SUCCESS FACTORS FOR RENEWABLE ENERGY COMMUNITIES: A THEORETICAL AND META-ANALYTIC REVIEW OF THE SCIENTIFIC LITERATURE

A Research Project

by

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Abstract

The challenges of sustainable development, especially climate change and peak oil demand system-wide transformations in the sociotechnical system of energy provision. In this direction, community renewable energy has been proposed as a new policy tool to take on these challenges, and thereby help achieve a low-carbon energy system. In the paper, I introduce and analyse a special type of investor group, namely renewable energy communities (RECs). Such communities have spread across Europe, attracting increasing attention as potential sources of innovation to support sustainable energy transitions. Research into RECs has looked into these communities and their success, but a systematic analysis of the complementary, or even contradictory, success factors drawing conclusions from the existing literature is still missing. Additionally, scholars used different definitions and nuances of RECs as well as of their success, and thus a clear definition of RECs and success are essential for this study. Consequently, the aim of the study is to investigate the factors contributing to the success of RECs, with a focus on European countries. To do so, I use a meta-analysis complemented by a theoretical scientific literature review to come up with the most and least frequently cited success factors of these communities, providing relevant information for the government and all support institutions that help the establishment and operation of RECs. Additionally, by applying multi-level perspective (MLP) to this context, I seek to better understand these factors, but also how interactions between them lead to enhanced REC success. The results suggest that mainly activities within niches mostly influence REC success, but interactions between the three socio-technical levels are necessary for this success to occur. The study also indicates areas where theory can be refined to better explain the survival and spread of RECs.

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1. Introduction

The transition from fossil fuels to renewable energy is one of the greatest current challenges, especially for European governments. European governments are working towards meeting the goals of the EU climate and energy package to which they have committed themselves, while their economies and industries are still largely depended on fossil fuels (European Parliament and Council, 2009; Oteman et al, 2014). Notably, a low carbon economy is now central to the European policy and there are climate and energy targets set for 2020, known as the 20-20-20 goals. By promoting renewable energy production, the EU wants to combat climate change, secure its energy supply and increase its competitiveness in the energy sector (European Commission, 2014).

In this context, an emerging body of work has come to focus on the significance of system-wide transformations in order to move to a low-carbon economy and therefore, address the challenges posed by climate change (Foxon et al, 2009; Jackson, 2009; UKERC, 2009; WSSD, 2002). Specifically, the difficulty of overcoming path dependency and lock-in to unsustainable development trajectories stresses the importance of managing and triggering system-wide transitions (Huijben and Verbong, 2012; Kallis and Norgaard, 2010; Sartorius, 2006; Tukker and Butter, 2007). Secondly, the concept of "peak oil" (the point after which, the oil production rates decline) and its transformative implications for fossil-fuel-based societal infrastructures is another issue that attracts growing interest and conventional support (Heinberg, 2004; IEA, 2008; Sorrell et al, 2009). Given these twin concerns and claims that fundamental shifts in the nature of large-scale energy systems are required, it is pertinent to investigate the relative importance of particular factors influencing and supporting the renewable sector's development.

In this paper I introduce a special type of grassroots-led innovation, namely renewable energy communities (RECs), whose aim is to create more sustainable energy systems. Community energy production includes people in a neighbourhood, who partake in local renewable projects and generate jointly the energy they consume, forming what we call RECs (Doci and Vasileiadou, 2014). All over Europe, such communities have become fairly numerous over the last decade and have received an increasing amount of political and media attention, but they have also been proposed as a new policy tool to help achieve the transition to a low-carbon energy system by investing in renewable energy technologies jointly to cover their own energy needs (Dagbladet Information, 2013; Doci et al, 2015; Seyfang et al, 2013;

Trouw, 2013). Introducing RECs makes it possible to take a new perspective into account, focusing on the social aspects and agents behind sustainability transitions.

At the same time, however, whilst many community activists and increasingly policy makers seek to promote their growth and spread, much of the existing work on RECs has mostly identified the difficulties they face in simply surviving and being alone in exerting an essential influence over wider unsustainable systems (Seyfang, 2009; Smith, 2007; Geels and Verhees, 2011). In trying to understand how RECs might overcome these challenges, I focus in this paper on their success factors. Scholars studying the community initiatives for renewable energy as well as the motivations of citizens to join and participate in RECs, have contributed to the literature on success factors for RECs. However, even though these studies are useful and provide fertile ground in order to understand the success factors behind RECs, a systematic analysis of the complementary, or even contradictory, success factors coming from different studies is still missing. Consequently, our understanding of the key success factors for RECs needs to be enhanced. Gaining insight about these factors of RECs is crucial, if we are seeking to support the establishment and survival of community energy projects and increase the market share of renewables. With these concerns in mind, the objective of this study is to address the following question: Which factors determine the success of investing in renewables at community level? Success in this paper is defined as the survival of RECs and the realisation of their goals, such as supporting and reducing the energy costs to the local community and increasing the market share of renewable energy, as well as their establishment and continued operation in the long run.

I aim to address this knowledge deficit by firstly reviewing the existing scientific literature on the factors influencing REC success, which will help us come up with a list of the factors contributing to the success of RECs. The multi-level perspective (MLP) is potentially helpful here in studying these factors, as it analyses the development and structural changes of technology in society, how innovations emerge and shift the incumbent regime toward sustainability (Doci et al., 2015; Genus and Coles, 2008). Such a theoretical framework will be the fundamental part of my work, since in the analysis part of the study I will try to answer the research question by taking into account the success factors highlighted in the current literature on RECs. To do so, I am going to conduct a meta-analysis of the relevant studies, synthesising their findings and ending up with the most commonly cited success factors for RECs.

As a result, this study contributes to community energy literature, by focusing on elements have not been clearly defined by the existing studies, namely the success factors of RECs. Starting from the observation that RECs vary in occurrence and variety across countries (Oteman et al., 2014; Dragoman, 2014), I ask which of their success factors are the most commonly cited in the literature around RECs. A particular focus of this study is given on European countries, where RECs have seen a commendable growth in the last decade, attracting the attention of transition scholars and thus, resulting in a growing literature on RECs at the European level. By identifying the prospects of community success, it becomes clear under which conditions communities can be a partner for governments in their search to make the successful shift from fossil fuels to renewable energy. Furthermore, this research enhances the knowledge around community energy projects and provides useful information for the government as well as institutions, which are involved in the establishment and survival of renewable energy communities. Gaining a better insight about which factors determine a successful transition to renewable energy at the community level is vital for the policy makers in order to improve the operation and survival of such communities as long-term processes, by designing particular policy tools. Thus, besides studying the state of community energy success factors in Europe, the study contributes to a better understanding of successful sustainability transitions.

