Employment associated with Renewable and Sustainable Energy Development in the Kingston Region

By

A. Megan MacCallum

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Abstract

The Kingston region has become a hub for sustainable energy development, in part because of the local geography’s potential to support biomass, wind and solar energy, as well as the availability of workers with necessary skill sets and knowledge, and the presence of educational institutions associated with alternative energy. A 2011 review of the region also found that Ontario’s Green Energy and Green Economy Act (2009), which provides incentives for renewable energy development, has had a significant influence on the initial growth of the local renewable energy sector.

Kingston’s renewable energy sector will be assessed to explore the local green labour trends and specific features of work, using four green job definitions (new direct, new indirect, ongoing direct and ongoing indirect) to effectively characterize green employment. This research combines a review of local projects, online surveys, and semi-structured interviews to gain a comprehensive perspective of green work within the sector. Green work was categorized into new, ongoing and temporary as well as direct and indirect employment to provide greater detail based on the type of green work. The results suggested that the region’s renewable energy sector is dominated by employment in solar energy, and that workers are predominantly specialized with technical skills. Approximately 65% of survey respondents noted their work indirectly supports renewable energy projects, providing secondary services and products.

A series of multipliers were developed to estimate the number of jobs created in each category of employment on a per megawatt (MW) basis. Specifically, survey data estimates that for every one new direct job, 0.65 new indirect jobs might be created, while 0.39 ongoing direct jobs and 1.06 ongoing indirect jobs might be retained. Using these multipliers, it can be estimated that 242 direct and indirect green jobs related to the renewable energy sector will be created across twelve wind and solar projects completed, approved or proposed within the region.
Co-Authorship

This research builds upon an undergraduate thesis carried out in 2011 by Lindsay Napier at the Queen's University Department of Geography, entitled “Employment and Work in the Renewable Energy Industry in the Kingston Region.”

This thesis contains material that has been published in a book chapter co-authored by Lindsay Napier, Dr. John Holmes and Dr. Warren Mabee. The title of this chapter is “Renewable Energy, Sustainable Jobs: The Case Study of the Kingston, Ontario Region”, in the 2015 book Working in a Warming World, edited by Carla Lipsig-Mummé and Stephen McBride and published by Queen's School of Policy Studies and McGill-Queen's University Press.
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<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>BC MEMPR</td>
<td>British Columbia Ministry of Energy, Mines and Petroleum Resources</td>
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<td>BLS</td>
<td>Bureau of Labor Statistics</td>
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<td>CE</td>
<td>Choice Experiment</td>
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<tr>
<td>CHP</td>
<td>Combined Heat Power</td>
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<tr>
<td>DoC</td>
<td>U.S Department of Commerce</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<td>EWEA</td>
<td>The European Wind Energy Association</td>
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<tr>
<td>FIT</td>
<td>Feed-in Tariff</td>
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<tr>
<td>GEA</td>
<td>Green Energy and Green Economy Act</td>
</tr>
<tr>
<td>GHG</td>
<td>Greenhouse Gas</td>
</tr>
<tr>
<td>GREB</td>
<td>General Research Ethics Board</td>
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<tr>
<td>GW</td>
<td>Gigawatt</td>
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<tr>
<td>ha</td>
<td>Hectares</td>
</tr>
<tr>
<td>IEA</td>
<td>International Energy Agency</td>
</tr>
<tr>
<td>IESO</td>
<td>Independent Electricity Systems Operator</td>
</tr>
<tr>
<td>IILS</td>
<td>International Institution for Labor Studies</td>
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<td>IIISD</td>
<td>International Institute for Sustainable Development</td>
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<tr>
<td>ILO</td>
<td>International Labor Organization</td>
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<tr>
<td>I-O</td>
<td>Input Output Model</td>
</tr>
<tr>
<td>IOE</td>
<td>International Organization of Employers</td>
</tr>
<tr>
<td>IPCC</td>
<td>International Panel of Climate Change</td>
</tr>
<tr>
<td>ITUC</td>
<td>International Trade Union Confederation</td>
</tr>
<tr>
<td>kWh</td>
<td>Kilowatt hour</td>
</tr>
<tr>
<td>kW</td>
<td>Kilowatt</td>
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<tr>
<td>LCOE</td>
<td>Levelized Cost of Energy</td>
</tr>
<tr>
<td>LOI</td>
<td>Letter of Information</td>
</tr>
<tr>
<td>Mt</td>
<td>Megatonnes</td>
</tr>
<tr>
<td>MW</td>
<td>Megawatt</td>
</tr>
<tr>
<td>NIMBY</td>
<td>Not in my back yard</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
</tr>
<tr>
<td>OPA</td>
<td>Ontario Power Authority</td>
</tr>
<tr>
<td>PV</td>
<td>Photo-voltaic</td>
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<tr>
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<td>Renewable Energy</td>
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<tr>
<td>SME</td>
<td>Small-Medium Enterprise</td>
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<tr>
<td>WTO</td>
<td>World Trade Organization</td>
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<tr>
<td>UNEP</td>
<td>United Nations Environmental Programme</td>
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<tr>
<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
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<td>US</td>
<td>United States of America</td>
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CHAPTER 1  Introduction

People are becoming increasingly aware that maintaining lives and livelihoods around the globe requires a healthy environment (Trilsh 2009). It is clear that traditional forms of energy production, and the associated greenhouse gas (GHG) emissions, are leading to devastating impacts on the health of the planet (IPCC 2013). As inhabitants of a cold, sparsely-settled, large country, Canadians are aware of their vulnerability to a carbon-constrained future.

Under the Copenhagen Accord, Canada’s federal government has committed to a 17% reduction in greenhouse gas emissions below 2005 levels by 2020 (UNFCCC 2009). The most recent reports indicate that the current trend in Canadian GHG emissions will result in total emissions of about 734 megatonnes (Mt) per year in 2020, about 122 Mt above the national target (Environment Canada 2014). In 2009, approximately 90% of Canada’s GHG emissions came from the production or use of fossil energy (Environment Canada 2011). While Canada’s energy mix is already fairly green – about 19% of total primary energy supply is renewable, with the majority coming from hydroelectric sources (IEA Statistics 2011) - there is clearly an impetus for Canadians to consider increasing the amount of renewable energy (RE) in use in order to meet Copenhagen goals.

In developing renewable energy, Canada’s provincial governments have taken a strong lead, actively developing green policies within their respected regions. Examples of provincial strategies to increase renewable energy use include British Columbia’s Energy Plan (BC MEMPR 2009), which targets 90% renewable electricity in provincial generation and zero net GHG emissions associated with thermal energy production. Alberta’s current energy strategy includes language about increasing renewable production, but also focuses on developing ‘cleaner’ options for fossil energy (Government of Alberta 2009). In autumn 2013, Québec began a public consultation process on the
future of the province’s energy sector, including the reduction of GHG emissions from fossil fuel use and increased use of renewables in a variety of sectors (Government of Québec 2013).

In 2007, the province of Ontario announced a plan to phase out coal-fired electricity generation, which at that time accounted for 25% of the province’s electricity supply, introducing renewable energy options in its place (IISD 2015). The province’s Long Term Energy Plan (2013) and the Green Energy and Green Economy Act (GEA) (2009) set goals for renewable energy production, and provide specific tools to implement new electricity generation capacity (Ontario Ministry of Energy 2013; Government of Ontario 2009). The main tool created through the GEA was a Feed-in Tariff (FIT), which offered set rates over extended periods for electricity produced from various renewable sources (Mabee, Mannion, and Carpenter 2012). The incorporation of the FIT program and investments in transmission and distribution infrastructure, represented fiscal investments of more than C$ 10 billion dollars (Ontario’s Long Term Energy Plan, 2013). The GEA also specified certain proportions of domestic content (Ontario-made parts and labour) in order to drive employment in the province.

From 2009-2013, the FIT program was subdivided into a FIT (projects greater than 10 kilowatts (kW) installed capacity) and microFIT (<10 kW) program. During the programs introduction in 2009, the price/kWh were as follows. Rooftop solar photovoltaic (PV) ranged from C$0.539/kWh (for projects >500 MW) to C$0.802/kWh (for projects <10 kW); ground-mounted solar PV projects were offered C$0.443/kWh for ground mounted systems (OPA 2009). Onshore wind projects of any capacity were offered C$0.135/kWh; biomass offerings ranged from C$0.130/kWh (for projects >10 MW) to C$0.138/kWh (for projects <10 MW).

Since September of 2009, FIT prices have been altered a total of six times, lowering solar PV and wind rates and raising biomass rates. Currently, rooftop solar PV ranges from C$0.316/kWh (for projects 100-500 kW) to C$0.384/kWh (for projects <10kW) (OPA 2015). Ground-mounted
solar PV is currently offered between C$0.288/kWh (for projects 100–500 kW) to C$0.291/kWh for microFIT systems (OPA 2015). On-shore wind projects less than 500 kW are offered C$0.115/kWh, while biomass projects less than 500 kW are offered at C$0.156/kWh (OPA 2015).

In 2013, the World Trade Organization (WTO) ruled that the domestic content requirements were too stringent given existing trade agreements; the implications of these changes are described in more detail later in this chapter. As of 2014, a new competitive procurement program will be created for projects greater than 500 kW, leaving the FIT program to service projects between 10-500 kW (Ontario Ministry of Energy 2013). Three rounds of the FIT program have been carried out, and authorized projects have been announced for the first three rounds (OPA 2015). As the original FIT program has evolved, one modification was the introduction of a priority points scheme to help determine which projects would receive funding. Up to 9 priority points can be awarded based on project readiness, community participation, aboriginal participation, municipal support, and electricity system benefits (OPA 2014a). By 2014, Ontario was no longer generating any electricity using coal; by June 2015, the province’s installed generation capacity included 34,780 MW from renewable energy sources (IESO 2015).

An interesting component of new energy policies is the expectation of increased employment. Some provincial documents include specific language around sustainable or ‘green’ jobs associated with renewable energy production (BC MEMPR 2009). Other provinces, such as Alberta, recognize that the renewable energy sector provides employment but do not identify ‘green jobs’ as a specific target (Government of Alberta 2009). Québec’s strategic goals include a more sustainable economy, which by definition must include employment (Government of Québec 2013). In Ontario, the original GEA (2009) set a goal of 50,000 green jobs by 2013 (Ontario Ministry of Energy and Infrastructure 2011). The employment opportunities expected to arise from Ontario’s emerging renewable energy sector are referred to as ‘green jobs’, but the exact nature of
this work is not defined by the legislation. It should be noted that no new employment target has been set since the World Trade Organization (WTO) ruled against parts of the GEA in 2013.

Green jobs associated with renewable energy production have also been identified as an important component of local economies. The City of Kingston, Ontario - located at the eastern end of Lake Ontario, midway between Toronto and Montréal - is one example of a municipality that expects to benefit from the development of renewable power, both in terms of improved environmental performance and in terms of increased employment (City of Kingston 2010). The region, which for this study includes the counties of Frontenac and Lennox and Addington, has always had the right geographical characteristics to support renewable energy development. Strong winds off of Lake Ontario are particularly advantageous for wind projects, and solar photovoltaic (PV) production potentials are among the 10 best in the world at 1198 kWh/kW (Natural Resources Canada 2014a). With the implementation of the GEA and the incentives that it brings, a number of new renewable energy projects have been constructed, or proposed, for the Kingston region.

The emerging renewable energy sector around Kingston has received considerable support from the municipal government, as the city itself aspires to be Canada’s most sustainable city (Sustainable Kingston Plan 2010). The greater Kingston region is home to three education institutions - Queen’s University, the Royal Military College (RMC), and St. Lawrence College - which have developed research centers specialized in renewable energy studies, enabling development in green technologies and renewable energy operations (County of Lennox and Addington 2013). It is expected that the labour pool being developed by these institutions would supply a diverse portfolio of green jobs in the renewable energy sector developing around Kingston.
1.1 Thesis goal and objectives

This thesis explores the relationship between renewable energy development and employment - referred to in the thesis as ‘green employment’, ‘green work’, or ‘green jobs’ - in Kingston and the surrounding region. The goal of the research is to better quantify the relation between renewable energy development and various employment opportunities. This includes the number of new and ongoing jobs directly and indirectly associated with different types of renewable energy initiatives, the characteristics of those jobs (full or part-time, permanent or temporary), and the nature of the work being done. Specific objectives of the work include:

1. Developing a working definition of ‘green’ jobs, in order to be able to quantify green job development in the Kingston region;

2. Evaluating current large-scale renewable energy projects (> 10 kW) within the Kingston region to determine employment opportunities associated with these projects;

3. Conducting a web-based survey and follow-up interviews to determine the relation between new and ongoing, direct and indirect employment opportunities associated with the renewable energy sector; and

4. Using the results of the survey and interviews to provide insight into the different types of green work being carried out in Kingston's renewable energy sector.

In order to meet these objectives, the thesis is structured as follows. In Chapter 2, a literature review is carried out that includes an analysis of current renewable energy projects in the Kingston region. In Chapter 3, the methodology for the thesis is described, and in Chapter 4, the results of the research are presented and discussed. Chapter 5 provides overall conclusions from the study.
CHAPTER 2  

Literature Review

2.1 Green jobs

In assessing the relation between renewable energy development and employment, the first critical issue is that of definitions. There is considerable variability in the understanding of what a ‘sustainable’ or ‘green’ job is. In its earliest use, authors tended to restrict the use of the label of ‘green jobs’ to employment in a limited number of fields or vocations (OECD 2012). The definition has been expanded or modified by various organizations to meet their own purposes, but there is no accepted definition. A recent US report highlights some of the issues involved in creating a cohesive definition (Gülen 2011).

2.1.1 Historical definitions of green jobs

One of the earliest discussions of green jobs dates to 1972, when Lele and Mellor addressed the impact of the ‘green revolution’ on employment (Lele and Mellor 1972). Over the years, studies on green jobs have typically been commissioned by governments or international organizations such as The United Nations Environmental Programme (UNEP), The International Labour Organization (ILO) and The International Institute for Labour Studies (IILS), with the intention of creating the foundation of dialogue and discourse on green work (UNEP et al. 2008). When green jobs have been discussed in relation to renewable energy, the majority of analyses focus on issues of social context, such as the impacts of the implementation of sustainable energy projects on host communities (Arriaga et al. 2013).

One of the earlier definitions of green jobs dates back to 1999, when the Organization of Economic Co-operation and Development (OECD) and Eurostat suggested that green jobs are associated with industries producing environmentally-friendly goods and services. By this narrow definition, only 2% of total employment across the EU may be considered ‘green’ as of 2010 (OECD 2012). Similarly, the United States Department of Commerce (DoC) has created a definition for
green jobs that focuses on performance metrics associated with greenhouse gas emissions and energy efficiency. The DoC estimated that in 2007, the US green economy represented 1-2% of all economic activity within the country (U.S. Department of Commerce 2010a; U.S. Department of Commerce 2010b).

These definitions may be seen as limited as they do not capture employment that supports a green agenda within more conventional companies, and also because they do not provide any quantitative means to compare workers in different sectors. Thus, conventional employment that is potentially sustainable (for example, jobs in agriculture or forestry) cannot be easily compared to conventional jobs in fossil resources that by definition are unsustainable in the long term. By 2008, the United Nations Environment Programme (UNEP) had constructed a broad definition of green jobs that included work in agriculture as well as manufacturing, research, administration and service that could be seen as substantially preserving or restoring environmental quality (UNEP et al. 2008).

