

1st Energy Economics Iberian Conference, EEIC | CIEE 2016, February 4-5, Lisbon, Portugal, APEEN (www.apeen.org) and AEEE (www.aeee.es)

Community Renewable Energy - Research Perspectives -

Nikola Šahović^{a, b, a}, Patricia Pereira da Silva^{a, b, c}

^aEnergy for Sustainability Initiative (EjS), Department of Mechanical Engineering, University of Coimbra, Rua Luís Reis dos Santos, Pólo II, 3030 - 788 Coimbra, Portugal

^bInstitute for Systems Engineering and Computers (INESC Coimbra), Rua Sílvio Lima, Pólo II, 3030-290 Coimbra, Portugal

^cFaculty of Economics, University of Coimbra, Av. Dias da Silva 165, 3004-512 Coimbra, Portugal

Abstract

A growing body of literature is addressing the emergence and impact of community renewable energy (CRE) schemes in Europe through focusing analysis on typology distinctions, governance models, financial characteristics and membership structures. The existing research has almost exclusively studied the emergence of CRE through a country specific prism and using economic and sociological theoretical models, with very few case studies, also of limited scope. The aim of this paper is to provide an overview of literature studying CRE schemes, in particular renewable energy cooperatives, to identify research gaps and to derive a research agenda for further examining the developing sub-sector.

© 2016 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review by the scientific conference committee of EEIC | CIEE 2016 under responsibility of Guest Editors.

Keywords: Energy transition; Social economy; Community renewable energy; Renewable energy cooperatives; Renewable energy policy; Cooperative identity.

1. Introduction

Rising concerns over climate change impacts, environmental sustainability and security of supply have exerted pressure towards initiating reform in the energy sector during the past two decades. Global efforts aim at a transition towards sustainable energy provision and use, in the industrial, transport, commercial and household sectors. This transition has resulted in application of new and reemergence of existing,

^a Corresponding author. Tel.: +351-915-870-258.

E-mail address: nikola.sahovic@gmail.com

during the past five decades to a certain extent sidelined [1-3], business models for production, distribution and trade of energy products. Namely, at the grassroots level it has included the establishment of community renewable energy (CRE) schemes, including renewable energy cooperatives and other forms of local or community based ownership/governance of renewable energy technologies. The European Union, in its Energy Union Package [4], encourages this path through outlining a vision of an Energy Union with citizens at its core, where citizens take ownership of energy transition, benefit from new technologies, and participate actively in the market.

But what is it that is distinctive about community projects and technology installations that distinguishes them from other renewable energy (RE) projects? In broader terms, as enterprises they belong to the Social Economy. This is a middle-path, or third sector that lies between the private sector dominated by investor owned firms, and the public sector dominated by state owned enterprise. Within it they can be defined as a set of:

“...private, formally organized enterprises, with autonomy of decision making and freedom of membership, created to meet their members’ needs through the market by producing goods and providing services, insurance and finance, where decision-making and any distribution of profits or surpluses among the members are not directly linked to the capital fees contributed by each member, each of whom has one vote...” [5].

Furthermore, community energy projects have introduced new forms of socio-economic organization to the system of energy provision. While the classical regime of energy provision usually involves highly centralized energy infrastructures with „end-of-wire captive consumers” [6], locally and cooperatively owned enterprise for energy production and/or supply can constitute a substantially different model of energy provision and distribution.

Although there is no universally accepted consensus in literature, policy makers, academics and practitioners infer varying degrees of community involvement in the CRE term [7]. Based on their survey carried out in the UK, Walker and Devine-Wright [8] identify the particularities of the ‘process’ and ‘outcome’ dimensions of renewable energy projects as indicative whether schemes deserve the ‘community’ prefix. From the first point of view, community projects are considered as those with a high degree of direct involvement and decision-making influence of local people in the planning, installation and operation of a project. The second perspective is concerned with where the benefits of a project are distributed, and is exemplified in community projects through local job creation, contribution to local infrastructure regeneration, providing local education resources and sensitizing the local population to sustainable energy provision topics (in addition to the wider global contribution towards further renewable capacities accumulation).

Within this defined scope, community renewable energy initiatives analyzed in literature still remain quite multifaceted, and a diversity of ownership models exists. Projects can be either completely owned by the community or developed in partnership with private or public sectors. Such ventures include many legal and financial models, such as cooperatives, community charities, development trusts representing communities’ interests, and shares owned by community based organizations [9]. Patterns of ownership are determined by project initiators and managers, who themselves operate within the boundaries set by locally applicable legal forms, available financing schemes, and equity capital. The relevance of the emerging sector is embodied in the fact that such alternative ownership schemes are responsible for

significant renewables' capacities in a number of European countries, most prominently in Germany where they constitute nearly 50% of installed RES capacities, 70% of which is owned by individuals, communities and cooperatives [10], and in Denmark where 70% of wind power plants are owned by cooperatives and farmers [11].