2. Theoretical background

2.1 The REC literature and Multi-level perspective

Seyfang and Smith (2007) highlight the RECs as "a neglected site of innovation for sustainability". Understanding RECs, they highlight a number of important ways in which RECs differ from the more mainstream, market-based innovations that to date, have been the mainstay of both empirical research and theoretical development in transition studies (Geels, 2015). These differences include among others, different resource bases, well-defined organisational forms, dissimilar contextual situations and alternative driving motivations (Seyfang and Smith, 2007). It is the nature of these differences, the fact that RECs exist in spaces where the rules, the protection for innovations, as well as the external environment of processes and factors that influence the rules are different from the mainstream, which makes RECs a deeply interesting and challenging site for the application and development of transition theories.

Since Seyfang and Smith (2007)'s work, a growing literature has focused on examining the community motivations for engaging in renewable energy projects, contributing to the literature on factors behind the success of RECs. Common across many of these studies, is the identification of the profound difficulties, RECs face even in simply surviving in the medium to the longer term, let alone in growing, diffusing or challenging mainstream systems (Hangreaves, 2013). In attempting to understand how RECs may be helped to survive for longer, diffuse and grow, we turn to developments in transition theories as offering some potentially helpful theoretical tools for studying the success factors of RECs. Here, I am particularly interested in the project of extending the MLP theory to better understand the success factors of RECs, a perspective which is now gaining increasing attention.

The MLP explains technological transitions by the interplay of processes at three different levels: the landscape, regime and niche levels (Geels, 2002; Geels, 2005). This is a nested hierarchy of structuring processes, with the co-evolution of the three socio-technical levels being requisite for transition (Geels and Schot, 2007; Doci et al., 2015). The key concept of the framework is the regime, because transitions are defined as shifts from one regime to another regime.

Regime

The socio-technical regime is located between the landscape and niche levels and refers to the semi-coherent set of rules that orient and coordinate the activities of the social groups that reproduce the diverse elements of socio-technical systems (Geels, 2011). Within the socio-technical regime, numerous sub-regimes exist, including policy, socio-cultural, markets, users and distribution networks regime, which represent different social groups and are aligned to each other by semi-coherent rule set. Examples of these sub-regimes are public authorities, financial networks, user groups and suppliers (Doci et al., 2015).

Following Smith et al. (2010), socio-technical regimes are structures composed of a co-evolutionary accumulation and alignments of knowledge, investments, objects, infrastructures, values and norms that bridge the production-consumption divide and are the current means for realising key societal functions. Additionally, according to Geels (2011) and Unruh (2000), because existing regimes are characterised by lock-in and path dependence, innovation occurs incrementally, strengthening the stability of the regime, which is resistant to radical innovation and thus, the dominance of incumbent actors, practices and rules.

Niches

In the MLP, transitions are critically dependent upon activities within niches (micro-level of the framework), where selection pressures existing in regimes are less noticeable. Niches are pivotal for transitions because they provide protective spaces for path-breaking, radical innovations, whose performance may not be competitive against the selection environment existing in the regime (Rip, 1992; Kemp et al., 1998). Consequently, niche actors work on radical innovations with the hope that they will be used in the regime or even replace it (Geels, 2011). In line with the literature on niche-innovation (Kemp et al., 1998; Schot and Geels, 2008; Geels, 2011), there are three niche development processes: the articulation of expectations and visions, which guide innovation activities and attract attention and funding from external actors, the construction of social networks and involvement of more actors, as well as the learning and articulation processes on diverse dimensions, such as market demand, business models and infrastructure requirements.

Landscape

The macro-level, the so-called landscape represents the external environment of factors and processes, which influence the regime and niche (Markard and Truffer, 2008). However, external shock to the regime can be created by slow landscape changes, like environmental, demographic or cultural changes and macro-political or macro-economic developments, as well as comparatively rapid developments, such as wars and economic crises (Geels, 2005). Landscape changes are a source of pressures on the regime level; sometimes landscapes can work to reinforce regime trajectories and at other times, they place regimes under substantial stress prompting consideration of niche alternatives (Smith et al., 2010). These pressures generate opportunities where radical innovations can break through, by undermining the regime's structure (Doci et al., 2015; Geels, 2002).

Because changes within the regime tend to be incremental, which also strengthen the dominance of current actors and technologies, only radical innovations (changes that are thoroughly dissimilar from solutions used by incumbent regime) can induce transition (Smith et al., 2010; Elzen and Wieczorek, 2005). The niche and landscape levels can be seen as "derived concepts", because they are defined in relation to the regime, namely as external environment that influence interactions between niche and regime and as technologies or practices that diverge significantly from the existing regime (Geels, 2011).

Consequently, "windows of opportunity" are created when mismatches occur at the landscape level or within the regime, where radical innovations can break through and enter the meso-level of the socio-technical system. Subsequently, once new radical technologies have came out in niches, they can take over the place of the incumbent ones and together with broader changes, form a new regime (Doci et al., 2015; Geels, 2004).

As regards renewable energy at the community level, Doci et al. (2015) and Arentsen and Bellekom (2014) argued that RECs are considered to be internally aligned social niches, not only for creating innovations for internal usage but also for fulfilling community expectations. These expectations are influenced by the social necessity to generate energy autonomously, but also by the desire to protect the environment and boost local economic growth. In this respect, innovations are the tools to meet these expectations and produce clean energy locally.

2.2 Success of RECs

In order to address the research question, first I have to define the success of RECs as demonstrated in the literature on these communities, before looking at the factors that determine this success. The success of community energy was defined by Seyfang (2013), Arentsen and Bellekom (2014) and Lepping (2014), as the emergence and development of RECs, while at the same time, achieving their potential as key players in the transition to a sustainable energy system. Likewise, for a number of authors including Rogers et al. (2008), Walker (2008) and Boon and Dieperink (2014), REC success is the establishment of these communities over time. According to Seyfang and Smith (2006), after the start-up phase, the survival and struggle to keep going are the main challenges that RECs face. Specifically, RECs spend about 90% of their time simply surviving in the medium to the longer term and only 10% developing the activity (Church 2005; Wakeman, 2005). REC success was further defined as the spread or reproduction of RECs elsewhere, while simultaneously ensuring that these communities are well connected regionally and nationally (Seyfang and Smith, 2006). Finally, another definition put forward for success is that of the survival of these communities from the "valley of death", obstacles that are blocking their embedding into the regime, in an attempt to influence and change its elements (Gallanger et al., 2006). In line with this definition, Smith et al. (2005) and Doci et al. (2015) argued that RECs have the potential to enter the regime and contribute to energy transitions, for instance through a re-orientation of technological trajectories or trajectory of emergent regime transformation.