Similar noteworthy documents include Defining “green”: Issues and considerations, published as part of a joint paper series by the International Institute for Labour Studies (IILS) which compared five definitions of green jobs, in an attempt to address the challenges with different definitions (IILS 2011). This paper reviews green job definitions included in the UNEP/ILO/IOE/ITUC report, as well as material from the DoC, the Workforce Information Council, the Bureau of Labor Statistics (BLS), and Eurostat, to synthesizes the main components and characteristics of green jobs, as well as the strengths and weaknesses associated with the various definitions (IILS 2011). Highlights of this report include the need to recognize new jobs as well as those that are maintained as a result of a shift towards a green economy, while also stressing the importance of a standardized working definition to better inform employment policy as well as ensuring clarity within discussion of green employment (IILS 2011).
The lack of a universal definition of green work means that the term can be used to include a significant range of professions, which in turn creates challenges when assessing the development of green employment (Davis 2013; Thomas et al. 2010). Because green work is an issue of interest in multiple sectors, different research approaches are often used to assess green employment that includes diverse considerations in terms of data inputs, and geographic or temporal scales. To illustrate this point, consider that the ILO (2008) broadly defines green work as “reducing the environmental impact of enterprises and economic sectors, ultimately to levels that are [ecologically] sustainable”. This differs from Goods (2011) that categorizes green work into ‘deep’, ‘mid’, and ‘light’ green employment, where ‘deep’ includes long-standing job opportunities such as work in nature conservation, ‘mid’ describes the greening of existing jobs, and ‘light’ considers short-term or temporary work that accommodates sustainable development through remediation of ecological projects.

Recently, the BLS carried out a study to better understand green employment in the United States by utilizing 14 different questionnaires to assess green jobs amongst different economic sectors, using illustrative examples to define different types of green work (Sommers 2013). The BLS published two distinct definitions to differentiate jobs in companies that produce goods or services of benefit to the environment, and jobs that include improving the impact that the company has upon the environment (Sommers 2013). The former definition encompasses jobs in most renewable energy companies that provide service with a lower environmental footprint (as measured through specific indicators such as GHG) when compared to conventional alternatives. A job under the second definition might include contracted sustainability managers that aim to improve the operations of an existing business, without necessarily changing the goods or services provided by that organization.
Canada has seen a number of definitions of green jobs emerge in different jurisdictions. At the federal level, the definition seems to be rooted in sectoral employment, particularly related to renewable energy, forestry, and agriculture; a recent federal report indicates that ‘green’ jobs accounted for 11% of job growth across Canada between March and May 2012 (Evergreen and ECO Canada 2012). The Environmental Careers Organization (ECO Canada), which bills itself as the largest online resource in the country for environmental jobs, training, and certification, defines green jobs by activity and training - any job that works directly to reduce environmental impacts and requires specialized skills or experience can be classified as a green job (ECO Canada 2010). The Globe Foundation in British Columbia has built on both ECO Canada’s definition and on the UNEP definition of green jobs, focusing on any activity that is able to reduce environmental impacts (Globe Foundation 2010). In a joint report authored for the Toronto, Peel and York regions of Ontario, the need to reduce environmental impacts is included in the green job definition, but the authors also suggest that a livable wage, including benefits that can support upward mobility is an important aspect of green jobs (D. Parsons & Associates 2009).

It can be seen from this discussion that the definition of green jobs is rarely comprehensive – no single definition described here addresses all of the issues identified in the previous section, and certain elements (such as the need for living wages or long-term employment) are not explicitly addressed. Definitions within a single country can vary from agency to agency (as seen in the US example) or from jurisdiction to jurisdiction (as seen in the Canadian example).

Research into green jobs, particularly those associated with a specific sector (such as renewable energy generation), are often hampered by the lack of clear definitions. When conducting a study with interview and survey participants, Sommers (2013) found that categorizing employment into “full time” or “part-time” were not sufficient options to examine green employment. The complicated nature of respondents work included full-time contract work
for a limited period of time, or providing services to a renewable energy project in an indirect fashion through an unrelated company (Sommers 2013).

2.1.2 **Key components of a green job definition**

The first critical issue in defining green jobs is that it can include both new job creation as well as ongoing employment that becomes ‘greener’. As seen in the previous section, a ‘green job’ label describes specific employment activities that have positive environmental impacts; thus, the label can be applied to both new and ongoing jobs. It should also be recognized that ongoing jobs may be modified to be considered green (Gülen 2011). While new jobs are often desirable (particularly from a government perspective), retained jobs are important given that ‘greening’ of employment is part of the process of meeting increasingly stringent requirements for lower greenhouse gas emissions and increased energy efficiency (D. Parsons & Associates 2009).

Certainly there is an emerging global imperative to improve the environmental performance of both products and processes, and this is having an impact on jobs in Canada’s energy sector.

A second issue highlighted by Gülen (2011) is that of direct vs. indirect employment. Consider that green jobs are often classified by sector; thus, jobs in renewable energy, agriculture, or forestry (for example) may be included in an assessment of green employment (OECD 2012). With any sector, jobs may be direct (i.e., 100% related to the sector) or indirect (or induced) (i.e. part-time, service-oriented, or engaged in an element of a supply chain). In Canada's forest sector, the indirect jobs far exceed direct employment (Natural Resources Canada 2014b). In the renewable energy sector, direct employment consists of roles central to power generation, as well as the work based in the production and manufacturing of key technologic pieces for renewable energy generation projects (Steinberg et al. 2012; Rutovitz and Atherton 2009; Blanco and Rodrigues 2009). Indirect employment is for the most part related to providing secondary services within the supply chain of renewable energy development (Yi 2013; Steinberg et al. 2012;
Hillebrand et al. 2006). Thus, definitions of green employment that include broad sector
categorizations should track the proportion of direct and indirect jobs included. Within the
renewable energy sector, this means tracking workers directly associated with developing and
operating power generating facilities, as well as those employed in supporting roles - growing
biomass, providing accounting services, hauling goods, and so on.

A third issue is the thought that green jobs should incorporate a dimension of economic sustainability – in essence, they should allow one to live off of these jobs over an extended period. This important consideration is often less of a focus when green jobs are defined. It is known that a large number of new green jobs are temporary, meaning they are associated with construction and start-up of new, greener processes (such as renewable energy projects). These jobs may be reported in a way that makes it appear as though green construction jobs are secure and rising (Gülen 2011). Simply reporting the number of green jobs created may fail to consider their permanence, along with other aspects of job quality such as wages, unions, benefits and the ability to “move up” the occupational ladder, all important components of long-term employment sustainability (Sommers 2013). A shift to a green economy will result in many transitional jobs – temporary employment associated with construction and project implementation that will not persist.

An illustrative example that highlights the differences in green job categories is Canada’s evolving energy sector. Trade influences the sector heavily, with partners such as the United States (US) and the European Union (EU). The US has indicated that environmental performance is a factor in the impending decision on the Keystone XL project, which would carry Canadian oil sands product to the Gulf of Mexico (Cryderman 2014). Across the member states of the EU, continued development of an emission-trading scheme in conjunction with increasingly stringent targets for greenhouse gas emission reductions has impacted many supply chains. This shift has created new
markets for Canadian energy outputs such as wood pellets (Aguilar et al. 2012) but may potentially limit markets for other Canadian products, such as oil sands outputs (Lapointe 2013). In order to meet stricter criteria for environmental performance, Canada’s petroleum producers need to find ways to reduce the impact of their processes, which might include adopting more renewable energy within their portfolio or turning to less energy intensive strategies for petroleum recovery.

Both of these strategies might create new jobs, as well as ‘greening’ existing, ongoing employment in the sector. Jobs associated with producing oil or renewable electricity would be direct employment in the sector, while jobs associated with financing or managing project development would be indirect, as would many jobs associated with servicing the equipment when complete. Building new infrastructure to support a greener energy sector would bring both full-time and temporary employment.

Governments in Canada recognize that retaining jobs within existing sectors through a greening process, by implementing skills and shifting focus to consider environmental considerations, could have a much greater impact than a sole focus on creating new jobs (Manitoba Education 2012). The same view is held around the world; the UNEP predicts that most workplaces will see modest changes to everyday occupational activities that will improve overall environmental performance, essentially implying that green jobs may be found in all sectors (UNEP et al. 2008),

Given the discussion above, it is possible to identify at least five categories of green jobs, as shown in Figure 2-1. The availability of data will obviously dictate whether it is possible to track employment in each of these categories, but each represents a distinct and important component of an emerging green economy.
One final issue regarding definitions of sustainable or green jobs is the nebulous nature of these terms. Indeed, activities in almost every industry of the economy can be considered green (Katz et al. 2012). Furthermore, technologies considered green by some standards (for instance, nuclear power viewed solely through the lens of greenhouse gas emissions) may not meet the criteria of sustainability when other environmental aspects are considered (for example, the disposal of spent nuclear fuels). The application of poor practices in forestry or agriculture, which are typically considered ‘green’ industries, have potentially significant negative environmental ramifications (Gülen 2011). Thus, the definition of green jobs should ultimately incorporate metrics (preferably universally adopted) to define the degree to which jobs might warrant the label.

The limited number of definitions for green employment indicates that the most feasible metric may be a categorization approach that organizes green jobs based on type (direct or indirect, new or ongoing) as well as the industry it belongs to.

A 2006 study on renewable energy initiatives within Scotland’s energy strategy used Choice Experiment (CE) methods as the economic model to quantify potential external costs and benefits associated with alternative energy (Berggman et al. 2006). Lancaster notes the service of a good is
defined by the characteristic of that good, rather than the consumption of the good, as well as the fact that goods normally encompass more than one characteristic and therefore will be shared with other goods (Bergmann et al. 2006). Thus, the value of a good is determined by the sum of the value of its characteristics (Bergmann et al. 2006). Although distinct from other literature that attempts to quantify aspects of green work, Berggman et al. (2006) incorporate various components within the economic system as a means to measure the indirect impact this has. Because every region that hosts renewable energy development has different policies, industries and municipal governments, each area is defined by different components that determine trends specific to the region, and therefore best practices cannot be applied liberally from region to region.

While green jobs may be difficult to define, it is expected that the number of green jobs will grow in the future. In an attempt to understand how green jobs will be affected by climate change over various time frames, Fankhauser et al. (2008) used data from the scientific literature and from different governmental bodies (U.S. Department of Labor, U.S. Department of Commerce, the Intergovernmental Panel on Climate Change, etc.) to assess short-, medium- and long-term employment trends. They conclude that in the short term, climate policy leads to positive trends in green jobs; over extended time horizons, they suggest that technical innovation to manage climate issues could drive a fundamental redevelopment of economies (Fankhauser et al. 2008).

2.1.3 Ontario’s policy framework for renewable energy development and green job creation

In Ontario, the term ‘green jobs’ is often linked to the Green Energy and Green Economy Act (GEA) (Government of Ontario 2009). In 2009 the GEA promised up to 50,000 jobs associated with renewable energy development over a three-year period (Ontario Ministry of Energy and Infrastructure 2011). In this initial statement, one might suspect that the definition of green jobs was left deliberately vague; the Act does not define green jobs, and thus no criteria can be applied to determine if the objective has been successfully reached (Spears 2013; Ontario 2009; Evergreen
and ECO Canada 2012). This means that evaluating the success that Ontario has had in creating green jobs through the GEA is difficult, and that the opportunity for the government to defend the GEA on the basis of employment is lost. 

One of Ontario’s key goals for renewable energy employment was the development of manufacturing capacity for wind and solar PV equipment. Under the initial GEA, a domestic content or ‘made-in-Ontario’ rule directed that 50% of wind power components and 60% of solar PV components must be made or assembled in Ontario (OPA 2014b). The thinking behind this was that a large number of manufacturing jobs would be created in Ontario to meet the requirement for wind and solar power components. This thinking was seemingly validated by claims that up to 31,000 new jobs had been created across the province, although there was never any real analysis provided of what form those jobs took (Stinson 2013).

After the World Trade Organization (WTO) ruled against these requirements, the domestic content requirement for wind power was reduced to 20%, while the requirement for solar PV now ranges between 19% (for concentrated PV) and 28% (for thin-film solar technology) (OPA 2014c). It is still uncertain what influence this ruling will have on future renewable energy projects, although demand for the program seems strong with almost 2000 applicants representing 500 MW competing in the 2014 round of contracts (OPA 2014d). An even bigger question looms regarding the future of existing manufacturing facilities that were intended to service these projects (Blackwell 2013), as the reduction in domestic content rules will make it more difficult for these companies to compete.

The previous section acknowledged that Canada lacks a universal definition of green employment, which limits the ability to quantify the number of green jobs within employment and labour statistics (Sommers 2013; Statistics Canada 2014a; ECO Canada 2010). Existing Ontario labour data for the renewable energy industry does not account for all types of jobs, again making it
difficult to quantify the success of the GEA. The job creation goal of the GEA treats direct jobs (such as a wind farm operator) and indirect jobs (such as a sales position associated with a solar PV installation company) as essentially equivalent, although the nature of these jobs, their long-term sustainability, and the training required are all very different (Sommers 2013). More information describing the range of green jobs associated with renewable energy generation in Ontario would give the province an improved ability to assess the impacts of the GEA, and would support more focused training and skills development to support an emerging economy based on renewable energy.

2.2 Renewable energy

Employment related to renewable energy projects tends to be assessed using a range of methods, ranging from surveys and interviews of participants in the sector (qualitative approaches) to input-output (I-O) and general equilibrium models (quantitative assessments) (Blanco 2009; Pollin 2009; Lehr et al. 2007). Gallant and Fox (2011) adopt a literature review methodology when assessing renewable energy policy within Ontario to drive large-scale wind project development. The authors used literature from newsletters, magazines, news sources as well as provincial documents such as the Ontario Power Authority (OPA) and the Ministry of Energy to assess wind energy development in Ontario (OPA 2012; Ontario Ministry of Energy 2013). This literature review outlines the various omissions that were excluded within the GEA (solar, wind, transmission, backup, export, revenue displacement, dividend reductions, conservation) to argue that energy bills will increase, based on news and provincial legislature sources of information.

Qualitative studies provide valuable information on the nature of work being carried out, and often focus on governmental relations (Ontario Ministry of Energy 2013; Ontario 2009; ECO Canada 2010). Interviews offer descriptive data that illustrate an individual’s opinions (expert or otherwise) or experiential knowledge on a subject (Tashakkori and Teddle 1998). Studies that use
interviews (structured or semi-structured) and various types of reviews are usually adopted to gain descriptive responses to socially sensitive issues (Creswell 2003). For example, a survey or interview approach is often used to qualify a population’s willingness to host renewable energy projects. An interview or survey approach can be very useful in determining aspects of employment beyond simple parameters - with these types of tools, specific data on what work is being undertaken, or the sustainability of a given employment opportunity, can be gleaned.

