

**CLEAN ECONOMY  
WORKING PAPER SERIES**

MAY 2018 / WP 18-05

# **CREATING AND OPTIMIZING EMPLOYMENT OPPORTUNITIES FOR WOMEN IN THE CLEAN ENERGY SECTOR IN CANADA**

---

**Bipasha Baruah, Ph.D**  
Western University

**Crystal Gaudet**  
Western University

*Creating and Optimizing Employment Opportunities for Women in the Clean Energy Sector in Canada*

**AUTHOR DETAILS:**

**1) *Bipasha Baruah, Ph.D.***

Professor and Canada Research Chair in Global Women's Issues

Department of Women's Studies and Feminist Research

Lawson Hall Room 3244

Western University

1151 Richmond Street

London, Ontario

Canada N6A 5B8

Tel: (519) 661-2111 (extn. 86316)

E-mail: [bbaruah@uwo.ca](mailto:bbaruah@uwo.ca)

**2) *Crystal Gaudet***

PhD Candidate, Women's Studies and Feminist Research, Western University

**TABLE OF CONTENTS**

KEY FINDINGS.....3

EXECUTIVE SUMMARY.....4

INTRODUCTION.....7

CONTEXT.....9

METHODOLOGY.....10

RESEARCH FINDINGS AND IMPLICATIONS FOR CANADA.....11

    Opportunities and Constraints for Women in RE Employment in Canada

*Misperceptions*.....12

*Self-Employment and Entrepreneurship*.....13

*Part-time work and job sharing*.....14

*Travel and Mobility*.....17

*Employment Generation and Skill Shortages*.....18

*Public Sector Involvement*.....23

    Selected Examples of Promising Initiatives in Canada.....25

FURTHER RESEARCH.....27

CONCLUSION.....28

BIBLIOGRAPHY.....29

## KEY FINDINGS

This research project identified opportunities and constraints for women's employment in renewable energy (RE) and energy conservation in Canada. It synthesized existing data on women's employment in renewables in Canada while drawing upon the Principal Investigator's previous research in other industrialized, emerging and developing economies to identify promising economic programs, financial instruments and public policies that Canada could draw upon to shape employment equity in its energy policies and practices. Our findings reveal that there are glaring gender inequalities in employment in renewables in most countries in the world, including Canada, as well as some counterintuitive trends - for example, the fact that developing countries and emerging economies are, broadly speaking, creating much larger volumes of employment for women, even if the jobs created are poorly paid and precarious. On the other hand, in many industrialized countries (Canada is a good example) there is a lot of attention paid to the technologies and financing for renewables but very little attention yet being paid to the employment equity and social justice implications of transitioning to renewables. Our findings reveal the need not just for specific employment equity policies to address the gender gap in both fossil-fuel based and RE employment but also wider socially progressive policies as well as shifts in societal attitudes about gender roles in order for women to benefit optimally from employment in the energy sector. Restructuring paid employment in innovative ways – through, for example, the creation of more part-time jobs and arrangements like work-sharing – while expanding social protection nets and delinking them from employment status, have been suggested in some industrialized countries as a way to accomplish economic security, environmental protection and gender equity. However, without more transformative social changes in gender relations, our findings suggest that such strategies may reinforce rather than challenge existing gender inequities both in paid employment and in unpaid domestic labour. The vast majority of RE initiatives in Canada have been driven by the private sector, municipalities and provincial governments. The federal government has, at least until very recently, not played an active role in framing and implementing effective policies to enable the transition to renewables. Despite a growing conversation about the potential for renewables to generate a larger volume of employment than fossil fuels, even organizations committed to advocating for employment equity and social justice in debates about environmental sustainability in Canada (Blue Green Canada and Green Skills Network are good examples) have never specifically mentioned or addressed gender inequity. The conversation about gender equity or social justice (more broadly) in Canada's green economy is at best incipient and tokenistic. Raising awareness about these issues is therefore urgent and critical. Since jobs in RE tend to be dispersed across different sectors of employment (such as construction, manufacturing, installations, fuel processing, operations and maintenance), collecting specific employment data on RE and energy conservation would be particularly valuable for informing employment equity policies. Sex-disaggregated data on employment in renewables is extremely spotty everywhere in the world. This makes analyzing trends and making comparisons challenging. Although the employment effects of RE investment, in particular, are increasingly gaining prominence in the debate on renewables in Canada, specific analytical work and empirical evidence on this important subject remain extremely limited. Further research aimed at documenting the gender gap in energy employment as well as informing strategies for promoting employment equity would be valuable. Having access to sex-disaggregated employment data on specific renewable sources such as wind, run-of-river hydro, solar, biomass and geothermal would enable us to better understand trends as well as to propose policies and interventions for promoting employment equity. Without data, there is no visibility. And without visibility, there is no policy priority. An assessment of data availability on RE employment in different industrialized countries suggests that Canada lags behind its OECD counterparts not just in framing and implementing policies for gender equity in RE employment but also in data collection and analysis. It is crucial that we conduct more policy-relevant empirical research on this topic in a consistent and sustained manner.

## EXECUTIVE SUMMARY

This research project identified opportunities and constraints for women's employment in renewable energy (RE) and energy conservation in Canada. It synthesized existing data on women's employment in renewables in Canada while drawing upon the PI's previous research in other industrialized, emerging and developing economies to identify promising economic programs, financial instruments and public policies that Canada could draw upon to shape employment equity in its energy policies and practices. Our findings reveal that there are glaring gender inequalities in employment in renewables in most countries in the world, including Canada, as well as some counterintuitive trends - for example, the fact that developing countries and emerging economies are, broadly speaking, creating much larger volumes of employment for women, even if the jobs created are poorly paid and precarious. On the other hand, in Canada and other OECD countries, there is a lot of attention paid to the technologies and financing for renewables but very little attention is yet being paid to the employment equity and social justice implications of transitioning to renewables. Our findings reveal the need not just for specific employment equity policies to address the gender gap in both fossil-fuel based and RE employment but also wider socially progressive policies as well as shifts in societal attitudes about gender roles in order for women to benefit optimally from employment in the energy sector. Restructuring paid employment in innovative ways – through, for example, the creation of more part-time jobs and arrangements like work-sharing – while expanding social protection nets and delinking them from employment status, have been suggested in some industrialized countries as a way to accomplish economic security, environmental protection and gender equity. However, without more transformative social changes in gender relations, our findings suggest that such strategies may reinforce rather than challenge existing gender inequities both in paid employment and in unpaid domestic labour.

The vast majority of RE initiatives in Canada have been driven by the private sector, municipalities and provincial governments. The federal government has, at least until very recently, not played an active role in framing and implementing effective policies to enable the transition to renewables. Despite a growing conversation about the potential for renewables to generate a larger volume of employment than fossil fuels, even organizations committed to advocating for employment equity and social justice in debates about environmental sustainability in Canada (Blue Green Canada, and Green Skills Network are good examples) have never specifically mentioned or addressed gender inequity. The conversation about gender equity or social justice (more broadly) in Canada's green economy is at best incipient and tokenistic. Raising awareness about these issues is therefore urgent and critical.

This knowledge synthesis included both scientific and practitioner knowledge sources. The peer-reviewed scholarship on this topic is currently very limited but there is a significant amount of “working knowledge” available from practitioner sources. Drawing upon and amalgamating both types of knowledge was important to better enable policymakers and other end users of this research to fully appreciate the nature, magnitude, nuance and complexity of the issues involved.

Although sex-disaggregated data on RE employment in industrialized countries is scarce, the numbers we were able to put together points to the severe underrepresentation of women. The available data from Canada, US, Spain, Germany and Italy indicate a general trend of women in the RE sector being employed mostly in less well-paid non-technical occupations. The greatest representation of women in RE in OECD countries is in sales, followed by administrative positions and then engineers and technicians. In absolute numbers, the largest sources of RE employment for women in industrialized countries are solar photovoltaics, solar heating/cooling, wind power, biomass and biofuels. The underrepresentation of women in RE in many OECD countries is part of a bigger problem of the underrepresentation of women

in STEM fields. There is an obvious economic benefit for women who choose to pursue these paths. While wage inequality also exists in STEM jobs, it is a smaller wage gap relative to men. Women in STEM jobs earn 33 percent more than those in non-STEM occupations. The gender wage gap in STEM jobs is roughly 14 percent, while the gender wage gap for non-STEM jobs is 21 percent. Findings from this research suggest that the professional community of engineers in Canada and other OECD countries may not be doing optimally well at leveraging the message that engineering is prestigious and socially useful work. By contrast, much larger numbers of middle-class women study engineering and other technical fields in some developing countries and emerging economies, at least partially because they are perceived as well-paid high-status occupations. Although women may continue to experience glass ceilings and employment discrimination in various forms in such countries, recruitment, especially for entry-level positions is not a challenge because of the large numbers of women earning engineering degrees.

A review of the available literature provides some indication of the proximate determinants and structural factors that may either impede or facilitate women's meaningful participation in the RE sector in Canada specifically, and in industrialized countries more broadly speaking. We have organized these opportunities and constraints under the following themes in this report:

- societal and self-misperceptions about women's technical abilities as well as about careers in technology;
- opportunities and constraints associated with self-employment and entrepreneurship;
- the pros and cons presented by part-time work and arrangements like job sharing;
- the limitations and opportunities women face in managing work-related travel;
- the potential for significant employment generation in the RE sector and simultaneous skill shortages;
- and the importance of public sector involvement in framing policy to enable employment equity in RE.