Various factors can be found behind the success of RECs. Recent years witnessed a growing literature on RECs focusing on motivations to participate in these communities and community initiatives for renewable energy, providing solid ground for understanding the factors for successful RECs. The present study will explore these factors, while at the same time, taking into account the findings from studies focusing on energy efficiency projects, with the assumption that the success factors from these studies are similar. A large number of studies argued that having sufficient resources that are the means or assets required to start-up and operate an enterprise or organization and to ensure that they function effectively, is one factor that is vital for the RECS to be successful. To be more precise, having the necessary specialist skills, knowledge and experience, have been shown to be critical for the success of these communities (Seyfang et al., 2013; Seyfang and Smith, 2007; Rogers et al., 2008; Hinshelwood, 2001; Middlemiss and Parrish, 2010; Vandevyvere and Nevens; 2015). Seyfang et al. (2013) examining the community energy in the UK, argued that a weakness of

community energy projects is the lack of time to carry out the project work, which if sufficient, is essential for the success of these communities (Seyfang and Smith, 2007; Seyfang and Haxeltine, 2012; Hinshelwood, 2001; Harnmeijer, 2012; Avelino and Frantzeskaki, 2012). Access to information has also been found to be a particularly important prerequisite for the establishment of such communities and thus, for their success (Hinshelwood, 2001; Seyfang et al., 2013; Oostra and Jablonska, 2013; Seyfang and Haxeltine, 2012; Harnmeijer, 2012). Additionally, Walker (2008) suggested that the long-term lack of community capacity is an issue, since community capacity keeps communities maintained and operating efficiently. Following Rogers et al. (2008) and Seyfang and Haxeltine (2012), financial viability and material resources are also necessary elements for the emergence and activities of community energy groups. It is through the exchange of these resources and especially, experiences and knowledge among the members of RECs, or otherwise the residents about what matters to local people and about what works in their localities, the social learning is enhanced, which is necessary for the establishment and operation of RECs (Lepping, 2014, Seyfang, 2007; Rogers et al., 2008; Bomberg and McEwen, 2012).

A second key success factor leading to the establishment of RECs is the social cohesion and involvement of citizens in RECs. (Arentsen and Bellecom, 2014). Doci and Vasileiadou (2014), Avelino and Frantzeskaki (2012) and Van Der Schoor and Scholtens (2015) pointed out that working together in partnership within the community, gives them the opportunity to communicate and interact with the community and hence, with the society throughout the lifecycle of RECs. Participation is vital in RECs, because it leads to substantial attitude changes towards wider issues in the energy sector (Schweizer-Ries, 2008; Yildiz et al., 2014; Boon, 2012). Schipper (2014) and Avelino et al. (2014) argued further that having a high degree of social cohesion in a community leads to the social acceptance of community renewable energy, which is a crucial determinant for the success of RECs. Based on these arguments, a number of studies emphasised the importance of the involvement of citizens in a community (Seyfang and Haxeltine, 2012; Schipper, 2014), claiming that citizen involvement could also be positive for the local people's understanding of and support for renewable energy (Walker and Devine-Wright, 2008).

It goes without saying that the policy context is important in explaining the success of community energy projects. Consistent with Seyfang et al. (2014), Seyfang et al. (2013) and Dragoman (2014), a consistent and stable policy context concerning renewable energy at

community level is a crucial need. The most interesting approach to this claim has been proposed by Huijben and Verbong (2013), Oostra and Jablonska (2013), Avelino et al. (2014), Weismeier-Sammer and Reiner (2011) and Hisschemoller (2012) according to which, most of the current legal conditions, regulations, laws, tax regimes and infrastructures block out RECs, and as a result, legislation limits the spread of renewable energy projects. Feed-in Tariffs serves as a good policy example of increasing the awareness of the opportunities of RECs, as well as the financial viability of these communities, according to Seyfang et al. (2014), Nolden (2013), Oteman et al. (2014) and Kusumawardhabi (2014). Besides policy context, the support and contribution of regime and niche actors is another factor leading to the success of RECs. On the one hand, numerous studies have suggested that the financial and ideological support by regime actors as well as the contribution of these actors, such as government, municipalities, business firms, financial institutions and many others both at the national and regional level, in the form of subsidies, grants and other governmental support, are of great interest for renewable energy investors and generators (Doci and Vasileiadou, 2014; Walker, 2008; Huijben and Verbong, 2012), whilst on the other hand, Smith et al. (2010) argued that the niche actors (producers and users) undertaking these experiments are relatively more supportive of the social and environmental qualities of the niche socio-technical practice, and more forgiving of teething troubles, owning to their different expectations of future performance compared to regime members. Van der Schoor (2013), Hoggett (2010) and Lepping (2014) have concluded that the anticipation of support by several actors for RECs is seen as a fundamental part of the procedure in helping their development, while in Nolden (2013) and Hoggett (2010) it was shown that the absence of public support leads to the downward scale of RECs. Furthermore, the support by regime actors is necessary for RECs because they can save money, not to mention to reduce the transaction costs and risks (Doci and Vasileiadou, 2014; Arentsen and Bellekom, 2014).

RECs' success is also dependent on organised local networks that are critical for RECs, affecting their form, foundation and establishment (Doci et al., 2015; Seyfang et al., 2013; Blonk et al., 2013). When RECs cooperate with organisations, a range of stakeholders and individuals, thereby sharing social capital, information and experiences, they gain main resources and learn from each other, allowing them to act cohesively and collectively (Seyfang et al., 2014; NESTA, 2010; Seyfang and Haxeltine, 2012). Working with local authority, businesses and many other actors, communities can achieve their goals and increase the institutional hybridization in the electricity supply and therefore, their continuity

and survival (Hisschemoller, 2012; Hinshelwood, 2001; Bird and Barnes, 2014; Doci and Vasileiadou, 2014; Seyfang and Haxeltine, 2012; Arentsen and Bellekom, 2014). Another factor for REC success suggested by Boon (2012) and Boon and Dieperink (2014) is the high levels of environmental awareness within society, which improves local support, and stimulates the development and acceptance of RECs. Under those circumstances, protecting the environment, communities become independent from conventional energy companies and so from the escalating fossil prices (Doci and Vasileiadou, 2014; Boon, 2012).