Interview approaches have been used to examine forces driving renewable energy development in North America and Europe, finding that a “successful formula” for promoting a strong renewable energy economy includes high FIT prices, easy transmission access and low transmission fees (Alagappen et al. 2011). Barriers to renewable energy projects have been identified through an interview approach in Saskatchewan (Richards et al. 2012) and across multiple nations (Sovacool 2009), which includes critical barriers such as local community disagreements with renewable energy investment strategies, conflicting sources of information on renewable energy technologies, lack of social interest and support, and low levels of political support. A common finding in these studies is that addressing these obstacles means highlighting the benefits of renewable energy - particularly in terms of lower energy prices or employment.

A quantitative approach is relevant when defining the benefits of renewable energy. Quantitative work tends to describe the impacts of renewable energy development using economic terms, which are useful in driving political and economic decisions (Haerer and Pratson 2015; Varela-Vazquez and Sanchez-Carreira 2015). Research using quantitative methodologies tends to have highly technical objectives, such as comparing the feasibility of different renewable energy sources, or estimating the potential energy output of a specific technology within a specific geographic setting (Duscha et al. 2014; Moreno and Lopez 2006). For example, Hoicka and Rowlands (2011) evaluated the combined energy production of wind and solar energy in Ontario
using quantitative estimates of capacity as determined by specific geographic constraints on wind and solar resource availability. This study modeled individual and combined systems, to show that integrating these two sources led to less variability in power generation over extended periods. It is clear that this type of research is critical to understanding renewable energy potential in terms of employment; as modes of energy generation change (for example, as hybrid systems are developed) and the number of people required to build and operate facilities will change.

One approach that combines both quantitative and qualitative research in this area is the development of employment multipliers, which link jobs created (or maintained) to specific renewable energy projects. This approach is increasingly used to summarize opportunities related to renewable energy development in a fashion relevant to policy objectives (Caldes et al. 2009; Ejdemo and Soderholm 2015; Hillring 2002). As this thesis is intended to explore trends around green jobs and renewable energy deployment in the greater Kingston region, the multiplier approach is one that will be utilized and described in greater detail in the methods and results chapters that follow.

2.2.1 Renewable energy potential in the greater Kingston, Ontario region

The City of Kingston has publicly set a goal of becoming Canada’s most sustainable city, and has developed a platform incorporating cultural vitality, economic health, environmental responsibility and social equity as part of this goal (City of Kingston 2010). This platform specifically refers to environmental issues such as climate change, but also economic issues such as regional development and new job creation. One of Kingston’s sustainability goals is to generate enough renewable energy to meet local needs (City of Kingston 2010).

Kingston and the surrounding region is well situated to take advantage of renewable energy opportunities, as the local geography is endowed with renewable resources including biomass, sunlight, and wind. In addition, the city of Kingston is home to a range of people and organizations
with the necessary skillsets to make renewable energy generation successful. One such organization is SWITCH Ontario, a not-for-profit organization launched in 2002 to promote development and implementation of energy efficient and renewable energy technologies (SWITCH 2013). With membership of almost 100 companies and individuals, this organization represents a range of capacity that can support renewable energy projects across the region.

A number of local educational institutions are also engaged in training highly qualified personnel able to work in the emerging renewable energy sector. Both Queen’s University and the Royal Military College (RMC) have introduced new programs to build expertise in sustainability and energy systems (Napier 2011). St. Lawrence College offers three programs in the renewable energy sector, focusing on energy systems engineering, wind turbines, and geothermal energy (St. Lawrence College 2014). Graduates from programs across higher level educational facilities have supported the development of business and services within Kingston related to the renewable energy sector (Napier 2011).

2.2.2 Biomass energy

Biomass-based renewable energy can be generated from a number of pathways (Sims et al. 2010). Solid biomass from forest or agricultural may be combusted producing heat and/or electricity, or may be converted through biological or thermochemical means to liquid fuels for transport; alternatively, biogas may be collected through anaerobic digestion of landfill material or farm manure (Mabee and Mirck 2011). Each iteration of Ontario’s FIT program has recognized 1. biomass-based electricity, 2. electricity from biogas on-farm, and 3. electricity from landfill gas; the current FIT program (which only applies to projects between 10-500 kW) offers base rates of C$ 0.13, C$ 0.077, and C$0.164 respectively for these bioenergy options respectively (OPA 2015). Because these rates do not attach value to the potential heat output of a combined heat and power facility, they are too low to drive significant investment in these power options (Moore, Durant, and
Mabee 2013); indeed, in the first two rounds of FIT funding (2010 and 2011), only 2.8% of all contracts offered (48.6 MW) went to the three biomass options.

Only one on-farm biogas facility in the immediate Kingston region has been approved through the first two rounds of the FIT program, the De Bruin Farms Biogas facility on Wolfe Island of 0.36 MW (OPA 2015). While few biomass-to-energy projects were created under the GEA across southern Ontario, it should be pointed out that there are rich biomass resources in the area. One study suggests that as much as 260,000 dry tonnes of residues are produced annually from sawmills in Eastern Ontario, which in turn could be used for bioenergy production (Levin, Krigstin, and Wetzel 2011). This figure is likely matched by ‘unused’ annual growth in the forest (i.e. biomass that could be sustainably harvested, but not currently used by the forest products sector) (Mabee and Mirck 2011).

Agricultural biomass supply, including potential energy sources such as corn stover, wheat straw, and hay, is detailed throughout the Census of Agriculture. Recent estimates suggest that agricultural biomass availability reaches as much as 725,000 dry tonnes per year across the five predominantly agricultural counties to the east of Kingston; taken together, forest and agricultural biomass could provide about 10% of energy requirements in eastern Ontario (Mabee and Mirck 2011). In addition to the limited incentive under the FIT program, the lack of good data on biomass availability in the region may contribute to the minimal uptake of this option (Calvert, Luciani, and Mabee 2014). Given the proper incentive and better data on resource availability, biomass energy options could become more important to Kingston in the future.

2.2.3 Wind energy

Wind energy is currently being developed in many locations across Ontario, and has been proposed (along with solar PV) as a potential means to support off-grid communities across the northern region of the province (Arriaga et al. 2013). Kingston’s geographical location, situated on
the eastern shore of Lake Ontario, provides ideal wind potential, particularly given prevailing westerly winds that gain speed as they travel across the expanse of the lake. The mean wind speed across most of Ontario, measured at 50 m above ground, ranges between 4-6 metres per second; at the eastern end of Lake Ontario, wind speeds are routinely in the 8 m/s range, making this area among the most suitable for wind farms in the province (Environment Canada 2008). Under the current (post-2013) FIT program, wind-based electricity receives a base rate of C$ 0.115/kWh. Approximately 34.9% of all contracts (615 MW) offered under the first three rounds of the FIT program went to wind-based electricity (OPA 2015).

In the Kingston region, the GEA has given rise to the development of four wind-to-electricity project proposals since 2009, as detailed in Table 2-1. Two of these projects have been approved to date (the Ernestown Wind Farm, which became operational in October 2014, and the Amherst Island Wind Farm, which was approved in fall 2015). The two proposed off-shore wind projects were proposed early in the FIT program, before a moratorium on off-shore wind was put in place (OPA 2015). The existing wind farm on Wolfe Island predates the GEA but is included here for the sake of completion.

Table 2-1 – Wind energy projects near Kingston by capacity and development status

<table>
<thead>
<tr>
<th>Project Information</th>
<th>MW</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wolfe Island Wind Farm:</strong> TransAlta operates a 198 MW wind farm consisting of 86 turbines on Wolfe Island</td>
<td>198</td>
<td>Complete*</td>
</tr>
<tr>
<td><strong>Ernestown Wind Farm:</strong> Ernestown Windpark Inc. (operating as Ernestown Windpark Limited Partnership) is a cooperative project constructing 5 turbines with total generation capacity of 10 MW</td>
<td>10</td>
<td>Approved</td>
</tr>
<tr>
<td><strong>Amherst Island Wind Farm Project:</strong> Windlectric Inc. plans to construct 36 turbines with total generation capacity of 75 MW</td>
<td>75</td>
<td>Approved</td>
</tr>
<tr>
<td><strong>Trillium Power Wind 1:</strong> proposed to engineer offshore wind farms in Lake Ontario aiming to intake 420 MW of energy</td>
<td>420</td>
<td>Proposed/ on hold</td>
</tr>
<tr>
<td><strong>Windstream Wolfe Island Shoal Inc.:</strong> proposes to develop an offshore wind farm across 19,400 ha producing 300 MW</td>
<td>300</td>
<td>Proposed/ on hold</td>
</tr>
</tbody>
</table>

*This project was contracted under the Renewable Energy Standard Offer Program Source: OPA 2015
2.2.4 Solar energy

Eastern Ontario has some of the greatest solar photovoltaic (PV) potential within Canada, and is recognized as one of the world’s sunniest places, falling just short of Rio de Janeiro, Brazil (Natural Resources Canada 2014a). Kingston has a yearly solar PV potential of 1197 kWh/kW, placing it fifth amongst Canadian municipalities with the greatest solar PV potential, and tenth globally (Natural Resources Canada 2014a). The Kingston region’s solar potential ranges between 3.52 – 3.96 kWh/m² of irradiation per day (Nguyen and Pearce 2010).

A 2010 study estimated the local potential for solar PV by considering a wide array of factors, including soil and land use classifications, digital elevation models, slope, aspect, latitude, albedo, clear sky index, and irradiation factors (Nguyen and Pearce 2010). Over 375,000 ha across the region were found to be suitable for solar farm development, suggesting a theoretical regional capacity of about 90 GW (Nguyen and Pearce 2010). Wiginton et al. (2010) developed a five step procedure to estimate total rooftop solar PV potential that could be applied to the region, using georeferencing to identify suitable buildings and modifying the surface area to account for shading, orientation, and other uses. This study established that 5.7 GW of solar PV capacity could be achieved by installing panels on appropriate roofs (Wiginton et al. 2010), in addition to the regional capacity for solar farm development. It is clear that the potential to expand solar PV in and around Kingston is dramatic.

Under the existing FIT program, contracts for all ground mounted solar PV projects are currently offered at C$ 0.291/kWh, while rooftop projects greater than 10 kW and less than 500 kW receive between C$ 0.329-0.346/kWh (OPA 2015). As such, solar PV projects receive the greatest incentive of all renewable energy types under the current FIT program, and not surprisingly constituted the largest percentage of projects contracted under the first two rounds of the FIT
program. Approximately 51.4% of projects (907 MW) contracted in the first two rounds were ground-mounted solar projects, while only 1.5 MW of projects used roof-mounted solar PV.

In the Kingston region, the GEA has resulted in six major solar projects under the FIT program, which are currently under development (see Table 2-2). Two additional projects, already operating, were contracted under the prior Renewable Energy Standard Offer Program (RESOP) which predated the GEA. In addition, a few local microFIT applications (10 kW of installed capacity or less) have been received, totaling less than 1 MW of installed capacity (OPA 2015). Only FIT-scale projects are included in Table 2-2.

Table 2-2 – Solar photovoltaic projects near Kingston by capacity and development status

<table>
<thead>
<tr>
<th>Project Information</th>
<th>MW</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Light I:</strong> Skypower/SunEdison built a 9.1 MW ground mount solar PV installation over 90 ha in Stone Mills</td>
<td>9.1</td>
<td>Complete*</td>
</tr>
<tr>
<td><strong>First Light II:</strong> Skypower built a 10.5 MW ground mount solar PV installation over 36 ha in Stone Mills</td>
<td>10.5</td>
<td>Complete*</td>
</tr>
<tr>
<td><strong>Kingston Gardiner TS Odessa:</strong> Axio Power Canada Inc./SunEdison Canada will construct a 10 MW ground mount solar PV project near Odessa</td>
<td>10</td>
<td>Approved</td>
</tr>
<tr>
<td><strong>Kingston Gardiner Hwy 2 South Solar Project:</strong> Axio Power Canada Inc./SunEdison Canada will construct a 10 MW ground mount solar PV project near Odessa</td>
<td>10</td>
<td>Approved</td>
</tr>
<tr>
<td><strong>Kingston Gardiner TS Unity Road Solar Project:</strong> Axio Power Canada Inc./SunEdison Canada will construct a 10 MW ground mount solar PV project in Kingston</td>
<td>10</td>
<td>Approved</td>
</tr>
<tr>
<td><strong>Napanee TS Taylor Kidd Solar Energy Project:</strong> Axio Power Canada Inc./SunEdison Canada will construct a 10 MW ground mount solar PV project near Millhaven</td>
<td>10</td>
<td>Approved</td>
</tr>
<tr>
<td><strong>Little Creek Solar Project:</strong> Canadian Solar will construct a 10 MW ground mount solar PV project in the County of Lennox and Addington</td>
<td>10</td>
<td>Approved</td>
</tr>
<tr>
<td><strong>Samsung Sol-Luce:</strong> Samsung will build and operate a solar power cluster in the City of Kingston and Loyalist Township which will generate approximately 100 MW of solar power</td>
<td>100</td>
<td>Approved</td>
</tr>
</tbody>
</table>

*These projects were contracted under the Renewable Energy Standard Offer Program
Source: OPA 2015

2.2.5 Issues impacting the development of different renewable energy technologies

There are a series of key economic considerations that should be reviewed during the development of renewable energy projects. One is the cost of electricity produced through each project. The levelized cost of electricity (LCOE) approach is a financial analysis of energy generation costs that considers all financial inputs including capital and operating costs over the
lifespan of the project (International Energy Agency 2010). This method enables a comparison of the overall competitiveness of different energy generating technologies represented in per-kilowatt hour cost (U.S. Energy Information Administration 2015).

The LCOE approach suggests that the most cost-effective renewable energy option is wind energy. According to an independent study by the Fraser Institute in 2012, in Canada, onshore wind technologies have an overnight capital cost of $2.75 USD per MW, in comparison to solar PV projects that range from $3.37-$7.31 depending on type of technology (includes park, industrial, commercial and residential). Therefore, onshore wind prices have the ability to generate power at competitive prices, with a 5% discount rate, in comparison to solar PV projects that are significantly less competitive. Furthermore, solar PV developments require much more initial investment, ranging from approximately $0.21-$0.46 per kilowatt hour, compared to roughly $0.08/kWh in initial investment costs for wind (Angevive 2012). This is reflected in the higher incentives offered for solar PV electricity: small rooftop installations qualified for incentives ranging from C$ 0.316-0.384/kWh, and ground-mounted installations qualified for between C$ 0.275-0.289/kWh, in comparison to wind which was offered C$ 0.128/kWh (IESO 2015).

Bioenergy sources tend to be more expensive due primarily to the need for feedstock, which adds a variable operational cost. Furthermore, biomass produces heat as well as electricity, meaning it is unlikely that bio-based electricity can compete without receiving income from that heat (Moore et al. 2013). However, the Fraser Institute notes that combined heat and power (CHP) through biomass is the least costly source of renewable energy power, after geothermal (Angevive 2012). The GEA did not provide an incentive for heat at the time that this study was carried out, which may explain why fewer bioenergy projects are underway; only 508 MW of bioenergy capacity was in development across the province by early 2015, compared to 2,171 MW of solar PV (IESO 2015).
Another important economic consideration is economy of scale, which describes the economic phenomena whereby the greater amount of goods produced, the lower the production cost (Panzar and Willig 1977). Economies of scale emerge when economic growth facilitates an increase in production to a point where cost-per-unit decreases, thus enhancing the competitiveness of a firm or sector as well as potentially creating economic monopoly conditions (Panzar and Willig 1977).