It is important to emphasize that the line between opportunity and constraint is quite fuzzy since some constraints may potentially become opportunities with appropriate policy interventions, shifts in societal attitudes, and economic and political changes. The implications of part-time work and job sharing, which we include in this report, do not apply solely to women in the RE sector. These are growing employment trends around the world and have deep implications for gender equity in all fields, not just in renewables. We include it for discussion in this report because it is important to understand women's access to employment in renewables within the context of broader trends in employment and social policy.

Reports from around the world warn of a looming skills gap as industrialized and emerging economies retool their existing industries and seek out new opportunities. In virtually all areas of energy development, there are skills shortages and calls for additional training. These shortages cover a wide range of different occupations, from engineers and architects to skilled trades, equipment operators, technicians and even construction laborers. Skills shortages also vary, regionally and by energy sector. Most of the shortages are for jobs in conventional energy production. However, the renewable sector is also experiencing significant shortages of qualified personnel. Although the skill shortages present challenges for labor supply, they also represent an opportunity to train and recruit women, visible minorities, Aboriginal peoples, new immigrants and other groups that have historically been marginalized in the energy sector

in Canada.

The conversation about gender equity or social justice (more broadly) in Canada's green economy is at best incipient and tokenistic. Reports that do highlight opportunities to employ underrepresented groups, including women, in the RE sector stop short of calling for the kinds of policy approaches and concrete action required to ensure equity. Most future green job creation in Canada will be in occupations in which women are currently underrepresented, such as engineering and the skilled trades. A Statistics Canada study found that in 2007 women only accounted for 1-2 percent of completions in apprenticeship training in major trade groups. Another report published by Statistics Canada shows that in 2011, women comprised just 23% of engineering graduates aged 25-34. Since workers are likely to transition from jobs in the "brown" economy (which is heavily male dominated) to the "green," it is a self-fulfilling prophecy that women will also be underrepresented in green jobs unless gender equity in employment is planned and implemented proactively. Recent media reports confirm this trend, indicating that laid-off oil and gas workers in Alberta are beginning to find employment in the RE sector.

Emerging research in the U.S. that evaluates initiatives specifically aimed at training women for entry-level positions in the green economy report low levels of success in ensuring women's long-term employment in the occupations for which they were trained. Comparable assessments of gender sensitive green job initiatives in the Canadian context have not been conducted - presumably due to the absence, to begin with, of gender-equity based initiatives in the RE sector. Past attempts to train women on social assistance in Canada in the skilled trades showed limited success in securing the long-term employment of women in their respective trades. These findings confirm the need not only for proactive equity policy, but also for policies that support work/life balance, such as affordable, universal child care and flexible working arrangements, as well as broader changes to workplace culture in traditionally male-dominated fields. Women can gain optimal traction from RE initiatives only if there are wider socially progressive policies in place. Since women's ability to take advantage of new energy-related employment options is, to begin with, often constrained by social barriers that limit their access to certain types of education and training, employment, credit and childcare, for example, it is crucial that social policies go beyond energy sector planning to optimize economic opportunities for women.

Sex-disaggregated data on employment in renewables is extremely spotty everywhere in the world. This makes analyzing trends and making comparisons challenging. Although the employment effects of RE investment, in particular, are increasingly gaining prominence in the debate on renewables in Canada, specific analytical work and empirical evidence on this important subject remain extremely limited. Further research aimed at documenting the gender gap in energy employment as well as informing strategies for promoting employment equity would be valuable. Having access to sex-disaggregated employment data on specific renewable sources such as wind, run-of-river hydro, solar, biomass and geothermal would enable us to better understand trends as well as to propose policies and interventions for promoting employment equity. Without data, there is no visibility. And without visibility, there is no policy priority. An assessment of data availability on RE employment in different industrialized countries suggests that Canada lags behind its OECD counterparts not just in framing and implementing policies for gender equity in RE employment but also in data collection and analysis. It is crucial that we conduct more policy-relevant empirical research on this topic in a consistent and sustained manner.

## INTRODUCTION

Employment in the energy industry is extremely male-dominated everywhere in the world. Globally, women make up 6 percent of technical staff, 4 percent of decision-makers, and only 1 percent of top management in the fossil-fuel based sector (UN Women, 2012). Women are also highly underrepresented in the renewable energy (RE) sector. Available data from OECD countries such as Canada, US, Spain, Germany and Italy estimates that only 20-25 percent of jobs in the RE sector are held by women, and these are mostly lower-paid non-technical, administrative and public relations positions (Pearl-Martinez, 2015). This contrasts sharply with the fact that women represent more than 50 percent of university students and almost half the labor force in these countries (ibid.). Concerns about environmental sustainability and fossil-fuel insecurity have convinced many industrialized, emerging and developing economies to transition to low-carbon energy supplies derived from renewables such as solar, hydro, geothermal, bioenergy and wind. Producing and distributing renewables is more labor-intensive than producing and distributing fossil fuels: all RE and low-carbon sources generate more jobs than the fossil fuel sector per unit of energy delivered (Wei et al., 2010). Therefore, this shift to renewables and low-carbon sources is creating new employment opportunities and also addressing energy poverty in remote or under-served communities. RE employed almost 8 million people, directly or indirectly, around the world in 2014, excluding large hydropower (IRENA, 2015). This is an 18 percent increase from the previous year and employment in the sector is expected to continue growing rapidly in the future (ibid). Although there is tremendous potential to create employment in renewables almost everywhere in the world, there is growing concern that women, who are already severely underrepresented in the sector, will become even more marginalized if gender equity policies and programs are not proactively planned and implemented (Fernández-Baldor et al, 2014; McFarland, 2013). In the absence of appropriately targeted training, education, apprenticeships, employment placement, financial tools and supportive social policies, transitioning to renewables may exacerbate existing gender inequities and also hinder broader human development goals (Baruah, 2016).

This research project, funded by a SSHRC Knowledge Synthesis Grant, identifies opportunities and constraints for women's employment in RE<sup>1</sup> and energy conservation<sup>2</sup> in Canada. It synthesizes existing

---

<sup>1</sup> For the purposes of this project, renewable energy includes occupations in the generation and distribution of wind energy, solar energy, bioenergy, geothermal and small hydropower.

<sup>2</sup> Energy conservation refers to jobs in energy-efficient building, including new building construction and retrofitting of existing buildings.



data on women's employment in renewables in Canada and draws upon the Principal Investigator (PI)'s previous research in other industrialized, emerging and developing economies to identify promising economic programs, financial instruments and public policies that Canada could draw upon to shape employment equity in its energy policies and practices. This Canada-specific knowledge synthesis project is part of a much larger project which examines existing research and data on women's employment in RE in OECD countries, emerging economies and developing countries.

This project is not intended as a comprehensive survey of women's employment in RE. The data does not currently exist to enable this. The countries included in the broader global project were simply ones for which the PI was able to find some reliable information. In fact, the need to collect data specific to the RE sector in order to inform evidence-based policymaking is one of the clearest findings from this study and those of others who have attempted to study employment generation in RE (see, for example, Antoni et al., 2015).

In this project, we have simply collected and thematically analyzed available reliable data on women's employment in RE. Even with the use of such a straightforward methodology, it is obvious that there are glaring gender inequalities in employment in renewables in most countries, including Canada, as well as some counterintuitive trends - for example, the fact that developing countries and emerging economies are, broadly speaking, creating much larger volumes of employment for women, even if the jobs created are poorly paid and precarious. On the other hand, in many industrialized countries (Canada is a good example) there is a lot of attention paid to the technologies and financing for renewables but very little attention yet being paid to the employment equity and social justice implications of transitioning to renewables. The major objective of the larger project was to point out such trends so that industrialized countries and emerging economies might learn from one another. The specific economic and political contexts of different countries are very relevant for an assessment of women's participation in RE, but we have only been able to engage with these aspects selectively in this project. There is a large body of feminist research we have drawn upon to provide the conceptual anchors and analytical framework for this study (the works of Isabella Bakker, Lourdes Beneria, Bina Agarwal, Jennifer Nedelsky and Thomas Malleson, for example) but we refer to this literature only selectively and economically in this report in order to allow for a more specific discussion about women in RE. We hope that the issues identified by this research will provide the grounding and detail against which other related issues and research, perhaps using very different methodologies, can be tested, verified and advanced.

## **CONTEXT**

The energy sector in Canada includes a broad range of different energy sources, technologies, facilities and employment patterns. The sources of energy include oil, natural gas, coal, nuclear power, large hydro, and various renewable sources such as wind, run-of-river hydro, solar, biomass and geothermal. Despite a growing focus on renewables, fossil fuels such as oil, natural gas and coal continue to dominate energy production. Although there are promising RE initiatives in Canada, the bulk of employment in the energy sector continues to be in fossil fuels, including non-conventional sources such as tar sands, shale and tight gas (Calvert and Cohen, 2011). Extraction methods for these fossil fuels tend to be even more environmentally damaging than conventional oil and gas production (ibid.).

