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Renewable Energy Cooperatives: A Review of Demonstrated Impacts and Limitations

ABSTRACT

Energy sectors of most industrialized countries are marked by a long history of state and corporate-owned and highly centralized energy generation (mostly from fossil-based sources) and distribution. Although technological developments and pressures from social/ecological movements resulted in an increased uptake of renewable energy (RE) technologies since the early 1990s, the application of these technologies have since predominantly taken place through large-scale projects owned by corporate actors. In response, an increasing number of individuals and community groups have been forming renewable energy cooperatives (RE co-ops) in recent years to provide bottom-up and collective solutions to their local needs and global environmental issues. The goal of this literature review is to summarize the demonstrated impacts of RE co-ops in the economic, social and environmental realms. Thereby, their impact on community development and role in accelerating the transition towards a sustainable energy sector is assessed. Findings of this review show that successful RE co-ops generated positive outcomes for their members and the wider community while accelerating the social and perceptual dimensions of the global energy transition. However, it has also been revealed that RE co-ops' success in generating positive impacts is often limited by various community-specific factors and by financial and perceptual barriers to their emergence and development.

KEY-WORDS

COOPERATIVES; COMMUNITY DEVELOPMENT; RENEWABLE ENERGY; COMMUNITY ENERGY; SUSTAINABILITY

Acknowledgments

The research for this paper was generously supported by "People, Power, Planet (PPP): Best Practices and Knowledge Mobilization in Community Energy Development", a research partnership funded by the The Social Sciences and Humanities Research Council of Canada (SSHRC).

JEL Classification:J54; Q01; Q42; Q56; O13 | **DOI:** <http://dx.doi.org/10.5947/jeod.2015.006>

1. Introduction

Energy sectors of most industrialized countries are marked by a long history of state-owned and highly centralized energy generation (mostly from fossil-based sources) and distribution. With the introduction of neoliberal policies in the early 1990s, many national energy markets in Europe, North America, and elsewhere were deregulated and privatized to allow for the involvement of corporate actors (van der Horst, 2008). It was also during this period that, through technological developments and pressures from social-ecological movements, policies supporting the uptake of renewable energy (RE) technologies were being introduced in numerous industrialized countries. Since then, energy markets have been mostly dominated by corporate actors that possess the necessary financial capacity and experience in developing large-scale RE projects (Mori 2013; Huybrechts and Mertens, 2014). However, the transition away from fossil-based fuels towards a sustainable energy sector requires not only a technological and political transformation, but also a social and behavioural one (Murphy, 2008). This multi-dimensional transition would be accelerated through the direct participation of individuals in the electricity sector as proactive agents of change rather than “end-of-wire” recipients of electricity from a centralized system (Devine-Wright, 2007). Towards this end, an increasing number of individuals and community groups have been forming renewable energy cooperatives (RE co-ops) to provide bottom-up and collective solutions to their local needs and global environmental issues. In Germany alone, 656 RE co-ops have been established between 2005 and 2013 (DGRV, 2013a), while citizens in the UK established over 30 of their own between 2008 and 2012 (Willis and Willis, 2012). The REScoop.eu¹ network reports that as of early 2014, approximately 3,000 RE co-ops were estimated across Europe while almost 80 per cent of these being located in Germany and Denmark (Huybrechts and Mertens, 2014). That being said, the proportion of RE generated by RE co-ops in industrialized countries still remains minimal due to various financial and perceptual barriers (Lipp, Lapierre-Fortin and McMurtry, 2012; Huybrechts and Mertens, 2014).

In this light, the purpose of this literature review is fourfold: (i) to summarize the demonstrated on the economic, social and environmental impacts of RE co-ops; (ii) to identify community-specific factors that influence the development and outcomes of cooperatively owned RE projects; (iii) to identify financial, policy-related and perceptual barriers to RE co-ops’ emergence and development; and (iv) to identify aspects of RE co-ops that require further inquiry through research.

¹ REScoop.eu is the Federation of Groups and Cooperatives of Citizens for Renewable Energy in Europe: <http://rescoop.eu/>

2. Framework for the review

2.1 Renewable Energy cooperatives (RE co-ops)

Cooperatives have long been involved in the energy sector through various business activities including energy generation (not necessarily RE), sales and distribution, and provision of energy services (ILO, 2013; Mori 2013; Huybrechts and Mertens, 2014). In most national jurisdictions where they are found, these usually take the form of user or consumer cooperatives (Birchall, 2010). This paper will solely focus on cooperatives whose primary business is the generation of renewable energy in the form of electricity and/or heat. These cooperatives will be referred to as RE co-ops throughout the paper.