Renewable energy cooperatives constitute the single most common business model in continental Europe and are most scalable in terms of member participation and scope of technology application among the variety of institutional, legal and financial models utilized for setting up CRE schemes. They are the prevailing institutional framework for involving citizens with political, social and financial aspects of renewable energy deployment, thus “democratizing” the energy sector [3].

Consequently, the aim of this review is to develop a preliminary overview of directions taken by researchers investigating the field of RE cooperatives, to identify perspectives, methodologies and tools used to explore the roles and impacts of cooperatives in the energy sector and the endogenous and exogenous factors that impact their work and affect realization of set goals. The purpose the review is to summarize the existing research, their results and insights gained, and to derive a set of topics and specific questions that can serve as a roadmap for future studies addressing the subject of RE cooperatives.

The remaining sections of this article are structured as follows. Section 2 revisits the concept of cooperative enterprise, provides a brief background of the conditions of its historical development in terms of the market induced challenges it was conceived to tackle, and describes its main features, internal organizational structure, underlying social values and ethical principles that guide operations. Section 3 contains the review of existing literature, structured according to the main aspects of RE cooperatives that it addresses, and presents the frameworks and methods applied and, conclusions obtained within its scope. Based on the studies identified in literature, section 4 discusses ideas for future research tracks in renewable energy cooperatives. Finally, section 5 concludes this paper with a specific research proposal that we think can lead to enhancing knowledge of the inner-workings, role and socio-economic impacts of cooperatives as actors in the energy sector.

2. Revisiting the concept of cooperative enterprise

The cooperative enterprise is active across virtually all industries: agricultural producer supply chains, consumer retail buying groups, financial credit societies and mutual funds, housing and building societies, workers cooperatives, cooperatives focusing on health and social care, as well as in energy production, distribution and trade (which are subject of this overview).

According to Henry [12], who summarizes the main features of cooperatives identified in relevant literature, cooperatives are autonomous self-help and member-controlled enterprises, which members join voluntarily and in which they enjoy equal rights, responsibilities and obligations. As social economy enterprises, cooperatives must also be democratic (one-member-one-vote principle), and members must own a part of the assets. The universally accepted definition states that cooperatives “...are autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations through a jointly owned and democratically controlled enterprise”^b. They should be designed

^b International Labour Organization - Recommendation 193 concerning the promotion of cooperatives.
See: http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:R193

to provide services for the exclusive benefit of their members and be member – not investment – focused. The creation of employment and the enhancement of member welfare and education are also features that define these organizations.

Cooperatives carry with them underlying social values and ethical principles. Around the world cooperatives operate according to the same seven core principles and values adopted by the International Co-operative Alliance (ICA). Those principles are: voluntary and open membership; democratic member control, economic participation by members; autonomy and independence; education, training and information; cooperation among cooperatives; and concern for the community^c.

According to Miller [13], the economic fundamentals of cooperatives are embodied in its focus on the enhancement of benefits of all its member patrons rather than a relatively small number of people who share the capital of an enterprise. The cooperative seeks to remove monopoly control within markets and in doing so promote economic equality and prevent economic privilege. The history of the cooperative movement demonstrates that the cooperative is formed in circumstances where the conventional investor owned firm or the government sector solution is not viable [1]. Due to its focus on member benefits, local supply or service, and the founding principles of democratic governance that have guided Cooperatives since the 1840s, it is often an effective business model for enhancing disadvantaged communities or regions. As such, of all the areas where the cooperative enterprise has the potential to make its greatest contribution is that of regional economic development. The cooperative was born in an environment of social and economic disadvantage, as a mechanism for self-development. Its utility within rural and regional communities as a vehicle for filling market failures highlights this capability.