Existing research suggests that there is often greater political unwillingness to give sufficient importance to expanding renewables and improving energy efficiency in countries that have large reserves of fossil fuels (Hostettler, 2015). Several researchers have, as recently as four or five years ago, suggested this to also be true for Canada (Calvert and Cohen, 2011; Katz, 2012). Clean Energy Canada has called for federal industrial policy, based on tax and research incentives, like the ones that helped Canada's aerospace and oil sands industries in their infancy. But the federal government has, at least until recently, been mostly “missing in action” in Canada (Cheadle, 2014). The vast majority of RE initiatives in Canada have been driven by the private sector, municipalities and provincial governments. In 2014, Clean Energy Canada emphasized that at a time when investment in clean energy technologies is growing worldwide, Canada is “looking the other way” and risks missing out on new opportunities for trade and employment by not investing more in RE and energy conservation. Recent research suggests that Canada has been hindered by a political structure that divides responsibility for policies related to climate and energy between the federal government and the provinces. This has led to a “patchwork of policies” at the provincial level exacerbated by an absence of federal leadership on the issue (Semeniuk and McCarthy, 2015). The newly-elected Liberal government has made more explicit commitments both to transitioning to renewables and to climate change mitigation more broadly than its Conservative predecessor but there has been no conversation whatsoever about employment equity and social justice in the transition to renewables and low-carbon sources of energy even with the recent change in federal government. Raising awareness about these issues is therefore urgent and critical.

## **METHODOLOGY**

This knowledge synthesis included both scientific and practitioner knowledge sources. The peer-reviewed

scholarship on this topic is currently very limited but there is a significant amount of “working knowledge” available from practitioner sources. Drawing upon and amalgamating both types of knowledge was important to better enable policymakers and other end users of this research to fully appreciate the nature, magnitude, nuance and complexity of the issues involved.

Because jobs in RE tend to be dispersed across different sectors of employment (such as construction, manufacturing, installations, fuel processing, operations and maintenance), specific information related to the sector is seldom captured in national statistics. Sex-disaggregated data on employment in renewables is even harder to find. The International Energy Agency (IEA) and the International Renewable Energy Agency (IRENA) maintain the most up-to-date publically available information on global employment in the RE sector. As a starting point, we assembled all available qualitative and quantitative data on women’s employment in renewables in Canada from the websites of IEA and IRENA. We also used online search engines such as Google Scholar, Scopus and Thomson Reuters (formerly ISI) Web of Knowledge to locate peer-reviewed scientific literature on women’s employment in RE and energy conservation as well as women’s employment in “green jobs,” “clean jobs” and related science, technology, engineering and math (STEM) and innovation fields in Canada. The inclusion of the latter is justified by the fact that employment in the most well-paid sectors of RE, namely, installations, construction, engineering and architecture (Antoni et al., 2015), tend to require STEM training. My previous research on OECD countries, including Canada, revealed that organizations like the Federation of Canadian Municipalities (FCM), Blue-Green Canada, Clean Energy Canada and the Green Skills Network have been playing an active role in advocating for employment equity and social justice in debates about environmental sustainability in Canada, albeit never from a gender equity perspective. Other energy and gender equality advocacy organizations such as Women in Renewable Energy (WiRE), Women in Electricity, Canadian Wind Energy Association (CanWEA) and Women Building Futures also served as good sources of information about women’s employment in clean energy. We collected and analyzed relevant materials from websites, annual reports, policy reviews, position papers and survey results from these organizations. Collected data were analyzed using the *Codebook for Standards of Evidence for Empirical Research* (SoE) (Heck & Minner, 2009). The SoE and the process for applying them resulted in a careful review of the claims of individual studies and reports based on six categories: adequate documentation, internal validity, analytic precision, generalizability/external validity determination, overall fit and warrants for claims. Complementing existing academic and practitioner literature revealed a range of previously undocumented challenges and opportunities faced by women in the RE sector in Canada. The broader data set from OECD countries, emerging economies and developing countries also revealed policies, programs

and practices that Canada might look at more closely and/or try to implement to optimize women's employment in clean energy and energy conservation.

## **RESEARCH FINDINGS AND IMPLICATIONS FOR CANADA**

### **Opportunities and Constraints for Women in RE Employment in Canada**

Although sex-disaggregated data on RE employment in industrialized countries is scarce, the numbers we are able to put together points to the severe underrepresentation of women. The available data from Canada, US, Spain, Germany and Italy indicate a general trend of women in the RE sector being employed mostly in non-technical occupations. The greatest representation of women in RE in OECD countries is in sales, followed by administrative positions and then engineers and technicians (IRENA, 2013). In absolute numbers, the largest sources of RE employment for women in industrialized countries are solar photovoltaics, solar heating/cooling, wind power, biomass and biofuels (ibid). The underrepresentation of women in RE in many OECD countries is part of a bigger problem of the underrepresentation of women in STEM fields. There is an obvious economic benefit for women who choose to pursue these paths. While wage inequality also exists in STEM jobs, it is a smaller wage gap relative to men. Women in STEM jobs earn 33 percent more than those in non-STEM occupations. The gender wage gap in STEM jobs is roughly 14 percent, while the gender wage gap for non-STEM jobs is 21 percent (The Nature Conservancy, 2014).

A review of the available literature provides some indication of the proximate determinants and structural factors that may either impede or facilitate women's meaningful participation in the RE sector in Canada specifically, and in industrialized countries more broadly speaking. We have organized these opportunities and constraints under the following themes in this report:

- societal and self-misperceptions about women's technical abilities as well as more generally about careers in technology;
- opportunities and constraints associated with self-employment and entrepreneurship;
- the pros and cons presented by part-time work and arrangements like job sharing;
- the limitations and opportunities women face in managing work-related travel;
- the potential for significant employment generation in the RE sector and simultaneous skill shortages;
- and the importance of public sector involvement in framing policy to enable employment equity in RE.

It is important to emphasize that the line between opportunity and constraint is quite fuzzy since some constraints may potentially become opportunities with appropriate policy interventions, shifts in societal attitudes, and economic and political changes. The implications of part-time work and job sharing, which we include in this report, do not apply solely to women in the RE sector. These are growing employment trends around the world and have deep implications for gender equity in all fields, not just in renewables. We include it for discussion in this report because it is important to understand women's access to employment in renewables within the context of broader trends in employment and social policy.

### ***Misperceptions***

A combination of women's self-perception as well as societal perceptions of women's incompetence in technical occupations has been identified quite frequently in the literature as an impediment for women's optimal participation in RE, and more broadly in STEM fields (see, for example, Riach and Rich, 2006). Although there are references to issues of perception and its consequences in studies of RE projects in different contexts (see, for example, Fernández-Baldor et al, 2014; Lehr, 2008) there does not appear to be any research devoted specifically towards documenting effects of such misperceptions upon women in RE. Findings drawn from similar fields such as construction and engineering occupations in various locations in the Global North and South do provide an understanding of how women are perceived, and often perceive themselves, in non-traditional male-dominated occupations (see, for example, research in India (Baruah, 2010), Nigeria (Adeyemi, 2006), Togo (Adubra, 2005), the US (Eisenberg, 1998; Paap, 2006), UK (Greed, 2000) and Canada (Little, 2005)). These studies reveal a common finding that women in these fields are deemed less competent than men even with the same or superior qualifications and work experience.

None of the above was surprising or new. However, this knowledge synthesis revealed that women may also be discouraged from entering occupations in RE and more broadly in engineering and technology fields because of misperceptions of the work involved in these fields. Because the technological aspects of these occupations get so much attention, women are often led to believe they are not socially useful. The message that these occupations can improve lives is often overshadowed by the technical aspects of building things (Tyseer Aboulnasr, dean of the faculty of applied science and a professor of electrical engineering at the University of British Columbia, quoted in Myers, 2010). This may explain why women are a significant presence, and often even the majority, in medical and biological sciences as well as in certain engineering disciplines (biosystems, environmental, chemical) in which they can clearly see how their work makes a difference but less well-represented in fields like civil, electronics and computer

engineering that are perceived as more technically focused and socially isolating (ibid.).

A 2009 Engineers Canada survey of female high school students found that many had negative perceptions of engineering and technology occupations, often as “dirty work that tradespeople would do” (Valerie Davidson, engineering professor at the University of Guelph, quoted in Myers, 2010). The same survey reports that women were more likely to equate engineering and technology (but especially engineering) with construction work, outdoor work, working in a cubicle, and relating primarily to computers and machines, rather than people. The result is that women may attribute lower status to engineering and technology occupations compared with, for example, health and social sciences. Of course, not all women aspire to be socially useful; some may just as easily be convinced by money, prestige or other factors regardless of the type of work or working conditions involved. It is important not to ascribe essentialist feminized attributes to all women. However, it does appear that the professional community of engineers, particularly in OECD countries, may not be doing optimally well at leveraging the message that engineering is prestigious and socially useful work. By contrast, much larger numbers of middle-class women study engineering and other technical fields in some developing countries and emerging economies, at least partially because they are perceived as well-paid high-status occupations. I discuss this in more detail later in this report.