2.2 Community energy

RE co-ops are considered to be part of the broader field of “community energy” (CE), for which there is a growing interest from the academia, public sector and civil society. CE is a diverse and dynamic field that lacks an unequivocal definition (Walker and Devine-Wright, 2008; Seyfang, Park and Smith, 2012). CE projects are developed under various legal structures such as community trusts, not-for-profit organizations, charities, and RE co-ops (Walker, 2008; Hoggett, 2010; Seyfang, Park and Smith, 2012). The legal structure impacts a RE project’s: (a) *processes*, or how and by whom the project is developed and run; and (b) *outcomes*, or how the economic and social costs, benefits and risks of a project are spatially and socially distributed (Walker and Devine-Wright, 2008). In an attempt to overcome CE’s challenge of definition, Walker and Devine-Wright (2008) argue that RE projects that are only developed and run through an open and participatory *process* and that entail local and collective *outcomes* can be legitimately classified as community-owned. In this regard, with participatory decision-making *processes* and collective *outcomes* embedded in their business model, RE co-ops epitomize “community” ownership of RE projects. The “RE co-op advantage” in stimulating community development will be discussed in detail in Section 4.

Despite not having collective ownership and management embedded in their business models, other CE legal structures may share similar attributes to RE co-ops such as local-scale generation, open and participatory *processes*, and collective *outcomes*. Despite its sole focus on RE co-ops, this article will present some of the demonstrated impacts of other CE ownership structures that share these attributes with RE co-ops. With this, the author’s goal is to underline the potential of RE co-ops in generating similar outcomes rather than attributing other ownership models’ impacts to RE co-ops.

2.3 Defining community

The flexibility of CE's boundaries derives from the self-defined nature of communities, which can be brought together by various determinants such as geography, identity, interest and process (Dalby and Mackenzie, 1997; Rogers et al., 2008; van der Horst, 2008; Hoggett, 2010). In his review of literature on RE co-ops, the author of this paper identified a contrast in the *processes* and *outcomes* of RE projects developed and owned by "communities-of-location" versus "communities-of-interest". Communities-of-location are geographically-bound communities that are also referred to as "communities-of-place" or "communities-of-geography". RE co-ops formed by communities-of-location often focus on generating electricity and/or heat for local consumption and/or addressing local economic, social and/or environmental needs. In contrast, communities-of-interest are not bound by geographic boundaries and are formed by individuals that are "assembled around a topic of common interest" (Henri and Pudenko, 2003: 478). Several RE co-ops from Germany (DGRV, 2013b), the UK (Willis and Willis, 2012) and Ontario, Canada (Community Power Fund, 2013) allow individuals that are not in geographic proximity of their project sites to become members. In this light, the membership base of these RE co-ops can be argued to be form a community that shares an economic and/or environmental interest instead of a geographic location. As will be discussed in Section 3.4.2, the type of community that forms the RE co-op impacts the *processes* and *outcomes*, and therefore the community development impact of cooperatively owned RE projects.

2.4 Data collecting

RE co-ops have been subject to a very limited number of academic studies. The more common methods in studying these organizations have been surveys and reports published by government agencies, cooperative associations and not-for-profit organizations in various jurisdictions. Findings from both academic and grey literature were reviewed and will be presented under four subsections in this paper:

- Economic impacts (Section 3.1): how does cooperative ownership of RE project impact individual and collective economic well-being?
- Social impacts (Section 3.2): how do cooperatively owned RE projects impact social cohesion and community empowerment?
- Environmental/behavioural impacts (Section 3.3): how do RE co-ops impact public perception of and action towards local and global energy and climate-related issues?
- Factors affecting RE co-ops' impacts on communities (Section 3.4): what internal and external factors impact RE co-ops' development and subsequent generation of *outcomes*?

Prior to presenting the review's findings, it is important to note that resources published by support organizations are inclined to highlight RE co-ops' positive impacts and may tend to overlook their potential negative ones. Moreover, only a very limited body of research looks into the

experiences of RE co-ops that failed to generate positive outcomes (Walker et al., 2010; Huybrechts and Mertens, 2014). Consequently, this literature review predominantly features positive impacts of RE co-ops. Notwithstanding, the author recognizes that these projects' success in generating positive impacts can be affected by numerous community-specific factors, which will be highlighted throughout Section 3.