There are a number of cooperative business models, and they are constantly evolving in terms of internal governance and external practices [14]. Traditional cooperatives are democratically controlled, with all members having an equal voice regardless of their equity share. In practice, a General Meeting composed of all cooperative members (or designated representatives in large cooperatives) elects the executive arm of the cooperative, the Board of Directors. A Board of Directors is made up of elected co-op members who are involved in day-to-day business operations, and who receive compensation for their role in accordance with the prevailing national cooperative laws (or where not strictly regulated at the national level, in line with the cooperatives internal by-laws). In addition, cooperatives have a Supervisory Committee, tasked with overseeing the Board of Directors and reporting their findings to the General Meeting. Other cooperative models, such as the Participative, Subsidiary and the New Generation cooperative (the detailed discussion of which is outside the scope of this article) are also quite distinct in comparison to corporate entities controlled by shareholders according to their investment share, where profits are distributed through i.e. annual dividends based on shareholding, and where corporate directors make business decisions. Cooperatives are also unlike nonprofit organizations, in which due to their very nature the non-distribution constraint does not allow distribution of profits (if any) among members [15], and which are usually controlled by a board of directors who are not receiving compensation, performing on a voluntary basis [16].

3. Avenues of research in community energy and the renewable energy cooperatives fields

^c Source: International Cooperative Alliance – www.ica.coop

And according to the literature [3, 17-18] as social and economic enterprises, renewable energy cooperatives strive for economic, social and cultural advancement of its members by following goals other than profit maximization. The one-member-one vote principle distinguishes them from enterprises with control rights that are proportionate to equity. Both the principles of democratic control and of voluntary and open membership make cooperatives particularly compatible with the societal expectations of multi-dimensional sustainability goals of renewable energy projects. Existing research has addressed energy cooperatives from various perspectives, most commonly through application of theoretical models, while to a lesser extent via empirical studies on the subject matter.

3.1. History, technology and industry value-chain profiles

From the technology perspective, solar PV and wind energy technologies have in the literature clearly been documented as the most extensively applied systems in RE cooperatives. Photovoltaics are particularly attractive because of their modularity, simplicity, high reliability, low maintenance requirements and short lead times. These attributes qualify solar PV for a variety of applications such as decentralized energy supply for rural communities, solar home systems, solar parks, etc. Those favorable characteristics can also be attributed to the case of on-shore wind energy, where the simplicity of the power generation process, the high reliability of the technology and the availability of service providers (in countries where many RE cooperatives are found today) facilitate its application. In addition, an increasing number of rural biomass farmers' cooperatives are documented in Austria and the South Tyrol province of Northern Italy [6, 16-17].

Numerous research papers and articles review the historical development of energy cooperatives, mostly focused on USA, Canada and Northern European countries (in particular Denmark and Germany), where a strong cooperative tradition was established since the middle of the 19th century, and where energy cooperatives played key roles in rural electrification during the first decades of the 20th century (e.g. in the USA) until WWII [3, 18-19], culminating with the emergence of modern RE cooperatives in the 21st century. It is in these countries where modern-day energy cooperatives have grown as renewable energy technologies for distributed generation have matured. For instance, Yildiz et al. [3] identify four phases of cooperative development in Germany: a boom in the first half of the 20th century, an interim phase until the late 1980s, a pioneering renewable energy phase in the 1990s, and a contemporary revival of the cooperative model in the energy sector in the 21st century.

The same authors catalogue RE cooperatives in Germany using the value chain approach according to their primary activities, distinguishing generation/production, and distribution/transmission and trading cooperatives. They proceeded to carry out an evaluation of generation cooperatives by analyzing their financial statements from the 2010-2012 period, finding that in 2012 65% of the cooperatives had up to one million Euros in equity, 20% had more than two million Euros, while very large cooperatives with a capital of over five million Euros were an exception. In terms of membership, in the same year, 50% of cooperatives had up to 100 members, 30% between 100 and 200 members, while 19% had more than 200 members. In line with fundamental cooperative principles 60% of the surveyed energy cooperatives had relatively high equity ratios, between 31% and 100% [3].

3.2. Institutional analysis and cooperative governance

Apart from the overviews of historical roots, applied technologies and cooperative profiles in the industry value chain, institutional conditions, organizational analysis and transaction cost economics are the most prominent topics within cooperative literature. Transaction costs are costs associated with gathering and sharing information, as well as reaching and monitoring agreements, and are contingent on characteristics that underlie the exchange of goods and services and collective-choice activities [20]. As Menard [21] explains, transaction cost economics distinguishes markets, hierarchies and hybrids as organizational forms. Investor-owned firms are classified as markets, public companies as hierarchies, whereas cooperatives are classified as hybrids, because they entail properties of markets and hierarchies. The central characteristic of hybrids is that they maintain distinct and autonomous property rights and their associated decision rights on most assets, which makes them different from integrated firms; however, they simultaneously involve sharing some strategic resources, which requires a tight coordination that goes far beyond what the price system can provide and thus makes them distinct from pure market arrangements. Distinct features of hybrids are the pooling of assets, the significance of a contract that coordinates their members, and the avoidance of ruinous competition.