### ***Self-employment and Entrepreneurship***

Self-employment and entrepreneurship have frequently been promoted as “solutions” for livelihood generation almost everywhere in the world in the current neoliberal economic climate. The issues of self- and societal perceptions discussed in the previous section may indeed be less of a constraint when women own enterprises or are otherwise self-employed. Provided that there is adequate business training, financial support and social safety nets in place, women seem to do well with self-employment. Women are establishing new RE enterprises both in industrialized countries and emerging economies. The founder of WiRE, a Canadian non-profit organization dedicated to advancing the role and recognition of women in the RE sector, revealed that of its membership base of over a thousand women in the province of Ontario, at least 10 percent were entrepreneurs in RE (Rebecca Black, interview, Toronto, Canada, May 7, 2015). She could not, however, provide additional information about whether the enterprises were in areas like communications and advertising, the actual generation of RE, or the sale of RE technologies. It is important to provide the right type of support for women’s entrepreneurial abilities but it is also important to be cognizant that entrepreneurship is often not a realistic livelihood strategy for some - particularly low-income - women, and even well-intentioned and progressive interventions by governments and social

enterprises fail to level the playing field for them (Baruah, 2015). Low-income women in both industrialized countries and emerging economies do not become entrepreneurs because the burden of entrepreneurship and the risk associated with loans is simply too high for them. Poorer women everywhere in the world tend generally to be more interested in stable wage employment rather than entrepreneurship (ibid.). Women's greater aversion to entrepreneurship also highlights the need to provide adequate social security to protect against vagaries in the market, illness, maternity, old age, job losses and other risks to people's wellbeing. Providing social protection within a human-rights framework and delinking social security from employment status is a strategy worth pursuing worldwide. Women can gain optimal traction from RE initiatives only if there are wider socially progressive policies in place. Since women's ability to take advantage of new energy-related employment options is, to begin with, often constrained by social barriers that limit their access to certain types of education and training, employment, credit and childcare, for example, it is crucial that social policies go beyond energy sector planning to optimize economic opportunities for women.

### ***Part-time work and job sharing***

A study conducted by a labor union organization in Spain revealed that in 2008, women accounted for just over 26 percent of the RE workforce (Arregui et al, 2010). This is slightly higher than the 24 percent average for Spain's broader industrial sector. Only 2 percent of jobs in RE in Spain are part time but women hold 67 percent of them. Generally speaking, RE companies do tend to hire a higher share of full-time workers, which should also contribute to above average wages for RE employees (ILO, 2011). The lower wage per hour in part-time employment in all sectors is often gendered even if it is also observed for men (Gornick and Jacobs, 1996) - i.e. part-time male workers may earn less than full-time male workers, but they tend to still be paid more than part-time female workers. Over the past two decades, the gender employment gap in Canada has declined by 9 percentage points and in 2011, 69 percent of women versus 75 percent of men of working-age (15-64 years) were employed. This is above the OECD average of 60 percent. Nevertheless, women in Canada are twice as likely to work part-time (27 percent) as compared to men (12 percent) (OECD, 2015). The gross overrepresentation of women in part-time employment and gender wage inequity in part-time work, not limited to the RE sector, is obviously a major concern, especially if most of these women would prefer to work full time. A study conducted over a decade ago indicated that in Spain, for example, women represent 81.4% of the total part-time labor market (National Employment Institute, 2004, quoted in Blazquez Cuesta and Ramos Martin, 2009); the numbers may be even higher in recent years. Large numbers of these women are involuntarily doing part-

time work (Angeloff, 2000).

Despite evidence of the generally negative implications for women of part-time work, it is important to ask whether part-time jobs always have to be “bad” jobs. Some recent research suggests that creating more part-time jobs and arrangements like work-sharing, provided that they have high wages, job security as well as health and pension benefits, may be a feasible way to restructure work in the future while creating both economic security and ecological sustainability in all sectors of the economy (Malleon, 2015). Since overproduction and overconsumption, particularly by the wealthy in all global settings, remains the biggest impediment to environmental sustainability, transitioning to clean energy sources, or to a green economy more broadly, is not going to be enough in and of itself to prevent climate change and address other environmental problems. Restructuring work in innovative ways while expanding social security nets may present some solutions for balancing economic needs and environmental concerns (Malleon, 2014; Nedelsky, 2014). The idea that in the future, we may all be able to work less, but live better, has also been explored by a number of authors (see, for example, Baruah, 2016a; Malleon, 2015).

The prospect of “good” part-time jobs, work-time reduction or flexi-time jobs may seem remote or even utopian in the current worldwide neoliberal economic climate of “austerity” and race-to-the-bottom “hyper-globalization” (Rodrik, 2011). However, there are suggestions that some countries may at least be experimenting with a range of promising possibilities despite the challenges of advancing a progressive labour agenda in the aftermath of the 2008 global financial crisis as well as the debt crisis many countries started experiencing in its aftermath. Work-time reduction for full-time jobs, for example, has not been very prevalent in North America, but it has been pursued with limited success in some European countries. Unions in France fought for and successfully won a 35-hour work week. Unions in the Netherlands have played a pivotal role in creating quality part-time jobs. And unlike in North America, these part-time jobs have roughly the same hourly pay as full-time work and similar benefits and security. The average American works about 1,900 hours per year, while the average Dutch person works about 1,350 hours per year - about 30 percent less (see Malleon, 2014 for promising practices in Europe).

While I agree with the potential of part-time work and job-sharing to promote economic security and environmental sustainability, I am ambivalent about the assertion made by Nedelsky (2014) that moving towards “part-time jobs for all” will lead to a more equitable division of household labor between women and men. This assumption is based on the fact that women do a disproportionate amount of household and caregiving work everywhere in the world while also working outside the home almost as much as men who have not reciprocated in a commensurate way in sharing caregiving work. The idea that larger



numbers of men will spend more time on caregiving if they have to work less and/or have access to flexible working schedules is hopeful but has not been supported with much empirical evidence. Countries with more equitable gender norms do tend to have a better-established tradition of flex-time policies so perhaps there is reason for optimism. In the US, for example, only 27 percent of firms offer more than 50 percent of their employees flex time. By contrast, 68 percent of Swedish workplaces offer flex time to 80 percent of employees (Malleon, 2015). Even if such policies were in place in more countries, we would be left with the more significant challenge of changing the perception of caregiving from being a burden to being considered as a deeply satisfying and important aspect of human existence. Governments can certainly play a role in enabling such a shift by instituting guaranteed annual income and “living wage” regulations; by changing labor laws, perhaps including maximum hours and minimum wage regulations; and by ensuring that part-time work is good work, with prohibitions against lower pay and fewer benefits. However, the deeper political and social consciousness required for a transformation of the intra-household gender division of labor would have to be enabled informally and socially, perhaps through collective action, but not through legal sanctions or other government actions. Policy by itself cannot make men want to spend more time caregiving if care-work continues to be perceived as low-status feminized work. Neither can policy require women to give up their control over care, particularly over the raising of children, if they have been socialized to believe that children are their primary responsibility. Until more transformative social change takes place in gender relations, flexible working schedules may just reinforce existing gender imbalances in employment and care. Nedelsky (2014) acknowledges this even as she promotes the possibility of part-time work for everyone.

Will workers unions remain relevant if part-time jobs become more of a norm, or will new modes for organizing, mobilizing and collective bargaining emerge in the future? These are also important questions to ask. Unions are generally much stronger in European (especially Scandinavian) countries and even in Canada and the UK than they are in the US (OECD Stats Database, 2013). Regardless of what form representative organizations may take in the future, promoting gender equity must feature as a core principle. Countries that have the highest union densities (Denmark, Netherlands, Sweden, Norway, France) have strong feminist movements and feminist contingents within the big unions. These movements have managed to rearticulate what contemporary unions should be, and brought back to prominence some of the union movement’s original causes, as well as broader societal questions about the importance of delinking social entitlements from employment status (Malleon, 2014). Other OECD countries and emerging economies that do not have strong feminist contingents within unions might benefit from such organizing and strategizing. The level of unionization in new “green” jobs tends to be

low to begin with in most countries. Whether new or reconfigured modes for organizing, mobilizing and collective bargaining will emerge in the future remains a matter of conjecture.

### ***Travel and mobility***

Much like jobs in the conventional fossil fuel industry, employment in the RE sector can require significant travel and time away from home. This can be challenging for men too but women with caregiving responsibilities, especially for young children, may be put at a particular disadvantage. The locations of large RE construction projects tend to be determined in part by the geography of natural resources and are often in isolated areas, with no provisions for the families of workers (IRENA, 2013). Such limitations may at least partially explain women's severe underrepresentation in the traditional oil and gas sector (see, Miller, 2004, for ethnographic accounts of Canadian women engineers and geologists in Calgary-based petroleum companies) as well as in emerging non-conventional sources such as tar sands, shale and tight gas (see, Wood, 2013, for what life is like for a certified electrician who is one of three women among 500 male employees working on a tar sands site two hours away from Fort McMurray in Alberta, Canada). Although such factors may explain women's underrepresentation in energy sector employment to some extent, many women may already work in less-than-optimal environments for much less pay than they would make in the energy industry and, given the option, would probably prefer work in the energy sector for higher wages. Available research indicates that RE firms do pay considerably more than their non-RE sector peers but also that women on average still earn less than men in the RE sector (see, Antoni et al., 2015 for findings from Germany). The relatively low share of women in RE companies (17-24 percent) in OECD countries might actually be another reason for higher wages in this field compared to non-RE companies (ibid.). Because of persistent entrenched male-biased hiring norms and workplace cultures in the traditional oil and gas and RE sectors, women may not be given the option to choose between difficult or dangerous working conditions with low pay and similar conditions with higher pay (McKee, 2014; Carpenter et al., 2015).