Profitability is another crucial factor for successful RECs. In order for the RECs to succeed in the future, they need to be feasible and profitable (Arentsen and Bellekom, 2014; Huijben and Verbong, 2012; Doci and Vasileiadou, 2014; Oteman et al., 2014). It is important, though, for the success of these communities, a rational payback scheme and a suitable return on investment (Oostra and Jablonska, 2013; Doci and Vasileiadou, 2014). As reported by Boon (2012), a short payback period depending on investment costs and efficiency ends up positively on the evaluation of the applied technology. However, in order for a community to be profitable, needs to take into account both costs and benefits and to allocate its costs effectively, meaning that they have to make a precise calculation of the expected costs (Walker, 2008; Hinshelwood, 2001, Vandevyvere and Nevens, 2015; Hisschemoller, 2012 and Meeuwsen, 2013). In addition to profitability, another essential success factor is the transparency and trust between the members of the community. Transparency is indispensable for the members, giving a sense of empowerment and inclusion. According to many scholars, benefits should be clearly presented and equally distributed in a community (Oostra and Jablonska, 2013; Walker and Devine-Wright, 2008; Frantzeskaki et al., 2008; Avelino and Frantzeskaki, 2012). By transparency, we also mean that the members can understand the community, its methods and objectives and that they can trust. Developing trust with the communities pre-exists the social cohesion, as through the engagement of members with these communities, the trust of the new energy systems and communities is increased (Seyfang et al., 2013; Lepping, 2014). By informing the members about the implications, benefits of the community and its fundamental values via unceasing communication, transparency can be attained during the communication and information process, supporting the development of RECs and contributing to a successful community transition toward an energy system based on renewable resources (Dragoman, 2014; Seyfang and Haxeltine, 2012; Lepping, 2014, Seyfang et al., 2013; Rogers et al., 2008; Timmerman; 2012; Preston et al., 2009).

Another key success factor highlighted in the REC literature is the management and organisational structure of RECs. Several authors, including Middlemiss and Parrish (2010), Hoppe et al. (2015) and Bird et al. (2013) have stressed the importance of having competent managers with high levels of personal capacity, who can better identify the barriers to action, and negotiate and mediate between actors when problems occur that need solving. As stated by Lepping (2014) and Hinshelwood (2001), management in a community can raise expectations on what the technology can deliver, provides flexibility, opportunism, and has the ability to respond to the necessities of the community, through building on capacity and strengths of managers. Moreover, a well-organised system is essential to maintain momentum and overcome obstacles, and a business model is an important determinant factor involved in enabling RECs to move forward independently and succeed (Rogers et al., 2008; Avelino et al., 2014; Hisschemoller, 2012; Tonen, 2013). REC literature has also identified market incentives and characteristics, such as the existence of competitors in the energy sector as well as the renewable energy prices compared to conventional ones and their fluctuations as important factors for the establishment and success of RECs (Walker, 2008; Dragoman, 2014; Boon and Dieperink, 2014; Boon, 2012). As argued by Oostra and Jablonska (2013); Dragoman (2014) and Hisschemoller (2012), market incentives and characteristics are defined in the first place by the interrelation of the supply of and demand for renewable energy; they are a result and expression of the dynamics of all processes and phenomena forming or influencing the supply and demand, including among others the fiscal and monetary policy of governments, international transactions, as well as speculations and expectations of future actions. Another key point highlighted by Tonen (2013) related to the market incentives, is that because energy market is conservative, rising the renewable energy share is less important than grid reliability and safety.

In his study, Walker (2008) suggested that there may be models of joint ownership, which are better suited to urban environments, even though urban communities are usually less clearly defined, and arguably, less jointly cohesive and organised than rural ones. In this case we have another success factor namely, the heterogeneity of RECs, including the location, size, motivations and technology, suggesting that it is for example better to design the project to fit local context, before initiating it (Doci et al., 2014; Rogers et al., 2012). Additionally, Arentsen and Bellekom (2014) argued that technological improvements have made renewable energy technology reliable, visible, proven, providing an acceptable payback time of investment and encouraging community renewable energy usage. Lastly, a few authors

identified the stability of the community-based renewable projects and thus, of RECs as an important success factor that helps to decrease the risk of investments (Doci and Vasileiadou, 2015; Seyfang and Smith, 2007; Meeuwsen, 2013). According to Doci and Vasileiadou (2015) and Oostra and Jablonska (2013), the stability of these communities was found to influence the return on investment and thus, their profitability, as the people want to invest in stability in terms of value, instead of virtual investments (Doci and Vasileiadou, 2015; Oostra and Jablonska, 2013).

2.3 Applying the Multi-level perspective to the success of RECs

Building on the MLP theory, in this subsection I am going to see how the factors discussed in the previous subsection, contribute to the development and success of RECs. The table, below, table 1, shows which of the three socio-technical levels of the MLP, each identified success factor corresponds to. Particularly, the majority of key factors that have been identified, through a critical review and analysis of the existing studies related to RECs, as important in facilitating the development of successful RECs, exist within the niche level of the MLP. To be more precise, the resources of RECs, the support and contribution of niche actors, the social cohesion and involvement of citizens in RECs, the networks, cooperation and collaboration of RECs with various organisations, the management and organisational structure of RECs, the profitability and stability of RECs, the transparency and trust in RECs as well as the heterogeneity of these communities are factors that fit within this level. These factors provide "protective spaces" for path-breaking, radical alternatives, so that RECs can overcome the constraining influence of regimes, establish, branch out and drive transformations in regime structures over the long-term (Smith et al., 2010). Wider circles of more powerful niche actors becoming involved in ways that mobilise widespread social and environmental legitimacy is the greatest determinant of niche success (Schot, 1998). Additionally, as stated by Raven (2006), Smith (2007) and Hendriks and Grin (2007), niche development is also predicted upon the transformative ideas and capabilities, namely the resources in RECs, which help niches compete with the incumbent regimes, outperform them and take over.

However, it is the dynamic structure of the socio-technical regime that sustainable niches must overcome, if they intend to destabilise the regime and seed a transition in order to survive. Dynamics within the regime contributing to success of RECs, includes a number of

factors identified in the literature namely, the support and contribution of regime actors, the policy context, as well as the market incentives and characteristics. Dynamism may also occur through the interaction with related regimes or in response to landscape developments (Raven and Venbong, 2007; Konrad et al., 2008). In particular, the landscape category, which is responsible for influencing the niche and regime dynamics, includes in this case, the environmental protection and awareness within society. According to Smith et al. (2010), growing environmental awareness is a landscape process and a socio-cultural development, which questions the performance of multiple regimes and generates opportunities for niches. These sources of dynamism and the pressures they generate, create windows of opportunity for niche alternatives to compete for influence and survival. Consequently, since regime shifts occur through inter-linkages and interactions between multiples developments on the three levels, the co-evolution of the factors is necessary for transition and REC success, yet an analysis of which of these factors determine mostly the success of RECs needs to be carried out.

