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Abstract

Women are globally underrepresented in the energy industry. This paper reviews existing academic and practitioner literature on women's employment in renewable energy in industrialized nations, emerging economies and developing countries. It highlights similarities and differences in occupational patterns in women's employment in renewables in different parts of the world, and makes recommendations for optimizing women's participation. Findings reveal the need for broader socially-progressive policies and shifts in societal attitudes about gender roles, in order for women to benefit optimally from employment in renewables. In some industrialized countries, restructuring paid employment in innovative ways while unlinking social protection from employment status has been suggested as a way to balance gender equity with economic security and environmental protection. However, without more transformative social changes in gender relations, such strategies may simply reinforce rather than subvert existing gender inequities both in paid employment and in unpaid domestic labor. Grounded interventions to promote gender equality in renewable energy employment – especially within the context of increasing access to energy services for underserved communities – are more prevalent and better-established in some non-OECD (Organisation for Economic Co-operation and Development) countries. OECD countries might be well-advised to try to implement certain programs and policies that are already in place in some emerging economies.

Keywords: Women; employment and labor; renewable energy; OECD countries; emerging economies; developing countries.

1. Introduction

Employment in the energy industry is male-dominated worldwide. Globally, women make up only 6% of technical staff, 4% of decision-makers, and just 1% 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 Organisation of Economic Co-operation and Development (OECD) countries such as Canada, United States, Spain, Germany and Italy estimate that only 20–25% of jobs in the RE sector are held by women, and that these jobs 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% of university students, and almost half of the labor force in most of these countries (Pearl-Martinez, 2015). Concerns about environmental sustainability and fossil fuel insecurity have encouraged many industrialized, emerging and developing economies to transition to low-carbon energy supplies

derived from renewables such as solar, hydro, bioenergy, geothermal and wind. Since producing and distributing RE is more labor-intensive than producing and distributing fossil fuels (Wei *et al.*, 2010), this shift is creating new employment opportunities, as well as addressing energy poverty in remote or under-served communities. Renewable energy-related employment provided jobs, either directly or indirectly, for nearly eight million people worldwide in 2014, excluding large hydropower (IRENA, 2015). This is an 18% increase from the previous year, and employment in the sector is expected to continue to grow rapidly in the future (IRENA, 2015). Although there is tremendous potential to create employment in the RE sector almost everywhere in the world, there is a growing concern that women, who are already drastically underrepresented in the sector, will become even more marginalized if gender equity policies and programs are not proactively planned and implemented (McFarland, 2013; Fernández-Baldor *et al.*, 2014). 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, as well as hinder broader human development

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goals (Baruah, 2015). This article reviews and synthesizes existing research and data on women's employment in RE in OECD countries, emerging economies and developing countries. It highlights similarities and differences in occupational patterns in women's employment in the RE sector in different parts of the world, and makes recommendations for optimizing women's participation in the sector.

Because jobs in RE tend to be scattered across different areas of employment (such as manufacturing, construction, installation, fuel processing, operations and maintenance), specific information related to the sector is seldom captured in national statistics. Sex-disaggregated data on employment in RE are even harder to find. The peer-reviewed scholarship on this topic is currently limited, but there is a significant amount of 'working knowledge' available from practitioner sources such as advocacy groups, professional associations, non-governmental organizations (NGOs), policy institutes and think-tanks. I collected and synthesized both types of knowledge in order to document the nature, magnitude, nuance and complexity of the issues involved. All secondary data were analyzed using the *Codebook for Standards of Evidence for Empirical Research* (SoE) (Heck and Minner, 2009). The SoE and their process of application result 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. Due to the scarcity of sex-disaggregated statistics on employment in RE, I also relied on data from the broader categories of 'green jobs' and 'clean jobs', as well as related science, technology, engineering and math (STEM) fields, in order to conduct this research. The inclusion of the latter is justified by the fact that employment in the most well-paid sectors of RE, namely, construction, installation, engineering and architecture, tend to require STEM training (Antoni *et al.*, 2015).

In addition to secondary data collection and analysis (as described above), I drew upon primary qualitative research (focus groups and interviews with women workers, employers, social enterprises and advocacy NGOs) that I had conducted in India between 2012 and 2014 to further understand the opportunities and constraints for women's employment in clean energy. Complementing existing academic and practitioner literature from OECD countries, emerging economies, and developing nations, along with empirical research conducted in India, revealed a range of previously undocumented challenges and opportunities faced by women in the RE sector.

This article is in no way intended as a comprehensive global survey of women's employment in RE. The data does not currently exist to allow for it. The countries included in this analysis are ones for which I was able to find some reliable secondary information in addition to the one (India) in which I conducted primary research on this topic. In fact, the need to collect data specific to the RE sector in order to inform evidence-based policymaking is

one of the most clear-cut findings from this study and those of others who have attempted to study employment generation in the sector (see, for example, Antoni *et al.*, 2015). Even within the constraints of such limited data availability, it is obvious that there are glaring gender inequalities in RE employment in most countries, 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 unstable. On the other hand, in many industrialized countries, such as Canada, there is a lot of attention paid to RE technology and financing, but very little to employment equity. The major objective of this paper is to point out such trends, and not to offer suggestions for specific programs that individual countries might emulate or replicate. While the distinct economic and political contexts of different countries are relevant in the assessment of women's participation in RE, I have only been able to comment selectively on these aspects in this paper. I hope that the issues identified by my 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.

