, below a Bachelor's degree. Six per cent of the jobs specify requirements for an advanced degree. Only about two per cent of job vacancies indicate that a high school education is sufficient for the position. A large portion of job openings in the sample (43 per cent) do not specify a specific educational requirement, but many of these jobs are for engineers, managers, and professionals, and as such, they likely require a significant amount of post-secondary education.

Table 5

Level of Educational Attainment Required in Job Vacancies Linked to a Green Economy, March-May 2012

EDUCATION LEVEL	SHARE OF SAMPLE OF JOB POSTINGS
High School	2%
Some Post-Secondary Education, Less than a Bachelor's	21%
Bachelor's	72%
Advanced Degree (Master's, PhD or Professional Degree)	6%
Total	100%

N = 476, Note: 43% of the sample of job vacancies do not indicate the minimum education the employer expects of job candidates.

Job Postings by Region. Ontario accounts for most of Canada's job vacancies (54 per cent), but vacancies for jobs supporting a green economy are under-represented in Ontario with the province accounting for about 40 per cent of green job vacancies. Alberta and British Columbia represent the bulk of the remaining vacant jobs linked to a green economy – they each represent just less than a quarter of vacant green jobs. British Columbia appears to be over-represented in green job opportunities – British Columbia accounts for 8 per cent of all job vacancies, while BC's share of the green job postings is an impressive 23 per cent. The share of job vacancies and green job vacancies in Québec is under-represented in this analysis because the algorithms developed for content analysis are specified in English. The Atlantic Provinces represent six per cent of the employed Canadian labour force. Only about two per cent of all job vacancies from March to May, 2012, were for jobs in the Atlantic Provinces, but six per cent of job vacancies linked to a green economy were located in these jurisdictions.

Table 6
Labour Force and Job Vacancy Postings by Region, March-May 2012

PROVINCE	SHARE OF EMPLOYED LABOUR FORCE (MAY 2012)	JOB VACANCIES	
		SHARE OF JOB VACANCY ADVERTISEMENTS LINKED TO A GREEN ECONOMY	SHARE OF ALL JOB VACANCY ADVERTISEMENTS
Atlantic Provinces (NL, NB, NS, PEI)	6%	6%	2%
Québec	23%	3%	7%
Ontario	39%	40%	54%
Prairies (MB, SK)	7%	4%	7%
Alberta	12%	22%	22%
British Columbia	13%	23%	8%
Territories	n/a	3%	0%
Canada (Total)	100%	100%	100%

Sources: Analysis of Job Vacancies, n=771. Note: Some jobs could not be classified by province; *Labour Force Survey*, Statistics Canada.

Job Postings by Occupational Category. Many of the job descriptions for job vacancies linked to a green economy cannot be easily classified according to the National Occupational Classification (NOC). The majority of job vacancies (69 per cent) do not have a strong match with any specific NOC occupation.²² Those that match are mainly associated with four occupational categories: 19 per cent are *Management Occupations*; 8 per cent are *Natural and Applied Sciences and Related Occupations* such as engineers, scientists, and related technicians, two per cent are *Trades, Transport and Equipment Operators and Related Occupations*, and two per cent are *Natural Resources, Agriculture and Related Production Occupations*.

²² Using the content analysis technique.

Job Postings by Green Sector

Of the 835 green job vacancies, 583 are strongly related to one of the eleven sectors often associated with a green economy (70 per cent). The remaining 30 per cent of job vacancies are not strongly related with one of the eleven sectors due to one of three reasons:

- (1) A conservative approach is used to categorize jobs into a green sector. Some jobs have requirements for environmental skills and knowledge that are applied in processes, but it is difficult to determine which sector the job is most closely aligned to due to the variability in how employers specify the application of required skills on the job.
- (2) In some cases, information in the job description is too limited to determine the industry or sector in which the environmental skills will be applied or in which the hiring company operates.
- (3) Some jobs are related to more than one green sector. For example, a job vacancy may require workers to perform environmental protection and resource management activities in the context of site selection and assessment for a wind farm in the green energy sector.

The largest number of vacancies by green sector is in the *Environmental Protection* sector, which represents 38 per cent of job vacancies supporting a green economy. Many of the jobs in this sector are well-established and have been in demand for decades. They include waste management, site assessment and reclamation, environmental health and safety, pollution control, and air and water quality.

The second largest sector by number of job vacancies is the *Resource Conservation* sector, which accounts for 21 per cent of job vacancies. This sector is also well-established and includes a variety of jobs in fisheries and wildlife management, organic and sustainable agriculture, sustainable forestry, land management, water and soil conservation, storm water management, water-efficient products for natural resource management, and other types of natural resource conservation.

The *Renewable/Green Energy* sector represents approximately 11 per cent of the vacant positions linked to a green economy. These jobs span all forms of renewable energy and heat (wind, PV solar, geothermal, etc.), biofuels, and other types of resource-efficient power generation (e.g. cogeneration). Jobs in the sector are diverse and include engineers, business managers, sales workers, skilled trades workers and facility service workers (e.g. wind turbine technicians).



Openings in the *Green Services* sector account for 10 per cent of job vacancies. This includes demand for workers in environmental education and training, environmental communications and public awareness, policy and legislation analysis and development, environmental research and development, financial services (including carbon finance and investment, financial services and venture capital for green businesses and energy trading), and business services including the use of ICT to lower environmental impact.

The remaining job openings are split among several sectors linked to a greener economy. About eight per cent of job openings are linked to the *Sustainability Planning/Urban Design* sector. Five per cent of job vacancies are related to *Eco-tourism* and four per cent are linked to the *Energy Efficiency and Green Building* sector. Two per cent of vacancies are related to the *Alternative/Sustainable Transportation* sector and one per cent or less is linked to the remaining sectors: *Green Retail, Carbon and Climate Change Mitigation, and Green Manufacturing*. It is worth mentioning again that these job vacancies are related only to the jobs in green sectors that require environmental competencies.²³

²³ For example, production workers in a green manufacturing business are not counted if they do not require environmental skills to perform their work, even though the production process or product they produce has a positive environmental benefit.

Table 7
Job Vacancies by Green Sector, March-May 2012

SECTOR	GREEN ECONOMY SECTOR	SHARE OF JOB POSTINGS IDENTIFIED/ANALYZED
1	Renewable/ Green Energy	11%
2	Energy Efficiency & Green Building	4%
3	Resource Conservation	21%
4	Alternative/Sustainable Transportation	2%
5	Environmental Protection	38%
6	Green Manufacturing	0%
7	Green Services	10%
8	Sustainability Planning / Design / Urban Design	8%
9	Carbon and Climate Change Mitigation	1%
10	Green Retail	1%
11	Eco-Tourism	5%
	Total	100%

N=583

The level of employer demand represented by job vacancies highlights a discrepancy between theory-based literature and current labour market reality. Much of the emphasis in the literature rests on the anticipation that job demand is mainly linked to new growth sectors such as renewable energy, energy efficiency, and green building. Green manufacturing and the production of environmental goods also is widely covered in the secondary literature, as qualitative researchers observe more companies responding to customers' preference for greener and cleaner products. The data on actual job vacancies tells a different story, however, suggesting that most of the job demand is still linked to the well-established green sectors of environmental protection and resource conservation.

This contradiction may be caused by the parameters of the jobs studied within the sample frame, which is limited to jobs that require specialized skills. It may also reflect the possibility that the transition to a green economy is in an "early adopter" stage and there is not yet a mass movement of demand for workers on the ground who possess environmental skills and knowledge. The disconnection may also simply be related to the lack of available hard data on jobs that support a green economy. In the absence of data on jobs linked to a green economy, the theoretical literature has focused on qualitative observations (e.g. what is new?) without access to information on the share of jobs that are linked to sectors driving a green economy.



I think many people would like to know the transition that is required and how they can be positioned in the future to meet the demand of the market.

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Top Competencies Required for Green Economy Jobs

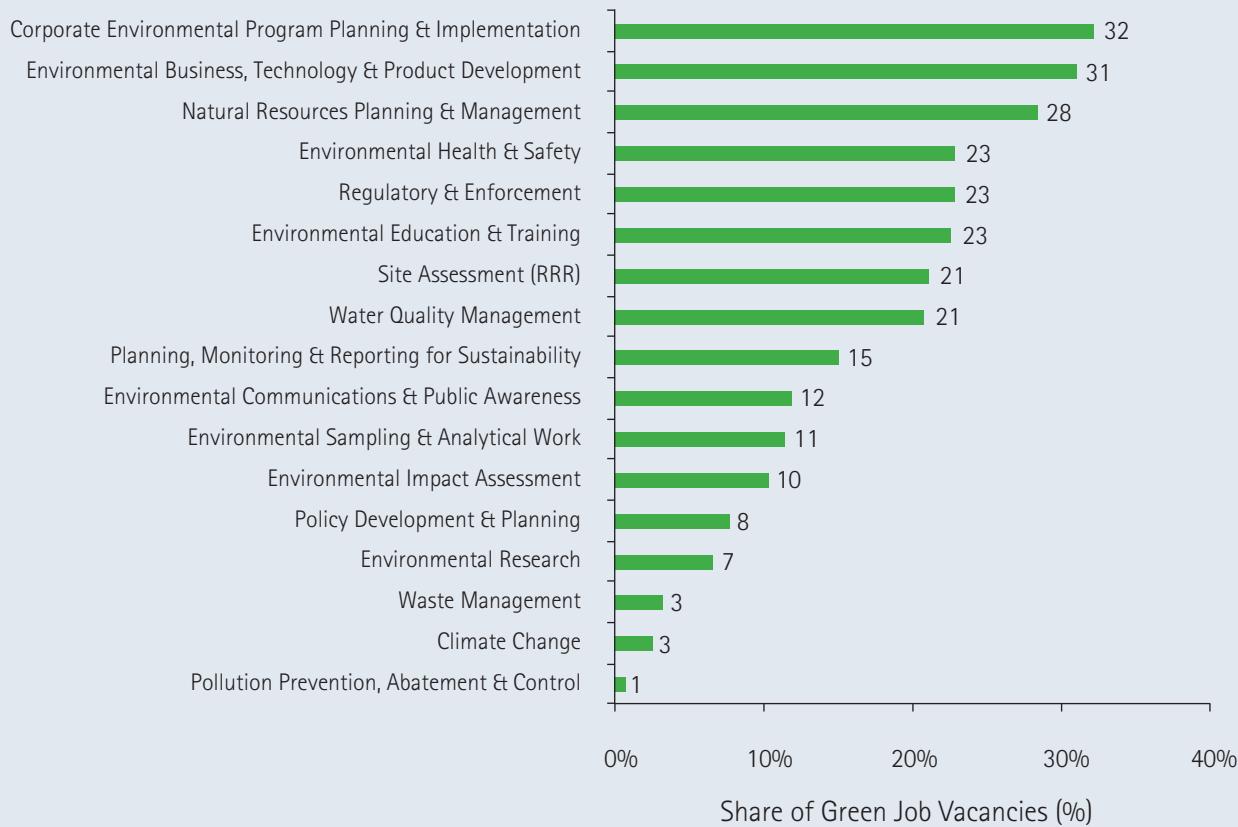
Analysis of the job descriptions for vacant positions reveals that eight of the 17 technical competencies described in ECO Canada's National Occupational Standards (NOS) are most frequently referenced as requirements for job vacancies. These include *Corporate Environmental Program Planning and Implementation* (required for 32 per cent of green job vacancies), *Environmental Business, Technology & Product Development* (31 per cent), *Natural Resource Planning & Management* (28 per cent), *Regulatory and Enforcement* (23 per cent) *Environmental Health and Safety* (23 per cent), *Environmental Education and Training* (23 per cent), *Site Assessment* (21 per cent) and *Water Quality Management* (21 per cent). Most job openings require a combination of these top eight competency areas.

Two NOS transferable competencies are commonly listed as requirements for job vacancies:

- *Professional Ethics and Work Style* competencies are required for most of the green job openings (55 per cent); and
- Competencies for *Leading/Influencing Others* are required for more than half (54 per cent) of the green jobs.

The other transferable skills were less frequently listed in requirements for vacant positions. About nine per cent of jobs have requirements for competencies in *Planning and Organizing Work and Projects*; about four per cent have requirements for *Communicating Effectively*; about three per cent state requirements related to *Business Acumen* and about one per cent make reference to competencies related to *Critical Thinking and Judgment*.

Figure 9
Demand for NOS Technical Competencies in Job Vacancies Linked to a Green Economy:
Share of Job Vacancies that Reference Requirements for Each NOS Technical Competency Category



Note: most jobs require several competencies, hence the percentages stated in the figure do not sum to 100%.

Figure 10
Number of Green Sectors with Job Requirements for NOS Technical Competencies



Transferability of Environmental Competencies among Sectors

Most NOS competencies are transferable between jobs in different green sectors. Competency areas with the highest level of inter-sector transferability include:

- *Corporate Environmental Program Planning and Implementation; and Environmental Business, Technology and Product Development.* These competencies are associated with job opportunities in eleven green sectors. *Environmental Communications & Public Awareness, Natural Resources Planning & Management, Environmental Health & Safety and Environmental Sampling and Analytical Work* are each associated with open positions in nine green sectors.

The level of demand for environmental technical and transferable skills varies among the eleven sectors. Table 8 summarizes the percentage of jobs in each sector that require each environmental competency.²⁴

²⁴ Note: caution should be exercised in interpreting these results because of small sample size of job vacancies for some of the green sectors. This analysis reflects job vacancies over a short period of time between March and May 2012 and is subject to sampling error and other limitations of the data that was collected.

Table 8
Percentage of Job Vacancies that Require Environmental Competencies

CATEGORY	NOS CATEGORY	GREEN SECTORS											# OF SECTORS WHERE SKILLS CAN TRANSFER
		1 RGE	2 EE/ GC	3 RC	4 AST	5 EP	6 GM	7 GS	8 SPD	9 CCCM	10 GR	11 ET	
NOS TECHNICAL													
A	Environmental Impact Assessment	-	9	8	23	8	-	8	19	13	-	-	7
B	Site Assessment (RRR)	18	20	5	15	25	-	13	3	-	-	25	8
C	Regulatory & Enforcement	15	17	13	8	28	-	33	28	-	-	-	7
D	Pollution Prevention, Abatement, & Control	-	-	-	-	-	-	-	3	13	-	-	3
E	Climate Change	8	11	5	-	3	33	8	-	13	-	-	7
F	Waste Management	3	3	-	8	10	-	3	6	-	-	-	6
G	Water Quality Management	-	31	27	31	24	33	10	19	-	-	6	8
H	Environmental Sampling & Analytical Work	18	17	14	38	25	33	13	14	13	-	-	9
I	Policy Development & Planning	3	9	6	8	11	-	21	19	-	-	6	8
J	Planning, Monitoring & Reporting for Sustainability	3	17	2	-	3	33	-	25	-	-	-	6
K	Corporate Environmental Program Planning & Implementation	38	14	16	23	38	-	26	33	25	-	-	8
L	Environmental Health & Safety	35	9	14	-	39	33	21	19	-	50	6	9
M	Natural Resources Planning & Management	35	49	67	15	29	-	36	58	25	-	63	9
N	Environmental Education & Training	13	34	19	23	19	33	56	33	13	-	13	10
O	Environmental Research	-	6	3	15	1	-	10	3	-	50	-	7
P	Environmental Business, Technology & Product Development	35	43	19	8	12	67	23	17	25	100	-	10
Q	Environmental Communications & Public Awareness	28	-	11	15	10	33	36	11	25	-	31	9

Table 8
Percentage of Job Vacancies that Require Environmental Competencies (continued)

CATEGORY	NOS CATEGORY	GREEN SECTORS											# OF SECTORS WHERE SKILLS CAN TRANSFER
		1 RGE	2 EE/ GC	3 RC	4 AST	5 EP	6 GM	7 GS	8 SPD	9 CCCM	10 GR	11 ET	
NOS TRANSFERABLE													
1	Professional Ethics and Work Style	60	26	30	38	38	33	51	33	50	50	38	11
2	Learning and Creativity	-	-	-	-	-	-	-	-	-	-	-	-
3	Communicating Effectively	-	3	-	15	1	-	3	-	-	-	-	4
4	Collaboration	-	-	-	-	-	-	-	-	-	-	-	-
5	Critical Thinking/Judgment	-	31	-	23	5	-	-	6	-	-	-	4
6	Planning and Organizing Work and Projects	-	-	-	-	1	-	-	-	13	-	-	2
7	Leading/Influencing Others	35	83	30	38	36	67	31	42	-	-	6	9
8	Business Acumen	5	-	-	-	-	-	-	-	-	-	-	1
OTHER TECHNICAL													
R	Sustainable Urban Planning	-	9	3	23	6	-	3	14	-	-	-	6
S	Power Generation Systems Management and Implementation	40	6	5	-	3	33	-	3	-	-	-	6
OTHER TRANSFERABLE													
9	Competencies for Data Analysis	18	20	29	23	32	33	8	14	38	50	-	10
10	Competencies for Human Resource Management	20	20	17	38	37	33	3	50	13	50	-	10

N=583; **Green Economy Industry Sectors:** RGE: Renewable/ Green Energy; EE/GB: Energy Efficiency & Green Building; RC: Resource Conservation; AST: Alternative/Sustainable Transportation; EP: Environmental Protection; GM: Green Manufacturing; GS: Green Services; SPD: Sustainability Planning / Design / Urban Design; CCCM: Carbon and Climate Change Mitigation; GR: Green Retail; and ET: Eco-Tourism.