		Identified Success factors
Socio-technical levels of the Multi-level perspective	*Niche*	• Resources of RECs • Support and contribution of niche actors • Social cohesion and involvement of citizens in RECs • Networks, cooperation and collaboration of RECs with various organisations • Management and organisational structure of RECs • Profitability of RECs • Stability of RECs • Transparency and trust in RECs • Heterogeneity of RECs
	Regime	• Support and contribution of regime actors • Policy context • Market incentives and characteristics

Landscape	• Environmental protection and awareness within society

Table 1. *Identified success factors within the three socio-technical levels of the Multi-level perspective.*

3. Methodology

3.1 Search procedures

The present meta-analysis included the published REC literature until April 2015, with the majority of the studies being published during the last four-year period. The literature search encompassed studies published in books, journals, books or book chapters, and dissertations or theses, which contributed to the literature on success factors for RECs and fulfilled the selection criteria.

An extensive literature search was conducted to identify the empirical studies relevant to the topic (see Figure 1). The process began by consulting the Web of Science database using the following key words: *"local community initiativ*", "energy communit*", "community energy initiativ*" and "renewable energy initiativ*"* and Google Scholar database using the following key words: *"local energy initiatives", "community energy initiatives", "local renewable energy initiatives", "local energy cooperatives" "renewable energy initiatives" and "sustainable energy initiatives"*. From both of the electronic databases, the key words produced 177 references. The structured search was expanded using the snowball method, where a manual search of the reference lists of the publications identified in the structured search was conducted. This approach is important because some major work appeared not to be published in peer-reviewed papers. After excluding duplicates, a total of 164 articles, books and book chapters was found. The publications identified using both approaches were then reduced after a detailed inspection of the manuscripts and the application of the selection criteria, resulting in a final selection of 60 articles. The majority of the excluded sources were eliminated for three main reasons namely, a lack of data in order to carry out the meta-analysis, papers that looked into RECs in countries other than European countries and the irrelevant content (e.g., similar keywords but different content).

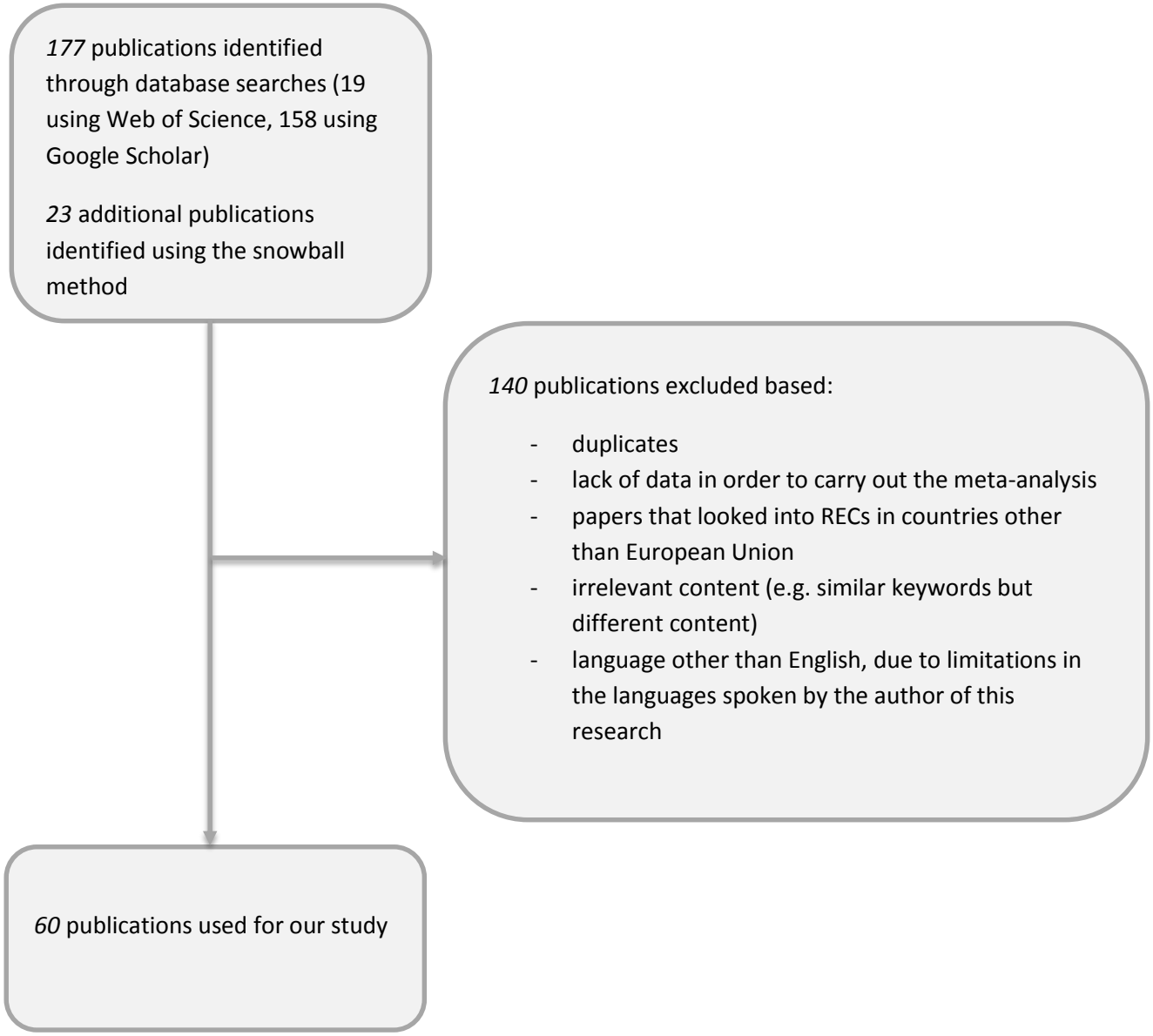

Figure 1. *Flow diagram outlining the literature selection process.*

3.2 Coding of studies

A description of the variables that were coded in the meta-analysis is presented below. If information for a variable was not available in a study, it was coded as "missing" (see third paragraph, how this was addressed). For variables that required coder judgement, studies that did not report enough information to make a reasonable judgement were coded as "cannot be determined".