As part of this research, I reviewed the existing literature on women's employment in the energy sector (both fossil fuel-based and renewable). The work of authors such as Rebecca Pearl-Martinez, Joy Clancy, Cornelia Fraune and Ulrike Lehr feature prominently in my analysis. I also reviewed feminist research on topics such as women and technical occupations, women and part-time work, gender and caregiving, and gender and institutional sexism, which were identified in the existing literature on women's employment in the energy sector as important for understanding the broader underpinnings of women's marginalization in energy sector employment. I selectively present the work of scholars such as Jennifer Nedelsky, Thomas Malleon, Marjorie Griffin Cohen and Gloria Miller throughout the paper, in order to frame and contextualize my findings about women's employment in RE.

The next section provides summaries of broad trends in women's employment in RE in industrialized, emerging and developing countries. This is followed by a documentation and analysis of comparative patterns of opportunities and constraints for women's employment in RE in various regional settings around the world, as well as selective but broad suggestions for optimizing women's participation in the sector.

2. A summary of women's employment in RE in OECD countries, emerging economies and developing countries

Although sex-disaggregated data on RE employment in industrialized countries are scarce, the numbers we are able

to put together point to a severe underrepresentation of women. The available data from Canada, United States, Spain, Germany and Italy indicate a general trend of women being employed mostly in non-technical occupations in RE. The greatest representation of women in the RE sector in OECD countries is in sales, followed by administrative positions and finally engineers and technicians (IRENA, 2013). In absolute numbers, the largest sources of RE employment for women in industrialized countries are solar photovoltaics (PV), solar heating/cooling, wind power, biomass, and biofuels (IRENA, 2013). Among the common RE technologies, solar PV creates the most jobs per unit of electricity output.

The underrepresentation of women in RE in many OECD countries appears to be part of the larger issue of the underrepresentation of women in STEM. There is an obvious economic benefit for women who choose to pursue these paths. While gendered wage inequality also exists in STEM jobs, research conducted by The Nature Conservancy in the United States and Canada, for example, indicates that it is less significant (14%) than in non-STEM fields (21%) (TNC, 2014). Women in STEM jobs also earn 33% more on average than those in non-STEM occupations (TNC, 2014). Research conducted in other OECD countries generally indicates similar ‘glass-half-empty and glass-half-full’ scenarios for women in STEM: higher, albeit not equal, average wages compared to men, but lower numbers of workers compared to other non-STEM fields (Riach and Rich, 2006; OECD, 2015).

Renewable energy (RE) deployment continues to grow sustainably and as an increasingly economically viable alternative to conventional sources of energy in emerging economies and developing countries. There is also increasing recognition of the positive social and economic impacts of RE deployment. The employment effects of RE investment, in particular, are increasingly gaining prominence in the global RE debate, but specific analytical work and empirical evidence on this important subject remain relatively limited. Even general employment data on RE are unavailable or unreliable in many settings. Sex-disaggregated data on employment in renewables are particularly spotty worldwide. This makes analyzing trends and making comparisons challenging. Estimates of women’s employment in renewables can also differ dramatically depending on whether the analysis includes or excludes large hydropower and informal employment in RE – particularly in traditional biomass and fuel-crop production in developing countries and emerging economies (IRENA, 2013).

There are no national data sets that can tell us the exact or even approximate numbers of women who are employed in informal jobs in activities such as fuelwood collection and charcoal production. Extrapolations from regional data sets suggest that the numbers are significant. For example, up to 13 million people may be employed in commercial biomass in sub-Saharan Africa (Openshaw, 2010).

Fuelwood and charcoal represent between 50 and 90% of all energy needs in developing countries, and 60–80% of total wood consumption (ESMAP, 2012). Since women are largely responsible for procuring fuelwood for household needs (Ilahi, 2000), it is reasonable to expect that millions of women are engaged formally or informally in the biomass sector. More broadly speaking, it is well established that women represent 50% of the agricultural workforce in sub-Saharan Africa (FAO, 2011). Given the similarities in the nature of these activities, it is reasonable to infer that women’s participation in biomass production is also significant.