CAREER PATHS IN A GREEN ECONOMY

Career Development and Flexibility

Most of the 17 competency categories are highly transferable, meaning that they are in demand for current job vacancies in several green sectors. Workers wishing to improve their career development potential can do so by focusing on the development of competencies that are in demand for a large percentage of job vacancies and are relevant for several sectors. Figure 11 highlights the most desirable competency areas in the "High Demand, High Inter-Sector Transferability" quadrant in the upper right.

Figure 11
Transferability and Demand for Environmental Competencies

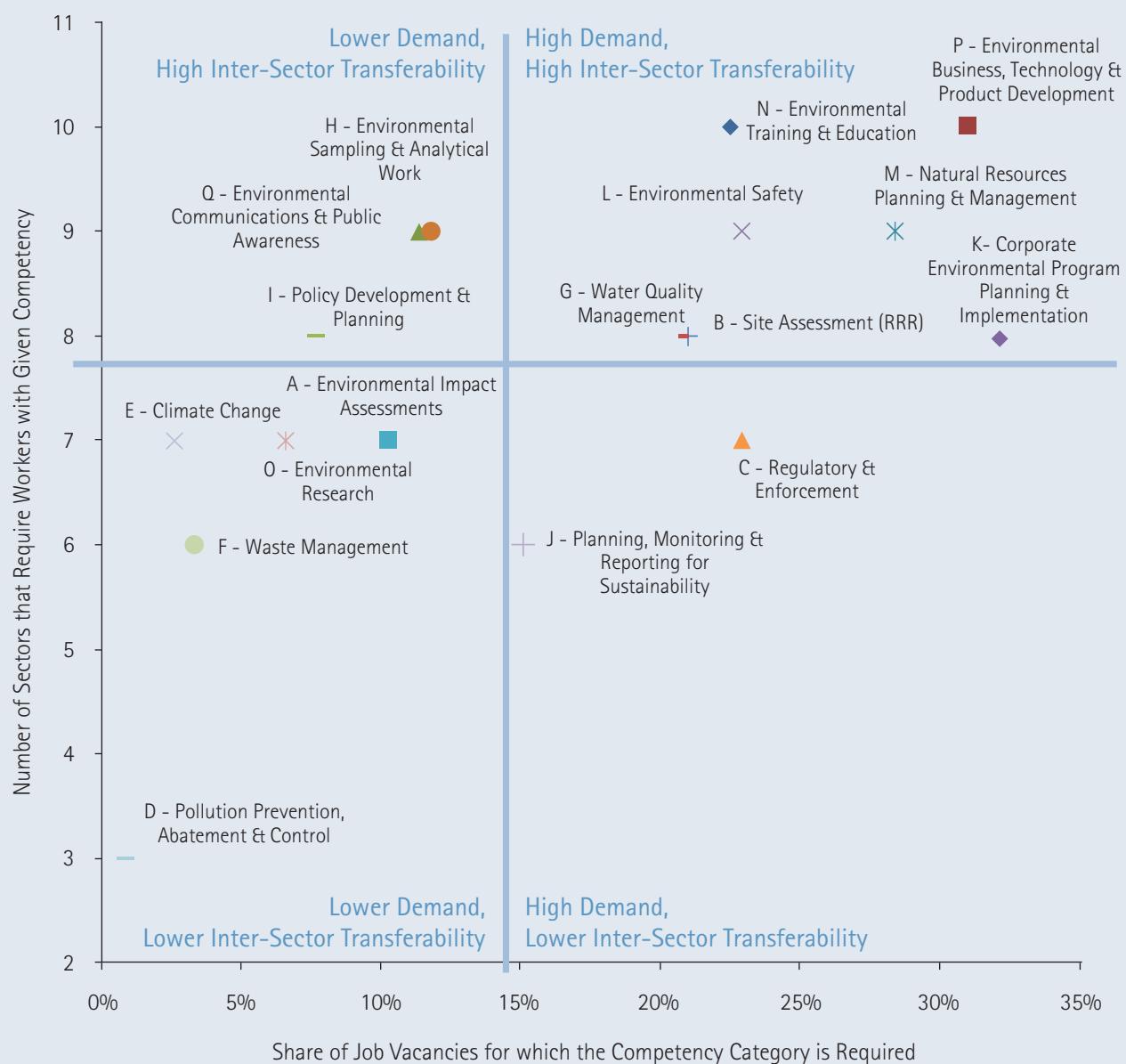


Table 9
Transferability and Demand for Environmental Competencies

COMPETENCY CATEGORY	SECTORS REQUIRING THE COMPETENCY	SHARE OF JOBS REQUIRING THE COMPETENCY
P – Environmental Business, Technology & Product Development	10	31%
N – Environmental Training & Education	10	23%
M – Natural Resources Planning & Management	9	28%
L – Environmental Safety	9	23%
Q – Environmental Communications & Public Awareness	9	12%
H – Environmental Sampling & Analytical Work	9	11%
K – Corporate Environmental Program Planning & Implementation	8	32%
B – Site Assessment (RRR)	8	21%
G – Water Quality Management	8	21%
I – Policy Development & Planning	8	8%
C – Regulatory & Enforcement	7	23%
A – Environmental Impact Assessments	7	10%
O – Environmental Research	7	7%
E – Climate Change	7	3%
J – Planning, Monitoring & Reporting for Sustainability	6	15%
F – Waste Management	6	3%
D – Pollution Prevention, Abatement & Control	3	1%

Between 20 per cent and 35 per cent of all job vacancies require competencies in one of the following categories:

- Corporate environmental program planning and implementation
- Environmental business, technology, and product development
- Natural resources planning and management
- Environmental training and education
- Environmental safety
- Site Assessment (RRR)
- Water Quality Management

Workers who gain skills and experience in these areas will enjoy the greatest flexibility in career choices. These competencies are in demand in at least eight out of the 11 green sectors identified.

Workers with the above-mentioned competencies will also benefit from comparatively greater opportunities for career advancement, with more job openings. Workers whose duties focus mainly on regulatory compliance and enforcement or planning, monitoring, and reporting for sustainability are also likely to have strong career development prospects, albeit in a fewer number of green sectors.



Workers whose main duties require competencies that fall in the lower-left quadrant of Figure 11, Lower Demand, Lower Inter-Sector Transferability, may be at a higher risk of becoming stuck in a career silo that offers fewer advancement opportunities. These skill areas are required for less than 10 per cent of green job vacancies:

- Environmental Impact Assessments
- Environmental Research
- Waste Management
- Climate Change Mitigation
- Pollution Prevention, Abatement, and Control

Competency areas falling in the upper-left quadrant of Figure 11 have a high level of transferability among green sectors, but remain in comparatively lower demand. These competency areas include:

- Environmental Sampling and Analytical Work
- Environmental Communications and Public Awareness
- Policy Development and Planning

Training and professional development for competencies in the upper right quadrant will help these workers to become more competitive for a larger portion of job openings.

Sector Career Directions for Mid-Career Workers

Workers who have attained a high level of competency in one or more environmental skill areas are able to develop rich careers within many sectors and are well-suited to adapt as economic conditions in any specific sector change. The table below highlights career directions that are available to workers with environmental competencies. For each competency area, the overall job demand is indicated, along with differences in demand by green sector. For instance, workers who perform environmental impact assessments can expect that about 10 per cent of green job vacancies will be available. Their skills are sought by employers in several sectors including sustainable transportation and urban planning.

Table 10
Transferability of Competencies – Requirements by Green Sector

DEMAND FOR COMPETENCIES, BY GREEN SECTOR	PERCENTAGE OF JOB VACANCIES THAT REQUIRE THE STATED COMPETENCY AREA
A – Environmental Impact Assessments	10%
Alternative/ Sustainable Transportation	23%
Sustainable Planning/ Urban Design	19%
Carbon & Climate Change Mitigation	13%
B – Site Assessment (RRR)	21%
Environmental Protection	25%
Eco-Tourism	25%
Energy Efficiency & Green Building	20%
C – Regulatory & Enforcement	23%
Green Services	33%
Environmental Protection	28%
Sustainable Planning/ Urban Design	28%
D – Pollution Prevention, Abatement & Control	1%
Carbon & Climate Change Mitigation	13%
Sustainable Planning/ Urban Design	3%
Environmental Protection	2%
E – Climate Change	3%
Green Manufacturing	33%
Carbon & Climate Change Mitigation	13%
Energy Efficiency & Green Building	11%
F – Waste Management	3%
Environmental Protection	10%
Alternative/ Sustainable Transportation	8%
Sustainable Planning/ Urban Design	6%
G – Water Quality Management	21%
Green Manufacturing	33%
Energy Efficiency & Green Building	31%
Alternative/ Sustainable Transportation	31%
H – Environmental Sampling & Analytical Work	11%
Alternative/ Sustainable Transportation	38%
Green Manufacturing	33%
Environmental Protection	25%

Table 10
Transferability of Competencies – Requirements by Green Sector (continued)

DEMAND FOR COMPETENCIES, BY GREEN SECTOR	PERCENTAGE OF JOB VACANCIES THAT REQUIRE THE STATED COMPETENCY AREA
I – Policy Development & Planning	8%
Green Services	21%
Sustainable Planning/ Urban Design	19%
Environmental Protection	11%
J – Planning, Monitoring & Reporting for Sustainability	15%
Green Manufacturing	33%
Sustainable Planning/ Urban Design	25%
Energy Efficiency & Green Building	17%
K – Corporate Environmental Program Planning & Implementation	32%
Environmental Protection	38%
Renewable/ Green Energy	38%
Sustainable Planning/ Urban Design	33%
L – Environmental Safety	23%
Green Retail	50%
Environmental Protection	39%
Renewable/ Green Energy	35%
M – Natural Resources Planning & Management	28%
Resource Conservation	67%
Eco-Tourism	63%
Sustainable Planning/ Urban Design	58%
N – Environmental Training & Education	23%
Green Services	56%
Energy Efficiency & Green Building	34%
Green Manufacturing	33%
Sustainable Planning/ Urban Design	33%
O – Environmental Research	7%
Green Retail	50%
Alternative/ Sustainable Transportation	15%
Green Services	10%
P – Environmental Business, Technology & Product Development	31%
Green Retail	100%
Green Manufacturing	67%
Energy Efficiency & Green Building	43%
Q – Environmental Communications & Public Awareness	12%
Green Services	36%
Green Manufacturing	33%
Eco-Tourism	31%

Occupations in a Green Economy

The review of job vacancies linked to a greener Canadian economy reveals a diverse set of job titles for which employers are seeking candidates. Out of 835 job vacancy postings, a total of 280 unique occupations have been identified, after combining similar job titles. Out of these occupations, about half (141 occupations) can be classified as managers, engineers, technicians and trades workers, scientists, and planners. The other half of occupations (139 occupations) represent specialist occupations in many sectors ranging from technical specialists to regulatory specialists to hospitality and recreation workers, to other occupations.

Employers in the Environmental Protection sector have vacancies for the largest number of different occupations, 108 occupations in total. Employers in the Resource Conservation sector advertised for vacancies linked to 41 different occupations. There were just under thirty different occupations in demand in the Renewable/Green Energy sector and a similar number in the Energy Efficiency and Green Building sector, as well as the Green Services sector. Job vacancies in other sectors reflect a smaller number of different occupations. Table 11 features a list of the main occupations in the top three green sectors with strong employment demand (Environmental Protection, Resource Conservation and Renewable/Green Energy). Appendix G contains the full list of the 280 occupations identified from job titles linked to a green economy.

Table 11
Occupations in Top Green Sectors

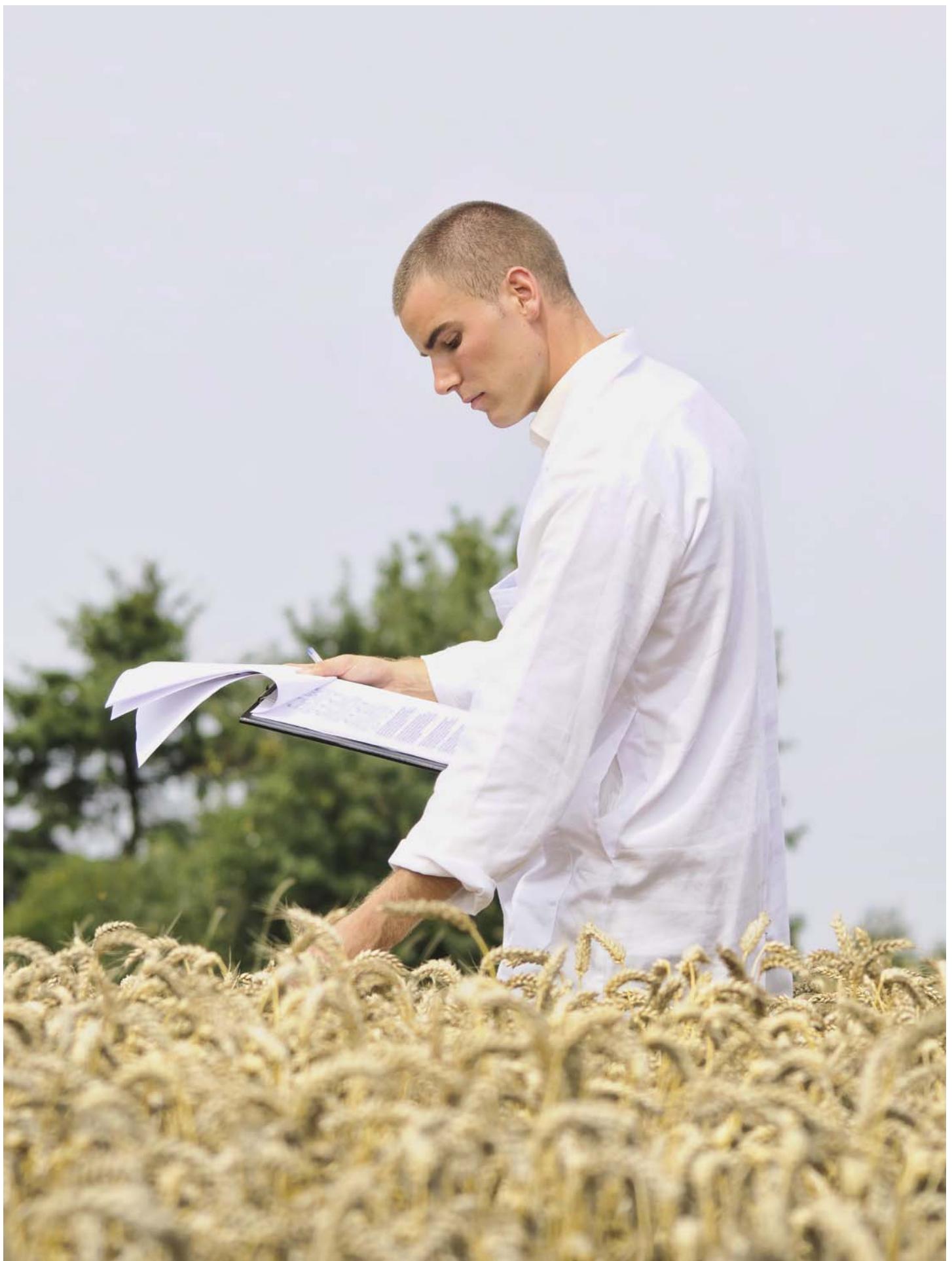
ENVIRONMENTAL PROTECTION	
Manager	Engineer
Aquatic resources manager Client portfolio manager Corporate HSE manager specialist Director of health, safety and environment Drilling operations manager Environmental consulting project manager Environmental manager Environmental professional project manager Environmental remediation site foreman Facility environmental compliance manager Manager health and safety Municipal infrastructure project manager Occupational hygienist specialist and project manager Operations manager Principal environmental scientist, manager Project administrator Project manager, contaminated sites or reclamation Project manager, wastewater infrastructure remediation Safety manager Technical director, water treatment Terrestrial resources manager VP operations Water & wastewater engineers, project managers	Air quality environmental engineer Water resources engineer/hydrologist Civil engineer Civil environmental engineer Environmental engineer Geo environmental engineer Geochemist Geoscientist Geotechnical environmental engineer Health and safety engineer Hydrogeologist Mineralogist Piping engineering specialists Process engineer Project engineer Water & wastewater environmental engineer Water resources engineer
Regulatory & Policy	
	Air quality compliance specialist Compliance coordinator Site environmental and regulatory coordinator Supervisor, regulatory compliance