### ***Employment generation and skills shortages***

Reports from around the world warn of a looming skill gap as industrialized and emerging economies retool their existing industries and seek out new opportunities. In virtually all areas of energy development, there are skills shortages and calls for additional training. These shortages cover a wide range of different occupations, from engineers and architects to skilled trades, equipment operators, technicians and even construction laborers. Skills shortages also vary, regionally and by energy sector (Calvert and Cohen,

2011). Most of the shortages are for jobs in conventional energy production. However, the renewable sector is also experiencing significant shortages of qualified personnel (Robitaille and Etcheverry, 2005; SQWenergy, 2008). Although the skill shortages present challenges for labor supply, they also represent an opportunity to train and recruit women, visible minorities, Aboriginal peoples, new immigrants and other groups that have historically been marginalized in the energy sector in Canada (Katz, 2012).

A report from FCM entitled *Act Locally* documents the impressive contributions that municipalities are making to cut greenhouse gas emissions in Canada (EnviroEconomics, 2009). The report emphasizes that municipalities have direct or indirect control over 45 percent of greenhouse gas emissions in Canada. Another FCM report notes that investments in the green economy will create both direct and indirect employment (Thompson and Joseph, 2011). Green economy sectors provide high levels of employment and gross domestic product (GDP) impact per dollar invested - from 10 to 20 person-years employment per million dollars invested. The oil and gas extraction sector, by comparison, receives significant subsidies in the name of job creation, but creates relatively few jobs per dollar invested - a third to a sixth of that produced by green economy sectors. Clean Energy Canada's 2015 report on green job creation found that the growth rate of jobs in the clean energy sector in 2013 outpaced job growth in all other sectors. According to the report, 26,900 direct jobs were produced by the clean energy sector in 2013, compared to 22,340 jobs in the oilsands. The FCM report goes on to identify key priority areas for municipalities, namely, sustainable transportation, energy efficiency of buildings, renewable electricity and conservation, wastewater treatment and water conservation, efficient urban land use and solid waste management. Additionally, it highlights the need for greater partnership between municipalities and the federal government, and the urgent need for the federal government to put in place the policy framework that will multiply the benefits of municipal action and position Canada for a low-carbon future.

Although the FCM report on Canada's green economy repeatedly highlights the potential for employment creation, there is no mention whatsoever of the importance of engaging proactively with gender equality or employment equity. This became a familiar picture over the course of this research: employment-related reports on the green economy in Canada do not mention gender equity issues at all (See, for example, CCPA, 2015; BlueGreen Canada, 2013). Another case in point is a report published by the Canadian Centre for Policy Alternatives in 2015, which calls for federal and provincial government action to ensure that those currently employed in coal, oil and natural gas industries in British Columbia do not lose well-paying jobs in the transition to a zero carbon economy. Lacking a gender equality or equity-based analysis, however, the report fails to recognize how targeted efforts to train people in the coal, oil and gas sectors,

the majority of who are male, for green jobs would also likely reproduce existing gender inequities in the fossil fuel industry within the RE sector. Other well-intentioned progressive initiatives that do not adopt a gender-sensitive approach, for instance, those that target chronically unemployed youth or Aboriginal people for green job training (see, for example, Katz, 2012), may also run the risk of excluding women from employment opportunities within the RE sector.

A recently published report by Clean Energy Canada (2015) provides an overview of existing provincial government policies and investments aimed at supporting the growth of clean energy production in Canada. While some of these initiatives have the potential to create significant employment opportunities, none of them include a commitment to equity as a goal of job creation.

The conversation about gender equity or social justice (more broadly) in Canada's green economy is at best incipient and tokenistic. Reports that do highlight opportunities to employ underrepresented groups, including women, in the RE sector stop short of calling for the kinds of policy approaches and concrete action required to ensure equity (see, for example, CCPA, 2010; BlueGreen Canada, 2012). Other researchers seem to concur (see, for example, Calvert and Cohen, 2011; McFarland, 2013). While strongly supporting the importance of job creation in the RE sector in Canada, these researchers unanimously agree and emphasize that if equity programs are not carefully planned, implemented and monitored, almost none of the more skilled and better-paid technical jobs would go to women. McFarland (2013), for example, estimates that in technical jobs in RE in the provinces of New Brunswick and Newfoundland, men outnumber women seven to two.

In a recently published follow-up to this study, McFarland (2015) uses 2011 census data to examine the current gender make-up of jobs that will likely be generated in the RE sector in New Brunswick. She found that women accounted for a very small percentage of those currently employed in "representative jobs" in building retrofitting, wind, solar and advanced biofuel production, mass transit freight rail expansion, and smart grid. In representative jobs in building retrofitting, for example, women comprised only 3.9 percent of managers, 2 percent of carpenters, 1.3 percent of electricians and 0 percent heating/air conditioning installers, roofers and building inspectors. According to McFarland, female representation in some of these occupations had actually worsened since her analysis of previous census data from 2006.

As McFarland's findings suggest, most future green job creation in Canada will be in occupations in which women are currently underrepresented, such as engineering and the skilled trades. A Statistics Canada study found that in 2007 women only accounted for 1-2 percent of completions in apprenticeship training

in major trade groups (McMullen et al, 2010). Another report published by Statistics Canada shows that in 2011, women comprised just 23 percent of engineering graduates aged 25 to 34 (Hango, 2013). Since workers are likely to transition from jobs in the “brown” economy (which is heavily male dominated) to the “green,” it is a self-fulfilling prophecy that women will also be underrepresented in green jobs unless gender equity in employment is planned and implemented proactively. Recent media reports confirm this trend, indicating that laid-off oil and gas workers in Alberta are beginning to find employment in the RE sector (Bickis, 2016).

Emerging research in the U.S. that evaluates initiatives specifically aimed at training women for entry-level positions in the green economy report low levels of success in ensuring women’s long-term employment in the occupations for which they were trained (Cohen, 2015). Comparable assessments of gender sensitive green job initiatives in the Canadian context have not been conducted - presumably due to the absence, to begin with, of gender-equity based initiatives in the RE sector. However, McFarland (2013) reports that past attempts in New Brunswick to train women on social assistance in the skilled trades showed limited success in securing the long-term employment of women in their respective trades. These findings confirm the need not only for proactive equity policy, but also for policies that support work/life balance, such as affordable, universal child care and flexible working arrangements, as well as broader changes to workplace culture in traditionally male-dominated fields.

Skill shortages, particularly for engineering and technical occupations, have been reported in the RE sector in all OECD countries (IRENA, 2013). Women’s underrepresentation in RE is often an outcome of the low percentages of women who graduate as engineers in industrialized countries. For example, in Germany it was estimated in 2011 that out of 1 million engineers, only 13 percent were women (Blau, 2011). Out of 384,000 engineering students, only 79,000 (21 percent) were women. Low as they are, these numbers for Germany are actually 10 percent higher than they were in 2001 (ibid.). These numbers are consistent with trends in STEM fields in other EU countries (Association of German Engineers, VDI 2009). Data from the US, on the other hand, indicates a reverse trend. The National Science Foundation (NSF) reports that between 2003 and 2008, the total number of four-year engineering degrees awarded annually increased by about 10,000 to 69,895 with almost all the increases going to male graduates. This effectively reduced the percentage of women receiving undergraduate engineering degrees in the US from 20.5 percent to 18.5 percent (Mahmud, 2012).

The number of women getting into engineering in Canada has also been on the decline, despite decades of efforts to encourage more girls to think of technical careers. Even though women currently make up

more than half of the undergraduate populations across Canada, the number of women enrolled in engineering programs dropped from a high of 21 per cent in 2001 to 17 per cent in 2009 (Myers, 2010). The numbers of licensed engineers in Canada who are women has grown from 7 percent in 2000, but the figure still sits at only 10 percent (ibid.). Women comprised 47 percent of the Canadian workforce in the 2006 census. The participation rate of women in the engineering field averaged 13 percent (Calnan and Valiquette, 2010). Meanwhile, employment growth in engineering and technology occupations overall surged by 45 percent between 1997 and 2008, according to Census data, compared to a growth rate of 24 percent for all other occupations. Despite the fact that there has been a dramatic increase in the number of new jobs in engineering and technology, the vast majority are still taken by men (ibid).

In the past few years, universities, technical schools and community colleges in Europe and North America have tried to integrate RE topics into their course offerings, and many have developed specialized RE courses and programs (see, for example, Wissenschaftsladen Bonn, 2012). An increasing number of companies have also begun partnering with higher education institutions and vocational colleges to develop tailor-made education and practical training for junior and specialized professionals (for examples in Canada, see Katz, 2012). The US Department of Labor's Think Women in Green Jobs initiative is a promising example of a program offering training on renewables specifically to women (Women's Bureau, 2010). However, very few other initiatives have any stated commitment to, or goals for, gender equity.

Unlike North America and Europe, where women remain a minority in engineering programs, comparatively large numbers of middle-class women in some emerging economies - India and China, for example - study engineering (Paris Tech Review, 2010). Although women may continue to experience glass ceilings and employment discrimination in various forms in such countries, recruitment, especially for entry-level positions is not a challenge because of the large numbers of women earning engineering degrees. In China, 40 percent of engineers are women (ibid). From less than 1 percent in the 1970s, enrolment of women in engineering degrees in India had grown to 15 percent in the early 2000s (Parikh and Sukhatme, 2004). The most popular specializations for Indian women also bode well for employment in RE. Thirty seven percent of electronics engineers in India are women. The figures for civil engineering, computer engineering, electrical engineering and mechanical engineering in the early 2000s were reported as 19.7 percent, 17.8 percent, 16.1 percent and 9.3 percent respectively (ibid).