Production of fuel crops is also an important source of formal and informal RE employment in developing countries (Kammen, 2011). Farming communities in the developing world have always known how to use oilseeds for lighting purposes. *Jatropha*, for example, is increasingly integrated into farm production systems in India, Cambodia and Mexico as a complement rather than as a substitute for food crops. A review of community biofuel projects carried out by the International Network on Gender and Sustainable Energy (ENERGIA) discovered that village-level production of biofuels can be economically sustainable, create employment and improve energy access in underserved rural and remote communities (see, ENER-GIA, 2009 for examples of specific projects). Such systems can reduce the drudgery of fuel collection for women, and improve their participation in community affairs and decision-making in developing countries (ENERGIA, 2009). The ENER-GIA report does, however, warn about the danger of shifting from integrated fuel and food crop production to mono-cropping for commercial production, as it may result in loss of land, income and food security. We have a better sense of the numbers of women who hold formal jobs or earn commissions in developing countries and emerging economies from activities such as manufacturing, constructing, operating, maintaining and selling solar lights and improved cook stoves, because these initiatives tend to be driven by governments, NGOs, private sector organizations and social enterprises (see, for example, Arthur, 2010; Lighting Africa, 2010; Baruah, 2015). For example, in India the Hariyali Green Energy Campaign run by the Self-Employed Women’s Association (SEWA) aims to reach one million households by 2020 through networks of female entrepreneurs and the Lighting a Billion Lives Project, run by The Energy and Resources Institute (TERI), which currently reaches over 640 rural communities across the country (see Baruah, 2015, for specific details).

3. A global perspective on opportunities and constraints for women in RE employment

Women’s participation in the formal labor market has been determined by a combination of social norms, cultural

attitudes, societal values and economic necessity. In many parts of the world, women's roles and responsibilities were traditionally geared toward household duties and unpaid labor. At the same time, gender roles tend to be malleable, and social norms are changing worldwide. Women are economically active even when confined to the private sphere, but they are also participating out of choice and necessity in the formal labor force in unprecedented numbers (Runyan and Peterson, 2013). A review of available literature reveals the following as factors that may either impede or facilitate women's meaningful participation in the RE sector in industrialized countries and emerging economies: both societal and self-misperceptions about women's technical abilities; 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; skill shortages in the RE sector; and 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 blurred, since with appropriate policy interventions, some constraints may potentially become opportunities as a result of shifts in societal attitudes, as well as economic and political changes within specific countries. The implications of part-time work and job sharing, which I include in the following section, 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. It is included for discussion in this paper because it is important to understand women's access to employment in renewables within the context of broader global trends in employment and social policy.

3.1. Misperceptions

A combination of women's self-perception and societal perceptions of women's incompetence in technical occupations has been frequently identified in scholarly 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 their consequences in studies of RE projects in different contexts (see, for example, Lehr, 2008; Fernández-Baldor *et al.*, 2014), there does not appear to be any research devoted specifically toward documenting the effects of such misperceptions upon women in RE. Findings drawn from similar fields, such as construction and engineering in various locations in the Global North and South do, however, 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), United States (Eisenberg, 1998; Paap, 2006), United Kingdom (Greed, 2000) and Canada (Little, 2005)). These

studies reveal a common finding that women in these fields are deemed less competent than men, regardless of qualifications. The fear of sexual harassment, as well as discomfort resulting from assumptions made about the sexuality of women in non-traditional occupations, is also frequently noted (see, for example, Price, 2000, 2006).

Women may also be discouraged from entering occupations in RE, and more broadly in engineering and technology, 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), where they can clearly see how their work makes a difference, but then less well-represented in fields like civil, electronic and computer engineering, which are perceived as disciplines that are more technically focused and socially isolating (Myers, 2010).

A 2009 Engineers Canada survey of female high school students found that many had negative perceptions of occupations in engineering and technology, often perceived 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 to people. The result is that women may attribute lower status to occupations in engineering and technology compared with, for example, health and social sciences. Of course, not all women aspire to be socially useful; some may just as easily be drawn by money, prestige or other factors. 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 optimally 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 paper.

3.2. Self-employment and entrepreneurship

In the current neoliberal economic climate, self-employment and entrepreneurship have frequently been promoted as 'solutions' for livelihood generation almost

everywhere in the world. The issues of self and societal perceptions, as 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 Women in Renewable Energy (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 1,000 women in the province of Ontario, at least 20% were entrepreneurs in RE (Rebecca Black, interview, Toronto, Canada, 7 May 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. Women are also very well-represented in the manufacturing, stocking and selling of improved cook stoves in Asian and African countries (GVEP, 2012). Of course, when gender inequality is viewed as a structural issue, as it should be, it is difficult not to be intellectually uncomfortable with the instrumental and stereotypical deployment of women in marketing and dissemination initiatives for improved cook stoves. At the same time, it is essential to recognize the creation of better-paid and less menial livelihoods for poor women (Baruah, 2015).

While it is important to provide the right type of support for women's entrepreneurial pursuits, 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. Worldwide, poorer women generally tend to be more interested in stable wage employment rather than entrepreneurship (Baruah, 2015).