In analysing the cooperative business model, Mazzarol [1] provides a very detailed overview, focusing on six units that are of key importance for its competitive market performance:

- Validity of the business model;
- Member value creation and recognition within the cooperative;
- Financial structure and funding of the cooperative business model;
- Cooperative leadership and governance;
- Supply chain management and strategic networking within cooperatives, and
- Cooperative enterprise as a mechanism for regional economic development.

The author underlines strengths and weaknesses of the cooperative model across the six categories, as compared to investor owned firms and public enterprise, concluding that cooperatives have strengths particularly in their ability to enter and service areas of market failure, where their strategic objectives are likely to focus on areas other than maximization of shareholder returns.

Researchers have also focused on institutional framework conditions (including financial support measures) in a particular country, or the comparison of such conditions in different countries, which may have incentivized the increasing emergence of energy cooperatives. A number of authors point to feed-in regulation, standardized rules for grid-connection and tax advantages as factors that have been conducive to the development of community wind projects in countries such as Denmark, Germany and Sweden [22-24].

The mobilization of sufficient capital is also identified as an important precondition for the development of RE cooperatives. Contributions towards this goal can come from preferential conditions for the availability of loans and insurances [25] as well as by specific forms of co-ownership between commercial actors and local private investors [23]. Furthermore, Enzensberger et al. [25] also refer to the importance of socio-demographic factors, namely the presence of sufficient people with sufficient financial capacities to invest.

Hall et al. [10] study the impact of financial institutions on renewable energy ownership models in the UK and Germany. Their conclusions suggest that if the UK and other market based economies want to encourage the development of a community energy sector that can achieve results like the one Germany, they would need to do more to develop appropriate financial institutions, such as more locally oriented banks, to support this. The authors underline that such an outcome is important in terms of realizing the potential of the civic energy sector to contribute to the energy transition in these countries, and also in terms of the extent to which benefits from these investments can be retained within local communities.

From a governance perspective and taking into account the institutional features within communities and their role in shaping decisions of community actors, literature also addresses micro-level processes of negotiation, conflict and the build-up of trust in cooperatives. This framework is utilized in the study by Wirth [2] to contextualize the emergence of biogas cooperatives in South Tyrol. The author applies a qualitative methodology composed of semi-structured interviews with South Tyrolean experts from the field of biogas, innovation, energy and agriculture, and with chairmen of seven regional biogas cooperatives. The analysis of responses showed that, apart from public support schemes for renewables, such as investment grants and financial compensation for electricity fed into the grid, four institutional features of community in particular have shaped the emergence and constitution of cooperative biogas plants. Those are: community spirit, a culturally established tradition of cooperatives, the high regard for value of local energy, and farmers' common sense of responsibility in terms of protecting the local environment, the local population, and tourism from negative effects (pollution and odor nuisance). In this article energy cooperatives are discussed as a strategy towards making energy generation and consumption more local and as a promising way of governing projects that implement renewable energy technologies. In terms of energy regions and energy self-sufficiency, community energy is expected to help transform a dominantly centralized energy supply into a more decentralized one [26].

3.3. Drivers and barriers for renewable energy cooperative enterprises

In addressing the role of urban electricity cooperatives in Germany, Muller and Rommel [17] argue that exogenous factors in the political, economic, social and technological spheres lead to the observed growth in the number of such cooperatives, and propose a typology to describe the impact of the identified factors with regard to the governance of the electricity enterprise and the cost of ownership (table 1).

Table 1. A typology of factors with an impact on ownership costs of electricity cooperatives (adapted from [17])

Factors	Collective decision cost	Agency cost	Cost of risk
Political	1. Revised coop law;		4. Renewable Energy Act; 5. Electricity market regulation (unbundling);
Economic	2. Need for local investments and jobs;	6. Differentiation of energy; 7. Interaction producer and customer;	8. Externalities of renewables;
Social	3. Entrepreneurial civil society;	9. Change in ownership tenant relationship;	
Technical	10. Small scale generation		

Based on those assumptions, the authors developed a questionnaire and interviewed two management level officials of a large electricity cooperative in Germany, in order to determine which of the identified factors were key drivers in decreasing ownership costs and facilitating the emergence of electricity cooperatives. They used a subjective scale of 1-7 for assigning weight to the factors. The results were of limited scope as the interviews were conducted in only one cooperative, and as the two interviewed officials did not concur as to which factors were key drivers.