3. Findings

3.1 Economic impacts

3.1.1 Economic impact on shareholders

The cooperative business structure enables individuals to share the costs, risks and responsibilities of capital-intensive RE projects that they may be individually unable to undertake (Cato et al., 2008). Once these RE projects become operational, members also share the economic rewards of generated electricity and/or heat. Existing literature points out that these economic rewards were realized through: (i) energy sales to the grid, (ii) consumption of generated energy by members, (iii) a combination of sales and member consumption, and (iv) generation of additional economic opportunities.

Firstly, economic rewards can be in the form of a stream of revenue if the generated electricity is sold on the market. This type of revenue generation is especially significant for RE co-ops in jurisdictions where feed-in-tariffs (FITs), or long-term electricity sales contracts for renewable energy, are in effect. Since the introduction of the first FIT law in 1991 in Germany², 136,000 citizens invested a total amount of 426 million euro in RE co-ops, which on average provided a 3.99 per cent return on these investments (DGRV, 2013a). In addition, the introduction of FITs in the UK (Willis and Willis, 2012), Denmark (DTI, 2004) and Ontario, Canada (FCPC, 2013) resulted in an increase in the number RE co-ops.

Secondly, literature points out that numerous RE co-ops have been established by communities-of-location in responding to their own electricity and/or heat consumption needs (DTI, 2004; DGRV, 2013b). For instance, combined heat and power (CHP) plants have been installed by RE co-ops in Denmark, Sweden (DTI, 2004) and Germany (DGRV, 2013b) to simultaneously provide electricity and heat for the use of the local community.

² The *Gesetz über die Einspeisung von Strom aus erneuerbaren Energien in das öffentliche Netz* (BGBl. I S. 2633), or *Stromeinspeisungsgesetz* in short, was passed on December 7, 1990 and became effective as of January 1, 1991.

Thirdly, several RE co-ops from Germany (DGRV, 2013b) and Denmark (MacArthur, 2010) enabled their members to simultaneously realize revenues and cost savings through involvement in both energy sales and local consumption. Although this paper solely focuses on cooperatives that are in the business of generating electricity and/or heat, it is worth mentioning here that some RE co-ops in Germany expanded from energy generation to buying and managing their local grid, which led to costs savings for their members through the elimination of the middle layers of power suppliers (DGRV, 2013b).

The fourth type of economic reward realized by RE co-ops is the generation of additional income for their members. For instance, besides generating heat and electricity for local consumption, farmer-led RE cooperatives in Germany (DGRV, 2013b), Austria (Schreuer and Weismeier-Sammer, 2010), Finland (Peltola, 2007) and Sweden (DTI, 2004) generated additional income for farmer members through buying their manure, livestock and other biological sources for energy generation purposes. Furthermore, farmer members received the processed manure back as an improved fertilizer (DTI, 2004; ILO, 2013).

It is important to note however that the above-listed economic benefits of RE co-ops are only available to those who are willing and financially able to invest in them (Walker, 2008). Although the minimum investment required to become a shareholder varies among RE co-ops, certain community members may not have the financial means to meet the requirements. Furthermore, existing research almost exclusively focuses on the experiences of RE co-ops from countries and communities with strong economic capabilities. While some policy reports and case studies of the use of RE in low-income communities have been produced (Agyeman and Evans, 2003; Center for Social Inclusion, 2010; Toroitich, 2012; World Resources Institute, 2013; Clean Energy Group, 2014), further in-depth research is required to identify strategies that could enable low-income communities and community members to participate in RE generation through cooperatives.

3.1.2 Local economic impacts

Existing research points out that successful RE projects owned by communities-of-location have the potential to help keep the economic benefits of renewable energy generation in the local economy. A study conducted in Iowa, US (Galluzzo, 2005) revealed that financial resources that remain in the host community are five-fold for small-scale wind projects owned by the local community compared to large-scale wind projects owned by out-of-state companies. This figure was calculated considering direct (i.e., on-site employment), indirect (i.e., business activity that results from the project), and induced (i.e., change in wealth and income of community members resulting from the project) economic effects (ibid.). Furthermore, Lantz (2009) compared the employment creation impact of RE projects owned by communities-of-location to hypothetical corporate projects developed by out-of-area organizations. The findings pointed at varying outcomes across projects, but the general pattern revealed that community-owned projects' impact on employment creation is 1.1 to 1.3 times higher during construction period, and 1.1 to 2.8 times higher during

the period of operations (ibid.). Here, it is worth mentioning that the abovementioned findings reveal the potential economic impacts of RE projects developed and owned by communities-of-interest. Consequently, these findings may not necessarily represent the economic potential of RE co-ops developed by communities-of-location. Furthermore, numerous cultural, social, economic and political factors impact the ability of RE projects owned by communities-of-location to generate positive local economic outcomes. These factors will be discussed further in detail in Section 3.4.2.