Research in various parts of developing countries and emerging economies, as well as in countries that were formally part of the Soviet Union, has demonstrated that microcredit is not an appropriate tool to support the development of small and medium enterprises (see, Bateman and Chang, 2012). More specifically, research in India demonstrates that particularly in the absence of subsidies, the higher cost associated with RE technology makes microcredit loans an inadequate tool for enterprise development in renewables (Baruah, 2015). Most poor women in developing countries and emerging economies are interested in the energy sector because of its potential for income generation, but they are also extremely averse to financial risk. They are much more likely to pursue opportunities in the energy sector if they can earn incomes

without becoming indebted. Acquiring new skills – such as learning to build and repair RE technologies – may be better suited for their economic realities and limitations. Organizations like SEWA in India and Grameen Shakti in Bangladesh are actively trying to meet their needs through various solar and biomass initiatives, but the creation of permanent and stable sources of income remains a challenge. Women who have been trained to build, install and repair solar technology, for example, continue to face the challenge of finding permanent employment with their newly acquired skills, as they are often only able to earn incomes on an intermittent basis through contracts and orders placed by non-profits and government agencies. This shortcoming is common to most livelihood initiatives in the RE sector in developing countries and emerging economies. It highlights the need for governments to provide adequate social security to protect against vagaries in the market, natural disasters, illness, maternity, old age, job losses and other risks to people's well-being. Providing social protection within a human-rights framework and unlinking it 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 legal or social barriers that limit their education, property rights, land tenure, and access to credit, it is crucial that government policies go beyond energy sector planning to optimize economic opportunities for women.

3.3. *Part-time work and job sharing*

Worldwide, the majority of part-time workers is comprised of women. Generally speaking, RE companies do tend to hire a higher proportion of full-time workers, which also contributes to above-average wages for RE employees (ILO, 2011). The lower wage per hour in part-time employment across 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 still tend to be paid more than part-time female workers. The overrepresentation of women in part-time employment and gender wage inequity in part-time work in all sectors is obviously a major concern, especially if some of these women would prefer to work full time. There is research that demonstrates that large numbers of women are indeed working part time involuntarily (Angeloff, 2000).

Sex-disaggregated data on part-time work are available in many countries. As an example, women in Canada are twice as likely to work part time (27%) compared to men (12%) (OECD, 2015). Sex-disaggregated data, specifically regarding part-time employment in RE, are virtually impossible to find. The only sex-disaggregated data I was able to find on part-time work specifically in RE are from

Spain, and it is striking because of the extent of the over-representation of women. A study conducted by a labor union organization in Spain revealed that in 2008, women accounted for just over 26% of the general (inclusive of full and part-time) RE workforce (Arregui *et al.*, 2010). This is slightly higher than the 24% average for Spain's broader industrial sector. Furthermore, while only 2% of jobs in RE in Spain are part-time, women hold 67% of them. Spain is known to have a lower rate of part-time work for women compared to other countries in Europe, so the extent to which part-time work in RE has become feminized is both a cause for concern and worthy of further investigation.

Despite evidence of the negative implications for women with part-time work, it is important to ask whether part-time jobs always have negative implications. Some recent research suggests that creating more part-time jobs and arrangements like work-sharing, provided that they have high wages and 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 global wealthy, remains the biggest impediment to environmental sustainability, transitioning to clean energy sources, or to a green economy more broadly speaking, will not 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 (Nedelsky, 2014; Malleon, 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, Malleon, 2015; Baruah, 2016).

The prospect of 'good' part-time jobs, work-time reduction or flexi-time jobs may seem remote or even utopian in the current global 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 labor agenda in the aftermath of the 2008 global financial crisis, as well as the debt crisis many countries began to experience 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 good-quality part-time jobs. And unlike in North America, these part-time jobs have roughly the same hourly pay as full-time work, in addition to 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% less (see Malleon, 2014, for promising practices in Europe).

While I agree with the potential of part-time work and job-sharing in promoting economic security and environmental sustainability, I am ambivalent about the assertion made by Nedelsky (2014) that moving toward '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 globally, women do a disproportionate amount of household and caregiving work while also working outside the home while men, who do not work much more outside the home, have not reciprocated in a commensurate way in the home. 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 United States, for example, only 27% of firms offer flex-time to more than 50% of their employees. By contrast, 68% of Swedish workplaces offer flex-time to 80% of their 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 that of a burden to that of 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 United Kingdom than they are in the United States (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 have brought back to prominence some of the union movement's original causes, as well as broader societal questions about the importance of unlinking 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. In most countries, the levels of unionization in new 'green' jobs tend to be low from the start. Whether new or reconfigured modes for organizing, mobilizing and collective bargaining will emerge in the future remains a matter of conjecture.

3.4. *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. While this can also be challenging for men, for women with caregiving responsibilities, especially for young children, it is particularly challenging. 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 source sectors, 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 sand site two hours away from Fort McMurray in Alberta, Canada). Although such factors may, to some extent, explain women's underrepresentation in energy sector employment, 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 on average, women 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%) in OECD countries might actually be another reason for higher wages in this field compared to non-RE companies (Antoni *et al.*, 2015). Because of persistent entrenched male-biased hiring norms in the traditional 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).