In a second example, to identify barriers towards community energy projects and the role of energy cooperatives in overcoming barriers to adoption of renewable energy Viardot [16] conducts a literature review and applies the Technology Acceptance Model (TAM^d) to the findings. The author identifies ten barriers that cooperatives are facing in adopting RE, including the perceived ease-of-use (PEOU), potentially low usefulness due to low reliability (intermittence), free-riding individual behavior, a lack of participation in community groups and lack of familiarity with RE technology.

Based on findings, the author designed a semi-structured questionnaire and interviewed 9 cooperatives (seven in Canada and one each in Denmark and the UK) in order to determine which technological, ontological and social, financial and legal, and physical hindrances represent barriers to adoption of RE in cooperatives and how those cooperatives address them. The study concludes that cooperatives undertake the following marketing initiatives to mitigate RE identified barriers:

- Information dissemination through websites, some very in-depth on the physics of RE technologies;
- Free seminars, workshops and public lectures;
- Educational tours to RE facilities or co-ops;
- Visits to energy expos.

3.4. Socio-economic impacts of CRE schemes

Several studies argue that small-scale community-based wind power projects receive strong levels of support from local people [27-29], while other authors indicate that local opposition towards wind energy projects, the so-called NIMBY^e attitude, has been reduced through local participation, participatory decision-making processes, and (equal or fair) distribution of economic benefits [24, 30-32].

However, although superior regional socio-economic impacts, as compared to those of the traditional enterprise, are commonly underlined as benefits of the cooperative model, very few studies that strive to evaluate the validity of such statements in the context of a specific RE cooperative were identified. Among such, two independent studies addressing CRE projects in the northern Scottish islands do endeavor to compute the contrasting local socio-economic impact of wind energy developments, on the one hand the impact they induce as a CRE scheme, while on the other hand their contribution to the local economy and society achieved through operating as a traditional investor owned firm.

^d Originally an information systems theory that models user technology acceptance, the TAM suggests that when users are presented with an innovation, numerous factors influence their willingness to use it. The idea of the model is to describe external factors affecting internal attitudes and usage intentions of the users, and through those, to predict the acceptance and use of the system [16].

^e Not in my back yard

Okkonen and Lehtonen [9] develop a regional-level input-output model for analyzing the CRE role in generating place-based income and employment effects of community wind power in three groups of Scottish islands. The results show that employment impacts of reinvestments can be eight times higher compared with pure traditional investor owned wind-power production impacts, building an opportunity for the maintenance and regeneration of the local economy. The social enterprise can, according to its results, be seen as an important tool for regional policy because the investments in the social enterprise in renewable energy offer development opportunities for such distant and sparsely populated rural areas. In the study region, the reinvestment of revenues offered an opportunity for organizing local services, developing community businesses and investing in infrastructure and communications. Similarly, revenues can be used to secure basic services such as health and education, the lack of which might limit future economic activities in peripheral rural areas. The authors suggest that social enterprise could be combined with appropriate place-based policy to integrate energy and regional policy aims at the community level. This would, they discuss, have positive impacts on economic regeneration, achieving the goal of low carbon economies, social cohesion and social acceptance of renewable energy.

A similar study [33] assesses of the potential local economic and employment impacts of a proposed large scale on-shore wind energy project in the Shetland islands (Scotland). The researches applied a Social Accounting Matrix (SAM), which they labeled a more appropriate tool than traditional input-output analysis for capturing the economic impacts in the particular case (isolated island group). Upon sensitivity analysis of various ownership models and alternative benefits compensation mechanisms to the local community, the study found that local ownership confers the greatest economic benefits to the local community by a substantial margin.

4. Avenues of research in community energy and the renewable energy cooperatives fields

Additional studies on the activities of renewable energy cooperatives, and their impact on the ongoing energy transition in Europe can be developed based on two distinct but complementary approaches. On the one hand, having in mind the prevailing geographical distribution of renewable energy cooperatives in Europe, a multiple cross-country comparative analysis of baseline national laws may shed light on to what extent policy frameworks influence renewable energy cooperative seeding across the continent. Namely, according to the European Federation of Groups and Cooperatives of Citizens for Renewable Energy (REScoop), in 2014 there were 2.397 CRE initiatives and renewable energy cooperatives in Europe (defined according to the REScoop as organizations operating “a business model where citizens jointly own & participate in RES and energy efficiency projects”). The overview of the REScoop membership structure reveals that the national counts of such enterprise are very disproportional. Almost 80% of member entities are based in and Austria, Denmark, and Germany while Greece, Spain and Portugal altogether are represented by only thirty-six such initiatives in the REScoop Federation [34]. In the context of the European targets for transition to sustainable energy provision and consumption, and having in mind the contribution of renewable energy cooperatives towards achieving the goals of this transition in countries such as Denmark and Germany (as described in section one), determining the impact of national policies to such outcomes can generate the development of appropriate recommendations for other countries and regions.