Whether developed by communities-of-location or communities-of-interest, RE cooperatives seem to be inclined to work in collaboration and/or partner with various stakeholders. RE co-ops have previously developed joint projects with local utility companies (DTI, 2004; Gervitz and Lipp, 2015; Duguid, 2007), schools (Willis and Willis, 2012), local businesses (DGRV, 2013b), government agencies (DGRV, 2013b), not-for-profit organizations (Willis and Willis, 2012), and other cooperatives (DTI, 2004). These partnerships enable the distribution of RE projects' economic benefits throughout the local economy and can also pave the way for future collaborations and partnerships. In addition, the democratic decision-making processes inherent in the cooperative business model enable co-op members to collectively decide how to spend surplus funds. In several cases, RE co-ops have invested their surplus funds in other community development activities (Hoggett, 2010; Community Power Fund, 2013; DGRV, 2013b). A developer of the River Bain Hydro Co-operative in the UK, for instance, stressed that, as members of the co-operative are also members of the local community, they would all benefit from investing in other programs that would enhance community life (Willis and Willis, 2012).

3.2 Social impacts

The democratic ownership and management structures of cooperatives have been linked to fostering social cohesion among its members (MacPherson, 2003; Fairbairn, 2006). The literature on RE co-ops reveals that this positive social outcome has also been generated by RE co-ops in various jurisdictions (Duguid, 2007; Willis and Willis, 2012; DGRV, 2013b). For instance, a member of Valley Wind Co-operative in England claimed to feel “a strong sense of community” through involvement in the project (Willis and Willis, 2012: 12). Meanwhile, members of Energiegenossenschaft Lieberhausen eG from Germany report that while “in the old days the tone was one of heated debate and dispute—these days, decisions are reached far more quickly” (DGRV, 2013b: 12). This change in member attitudes towards collective decision-making processes supports existing literature that identifies cooperatives as organizations where various types of learning takes place for members (MacPherson, 2003; Vieta, 2014; Webb and Cheney, 2014).

Another reported social impact of RE co-ops is the creation of new linkages within communities—both of location and of interest—(DTI, 2004; Willis and Willis, 2012; DGRV, 2013b). As mentioned in Section 3.1.2, it is common for RE co-op projects to bring together multiple stakeholders through joint ownership and professional service contracts (DTI, 2004). In Denmark, for instance, Hashøj Biogas Co-operative provided gas for the local CHP plant owned

by Hashøj Kraftvarmeforsyning Co-operative. The relationship between Hashøj Biogas and Hashøj Kraftvarmeforsyning demonstrates RE co-ops' potential to improve linkages between the urban and rural residents of geographic proximity. This relationship brought together and benefited the entire community through generating revenue for rural residents and electricity and heat for the urban residents (ibid.).

Existing research points out that RE co-ops can also increase communities' confidence, interest and capacity to take collective positive action. For example, a survey undertaken by Co-operatives UK revealed that RE co-op members involved in project development experienced an increased confidence in finding collective responses to local issues over the long term (Willis and Willis, 2012), the "empowering impact of raising funds from within the community and not some big company from somewhere else" (ibid.: 26).