Wind power tends to scale towards larger facilities since the current FIT pricing does not reward smaller-scale facilities, compared to solar PV, which benefits from the presence of a microFIT program which rewards individual rooftop facilities with a higher incentive (IESO 2015). The current pricing for solar PV actually supports installations from small-scale rooftops to large-scale commercial projects funded through either a commercial feed-in-tariff or via a standard offer program (IESO 2011). Thus, while economies of scale might select larger solar PV facilities, the incentive program effectively bypasses this and allows for smaller-scale projects to compete.

A third issue is that of social license. Of all forms of renewable energy, wind energy suffers the most from NIMBYism (not in my backyard); there is a significant amount of social friction felt by individuals that do not support wind turbines due to a wide array of socioeconomic issues, related to health, property value, general aesthetics as well its effect on wildlife (Fast and McLeman 2012). Opponents often raise the issue of variability and intermittency; it is well known that wind power is more sporadic and not able to generate energy consistently, which impacts the overall cost of production (Angevive 2012). Socioeconomic barriers such as social friction, as well as an extensive application and development process, hinder the feasibility of wind energy.

The amount of public opposition towards wind farms has resulted in difficulties for developers looking to establish wind energy projects. This opposition resulted in time delays in project development, as well as excess fees related to local donations to the host community to
support the project as well as the costs associated with prolonged timelines (International Renewable Energy Agency 2012). Although some projects may suffer as a result of difficulty achieving social license, ensuring that community and other stakeholder groups support a project can prove favorable. Positive outcomes of developing social license for a project may include general public assurance regarding social and environmental risks, a commitment to responsible action and best practices, as well as protecting or enhancing the reputation of an organization (Rooney, Leach and Ashworth 2014).

The literature suggests that renewable energy development may suffer from the "chicken or egg" scenario. In order for the industry to grow and become attractive to investors, it must expand, which is impossible without investment (McCormick and Kaberger 2007). As one technology pulls ahead - in the Kingston region, solar PV - its success may be drawing investment away from other technologies such as wind and bioenergy. Jacobbson (2000) suggests that newer technologies often face hardships being accepted, and that technologies with greater recognition and acceptance are considered safer investments. Firms that are looking to enhance their technology portfolio are often more likely to build upon their existing technological base, than embark into new projects where the firm may not have existing knowledge on the technology (Dosi 1988).

The discussion of LCOE, economy of scale, and social license provides some insight into the pattern of renewable energy development in the Kingston region. It can be concluded that each technology faces specific challenges; solar PV has high costs which are partially managed through greater government incentives, while wind energy has lower costs but greater issues with social license, and bioenergy faces a challenge because heat outputs are not recognized with any incentive. The important role of policy in determining incentives, and the fickle nature of these incentives, suggests that the pattern of development could change in the future, but the entrenched nature of solar PV projects may favour continued development of that technology.
2.2.6 Previous work on green employment associated with renewable energy projects

The green job label is linked to a number of different employment categories, as shown in previous sections, but is fundamentally linked to work that can help reduce society's carbon footprint on the planet. Renewable energy, when implemented in a sustainable fashion, helps reduce greenhouse gas emissions and can have positive environmental impacts across a wide range of criteria (IPCC 2013). Therefore, direct or indirect employment - whether permanent or temporary, new or ongoing in character - that is related to renewable energy development qualifies for a green job label. It is helpful to review past work done to quantify employment related to renewable energy development.

Sastresa et al. (2009) utilized survey questionnaires in conjunction with semi-structured interviews to examine green job creation related to renewable energy deployment around Aragon, Spain. The study considered variables including technological and regional development, income per capita, as well as human capital, observing that the majority of renewable energy companies in Aragon employ less than 10 people and specialize in marketing and installing solar PV (Sastresa et al. 2009). Across the region, they found that 2500 stable jobs had been created, accounting for 2.3% of industrial work that is conducted within the region.

Steinberg et al. (2012) employed survey questionnaires followed by interviews to assess employment associated with solar PV installations in the USA; they conclude that construction and installation of solar PV and large scale wind projects based on a federal grants program employed 52,000-75,000 individuals in direct and indirect jobs between 2009-2011. Moreover, this study found that indirect jobs associated with supply-chain sectors offered significantly more employment (approximately 43,000-66,000) than direct work involving the development and construction of projects (approximately 9,400) jobs per year (Steinberg et al. 2012).
Recent work has assessed direct employment associated with wind energy deployment across the EU, using surveys and interviews. The results indicate that over the entire region, 104,350 people worked directly for wind energy companies, based predominantly in Denmark, Germany and Spain (EWEA 2003; Blanco 2009). The majority of direct employment associated with wind energy is found in the manufacturing of turbines (37%) and other components (22%); project developers account for 16% of jobs, while installation and repair accounts for only 11% (Blanco 2009). This analysis was interesting in that it showed that employment is actually limited by a lack of experienced, well-trained candidates to work in the industry, and the jobs that are most difficult to fill are related to operations and management, where there is little training (Blanco 2009).

Rutovitz and Atherton (2009) reviewed data on employment related to solar photovoltaic (PV) deployment. Building on previous industrial analyses by companies such as Suntech, Q-Cells, and First Solar, a multiplier value was established - essentially an index of jobs created per megawatt (MW) of solar PV installed - to determine the impacts of renewable energy development on regional employment (Rutovitz and Atherton 2009). As discussed previously, multipliers are useful tools to predict the amount of green employment that might be expected in response to a policy or initiative that promotes renewable energy capacity on the landscape. However, it is imperative to consider the local characteristics and specific factors of employment into account. In this report, multipliers associated with operating solar PV installations are provided for a number of nations (0.12-0.25 ongoing jobs/MW installed in the USA, 0.45-0.48 ongoing jobs/MW installed in the UK and Germany), as well as the jobs associated with solar panel production in China, which range from 3.1-9.1 jobs per MW of production capacity at different plants (Rutovitz and Atherton 2009).
Cai et al. (2014) used input-output (I-O) models, which include a variety of multiplier equations to represent the ways in which renewable energy development impacts indirect employment (see Kamman et al. 2006), to assess the relation between renewable energy and other sectors in China. The results from this study established that the development of renewable energy and new energy projects will increase total employment in China over time, across multiple sectors and largely through indirect employment (Cai et al. 2014).

Other sources of literature combine quantitative and qualitative assessments to provide an overview of green job development associated with renewable energy deployment. It is evident from this review that mixed method approaches - the combination of interviews and surveys using a qualitative assessment of employment - have the potential to provide a more accurate picture of employment characteristics, particularly in determining the role of direct and indirect employment in the renewable energy sector.
CHAPTER 3  Methods

3.1 Research approach

This study will employ a mixed method approach to assess green jobs related to renewable energy development in the greater Kingston, Ontario region. Mixed method research has the ability to “attack a research problem with an arsenal of methods that have non-overlapping weaknesses in addition to their complementary strengths” (Brewer and Hunter 1989). In some eyes, mixed methods are considered a superior approach to assessing qualitative and quantitative features because they foster overlapping cycles of deductive and inductive reasoning (Tashakkori and Teddle 1998). Mixed methods also offer an opportunity for triangulation, where two different methods are used to understand research findings more profoundly, as well as acting as a validity tool (Leech and Onwuegbuzie 2007). Academics argue that integrating qualitative and quantitative data enables increased exploration and discussion of a topic, ultimately leading to enhanced enlightenment (Creswell 2003).

Successful application of mixed methods approaches to measure green jobs related to renewable energy deployment have been carried out by Sastresa et al. (2009) and Janhunen et al. (2013). Each used data from statistical models and surveys in conjunction with data from interviews to better understand the impact of renewable energy development. Similarly, Umar et al. (2013) combined surveys and in-depth interviews to better understand complexities of the palm oil markets in Malaysia (Umar et al. 2013). The ILO has reviewed various quantitative methods associated with measuring green jobs, such as surveys, input-output (I-O) models, and general equilibrium models, to identify the strengths and weaknesses associated with each method. The report suggests that surveys are the most cost-effective and timely tool to measure green jobs; I-O models and general equilibrium models each require significantly more resources to operate and are less likely to provide timely results (ILO 2013).
3.1.1 Research Design

The research design used in this thesis includes three primary phases of work. First, a review of literature and documents detailing the employment (real or expected) associated with 14 renewable energy FIT projects in the Kingston region was carried out. Secondly, online invitations were sent to approximately 130 individuals asking for their participation in a survey questionnaire intended to gather information regarding employment both directly and indirectly related to eastern Ontario’s renewable energy sector. Finally, semi-structured interviews with 12 individuals, each of whom had previously participated in the survey phase, were carried out to enhance understanding of employment characteristics associated with the green jobs described previously.

In this way, the methods moved from a quantitative assessment to qualitative exploration of green jobs and employment associated with the development of renewable energy in the Kingston region. Ultimately, the work was designed to better describe trends in green jobs - specifically, the direct or indirect nature of this employment, the sustainability or permanence of work, and the actual type of jobs being carried out in a direct or indirect fashion. A key research goal was the development of employment multipliers - the expected number of jobs associated with renewable energy development - adjusted for the local Kingston economy. Understanding these aspects of green work will hopefully support better planning and management of renewable energy economies.

3.2 Quantitative assessment of regional renewable energy projects

The first stage of the quantitative assessment was to review the FIT projects that have been built or which are under construction within the region, in order to determine how many new jobs might be associated with each development. Company literature and websites were scanned, and press releases were reviewed in order to determine how many jobs each project had brought to the region. The number of employees that companies expected to hire on a temporary or permanent
basis were recorded, and the levels of employment were compared with previously published data available in peer-reviewed journal articles, news and magazine articles, and policy reviews.

Results from the initial project assessment allowed the development of multipliers for new direct employment in renewable energy projects - an approximation of the number of newly created green jobs (permanent or temporary) on a per megawatt (MW) installed basis, by the type of technology being developed (e.g. solar, wind or bioenergy). It is important to note that these multipliers are not necessarily linear; smaller projects very likely employ more people per project than very large developments. Because most projects approved or proposed in the region are of similar size, however, the multipliers that are developed may be said to represent employment opportunities specifically related to FIT projects within the Kingston regions renewable energy sector.

3.3 Survey of the greater Kingston regions renewable energy sector

The initial review of literature helped define new, direct jobs associated with renewable energy projects, as well as temporary jobs typically involved with renewable energy project construction. What was not clear was indirect employment that provides ongoing support for the renewable energy sector. It was also difficult to determine how renewable energy might impact ongoing employment. In order to fill these gaps, an invitation to participate in a short online survey questionnaire was sent to 130 individuals that work within the local renewable energy sector, including people in government, industry, and academic postings.

The survey asked questions designed to describe employment characteristics attributed directly or indirectly to renewable energy projects, the types of services offered by the company or organization, the renewable energy type(s) being offered or serviced (e.g. wind, solar, or biomass), information on training and skills requirements, and assessments of future economic opportunities.
This meant that survey respondents were reporting on work performed within their specific role, as well as within their organization.

Survey sample responses helped to define the nature of employment associated with renewable energy development, both in terms of direct employment with the sector and indirect employment supporting the development or operation of the sector, as well as in terms of new vs. ongoing employment. Importantly, the survey provides data that can help define the relation between direct and indirect employment in the region, and the ability of renewable energy projects to help maintain jobs or create new opportunities.

3.3.1 Target Population and Sample

The survey was designed to reach a range of people involved in the renewable energy sector. In order to capture both direct and indirect jobs, potential participants were targeted from a variety of backgrounds, including government, industry, institutions, and academic groups. Potential survey participants were recruited by canvassing membership pages of two local organizations (SWITCH, Sustainable Kingston) to obtain contact information for individuals (either independent or as representatives of businesses) within the greater Kingston region who participate in sustainable energy development. SWITCH (www.switchontario.ca) is a networking organization designed to bring businesses, research and educational institutions, public sector participants, and community-minded volunteers together in order to advance sustainable energy solutions. Sustainable Kingston (sustainablekingston.ca) is dedicated to making Kingston one of Canada’s most sustainable cities. A potential issue associated with this approach is that respondents might share similar perspectives, which is why categories of participants - industry, government, institutions, and academia - were specifically sought out and engaged.
One group that was not targeted in the survey were those that undertake contract work, which is usually association with the construction phase of renewable projects, as these jobs are typically temporary, and the survey was focused on full-time direct and indirect employment.

Invitations were sent out in waves, the first occurring in May 2014 when approximately 100 emails were sent to a list of participants. After a slow rate of participation, a second wave of invitations were issued in July 2014 to expand the list of potential participants to about 130. It should be noted that invitations to take part in the survey also included an invitation to take part in a subsequent interview (see Section 3.4). Ultimately, 36 people participated in the web-based survey questionnaire.

### 3.3.2 Data Collection

Survey invitations were sent out with a Letter of Information (LOI) that had been approved by the General Research Ethics Board (GREB) at Queen’s University (see Appendix 1 for a copy of the LOI). The LOI included contact information for the researcher and supervisors, the purpose of study, procedures involved in the research, participation inquiries, compensation as well as the voluntary nature of their potential commitment to participation. The LOI stated that the research study had received clearance according to the Canadian ethics guidelines as well as conforming with Queen’s Universities policies. This was an essential document for those invited to participate, as it comprehensively guides the respondent through the entire research process as well as identified popular areas of concern related to participation in research endeavors.

The survey itself is found in Appendix 2. Survey questions were designed to help define the characteristics of employment related to the renewable energy sector. Topics of interest included (1) specific activities undertaken by the company or organization within or supporting the renewable energy sector, (2) specific activities and responsibilities associated with individual respondents’ jobs, and (3) anticipated requirements, in terms of work expertise, associated with
current and future activities. The survey questions were designed to allow the researcher to assess whether employment was direct or indirect; the responses would also shed light as to whether the employment opportunity was newly created or an ongoing job.

The survey was designed to use predominantly close-ended multiple-choice questions, although a limited number of open-ended questions were also employed. For example, Question 17 asks “How many employees within the organization were educated or trained in local post-secondary educational institutions?” in order to shed light upon the importance of a locally-trained workforce. Of the 19 survey questions, 12 were multiple-choice, six were fill-in-the-blank and one was a “yes” or “no” question. Multiple-choice and “yes” or “no” questions were utilized because they are easy for respondents to answer and provide sound, objective data. Fill-in-the-blank questions were used when it was difficult to define an answer scale for a particular question. Multiple-choice answers provided in the survey were typically qualitative rather than quantitative, which limited the potential for statistical analysis of the data. It was felt that the rather small sample size and narrow focus of the survey would not provide a response large enough to warrant statistical analysis. One issue was the lack of existing data describing Eastern Ontario’s renewable energy industry. Therefore, the survey was appropriately designed to be a first look at the region’s renewable energy sector.

The questionnaire was created through an online surveying platform called Fluid Surveys (now owned by Survey Monkey). This software allows users to construct free surveys, provides various survey templates that allow users to choose between multiple-choice questions, open-ended questions, ranking questions, “yes” or “no” responses and so forth.