The variables were coded as follows: (a) *trial number* (number of study included in meta-analysis in ascending order), (b) *trial name* (name of author(s)), (c) *year of data collection*,

(d) *methodology used in each paper* (literature review (including snowball method), qualitative analysis (including interviews, comparative analysis, case study research, fieldwork, workshops and monitoring of community's construction process by author) and quantitative analysis (including web-based survey and questionnaire survey) or mixed[1]), (e) *country of data collection* (Netherlands, Germany, United Kingdom, Denmark, Italy, Austria, Spain, Sweden, Belgium, France, Romania or mixed[2]), (f) *type of renewable energy* considered in each paper (solar, wind, biomass (including wood fuel), hydro, all technologies and other (including biogas, heat, hybrid, wave, geothermal, anaerobic digestion and tidal) or mixed[3]), (g) identified *success factors* (twelve variables for the following success factors: resources of RECs, social cohesion and involvement of citizens in RECs, policy context, support and contribution of regime and niche actors, network, cooperation and collaboration of RECs, environmental protection and awareness, profitability of RECs, transparency and trust in RECs, management and organisational structure of RECs, market incentives, heterogeneity of RECs and stability of RECs) and (h) *number of factors* (scale variable representing the number of success factors identified in each study).

The variable, year of data collection, had missing data for 78.3% of the cases. This issue was addressed by assuming as data collection year, two years before the publication year of the paper, which was actually the average value of the cases that we did have data for. The following categorical variables: methodology used in each paper, county of data collection and type of renewable energy considered in each paper, were coded in ascending order (from "1" to "the number of categories generated for each variable"), but similar to other published meta-analyses, those values of a variable that were conceptually similar between papers, were coded with the same number (Ng et al., 2005; Valentine et al., 2004). Finally, the dummy variables that were created to indicate the success factors investigated in each paper, took on the value "1" if a success factor was identified in a study and the value "0" otherwise.

[1] *For studies that used more than one methodology.*
[2] *For studies that used more than one country for their data collection.*
[3] *For studies that considered more than one type of renewable energy.*

3.3 Statistical analysis

As the paper is interested in investigating the most prominent success factors of RECs in the existing literature on these communities, a meta-analysis approach drawing conclusions from the literature, has the advantage of being able to systematically account for the most frequently identified factors that enhance the success of these communities. Notably, a meta-analysis of the relationships between specified factor variables and success of RECs should be of great relevance to both researchers and practitioners because of the unique ability to quantitatively summarise the literature. Meta analysis has several advantages over several narrative reviews (Arthur at al., 2001; Bell, 2004). Meta-analysis qualitatively aggregates the results of individual studies to arrive at an overall conclusion or to estimate relationships between variables across multiple studies. Thus, information can be garnered on which specified factor variables explain mostly the successful RECs. Because of growing research on RECs contributing to the literature on success of RECs and the factors that determine this success, this area readily lends itself to meta-analysis. Applying meta-analytic techniques to hypothesized relationships between the factors and success of RECs should be useful to researchers and practitioners because it can unify the literature on the success of RECs and contribute knowledge to the survival and spread of RECs.

To synthesise the details of the criteria used in coding all of the variables of the studies and conduct a meta-analysis, the data were manually entered into a Microsoft Excel spread sheet, before they were transferred into Stata format. As argued above, meta–analytic techniques were employed in order to answer the research question. However, the analysis and data of the study also allowed me to pay attention to other questions related to the success of RECs. More specifically, I looked into whether any of the success factors come together or are dependent on the methodology of the study, type of renewable energy, as well as the country and year of data collection. In addition, I sought to identify whether the categorical variables and the data collection year determine the number of success factors identified. The process of analysis consisted mainly of performing both cross-tabulation analysis and Pearson's chi-squared tests of independence, in order to test the dependence among success factors, and between the success factors and categorical variables (including the data collection year). One-way ANOVAs were done to determine whether the number of success factors is affected by the categorical variables, while in the case that the independent variable was the data collection year, a correlation and chi-squared test were carried out. Finally, the research

question was addressed by looking into the frequencies of the factor variables. All the statistical analyses were carried out using the Stata software.

4. Results

As demonstrated in the previous section, 60 studies were selected through a careful search procedure, for inclusion in the meta-analysis. The total number of these studies per year of publication is presented in the following figure (Figure 2). While the studies selected were published within the last fourteen years with the oldest study being published in 2001, more than two-thirds (78.3 per cent) of the studies were published between 2011 and 2015. As it can be seen in the figure, the average number of studies was around 2.2 for the first ten years of publication, before seeing a steep increase from 2011 onwards, reaching a peak of 15 studies in 2014. Then, this number decreased to 8 studies in April 2015, which is the month that the search procedure was carried out, but considering the fact that this paper took into account only the studies published within the first four months of 2015, this number is projected to more than double by the end of 2015. This upward trend in the number of studies lends support to the suggestion that the literature published on RECs contributing to the literature on success of RECs and the factors that determine this success, has seen significant growth, providing the ground for meta-analysis, which is the statistical technique used in this paper.