Table 11
Occupations in Top Green Sectors (continued)

ENVIRONMENTAL PROTECTION (CONTINUED)	
Remediation	
Contaminated sites professional	
Safety & Health	
EHS auditor	
Environment, health and safety coordinator	
Environmental health and safety manager	
Health & safety compliance management specialist	
Health and safety administrator	
Health, safety & environment advisor	
Infection control practitioner	
Occupational hygiene & safety specialist	
Occupational hygiene consultant	
Process safety technical authority	
Sales & Support	
Account manager, environmental	
Inside technical sales	
Seasonal	
Park person, seasonal	
Sustainability	
Infrastructure sustainability leader	
Specialist	
Air emissions specialist	
GIS analyst coordinator	
Industrial monitoring team lead	
Mining closure & rehabilitation specialist	
Operator - research and testing facility	
QA analyst	
Reclamation specialist	
Technical advisor	
Technical analyst infrastructure assessment	
Water specialist	
Technician	
Civil engineering or geotechnical technologists	
Emissions testing field technician	
Environmental technician	
Erosion control technician	
Hazardous materials technologist	
Laboratory technologist	
Materials management technician	
Materials technicians (soil, concrete & asphalt)	
Reclamation technologist	
Wildlife biologist, technician	
Biologists	
Aquatic biologist	
Terrestrial and wetland biologist	
Terrestrial biologists & ecologists	
Ecology	
Aquatic ecologist	
Other Scientist	
Atmospherics scientist	
Hydrogeologist	
Hydrologist	
Reclamation scientist	
Soil scientist	
Planning	
Infrastructure planning supervisor	
Land development design technologist	
Other Reclamation	
Environmental & reclamation assessments professional	
Other Environmental Protection Occupations	
Environment supervisor	
Environmental advisor	
Environmental affairs coordinator	
Environmental consultant	
Environmental coordinator	
Environmental draftsperson	
Environmental field staff	
Environmental inspector	
Environmental scientist	
Environmental services intern	
Environmental site assessor	
Environmental specialist	
Environmental technologist	
Field environment advisor	
Pipeline environmental supervisor	
Transmission line environmental inspector	

Table 11
Occupations in Top Green Sectors (continued)

RESOURCE CONSERVATION	
Manager	Ecology
Aquatic resources manager Chairperson, agriculture & environment programming Conservation crew leader Garden centre manager & gardeners workers International project manager Managing leader environmental services Terrestrial resources manager	Restoration ecology
Engineer	Farm-Related
Municipal engineering manager Water resources engineer Environmental engineer geoscientist	Ecological farming systems development intern Farm help Grass fed beef farm intern Organic farm apprenticeship internship Organic farm intern Organic gardener Organic vegetable farm manager Soil farm apprentice Sustainable farm intern
Specialist	Other Natural Resources Occupations
Arborist Beekeeping intern Community engagement facilitator Conservation programs specialist Environmental specialist - fisheries and aquatics Experienced point counter GIS specialist Invasive species specialist Stewardship & horticultural assistant	Chief land administrator Forestry program assistant Hydrogeologist Hydrologist Soil and terrain scientist Urban forest bursary Water resources analyst Wildlife hotline emergency services operator/educator
Biologists	Research
Fisheries biologist Marine biologist Wildlife biologist	Research associate
Planning	
	Infrastructure planning supervisor Land development design technologist
RENEWABLE / GREEN ENERGY	
Manager	Operator
Business development manager Operations manager Project manager Quality control manager Regulatory manager	Boiler operator
Engineer	Trades
Civil engineer Generator mechanical design engineer Hydro electrical engineer Process engineer, solar manufacturing Project engineer, renewable power Turbine & generator equipment support engineer	Arc welder Master electrician
Specialist	Scientist
Security advisor Technical specialist Training coordinator, cogeneration facility	Physics technical specialist R&D scientist (metallurgy)
Technician	Regulatory & Policy
Mechanical service technician Wind technician	Policy advisor Regulatory manager
	Sales & Support
	Customer representative Sales professional, solar PV & thermal Sales representative, geoexchange
	Support
	Program assistant



KEY CONCEPTS TO MAKE SENSE OF CAREER PATHS IN A GREEN ECONOMY



The proposed framework for understanding jobs in a green economy is based on a career path model. There is a demonstrated need for greater clarity in career path plans that workers, employers, and educational stakeholders can use to guide professional development for green jobs. Three concepts are of central importance for career paths in a green economy:

- Competencies required,
- Occupational Profiles, and
- Sectors comprised of companies that employ workers.

Competencies

The competencies for career paths in a green economy are based on the 308 technical competencies and 42 transferable competencies defined in ECO Canada's National Occupational Standards (NOS) (see Appendix E). The NOS is a living document that is continuously refreshed and refined as demand for environmental skills and knowledge is shaped and changed by the needs of employers. Over the course of this study, four additional skill areas have been identified (urban planning, power generation, data analysis, and human resource management) which should be integrated into the NOS. Further consultation is needed with professionals and employers to establish competency statements that describe how these competency areas are applied and the specific knowledge that is required.

“
Every job needs to have an element of sustainability if we want to create the solution we need to create, or gather the momentum we need.

GREEN ECONOMY EXPERT PANELIST

”

Occupational Profiles

Occupations in the green economy are diverse. In this research, out of 835 job vacancies, 280 different occupations were identified. The most common occupational categories were managers, engineers, technicians/trades workers, scientists, and planning occupations. The prevalence of demand for workers in these well-established occupational categories suggests that the discipline-plus concept²⁵ is well-suited to describing many green occupations. In addition to occupations that fit the discipline-plus concept, there are other occupational clusters that are better described by the special skill combinations workers apply, rather than by formal disciplines, such as engineers, biologists, etc. For example, there are occupations for energy simulation specialists and strategic energy initiatives coordinators in the energy efficiency sector, and these types of occupations require a very broad set of interdisciplinary skills that draw on many formal disciplines. Workers in these jobs then apply such competencies to unique work activities like strategic energy use assessment, energy planning, and energy systems implementation for buildings.

In order to accurately map career paths in Canada's green economy, clear and well-developed occupational profiles are a must. The occupational profiling process used by ECO Canada defines occupations based on a combination of the competencies that workers must possess in order to work proficiently in their area of practice and the level at which these competencies need to be performed by practitioners.

Example:

Stakeholder Relations and Engagement Professionals –
Jobs in this cluster describe workers whose activities include community engagement, outreach, liaising among stakeholders, municipal and public sector affairs, industry relations, and other communication activities. Characteristics for jobs in this area include strong demand for skills in influencing others and corporate environmental program management and implementation.

Sectors in a Green Economy

Sectors in a green economy were identified through secondary research. The sectors within the framework fall into three categories:

- (1) Sectors linked to the traditional environmental sector
- (2) Sectors that are newer and linked to inter-related value chains and supply chains such as the value chain for the renewable energy sector.
- (3) Companies that use processes that are more resource efficient and/or reduce environmental impact in the provision of goods and services.

Appendix B contains a list of the eleven sectors linked to a green economy and their sub-segments. As new clean technologies and sectors grow and develop, the definitions for these sectors will require expansion and augmentation.



²⁵ Occupational Research conducted by ECO Canada has demonstrated that environmental work tends to be founded first on formal disciplines (e.g. engineers, chemists, geologists, etc.), and secondly on multi-disciplinary work, or "discipline-plus", developed from experience and professional training. These competencies may be shared amongst many different occupations within the environmental sector, but are specific to environmental work. "Discipline-plus" competencies are identified in the NOS for Environmental Employment.



FUTURE DIRECTIONS

By tracing the unique characteristics of careers in the green economy, *The Green Jobs Map* provides critical new information on some of the biggest trends to impact Canadian employment today. As the transition to greener industries, products and company practices continues to reshape Canada's business landscape, greater insight is needed on how all of these changes affect jobs. As a result, this type of research helps numerous individuals make informed decisions about green careers and workforce development, including job-seekers, employers, policy makers, educators and students.

The Green Jobs Map also sets a new precedent for research on Canadian green employment through the use of innovative content analysis techniques and the application of ECO Canada's National Occupational Standards (NOS). While this study is an exciting step in a promising new direction, further work is still needed to expand the present study's findings. In subsequent research, the methodology from *The Green Jobs Map* should be adjusted to include a larger sample of job postings collected over an extended time period, as well as the use of job listings from different sources.

In addition, the present study has focused on the demand side of green employment, such as the types of occupations that companies are looking to fill and the key competencies that matter most to these employers. Further research is now needed to assess the supply side of the green jobs equation. Businesses may be seeking environmental professionals to fill certain positions or apply specific competencies, but are there enough workers with the skills and training to meet this need? Future studies must address this crucial question.

If there is just one final message to remember from *The Green Jobs Map*, it is that the transition to a greener Canadian economy is a highly dynamic process, and as a result, jobs linked to this transition are also in state of ongoing evolution. As the emergence of new technologies, regulations, and consumer demand continues to impact how businesses operate, more companies will need skilled professionals who can help them make the most of this phase of opportunity and growth.

“
The career path framework is useful from the perspective of informing people who want to contribute to a green economy – what they need to find jobs that make a contribution.

But a green economy is about a dynamic transition. Fluctuations and changes are a constant feature. The proposed categorization might miss part of the story, or limit opportunities that are not captured within it.

GREEN ECONOMY EXPERT PANELISTS

”

APPENDIX A: METHODOLOGY FOR RESEARCH AND CONTENT ANALYSIS

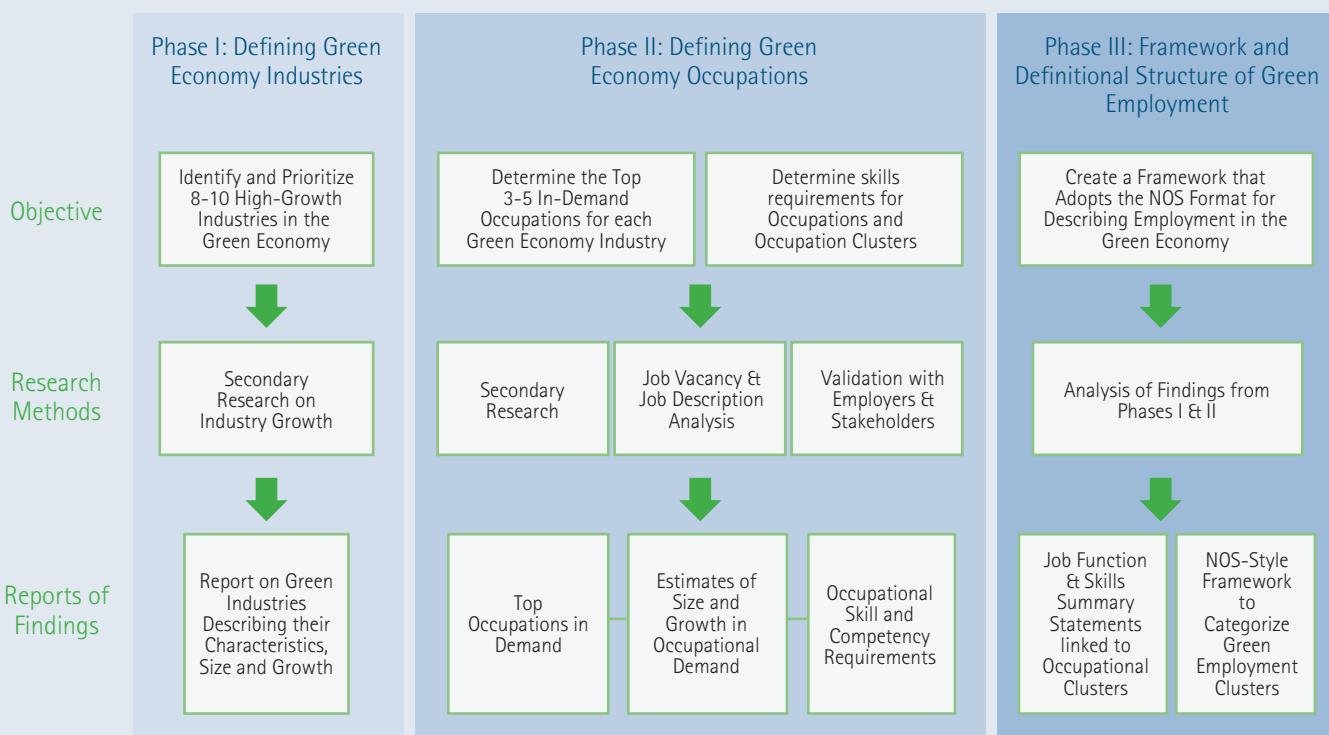
Methods & Approach

The research objectives for a green economy trends project can be summarized into three overarching goals:

1. Define green industries.
2. Identify the top in-demand occupations and their skill requirements.
3. Describe these occupations with job function statements, using the NOS format.

A three-phase methodology was used to achieve these goals, described in Figure 12. Through the research phases, it became clear that defining the occupations in demand was difficult due to the diversity of occupations identified through web-scraping of job vacancies. The research process was modified to focus on the competencies that are in demand for job vacancies, which produces more useful profiles for career planning.

Figure 12
Objectives, Research Methods and Reporting Summary Diagram



Phase I – Literature Review

A total of 33 secondary research reports on a green economy have been reviewed. Ten of these reports contain taxonomies of industries within a green economy or contain discussion of multiple sectors that comprise a green economy. These reports form the basis for the identification of key industries in a green economy. In addition to the reports describing a green economy, a variety of other secondary research reports were reviewed to identify labour force size and growth trends for sub-segments of a green economy.

Table 12
Green Economy Expert Panel

NO.	SOURCE / AUTHOR	REPORT
1	Brookings - Battelle	Sizing the Clean Economy
2	Brookings - Battelle	Sizing the Clean Economy - Methodology
3	Bureau of Labor Statistics (BLS)	Green Jobs Initiative
4	Bureau of Labor Statistics (BLS)	Green Jobs Definition
5	Bureau of Labor Statistics (BLS)	Green Goods and Services Survey Questionnaire
6	California Centers of Excellence (CCOE)	California's Green Economy Industry and Workforce Studies (multiple reports)
7	Canada West Foundation	The Green Grail
8	Canadian Institute for Environmental Law and Policy	A Green Economy for Canada: Consulting with Canadians
9	Center for Community Innovation	Innovating a green economy in California
10	Commission for Environmental Cooperation	Renewable Energy Training Resources - Survey and Assessment
11	D. Parsons & Associates	Greening the Economy: Transitions to New Careers
12	ECO Canada	Profile of Environmental Employment 2010
13	ECO Canada	Canadian Environmental Sector Trends 2010
14	EIANZ	Green Collar Worker Report
15	Federation of Canadian Municipalities	Building Canada's Green Economy: The Municipal Role
16	Globe Group	British Columbia's Green Economy: Securing the Workforce of Tomorrow
17	Globe Group	Careers for a Sustainable Future: A Reference Guide to Green Jobs in British Columbia
18	Globe Group	British Columbia's Green Economy: Building a Strong Low-Carbon Future
19	HRSDC	Green Jobs Taxonomy
20	ILO	Anticipating Skill Needs for the Low Carbon Economy? Difficult, But Not Impossible
21	ILO	Skills for the Low Carbon Economy
22	OECD	Towards Green Growth
23	OECD	Towards Green Growth, Summary for Policy Makers
24	Pembina Institute	Reducing Pollution, Creating Jobs
25	PERI	Job Opportunities for a green economy

Table 12
Green Economy Expert Panel (continued)

NO.	SOURCE / AUTHOR	REPORT
26	PERI	Building a green economy: Employment Effects for Green Energy Investments for Ontario
27	Pernick, Wilder, and Winnie	Clean Energy Trends (2012)
28	Pew Charitable Trusts	The Clean Energy Economy: A Definition and Framework
29	Statistics Canada	Canadian Business Patterns Database
30	Statistics Canada	Labour Force Survey
31	Statistics Canada	2001 and 2006 Census of Canada, Selected Tables
32	UNEP	Green Economy Report - A Preview
33	US Department of Commerce	Measuring a green economy

Phase II – Content Analysis of Job Vacancies Linked to a Green Economy

In Phase II of the research, content analysis methods have been used to characterize jobs in a green economy and explore the skills requirements of these jobs, based on an empirical analysis of the content of job postings. Initial content analysis findings are based on analysis of a sample of 430 unique job descriptions were identified as "green" jobs, or jobs that are clearly identified as part of a green economy. Over the course of the research project, additional job vacancies were identified through an online content scraper which augmented the sample of job vacancies linked to a green economy. At the conclusion of the project, a total of 835 jobs were identified that require environmental skills and are linked to sectors in a green economy. This sample was drawn from 83,451 online job postings collected during the months of March, April, and May, 2012. Job vacancies were limited to Canadian jobs and content analysis techniques were specified for English language.