3.3.3 Data Analysis

Once participants had responded to the survey questionnaire, their results were securely held within the Fluid Survey account, which is located on an encrypted hard drive, until they were
transferred as an Excel file to an encrypted drive on the researcher’s computer. Two different spreadsheets were created to analyze the data. One spreadsheet presented each participant’s responses individually, allowing a profile of their employment to be constructed. A second spreadsheet was built to pool all responses by question, so that the range of responses associated with each query could be assessed. This allowed the researcher to identify potential relationships between different variables and verify the existence of any trends. Each respondent was categorized by the direct or indirect nature of their work, by the nature of the employment (new vs. ongoing), and by the actual work being carried out. Data were illustrated in the form of histograms and pie charts in order to highlight trends and key findings.

3.4 Interviews with selected survey respondents

The final stage of the research process utilized semi-structured interviews with a subset of survey respondents (see Section 3.3) in order to gain a greater understanding of significant issues within the Kingston region’s renewable energy sector. The interview approach allowed the researcher to explore the results of the quantitative assessment and survey stages, and to identify root causes behind trends in renewable energy development in the region.

3.4.1 Target population and sample

From the 36 survey questionnaire responses, a target of 10-12 individual semi-structured interviews was established; this target reflected the need for a range of respondents but also acknowledged time limitations for a Master’s thesis. Individuals were chosen based on purposive sampling methods, whereby participants whose responses aligned with key trends defined within the initial quantitative survey questionnaire were chosen for the semi-structured interview (McMillan and Schumacher 1994). To ensure that the sample was balanced in terms of respondents perspectives, maximal variation sampling was used to invite people from various areas of work,
such as institutional or public sectors, education, construction, government as well as a wide variety of renewable energy specializations such as solar, wind and biomass (Creswell 2002).

Potential participants were emailed a letter of information (see Appendix C), which mentioned details about the process such as the fact that the interview would be recorded, along with the consent form (see Appendix D). The recording process is essential to qualitative methods, as it allows the researcher to fully immerse themselves in the conversation of the interview while remaining confident of being able to review the interview, transcribe the conversation, and parse the responses for trends. Furthermore, recording supports the semi-structured nature of interviewing, as the flow of the conversation facilitates the interviewers ability to transition into topics that are brought up organically.

The majority of potential interviewees were either an expert in their field or had been involved in their work for an extensive period of time. This meant that each participant had a very refined and unique perspective of the workforce related to renewable energy within the Kingston area that could only be appropriately studied in a semi-structured interview styling.

Approximately 20 emails were sent to survey participants that appeared to be ideal candidates for the semi-structured interview based on the characteristics of their work, and how this aligned with existing themes. After the first solicitation for participants, only five respondents agreed to participate in the semi-structured interview. When a follow-up email produced similar results, the initial list of participants was expanded to incorporate more individuals. Ultimately, 12 participants were recruited to participate in the semi-structured interview.

3.4.2 Data collection

The interview process itself consisted of administering a semi-structured interview in person or over the phone; interviews generally lasted between 20-60 minutes. The semi-structured
research questions (see Appendix E) followed very similar themes mentioned in the survey questionnaire, but permitted much more latitude in responses in order to explore various themes more extensively. Some of the interview questions were purposely identical to those posed in the web-based survey. This allowed the participant a comfortable place to begin their response, as they were familiar with the question; it also allowed the researcher to reaffirm each participant’s initial responses, and to probe their response in a descriptive manner. It was found that even simple questions provoked more robust responses that described complex processes, systems or underlying issues that were not evident from the survey responses. Moreover, the interview process allowed respondents to voice any confusion or misinterpretations they may have had in answering the web-based survey, providing confirmation they were answering the question appropriately. Although interviews were semi-structured and conversation organically flowed between questions based on the individual’s responses, each interview followed the same questions that were administered to all participants (see Appendix E).

After each interview was completed and the proper documents signed, the recorded interview was uploaded as an audio file to an encrypted drive on the researcher’s computer. Each audio file was transcribed and the resulting Word documents were stored on the encrypted drive.

3.4.3 Data Analysis

After the audio recordings had been transcribed into scripts of the interview, a coding method was used to categorize the scripts, in order to organize data and to identify key findings and trends. Coding is used to narrow down sizable amounts of qualitative data into a series of simplified themes, in order to highlight major trends (Berg 2001). Following the collection of quantitative surveys and qualitative semi-structured interviews, triangulation was employed to test for the validity of both sets of results. Key findings of the interviews were linked to quantitative outcomes of the first two stages of the research. Content analysis was applied to understand major
themes within data and to explore their relation to other variables; this work underpins the construction of the research narrative that will be detailed in Chapter 4.
CHAPTER 4 Results and discussion

4.1 Classifying green work in the Kingston region

4.1.1 Quantitative assessment of renewable energy projects in the region

In the Kingston region, the largest wind farm predates the Green Energy and Green Economy Act of 2009 (see Chapter 2, Table 2-1). In 2008, Canadian Hydro Developers Inc. developed an 86 turbine wind farm on Wolfe Island, directly across from Kingston. The nameplate capacity of this facility is 198 MW of power, enough to power 75,000 homes within the region (TransAlta 2014). Development of the farm took over a year and employed over 400 construction workers at peak staffing, including trades, truck and barge operators, and other affiliated workers; at the current time, there are 12 permanent, new, direct jobs associated with the project (O’Meara 2013). A simple multiplier can be developed to predict new direct jobs per MW (12/198 or 0.06/MW) as well as the number of temporary jobs (400/198 or 2.02/MW). The multipliers are applicable to on-shore wind developments, but for the purpose of this study we applied it to the two off-shore wind farms currently on hold. In reality, off-shore wind developments would probably require more temporary workers and perhaps more permanent staff to maintain their operations.

It is known that the Kingston region is home to two operating solar farms (see Chapter 2, Table 2-2). The first commercial solar farm in Canada, the First Light I facility is a 9.1 MW farm constructed in the small rural municipality of Stone Mills, located about 20 minutes west of Kingston, by SkyPower and SunEdison (SunEdison 2014). A second solar farm, First Light II, is a 10.5 MW facility built close to the original facility in Stone Mills (Skypower Global 2014). The First Light I solar farm occupies approximately 36 ha of land and uses over 120,000 thin film photovoltaic solar panels, generating enough power through the season to supply about 1,000 homes annually (SunEdison 2014). The First Light I project employed around 100 people during the construction phase, and two to four permanent jobs are associated with the facility (SunEdison...
2014). It should be noted that for subsequent solar installations carried out by this company, estimates of permanent employment on a per-unit-of-output basis drop significantly, to between 1 and 2 permanent employees for a 10 MW facility (SunEdison 2011). Again, simple multipliers can be developed, for new direct jobs (2/10 or 0.20/MW, using the more conservative employment estimates) and temporary employment (100/9.1 or 10.99/MW).

The simple multipliers determined through this review were applied to all wind and solar PV projects being discussed, built, or operated in the Kingston region. The results of this exercise are shown in Table 4-1. There is significant potential for employment on a temporary basis, during the construction phase. As many as 815 person-years of work were created with the three operating renewable energy projects around Kingston. Another 570 person-years of work would be created if all approved projects are built as planned, and proposed projects could add a massive 2,130 person-years of work within the region. This data is particularly noteworthy when one considers the size of the Kingston work force. Currently, Kingston has a population of 135,900 with an employed labour force of 81,900 and an unemployment rate of 6.2% (Statistics Canada 2014b). Temporary construction work could bolster existing jobs or create new opportunities for unemployed workers in the city.

New direct jobs associated with wind and solar PV installations are very limited in comparison to the boom in temporary employment. It is estimated that only 16 permanent jobs are associated with the three completed projects in the Kingston region. Moreover, the quality of these jobs cannot be determined at this stage of the review, and thus no comment can be made on the sustainability of these positions. The approved projects currently expected within the region may add 12 new positions, while proposed projects could raise that figure by another 50 jobs. Again, in an employment market the size of Kingston, 78 new jobs are not insignificant, but at the same time this level of employment is not on par with major employers in the municipality.
### Table 4-1 – New direct, temporary employment estimates by renewable energy project

<table>
<thead>
<tr>
<th>Name</th>
<th>Energy Type</th>
<th>Project Status</th>
<th>MW</th>
<th>Temporary Jobs</th>
<th>New Direct Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Light I</td>
<td>Solar PV</td>
<td>Complete</td>
<td>9.1</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>First Light II</td>
<td>Solar PV</td>
<td>Complete</td>
<td>10.5</td>
<td>115</td>
<td>2</td>
</tr>
<tr>
<td>Wolfe Island Wind Farm</td>
<td>Wind</td>
<td>Complete</td>
<td>198</td>
<td>600</td>
<td>10</td>
</tr>
<tr>
<td>Little Creek</td>
<td>Solar PV</td>
<td>Approved</td>
<td>10</td>
<td>110</td>
<td>2</td>
</tr>
<tr>
<td>Napanee TS Taylor Kidd</td>
<td>Solar PV</td>
<td>Approved</td>
<td>10</td>
<td>110</td>
<td>2</td>
</tr>
<tr>
<td>Kingston Gardiner TS Odessa</td>
<td>Solar PV</td>
<td>Approved</td>
<td>10</td>
<td>110</td>
<td>2</td>
</tr>
<tr>
<td>Kingston Gardiner HWY 2 South</td>
<td>Solar PV</td>
<td>Approved</td>
<td>10</td>
<td>110</td>
<td>2</td>
</tr>
<tr>
<td>Kingston Gardiner TS Unity</td>
<td>Solar PV</td>
<td>Approved</td>
<td>10</td>
<td>110</td>
<td>2</td>
</tr>
<tr>
<td>Ernestown Wind Park</td>
<td>Wind</td>
<td>Approved</td>
<td>10</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>Kingston Solar Farms</td>
<td>Solar PV</td>
<td>Proposed</td>
<td>80</td>
<td>880</td>
<td>16</td>
</tr>
<tr>
<td>Samsung Sol-Luce</td>
<td>Solar PV</td>
<td>Proposed</td>
<td>100</td>
<td>1,100</td>
<td>30</td>
</tr>
<tr>
<td>Amherst Island Wind Energy</td>
<td>Wind</td>
<td>Proposed</td>
<td>75</td>
<td>150</td>
<td>4</td>
</tr>
<tr>
<td>Trillium Power Wind I</td>
<td>Wind*</td>
<td>On hold</td>
<td>420</td>
<td>848</td>
<td>25</td>
</tr>
<tr>
<td>Windstream Wolfe Island</td>
<td>Wind*</td>
<td>On hold</td>
<td>300</td>
<td>606</td>
<td>18</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Complete</td>
<td></td>
<td>217.6</td>
<td>815</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Approved</td>
<td></td>
<td>60</td>
<td>570</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Proposed</td>
<td></td>
<td>255</td>
<td>2,130</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>On hold</td>
<td></td>
<td>720</td>
<td>1,454</td>
<td>43</td>
</tr>
</tbody>
</table>

*These proposed installations are off-shore wind projects and currently under a moratorium

As stated above, unknowns remain about the quality of new direct jobs associated with the renewable energy sector in Kingston, but there may be a certain amount of attraction associated with these positions that will bring interested applicants to the table. In comparison with jobs within other energy sectors, such as oil or natural gas, employment within the renewable energy sector can be considered sustainable over the long-term and may therefore be favoured over traditional sectors.

#### 4.1.2 Direct and indirect green jobs within Kingston regions renewable energy sector

The review of the projects in the previous section helps us to identify employment in two of the five categories of green jobs identified in Chapter 2. Questions remain, however, about other green job categories. In this section, the relation between direct and indirect employment in the renewable energy sector is explored using the results of the web-based survey. Both the web-based survey and subsequent interviews were targeted at full-time employees rather than part-time or
temporary employment, although previous work indicated that temporary work was important. The majority of survey respondents (28 of 36) and interview participants (9 of 12) identified as full-time employees. The majority of results presented in this section are therefore indicative of trends in full-time work.

As previously discussed, indirect employment can take a number of forms; in the solar PV and wind sectors, indirect jobs could include electricians, accountants, or other skilled trades; these individuals could work with a range of renewable energy projects and would benefit proportionally to time spent. In all cases, these examples might be interpreted as new or ongoing indirect employment associated with the renewable energy sector.

The importance of indirect employment may be highlighted by considering the case of bioethanol production. Greenfield Ethanol, the largest biofuel company in Canada, operates three plants in Ontario, and can produce about 10 litres of ethanol per bushel of corn used as feedstock (Greenfield Ethanol 2014). In 2012, Ontario produced about 9.6 tonnes of corn per ha (Ontario Ministry of Food Agriculture and Rural Affairs 2014); the average farm size in Ontario is about 99 ha with 1.44 farmers employed (Statistics Canada 2014a). Given these statistics, one can estimate that for a single plant with capacity of 200 million litres per year – such as the Greenfield facility near Prescott, just an hour away from Kingston – the equivalent of 2,000 farmers are engaged in producing feedstock for the operation on an annual basis.

An unpublished project carried out at Queen’s University in the summer of 2011 found that the development of indirect employment opportunities in the Kingston region was primarily linked to services, such as installation companies or electricians, which supported solar and wind projects. In this study, the most important source of indirect employment was found to be businesses that could install and service rooftop solar PV (Napier 2011). It was interesting to note that 77 of the companies interviewed were small, locally-owned businesses, and that half of the companies that
responded had less than 10 full-time employees. One third of the businesses interviewed in 2011 were made up of graduates from local training programs (Napier 2011).

The results of the web-based survey are shown in Figure 4-1. The large pie chart on the top shows direct and indirect employment across all respondents, while the smaller pie charts break the data down by renewable energy technology type. Please note that the total number of direct jobs is reported consistently, as direct jobs can be assigned to a discrete renewable energy technology. By comparison, respondents engaged in indirect employment sometimes indicated that they supported more than one renewable energy type. Thus, unique indirect jobs may appear in more than one renewable energy type.

When interpreting these results, it is important to note that 10 respondents engaged in indirect employment indicated ‘other’ as a response when asked to associated their job with one or more renewable energy type. One of these respondents indicated that their job was a new indirect job, while 7 indicated that their jobs were ongoing indirect employment, and 2 did not specify if their jobs were new or ongoing. The ‘other’ respondents are included in the summary pie chart, but are not included in the technology-specific breakout charts in Figure 4-1.
As shown in Figure 4-1, two-thirds (23) of the 36 respondents of the web-based survey identified their work as indirectly related to renewable energy generation. Even given the small sample size, there is a clear indication that indirect employment is at least as important as direct employment, and confirms that indirect jobs likely represent a larger proportion of jobs associated with the renewable energy sector. It was further possible to assess direct and indirect employment
by renewable energy technology, first establishing 18 respondents work is related to solar PV, 8 to wind, and 9 to bioenergy.