On the other hand, as energy production, distribution and consumption have both technical and human components, and involve human causes and consequences of energy-related activities and processes as well as social structures that shape how people engage with energy systems, it would be interesting to look beyond the dimensions of technology and economics and to include social and human elements in

energy cooperative research. To do so, it is necessary to undertake a more specific research. Only a few of the identified studies utilize field research, surveys, interviews or focus groups, cross-national or other benchmarking aspects. Such methods are essential to capturing the human dimensions to energy production/use in cooperatives. Human centered methods are also necessary to uncover the multidimensional role of attitudes, habits and experience [35] in shaping cooperative actions.

Taking into account the two identified broad research paths, as well as corresponding proposals found in the literature, further examination of the role of energy cooperatives in the energy transition can include an assessment of whether the specific attributes of cooperatives render them more advantageous (or inferior) than other businesses to undertake RE projects [16]. Furthermore, a comparative cross-country analysis on drivers and barriers could yield new insights on cultural and institutional characteristics that foster the deployment of cooperatives [3]. The analysis and cross-country comparison of citizens participation schemes can include appraisal of business models, research on the different political and institutional frameworks within the diffusion of citizens participation schemes as well as on the transferability of existing business models to countries where citizens are not active in the field of renewables, or where deployment is progressing slowly in general, in order to further streamline the transition towards clean energy.

A thorough international comparison of baseline laws (cooperative law, renewable energy, electricity markets legislation) and the effects of policy frameworks and measures on citizens participation in such schemes, including how business models can be modified to encourage stronger cooperative development in areas where they are comparatively less present [19], should be the point of departure for analysis. Such an overview can also be complimented by international comparative examination of how the transition of ownership and control structures from the traditional to the newer form of cooperative (i.e. “New Generation Cooperative”) has impacted governance and management of cooperatives that have gone through the transformation process [1].

5. Conclusion

As stated in the section 2, the goals of cooperative enterprises as legal entities differ from those of for-profit and not-for-profit entities. The cooperative’s distinctions are reflected in their objectives (mutual purpose, i.e. producer and/or supplier and/or worker cooperative), governance (democratic member control, cooperative autonomy, principle of open membership) and financial (role of capital, allocation of profits, cooperative financing) structures, which stem from the ICA Principals and are specifically set by national cooperative legislation (to a varying degree of detail from country to country [15]). Consequently, as described in section 4, there is a broad array of research opportunities in analyzing cooperative enterprise’s role in the energy sector. Here, though we propose to start with a cross-country policy benchmarking and the analysis of financing resources available and utilized by RE cooperatives.

From a policy framework oriented perspective, it is important to understand what are the specific differences in relevant national policies (including cooperative law, renewables deployment policies and tax law applicable to cooperatives and renewable energy enterprise) in countries where RE cooperatives are abundant as compared to countries where they are marginally present. Such a review can be followed up with a survey among RE cooperatives (or broadened to CRE initiatives in general) in those same countries, specifically focusing on their judgments about legislative drivers and barriers (e.g. via semi-structured interviews). This approach can highlight which policy measures that are considered as conducive to RE cooperatives in some jurisdictions are missing in others, and vice-versa. A specific

outcome of this research strategy can be a “*Community Energy Index*” (CEI), with its scale indicating the baseline conditions for development of RE cooperatives and other CRE initiatives in the individual countries (or regions) under analysis. Tools would include Likert scale application in survey questions, and processing results using Principle Component or Factor Analysis.

The proposed survey can be extended to explore aspects of project financing and the financial performance of RE cooperatives. Having in mind the prevailing geographic distribution of RE cooperatives, and taking into account the ICA principle of cooperation among cooperatives, the question of if and to what extent developed cooperatives in Northern European countries are involved in the development of new cooperative enterprise in in Southern Europe through providing financial support (and whether there are incentives for the former to do so) can be addressed. Insights can additionally be complemented through assessing the role of cooperative banks and ethical banks^f in financing cooperative enterprise in the renewable energy sector. Furthermore, from the perspective of locally available resources [25], a comparison of per capita GDP across NUTS-2^g EU regions can be conducted to understand whether there is a correlation with residents’ location specific wealth and the development of renewable energy cooperatives in European regions. In this respect it is also relevant to take into consideration whether RE cooperatives are using additional measures to secure financing, such as those stemming from cooperative membership structures, e.g. Investor Members (if in accordance with national laws), and/or whether they may be issuing cooperative securities. Finally, an analysis of the financial performance of energy cooperatives (compared to investor-owned firms), taking into account the indirect benefits for members, should be included to provide insights regarding their long-term sustainability.