Women in developing countries and emerging economies also face mobility constraints owing to personal safety considerations, social responsibilities and the traditional division of household labor, but some do manage to find creative solutions. For example, a group of low-income rural women in India, who were trained by a social enterprise called Technology Informatics Design Endeavour (TIDE) to construct biogas cook stoves, set itself up as a cooperative. The women travel in groups of two or more to build stoves in distant rural areas (Baruah, 2015).

Although women continued to shoulder much of the responsibility for childcare and household maintenance, family members often become more willing to share responsibility for domestic chores once the women started earning higher incomes. Researchers working in India (see, for example, Patel, 2014 and other contributions to Nielsen and Waldrop, 2014) have corroborated that gender roles tend to be malleable, that the intra-household division of labor is dynamic and negotiable, and that economics often trumps 'culture and tradition'. Extended, joint and inter-generational family set-ups, where grandparents live with married children and grandchildren, can be particularly helpful for women in occupations that require extensive travel and time away from children. I have collaborated frequently on research projects with middle-class professional women in India and China. Many have small children, but are able to travel for work both domestically and internationally far more frequently than most professional women in North America and Europe, precisely because they live in 'traditional' joint family settings in which grandparents are always available to take care of children (Mini Govindan, interview, New Delhi, India, 16 April 2013). The availability of affordable live-in caregivers also often gives middle-class professional women in developing countries and emerging economies a mobility advantage that most of their counterparts in industrialized countries cannot afford. Although the gender division of intra-household labor may remain intact in both industrialized countries and emerging economies, inasmuch as it is still mainly women doing the caregiving, middle-class women in some settings in the Global South often have a comparative career advantage due to these factors. Furthermore, since there is often a stronger sense of collective and social parenting in many non-Western settings, women are also judged less harshly, if at all, for 'leaving' their children with other family members or caregivers in order to travel for work for brief periods of time (Govindan, interview). Of course, there may be negative implications for children of poor migrants who have to leave their children with family members for extended periods of time to migrate or seek work overseas (see, for example, Giannelli and Mangiavacchi, 2010; Tomsa and Jenaro, 2015), but there is absolutely no evidence of any damage to children of highly-educated and well-paid professional women in emerging economies like India and China, who benefit from extended family and caregiving support and travel regularly to advance their

careers. Women are far less likely to be held solely responsible for parenting in cultures that believe in collective and social parenting. Several researchers and journalists have written about the role such factors can play in enabling middle-class women's careers in non-Western settings. For example, as part of the New York Times' *Female Factor* series, Timmons (2010) explores why women remain scarce among top bankers in New York and London despite decades of struggle to climb the corporate ladder, yet hold some of the most prestigious portfolios in India's relatively young financial industry.

3.5. Skill Shortages

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 one million engineers, only 13% were women (Blau, 2011). Out of 384,000 engineering students, only 79,000 (21%) were women. Low as they are, these numbers for Germany are actually 10% higher than they were in 2001 (Blau, 2011). These numbers are consistent with trends in STEM fields in other EU countries (VDI (Association of German Engineers), 2009). On the other hand, data from the United States indicate 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 10,000–69,895, almost entirely attributed to male graduates. This effectively reduced the percentage of women receiving undergraduate engineering degrees in the United States from 20.5 to 18.5% (Mahmud, 2012).

The number of women going into engineering in Canada has also been on the decline, despite decades of efforts to encourage more girls to consider technical careers. Even though women currently make up more than half of the undergraduate population across Canada, the number of women enrolled in engineering programs dropped from a high of 21% in 2001 to 17% in 2009 (Myers, 2010). The number of licensed engineers in Canada who are women has grown from 7% in 2000, but the figure still sits at only 10% (Myers, 2010). Although women comprised 47% of the Canadian workforce in the 2006 census, the participation rate of women in engineering averaged only 13% (Calnan and Valiquette, 2010). Meanwhile, according to census data, overall employment growth in occupations in engineering and technology surged by 45% between 1997 and 2008, compared to a growth rate of 24% 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 (Calnan and Valiquette, 2010).

The numbers for women in engineering in Australia are equally unimpressive (Engineers Australia, 2012).

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.

Skill shortages in the RE sector are also being reported in developing countries and emerging economies (IRENA, 2013). Especially among women, there is often a lack of technical and business skills required for employment and enterprise development in renewables. Low levels of literacy and limited access to basic education make such skills particularly challenging for poor and rural women to acquire (Baruah, 2010). Organizations like the Indira Gandhi National Open University, Solar Sister, Grameen Shakti, Barefoot College, Innovation Centre for the Poor, and SEWA, which provide customized solutions for training for individual women and opportunities for cross-mentoring among local entrepreneurs, are attempting to close some of these gaps.

Unlike in North America and Europe, where women remain a minority in engineering programs, comparatively large numbers of middle-class women in some emerging economies such as India and China, 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 due to the large numbers of women who earn engineering degrees. In China, 40% of engineers are women (Paris Tech Review, 2010). From less than 1% in the 1970s, enrolment of women in engineering degrees in India had grown to 15% by 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 electronic engineers in India are women. The figures for civil, computer, electrical and mechanical engineering in the early 2000s were reported to be 19.7, 17.8, 16.1 and 9.3%, respectively (Parikh and Sukhatme, 2004).