A conservative approach is used to determine whether a job is associated with a green economy and this is reflected in the decision rule regarding the minimum threshold for what is considered a green job. Only job descriptions with a clear relationship to a green sector, company, product, or process are included in the analysis, thereby excluding jobs that have a weak or questionable connection with a green economy. Jobs were further filtered to include only those that describe requirements for specific skills identified in the NOS or otherwise defined through the research. This excluded jobs such as well drilling operators for geo-exchange systems, which are linked to a renewable energy sector, but do not state requirements for environmental skills in the job description for vacant positions.

Ambiguity surrounding the definition of a green economy complicates the task of identifying which jobs are to be defined as belonging to a green economy. The literature review in Phase I found that jobs in a green economy are identified based on a combination of several markers including (1) industry²⁶, (2) the types of skills used by workers, (3) the types of products and services a company provides, (4) a job's connection with a green sector's supply chain (e.g. a metal parts manufacturer that is a supplier for the wind energy sector), or (5) the types of processes used in the provision of products and services (i.e. processes that are more environmentally-friendly). In applying the content analysis methodology, the research team found that the *types of skills* described in the text of a job ad were most often the marker that indicated whether a job could be identified as belonging to a green economy. This is an important distinction because some ads for jobs in a green economy do not contain textual content to indicate that a job is, in fact, associated with a green economy. Our sample of jobs in a green economy is therefore largely limited to only those jobs that describe requirements for specialized knowledge or skills.

²⁶ Some industries, such as environmental remediation, are considered by analysts to be wholly included in the Green Economy

Some job categories in a green economy are underrepresented or excluded in our analysis. For instance, the Brookings Institution's report, *Sizing a Clean Economy*, found that the second-largest employment category in the US Green Economy is public mass transportation (over 350,000 workers in the US). The majority of workers in public mass transit are operators (e.g. bus drivers) and online ads for these positions are often brief, with little description of the skills or knowledge required for the job as well as few clues to indicate that the job is in fact part of a green economy. An unintended consequence is that the sample of green jobs in our sample meets both criteria identified in the ECO Canada report, *Defining the Green Economy*:

"ECO Canada defines a green job as one that works directly with information, technologies, or materials that minimize environmental impact, and also requires specialized skills, knowledge, training, or experience related to these areas."

It should be recognized that this methodology provides a rich level of detailed information on the skills, knowledge and experience required for real jobs linked to a green economy, but it is limited by the sample analyzed, which includes only job vacancies (not filled positions), jobs which are filled using online job posting methods that are captured by job aggregators, and jobs that were vacant during a specified period: March-May 2012. The sample therefore does not capture the full scope of jobs linked to a green economy.

Phase III – Framework for Green Careers

Using the coded data for job descriptions, a set of simple cross tabulations and frequencies were performed on the data to determine patterns of demand for competency requirements. The findings of these tabulations are published in this report.

As a final step in the research process, preliminary results of the research were shared with an online panel of green economy experts. Feedback from the panel was used to refine the framework for career paths in a green economy.

Table 13
Green Economy Secondary Research Reports Reviewed

PANEL PARTICIPANT	POSITION	ORGANIZATION
John Adams	Director, Applications	SDTC
Mark Anielski	President and CEO	Anielski Management Inc.
Jeff Bell	Specialist	Alternative and Renewable Energy Specialist, Alberta Environment
Tom Bevers	Employment Committee Member, EuroStat	European Commission
Rachel Birenbaum	Manager, Human Resources	Jantzi-Sustainalytics
Peter Blanchard	Founder and Coordinator	GoodWork Canada Green Jobs
Keith Brooks	Project Manager	Blue Green Alliance Canada
Stephanie Cairns	President	Wrangelia Consulting
Morag Carter	Program Director, Climate Change and Clean Energy	David Suzuki Foundation

Table 13
 Green Economy Secondary Research Reports Reviewed (continued)

PANEL PARTICIPANT	POSITION	ORGANIZATION
Raymond Côté	Professor Emeritus	Dalhousie University
John Cuddihy	Senior Policy Advisor	NRTEE
Tyler Elm	Vice-President, Corporate Strategy & Business Sustainability	Canadian Tire
Bob Elton	Former CEO and President	BC Hydro
Tyler Hamilton	Editor in Chief	Corporate Knights
Chris Higgins	LEED Canada for Homes Program Leader	Canada Green Building Council
Robert Hornung	President	Canadian Wind Energy Association
Eddy Isaacs	CEO	Energy and Environment Solutions, Alberta Innovates
Mike Kennedy	President and CEO	Green Analytics
David Layzell	Executive Director	Institute for Sustainable Energy, Environment and Economy
Carla Lipsig-Mummé	Professor of Work and Labour Studies	York University
Robert Page	Professor, Institute for Sustainable Energy, Environment & Economy, University of Calgary	Former NRTEE Chairperson
Thomas Rankin	Investment Manager	Innovacorp
Marlo Reynolds	Former Executive Director	Pembina Institute
John Robinson	Executive Director, UBC Vancouver Sustainability Professor	Institute of Resources, Environment and Sustainability, and Department of Geography University of British Columbia
Laurie Simmonds	President & CEO	Green Living
Dixie Sommers	Assistant Commissioner for Occupational Statistics and Employment Projections	U.S. Bureau of Labour Statistics
Esther Speck	Director, Sustainability	Mountain Equipment Co-op
Jim Stanford	Economist	Canadian Autoworkers Union
Coro Strandburg	Principal	Strandburg Consulting
Denise Taschereau	Owner	Fairware Promotional Products
Andrew van Iterson	Coordinator	Green Budget Coalition
Lyle Walker	Senior Transportation Planner	Translink
Sara Wilson	Principal	Natural Capital Research and Consulting
Mark Winfield	Assistant Professor	York University
Alex Wood	Senior Director, Policy and Markets	Sustainable Prosperity

APPENDIX B: SECTORS OF A GREEN ECONOMY AND RELATED SUB-SECTORS

Table 14
Commonly-Noted Industries in a green economy and their Sub-Segments

GREEN ECONOMY SECTOR		GREEN ECONOMY SECTOR	
1	Renewable/ Green Energy	3	Resource Conservation
1.1	Renewable Energy	3.1	Fisheries and Wildlife
1.1.1	Geo-exchange /Earth Energy	3.2	Natural Resource Management
1.1.2	Hydropower	3.2.1	Organic & Sustainable Agriculture
1.1.2.1	Small Hydro	3.2.2	Sustainable Forestry
1.1.3	Ocean/Wave Energy	3.2.3	Land Management
1.1.4	Solar Energy	3.2.4	Water, soil conservation
1.1.4.1	PV Solar	3.2.4.1	Storm Water Management
1.1.4.2	Solar Thermal	3.2.4.2	Water Efficient Products
1.1.5	Wind	3.2.5	Conservation (other)
1.2	Other Green Energy	4	Alternative/Sustainable Transportation
1.2.1	Cogeneration	4.1	Vehicles
1.2.2	Hydrogen	4.1.1	Electric/Hybrid/Alternative Fuels/Fuel Cell Vehicle
1.2.3	Nuclear Energy	4.1.2	Repair and Maintenance of Alternative vehicles
1.3	Biofuels and Biogas	4.1.3	Fueling Stations (natural gas, hydrogen, electric, etc.)
1.3.1	Bioenergy/ Biofuels	4.2	Transportation Systems and Planning
1.3.2	Landfill Gas	4.2.1	Logistics (fleet tracking, traffic monitoring software)
1.3.3	Municipal Solid Waste to Fuel	4.2.2	Transportation Systems Planning
1.4	Renewable Energy Services	4.2.3	Mass Transit
2	Energy Efficiency & Green Building	5	Environmental Protection
2.1	Energy Efficiency	5.1	Air Quality
2.1.1	Energy Storage/Battery Technologies	5.1.1	Air Purification Technologies
2.1.2	Energy Transmission Infrastructure/Smart Grid/T	5.2	Water Quality
2.1.3	Fuel Cells	5.2.1	Water Purification Technologies
2.1.4	Energy Saving Consumer Products/Appliances	5.2.2	Wastewater Treatment
2.1.5	Energy consulting, software, services	5.3	Site Assessment & Reclamation
2.2	Green Building	5.4	Waste Management
2.2.1	Architecture and construction services	5.4.1	Recycling
2.2.2.1	Retrofit	5.4.2	Waste Treatment
2.2.2	Building Inspection	5.5	Professional Environmental Services
2.2.3	Deconstruction	5.6	Pollution control
2.2.4	Landscaping	5.7	Health and Safety
2.2.5	Energy-Saving Building Materials		
2.2.6	HVAC and Building Control Systems		
2.2.7	Lighting		
2.2.8	Professional Energy Services		
2.2.9	Water Systems		

Table 14
Commonly-Noted Industries in a green economy and their Sub-Segments (continued)

GREEN ECONOMY SECTOR		GREEN ECONOMY SECTOR	
6	Green Manufacturing	8	Sustainability Planning / Design / Urban Design
6.1	Green Building Materials	9	Carbon and Climate Change Mitigation
6.2	Chemical, Plastics and Rubber Products/ Biomaterials	9.1	Carbon Storage and Capture
6.3	Green Consumer Products	10	Green Retail
6.3.1	Electrical Equipment, Appliance and Components	11	Eco-Tourism
6.4	Monitoring and Control Products		
6.5	Machinery Manufacturing		
6.6	Paper Manufacturing		
6.7	Petroleum and Coal Product Manufacturing		
6.8	Recycled Content Products		
6.9	Eco-Friendly Packaging		
6.10	Process Management		
7	Green Services		
7.1	Business services (legal, marketing, etc.)		
7.1.1	ICT		
7.2	Education and Training		
7.3	Financial Services		
7.3.1	Carbon Finance & Investment		
7.3.2	Financial Services/Venture Capital		
7.3.3	Energy Traders		
7.4	Communication and Public Awareness		
7.4.1	NGOs		
7.5	Policy and Legislation		
7.5.1	Compliance		
7.6	Research and Development		

APPENDIX C: COMPETENCY TRANSFERABILITY BY GREEN SECTOR

Table 15
Transferability of Competencies – Requirements by Green Sector

DEMAND FOR COMPETENCIES, BY GREEN SECTOR	PERCENTAGE OF JOB VACANCIES THAT REQUIRE THE STATED COMPETENCY AREA	DEMAND FOR COMPETENCIES, BY GREEN SECTOR	PERCENTAGE OF JOB VACANCIES THAT REQUIRE THE STATED SKILL AREA
A – Environmental Impact Assessments	10%	D – Pollution Prevention, Abatement & Control	1%
Alternative/ Sustainable Transportation	23%	Carbon & Climate Change Mitigation	13%
Sustainable Planning/ Urban Design	19%	Sustainable Planning/ Urban Design	3%
Carbon & Climate Change Mitigation	13%	Environmental Protection	2%
Energy Efficiency & Green Building	9%	Renewable/ Green Energy	0%
Environmental Protection	8%	Energy Efficiency & Green Building	0%
Resource Conservation	8%	Resource Conservation	0%
Green Services	8%	Alternative/ Sustainable Transportation	0%
Renewable/ Green Energy	0%	Green Manufacturing	0%
Green Manufacturing	0%	Green Services	0%
Green Retail	0%	Green Retail	0%
Eco-Tourism	0%	Eco-Tourism	0%
B – Site Assessment (RRR)	21%	E – Climate Change	3%
Environmental Protection	25%	Green Manufacturing	33%
Eco-Tourism	25%	Carbon & Climate Change Mitigation	13%
Energy Efficiency & Green Building	20%	Energy Efficiency & Green Building	11%
Renewable/ Green Energy	18%	Green Services	8%
Alternative/ Sustainable Transportation	15%	Renewable/ Green Energy	8%
Green Services	13%	Resource Conservation	5%
Resource Conservation	5%	Environmental Protection	3%
Sustainable Planning/ Urban Design	3%	Alternative/ Sustainable Transportation	0%
Green Manufacturing	0%	Sustainable Planning/ Urban Design	0%
Carbon & Climate Change Mitigation	0%	Green Retail	0%
Green Retail	0%	Eco-Tourism	0%
B – Site Assessment (RRR)	21%	F – Waste Management	3%
Green Services	33%	Environmental Protection	10%
Environmental Protection	28%	Alternative/ Sustainable Transportation	8%
Sustainable Planning/ Urban Design	28%	Sustainable Planning/ Urban Design	6%
Energy Efficiency & Green Building	17%	Energy Efficiency & Green Building	3%
Renewable/ Green Energy	15%	Green Services	3%
Resource Conservation	13%	Renewable/ Green Energy	3%
Alternative/ Sustainable Transportation	8%	Resource Conservation	0%
Green Manufacturing	0%	Green Manufacturing	0%
Carbon & Climate Change Mitigation	0%	Carbon & Climate Change Mitigation	0%
Green Retail	0%	Green Retail	0%
Eco-Tourism	0%	Eco-Tourism	0%

Table 15
Transferability of Competencies – Requirements by Green Sector (continued)

DEMAND FOR COMPETENCIES, BY GREEN SECTOR	PERCENTAGE OF JOB VACANCIES THAT REQUIRE THE STATED COMPETENCY AREA	DEMAND FOR COMPETENCIES, BY GREEN SECTOR	PERCENTAGE OF JOB VACANCIES THAT REQUIRE THE STATED COMPETENCY AREA
G – Water Quality Management	21%	J – Planning, Monitoring & Reporting for Sustainability	15%
Green Manufacturing	33%	Green Manufacturing	33%
Energy Efficiency & Green Building	31%	Sustainable Planning/ Urban Design	25%
Alternative/ Sustainable Transportation	31%	Energy Efficiency & Green Building	17%
Resource Conservation	27%	Environmental Protection	3%
Environmental Protection	24%	Renewable/ Green Energy	3%
Sustainable Planning/ Urban Design	19%	Resource Conservation	2%
Green Services	10%	Alternative/ Sustainable Transportation	0%
Eco-Tourism	6%	Green Services	0%
Renewable/ Green Energy	0%	Carbon & Climate Change Mitigation	0%
Carbon & Climate Change Mitigation	0%	Green Retail	0%
Green Retail	0%	Eco-Tourism	0%
H – Environmental Sampling & Analytical Work	11%	K – Corporate Environmental Program Planning & Implementation	32%
Alternative/ Sustainable Transportation	38%	Environmental Protection	38%
Green Manufacturing	33%	Renewable/ Green Energy	38%
Environmental Protection	25%	Sustainable Planning/ Urban Design	33%
Renewable/ Green Energy	18%	Green Services	26%
Energy Efficiency & Green Building	17%	Carbon & Climate Change Mitigation	25%
Resource Conservation	14%	Alternative/ Sustainable Transportation	23%
Sustainable Planning/ Urban Design	14%	Resource Conservation	16%
Green Services	13%	Energy Efficiency & Green Building	14%
Carbon & Climate Change Mitigation	13%	Green Manufacturing	0%
Green Retail	0%	Green Retail	0%
Eco-Tourism	0%	Eco-Tourism	0%
I – Policy Development & Planning	8%	L – Environmental Safety	23%
Green Services	21%	Green Retail	50%
Sustainable Planning/ Urban Design	19%	Environmental Protection	39%
Environmental Protection	11%	Renewable/ Green Energy	35%
Energy Efficiency & Green Building	9%	Green Manufacturing	33%
Alternative/ Sustainable Transportation	8%	Green Services	21%
Resource Conservation	6%	Sustainable Planning/ Urban Design	19%
Eco-Tourism	6%	Resource Conservation	14%
Renewable/ Green Energy	3%	Energy Efficiency & Green Building	9%
Green Manufacturing	0%	Eco-Tourism	6%
Carbon & Climate Change Mitigation	0%	Alternative/ Sustainable Transportation	0%
Green Retail	0%	Carbon & Climate Change Mitigation	0%

Table 15
Transferability of Competencies – Requirements by Green Sector (continued)

DEMAND FOR COMPETENCIES, BY GREEN SECTOR	PERCENTAGE OF JOB VACANCIES THAT REQUIRE THE STATED COMPETENCY AREA	DEMAND FOR COMPETENCIES, BY GREEN SECTOR	PERCENTAGE OF JOB VACANCIES THAT REQUIRE THE STATED COMPETENCIES AREA
M – Natural Resources Planning & Management	28%	P – Environmental Business, Technology & Product Development	31%
Resource Conservation	67%	Green Retail	100%
Eco-Tourism	63%	Green Manufacturing	67%
Sustainable Planning/ Urban Design	58%	Energy Efficiency & Green Building	43%
Energy Efficiency & Green Building	49%	Renewable/ Green Energy	35%
Green Services	36%	Carbon & Climate Change Mitigation	25%
Renewable/ Green Energy	35%	Green Services	23%
Environmental Protection	29%	Resource Conservation	19%
Carbon & Climate Change Mitigation	25%	Sustainable Planning/ Urban Design	17%
Alternative/ Sustainable Transportation	15%	Environmental Protection	12%
Green Manufacturing	0%	Alternative/ Sustainable Transportation	8%
Green Retail	0%	Eco-Tourism	0%
N – Environmental Training & Education	23%	Q – Environmental Communications & Public Awareness	12%
Green Services	56%	Green Services	36%
Energy Efficiency & Green Building	34%	Green Manufacturing	33%
Green Manufacturing	33%	Eco-Tourism	31%
Sustainable Planning/ Urban Design	33%	Renewable/ Green Energy	28%
Alternative/ Sustainable Transportation	23%	Carbon & Climate Change Mitigation	25%
Resource Conservation	19%	Alternative/ Sustainable Transportation	15%
Environmental Protection	19%	Resource Conservation	11%
Renewable/ Green Energy	13%	Sustainable Planning/ Urban Design	11%
Carbon & Climate Change Mitigation	13%	Environmental Protection	10%
Eco-Tourism	13%	Energy Efficiency & Green Building	0%
Green Retail	0%	Green Retail	0%
O – Environmental Research	7%		
Green Retail	50%		
Alternative/ Sustainable Transportation	15%		
Green Services	10%		
Energy Efficiency & Green Building	6%		
Resource Conservation	3%		
Sustainable Planning/ Urban Design	3%		
Environmental Protection	1%		
Renewable/ Green Energy	0%		
Green Manufacturing	0%		
Carbon & Climate Change Mitigation	0%		
Eco-Tourism	0%		

APPENDIX D: TOP COMPETENCY REQUIREMENTS FOR GREEN JOBS

Demand for the seventeen NOS technical competencies and eight NOS transferable competencies are listed in Table 16. Note: most jobs require several competencies, hence the percentages stated in the table do not sum to 100%.