The large number of respondents associated with solar energy is not surprising. In the Kingston region, development of large and small-scale solar PV projects has grown at a considerably faster rate than wind and bioenergy development. Some interview respondents noted that solar energy was given greater incentives under the GEA; indeed, the 2015 Ontario Energy Report indicates 63% of the provinces contracted renewable energy generation projects are solar, whereas wind accounts for 16% and bioenergy 3% (Government of Ontario, IESO, and Ontario Energy Board 2015). The most recent FIT program report from March 31, 2013 outlines that up until that point, 583 solar PV (including rooftop and ground) projects were delivering electricity to the grid, compared to 9 wind projects and 23 bioenergy projects across the province of Ontario (IESO 2013).

Interview respondents mentioned their dismay that the same support and attention was not provided to other technologies, specifically wind and bioenergy, as they identified these as being potentially stronger contributors to the regions local economy. Many noted that uneven FIT incentives favouring solar energy have driven stronger growth in solar PV development, which in turn has taken away potential wind and bioenergy projects. One interviewee highlighted the fact that a wind energy project application process may last anywhere from 5-10 years before the building stage of the project can even begin (Interview Respondent #5). Another respondent noted that bioenergy is much more underdeveloped in terms of technological maturity as well as marketing and awareness of the technology itself (Interview Respondent #2).

The results suggest that for every one direct solar job, approximately 1.5 indirect jobs are created. For every one direct job in wind energy, one indirect job is created, while in bioenergy every one direct job is matched by approximately 3.5 indirect jobs. While the sample sizes here are
too low to label these ratios as definitive multipliers, they do match expectations based on literature reported in Chapter 2, and based on the discussion in this Chapter.

Importantly, the survey results illustrate that the local renewable energy sector is dominated by indirect green work that provides services to enable the process of generating renewable energy. Furthermore, it seems that these indirect jobs are more prevalent in solar and bioenergy specializations.

4.1.3 New and ongoing green employment trends within local renewable energy industry

An important question asked in the web-based survey was whether or not the respondent’s employment was a new position, or an ongoing position that had undergone “greening” to include duties related to the renewable energy sector. The results of this question are shown in Figure 4-2. As in the previous section, the large pie chart shows the broad classifications of employment - new and ongoing, direct and indirect - across all 36 survey respondents, while the smaller pie charts break the data down by renewable energy technology type. Again, it should be noted that direct jobs are all assigned to a discrete renewable energy technology, but respondents engaged in new or ongoing indirect employment sometimes work with more than one renewable energy type, and thus may be counted in more than one figure. Thus, unique indirect jobs may be counted in more than one renewable energy type.
Figure 4-2 - New and ongoing, direct and indirect employment trends by renewable energy type

Included in the summary pie chart, but not in the technology specific breakout charts, are respondents that indicated 'other' when asked to identify with specific renewable energy types. Of these ten respondents, one indicated that their job was a new indirect job, while 7 indicated that their jobs were ongoing indirect employment, and 2 did not specify if their jobs were new or ongoing.
It can be seen from the results shown in Figure 4-2 that 17 of the 36 web-based survey respondents occupied 'new' jobs, and that half of these new jobs were classified as direct employment in the renewable energy sector. Another 15 of the respondents occupied ongoing jobs, of which the majority (11) were indirect employment. Four respondents indirectly employed by the renewable energy sector in the Kingston region did not indicate if their jobs were new or ongoing.

The findings suggest that every new job directly involved in the renewable energy sector will be matched by a new job indirectly supporting the sector, although there may be variation between different types of renewable energy projects. The figure includes a breakdown of new and ongoing employment by each of the main renewable energy types, and while the low number of respondents (particularly for wind and biomass projects) makes it difficult to draw firm conclusions, the proportion of new direct to new indirect jobs varies dramatically across different technological types. This is not unexpected. The proportion of new indirect employment associated with biomass, for example, is much higher than new direct employment; this supports findings reported in Chapter 2 suggesting that biomass producers (who are indirectly engaged in the industry) far outweigh the actual energy generators. None of the survey respondents engaged in wind energy reported new indirect employment, but this may reflect the fact that the parent companies of wind projects are located in other parts of Canada, and the survey was not able to reach people who are in fact participating indirectly in the project. Solar projects in the region range from very large to small, rooftop installations, and thus a good mix of new direct and indirect jobs should be expected. Note that the most robust subset of the survey sample was in fact those engaged in solar power, and the proportions of new and ongoing, direct and indirect employment in this sector closely matched the overall trend. It is important to recall the local prevalence of solar energy, with eight solar farms either completed or approved that together will provide approximately 170 MW of solar energy to the greater Kingston region.
Ongoing indirect employment was the largest category of employment observed in the survey results, and this held true across all technology types. This result is important because it supports the concept that renewable energy development can help maintain existing jobs, and shift existing jobs towards a greener profile. As pointed out in Chapter 2, it is widely expected by governments that this outcome will be associated with renewable energy development, and this finding confirms that this policy expectation is being met.

4.1.4 Implications for green employment within the regions renewable energy sector

It should be clear from the discussion in previous sections that the relations developed between direct and indirect, new and ongoing green employment are highly dependent upon the nature of the projects and the stage of development currently observed in Kingston. While the sample size of the web-based survey was not large (36 respondents), it does represent a significant sampling of the estimated total direct employment associated with major renewable energy projects at the completed, in development, and proposed phases (approximately 78 jobs, as described in Table 4-1). Estimates of employment trends based on these results are shown in Table 4-2.

Table 4-2 – Employment estimates across all green job categories by renewable energy project

<table>
<thead>
<tr>
<th>Name</th>
<th>Energy type</th>
<th>Temporary jobs</th>
<th>New direct jobs</th>
<th>New indirect jobs</th>
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<th>Ongoing indirect jobs</th>
</tr>
</thead>
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</tr>
<tr>
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<td>2</td>
<td>1.6</td>
<td>0.8</td>
<td>2</td>
</tr>
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<td>2</td>
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<td>2</td>
</tr>
<tr>
<td>Kingston Gardiner HWY 2 South</td>
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<td>2</td>
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<td>0.8</td>
<td>2</td>
</tr>
<tr>
<td>Kingston Gardiner TS Unity</td>
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<td>0.8</td>
<td>2</td>
</tr>
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<td>2</td>
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<td>0.8</td>
<td>2</td>
</tr>
<tr>
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<td>Solar PV</td>
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<td>16</td>
<td>12.8</td>
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<td>16</td>
</tr>
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<td>30</td>
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<td>12.0</td>
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<td><strong>51</strong></td>
<td><strong>30</strong></td>
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If the findings reported in the two previous sections are applied to these projects, a sense of potential new and ongoing, direct and indirect green employment associated with renewable energy in Kingston can be developed. A series of simple multipliers that incorporate scenarios within the Kingston regions renewable energy sector can be created, as was done in Section 4.1.1. For every one new direct job, 0.65 new indirect jobs might be created, while 0.39 ongoing direct jobs and 1.06 ongoing indirect jobs might be retained. Based on these ratios, estimates were assembled as shown in Table 4-2. If the relations described by the web-based survey hold true, the category of new indirect jobs could see 51 positions added to the local economy if all proposed and in-development projects are completed; in such a scenario, ongoing direct and indirect employment could account for at least a portion of another 113 jobs across the region. In all, the categories of new and ongoing, direct and indirect employment could account for up to 242 positions in the Kingston area. As pointed out in a previous section, Kingston’s total labour force totals 81,000, with approximately 5,000 unemployed at any given time (Statistics Canada 2014b). A contribution of 242 positions, or approximately 5% of the currently unemployed workforce, is a significant but not overwhelming contribution to alleviating employment problems in the region.

The multipliers used within this study were designed to forecast employment trends specific to the greater Kingston region, and therefore cannot be simply applied to other regions. These multipliers were designed based on regional considerations, such as job creation data from existing solar and wind projects, as well as employment characteristics found in the survey results. For other regions to consider these multipliers as an appropriate metric to estimate future green employment, there would need to be considerable consistencies within both localities. Also of importance is the size of the renewable energy project under consideration; multipliers are not likely to be linear, as smaller projects would likely employ more people on a per megawatt basis than larger projects, and thus the multipliers should only be used when comparing similarly-scaled
projects. Considering population size, industry trends, geography, educational institutions, and municipal and community support for renewable energy development, is essential in assessing the applicability of these multipliers to other regions.

It should also be stressed here that this thesis only examines major or large-scale renewable energy projects in the Kingston area, and that there are many smaller-scale microFIT projects underway in the areas of solar PV and biomass energy across this region. It can, however, be assumed that jobs related to microFIT projects would be considered direct work that specializes in technical skills such as the building and installation. The small-scale nature of microFIT projects leads us to believe these employment opportunities would be directly related to renewable energy generation, and will be explored further in the discussion section.

The estimates shown above do not include these figures, and so employment associated with renewable energy across the region are likely higher. A doubling in all employment categories would suggest that renewable energy projects in the Kingston region alone could provide up to 500 employment opportunities, in both new and ongoing positions.

4.2 Qualitative assessment of green work in the region

4.2.1 Trends in green jobs based on employment characteristics

The web-based survey and subsequent interviews provided insight into both employment characteristics (i.e., what do the respondents do in their job?) as well as the services offered by different organizations (i.e., what does the company or organization provide?), which in turn can be examined to get a sense of the sustainability of these jobs. This section discusses the differences in employment characteristics between direct and indirect work. The survey results did not make it clear whether these work characteristics applied to temporary work or to full-time employment; when asked about the hiring patterns within their organizations, interview respondents indicated that the ratios of temporary:full-time workers were highly variable, ranging from a high of 2.6:1
(Interview Respondent #1) to 0.1:1 (Interview Respondent #9). This would suggest that the findings presented in this section may apply to a combination of full-time and temporary jobs.

Figure 4-3 illustrates the most common types of direct and indirect employment related to RE in the Kingston region. Note that the chart is based on the number of responses received in each category; respondents were able to select more than one category, so the number of observations is greater than the number of respondents in most cases.

![Figure 4-3 - Job descriptions of survey respondents based on direct or indirect employment](image)

The most common form of direct employment was owning/operating generation facilities (28%) and building/installing generation facilities (25%). It can be assumed that these results are linked to two factors, including the prevalence of small- to large-scale solar PV projects within the region, and the relatively early stages of RE development across the region. A significant proportion of respondents indicated direct employment in providing technical services, or management &
business support, to companies in the region. A small number of respondents indicated that
deriving rental income or playing other roles constituted direct employment in the RE sector.

Interview respondents provided additional insights into the types of work carried out by
full-time and temporary workers, with temporary jobs most often used for services or skills
described as “not core” to the organization’s primary operations. These included jobs such as
accounting, contracting and consulting (Interview Respondents #1, #2, #3, and #9). Interviewees
with direct employment were largely employed by SMEs, which means these organizations may not
have much capacity beyond meeting ‘core’ objectives, and thus might be more likely to outsource to
complete various tasks. It was noted that full-time positions are often reserved for those individuals
with technical and/or engineering skill sets (Interview Respondents #7 and #10).

Because microFIT systems were not considered when creating the multipliers, employment
characteristics related to these projects are unknown. Considering the small-scale nature of these
projects, however, it can be assumed that organizations performing microFIT installations are
small- to medium-scale enterprises (SMEs). Therefore, it is likely that the job opportunities
associated with small-scale projects may align with those present in SME’s, which are often directly
related to energy generation and specialized in technical skills, such as building and installing
renewable energy generation projects.

The survey results present an interesting finding. Our initial review of green job definitions
(presented in Chapter 2) suggested that technical support, business services, and rental income
would likely be associated with indirect employment, but some of our respondents clearly
identified themselves as being directly engaged in the renewable energy sector. This suggests that
some service providers or farmers providing land for RE projects are more deeply invested in the
renewable energy sector than we had initially supposed. It may also suggest that the importance of
the RE sector to these respondents may supersede other sources of income, to the point that they
recognize the RE sector as ‘their’ sector. Without a clear-cut government definition of what exactly a ‘green’ job in the renewable sector is, the respondents’ choice to label themselves as directly employed might be accepted. The findings here highlight the need for clear definitions in future studies and reviews.

Following on this discussion, it is interesting to contrast direct employment characteristics with those of indirect employment. It seems clear that indirectly employed respondents had a more difficult time labeling the work that they did within the RE sector. As shown in Figure 4-3, 12 of the 23 indirect respondents identified “other” as the service and/or products they provide. This finding suggests that individual jobs being carried out with relation to the RE sector occupy different niches in the economy; it may be speculated that the range of work necessary to support RE projects does not fit easily into the work categories provided. When respondents were asked to describe what “other” represented, they identified work including design, manufacturing, and policy development as their specializations.

Respondents engaged in indirect employment were also involved in providing management services and business support, owning/operating RE facilities, and building/installing renewable energy facilities. In these cases, the respondents clearly see the RE sector as a smaller portion of their overall employment. These results, which reflect the views of about a third of all respondents, is more closely aligned with the more traditional definitions of indirect employment described in Chapter 2.

The findings suggest that there are overlaps between direct and indirect categories of work, which reinforces the notion that green work related to the renewable energy sector is in a dynamic state, perhaps due to the relative youth of the RE sector and the early stages of its implementation in eastern Ontario.
It should be noted that the employment characteristics of green jobs not only varied by direct and indirect employment, but also by the type of technology they work in, as detailed in Figure 4-4. With 18 respondents directly or indirectly employed in solar PV, the full range of employment characteristics were represented, with the dominant roles including/operating renewable energy facilities, building/installing renewable energy facilities, providing technical services or providing management and business support. With fewer respondents, direct and indirect employment characteristics of the wind and biomass energy sectors were more focused on a limited number of roles; the majority of wind respondents focused on building/installing projects, while two out of three biomass energy respondents reported that they were business owners or operators.

Figure 4-4 - Job descriptions of survey respondents based on renewable energy type

### 4.2.2 Green jobs based on the services companies or organizations provide

Figure 4-5 illustrates the most common services offered by companies or organizations related to renewable energy in the Kingston region. As with previous figures, note that the chart is
based on the number of responses received in each category; respondents were able to select more than one category, so the number of observations is greater than the number of respondents in most cases.

As shown in Figure 4-5, 13 respondents with direct employment in the renewable energy sector noted that their organization is engaged in new energy generation. Fewer respondents noted services such as energy efficiency and conservation, transmission and smart grid, installation and technical support, and research or technology. Data also make it clear that 9 of 13 respondents that work directly to renewable energy generation are employed at organizations that provide more than one service and/or product. It can be concluded that local organizations offering direct employment offer a diverse range of services.

No respondent with indirect employment in the sector reported being involved in new energy generation; the majority of these respondents indicated that their organization provided energy efficiency and conservation services. Other important roles of companies or organizations engaged in indirect work included research and development and 'other' services. Follow-up interviews indicated that these other services could include advising on policy issues or project management. As with organizations offering direct employment, most organizations indirectly engaged with the sector offer more than one service.
The web-based survey results support the notion that renewable energy development drives both direct and indirect employment across a range of work opportunities. The large number of companies that offer direct employment in project development may over time adjust their focus, as the renewable energy sector matures and as the number of new projects being started drops. It can be anticipated that employees and organizations working on project development may be forced to take on different roles in the future, but the fact that respondents report working in a range of occupations suggests that there are a range of alternatives. One interview respondent stressed that most direct, full-time employment is dependent upon project completion, and that growth in employment thus depends upon new projects being carried through to completion (Interview Respondent #5).