In the 1980s, 58% of engineers in the USSR were women, but with the collapse of the USSR and its industrial model, the well-established tradition of state-enforced gender diversity disintegrated in the 1990s and 2000s. In 1998, women accounted for 43.3% of engineers in Russia and in 2002, just 40.9% (Paris Tech Review, 2010).

Moreover, the numbers have continued to further decline. The Baltic nations of Estonia, Latvia, and Lithuania, which 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% compared to 32% (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 (Anderssen, 2013). 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 can be effective, and can benefit the RE sector in both OECD countries and emerging economies. In the next section, I discuss the potential and need for state intervention in more detail.

3.6. *Public sector involvement*

Generally speaking, both the fossil fuel-based and RE global workforce represents a vertically and horizontally gender-stratified labor market, with women concentrated in the lowest-paid positions, closest to the most menial and tedious aspects, 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, which requires further investigation. 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, Barefoot College in India and Char Montaz in Bangladesh) have actively sought to use RE technologies to secure and improve livelihoods. Such off-grid, mini-grid and stand-alone decentralized RE initiatives have offered more opportunities for employment to women (albeit often poorly-compensated and unstable), 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, and where women are more likely to be underrepresented (Smith, 2000). That said, it is important to be cognizant of the fact 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 overly optimistic to assume that women will never be marginalized in community RE projects. Social factors such as gender, financial limitations and occupational segregation influence individual agency to participate even in RE projects operated by citizens' associations (Fraune, 2015). 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 in which such projects operate, 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 to as ensure employment equity has been made in OECD countries as well as in developing countries and emerging economies (ENERGIA, 2006; Calvert and Cohen, 2011). Power generation from renewable sources is growing twice as fast in non-OECD countries and continents, led by China, and followed by India, Latin America and Africa (Hostettler, 2015). The 10 countries with the highest levels of employment in RE 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 continues 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 otherwise would 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% 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 might be well-advised to try to 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 gender. 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 almost completely male-dominated sectors, like that of energy. Other researchers (see, for example, Clancy and Roehr, 2003) agree that even straightforward liberal employment equity policies would serve as good starting points 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 the 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 workforces. Green stimulus spending should come with conditional requirements for the recruitment and retention of women. Although countries like Canada, United States, Australia, France and United Kingdom earmarked significant stimulus funding for green initiatives in the aftermath of the 2008 financial crisis, very little, if any, funds were allocated for the integration of women into green occupations (Cohen, 2015). In its American Recovery and Investment Act of 2009, the United States 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. 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 United States are hard to find in many OECD countries. In Canada, a few promising initiatives aimed at training and employing First Nations and inner city workers in RE and building retrofits have recently emerged as a result of collaborations among provincial governments, publicly-owned utilities and social enterprises (Fernandez, 2015). Such initiatives remain rare, and the possibilities for replication in other settings are unclear.

4. Conclusion

There are similarities and differences between industrialized, emerging and developing economies with regard to 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, which 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, as well as 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 not enough.

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References

- Adeyemi, A.Y., 2006. Empirical evidence of women's underrepresentation in the construction industry in Nigeria. *Women in Management Review*, 21(7): 567–577.
- Aubra, A.L., 2005. *Non-Traditional Occupations, Empowerment and Women: A Case of Togolese Women*. Routledge, New York, NY.
- Anderssen, E., 2013. Gender geography: Where's the best place in the world to be a woman. *The Globe and Mail*, March 8. Available at <http://www.theglobeandmail.com/news/national/gender-geography-wheres-the-best-place-in-the-world-to-be-a-woman/article9488293/> (accessed 15 September 2016).
- Angeloff, T., 2000. *Le temps partiel: un marché de dupes?* Syros, Paris.
- 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. Available at www.istas.net/web/abreenlace.asp?idenlace=8769 (accessed 15 September 2016).
- Arthur, C., 2010. Women solar entrepreneurs transform Bangladesh. *Policy Innovations*, August 16. Available at <http://www.>