Table 16
 Demand for Environmental Competencies for Vacant Job Positions Linked
 to a Green Economy: NOS Technical Competencies, NOS Transferable Competencies,
 and Other Competency Areas Identified, March-May 2012

CATEGORY	COMPETENCY AREA	PERCENTAGE OF JOB VACANCIES THAT REQUIRE THE COMPETENCY
Technical	Technical Competencies (NOS Categories)	
A	Environmental Impact Assessment	10.3
B	Site Assessment (RRR)	21.0
C	Regulatory & Enforcement	22.9
D	Pollution Prevention, Abatement, & Control	0.7
E	Climate Change	2.6
F	Waste Management	3.3
G	Water Quality Management	20.7
H	Environmental Sampling & Analytical Work	11.4
I	Policy Development & Planning	7.7
J	Planning, Monitoring & Reporting for Sustainability	15.1
K	Corporate Environmental Program Planning & Implementation	32.1
L	Environmental Health & Safety	22.9
M	Natural Resources Planning & Management	28.4
N	Environmental Education & Training	22.5
O	Environmental Research	6.6
P	Environmental Business, Technology & Product Development	31.0
Q	Environmental Communications & Public Awareness	11.8
Transferable	Technical Competencies (NOS Categories)	
1	Professional Ethics and Work Style	55.7
2	Learning and Creativity	--
3	Communicating Effectively	3.7
4	Collaboration	--
5	Critical Thinking/Judgment	1.1
6	Planning and Organizing Work and Projects	8.9
7	Leading/Influencing Others	54.2
8	Business Acumen	2.6

N=583

APPENDIX E: TECHNICAL AND TRANSFERABLE COMPETENCY DICTIONARY

Technical Competency Dictionary

Category A – Environmental Impact Assessments

A Conducting environmental impact assessments

- 1 Ensures the identification of the geographic, environmental, economic, social, and cultural scope and parameters to be used for the impact assessment study.
- 2 Develops a project management plan for the impact assessment study for proposed developments, change in facility operations, change in land use, amended or proposed new policies, etc.
- 3 Reviews earth and life science systems, functions, inventories and existing studies to determine if sufficient baseline data is available for the impact assessment study.
- 4 Reviews facility/development design, production/manufacturing processes.
- 5 Consults with stakeholders (including regulators, municipalities, public, interest groups, indigenous peoples, NGOs, etc.) to gather information regarding the perceived impacts of development activities on communities, the environment and natural resources.
- 6 Identifies which areas are likely to be significantly impacted either negatively or positively by development activities, e.g. biophysical, economic, social, cultural, and heritage resources.
- 7 Assesses qualitative and quantitative environmental issues, risks or problems, including their cumulative effect and corresponding economic, social and cultural impacts.
- 8 Develops mitigation and/or habitat compensation plans, strategies and measures using culturally appropriate approaches.
- 9 Prepares environmental impact assessment report(s) that may include mitigation, environmental protection, and recovery plans.

Category B – Site Assessment (RRR)

B2 Conducting environmental site assessments (ESA – Phase 1 and Phase 2)

- 10 Identifies the scope of the site assessment (phase 1 and 2) project, including identification of the standards to be followed.
- 11 Reviews historical records for the site (e.g. site plans, fire insurance maps, legal title searches, business directories, air photos, satellite images, etc.) to determine previous land use.
- 12 Carries out visual inspection of site and neighbouring properties to inventory/identify current operations, evidence of discharges, visible contamination, buried tanks, dumping, etc.

- 13 Collects related information from key stakeholders (e.g. owners and staff, municipalities, regulators) regarding land use, facility operations, permits, relevant legislation, etc.
- 14 Conducts investigation, sampling, screening, and analysis (including geophysical mapping) activities of landforms, soil, ground water, sediments, airborne contaminants, etc., as required.
- 15 Characterizes environmental aspects of site (such as landforms, drainage, plant communities, and soil properties) based on interpretation of data collected during site investigation, sampling and analysis (for example, contaminants, their concentration and general extent).
- 16 Prepares site assessment report(s) to meet regulatory and other requirements, identifying potential risk and scope of further action by appropriate stakeholders, if necessary.
- 17 Ensures site assessment is completed properly and that action plans are developed and implemented to satisfactorily achieve the desired outcomes.
- 18 Communicates results of site assessment to stakeholders such as property owners, responsible party, regulators, the public, etc. via a public consultation or other appropriate communication process.

B3 Developing/Implementing site remediation (Phase 3) plan

- 19 Evaluates possible remediation/restoration/reclamation alternatives, taking into account costs, technological constraints, characteristics of the contaminant, characteristics of the affected land, and stakeholders' concerns.
- 20 Recommends remediation clean-up targets to make the site fit for its intended use or return it to its original condition (applies to all sites including watershed restoration, forestry site reclamation, mine closures, etc.).
- 21 Develops site remediation/restoration/reclamation plans and programs, including objectives, targets, contamination description, issue resolution process, pilot requirements, time schedule, and cost estimate.
- 22 Conducts pilot tests, including treatability studies, to assess the effectiveness of the intended remediation method and/or to advance science and technology.
- 23 Conducts full-scale remediation activities (e.g. thermal, biological, chemical or physical treatment, containment, vapour extraction, excavation, removal of heritage objects, etc.).
- 24 Monitors post-remediation conditions and results to assess if targets and regulatory requirements have been met.
- 25 Prepares remediation completion report, including documentation of remediation and post-remediation monitoring data, and review of environmental outcomes relative to standards, for submission to regulators and stakeholders.

Technical Competency Dictionary (continued)

B4 Developing/Implementing site restoration/reclamation (Phase 3) plans

- 26 Investigates attributes of materials, such as physical, chemical, and geotechnical involved in the restoration/reclamation.
- 27 Develops appropriate construction and reclamation procedures and contingency plans based on best management and health and safety practices, and a minimum "footprint".
- 28 Conducts on-site reclamation activities (including landscaping, tree-planting, and habitat development), using appropriate species and procedures for re-vegetation.
- 29 Provides environmental inspection during construction and reclamation to ensure that regulatory requirements are met and that procedures and plans are being followed.
- 30 Conducts on-site restoration activities as required, e.g. restore riparian, coastal zone, and wetland habitats.
- 31 Ensures that best practices are followed in the restoration/reclamation process to minimize the impact on the environment.
- 32 Monitors post-restoration/reclamation conditions and results to assess if targets and regulatory requirements have been met.
- 33 Prepares site restoration and site reclamation report(s) for submission to the appropriate regulators and stakeholders.

Category C – Regulatory & Enforcement

C5 Interpreting/enforcing/complying with environmental regulations and standards

- 34 Provides expert advice and/or testimony to senior management, internal staff, regulatory bodies, interest groups and the public on matters related to disputes, compliance and other environmental issues, including processes for acquiring regulatory approval.
- 35 Applies environmental legislation regarding issues such as contaminated sites, hazardous materials and waste, pesticide use, storage tanks, etc. to specific applications as appropriate.
- 36 Defines environmental performance requirements for specific jurisdictions.
- 37 Prepares regulatory applications.
- 38 Prepares permits and operational permit reports (including air permits, waste disposal permits, resource harvesting permits, etc.).
- 39 Negotiates the terms and approval of compliance procedures and permits, including approval of development plans and use of technology such as Pollution Prevention, Abatement, and Control equipment and systems.
- 40 Develops plans and programs to meet regulatory requirements, including monitoring programs and employee information and communication plans.
- 41 Implements programs, including monitoring activities, to ensure regulatory compliance.

- 42 Evaluates compliance with environmental regulations, including the documentation of violations and non-compliance episodes.
- 43 Prepares compliance and regulatory reports for internal use and for filing with regulatory agencies.
- 44 Enforces regulations pertaining to the environment and natural resources, including inspecting sites, patrolling, and issuing warnings.
- 45 Oversees or participates in audits of the environmental performance of organizations and jurisdictions to determine the adequacy of their policies and procedures, and non-compliance issues.

Category D – Pollution Prevention, Abatement & Control

D6 Implementing pollution prevention, abatement & control (PAC) methods

- 46 Assesses operations and processes for potential pollution problems (involves identifying contaminant sources, determining their characteristics and the magnitude of the potential risks).
- 47 Characterizes the attributes of processes and products generated (for example, chemical/biological composition, toxicity, physical properties and degradability).
- 48 Evaluates the presence and dispersion of pollutants over large geographic areas using, for example, remote sensing devices such as satellites and aerial photos, regional monitoring devices and government reports, and regulated models.
- 49 Develops recommendations for the best management practice for pollution prevention, abatement, and control measure(s), including the evaluation of control options versus process changes.
- 50 Implements pollution prevention, abatement, and control methods/solutions to prevent, abate, control and reduce pollution, contamination or emissions (e.g. devises ways to prevent contamination of water by agri-chemicals and petroleum products).
- 51 Monitors the effectiveness of Pollution Prevention, Abatement, and Control (PAC) solutions, and the performance of installed PAC equipment, systems and technologies.

Category E – Climate Change

E7 Identifying and mitigating climate change impacts

- 47 Monitors global climate and air quality phenomena such as stratospheric ozone depletion and the greenhouse effect.
- 48 Develops strategies and programs to address energy consumption and greenhouse gas generation that conform to standard protocols and legislated requirements.
- 49 Implements GHG adaptation strategies to optimize the utilization of renewable energy and/or conservation of natural energy resources.
- 50 Develops progressive approaches and solutions to modify national, corporate and individual habits to react to potential global climate changes.

Technical Competency Dictionary (continued)

- 51 Develops greenhouse gas emissions inventories/trading systems to be compatible with the regulatory programs.
- 52 Tracks air quality and greenhouse gas emissions for purposes such as evaluating, reporting and trading emissions.
- 53 Develops greenhouse gas emissions/climate change reports.

Category F – Waste Management

F8 Developing/Implementing waste management plans and programs

- 54 Monitors global climate and air quality phenomena such as stratospheric ozone depletion and the greenhouse effect.
- 55 Develops strategies and programs to address energy consumption and greenhouse gas generation that conform to standard protocols and legislated requirements.
- 56 Implements GHG adaptation strategies to optimize the utilization of renewable energy and/or conservation of natural energy resources.
- 57 Develops progressive approaches and solutions to modify national, corporate and individual habits to react to potential global climate changes.
- 58 Develops greenhouse gas emissions inventories/trading systems to be compatible with the regulatory programs.
- 59 Tracks air quality and greenhouse gas emissions for purposes such as evaluating, reporting and trading emissions.
- 60 Develops greenhouse gas emissions/climate change reports.
- F9 Monitoring waste application/disposal/reduction programs and activities
- 61 Determines requirements of new/improved waste disposal, treatment and recycling systems (e.g. waste volumes, types and methods of treatment).
- 62 Characterizes waste and waste streams.
- 63 Monitors (potential) emissions and discharges of waste disposal sites for their effects on surrounding air, water and soils (including for example sanitary landfills, hazardous waste disposal sites, etc.).
- 64 Uses models to simulate the fate, transport and impacts of contaminants such as discharges, emissions, and toxicants, etc.
- 65 Tracks waste generation: source, volume, type, location, storage, transportation and disposal.
- 66 Conducts waste audits to determine, for example, if waste is properly identified and managed, and if material being disposed conforms to permitted use of the disposal facility/site.

Category G – Water Quality Management

G10 Developing/Implementing water supply and water efficiency plans and programs

- 62 Assesses the environmental aspects of the design, operation and maintenance of water and wastewater distribution/collection systems.

- 63 Assesses the quality and availability of water supply (both surface and groundwater).
- 64 Develops water management programs including demand management, water conservation, and water or wastewater treatment programs.
- 65 Implements strategies to achieve demand management and water conservation targets through programs and projects.
- 66 Monitors effectiveness of water/wastewater programs and water treatment equipment and processes to meet environmental performance requirements.
- 67 Provides expert advice for the development of plans for a variety of financially, socially and environmentally acceptable water efficiency projects and programs.
- 68 Determines site requirements for water wells, farm buildings, industry and feedlots considering such factors as waste run-off patterns and municipal/provincial regulations.
- 69 Designs water treatment plants, storage facilities and diversion methods to enhance efficiency and minimize environmental impact.
- 70 Provides guidance and management on day to day operations of water treatment plants.
- 71 Supports in the optimization of plant processes and operations to ensure/maintain excellent water quality.

Category H – Environmental Sampling & Analytical Work

H11 Developing environmental sampling, testing and monitoring programs

- 72 Determines the need and scope for sampling program, including environmental indicators, chemicals of concern, and sampling constraints (such as access to sites, fiscal or other limitations).
- 73 Develops environmental sampling protocols, including data quality objectives, the frequency and timing of sampling, optimum locations for continuous or discrete sampling, data capture systems, sampling procedures, sampling methodology, personnel, and parameter list for analysis.
- 74 Develops site-specific work plans, including Quality Assurance/Quality Control (QA/QC) methods, measuring/monitoring procedures and analytical equipment (both field and lab equipment) to be used for the specific application (e.g. air, water, soil, sediments, rock, fauna, flora, human, workplace, etc.).
- 75 Develops methodologies and protocols for the collection and analysis of qualitative data to complement any quantitative data collected.
- 76 Modifies existing sampling programs to reflect changing research priorities and/or environmental circumstances.
- 77 Maintains analytical test instruments and monitoring or sampling equipment as per manufacturers' user-maintenance specifications and user's standard operating procedures, including calibration of instruments/equipment.

Technical Competency Dictionary (continued)

H12 Collecting samples and data for environmental purposes

- 78 Determines the appropriate sample size, sampling containers, protocols, preservation methods, collection apparatus and transportation, etc.
- 79 Selects, assembles and deploys analytical test instruments or sampling equipment (such as data capture systems, continuous monitoring devices, drilling cores, water bailers, etc.), including assembly and documentation of deployment and operational conditions and other pertinent details, such as any deviation to standard procedures.
- 80 Collects samples and specimens as per established protocol, using more routine sampling procedures and apparatus.
- 81 Collects samples and specimens as per established protocol, using more complex sampling procedures and apparatus.
- 82 Uses appropriate techniques to prepare (code, preserve, pre-treat and transport) samples for analysis while maintaining chain of custody requirements and sample integrity.
- 83 Prepares samples (other than biological) for lab analysis using techniques such as grinding, dehydration, dilution or concentration, chemical extraction, digestion, and fractionation.
- 84 Prepares biological samples for lab analysis using techniques such as dissection, emulsification, and tissue or bacterial culturing.
- 85 Performs direct measurement of physical parameters for air/water/soil, including for example, temperature, flow rates, pressure, gaseous/particulate emissions, etc.
- 86 Collects data on odours or taste (e.g. for muddy flavour) using appropriate means to determine thresholds.
- 87 Collects data from images obtained from sources such as remote sensing devices, satellite, and aerial/terrestrial/underwater cameras/sensors.
- 88 Maintains appropriate records and ongoing documentation pertaining to field and laboratory analytical work, including regulatory documentation.

H13 Analyzing and interpreting environmental samples and data

- 89 Uses more routine analytical procedures and instruments (such as meters, electrodes, and spectrophotometers) to identify and/or quantify the physicochemical properties, specific chemicals or chemical groups, etc. of the samples collected.
- 90 Uses more complex analytical procedures and advanced instruments, such as gas liquid chromatography, mass spectrometry, polymerase chain reaction and Enzyme-Linked ImmunoSorbent -Assay, to identify and/or quantify chemical properties, specific chemicals or chemical groups (including those present at trace concentrations), etc. in the samples collected.
- 91 Analyzes samples for microbiological organisms by application of basic methods such as aseptic techniques, membrane filtration, staining procedures, culturing & isolation procedures, microscopic and related techniques.