Companies and organizations offering indirect employment are largely focused on support roles, such as developing energy efficiency and conservation, offering research and/or technology
development services, and providing business support. One inference that might be taken from the findings is that training and certification required for indirect work is significantly different than those required for direct work; the technical skills needed to develop a new energy project are not the same as those needed to conduct research or develop an energy efficiency plan.

It is interesting to note the variation in the roles that different organizations play when working with different renewable energy technologies, as shown in

. Respondents engaged with solar energy represented organizations focused on project development, efficiency and conservation services, and research & development. Companies engaged with wind energy offered business support services, research & development, and project development. Finally, those organizations engaged in biomass to energy were largely involved in efficiency & conservation efforts.
It seems clear that direct employment within the Kingston region is dominated by individuals and organizations playing technical roles in creating and operating a renewable energy sector, compared to individuals and organizations indirectly implementing energy efficiency, or providing management and business support. The analysis of services offered in relation to each of the renewable energy technologies suggests that in the area of solar PV, there is a healthy mix of offerings that cover both direct and indirect employment, compared to organizations working with wind and biomass energy, where the profile seems skewed towards services which are more typical of indirect employment.

4.2.3 Local economic opportunities associated with renewable energy development

Survey respondents were asked to describe the economic opportunities for their organization between 2012 and 2014. Of the 13 respondents with direct employment, 12 noted that there had been a rise in the number of economic opportunities over this period, with the remaining respondent indicating that no change had occurred. All 12 respondents expected that their organizations would see growth in full-time employment over the next 10 years.

The 23 respondents indirectly employed by the renewable energy sector were also relatively positive. Of these, 12 noted a rise in opportunities between 2012 and 2014; eight additional respondents said that there had been no change, and two observed a decline in employment activities. One respondent abstained from answering the question. Because respondents indirectly engaged with renewable energy generation are less invested in the sector, they may take a more cautious perspective when it comes to growth in the sector, and may be more willing to acknowledge challenges that must be overcome before growth in the sector can be achieved.
The survey also provided insight into the potential for growth associated with different renewable energy technologies. Fourteen of the 18 respondents working in solar energy reported a rise in economic opportunities between 2012 and 2014, as did six of eight respondents working in wind and eight of nine respondents working in bioenergy. Two of the respondents working in solar energy reported a decline in opportunities over the same period. All other respondents reported no change. Based on the past few years, most of our respondents anticipate economic growth over the next decade.

Economic opportunities associated with green employment in the renewable energy sector may be threatened, at least in part, by social resistance to new projects in the region. Interview respondents identified social friction as having a negative impact on the growth of the RE sector. This was particularly true when wind energy projects are being discussed; interviewees suggested that development of new wind farms would take 5-10 years prior to any actual construction, and that issues of social friction had increased these times (Interview Respondent #5, and #11). The interviews suggest that much of the negativity associated with wind farms can be traced to perceived negative impacts on human health, ecosystems, and real estate values; these findings are borne out by the literature (e.g. Fast and McLeman 2012). Social resistance has led to increased costs due to time delays for project development, and an increased need for companies to deliver positive economic benefits to host communities (Interview Respondent #2; IRENA 2014; IRENA 2015).

4.2.4 Key issues identified with quantifying and qualifying green employment

When the results of the web-based survey were assembled and analyzed, it became clear that many respondents saw their role as spanning multiple categories, particularly for those engaged in indirect employment. It was not unusual for respondents to serve more than one role within an organization, or to work with projects covering more than one type of renewable energy
technology. Respondents faced with multiple selections would often simply choose the ‘other’ category, making it more difficult to assess the nature of their work, or what they really did within their organization. In retrospect, the survey could have eliminated the ‘other’ category from some of the questions in order to force respondents to select the appropriate categories.

The confusion exhibited by some survey respondents when asked to define their work speaks to the adolescent nature of the sector, as well as the varying nomenclatures associated with green employment. The variation in survey responses when describing ones work illustrates that either the types of green employment established in the study were unclear, or the process of defining green work is more complex than originally thought. Therefore, there may be more effective ways to define and characterize green employment related to renewable energy generation.

A number of unique employment trends exist within the regions renewable energy sector that make it a difficult area to study concisely. Most significant are the number of temporary employment opportunities that exist during the construction phase of large-scale renewable energy projects. Many studies consider construction jobs associated with renewable energy project development as a newly created, temporary positions, although the workers themselves may be in a full-time job that moves from project to project over time (Ontario Ministry of Energy and Infrastructure 2011; U.S. Department of Commerce 2010; Haerer and Pratson 2015; Gülen 2014). Thus, the term ‘temporary’ may not be appropriate, and could be revisited in future work. To add to the confusion, an individual may work on multiple short-term projects throughout the year to create the allusion that multiple jobs have been created, when in actuality these projects have supported one job for one person. Defining and categorizing green employment as related to temporary or construction work remains a challenge.

This study faced issues within the methodologies where certain variables impacted the validity of the data. In the data analysis process, it was clear that the results from the survey
questionnaire and the semi-structured interviews were not supplementing one another as a means to strengthen trends. After reflecting on the survey and interview questions, it was evident that both methods had different research objectives, which produced inconsistent data between the two methodological styles. Therefore, the themes within one medium did not always align with the other, limiting the effectiveness of the data to reinforce data trends between the two methods. This instance demonstrates the intricacy and depth of considerations that exist when studying "green work".

Further obstacles presented themselves within the survey questionnaire, where qualitative means were undertaken due to a lack of previous work on the subject. This produced instances where qualitative data was retrieved that could not be applied to statistical programs or equations, which hindered statistical validity. As previously discussed, the confusing nature of green work meant that the majority of answer keys were heavily worded to provide clarity, and most questions were given an “other” option. The body of literature on green work is still growing, which means research studies on the subject face barriers in the methodology process. More studies are necessary to continue to grow our understanding of green employment. It is likely that expanding our knowledge will limit the barriers within the research process and allow a more straightforward approach to study green work.

4.2.5 Implications for green employment in the Kingston regions renewable energy sector

It is clear from the results that direct employment is dominated by owning/operating generating facilities, and building/installing generating facilities. It was previously noted that the large number of jobs focused on building plants or installing equipment are likely linked to the fact that renewable energy generation is not yet a mature industry in the region; many projects are only now being built, and thus a significant number of jobs are associated with getting the projects going. It should be questioned, however, how sustainable these jobs are in the long term. As projects
become established, it is expected that the number of builders or installers required will fall. There is faith these jobs are reabsorbed into other categories of green employment, and that technicians and skilled workers move into the provision of technical services or business support, but this cannot be guaranteed. The findings suggest that up to 25% of direct employment associated with the renewable energy sector in Kingston consists of jobs that may not be sustainable in the longer term. A much smaller proportion (about 12%) of indirect jobs are found in the same category of building/installing, and these jobs also may be vulnerable over extended periods. It should be noted that respondents in these categories were almost all working with solar and wind projects, and that wind projects have the greatest proportion of potentially vulnerable jobs.

Project development and installation accounted for more than 50% of the services offered by companies or organizations directly engaged in the industry. Again, these are the type of services that are likely to be vulnerable as the renewable energy sector matures, and the number of new installations and new projects being developed drops off. Direct employment in the renewable energy industry could drop significantly - by up to 50% - if new project development and installation become less of a priority. By comparison, indirect employment is largely found in organizations offering longer-term services - energy efficiency and conservation, research and development, and other services including policy analysis - which are more robust and likely sustainable in the long term. Interestingly, the organizations involved in wind energy captured in the survey are more focused on business support and research and development than they are in project development, which suggests that the relatively low number of respondents engaged in wind energy represented a sample skewed towards the construction of new projects and may not represent the true breadth of sector activities.

Overall, the results suggest that indirect green employment related to Kingston’s renewable energy sector are relatively stable due to the range of work opportunities that account for many
different services that support renewable energy generation. Oppositely, 25-50% of direct work may be vulnerable in the long term due to their focus on project development and installation.

Based on results presented in

Table 4-2 (page Error! Bookmark not defined.), this suggests that between 27 and 54 green jobs associated with major renewable energy projects completed, approved, or planned for the region could be relatively unsustainable. This leaves just under 200 new and ongoing, direct and indirect jobs associated with the sector that may be considered sustainable in the longer run.

Although these numbers may appear small, it should be stressed that these figures only capture green employment growth in the greater Kingston region. Therefore, if similar studies were conducted in other regions of the province that are also involved in renewable energy development, this could represent a sizable amount of jobs for the entire province. Furthermore, indirect work trends within the Kingston region identified the potential for job creation in support sectors, such as research and development, business support and conservation. This indicates that areas that do not possess the ideal geography for renewable energy generation could still expect job creation in an indirect manner. Information such as this could support future policy that consider renewable energy projects as a means to expand green employment and drive sustainable economic development.
CHAPTER 5  Conclusions

This thesis set out to better quantify the relation between renewable energy development and employment. Using renewable energy development in and around Kingston, Ontario, Canada as a case study, the project set out to determine the number of new and ongoing jobs directly and indirectly associated with different types of renewable energy initiatives, the characteristics of those jobs (full or part-time, permanent or temporary), and the nature of the work being done. Major conclusions from this work may be found in the sections below.

5.1 Developing a working definition of ‘green’ jobs

It is clear from the literature review that the definition of green jobs is currently nebulous and lacks consistency from jurisdiction to jurisdiction, or from agency to agency. In Ontario – despite the fact that green jobs are a desired output of the 2009 Green Energy and Green Economy Act (GEA), no single definition has been officially adopted by the provincial government. The review of existing issues suggests that categories of green jobs are required to address key issues of permanence, originality, and quality. A framework of five categories for green jobs is adapted from the previous work carried out at Queen's University; these categories include new direct and indirect employment, ongoing direct and indirect jobs, and temporary work.

It is also pointed out that no working definition of green jobs currently includes a quantitative metric (or metrics) to define ‘green’. Incorporating such metrics would require widespread agreement of important goals (such as reductions in GHG emissions) and acceptance of a common definition. The lack of common definitions means that the term ‘green job’ can take on a variety of meanings, greatly reducing its use as a goal or metric within government policy.
5.2 Current green employment opportunities near Kingston

The Kingston region has both significant potential for renewable energy production, based on the natural resources of the area, as well as considerable implementation of renewable energy projects, primarily using wind and solar photovoltaic technologies. The selection of wind and solar options is largely driven by Ontario’s Green Energy and Green Economy Act, which created a feed-in tariff (FIT) program, heavily favouring the application of these technologies at a relatively large scale. At the time of writing, about 218 MW of large-scale wind and solar power are installed in the region; another 60 MW approved and 255 MW proposed. These installations would provide a significant proportion of Kingston's energy requirements. Also present in the region are dozens of smaller-scale projects, primarily solar PV on rooftops and small-scale bioenergy on farms or attached to greenhouses, which are also an important part of the renewable energy sector.

A series of simple multipliers for new direct and temporary employment were assembled based on the data available describing existing and planned projects in the Kingston region. For solar PV projects, data suggested that 0.20 new direct jobs and 10.99 temporary jobs might be expected per MW installed. For wind projects, the data suggested 0.06 new direct jobs and 2.02 temporary jobs might evolve per MW installed.

It was clear from the review that there are many temporary construction jobs associated with the renewable energy sector; it is estimated that over 3,500 person-years of work will be created in the Kingston region when all major renewable energy projects are completed. The estimated number of permanent, new jobs directly engaged in major renewable energy projects is much more limited, with an estimated 78 new jobs added to the local economy. Estimates of the green jobs associated with the renewable energy developments around Kingston are confounded by a number of factors, including changes to the domestic content rules which will certainly impact
the number of manufacturing jobs across the province, and a lack of data describing the flow of goods and services through the local economy.

5.3 Relation between new and ongoing, direct and indirect employment opportunities

The third objective of the research was to expand our understanding of three categories of green employment associated with renewable energy development: new indirect work, and ongoing direct and indirect jobs. A web-based survey (36 respondents), coupled with a series of interviews (12 respondents), was carried out to examine these issues. It was clear that indirect employment - work carried out in support of the renewable energy sector - was significant, as approximately 64% of survey respondents identified their role in renewable energy development as indirect. The survey responses also allowed the researcher to get a sense of how many jobs were new as opposed to ongoing or retained jobs. Based on the survey responses, it was estimated that for every one new direct job, 0.65 new indirect jobs might be created, while 0.39 ongoing direct jobs and 1.06 ongoing indirect jobs might be retained. This could translate into a total of 164 direct and indirect jobs in addition to the estimated 78 new, direct jobs associated with the sector. These findings are based on the web survey and as such are highly localized to the Kingston region case study, which represents an immature renewable energy sector still in the development stage; however, the results provide insight into the impact that major renewable energy projects might have beyond the creation of direct new jobs or temporary employment associated with the construction phase of the project. Interview results support these findings; 75% of interviewees suggested that the RE sector now supports a significant number of ongoing direct and indirect jobs.

Importantly, the inclusion of indirect and ongoing jobs might triple estimates of total employment across the sector; however, it was noted that the overall contribution of renewable energy generation to employment in Kingston remains very small, with the total of 242 potential
jobs representing about only 5% of currently unemployed workers, and less than 1% of the total workforce.

5.4 Types of green work being carried out in Kingston’s renewable energy sector

It was found that direct work in Kingston’s renewable energy sector tends to be more technically specialized, with the majority of respondents acting as owner/operators or focused on building/installing renewable energy facilities. The findings suggest that up to 25% of direct employment associated with the renewable energy sector in Kingston consists of jobs that may not be sustainable in the longer term as renewable energy capacity goals are reached and the need for construction or installation services falls off. Organizations offering direct employment were also highly focused on project development and installation services, with the data suggesting that 50% of the responding companies might face challenges in the longer term. Across the Kingston region, this would translate into between 27 and 54 jobs that would be at risk. By comparison, indirect green work includes employment offering services such as management and business support, with organizations focused primarily on energy efficiency and conservation, research and technology development as well as business support. These categories of employment are likely to be much more stable as they will be required to support the renewable energy industry throughout its development phase and into maturity.

This thesis has sought to understand the trends in green employment, associated with renewable energy development, using the Kingston region as an example. Future work needs to be carried out to determine if the findings presented in the thesis can be applied to other regions, or across other larger scales. Greater understanding of the potential for renewable energy development to drive employment is essential for stronger planning by governments and communities.
5.5 Future Work

Overall, more research needs to be conducted to refine the way green work is defined. As mentioned in the literature review, there is still improvement that can be made to designate clear categories of types of green work, due to the vast and inclusive nature of green employment. Creating a concise guide that defines different types and categories of green employment limits uncertainty and interpretation, thus improving our understanding of green work. Gaining a more comprehensive understanding of green employment can also provide the framework to quantify green jobs more concisely using sophisticated multipliers to account for various scenarios.

Specifically, limitations discovered when defining the types of green jobs, as well as certain aspects of the methods used within this research should be taken into consideration as green work continues to be studied. There is potential for the definitions of green employment to be refined in order to allow a more detailed analysis. Examples include renaming “temporary” work as “construction” work, as temporary may be too general and does not best capture employment in this area. Also, future work may include quantifying green employment based on person-years rather than per MW to allow greater consistency and applicability when comparing to other studies, and to overcome the difficulty of double-counting a single person who is employed on more than one project within the year.