In the 1980s, 58 percent of engineers in the USSR were women but a well-established tradition of state-enforced gender diversity disintegrated in the 1990s and 2000s with the collapse of the USSR and its

industrial model. In 1998, women accounted for 43.3 percent of engineers in Russia; in 2002, only 40.9 percent (Paris Tech Review, 2010). And the numbers have continued to decline further. The Baltic nations (Estonia, Latvia, Lithuania) that were formerly part of the USSR, but joined the EU in the 1990s, revealed similar patterns of comparably high but declining rates of participation by women in engineering and technology fields. The World Economic Forum (WEF) reports that in Estonia, for example, female professional and technical workers still outnumber men two to one – 68 percent compared to 32 percent (Anderssen, 2013). Estonia offers significant tuition incentives to draw high-school graduates into fields such as engineering and continues to be identified by the WEF as the country with the highest per-capita number of female engineers even as the numbers of women joining the field have declined over the decades (ibid.). Although I am not advocating a return to Soviet-style central planning, it is important to emphasize that state initiatives aimed at improving representation and removing barriers for career advancement for women in engineering and policy making do work, and they can benefit the RE sector in both OECD countries and emerging economies. I discuss the potential and need for state intervention in more detail in the next section.

### ***Public sector involvement***

Generally speaking, both the fossil-fuel based and RE workforce globally represents a vertically and horizontally gender-stratified labor market, with women concentrated in the lowest-paid positions, closest to the most menial and tedious components and furthest from the creative design of technology and the authority of management or policymaking (Baruah, 2015). However, there are qualitative differences in women's employment in renewables in different contexts that needs to be fleshed out further. Much of the expansion of renewables in developing countries and emerging economies has occurred because large numbers of rural, urban poor and remote communities either have no access to the grid, or they have unreliable or inadequate access to electricity for lighting, heating and cooling purposes. A large volume of employment has been generated for both men and women in these contexts because organizations serving such communities (see, for example, the initiatives of Solar Sister in various African countries, the Barefoot College in India, Char Montaz in Bangladesh, Arthur, 2010) have actively sought to use RE technologies to also secure and improve livelihoods. Such off-grid, mini-grid and stand-alone decentralized RE initiatives have offered women a larger volume of employment (albeit often poorly compensated and insecure) as well as limited opportunities to participate in decision making. This is because these initiatives are deployed at the local level where women are more likely to be involved in the procurement, design, installation, operation, maintenance and consumption of energy (Smith, 2000).

Decision making within bigger energy utility systems in both the Global North and South are, on the other hand, carried out by higher-level professional staff within the spheres of generation, transmission and distribution where women are more likely to be underrepresented (ibid.). That said, it is important to be cognizant that men may participate more actively and in far larger numbers than women even in more localized community RE projects. Citizen participation schemes in renewable electricity production supported by the German government are a good example (Fraune, 2015). It would be overoptimistic to assume that women will not be marginalized in community RE projects. Social factors such as gender, wealth gap and occupational segregation influence individual agency to participate even in RE projects operated by citizens' associations (ibid). Therefore, the need for proactive policy engagement to ensure gender equity is crucial at all levels of RE deployment. Additionally, research on community energy projects should engage with the broader social, cultural and political contexts such projects operate in since these shape individuals' agency and capabilities to participate.

The importance of public sector involvement in creating a policy framework to enable the sustainable development and dissemination of renewables as well as to ensure employment equity has been made in OECD countries as well as in developing countries and emerging economies (Calvert and Cohen, 2011; ENERGIA, 2006). Power generation from renewable sources is growing twice as fast in non-OECD countries and continents, led by China, India, Latin America and Africa (Hostettler, 2015). The 10 countries with the largest RE employment in 2014 were China, Brazil, the United States, India, Germany, Indonesia, Japan, France, Bangladesh and Colombia (IRENA, 2015). These countries have become major manufacturers of RE equipment, producers of bioenergy feedstock and installers of production capacity. An array of industrial and trade policies continue to shape employment, with stable and predictable government interventions favoring job creation. Although governments in these countries may not be directly involved in developing and disseminating renewables, they have put incentives and subsidy structures in place that direct private investment to areas that would otherwise not be prioritized. Several countries have introduced programs and policies to promote employment equity in the RE sector. Brazil, for example, has become a world leader in RE (IEA, 2013) and also succeeded in enabling women's substantial participation in science, technology and engineering fields through progressive social policies that include state-funded tuition and scholarship awards at the undergraduate and graduate level (Huyer and Hafkin, 2013). India adopted a Companies Bill in 2012, which requires corporations to spend at least 2 percent of their net profit on Corporate Social Responsibility (CSR) activities. Revenues from CSR are being used to, among other initiatives, enable women's entrepreneurship in solar and bioenergy (Baruah, 2015). OECD countries, including Canada, might be well-advised to try to look closely and implement



some programs and policies that are already in place in emerging economies like Brazil and India.

Equity and access policies adopted to promote gender equality are often linear and positivist in both industrialized countries and emerging economies (Baruah, 2015). They do not seek any special privileges for women and simply demand that everyone receive consideration without discrimination on the basis of sex. They are inadequate because they fail to address the wide range of social and institutional factors that prevent women from succeeding, and also because they do not demand preferential pro-women hiring practices to correct historical and current injustices and inequalities. However, I would argue that even such simplistic liberal policies can improve women's access to opportunities in sectors like energy that are almost completely male-dominated. Other researchers (see, for example, Clancy and Roehr, 2003) agree that even straightforward liberal employment equity policies would serve as a good starting point to improve women's access to employment in the energy sector in North America and Europe.

More comprehensive and finely-tuned policies that take structural constraints into consideration will optimize women's performance and advancement in RE sector. Government spending through stimulus packages and public procurement can also address gender inequality (Stevens, 2009). Contractors for public agencies should be required to adopt affirmative action goals to correct the underrepresentation of women in their workforce. Green stimulus spending should come with conditional requirements for the recruitment and retention of women. Although countries like Canada, US, Australia, France and UK earmarked significant stimulus funding in the aftermath of the 2008 financial crisis for green initiatives, very little, if any, funds were allocated for integration of women into green occupations (Cohen, 2015). The US did allocate minor funds - out of the \$27 billion in total allocated for energy efficiency and RE research and investments - for training women for green occupations in its American Recovery and Investment Act of 2009. Even this minor injection of funds resulted in several short-term pilot initiatives to demonstrate the potential for women in high-growth green occupations (see Cohen, 2015 for examples). Despite the constant lip-service paid to the importance of green jobs in industrialized economies, even boutique initiatives of the kind enabled by stimulus funding in the US are hard to find in many OECD countries.

### **Selected Examples of Promising Initiatives in Canada**

There are promising examples of typically non-profit initiatives that advocate for gender equality in the energy sector in Canada. Launched in October 2013, WiRE, for example, is dedicated to advancing the role and recognition of women in the RE sector through networking and mentoring activities. WiRE forges

partnerships with a spectrum of RE industry associations and other related networking groups for professional women from across the energy sector. Although initially started in Ontario, WiRE hopes to eventually have chapters all over Canada. Similarly, Women in Electricity is a networking group for women who work in Ontario's electricity sector. It has more than 400 members from over 80 companies spanning many roles in the industry - generation, transmission, distribution, regulation, policy, system operation, law, technology and recruitment. There are examples of similar organizations in other provinces in Canada (notably BC and Alberta). These organizations certainly play an important role in creating awareness about the need for gender equity in the traditional and clean energy sectors. Their ability to influence and inform gender equity policy at the provincial and federal level is still rather limited, largely because the issue of gender inequity in energy employment has not been on the radar of the provincial or federal governments. Given the recent election of a Liberal federal government in Canada, this may change in the future. These organizations have until now justifiably prioritized professional development, networking and advocacy activities. Especially with access to more staff, financial resources and collaborations with academic and government researchers, in the future these organizations may be well placed to take on a research and policy role. Collecting and disseminating employment-related data about its membership in a consistent manner (through surveys and focus groups, for example) would certainly also enable these organizations to play a strategic role in informing and influencing policy.

The government of Manitoba has played an important role in supporting RE social enterprises with an explicit focus on employment equity and social justice. Through Manitoba Hydro and Manitoba Housing, the provincial government of Manitoba has supported three social enterprises that are committed to training and hiring individuals who experience multiple barriers to employment, particularly Aboriginal men, in jobs in building retrofitting and RE installations. One of these non-profit enterprises is Aki Energy, which has been working with publicly owned Manitoba Hydro to lower energy costs in First Nations communities through the expansion of geothermal, solar, and bioenergy while also training and employing local people. According to a report published by the Canadian Centre for Policy Alternatives (2015), “In its first year Aki Energy trained 30 First Nation geothermal installers who installed 110 residential geothermal systems in two First Nation communities – Peguis First Nation and Fisher River Cree Nation”. With plans to expand the program to other First Nation communities, Aki Energy is committed to working with local construction companies “to train tradespeople to install and maintain the systems independently. Where First Nations do not have local construction capacity, Aki Energy will train and directly employ local tradespeople to install the systems” (Fernandez, 2015; 5-6).