Acknowledgements

The first author would like to acknowledge Fundação para a Ciência e Tecnologia (FCT) for supporting this work through the Doctoral Grant PD/BD/105991/2014, awarded on the framework of the MIT Portugal Program funded through the POPH/FSE. This work has been partially supported by the Fundação para a Ciência e a Tecnologia (FCT) under project grant UID/MULTI/00308/2013.

References

- [1] Mazzarol T. Co-operative Enterprise A Discussion Paper & Literature Review. University of Western Australia, 2009 (February).
- [2] Wirth, S. Communities matter: Institutional preconditions for community renewable energy. *Energy Policy* 2014; 70:236–246. <http://doi.org/10.1016/j.enpol.2014.03.021>
- [3] Yildiz Ö, Rommel J, Debor S, Holstenkamp L, Mey F, Müller JR, et al. Renewable energy cooperatives as gatekeepers or facilitators? Recent developments in Germany and a multidisciplinary research agenda. *Energy Research & Social Science* 2015;6:59–73. <http://doi.org/10.1016/j.erss.2014.12.001>
- [4] EC. Energy Union Package. *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee of the Regions and the European Investment Bank*. A Framework Strategy for a Resilient Energy Union. 2015. 1–21. <http://doi.org/10.1017/CBO9781107415324.004>
- [5] EESC. The Social Economy in the European Union. *European Economic and Social Council*. Brussels. 2012. Retrieved from <http://www.eesc.europa.eu/resources/docs/qe-31-12-784-en-c.pdf>
- [6] Schreuer A, Weismeier-Sammer D. Energy cooperatives and local ownership in the field of renewable energy technologies: a