However, RE co-ops, despite their democratic ownership and governance structure, do not automatically entail the generation of positive social outcomes. The nature of the *process* and *outcome* of community-owned energy projects seem to be a significant determinant of their social impact (Gross, 2007; Walker et al., 2010). Walker et al. (2010) compared the experiences of Moel Maelogan in Wales and Gamblesby in England, two rural communities of similar economic backgrounds that developed RE projects labelled as "community-owned." The wind project in Moel Maelogan was owned cooperatively by three local farmers that did not show an effort to involve other members of the local community in decision-making processes, and later expanded the project and sold it to an out-of-community electricity company. The result was diminished trust and increased social friction among the residents of Moel Maelogan. Differently, residents of Gamblesby planned, fundraised for and installed a ground source heat pump for their previously unusable village hall. The planning process was open to all residents and encouraged their participation, and the revival of the village hall generated shared positive outcomes for the entire community. Consequently, residents of Gamblesby mentioned experiencing an increased trust and connection to other residents, and enhanced confidence in developing community-owned projects. Similarly, Huybrechts and Mertens (2014) highlight two instances from UK and Belgium where RE co-ops served to further widen pre-existing social divides within communities. In these cases, the RE co-ops were "associated with a particular ideological stream, typically with the local green party" (ibid.: 204) and faced strong opposition from individuals with different political tendencies.

These varied experiences demonstrate that, despite their perceived potential in enhancing social cohesion, RE co-ops may also generate social friction between shareholders and other community members who may feel that they are bearing the costs without benefiting from the project. Further research is required to look into the experiences of RE co-ops that failed to generate positive social outcomes.

3.3 Environmental impacts

3.3.1 Cultivating a culture of conservation

Perhaps the most widely acknowledged environmental benefit of renewable energy technologies is their minimal greenhouse gas emissions throughout their life cycle in comparison to fossil fuels (World Energy Council, 2004). Notwithstanding this, in achieving and sustaining the transition away from traditional methods and sources of electricity, expansion of renewable power supply must be accompanied by a curtailing of demand for electricity (Roseland and Connelly, 2005). The current scheme of centralized global electricity production from traditional sources creates a spatial, and consequently psychological, distance between energy generation and use (Pasqualetti, 1999), which results in a lack of public awareness about the economic, social, environmental and personal impacts of electricity generation and use (Warren and McFadyen, 2010). In response, RE co-ops could help reduce the spatial, social and psychological detachment of the public from energy systems via community ownership, and thereby transform “end-of-wire” consumers to “energy citizens” or “prosumers” (i.e., producers and consumers). There is a growing body of literature identifying prosumers as being inclined to take individual and collective action towards energy conservation (Stern et al. 1999; Devine-Wright, 2007; Sioshansi, 2013; Nowak, Rychwalska and Szamrej, 2014; Reid, Ellsworth-Krebs and McCauley, 2014). Furthermore, the reduction of the geographic and psychological distance between electricity generation and consumption helps individuals gain an “elevated awareness of consequences, ascription of personal responsibility and personal norms that Stern et al. (1999) identified as psychological determinants of pro-environmental behaviour” (Devine-Wright, 2007: 73).

Furthermore, Huybrechts and Mertens (2014) argue that RE co-ops distinguish themselves from mainstream electricity corporations through directly promoting energy conservation. They point out that several RE co-ops from various parts of the world included in their missions and implemented methods to help their members reduce their consumption. That being said, the qualitative and quantitative impacts of RE co-ops on their members’ energy consumption behaviours deserve further attention and inquiry through research.

3.3.2 Public perception of renewable energy

A significant obstacle in the way of the expansion of clean power supply is the negative public perception towards certain renewable energy projects. Mostly over-simplified as the not-in-my-backyard (NIMBY) movement, community members worldwide are opposing renewable—mostly wind energy developments—not only due to the resulting noise and negative visual impacts on the landscape, but also a lack of community consultation process by project developers and perceived economic injustices (Rogers et al., 2008; Walker et al.,

2010; Warren and McFadyen, 2010; Huybrechts and Mertens, 2014). If decisions regarding a project are made through closed and mostly institutional processes, and the outcomes of the project benefit a limited number of individuals and/or organizations that are distant to the host community, community members may feel that the project is being imposed upon them and that its disadvantages outweigh the advantages (Gross 2007; Pahl 2007; van der Horst 2008). In contrast, RE co-ops from various jurisdictions have shown that public acceptance of RE projects is enhanced and the public can become supportive of renewable energy initiatives when included in the deliberation process. For instance, the residents of Zschadraß in eastern Germany, where a wind energy project is owned cooperatively by the community, have been consistently more positive towards renewable energy compared to the residents of the nearby town of Nossen, where a private developer owns a renewable energy project (Musall and Kuik, 2011). When one hundred residents from both communities were asked about their attitudes towards an increased use of wind energy in their community, positive responses received from Zschadraß were over triple of those received from Nossen.