Two other social enterprises that have received support from the government of Manitoba are the Brandon Energy Efficiency Program (BEEP) and Building Urban Industry for Local Development (BUILD). BEEP holds contracts with Manitoba Hydro and Manitoba Housing, to install energy efficient windows and doors, and has completed energy and water efficiency upgrades in over 600 Manitoba Housing units, installing low-flush toilets, showerheads and aerators, insulating attics and basements, and installing electrical gaskets. To date BEEP has provided training and apprenticeships in skilled trades to 129 people, the majority of whom are Aboriginal men on unemployment insurance.

BUILD also holds contracts with Manitoba Hydro and Manitoba Housing and provides 6-month training programs to approximately 50 individuals every year. Trainees are mainly Aboriginal men, as well as some new immigrants and women, most of whom “are undereducated, lack stable housing, and most have had contact (some extensive) with the criminal justice system” (Fernandez, 2015: 7-8). The success of these partnerships demonstrates that governments can use fiscal policies to influence social equity even without getting directly involved in providing employment or training. It is important to acknowledge, however, that anecdotal evidence suggests those who receive training through BUILD and BEEP experience difficulties competing for jobs in the private sector; thus indicating the limitations of social enterprise to address issues of equity (ibid.). It is also important to emphasize that such initiatives remain rare in Canada and the possibilities for replication in other provinces are unclear.

## **FURTHER RESEARCH**

## Number of jobs created for every \$1 million invested

### OIL & GAS



### CLEAN ENERGY (wind, solar, hydro and biomass)



**Where do you want Canada to invest?**

\*Blue Green Canada. (2012, November 22).

*More Bang For Our Buck: How Canada can create more jobs and less pollution.*

As mentioned in a previous section, RE initiatives in Canada have mostly been taken up by the private sector, municipalities and provinces. The federal government has, at least until very recently, not played an active role in framing and implementing an effective policy framework to enable the transition to renewables. Despite awareness about the potential for renewables to generate a larger volume of employment than fossil fuels (see, for example, Blue Green Canada advertisement), even organizations committed to advocating for employment equity and social justice in debates about environmental sustainability in Canada have never specifically mentioned gender equity. The conversation about gender equity or social justice (more broadly) in Canada's green economy is at best incipient and tokenistic. Raising awareness about these issues is therefore urgent and critical.

Since jobs in RE tend to be dispersed across different sectors of employment (such as construction, manufacturing, installations, fuel processing, operations and maintenance), collecting specific employment data on RE and energy conservation would be particularly valuable. Sex-disaggregated data on employment in renewables is spotty everywhere in the world. This makes analyzing trends and making comparisons challenging. Although the employment effects of RE investment, in particular, are

increasingly gaining prominence in the debate on renewables in Canada, specific analytical work and empirical evidence on this important subject remain extremely limited. Further research aimed at documenting the gender gap in energy employment as well as informing strategies for promoting employment equity would be valuable. Having access to sex-disaggregated employment data on specific renewable sources such as wind, run-of-river hydro, solar, biomass and geothermal would enable us to better understand trends as well as to propose policies and interventions for promoting employment equity. Without data and empirical evidence, there is no visibility. And without visibility, there is no policy priority. An assessment of data availability on RE employment in different industrialized countries suggests that Canada lags behind its OECD counterparts not just in framing and implementing policies for gender equity in RE employment but also in data collection and analysis. It is crucial that we conduct more policy-relevant empirical research on this topic in a consistent and sustained manner.

## **CONCLUSION**

There are similarities and differences between industrialized, emerging and developing economies in the patterns of women's employment in the RE sector. A much larger volume of employment has been generated for women in developing and emerging economies through off-grid, mini-grid and stand-alone decentralized RE initiatives that also address energy poverty in remote or underserved communities. There is tremendous additional potential to create livelihoods for women in the RE sector. However, women can gain optimal traction from RE initiatives only within the context of wider socially progressive pro-women policies and more transformative shifts in societal attitudes about gender roles. This is as true for developing countries and emerging economies as it is for industrialized nations.

The growth of the RE sector should benefit both women and men but we must be proactive about enabling women to establish a stronger equity stake to compensate for historical and contemporary economic injustices and unequal outcomes. This will require more concrete and proactive actions and policies. Simply creating opportunities for training and employment in new fields and suggesting that women are not unwelcome in them is obviously not enough.

## BIBLIOGRAPHY

Adeyemi, A.Y. (2006) Empirical evidence of women's under-representation in the construction industry in Nigeria. *Women in Management Review* 21(7): 567-77.

Adubra, A.L. (2005) *Non-traditional occupations, empowerment and women: A case of Togolese women*. New York: Routledge.

Anderssen, E. (2013) Gender geography: Where's the best place in the world to be a woman. *The Globe and Mail*, March 8. <http://www.theglobeandmail.com/news/national/gender-geography-wheres-the-best-place-in-the-world-to-be-a-woman/article9488293/>

Angeloff, T. (2000). *Le temps partiel: un marché de dupes?* Paris: Syros.

Antoni, M., Janser, M., & Lehmer, F. (2015). The Hidden Winners of Renewable Energy Promotion: Insights into Sector-Specific Wage Differentials. *Energy Policy* 86: 595-613.

Arregui, G., Candela, J., Estrada, B., Medialdea, B. & Pérez, S. (2010) *Study on employment associated to the promotion of renewable energies in Spain*. ISTAS. [www.istas.net/web/abreenlace.asp?idenlace=8769](http://www.istas.net/web/abreenlace.asp?idenlace=8769)

Arthur, C. (2010) Women solar entrepreneurs transform Bangladesh. Policy Innovations, 16 August. <http://www.renewableenergyworld.com/articles/2010/04/women-solar-entrepreneurs-transforming-bangladesh.html>

Baruah, B. (2010) Gender and Globalization: Opportunities and Constraints Faced by Women in the Construction Industry in India. *Labor Studies Journal* 35(2): 198-221.

\_\_\_\_\_. (2015) Creating Opportunities for Women in the Renewable Energy Sector: Findings from India. *Feminist Economics* 21(2): 53-76.

\_\_\_\_\_. (2016). There's a Gender Gap In The Global Renewable Energy Workforce. *Huffington Post*. [http://www.huffingtonpost.ca/development-unplugged/renewable-inequityglobal\\_b\\_9402854.html](http://www.huffingtonpost.ca/development-unplugged/renewable-inequityglobal_b_9402854.html)

\_\_\_\_\_. (2016a). Reconciling Economic Security, Environmental Protection and Social Justice. *Huffington Post*. [http://www.huffingtonpost.ca/development-unplugged/reconciling-economic-security\\_b\\_9583020.html](http://www.huffingtonpost.ca/development-unplugged/reconciling-economic-security_b_9583020.html)

Blau, J. (2011) Germany Faces a Shortage of Engineers. *IEEE Spectrum*. <http://spectrum.ieee.org/work/tech-careers/germanyfaces-a-shortage-of-engineers>

Bickis, I. (2016) Renewable Energy, Other Industries Draw laid-off Oil and Gas Workers. HuffPost Alberta. [http://www.huffingtonpost.ca/2016/01/27/oil-and-gas-career-change\\_n\\_9089360.html](http://www.huffingtonpost.ca/2016/01/27/oil-and-gas-career-change_n_9089360.html)

Blázquez Cuesta, M. & Ramos Martin, N.E. (2009) Part-time employment: a comparative analysis of Spain and the Netherlands. *European Journal of Law and Economics* 28: 223-56.

BlueGreen Canada. (2012) Building Ontario's green economy: A road map. <http://environmentaldefence.ca/report/report-building-ontarios-green-economy-road-map/>

BlueGreen Canada. (2013) More jobs, less pollution: Why energy conservation is common sense for Ontario. [http://www.bluegreencanada.ca/sites/default/files/resources/BLUEgreen\\_engRPT-FINAL-web.pdf](http://www.bluegreencanada.ca/sites/default/files/resources/BLUEgreen_engRPT-FINAL-web.pdf)

Calvert, J & Cohen, M. (2011) *Climate Change and the Canadian Energy Sector: Implications for Labour and Trade Unions*. Ottawa: Canadian Centre for Policy Alternatives.

Calnan, J. & Valiquette, L. (2010) *Paying Heed to the Canaries in the Coal Mine: Strategies to attract and retain more women in the engineering profession through Green Light Leadership*. Ottawa: Engineers Canada.

Carpenter, J.P., Matthews, P.H. & Robbett, A. (2015) Compensating Differentials in Experimental Labor Markets. IZA Discussion Papers, 8820. Bonn, Institute for the Study of Labor (IZA).

Cheadle, Bruce. (2014) Clean Energy Jobs Now Exceed Oilsands Jobs In Canada. *Huffington Post*. February 2.

Clancy, J & Roehr, U. (2003) Gender and Energy: is there a Northern perspective? *Energy for Sustainable Development* 7(3): 44-49.

Clean Energy Canada. (2015) Tracking the energy revolution. <http://cleanenergycanada.org/wp-content/uploads/2014/09/Tracking-The-Energy-Revolution-Global-2014.pdf>

Cohen, M. (2015) Gender in Government Actions on Climate Change and Work. *Women & Environments International* 94/95: 11-16.