- 92 Classifies samples using applicable classifications (e.g., CSCC soil classification, taxonomy, sorting sample by phylum, order, family, species).
- 93 Classifies soils, land formations, minerals, etc. by their type, chemical and geophysical properties, etc.
- 94 Makes required calculations and estimates including for example, calculation of air quality indices (e.g. daily smog ratings).
- 95 Conducts statistical analysis of data using appropriate computer software, databases, etc.
- 96 Assesses the accuracy and precision of analytical results by applying good practice guidance or established QA/QC methods.
- 97 Interprets analytical data to identify trends, significant changes from historical patterns, deviations, or evidence of environmental stresses, etc.
- 98 Determines how results will be applied, for example redesigning sampling protocol, redesigning research methodology, developing a baseline dataset, etc.
- 99 Conducts quality control reviews of data collection, processing, and analysis to ensure data is 'fit for purpose' using accepted scientific practices and proper Quality Assurance/Quality Control (QA/QC) protocols.
- 100 Prepares summary reports of analysis results using technical formats such as tables, charts, and diagrams for integration into technical reports and/or presentation to expert and/or non-expert audience through scientific journals, oral presentations, etc.

Category I – Policy Development & Planning

I14 Developing environmental policies, measures & standards

- 101 Lobbies legislators to develop appropriate environmental policy and to enforce regulations and standards.
- 102 Reviews existing and/or proposed environmental policies/legislation/standards (and the rationale supporting them) to assess implications to stakeholders, including customers and suppliers.
- 103 Influences environmental policy and legislation by participating in or leading expert level environmental committees and associations.
- 104 Consults with experts, including environmental, policy and legislative experts in public, corporate, non-governmental organizations (NGO), and governments, regarding new or revised environmental policies and legislation to make recommendations to regulatory authorities.
- 105 Develops environmental frameworks to address policy issues across multiple jurisdictions, including legal and legislative limitations of the various jurisdictions.
- 106 Evaluates environmental business management practices in Canada in light of international policy changes in order to influence future changes in Canada's legislative framework.
- 107 Drafts new or revised environmental legislation, regulations, standards and guidelines.

Technical Competency Dictionary (continued)

J15 Liaising and partnering with stakeholders

- 108 Liaises with stakeholders (e.g. governments, private sector, environmental experts, farmers, producers, NGOs, culturally diverse groups, communities, etc.) to collaborate on stewardship and sustainability issues and concerns (e.g. broad-based habitat preservation and management practices and ecological fiscal reform).
- 109 Identifies ethical and cultural concerns regarding the economic, social, cultural, and spiritual valuing of specific natural resources, and the implications for informed decision-making regarding sustainability.
- 110 Builds consensus regarding the goals and timelines of sustainable development initiatives (e.g. use of natural resources), considering the competing interests of all stakeholders (e.g. economics, increased productivity or harvesting, protecting habitats, access and rights to land, etc.).
- 111 Develops partnerships with key stakeholders (e.g. industry, governments, local communities and other stakeholder groups) to address environmental sustainability and stewardship issues and concerns.
- 112 Develops partnership and stewardship agreements which incorporate sustainable development guidelines, indicators, targets, and processes for measuring progress related to specific environmental issues.
- 113 Secures partnerships involving industry joint ventures, environmental consulting, and/or environmental technology transfer at municipal, provincial, national and international levels.

Category J – Planning, Monitoring & Reporting for Sustainability

J16 Developing sustainable development indicators, plans, and strategies

- 114 Develops a framework and policies, with input from key stakeholders, for identifying sustainable development approaches and solutions that balance environmental, economic, social and cultural needs.
- 115 Identifies gaps in scientific, technical and cultural knowledge that aid in forecasting/modeling sustainable development scenarios.
- 116 Identifies/stays current with emerging developments, best management practices and guiding principles for sustainable environmental development.
- 117 Provides technical input to the development of positions on environmental issues and sustainable development plans, in areas such as reasonable timelines, priority actions, indicators towards progress, etc.
- 118 Evaluates the environmental, economic, social and cultural implications (both short and long term) of potential sustainable development initiatives.
- 119 Uses a multiple account approach to identify the potential indicators of environmental, economic, social and cultural change and the targets for sustainable development.

- 120 Develops sustainable development indicators and a process for reporting progress towards environmental performance targets.

- 121 Creates holistic sustainable development plans that integrate economic, social and cultural needs with ecosystem-based management strategies.

J17 Implementing/monitoring sustainable development strategies and programs

- 122 Implements sustainable development strategies, including the promotion of sustainable development practices (such as "green building" and sustainable communities).
- 123 Monitors the changing needs of stakeholders and the effectiveness of sustainable development strategies over short and long timelines to determine if strategies, targets, and/or timelines need to be modified.

Category K – Corporate Environmental Program Planning & Implementation

K18 Developing corporate environmental plans, policies, and procedures

- 124 Advocates with senior management and other key stakeholders to ensure due consideration of and commitment to environmental management and sustainable development principles and strategies.
- 125 Develops strategic internal and external partnerships and relationships with key stakeholders to garner their advice and gain their commitment to the organization's environmental policies and initiatives.
- 126 Advises senior management (and other stakeholders) on corporate environmental matters related to leadership responsibilities, regulatory and reporting requirements, and corporate liability.
- 127 Provides advice to senior decision makers on the extent to which environmental liabilities and risk are being managed appropriately.
- 128 Evaluates the environmental, economic, social and cultural impacts and implications of the organization's operations and processes.
- 129 Evaluates the effectiveness of indicators (including economic, social, cultural, and human health benefits) to measure progress in areas such as a reduction in emissions to the environment.
- 130 Prepares environmental performance reports relative to established metrics for communication to internal management, regulatory and stakeholder groups.
- 131 Makes recommendations for improvements to organizational operations based on an evaluation of corporate environmental performance.
- 132 Benchmarks environmental policies and performance against those of corporate, municipal, provincial, regional, national, or international peers.
- 133 Develops the organization's environmental policies and program in alignment with regulatory requirements, corporate values, and stakeholders' environmental, economic, social and cultural expectations.

Technical Competency Dictionary (continued)

- 134 Assesses the cost-benefit implications of the changes in process or practices required to conform to new standards or guidelines.
- 135 Develops the environmental policy component of the organization's strategic plan, including the processes and practices that support the environmental policy.
- K19 Conducting environmental risk assessments**
- 136 Identifies hazards, opportunities or potential risks to human health, the environment, facility operation/financial loss, legal liability, social impact, public perception through such activities as collecting source data, reviewing literature, investigating illness/injuries, and obtaining feedback from workers or the public.
- 137 Conducts hazards and operability studies (e.g. of oilfield facilities and operations).
- 138 Predicts the probable exposure to hazards using exposure and chemical fate/transport models, and the physical and chemical properties of contaminants.
- 139 Conducts qualitative assessment of risk by identifying the likelihood of events and the likelihood and severity of individual consequences.
- 140 Conducts quantitative risk assessment to identify the direct and indirect consequences of individual and multiple environmental impacts, including remediation and restoration activities if applicable.
- 141 Characterizes the risks of environmental stressors or contaminants at varying intensities and cumulative dosages on human health and/or the ecosystem.
- 142 Develops site specific standards/criteria to identify and manage risk with help from toxicologists and medical staff.
- 143 Develops risk management strategies, including prioritization of risks and actions to address ecological and human risks, and to manage financial, legal, social, and public perception issues.
- 144 Uses models to evaluate the effectiveness of the risk management strategies in the Environmental
- 145 Management Systems for contaminants of concern, and the resulting impact on the environment (for example, reduction of green house gas emissions).
- 146 Assesses the effectiveness of risk management activities to minimize impact on the environment and human health.
- K20 Implementing environmental management systems**
- 147 Develops an Environmental Management System which is consistent with the organization's strategic plan and regulatory requirements, including goals, objectives, and targets.
- 148 Implements the Environmental Management System strategies and practices.
- 149 Integrates the environmental management components of new operations, new projects, facility expansions, etc. into the corporate environmental management program.
- 150 Provides leadership to all aspects of the design, implementation, monitoring and reporting on the corporate environmental management program.
- 151 Ensures that corporate environmental management projects and proposals meet corporate standards, and financial and budgetary requirements.
- 152 Advises on human resource issues pertaining to the responsibilities and selection of external environmental contractors and consultants and the internal environmental team in accordance with the organization's policies and regulatory standards.
- 153 Develops full life cycle plans for the stewardship of environmental resources (from development to restoration, if applicable).
- 154 Implements programs and practices that encourage accountability, for example, by integrating environmental responsibilities into employees' jobs.
- 155 Integrates risk management decisions into the Environmental Management System and/or corporate business/strategic planning.
- K21 Managing environmental management systems and practices**
- 156 Uses information systems to monitor and track regulatory compliance, environmental incidents, permits, waste streams and other Environmental Management Systems requirements.
- 157 Revises Environmental Management System practices and outcomes to correct and prevent non-conformance.
- 158 Manages audits of the Environmental Management System to identify areas where corrective actions are needed.
- 159 Benchmarks the organization's Environmental Management System against that of other companies and/or international standards (e.g. ISO).
- K22 Coordinating environmental aspects of facility design & operation**
- 160 Determines the environmental aspects of the design and operation of the proposed facility, plant, landfill, etc.
- 161 Develops plans, protocols and procedures to address the environmental aspects of facility design, construction, operation and closing.
- 162 Coordinates the implementation of the environmental aspects of plans, protocols and procedures related to facility construction and operations.
- 163 Implements measures to correct environmental or safety problems relative to the facility or operation site.
- 164 Implements the environmental aspects of decommissioning facilities, operations or exploitation sites.

Category L – Environmental Safety

L23 Monitoring/addressing occupational and public health and safety

- 165 Evaluates the significance of environmental occupational/public hazards and safety issues as a basis for the development of policies, programs and procedures.

Technical Competency Dictionary (continued)

- 166 Develops and implement programs to manage risk to the public.
- 167 Develops preventative programs that help protect workers' (or the public's) health and safety in response to environmental concerns.
- 168 Develops organizational procedures concerning environmental and occupational/public health and safety matters.
- 169 Implements measures to mitigate the health & safety hazards associated with environmental issues created by operations or construction activities and their by-products such as hazardous leachates, effluents and dusts.
- 170 Develops emergency response plans and procedures to address environmental crises (such as accidental emissions, discharges, releases, explosions, leaks or spills that could cause a threat to humans and the environment), in consultation with stakeholders and emergency response experts.
- 171 Plans responses to mitigate human health risks/dangers of catastrophic events and insidious damage, such as the release of toxic gases.
- 172 Monitors existing or potential environmental health hazards and stressors such as noise, energy (UV, IR, radiation), chemical/biological pollutants in the air, water, and/or soil.
- 173 Monitors HVAC systems relative to health and safety standards for indoor air quality.
- 174 Assesses the effectiveness of health and safety programs for continuous improvement of programs and results.
- 182 Identifies the impact of development/exploration/exploitation activities on the biodiversity of surrounding natural habitats (such as the "downstream" impacts of agricultural activities on surrounding soil and water).
- 183 Applies GIS tools to monitor change and identify trends in natural habitats and/or ecosystems in order to manage habitat quality and resource sustainability.
- 184 Evaluates the capability of target sites to sustain restoration, rehabilitation and/or enhancement activities (of fisheries, forestry, etc.).
- 185 Evaluates the benefit of human-built structures (such as dams, ditches and fish weirs) to prevent destruction or erosion and/or to rehabilitate the habitat.
- 186 Evaluates the best sites and routes (e.g. gas/oil wells, gas processing plants, pipelines, and mines) for habitat and ecosystem preservation and conservation of natural resources.
- 187 Conducts modeling of ecosystem variables to predict potential outcomes of habitat restoration practices (such as fisheries rehabilitation or forestry regeneration).
- 188 Determines how and to what extent the natural resource can be modified (e.g. soil tilled, forest harvested) based on its characteristics.
- 189 Compiles a comprehensive inventory of data collected to establish a baseline that characterizes ecosystems, natural resources, and social and cultural factors, and/or to determine suitability for an intended use.
- 190 Prepares baseline report including gap analysis report where baseline data is incomplete, interpretation of baseline data and development of recommendations for consideration by stakeholders and decision-makers.
- 191 Designs monitoring systems for measuring human impacts on natural resources and/or ecosystems.
- 192 Tracks the deviation of earth and life science inventories from baseline levels through environmental monitoring programs.

Category M – Natural Resources Planning & Management

M24 Conducting studies related to ecosystem and habitat preservation and/or the management of natural resources

- 175 Develops models to set targets for sustainable use and/or to predict outcomes of conservation practices.
- 176 Develops methods for indexing existing natural resources and parameters (e.g. wildlife populations and harvest mortality).
- 177 Defines data (e.g. age, size, structure of population, genetics, distribution, migration patterns, abundance, water temperature, environmental factors, etc.) to forecast future state of natural resources, such as fish populations.
- 178 Establishes the biodiversity baseline (e.g. nature, number and location of species involved) of the management area under study.
- 179 Identifies interrelationships between individual ecosystem parameters to develop comprehensive databases of natural resources.
- 180 Assesses the economic, social and cultural value of natural and physical resources, such as parks/open spaces, heritage resources, wildlife, minerals, etc.
- 181 Establishes background levels of naturally occurring biological, chemical, and physical activity in ecosystems, such as naturally occurring emissions from forests.

M25 Developing and implementing plans, programs and practices for ecosystem and habitat preservation and/or the management of natural resources

M26 Monitoring/evaluating effectiveness of programs and practices related to ecosystem and habitat preservation and/or management of natural resources

Category N – Environmental Training & Education

N27 Developing environmental curricula and programs

- 193 Investigates significant occurrences and changes that may signal the need for a resource management and/or ecosystem preservation plan.
- 194 Seeks input from technical specialists (e.g., biologists, taxonomists, modelers) and other stakeholders (governments, non-governmental organizations, aboriginal peoples, etc.) with respect

Technical Competency Dictionary (continued)

- to resource management and habitat protection (such as the identification of important habitat sites).
- 195 Determines opportunities, options, and targets for increased productivity, utilization or yield of natural resources.
- 196 Establishes indicators of ecosystem health, based on established baseline data or extrapolations from similar ecosystems and/or traditional knowledge where available.
- 197 Determines end-use of natural resources (e.g., crops, forest, fisheries) to forecast future needs and demands and the corresponding resource management practices and the basis for its selection.
- 198 Formulates integrated ecosystem and habitat management plans (including interim management plans for public consultations) and programs to address identified preservation and conservation needs.
- 199 Implements ecosystem and habitat preservation projects and practices (such as preservation of fish and wildlife habitats and restoration in lakes, rivers, streams, wetlands, marshlands, etc.) to protect and conserve the biodiversity and health of ecosystems.
- 200 Implements fisheries and wildlife management and conservation practices such as limiting catch and capture, restocking, banding, and increasing nesting and breeding sites.
- 201 Implements forestry management and conservation practices such as site preparation, fertilization, replanting, seeding, pre-commercial thinning, brushing, pest control, etc.
- 202 Identifies effective resource management practices, including consideration of cultural and spiritual values of various jurisdictions and stakeholders (including indigenous peoples).
- 203 Develops effective practices to deal with naturally occurring phenomena, such as damage to crops caused by wildlife or damage/benefits to forests caused by fire.
- 204 Determines the resources and partnerships required to implement a natural resource management/conservation plan (e.g. funding mechanisms, services).
- 205 Formulates integrated natural resource management plans (including interim management plans for public consultations) and programs to address identified preservation and conservation needs.
- 206 Implements agricultural land conservation practices (such as preventing wind or water erosion, maintaining soil organic matter, correcting or controlling soil salinity problems, etc.) to conserve the availability and productivity of agricultural land.
- 207 Advises producers on the full range of sustainable resource utilization and harvesting practices and techniques, such as soil conservation/enhancement technologies (e.g. tillage options, measures to prevent wind and water erosion, crop rotation, cropping systems, nutrient management, residue management).
- 208 Implements conservation and preservation practices to manage the environmental impact of human activity in parks and natural recreation areas.
- 209 Implements urban land resource management practices to minimize detrimental impacts and to maximize environmental benefits, such as restoring undeveloped public lands to their natural state and ensuring proposed developments are consistent with land-use management criteria.
- 210 Identifies criteria, in collaboration with stakeholders, for evaluating proposals and land-use plans to determine impacts of changes in use of land resources such as conversion of agricultural land to urban use.
- 211 Identifies residual environmental impact and the associated economic implications (e.g. cash compensation to landowners for land use) of a proposed change in the use of natural resources.
- 212 Uses models and data (such as projections of population growth, municipal infrastructure needs, and increased demand for resource-based commodities) to forecast the environmental impact of long-term requirements for land resources such as parks, natural recreation sites, agricultural land, and urban development.
- 213 Develops long term integrated land-use plans (for urban, recreational, industrial, and agricultural uses) that include strategies (such as landscape ecology) to minimize adverse environmental impact.
- N28 Implementing environmental education and training**
- 214 Evaluates exploitation or exploration technologies (used to harvest/use natural resources) that do the least damage (low impact) to ecosystems.
- 215 Monitors baseline data to identify changes, both positive and negative, in order to continually improve conservation and preservation practices.
- 216 Assesses the effectiveness of conservation and preservation practices, including the interpretation of monitoring data and the validation of conclusions with experts in the field (e.g. government agencies, harvesters, industry, and non-governmental organizations).
- 217 Evaluates the effectiveness of alternative conservation practices (such as silviculture systems) that are perpetual or require minimal maintenance.
- 218 Evaluates the effectiveness of changes in municipal by-laws, regulations, and/or targets (such as targets for "green" and/or natural space) in minimizing the adverse impact of land-use activities on natural ecosystems.
- 219 Evaluates the socio-economic costs and benefits of conservation and preservation practices, including the spin-off costs and benefits, and where appropriate, the social assessment parameters.
- N29 Evaluating/Mentoring/Supervising students/practitioners**
- 220 Mentors students and environmental practitioners by advising, supervising, and challenging them to facilitate the development and application of new knowledge in their role as environmental practitioners and community partners in their role in the delivery of sustainable environmental practices.
- 221 Cultivates a stewardship approach within students and practitioners in the application of sound environmental practices within specific industries.