Similarly, plans for a commercial, developer-owned wind farm near Seeheim-Jugenheim in western Germany faced a high level of adversity from the local residents and media. When the developers of the project and the local energy cooperative agreed to joint ownership of the project, local residents' perceptions changed drastically and 230 residents from the region, almost half being from the direct vicinity of the site, invested in the WindSTARK1 project (DGRV, 2013b: 9). The experience of Valley Wind Co-operative (VWC) in Huddersfield, England serves as another testimony to the potential of RE co-ops for increasing public acceptance of RE. Prior to marketing their project, the founders of the VWC conducted an initial survey, which revealed that 82 per cent of people were in favour of wind energy development in the area. Subsequently, they conducted a second survey after declaring that the project was going to be cooperatively owned and noticed an increase of 7 per cent in community members supporting the project (Willis and Willis, 2012).

It is important however not to assume the automatic success of RE co-ops in increasing public acceptance of RE. In certain cases, RE co-ops even served to reinforce opposition to RE facilities, as the cooperative was "associated with a particular ideological stream, typically with the local Green Party" (Huybrechts and Mertens, 2014: 204). Consequently, these RE co-ops faced strong opposition from individuals with different political tendencies and caused the further widening of pre-existing social divides. Overall, as Huybrechts and Mertens (2014) argue, RE co-ops that are comprised of pluralistic groups of individuals seem to be more likely to improve the public perception of RE.

3.4 Factors affecting RE co-ops' impacts on communities

3.4.1. Barriers to RE co-ops' emergence

In order for RE co-ops to realize the economic, social and environmental outcomes mentioned in Sections 3.1, 3.2 and 3.3, they first need to overcome various barriers to their market entry. One of the most significant barriers faced by RE co-ops is access to capital, especially during their start-up phase (Huybrechts and Mertens, 2014: 206). The lack of sufficient resources in initial phases translates into limited access to paid services from staff and professional consultants (Seyfang, Park and Smith, 2012), and reliance on the work of a dedicated group of volunteers with key financial, legal and technical skills (van der Horst, 2008; Walker, 2008; Willis and Willis, 2012; Community Power Fund, 2013; DGRV, 2013b). Furthermore, RE co-ops may seem less attractive to financial lenders and investors that are primarily looking for profit maximization (Huybrechts and Mertens, 2014). Consequently, RE co-ops could end up having to raise a significant portion of their project equity from their members, which could lead to under-capitalization in the capital-intensive RE sector. In the face of this challenge, several RE co-ops have entered into joint venture agreements with public entities, other community-based organizations and corporate actors (Duguid, 2007; Willis and Willis, 2012; DGRV, 2013b; Huybrechts and Mertens, 2014). Further research would help in developing a stronger understanding of the power relations inherent in joint ventures, how they compare and contrast between national and regional jurisdictions and how these impact RE co-ops' independence and impact.

Furthermore, other factors that have been identified as preventing RE co-ops from entering the energy market include: limited access to locations for RE facilities (Schreuer and Weismeier-Sammer, 2010; Huybrechts and Mertens, 2014), limited access to the electricity grid (Lipp, Lapierre-Fortin and McMurtry, 2012; Huybrechts and Mertens, 2014) and lack of available support mechanisms for project development and financing (DTI, 2004; Walker, 2008; Seyfang et al., 2012; Community Power Fund, 2013). Consequently, a supportive political landscape is considered by an extensive body of literature to be a deciding factor in the successful development of RE co-ops (DTI, 2004; Walker, 2008; Walker and Devine-Wright, 2008; Lipp, Lapierre-Fortin and McMurtry, 2012; Seyfang, Park and Smith, 2012; Willis and Willis, 2012).

A survey conducted in Thirlmere, England (Rogers et al., 2008) revealed that communities could also face perceptual barriers in setting up their own RE projects. While Thirlmere residents widely supported local renewable energy generation, they showed a lower desire for active involvement in potential projects due to the perceived difficulty of setting up a community-owned energy project among local residents, and a lack of confidence in the community's ability to lead the project (ibid.). Authors of the study link this reluctance to the long history of centralized control of energy policy and planning in the UK, which led individuals towards a tendency to expect leadership from outside agencies, uncertainty about the roles and responsibilities of different parties in a community-owned

RE project and a lack of confidence in assuming such responsibilities (ibid.). Furthermore, low levels of awareness among the general public, politicians, the financial sector and other potential partners in regards to the cooperative model are also identified as constraining the emergence of RE co-ops (Huybrechts and Mertens, 2014).