Two issues that were not dealt with within this study were temporary employment characteristics, and green jobs associated with microFIT projects. Research to describe the characteristics of temporary (or construction) green work within renewable energy sectors is essential to understand key trends of green work in renewable energy industries. This is especially important due to the amount of survey and interview respondents that noted the presence of temporary work in the region, as well as the role temporary work has in the development of new renewable energy projects. Employment trends within microFIT projects were not explored, but it
is noted that there is a potential correlation between services provided by SME’s and microFIT projects which should be studied further. Individuals involved in temporary or construction work and opportunities associated with microFIT projects were difficult to contact based on the accessibility of their contact information, especially in comparison to full-time employees within large organizations. Future studies on green employment within renewable energy sectors should explore temporary jobs, as well as those associated to microFIT projects, in order to better understand the significance of these forms of employment.
References


Appendix A – Survey Letter of Information

Letter of Information
“The Economic Effects of Renewable and Sustainable Energy Production on the Kingston Region”

Megan MacCallum  Dr. Warren Mabee  Dr. John Holmes
MA Candidate  Professor  Professor
Dept. of Geography  School of Policy Studies  Dept. of Geography
Queen’s University  Queen’s University  Queen’s University
Kingston, Ontario  Kingston, Ontario  Kingston, Ontario
a.maccallum@queensu.ca  warren.mabee@queensu.ca  holmesj@queensu.ca
613-876-5226  613-533-6000 ext.77092  613-533-6043

This research is being conducted by Megan MacCallum, a Master’s candidate (MA) in the Department of Geography at Queen’s University in Kingston, Ontario. Megan is under the supervision of Dr. Warren Mabee, Professor, School of Policy Studies and Dr. John Holmes, Professor, Department of Geography, Queen’s University.

Purpose of study: The purpose of this research is to gain insight into the growth of “green jobs” within the region covered by Kingston and the Counties of Frontenac, Lennox and Addington and Leeds, specifically focusing on the renewable and sustainable energy sector. I will be investigating the specific components of jobs being created in this sector and the potential impact on the renewable energy industry in Ontario. These occupational characteristics include the company’s sustainable services, employee demographics, as well as training and educational opportunities.

Procedures involved in the Research: You have been selected to participate in this study because of your investment in the renewable energy industry. The study will require you to participate in an online-based survey in which your personal responses will be confidential and encrypted for your privacy. There are no known physical, psychological, economic, or social risks associated with participating in this study.

Is my participation voluntary? Yes. Although it would be greatly appreciated if you would answer all questions as frankly as possible, at no time should you feel obliged to answer any question that you find objectionable or that makes you feel uncomfortable. You may also withdraw from the study at any time without consequences, and, at your request, the information you have provided prior to withdrawal will be destroyed.

What will happen to my responses? We will keep your responses as confidential as possible. Only my faculty supervisors and myself will have access to this information until time of publication. The data may also be published in professional journals or presented at conferences, but any such presentations will be of general findings and will never breach individual confidentiality. At this time of publication, you will not be identified by your name or your company’s name, but simply by “respondent 1” or “company 1”. Should you be interested, you are entitled to a copy of the findings.

Will I be compensated for my participation? No, there will not be any compensation for this study.

What if I have concerns? Any questions about study participation may be directed to Megan MacCallum: a.maccallum@queensu.ca. Any ethical concerns about the study may be directed to the Chair of the Queen’s University General Research Ethics Board at Chair. GREB@queensu.ca or 613-533-6081.

Again, thank you. Your interest in participating in this research study is greatly appreciated.

This study has been granted clearance according to the recommended principles of Canadian ethics guidelines, and Queen’s policies.
Appendix B - Web-based Survey Questions

Company name:  
Company address:  
Your name:  
Your role in the company:  
Email:  
Phone number:  
Webpage:  

1. In what year was your company founded? _________

2. In what year did the company establish a location in the Kingston region, including counties of Prince Edward, Hastings, Lennox and Addington, Frontenac, and Leeds and Grenville? _________

3. Is your company/organization (please select one):
   a. Public
   b. Private
   c. Not for profit (NGO)
   d. Other, please specify:

4. Does your company/organization fall within the renewable energy sector?
   a. Yes
   b. No

5. If you answered yes, what type of renewable energy?
   a. Solar
   b. Wind
   c. Biomass
   d. Biogas
   e. Geothermal
   f. Other, please specify:

6. What percentage of your company/organizations business would you estimate is associated with renewable energy generation?
   a. 0-20%
   b. 20-40%
   c. 40-60%
   d. 60-80%
   e. 80-100%
7. What products or services does the company/organization provide that are associated with the local renewable energy industry? Select all that apply.
   a. Own/operate renewable energy facilities
   b. Build/install renewable energy facilities
   c. Provide technical services for renewable energy facilities
   d. Provide management or business support for renewable energy facilities/companies
   e. Derive rental income from renewable energy facilities
   f. Other, please specify:
   g. None

8. Is your company/organization involved in any of the following? Select all that apply.
   a. Energy efficiency and conservation
   b. New energy generation
   c. Transmission and smart grid
   d. Installation and technical support
   e. Research and technology development
   f. Business support
   g. Other, please specify:

9. Please tell us a little about your job. How would you define your job?
   a. Temporary or part time employment (such as construction)
   b. Full time employment

10. Is your job:
    a. A new job directly related to renewable energy opportunities?
    b. An ongoing job which is now focused on new renewable energy opportunities?
    c. A new job which supports renewable energy development (but also includes other responsibilities)?
    d. An ongoing job which now supports renewable energy development (but also includes other responsibilities)?

11. If you don't mind, what is your average salary range? Feel free to skip this question if you like
    a. $0-$40,000
    b. $40,000-$60,000
    c. $60,000-$80,000
    d. $80,000-$100,000
    e. $100,000+

12. Currently, how many full time employees do you have on staff within the Kingston region? 
    __________

    How many do you estimate your organization will hire in the next 5 years __________
    How many do you estimate your organization will hire in the next 10 years __________
13. How many part time or temporary employees do you currently have on staff within the Kingston region? __________

How many do you estimate your organization will hire in the next 5 years __________
How many do you estimate your organization will hire in the next 10 years __________

14. When hiring, which of the follow skill sets do you find desirable? Select all that apply
   a. Management skills
   b. Engineering skills
   c. Technical/operational skills
   d. Business support
   e. Other, please specify:

15. When hiring, which skill sets does your company/organization find most difficult to fill?
Select all that apply
   a. Management skills
   b. Engineering skills
   c. Technical/operational skills
   d. Business support
   e. Other, please specify:

16. How many of your employees were educated / trained in local post-secondary educational institutions?

____________________________________________________________________________
____________________________________________________________________________

17. Over the past two years, how would you describe opportunities for your company/organization (economic or otherwise)?
   a. Rising
   b. Declining
   c. Not changing

18. If you don't mind, what was the approximate revenue of your company/organization in 2013?

____________________________________________________________________________

Thank you for your time!
Appendix C – Semi-structured Interview Letter of Information

August 15, 2014

To whom it may concern,

My name is Megan MacCallum and I am a Master’s of Geography candidate at Queen’s University. Since May 2013 I have pursued research surrounding the effects of renewable energy production on employment within Kingston Frontenac and Lennox and Addington area. Due to your involvement within sustainable energy, I would really appreciate a small fragment of your time, ranging from 30-60 minutes, to conduct a semi-structured interview with you.

I am hoping to expand on my initial online survey entitled “The Economic Effects of Renewable and Sustainable Energy Production in the Kingston Region” that you responded to between May and July 2014. The data collected through this primary research endeavor has highlighted particular trends within the greater Kingston regions renewable energy industry as well as its corresponding job market. Enhancing the breadth of knowledge on this subject is imperative to supporting various socioeconomic and political bodies as well as specifically contributing to renewable energy and labour forecasting and modeling methods.

Attached is a letter of information and consent form. If you have any questions, feel free to contact me, a.maccallum@queensu.ca; (613-876-5226) or my supervisors Dr. Warren Mabee; mabeew@queensu.ca; (613-533-6000 x77092) and Dr. John Holmes, holmesj@queensu.ca; (613-533-9043).

Thank you for time,

Megan MacCallum
Letter of Information

“The Economic Effects of Renewable and Sustainable Energy Production in the Kingston Region”

Megan MacCallum  Dr. Warren Mabee  Dr. John Holmes
MA Candidate  Professor  Professor
Dept. of Geography  School of Policy Studies  Dept. of Geography
Queen’s University  Queen’s University  Queen’s University
Kingston, Ontario  Kingston, Ontario  Kingston, Ontario
a.maccallum@queensu.ca  warren.mabee@queensu.ca  holmesj@queensu.ca
613-876-5226  613-533-6000 ext.77092  613-533-6043

This research is being conducted by Megan MacCallum, a Master’s candidate (MA) in the Department of Geography at Queen’s University in Kingston, Ontario. Megan is under the supervision of Dr. Warren Mabee, Professor, School of Policy Studies and Dr. John Holmes, Professor, Department of Geography, Queen’s University.

Purpose of study: The purpose of this research is to gain insight into the growth of “green jobs” within the region covered by Kingston and the Counties of Frontenac, Lennox and Addington and Leeds, specifically focusing on the renewable and sustainable energy sector. I will be investigating both the specific characteristics of jobs being created in this sector and the potential impact on the renewable energy industry in Ontario.

Procedures involved in the Research: You have been selected to participate in this study because of your involvement in and/or knowledge of the renewable energy industry. The study will require you to participate in a semi-structured interview that with your permission will be recorded using an audio recording device, and is anticipated to span between 30-60 minutes. There are no known physical, psychological, economic, or social risks associated with participating in this study.

Is my participation voluntary? Yes, although it would be greatly appreciated if you would answer all questions as frankly as possible. However, at no time should you feel obliged to answer any questions that you find objectionable or that makes you feel uncomfortable. You may also withdraw from the study at any time without consequences, and, at your request, the information you have provided prior to withdrawal will be destroyed.

What will happen to my responses? We will keep your responses as confidential as possible. Only my faculty supervisors and myself will have access to this information until time of publication. The data may also be published in professional journals or presented at conferences, but any such presentations will be of general findings and will never breach individual confidentiality. At this time of publication, you will not be identified by your name or your organizations name, but simply by “respondent 1” or “organization 1”. Should you be interested, you are entitled to a copy of the findings.

Will I be compensated for my participation? No, there will not be any compensation for this study.

What if I have concerns? Any questions about study participation may be directed to Megan MacCallum: a.maccallum@queensu.ca. Any ethical concerns about the study may be directed to the Chair of the Queen’s University General Research Ethics Board at Chair. GREB@queensu.ca or 613-533-6081.

Again, thank you. Your interest in participating in this research study is greatly appreciated.

This study has been granted clearance according to the recommended principles of Canadian ethics guidelines, and Queen's policies
Appendix D – Semi-structured Interview Consent Form

Consent Form
“The Economic Effects of Renewable and Sustainable Energy Production in the Kingston Region”

Name (please print clearly): ________________________________________

2. I have read the Letter of Information and have had any questions answered to my satisfaction.

3. I understand that I will be participating in the study called “Economic Effects of Renewable and Sustainable Energy Production on the Kingston Region”. I understand that this means that I will be involved in answering questions in a semi-structured interview, which incorporates the use of audio recording.

4. I am aware that if I feel uncomfortable with any of the research questions I reserve the right to decline to answer. I understand that my participation in this study is voluntary and I may withdraw at any time without penalty.

5. I understand that my responses will be kept as confidential as possible, and therefore give permission for the information I contribute to be used by the researcher. The data may also be published in professional journals or presented at conferences, however you will not be identified by your name or your organizations name, but simply by “respondent 1” or “organization 1”. If I am interested, I am aware I am entitled to a copy of the findings.

6. I recognize that by consenting to participation in this research I am in not waiving my legal rights.

7. I am aware that if I have any questions, concerns, or complaints, I may contact:

Megan MacCallum (613-876-5226); a.maccallum@queensu.ca

Project supervisors: Dr. Warren Mabee (613-533-6000 x 77092); mabeew@queensu.ca, Dr. John Holmes (613-533-6043); holmesj@queensu.ca, or the Chair of the General Research Ethics Board (613-533-6081) at Queen’s University.

I have read the above statements and freely consent to participate in this research:

Signature: _____________________________________   Date: _____________________

I consent to the audio recording of this interview:

Signature: _____________________________________   Date: _____________________
Appendix E – Semi-structured Interview Questions

What is your name?
What organization do you work for?
What is your job at this organization?
What renewable energy sector is your organization involved in? (list all that apply)
1. What are the specific involvements, services and/or products that your organization partakes in that are associated with the local renewable energy industry

2. Can you please discuss the typical kinds of renewable energy projects your organization spearheads?
   *Are you aware of the Green Energy and Green Economy Act? (If not, take this time to explain)*

3. I am going to read some job descriptions to you and I want you to tell me which description most suits your occupation. Is your job…
   • A new job created in response to the GEA that directly serves renewable energy sector?
   • A new job that created in response to the GEA that serves the renewable energy sector among other responsibilities?
   • An ongoing job that continues to exist because of the GEA that directly serves the renewable energy sector?
   • An ongoing job that continues to exist because of the GEA that serves the renewable energy sector among other responsibilities?
   • If your job does not match any of these descriptions can you please tell me why

4. Could you please describe the role and responsibilities that your job accounts for?

5. Is your job full time or temporary?

6. How many employees that works at your organization…
   • Are full time
   • Are temporary (contract)

7. Could you please describe the distinction between the work or skill sets that are associated with full time versus temporary work at your organization?

8. Are the majority of employees within your organization educated in the greater Kingston region? If not, is there a place or institutions most were educated for specific job types?

9. Do you find it difficult to fill certain jobs or skill sets? Oppositely, do you find that any certain roles are over saturated within the job market?
   • Are there any additional training or upgrading programs that you wish yourself or others could receive locally to enhance ones qualifications? If so, why do you think these opportunities are not available?
10. Can you please explain the relationship between the dates your organization was established in general as well as when it was founded within Kingston? Were there any significant events that led you to the Kingston region?

11. What, if any potential opportunities for your organization have transpired within the past two years? (Economic of otherwise)?

12. Is the local renewable energy industry dominated by any driving forces or trends that may be contributing to economic or work related growth? *Can you relate these shifts to an event, policy change, etc.? GEA?*
   - Do you or the organization you work for plan on hiring anyone within the next 6 months to a year?

13. How would you describe the work force within Kingston’s sustainable energy sector? Do you believe some needs aren’t being met?

14. How do you see the future of renewable energy in Kingston and surrounding areas evolving, whether it is increasing, decreasing or staying the same? *What about jobs? What are the measures to support these trends?*

15. From your perspective, has the Green Energy Act, and specifically the FIT program, been a success or failure? How do you measure the potential successes or failures?

16. Where are we now in terms of the local renewable energy industry, policy and labour? Do you believe certain bodies should be doing more? Why or why not?

17. Was there anything I forgot to ask? *Renewable energy, environmental policy, labour*