Technical Competency Dictionary (continued)

- 222 Evaluates the transfer of knowledge and skills, including comprehension of: the multidisciplinary nature of environmental practice, current best practices in industry, and the need for a global perspective for solving environmental problems.
- 235 Conducts science and social science environmental research (e.g. eco-toxicology studies, developing models, identifying optimal agri-chemical application rates, studies on environmental perspectives and the effectiveness of public education programs, etc.).
- 236 Provides expert guidance to others who may be assisting with the environmental research within or outside the organization.
- 237 Analyzes the environmental research findings to determine if research objectives have been met, or if research methodologies need to be modified.
- 238 Develops recommendations for the application of the environmental research findings based on pilot testing and demonstration.
- 239 Writes up the results of the environmental research in accordance with rigorous publishing guidelines (for publication in peer-reviewed journals, presentation at conferences, etc.).
- 240 Reviews other environmental researcher's reports, proposals, and publication papers to ensure their technical accuracy and soundness.
- Category 0 – Environmental Research**
- O30 Designing/developing environmental research and development proposals, programs, and projects**
- 223 Participates in taskforces and committees (set up by industry, governments or professional associations) to expand the body of knowledge on environmental research priorities, methodologies, and breakthroughs.
- 224 Identifies research priorities and opportunities for funding, considering financial viability and other indicators such as, current environmental conditions, scientific knowledge gaps, need for industrial improvements, socio-economic and cultural factors.
- 225 Defines the environmentally-related problem or opportunity and potential scientific, ecological or socio-economic benefits of conducting research (often including its practical application).
- 226 Conducts review of literature and existing data pertinent to the potential environmental research program/project.
- 227 Defines the scope, strategy and objectives for specific environmental research projects and programs, including appropriative quantitative and qualitative methodologies and tools.
- 228 Writes a proposal, communicating the scientific rationale behind the environmental research project to obtain funding and/or approval from internal, industry, government, or other sources.
- 229 Evaluates the technical, environmental and socio-economic merits of proposals (e.g. for determining eligibility and allocation of funds).
- 230 Develops a research action plan for the environmental project (e.g. establish budget, deliverables, timelines and human resource needs) for consideration by stakeholders and decision-makers.
- 231 Identifies the laboratory, equipment and other site-specific needs for the environmental research program.
- 232 Provides expert input for the recruitment of environmental research staff.
- P32 Developing/Coordinating/Implementing energy efficiency programs**
- 241 Develops energy efficiency programs such as Fleet Smart and ENFOR (energy from the forest).
- 242 Identifies best practices, objectives, and targets for implementation of energy efficiency programs.
- 243 Implements the technological and process changes relevant to the energy efficiency programs.
- 244 Develops energy efficiency tracking systems.
- 245 Monitors success of energy efficiency programs to identify and report on how closely objectives are met and what revisions are necessary.
- P33 Identifying/Implementing activities pertinent to commercialization of environmental technologies, systems & equipment**
- 246 Assesses the environmental implications of consumer behaviour and the resulting demand for products, services or natural resources.
- 247 Assesses emerging opportunities for manufacturing or business start-ups and services in response to changing environmental policies and consumer demand.
- 248 Advises on corporate strategies and product lines which take into account the drivers of environmental change and their impacts on consumer demand, regulatory changes, and competitive market forces.
- 249 Articulates the concept and ideas for new environmental technological processes and equipment, such as technologies to remove greenhouse gases from the atmosphere or to destroy waste materials.
- O31 Conducting environmental research/publishing results**
- 233 Establishes the framework, baselines and benchmarks against which environmental research outcomes can be measured.
- 234 Defines the specific methodologies and protocols appropriate to the environmental research project.

Technical Competency Dictionary (continued)

- 250 Assesses the economic feasibility of new environment-related products and technologies, including biotechnologies such as new crop species.
- 251 Determines objectives of the commercialization of new equipment or biotechnology products, considering environmental, technical, regulatory and financial constraints.
- 252 Provides expert input to the preparation or evaluation of proposals to conduct environmental technology development projects (including responding to RFP and preparing unsolicited proposals).
- 253 Develops new products and species, such as crops, trees, fish, etc. with the long term goal to reduce the burden on the natural resources and ecosystems.
- 254 Conducts laboratory-scale experiments to determine feasibility of proposed technologies/equipment.
- 255 Guides the development of new products and equipment from prototype to commercial scale, including trials of new agri-chemicals and their applications.
- 256 Conducts product and/or process life cycle analysis, including end-products, constituents used to produce them, and the methods used to dispose of them (focusing especially on the environmental implications over the full life cycle).
- 257 Develops improvements that will make the products (or the processes in which they are used or by which they are made) safer or more environmentally acceptable.
- 258 Provides expert input to the marketing and sales of environmental products or services (i.e. technical sales and ongoing client services)
- 265 Provides expert input to the development of a marketing/communication plan to promote/fully describe the organization's environmental capabilities and accomplishments.
- 266 Ensures the creation (research, writing, and design) of web-based and print communications and educational resources in support of the environmental communications strategies.
- 267 Develops means to address constraints, sensitivities, or opposing views on environmental concerns so that the message reaches the designated target audience(s) (using a variety of formats such as printed materials, videos, internet, CD ROMs).
- 268 Establishes goals for environmental awareness programs that will help ensure the intended message is accurately conveyed to the appropriate target audience.
- 269 Develops the content of environmental awareness programs designed, for example, to encourage and reward environmentally responsible behaviour.
- 270 Makes presentations to a variety of audiences (including schools, and community and non-governmental organizations) to build awareness of environmental issues, concerns and/or programs (e.g. the health-related effects of chemical enhancements to agricultural food production).
- 271 Champions environmental programs and their implementation with media, outside audiences, organizations, etc.
- 272 Assesses the effectiveness of environmental communications/awareness programs in attaining their goals.

Q35 Presenting expert information on environmental matters

- 273 Manages customer relations on environmental matters in a manner that builds positive, productive partnerships with clients, suppliers and other stakeholders.
- 274 Manages media relations concerning environmental matters to build, foster and sustain a positive public image for the organization.
- 275 Acts as the organization's spokesperson concerning environment-related issues and inquiries (e.g. health & safety, contamination of air, water, soil/water, etc.).
- 276 Conducts informational meetings to identify community and stakeholder priorities on environmental issues and concerns.
- 277 Identifies current environment-related trends and top companies/thought leaders in the global environmental business sector for the selection of content and speakers for conferences, seminars, focus groups, public consultations and forums.
- 278 Participates as a speaker, panelist, witness, or expert in conferences, public forums on environment-related topics and issues, or hearings (such as defending the Environmental Impact Assessment report).
- 279 Critiques environmental reports, proposals, and publications of peers or staff.

Transferable Competency Dictionary

Professional Ethics & Work Style

- 1 Maintains good standing in professional associations, practicing professional ethics and remaining current in practice requirements.
- 2 Demonstrates professional, ethical conduct, such as trust, integrity, confidentiality and discretion during the conduct of all work activities.
- 3 Demonstrates self reliance, motivation and commitment in the conduct of day to day activities.
- 4 Demonstrates flexibility and creativity in the face of unusual or unexpected circumstances.
- 5 Cooperates willingly with others in dealing with changing situations, conditions, and expectations.
- 6 Demonstrates attention to detail to ensure the thoroughness and accuracy of work results.
- 7 Balances the need for 'attention to detail' with a focus on goals and objectives to achieve the desired outcomes.
- 8 Applies principles of quality assurance and scientific rigour in all work activities.

Learning & Creativity

- 9 Stays current on the theory and practice pertinent to one's roles and responsibilities.
- 10 Integrates relevant data and information from a variety of disciplines/sources.
- 11 Continuously pursues personal learning and development opportunities to promote professional growth and development.
- 12 Uses creative approaches to develop innovative ways of working, new designs and technologies, and cost-effective solutions to technical and business challenges.

Communicating Effectively

- 13 Prepares clear, well-formatted reports and other written communications that meet established protocols and are appropriate to the target audience.
- 14 Communicates clearly and respectfully using verbal and nonverbal language appropriate to the cultural and social context.
- 15 Uses effective interviewing techniques, including appropriate and respectful questioning, clarifying and listening skills, to elicit accurate and complete information.
- 16 Conveys technical information accurately, clearly and concisely, interpreting it appropriately and effectively for the target audience.
- 17 Uses appropriate content, graphics and format in oral presentations to address the specific needs of target audiences.

Collaboration

- 18 Builds constructive networks inside and outside the organization to facilitate the accomplishment of results.
- 19 Builds strong relationships and trust with team members that make it possible to receive everyone's input and ideas, and maximize individual and team output and potential.
- 20 Works cooperatively with multiple stakeholders, demonstrating willingness to consider alternative approaches or ideas.
- 21 Deals effectively with confrontational situations, demonstrating diplomacy, tact, empathy and consideration for differing points of view.

Critical Thinking/Judgment

- 22 Carries out independent primary, secondary and tertiary research to collect sufficient data and information pertinent to the area of inquiry.
- 23 Performs an objective and thorough analysis of information and data from multiple sources.
- 24 Distinguishes between facts, inferences and assumptions to establish the quality of the information collected and the reliability of its source.
- 25 Employs professional skepticism to assess the objectivity and reliability of assumptions and evidence asserted by a responsible party or client.
- 26 Makes decisions in a timely manner, committing to a course of action that considers pertinent data, information, options and implications.

Planning & Organizing Work and Projects

- 27 Uses ICT (information communication technologies) as appropriate to manage work effectively and increase efficiency.
- 28 Manages multiple priorities through the selection and application of time and project management tools and approaches.
- 29 Develops work/project plans, identifying the work to be accomplished, the risk/contingencies that may arise, and how they will be addressed.
- 30 Coordinates resources (including financial, logistical, supplies, etc.) needed to implement work/project plans and achieve desired results.

Leading & Influencing Others

- 31 Manages the work of others, including project teams, working groups and contractors.
- 32 Builds consensus and commitment to the team mandate, vision, goals, roles, responsibilities, and processes.
- 33 Facilitates solutions to barriers that affect individual, team and project performance.
- 34 Identifies the individual/and or team competencies that are required to accomplish work/project objectives and deliverables.
- 35 Mentors peers and team members to facilitate their technical competence and on-going professional development.
- 36 Creates an environment that promotes innovation, creativity and entrepreneurial thinking within the organization.
- 37 Navigates effectively through political and organizational complexities to avoid or overcome potential barriers to successful completion.

Business Acumen

- 38 Analyzes relevant business trends, financial measures, economic factors and new regulations, assessing and articulating their impact on the organization.
- 39 Recognizes business threats and/or opportunities affecting their area of the business, recommending actions to address them.
- 40 Identifies clients' stated and underlying needs, and the work activities and methodologies that will best address these needs.
- 41 Translates the organization's vision and goals into relevant plans and actions, realigning work efforts with changes in organizational direction.
- 42 Drives the implementation of changes, tracking their impact to ensure organizational performance is improved or sustained.

APPENDIX F: GREEN SECTORS IDENTIFIED IN PREVALENT GREEN ECONOMY TAXONOMIES

Table 17
Summary of Categories Identified in Green Economy Secondary Reports

SECTOR NUMBER	GREEN ECONOMY SECTOR	REPORT:	MENTIONS	GREEN JOBS DEFINITION (BLS)	SIZING THE CLEAN ECONOMY (BROOKINGS-BATTELLE)	BRITISH COLUMBIA'S GREEN ECONOMY: SECURING THE WORKFORCE OF TOMORROW (GLOBE GROUP)	GREENING THE ECONOMY, TRANSITIONING TO NEW CAREERS (PARSONS & ASSOCIATES)	THE CLEAN ENERGY ECONOMY (PEW CHARITABLE TRUST)	MEASURING A GREEN ECONOMY (US DEPARTMENT OF COMMERCE)	JOB OPPORTUNITIES FOR A GREEN ECONOMY (PERI)	UNDERSTANDING THE GREEN ECONOMY IN CALIFORNIA - A COMMUNITY COLLEGE PERSPECTIVE (CCOE)	ADAPTATION OF CCOE (HRSDC)	TOWARDS A GREEN ECONOMY (UNEP)
1	Renewable/ Green Energy	10	x	x	x		x	x	x	x	x	x	x
2	Energy Efficiency & Green Building	10	x	x	x	x	x	x	x	x	x	x	x
2.1	Energy Efficiency	8		x	x	x	x	x	x		x	x	x
2.2	Green Building	9		x	x	x	x	x	x	x	x	x	x
3	Resource Conservation	9	x	x	x	x	x	x	x		x	x	x
4	Alternative/Sustainable Transportation	8		x	x			x	x	x	x	x	x
4.1	Vehicles	6		x	x				x	x	x	x	x
4.2	Transportation Systems and Planning	5		x	x			x		x	x		
4.2.3	Mass Transit	4		x	x					x	x		
5	Environmental Protection	8	x	x	x	x	x	x			x	x	x
6	Green Manufacturing	7		x			x	x	x		x	x	x
7	Green Services	6		x	x			x	x		x	x	
7.1	Business services (legal, marketing, ICT)	4			x			x	x			x	
7.2	Education and Training	4		x	x			x				x	
7.3	Financial Services	3			x			x				x	
7.4	Communication and Public Awareness	3			x			x				x	
7.5	Policy and Legislation	4		x	x						x	x	
7.6	Research and Development	3			x			x				x	
8	Sustainability Planning / Urban Design	4		x					x		x		x
9	Carbon and Climate Change Mitigation	3	x	x								x	
10	Green Retail	2					x		x				
11	Eco-Tourism	2									x	x	

Table 18
Green Economy Subsectors Mentioned in Selected Reports

SECTOR NUMBER	GREEN ECONOMY SECTOR	REPORT:	MENTS	GREEN JOBS DEFINITION (BLS)	SIZING THE CLEAN ECONOMY (BROOKINGS-BATTTELLE)	BRITISH COLUMBIA'S GREEN ECONOMY: SECURING THE WORKFORCE OF TOMORROW (GLOBE GROUP)	GREENING THE ECONOMY, TRANSITIONING TO NEW CAREERS (PERSONS & ASSOCIATES)	THE CLEAN ENERGY ECONOMY (PEW CHARITABLE TRUST)	MEASURING A GREEN ECONOMY (US DEPARTMENT OF COMMERCE)	JOB OPPORTUNITIES FOR A GREEN ECONOMY (PERI)	UNDERSTANDING THE GREEN ECONOMY IN CALIFORNIA-A COMMUNITY COLLEGE PERSPECTIVE (CCE)	ADAPTATION OF CCOE (HRSDC)	TOWARDS A GREEN ECONOMY (UNEP)
			MENTIONS										
1	Renewable/ Green Energy		10	x	x	x	x	x	x	x	x	x	x
1.1	Renewable Energy		10	x	x	x	x	x	x	x	x	x	x
1.1.1	Geo-exchange / Earth Energy		6	x	x	x		x			x	x	
1.1.2	Hydropower		6		x	x		x	x		x	x	
1.1.2.1	Small Hydro		2			x		x					
1.1.3	Ocean/Wave Energy		4		x	x		x				x	
1.1.4	Solar Energy		7		x	x		x	x	x	x	x	
1.1.4.1	PV Solar		7		x	x		x	x	x	x	x	
1.1.4.2	Solar Thermal		6		x	x		x		x	x	x	
1.1.5	Wind		7		x	x		x	x	x	x	x	
1.2	Other Green Energy (Cogeneration, Nuclear, Hydrogen)		5	x	x			x			x	x	
1.2.1	Cogeneration		3	x				x				x	
1.2.2	Hydrogen		2					x			x		
1.2.3	Nuclear Energy		2		x							x	
1.3	Biofuels and Biogas		8	x	x	x		x	x	x	x	x	
1.3.1	Bioenergy/ Biofuels		8	x	x	x		x	x	x	x	x	
1.3.2	Landfill Gas		4	x	x	x					x		
1.3.3	Municipal Solid Waste to Fuel		4	x	x	x					x		
1.4	Renewable Energy Services		4		x	x		x			x		
2	Energy Efficiency & Green Building		10	x	x	x	x	x	x	x	x	x	x
2.1	Energy Efficiency		8		x	x	x	x	x		x	x	x
2.1.2	Energy Transmission Infrastructure/Smart Grid/T		4		x	x		x				x	
2.1.3	Fuel Cells		4		x	x		x	x				
2.1.4	Energy Saving Consumer Products/Appliances		3		x			x	x				
2.1.5	Energy consulting, software, services		2			x		x					
2.2	Green Building		9		x	x	x	x	x	x	x	x	x
2.2.1	Architecture and construction services		5		x			x	x	x		x	
2.2.1.1	Retrofit		3		x					x		x	
2.2	Building Inspection		1									x	
2.3	Deconstruction		2					x			x		
2.4	Landscaping		3		x						x	x	
2.5	Energy-Saving Building Materials		1		x								
2.6	HVAC and Building Control Systems		4		x	x				x	x		