3.4.2 Type of community forming the RE co-op

The distinction between RE projects developed by communities-of-location (i.e., geographically bound communities, also called “communities-of-place” or “communities-of-geography”) versus communities-of-interest (i.e., communities bound by various groups with similar interests) has previously been introduced in Section 2.3. Within communities-of-location, existing levels of trust (Rogers et al., 2008; Walker et al., 2010), familiarity with co-operatives (DTI, 2004; Willis and Willis, 2012), and a history of cooperation and successful community projects (DTI, 2004; Walker et al., 2010; Willis and Willis, 2012; DGRV, 2013b) are recognized as local factors affecting successful project implementation by RE co-ops. Existing studies also highlight that the impacts of RE projects developed by communities-of-location are felt and shared directly at the local level (DTI, 2004; Willis and Willis 2012; DGRV, 2013b), which can lead to an increased participation, involvement and a sense of connection to the project. In contrast, communities-of-interest usually establish cooperatives to attract investment from a wider population driven by economic and/or environmental motives. Although these projects could play an important role in expanding the reach of RE co-ops to a greater number of individuals, they could also result in a widened geographic and psychological distancing between members, the broader public and decision-making processes (DTI, 2004). This increased risk of distancing can also reduce public participation and involvement, and thereby water down the social and behavioural impacts of RE co-ops.

4. Conclusion

Overall, the findings in this literature review show that successful RE co-ops generate positive economic, social and environmental outcomes while accelerating the social and psychological dimensions of the global transition towards clean energy sources. In the economic sphere, RE co-ops allow individuals to share the costs, risks and responsibilities of capital-intensive RE projects, and thereby enable them to become active participants in a sector historically dominated by state and corporate actors. Besides generating economic benefits for their members in the form of energy savings and/or dividend payments, successful RE co-ops manage to uplift local economies through: (i) providing employment opportunities; (ii) partnering with other local organizations; and (iii) creating additional business opportunities. In the social sphere, RE co-ops provide a platform for individuals to collectively develop and work towards achieving common goals through democratic

decision-making and resource pooling. Finally, in the environmental front, successful RE co-ops contribute to the imperative transition towards a sustainable energy sector through nurturing a culture of conservation and increasing public acceptance of RE projects.

However, RE co-ops' success in generating positive impacts is often limited by their lack of access to capital during the critical start-up phase and a resulting over-reliance on supportive policy environments. RE co-ops' success is also constrained by numerous community-specific factors such as: (i) the type of community developing the project (i.e. community-of-interest versus community-of-location); (ii) existing levels of trust within a community; and (iii) a community's past experience in undertaking community development initiatives. Without the participation of a pluralistic group of individuals and ensuring of collective decision-making *processes* and equitable *outcomes*, these three factors could potentially lead to the further widening of social gaps within communities. Furthermore, as discussed in Section 3.4.1, RE co-ops face two main perceptual barriers: (i) on the part of communities, a lack of individual and collective confidence in undertaking successful RE projects; and (ii) external to communities, low levels of awareness among the general public, politicians, the financial sector and other potential project partners.

This literature review also identified the need for further research to provide insight into the experiences of RE co-ops that failed to produce positive economic, social and environmental outcomes; to identify methods that could support their proliferation in communities with various economic capabilities; and to assess their qualitative and quantitative impact on members' awareness and behaviours in regards to energy conservation.

According to the *Achieving better community development model (ABCD)* developed by the Scottish Community Development Centre (SCDC), the *process* of developing community projects needs to involve community organizing, participation and involvement from the part of the citizenry, which brings about personal and community empowerment (Barr and Hashagen, quoted in Ledwith, 2011: 81-83). This empowerment would then result in community action to undertake projects aimed at enhancing some or all of the social, economic, environmental, educational, political and cultural dimensions of community life. RE co-ops, with participatory *processes* and shared *outcomes* embedded in their business structure, provide a platform for communities to collectively develop energy solutions according to their needs and assets. The true advantage of the RE co-op model for community development rests in its long-lasting impact on personal and community empowerment: when successful, RE co-ops build individual and collective confidence, interest and capacity in taking positive action towards "more sustainable, liveable and equitable" community and planet (ibid.: 83). In this regard, it is imperative for social movements and policy-makers across the world to learn from the experiences of existing RE co-ops and to provide the necessary support for their future proliferation.

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