Cooling, K., Lee, M., Daub, S. & Singer, J. (2015) Just Transition: creating a green social contract for BC's resource workers. British Columbia: Canadian Centre for Policy Alternatives.

ENERGIA. (2006). Incorporating Women's Concerns into Energy Policies. ENERGIA, Leusden, the Netherlands. [http://www.energia.org/fileadmin/files/media/factsheets/factsheet\\_policies.pdf](http://www.energia.org/fileadmin/files/media/factsheets/factsheet_policies.pdf).

EnviroEconomics. (2009). Act Locally: The Municipal Role in Fighting Climate Change. Ottawa: Federation of Canadian Municipalities.

Eisenberg, S. (1998) *We'll call you if we need you: Experiences of women working construction*. Ithaca, NY: ILR Press.

Fernandez, L. (2015) *How Government Support for Social Enterprise Can Reduce Poverty and Green House Gases*. Manitoba: Canadian Centre for Policy Alternatives.

Fernández-Baldor, Á., Boni, A., Lillo, P. & Hueso, A. (2014) Are technological projects reducing social inequalities and improving people's well-being? A capability approach analysis of renewable energy-based electrification projects in Cajamarca, Peru. *Journal of Human Development and Capabilities* 15(1): 13-27.

Fraune, C. (2015) Gender matters: Women, renewable energy, and citizen participation in Germany. *Energy Research & Social Science* 7: 55-65.

Gornick, J.C. and Jacobs, J.A. (1996) A cross-national analysis of the wages of part-time workers: evidence from the United States, the United Kingdom, Canada and Australia. *Work Employment and Society* 10 (1): 1-27.

Greed, C. (2000) Women in the construction professions: Achieving critical mass. *Gender, Work and Organization* 7(3): 181-96.

Hango, D. (2013) Gender differences in science, technology, engineering, mathematics, and computer science programs at university. Ottawa: Statistics Canada.

Heck, D. J. & D.D. Minner. 2009. *Codebook for standards of evidence for empirical research*. Chapel Hill, NC: Horizon Research, Inc.



Hostettler, S. 2015. Energy Challenges in the Global South. In Hostettler, S., Gadgil, A. & E. Hazboun (eds.). *Sustainable Access to Energy in the Global South: Essential Technologies and Implementation Approaches*. New York: Springer.

Huyer, S. & Hafkin, N. (2013) Brazilian women lead in science, technology and innovation, study shows. *Elsevier Connect*. <http://www.elsevier.com/connect/brazilian-women-lead-in-science-technology-and-innovation-study-shows>

International Energy Agency (2013) *World Energy Outlook 2013*. Paris: OECD/IEA Publications.

ILO. (2011) *Skills and Occupational Needs in Renewable Energy 2011*. Geneva: International Labour Office.

IRENA. (2013) *Renewable Energy and Jobs*. Abu Dhabi: International Renewable Energy Agency.

\_\_\_\_\_. (2015) *Renewable Energy and Jobs: Annual Review*. Abu Dhabi: International Renewable Energy Agency.

Katz, J. (2012) *Emerging Green Jobs in Canada: Insights for Employment Counsellors into the Changing Labour Market and its Potential for Entry-Level Employment*. Toronto: Green Skills Network.

Lehr, U. (2008) Renewable energy and employment in Germany. *Energy Policy* 36(1): 108-117.

Lee, M. & Carlaw, K.I. (2010) Climate justice, green jobs and sustainable production in BC. British Columbia: Canadian Centre for Policy Alternatives.

Little, M. (2005) *If I had a hammer: Retraining that really works*. Vancouver: University of British Columbia Press.

Mahmud, A. (2012) Graduate Studies Spur Success in Engineering. *ASME*. <https://www.asme.org/career-education/articles/graduate-students/graduate-studies-spur-success-in-engineering>.

Malleson, T. (2014) *After Occupy: Economic Democracy for the 21st Century*. New York and London: Oxford University Press.

\_\_\_\_\_. (2015) Interview: How Shorter Work Hours Can Help the Climate and Women's Equality. *LaborNotes*, March 8. <http://labornotes.org/2015/03/interview-how-shorter-work-hours-can-help>

climate-womens-equality

McFarland, J. (2013) The Gender Impact of Green Job Creation. Presentation at *Work In a Warming World International Conference*, Toronto, November 29-December 1.

\_\_\_\_\_. (2015) Are there jobs for women in green job creation? *Women and Environments International Magazine* 94/95, 22-25.

McKee, L. (2014) Women in American Energy: De-feminizing Poverty in the Oil and Gas Industries. *Journal of International Women's Studies* 15(1): 167-178.

McMullen, K., J. Gilmore & C. Le Petit. 2010. *Women in Non-traditional Occupations and Fields of Study*. Ottawa: Statistics Canada.

Miller, G. (2004) Frontier masculinity in the oil industry: the experiences of women engineers. *Gender, Work and Organization* 11(1): 47-73.

Myers, J. (2010) Why more women aren't becoming engineers. *Globe and Mail*, November 29  
<http://www.theglobeandmail.com/report-on-business/careers/career-advice/why-more-women-arent-becoming-engineers/article1216432/>

Nedelsky, J. (2014) Part-time for All: Creating New Norms of Work and Care. *Natural Law Colloquium Fall 2014 Lecture*. New York: Fordham University.

OECD Stats (2013) Trade Union Density. [https://stats.oecd.org/Index.aspx?DataSetCode=UN\\_DEN](https://stats.oecd.org/Index.aspx?DataSetCode=UN_DEN)

OECD (2015) *Education at a glance*. Paris: The Organisation for Economic Co-operation and Development.

Parikh, P. & Sukhatme, S. (2004) Women Engineers in India. *Economic and Political Weekly* 39(2): 193-201.

Paap, K. (2006) *Why White working-class men put themselves—and the labor movement—in harm's way*. Ithaca, NY: Cornell University Press.

Paris Tech Review. (2010) Why aren't there more women engineers?  
<http://www.paristechreview.com/2010/09/29/why-more-women-engineers/>

Pearl-Martinez, R. (2015) *All Hands On Deck: Who's Missing in the Clean Energy Workforce*. Tufts University, Massachusetts: Renewable Equity Project.

Riach, P. A. & Rich, J. (2006) An Experimental Investigation of Sexual Discrimination in Hiring in the English Labor Market." *B.E. Journal of Economic Analysis & Policy* 6(2): 1-20.

Robitaille, L. & Etcheverry, J. (2005). Training, Education, and Public Awareness: key components for developing a strong and vibrant Canadian solar industry. The Solar and Sustainable Energy Society of Canada.

Rodrik, D. (2011) *The Globalization Paradox*. Oxford, UK: Oxford University Press.

Semeniuk, I. and S. McCarthy. May 18, 2015. Complete shift to renewable energy within Canada's reach, academics say. *Globe and Mail*. <http://www.theglobeandmail.com/news/politics/complete-shift-to-renewable-energy-within-canadas-reach-academics-say/article23513579/>

Smith, J. (2000) Solar-based rural electrification and microenterprise development in Latin America: A gender analysis. Boston, US: National Renewable Energy Laboratory. [www.nrel.gov/docs/fy01osti/28995.pdf](http://www.nrel.gov/docs/fy01osti/28995.pdf).

SQWenergy. (2008). Today's Investment and Tomorrow's Assets: skills and employment in the wind, wave, and tidal sector. A report to the British Wind Energy Association. BWEA . October

Stevens, C. (2009) Green Jobs and Women Workers: Employment, Equity and Equality. *Sustainlabour*. [www.sustainlabour.org/IMG/pdf/women.en.pdf](http://www.sustainlabour.org/IMG/pdf/women.en.pdf)

Thompson, D. & Joseph, S.A. (2011). Building Canada's Green Economy: The Municipal Role. Ottawa: Federation of Canadian Municipalities.

TNC (The Nature Conservancy) (2014) The untapped potential of young women in natural sciences. *Treehugger*, June 16. <http://www.treehugger.com/green-jobs/untapped-potential-young-women-natural-sciences.html>

UN Women. (2012) Fast-forwarding Women's Leadership in the Green Economy. <http://www.unwomen.org/2012/06/fast-forwarding-womens-leadership-in-the-green-economy/>

VDI (Association of German Engineers) (2009) European Engineering Report.  
[www.vdi.de/uploads/media/2010-04\\_IW\\_European\\_Engineering\\_Report\\_02.pdf](http://www.vdi.de/uploads/media/2010-04_IW_European_Engineering_Report_02.pdf).

Wei M., Patadia S. & Kammen D. (2010) Putting Renewables and Energy Efficiency to Work: How Many Jobs Can the Clean Energy Industry Generate in the US? *Energy Policy* 38(2): 919-931.

Wissenschaftsladen Bonn. (2012) Study offerings for renewable energies.  
[www.wilabonn.de/images/PDFs/Erneuerbare/studienangebote-ee-dez-2012.pdf](http://www.wilabonn.de/images/PDFs/Erneuerbare/studienangebote-ee-dez-2012.pdf)

Women's Bureau (2010) Think Women in Green Jobs. US Department of Labor.  
<https://www.dol.gov/wb/media/Greenprojects.htm>

Wood, L. (2013) Success, sex, and morality in the tar sands. *Vancouver Observer*. July 10.  
<http://www.vancouverobserver.com/environment/success-sex-and-morality-tar-sands>