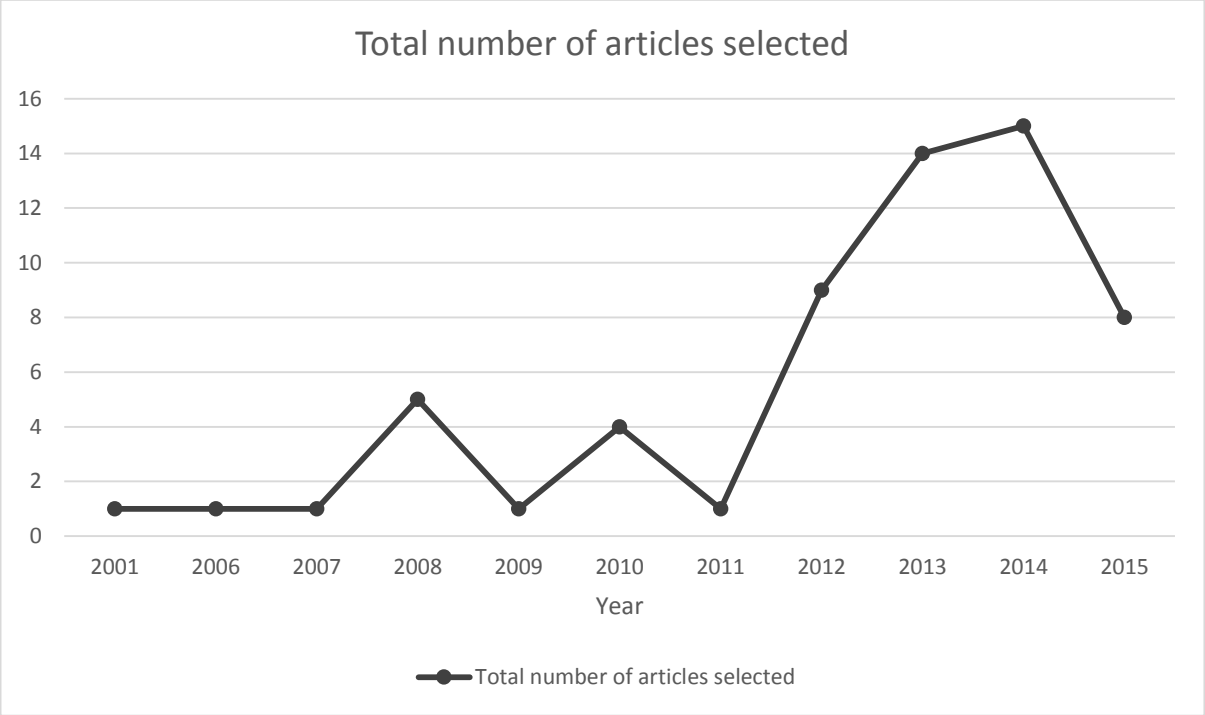

Figure 2. *Total number of articles selected for inclusion in the meta-analysis, per year of publication.*

In this section, I present my findings organised according to four sub-questions, which I aim to answer, as an attempt to come up with vital insights as to how we can support the effective operation, survival and spread of RECs. I do this by applying meta-analytic techniques and presenting my results using figures and tables.

4.1 Which are the most often identified success factors?

For drawing important insights about how RECs can further develop and establish over time, the analysis first has to start with investigating the success factors most commonly identified in the literature, which can result in the development of more effective supporting mechanisms by the policy makers, that are central to the establishment and operation of these communities. Consequently, an answer to this question serves towards addressing the research question of this paper.

The paper uncovered a wide range of success factors with different frequencies, indicating which of these are the most and least prominent, as demonstrated in the existing literature (see Figure 3). As figure 3 shows, the most commonly factors identified in the studies included the resources of RECs (present in 83.3% of studies), support and contribution of regime and niche actors (75%), social cohesion and involvement of citizens in RECs (68.3%), network, cooperation and collaboration of RECs (58.3%), management and organisational structure of RECs (56.6%) and policy context (48.3%). Other factors identified in these studies, but to a lesser extent, were the following: transparency and trust in RECs (33.3%), profitability of RECs (31.6%), heterogeneity of RECs (23.3%), market incentives (21.6%), environmental protection and awareness (16.6%) and stability of RECs (15%).

The findings show that a great deal of REC success depends upon activities within niches. Similarly, to what has been argued in the theoretical background section of this study, my findings highlight the important roles played mainly by two success factors, namely the resources of RECs, and the support and contribution of niche actors. Niche development and success, as we have seen, rest upon these two factors that are critical for the establishment and success of RECs. On the other hand, increasing environmental protection and awareness, a landscape process that prompts responses within the regime and generates opportunities for niches was not found to be among the six most frequently identified factors for successful RECS.

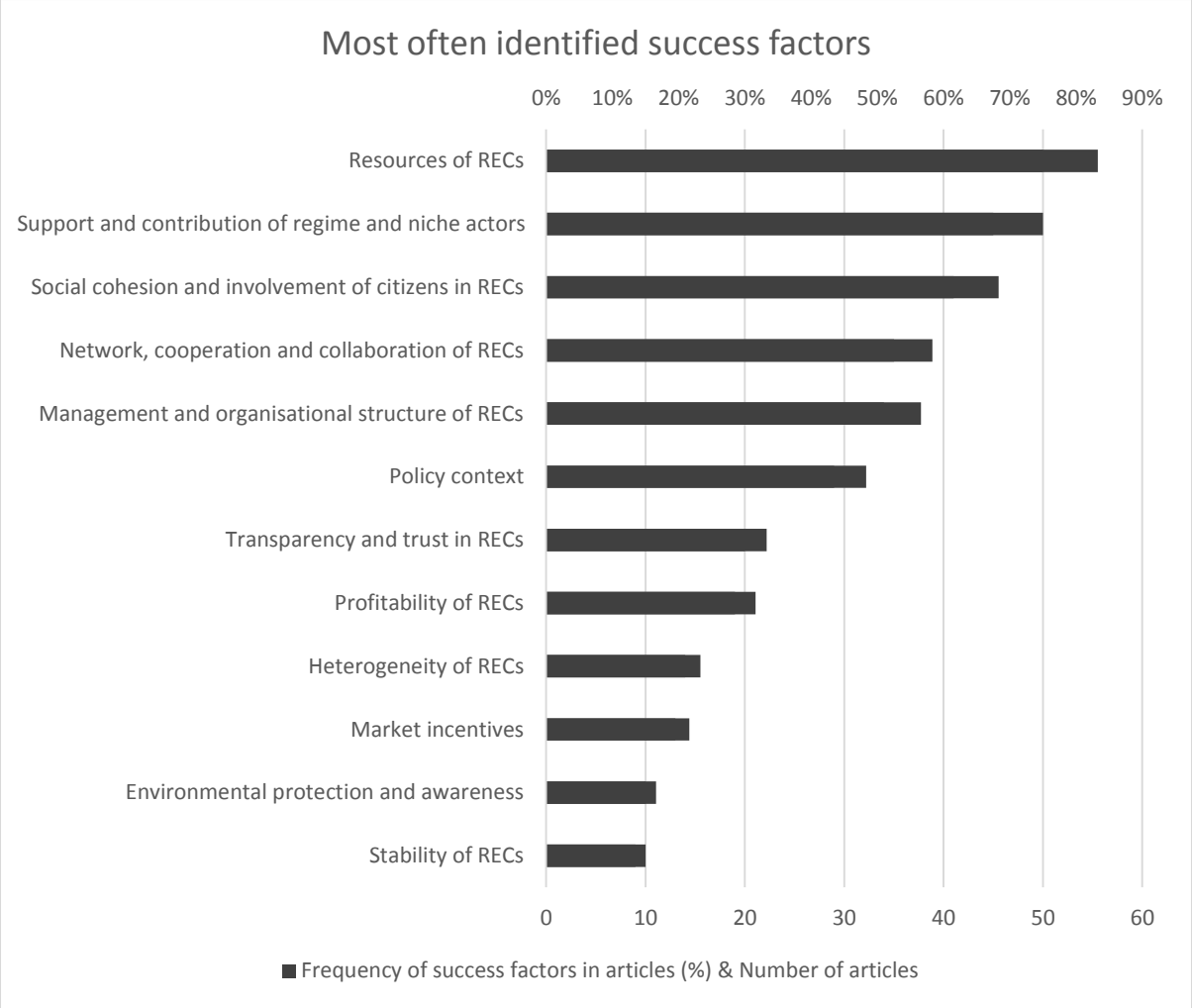

Figure 3. *Most common success factors identified in the articles. Source: Articles reviewed and meta-analysis carried out using the Stata software.*

4.2 Which success factors often come together?

By recognising the most prominent success factors for RECs, as identified in the literature, it calls into question if relationships among them say anything about the success of RECs. For each relationship between two success factors (resources of RECs, support and contribution of regime and niche actors, social cohesion and involvement of citizens in RECs, network, cooperation and collaboration of RECs, management and organisational structure of RECs, policy context, transparency and trust in RECs, profitability of RECs, heterogeneity of RECs, market incentives, environmental protection and awareness and stability of RECs), I carried out cross-tabulation analysis and Pearson's chi-squared tests of independence, to obtain the frequency of each relationship in the studies selected, together with its X^2 chi-squared statistic and p chi-squared test p-value.