- renewableenergyworld.com/articles/2010/04/women-solar-entrepreneurs-transforming-bangladesh.html (accessed 15 September 2016).
- 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.
- Baruah, B., 2015. Creating opportunities for women in the renewable energy sector: Findings from India. *Feminist Economics*, 21(2): 53–76.
- Baruah, B., 2016. Reconciling economic security, environmental protection and social justice. *Huffington Post*. Available at http://www.huffingtonpost.ca/development-unplugged/reconciling-economic-security_b_9583020.html (accessed 15 September 2016).
- Bateman, M., Chang, H., 2012. Microfinance and the illusion of development: From hubris to nemesis in thirty years. *World Economic Review*, 1: 13–36.
- Blau, J., 2011. Germany faces a shortage of engineers. *IEEE Spectrum*. Available at <http://spectrum.ieee.org/at-work/tech-careers/germanyfaces-a-shortage-of-engineers> (accessed 15 September 2016).
- 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*. Engineers Canada, Ottawa.
- Calvert, J., Cohen, M., 2011. *Climate Change and the Canadian Energy Sector: Implications for Labour and Trade Unions*. Canadian Centre for Policy Alternatives, Ottawa.
- Carpenter, J.P., Matthews, P.H., Robbett, A., 2015. Compensating differentials in experimental labor markets. IZA Discussion Papers, 8820. Institute for the Study of Labor (IZA), Bonn.
- Clancy, J., Roehr, U., 2003. Gender and energy: Is there a Northern perspective? *Energy for Sustainable Development*, 7(3): 44–49.
- Cohen, M., 2015. Gender in government actions on climate change and work. *Women & Environments International*, 94/95: 11–16.
- Eisenberg, S., 1998. *We'll Call You if We Need You: Experiences of Women Working Construction*. ILR Press, Ithaca, NY.
- ENERGIA, 2006. *Incorporating Women's Concerns into Energy Policies*. ENERGIA, The Hague, The Netherlands. Available at http://www.energia.org/fileadmin/files/media/factsheets/factsheet_policies.pdf (accessed 15 September 2016).
- ENERGIA, 2009. *Biofuels for Sustainable Rural Development and Empowerment of Women: Cases Studies from Africa and Asia*. ENERGIA, The Netherlands. Available at www.theworkingcentre.org/sites/default/files/ENERGIA_Biofuels_book_text_pages.pdf (accessed 15 September 2016).
- Engineers Australia, 2012. *The Engineering Profession: A Statistical Overview*. ACT: Institution of Engineers Australia, Barton. Available at https://www.engineersaustralia.org.au/sites/default/files/shado/Representation/Stats/statistical_overview_2012_1.pdf (accessed 15 September 2016).
- ESMAP (Energy Sector Management Assistance Program), 2012. Commercial woodfuel production. Available at www.esmap.org/sites/esmap.org/files/FINAL-CommercialWoodfuel-KS12-12_Optimized.pdf (accessed 15 September 2016).
- FAO, 2011. *The State of Food and Agriculture in 2010–2011*. FAO, Rome.
- Fernandez, L., 2015. *How Government Support for Social Enterprise Can Reduce Poverty and Green House Gases*. Canadian Centre for Policy Alternatives, Manitoba.
- 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.
- Giannelli, G.C., Mangiacchi, L., 2010. Children's schooling and parental migration: Empirical evidence on the 'left-behind' generation in Albania. *Labour*, 24(1): 76–92.
- Gornick, J.C., 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): 181–196.
- GVEP (Global Village Energy Partnership), 2012. The improved cookstove sector in East Africa: Experience from the Developing Energy Enterprise Programme (DEEP). Available at www.gvepinternational.org/sites/default/files/deep_cookstoves_report_lq_for_web.pdf (accessed 15 September 2016).
- Heck, D.J., Minner, D.D., 2009. *Codebook for Standards of Evidence for Empirical Research*. Horizon Research, Inc, Chapel Hill, NC.
- Hostettler, S., 2015. Energy Challenges in the Global South. In: Hostettler, S., Gadgil, A., Hazboun, E. (Eds), *Sustainable Access to Energy in the Global South: Essential Technologies and Implementation Approaches*. Springer, New York, NY, 3–9.
- Huyer, S., Hafkin, N., 2013. Brazilian women lead in science, technology and innovation, study shows. *Elsevier Connect*. Available at <http://www.elsevier.com/connect/brazilian-women-lead-in-science-technology-and-innovation-study-shows> (accessed 15 September 2016).
- Ilahi, N., 2000. *The Intra-household Allocation of Time and Tasks: What Have We Learnt from the Empirical Literature?* The World Bank, Washington, DC. Available at <http://siteresources.worldbank.org/INTGENDER/Resources/wp13.pdf> (accessed 15 September 2016).
- ILO, 2011. *Skills and Occupational Needs in RE 2011*. International Labour Office, Geneva.
- International Energy Agency, 2013. *World Energy Outlook 2013*. OECD/IEA Publications, Paris.
- IRENA, 2013. *Renewable Energy and Jobs: Annual Review*. International Renewable Energy Agency, Abu Dhabi.
- IRENA, 2015. *Renewable Energy and Jobs: Annual Review*. International Renewable Energy Agency, Abu Dhabi.
- Kammen, D., 2011. Biofuels: Threat or opportunity for women? *World Bank Blogs*. Available at <http://blogs.worldbank.org/climatechange/biofuelthreat-or-opportunity-women> (accessed 15 September 2016).