Table 18
Green Economy Subsectors Mentioned in Selected Reports (continued)

SECTOR NUMBER	GREEN ECONOMY SECTOR	REPORT:										
			MENTIONS	GREEN JOBS DEFINITION (BLS)	SIZING THE CLEAN ECONOMY (BROOKINGS-BATTELLE)	BRITISH COLUMBIA'S GREEN ECONOMY: SECURING THE WORKFORCE OF TOMORROW (GLOBE GROUP)	GREENING THE ECONOMY: TRANSITIONING TO NEW CAREERS (PERSONS & ASSOCIATES)	THE CLEAN ENERGY ECONOMY (PEW CHARITABLE TRUST)	MEASURING A GREEN ECONOMY (US DEPARTMENT OF COMMERCE)	JOB OPPORTUNITIES FOR A GREEN ECONOMY (PERI)	UNDERSTANDING THE GREEN ECONOMY IN CALIFORNIA: A COMMUNITY COLLEGE PERSPECTIVE (CCE)	ADAPTATION OF CCOE (HRSDC)
2.7	Lighting	5		x	x				x	x	x	
2.8	Professional Energy Services	2		x							x	
2.9	Water Systems	2			x						x	
3	Resource Conservation	9	x	x	x	x	x	x		x	x	x
3.1	Fisheries and Wildlife	5	x				x			x	x	x
3.2	Natural Resource Management	9	x	x	x	x	x	x		x	x	x
3.2.1	Organic & Sustainable Agriculture	8	x	x		x	x	x		x	x	x
3.2.2	Sustainable Forestry	5	x	x			x				x	x
3.2.3	Land Management	3	x	x			x					
3.2.4	Water, soil conservation	4	x	x		x	x					
3.2.4.1	Storm Water Management	2	x			x						
3.2.4.2	Water Efficient Products	1		x								
3.2.5	Conservation (other)	3	x	x			x					
4	Alternative/Sustainable Transportation	8		x	x		x	x	x	x	x	x
4.1	Vehicles	6		x	x			x	x	x	x	
4.1.1	Electric/Hybrid/Alternative Fuels/ Fuel Cell Vehicle	6		x	x			x	x	x	x	
4.1.2	Repair and Maintenance of Alternative vehicles	1								x		
4.1.3	Fueling Stations (natural gas, hydrogen, electric, etc.)	1								x		
4.2	Transportation Systems and Planning	5		x	x		x		x	x		
4.2.1	Logistics (fleet tracking, traffic monitoring software)	2					x			x		
4.2.2	Transportation Systems Planning	1								x		
4.2.3	Mass Transit	4		x	x				x	x		
5	Environmental Protection	8	x	x	x	x	x			x	x	x
5.1	Air Quality	3	x	x			x					
5.1.1	Air Purification Technologies	2		x			x					
5.2	Water Quality	5	x	x		x	x					x
5.2.1	Water Purification Technologies	3		x			x					x
5.2.2	Wastewater Treatment	3				x	x					x
5.3	Site Assessment & Reclamation	6	x	x	x		x			x	x	
5.4	Waste Management	5	x	x			x				x	x
5.4.1	Recycling	5	x	x			x				x	x
5.4.2	Waste Treatment	4		x			x				x	x
5.5	Professional Environmental Services	4		x	x		x				x	

Table 18
Green Economy Subsectors Mentioned in Selected Reports (continued)

SECTOR NUMBER	GREEN ECONOMY SECTOR	REPORT:										
			MENTIONS	GREEN JOBS DEFINITION (BLS)	SIZING THE CLEAN ECONOMY (BROOKINGS-BATTELLE)	BRITISH COLUMBIA'S GREEN ECONOMY: SECURING THE WORKFORCE OF TOMORROW (GLOBE GROUP)	GREENING THE ECONOMY: TRANSITIONING TO NEW CAREERS (PERSONS & ASSOCIATES)	THE CLEAN ENERGY ECONOMY (PEW CHARITABLE TRUST)	MEASURING A GREEN ECONOMY (US DEPARTMENT OF COMMERCE)	JOB OPPORTUNITIES FOR A GREEN ECONOMY (PERI)	UNDERSTANDING THE GREEN ECONOMY IN CALIFORNIA: A COMMUNITY COLLEGE PERSPECTIVE (CCE)	ADAPTATION OF CCOE (HRSDC)
5.6	Pollution control	5		x	x			x			x	x
5.7	Health and Safety	0										
6	Green Manufacturing	7		x		x	x	x	x	x	x	
6.1	Green Building Materials	5		x			x	x		x	x	
6.2	Chemical, Plastics and Rubber Products/ Biomaterials	4		x			x	x			x	
6.3	Green Consumer Products	5		x		x		x		x	x	
6.3.1	Electrical Equipment, Appliance and Components	1									x	
6.4	Monitoring and Control Products	2					x			x		
6.5	Machinery Manufacturing	1									x	
6.6	Paper Manufacturing	1									x	
6.7	Petroleum and Coal Product Manufacturing	1									x	
6.8	Recycled Content Products	2		x		x						
6.9	Eco-friendly Packaging	2				x	x					
6.10	Process Management	1					x					
7	Green Services	6		x	x		x	x		x	x	
7.1	Business services (legal, marketing, etc.)	4			x		x	x			x	
7.1.1	ICT	3			x		x	x				
7.2	Education and Training	4		x	x		x				x	
7.3	Financial Services	3			x		x				x	
7.3.1	Carbon Finance & Investment	3			x		x				x	
7.3.2	Financial Services/Venture Capital	1									x	
7.3.3	Energy Traders	1									x	
7.4	Communication and Public Awareness	3			x		x				x	
7.4.1	NGOs	2			x		x					
7.5	Policy and Legislation	4		x	x					x	x	
7.5.1	Compliance	1		x								
7.6	Research and Development	3			x		x				x	
8	Sustainability Planning / Design / Urban Design	4		x				x		x	x	
9	Carbon and Climate Change Mitigation	3	x	x							x	
9.1	Carbon Storage and Capture	2		x							x	
10	Green Retail	2				x		x				
11	Eco-Tourism	2								x	x	

APPENDIX G: LIST OF OCCUPATIONS IN KEY GREEN SECTORS

Table 19
Jobs in Demand: Job Vacancies for Occupations Supporting a Green Economy

RENEWABLE / GREEN ENERGY	EFFICIENCY & GREEN BUILDING
Manager	Manager
Business development manager	Building operations manager
Operations manager	Energy project manager
Project manager	Green buildings manager
Quality control manager	Manager - energy & environment management
Regulatory manager	Municipal infrastructure project manager
Engineer	Engineer
Civil engineer	Building science & engineering technologist
Generator mechanical design engineer	Buildings mechanical engineering manager
Hydro electrical engineer	Civil structural engineer
Process engineer, solar manufacturing	Facility assessment engineer project manager
Project engineer, renewable power	Structural engineer buildings
Turbine & generator equipment support engineer	
Specialist	Specialist
Security advisor	Consultation advisor
Technical specialist	Energy efficiency program project consultant
Training coordinator, cogeneration facility	Energy simulation specialist
Technician	Environmental site coordinator
Mechanical service technician	Facility condition assessor
Wind technician	Field inspector
Operator	Strategic energy initiatives coordinator
Boiler operator	Sustainability consultant
Trades	Technician
Arc welder	Building science consultant
Master electrician	Buildings mechanical engineer technologist
Scientist	Civil technologist
Physics technical specialist	Civil engineering technologist, environmental & geotechnical
R&D scientist (metallurgy)	
Regulatory & Policy	Landscape
Policy advisor	Landscape architect
Regulatory manager	Landscape architectural technologist
Sales & Support	Research scientist - nursery and landscape horticulture
Customer representative	
Sales professional, solar PV & thermal	
Sales representative, geo-exchange	
Support	
Program assistant	

Table 19
Jobs in Demand: Job Vacancies for Occupations Supporting a Green Economy (continued)

RESOURCE CONSERVATION		RESOURCE CONSERVATION
Manager		Other Natural Resources Occupations
Aquatic resources manager		Chief land administrator
Chairperson, agriculture & environment programming		Forestry program assistant
Conservation crew leader		Hydrogeologist
Garden centre manager & gardeners workers		Hydrologist
International project manager		Soil and terrain scientist
Managing leader environmental services		Urban forest bursary
Terrestrial resources manager		Water resources analyst
Engineer		Wildlife hotline emergency services operator/educator
Municipal engineering manager		Research
Water resources engineer		Research associate
Environmental engineer geoscientist		
Specialist		
Arborist		
Beekeeping intern		
Community engagement facilitator		
Conservation programs specialist		
Environmental specialist - fisheries and aquatics		
Experienced point counter		
GIS specialist		
Invasive species specialist		
Stewardship & horticultural assistant		
Biologists		
Fisheries biologist		
Marine biologist		
Wildlife biologist		
Ecology		
Restoration ecology		
Farm-Related		
Ecological farming systems development intern		
Farm help		
Grass fed beef farm intern		
Organic farm apprenticeship internship		
Organic farm intern		
Organic gardener		
Organic vegetable farm manager		
Soil farm apprentice		
Sustainable farm intern		

Table 19
Jobs in Demand: Job Vacancies for Occupations Supporting a Green Economy (continued)

ENVIRONMENTAL PROTECTION	
Manager	ENVIRONMENTAL PROTECTION
Aquatic resources manager	Regulatory & Policy
Client portfolio manager	Air quality compliance specialist
Corporate HSE manager specialist	Compliance coordinator
Director of health, safety and environment	Site environmental and regulatory coordinator
Drilling operations manager	Supervisor, regulatory compliance
Environmental consulting project manager	Remediation
Environmental manager	Contaminated sites professional
Environmental professional project manager	Safety & Health
Environmental remediation site foreman	EHS auditor
Facility environmental compliance manager	Environment, health and safety coordinator
Manager health and safety	Environmental health and safety manager
Municipal infrastructure project manager	Health & safety compliance management specialist
Occupational hygienist specialist and project manager	Health and safety administrator
Operations manager	Health, safety & environment advisor
Principal environmental scientist, manager	Infection control practitioner
Project administrator	Occupational hygiene & safety specialist
Project manager, contaminated sites or reclamation	Occupational hygiene consultant
Project manager, wastewater infrastructure remediation	Process safety technical authority
Safety manager	Sales & Support
Technical director, water treatment	Account manager, environmental
Terrestrial resources manager	Inside technical sales
VP operations	Seasonal
Water & wastewater engineers, project managers	Park person, seasonal
Engineer	Sustainability
Air quality environmental engineer	Infrastructure sustainability leader
Civil engineer	Water resources engineer/hydrologist
Civil environmental engineer	Specialist
Environmental engineer	Air emissions specialist
Geo environmental engineer	GIS analyst coordinator
Geochemist	Industrial monitoring team lead
Geoscientist	Mining closure & rehabilitation specialist
Geotechnical environmental engineer	Operator - research and testing facility
Health and safety engineer	QA analyst
Hydrogeologist	Reclamation specialist
Mineralogist	Technical advisor
Piping engineering specialists	Technical analyst infrastructure assessment
Process engineer	Water specialist
Project engineer	
Water & wastewater environmental engineer	
Water resources engineer	

Table 19
Jobs in Demand: Job Vacancies for Occupations Supporting a Green Economy (continued)

ENVIRONMENTAL PROTECTION	GREEN SERVICES
Technician	
Civil engineering or geotechnical technologists	
Emissions testing field technician	
Environmental technician	
Erosion control technician	
Hazardous materials technologist	
Laboratory technologist	
Materials management technician	
Materials technicians (soil, concrete & asphalt)	
Reclamation technologist	
Wildlife biologist, technician	
Biologists	
Aquatic biologist	
Terrestrial and wetland biologist	
Terrestrial biologists & ecologists	
Ecology	
Aquatic ecologist	
Other Scientist	
Atmospherics scientist	
Hydrogeologist	
Hydrologist	
Reclamation scientist	
Soil scientist	
Planning	
Infrastructure planning supervisor	
Land development design technologist	
Other Reclamation	
Environmental & reclamation assessments professional	
Other Environmental Protection Occupations	
Environment supervisor	
Environmental advisor	
Environmental affairs coordinator	
Environmental consultant	
Environmental coordinator	
Environmental draftsperson	
Environmental field staff	
Environmental inspector	
Environmental scientist	
Environmental services intern	
Environmental site assessor	
Environmental specialist	
Environmental technologist	
Field environment advisor	
Pipeline environmental supervisor	
Transmission line environmental inspector	
	Manager
	Environmental manager
	Environmental project manager
	Manager, environmental partnerships
	Manager, sustainability and stakeholder communications
	Project manager, mining permitting
	Specialist
	Ecological farming systems development intern
	Fundraiser
	Garden workshop animators
	Interpretive program guide
	Network coordinator
	Senior consultant management systems
	Summer program instructors for eco adventure kids camp
	Scientist
	Social or economic scientist
	Staff scientist
	Maintenance
	Lead hand (grounds worker, parks)
	Meteorology
	Meteorologist
	Regulatory & Policy
	Environmental compliance coordinator
	Environmental regulatory specialist
	Regulatory compliance coordinator
	Stakeholder Relations
	Communications and special projects assistant
	Community relations coordinator
	Frontline campaigner
	Invasive species community outreach liaison
	Municipal affairs specialist
	Public information officer
	Team lead, government and industry relations
	Other Environmental
	Environmental analyst
	Environmental outreach campaigner
	Environmental policy analyst

Table 19
Jobs in Demand: Job Vacancies for Occupations Supporting a Green Economy (continued)

GREEN PRODUCTS MANUFACTURING		CARBON AND CLIMATE CHANGE MITIGATION	
Manager		Manager	
Energy project manager		Sales and marketing manager	
Quality control manager		Specialist	
Engineer		Business analyst, Teksystems	
Corporate environmental health & safety engineer		Strategic energy initiatives coordinator	
SUSTAINABILITY PLANNING & URBAN DESIGN		Technician	
Manager		Field technician/technologist, emissions testing	
Manager, environmental & permitting		Scientist	
Manager, operational sustainability		Staff scientist	
Project manager urban development		Regulatory & Policy	
Project manager, sustainability environment & climate change		Associate director of policy	
Economics & sustainability location operations director		Environmental	
Planning		Environmental services intern	
Administrative planning technician			
Ecological planner			
Resource planning technician			
Regulatory & Policy			
Senior policy analyst, sustainability			
Other Environmental Occupations			
Corporate environmental specialist			
Environmental planner & monitor			
Environmental services mining practice leader			
Environmental specialist, air quality			
GREEN RETAIL		ECO-TOURISM	
Specialist		Manager	
E-commerce coordinator at grassroots		Canoe trip support/logistics manager	
Analyst, product & environmental stewardship		Hospitality Staff	
		Dining room server	
		Hostel manager and farm hand	
		Housekeeping staff	
		Outdoor Guides & Instructors	
		Canoe guide	
		Sea kayaking guide	
		Summer program instructors for eco adventure kids camp	
		Wilderness canoe instructor	
		Outdoors Support	
		Camp counselors & specialists, waterfront staff	
		Campground office workers	
		Maintenance summer camp male staff positions	
		Specialist	
		Dog handler maintenance cleaner	
		Dog handler office worker cleaner	
		Provincial park warden	



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The Green Jobs Map

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