^f See: <http://www.gabv.org/>, Global Alliance for Banking on Values

^g See: <http://ec.europa.eu/eurostat/web/nuts/overview>

- literature review. 2010. Retrieved from [http://epub.wu.ac.at/2897/1/Literature_Overview_energy_cooperatives_final_\(2\).pdf](http://epub.wu.ac.at/2897/1/Literature_Overview_energy_cooperatives_final_(2).pdf)
- [7] Seyfang G, Park JJ, Smith A. A thousand flowers blooming? An examination of community energy in the UK. *Energy Policy* 2013;61:977–989. <http://doi.org/10.1016/j.enpol.2013.06.030>
- [8] Walker G, Devine-Wright P. Community renewable energy: What should it mean? *Energy Policy* 2008;36(2): 497–500. <http://doi.org/10.1016/j.enpol.2007.10.019>
- [9] Okkonen L, Lehtonen O. Socio-economic impacts of community wind power projects in Northern Scotland. *Renewable Energy* 2016;85:826–833. <http://doi.org/10.1016/j.renene.2015.07.047>
- [10] Hall S, Foxon TJ, Bolton R. Financing the civic energy sector: How financial institutions affect ownership models in Germany and the United Kingdom. *Energy Research & Social Science* 2016;12:5–15.
- [11] UNDP Croatia. Innovative financing and business models for RES. Joint IRENA-ENC workshop on renewable energy. Energy Community. Vienna: 3-4 March 2016. Retrieved from: https://www.energy-community.org/portal/page/portal/ENC_HOME/CALENDAR/Other_Meetings/2016/03_Mar
- [12] Henry, H. Guidelines for Cooperative Legislation (Third Edit). Geneva: *International Labour Office. ILO*. 2012. Retrieved from http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/publication/wcms_094045.pdf
- [13] Miller, MG. The Democratic Theory of Cooperation. *Annals of the American Academy of Political and Social Sciences* 1937;191(2):29-37.
- [14] Nilsson J. Co-operative Organisational. *The Finnish Journal of Business Economics* 1999;4(99):449–470.
- [15] Fici A. An Introduction to Cooperative Law. In D Cracogna, Fici A, Henry H, editors. *International Handbook of Cooperative Law*. Berlin, Heidelberg: Springer Berlin Heidelberg; 2013, Vol. XIV, pp. 3–62. http://doi.org/10.1007/978-3-642-30129-2_1
- [16] Viardot E. The role of cooperatives in overcoming the barriers to adoption of renewable energy. *Energy Policy* 2013;63:756–764. <http://doi.org/10.1016/j.enpol.2013.08.034>
- [17] Müller J, Rommel J. Is There a Future Role for Urban Electricity Cooperatives? The Case of Greenpeace Energy. In Biennial International Workshop “Advances in Energy Studies.” Barcelona, Spain. 2010.
- [18] Sagebiel J, Müller JR, Rommel J. Are consumers willing to pay more for electricity from cooperatives? Results from an online Choice Experiment in Germany. *Energy Research and Social Science* 2014;2:90–101. <http://doi.org/10.1016/j.erss.2014.04.003>
- [19] Yildiz Ö. Financing renewable energy infrastructures via financial citizen participation - The case of Germany. *Renewable Energy* 2014;68:677–685. <http://doi.org/10.1016/j.renene.2014.02.038>
- [20] Villamayor-Tomas S, Grundmann P, Epstein G. The water-energy-food security nexus through the lense of the value chain and Institutional Analysis and Development frameworks. *Water Alternatives* 2015;8(1):735-755.
- [21] Menard C. A New Institutional Approach to Organization. In Menard C, Shirley M, editors. *Handbook of New Institutional Economics*. New York: Springer, 2007:281-318.
- [22] Bolinger, M. Community Wind Power Ownership Schemes in Europe and their Relevance to the United States. Berkeley Lab. Berkeley, California. 2001. Retrieved from <http://eetd.lbl.gov/EA/EMP/>
- [23] Bolinger M. Making European-style community wind power development work in the US. *Renewable and Sustainable Energy Reviews* 2005;9(6):556–575. <http://doi.org/10.1016/j.rser.2004.04.002>
- [24] Breukers S, Wolsink M. Wind power implementation in changing institutional landscapes: An international comparison. *Energy Policy* 2007;35(5):2737–2750. <http://doi.org/10.1016/j.enpol.2006.12.004>
- [25] Enzensberger N, Fichtner W, Rentz O. Evolution of local citizens participation schemes in the German wind market. *International Journal of Global Energy Issues* 2003;20:191-207.
- [26] Späth P, Rohracher H. “Energy regions”: The transformative power of regional discourses on socio-technical futures. *Research Policy* 2010;39(4):449–458. <http://doi.org/10.1016/j.respol.2010.01.017>
- [27] Barry M, Chapman R. Distributed small-scale wind in New Zealand: Advantages, barriers and policy support instruments. *Energy Policy* 2009;37(9):3358–3369. <http://doi.org/10.1016/j.enpol.2009.01.006>
- [28] Rogers JC, Simmons E, Convery I, Weatherall A. Public perceptions of opportunities for community-based renewable energy projects. *Energy Policy* 2008;36(11):4217–4226. <http://doi.org/10.1016/j.enpol.2008.07.028>

- [29] Warren CR, McFadyen M. Does community ownership affect public attitudes to wind energy? A case study from south-west Scotland. *Land Use Policy* 2010;27(2):204–213. <http://doi.org/10.1016/j.landusepol.2008.12.010>
- [30] Agterbosch S, Vermeulen W, Glasbergen P. Implementation of wind energy in the Netherlands: The importance of the social-institutional setting. *Energy Policy* 2004;32(18):2049–2066. [http://doi.org/10.1016/S0301-4215\(03\)00180-0](http://doi.org/10.1016/S0301-4215(03)00180-0)
- [31] Musall FD, Kuik O. Local acceptance of renewable energy-A case study from southeast Germany. *Energy Policy* 2011;39(6):3252–3260. <http://doi.org/10.1016/j.enpol.2011.03.017>
- [32] Toke D, Breukers S, Wolsink M. Wind power deployment outcomes: How can we account for the differences? *Renewable and Sustainable Energy Reviews* 2008;12(4):1129–1147. <http://doi.org/10.1016/j.rser.2006.10.021>
- [33] Allan G, Ault G, McGregor P. The Importance of Revenue Sharing for the Local Economic Impacts of a Renewable Energy Project: A Social Accounting Matrix Approach. Working Papers. 2011. Retrieved from <http://ideas.repec.org/p/str/wpaper/0811.html>
- [34] Enercoop. People Power - Renewable Energy Cooperatives in Europe. *Joint IRENA-ENC workshop on renewable energy. Energy Community*. Vienna: 3-4 March 2016. Retrieved from: https://www.energy-community.org/portal/page/portal/ENC_HOME/CALENDAR/Other_Meetings/2016/03_Mar
- [35] Sovacool BK. What are we doing here? Analyzing fifteen years of energy scholarship and proposing a social science research agenda. *Energy Research and Social Science* 2014;1:1–29. <http://doi.org/10.1016/j.erss.2014.02.003>