- Katz, J., 2012. *Emerging Green Jobs in Canada: Insights for Employment Counsellors into the Changing Labour Market and its Potential for Entry-Level Employment*. Green Skills Network, Toronto.
- Lehr, U., 2008. Renewable energy and employment in Germany. *Energy Policy*, 36(1): 108–117.
- Lighting Africa, 2010. *Solar Lighting for the Base of the Pyramid: Overview of an Emerging Market*. The World Bank Group, Washington, DC.
- Little, M., 2005. *If I Had a Hammer: Retraining that Really Works*. University of British Columbia Press, Vancouver.
- Mahmud, A., 2012. *Graduate Studies Spur Success in Engineering*. ASME. Available at <https://www.asme.org/career-education/articles/graduate-students/graduate-studies-spur-success-in-engineering> (accessed 15 September 2016).
- Malleson, T., 2014. *After Occupy: Economic Democracy for the 21st Century*. Oxford University Press, New York, NY and London.
- Malleson, T., 2015. Interview: How shorter work hours can help the climate and women's equality. *LaborNotes*, March 8. Available at <http://labornotes.org/2015/03/interview-how-shorter-work-hours-can-help-climate-womens-equality> (accessed 15 September 2016).
- McFarland, J., 2013. The gender impact of green job creation, Presentation at Work in a Warming World International Conference, Toronto, 29 November–1 December.
- 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.
- 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. Available at <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*. Fordham University, New York, NY.
- Nielsen, K., Waldrop, A. (Eds.), 2014. *Women, Gender and Everyday Social Transformation in India*. Anthem Press, London and New York, NY.
- OECD, 2015. *Education at a Glance*. The Organisation for Economic Co-operation and Development, Paris, France, published in-house by OECD.
- OECD Stats, 2013. Trade union density. Available at https://stats.oecd.org/Index.aspx?DataSetCode=UN_DEN (accessed 15 September 2016).
- Openshaw, K., 2010. Biomass energy: Employment generation and its contribution to poverty alleviation. *Biomass and Bioenergy*, 34(3): 365–378.
- Paap, K., 2006. *Why White Working-Class Men Put Themselves—and the Labor Movement—in harm's Way*. Cornell University Press, Ithaca, NY.
- Parikh, P., Sukhatme, S., 2004. Women engineers in India. *Economic and Political Weekly*, 39(2): 193–201.
- Paris Tech Review*, 2010. Why aren't there more women engineers? Available at <http://www.paristechreview.com/2010/09/29/why-more-women-engineers/> (accessed 15 September 2016).
- Patel, R., 2014. Today's 'good girl': The women behind India's BPO Industry. In: Nielsen, K., Waldrop, A. (Eds), *Women, Gender and Everyday Social Transformation in India*. Anthem Press, London and New York, NY, 21–32.
- Pearl-Martinez, R., 2015. *All Hands On Deck: Who's Missing in the Clean Energy Workforce*. Renewable Equity Project, Tufts University, Medford, MA.
- Price, V., 2000. *Hammering it Out: Women in the Construction Zone* [Motion picture]. Women Make Movies, New York, NY.
- Price, V., 2006. *Transnational Tradeswomen* [Motion picture]. Women Make Movies, New York, NY.
- 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.
- Rodrik, D., 2011. *The Globalization Paradox*. Oxford University Press, Oxford.
- Runyan, A., Peterson, S., 2013. *Global Gender Issues in the New Millennium*. Westview Press, New York, NY.
- Smith, J., 2000. *Solar-Based Rural Electrification and Microenterprise Development in Latin America: A Gender Analysis*. National Renewable Energy Laboratory, Boston, MA. Available at www.nrel.gov/docs/fy01osti/28995.pdf. (accessed 15 September 2016).
- Stevens, C., 2009. Green jobs and women workers: Employment, equity and equality. *Sustainlabour*. Available at www.sustainlabour.org/IMG/pdf/women.en.pdf (accessed 15 September 2016).
- Timmons, H., 2010. Female bankers in India earn chances to rule. *New York Times*, January 27. Available at http://www.nytimes.com/2010/01/28/world/asia/28iht-windia.html?_r=0 (accessed 15 September 2016).
- TNC (The Nature Conservancy), 2014. The untapped potential of young women in natural sciences. *Treehugger*, June 16. Available at <http://www.treehugger.com/green-jobs/untapped-potential-young-women-natural-sciences.html>
- Tomsa, R., Jenaro, C., 2015. Children left behind in romania: Anxiety and predictor variables. *Psychological Reports*, 116(2): 485–512.
- UN Women, 2012. Fast-forwarding women's leadership in the green economy. Available at <http://www.unwomen.org/2012/06/fast-forwarding-womens-leadership-in-the-green-economy/>
- VDI (Association of German Engineers), 2009. European engineering report. Available at www.vdi.de/uploads/media/2010-04_IW_European_Engineering_Report_02.pdf. (accessed 15 September 2016).
- 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. Available at www.wilabonn.de/images/PDFs/Erneuerbare/studienangebote-ee-dez-2012.pdf.
- Women's Bureau, 2010. *Think Women in Green Jobs*. US Department of Labor. Available at <https://www.dol.gov/wb/media/Greenprojects.htm>.
- Wood, L., 2013. Success, sex, and morality in the tar sands. *Vancouver Observer*. July 10. Available at <http://www.vancouverobserver.com/environment/success-sex-and-morality-tar-sands>