Table 1 shows the results (for all the relationships see Appendix A). As we can see in this table, of the 67 relationships among success factors, only 11 were found to be statistically significant at the 5% level. Around one-third of these 11 relationships were statistically significant at the 1% level. These included the relationships between social cohesion and involvement of citizens in RECs & transparency in RECs (p=0.002), policy context & support and contribution of regime and niche actors (p=0.000) and profitability of RECs & market incentives (p=0.000). At the 5% level, the results indicate 8 additional statistically significant relationships to exist between the resources of RECs & support and contribution of regime and niche actors (p=0.046), social cohesion and involvement of citizens in RECs & market incentives (p=0.036), policy context & environmental protection and awareness (p=0.028), policy context & profitability of RECs (p=0.034), support and contribution of regime and niche actors & environmental protection and awareness (p=0.046), environmental protection and awareness & profitability of RECs (p=0.035), environmental protection and awareness & market incentives (p=0.017), profitability of RECs & management and organisational structure of RECs (p=0.035).

Relationship among success factors	**Frequency (%)**	**Pearson's chi-squared statistic (X^2)**	**Chi-squared test p-value (p)**
Resources of RECs & Support and contribution of regime and niche actors	66.6%	4.0000	**0.046***
Social cohesion and involvement of citizens in RECs & Transparency and trust in RECs	31.6%	9.8588	**0.002****
Social cohesion and involvement of citizens in RECs & Market incentives	20%	4.4081	**0.036***
Policy context & Support and contribution of regime and niche actors	46.6%	13.9043	**0.000****
Policy context & Environmental protection and awareness	13.3%	4.8187	**0.028***
Policy context & Profitability of RECs	21.6%	4.4929	**0.034***
Support and contribution of regime and niche actors & Environmental protection and awareness	16.6%	4.0000	**0.046***
Environmental protection and awareness & Profitability of RECs	10%	4.4519	**0.035***
Environmental protection and awareness & Market incentives	8.3%	5.6759	**0.017***
Profitability of RECs & Management and organisational structure	11.6%	4.4502	**0.035***
Profitability of RECs & Market incentives	16.6%	15.7080	**0.000****

Table 2. *Meta-analytic results for the statistically significant relationships among success factors. Please note: *, ** indicate statistical significance at 5% and 1%*

levels (p<0.05 and p<0.01), respectively. Source: Articles reviewed and meta-analysis carried out using the Stata software.

Several interesting observations are readily apparent from reviewing which relationships are statistically significant at the 5% level in Table 1. The socio-technical transitions and REC success as we have seen, rest upon the co-evolution of the three socio-technical levels. Several interactions between the three socio-technical levels can be observed when looking at this table. First, the relationships between the resources of RECs & support and contribution of niche actors, social cohesion and involvement of citizens in RECs & transparency and trust in RECs, and profitability of RECs & management and organisational structure imply interactions between the protected spaces provided by niches, which result in more robust niches that are more likely to overcome the constraining influence of regimes and establish. For instance, if RECs have competent managers with high levels of personal capacity or a well-organised system, then it is more likely that they will end up being profitable and a higher probability will exist that they will succeed. Additionally, having a high degree of social cohesion and citizen involvement gives the citizens the opportunity to communicate and interact with the community and hence, with the society throughout the REC lifecycle, which in turn increases the members' understanding of the community, its methods and objectives and thus, leads to an enhancement of the transparency and trust in RECs.

Second, as previously stated, RECs constitute internally, oriented niches that have the potential to enter the regime and contribute to energy transitions. On this matter, four of the relationships created reflect interactions between the niche and regime, interactions that are necessary for a transition to occur as well as for the RECs to survive and spread. These interactions include the relationships between the social cohesion and involvement of citizens in RECs & market incentives, support and contribution of niche actors & policy context, profitability of RECs & policy context, profitability of RECs & market incentives, and resources of RECs & support and contribution of regime actors.

Third, as it has been argued the macro-level socio-technical landscape provides a highly structural context for both the regime and niche, prompting responses from within the regime and generating opportunities for niches. In this regard, growing environmental protection and awareness within the society was found to exert pressure on the regime either by influencing the policy context, such as introducing policy mechanisms (e.g. feed-in tariffs) designed to accelerate investment in renewable energy technologies, influencing the market incentives

and characteristics as more renewable energy investors will be wiling to enter this sector driven by the common social need for environmental protection and as there may be a shift in the demand curve of renewable energy driven by the same need which in turn will cause the renewable energy prices to change compared to the conventional ones, or by attracting a large number of regime actors and creating links with powerful social groups of the incumbent sub-regimes that are open for this change. On the other hand, increasing environmental protection influences the niche either by influencing the support that they get from niche actors that undertake these experiments and are more supportive of the social and environmental qualities of the niche socio-technical practice, or by influencing the profitability of these communities.

Finally, an interaction within the regime can be observed, which is another way of opening windows of opportunity, necessary for radical innovations from niches to break through and enter the meso-level of the socio-technical system in order to survive. Specifically, the relationship between the policy context & support and contribution of regime actors suggests that policy mechanisms in favour of RECs (e.g. feed-in tariffs), lead to mismatches within the regime by influencing the support that they get from powerful regime actors which even unintended can trigger changes in the entire socio-technical regime.

4.3 Are the success factors dependent on the country of the study, the methodology of the study, the type of renewable energy or the year of the study?

In order to further grasp the key factors that influence the development and success of RECs, similarly to the previous subsection, I undertook cross-tabulation analysis and Pearson's chi-squared tests, to see whether there is a dependency between these factors and the country, methodology, type of renewable energy and year of the study. In doing so, I tested the relationships between the twelve success factors identified and the categorical variables, as well as the year of study. In line with the methodology section, for the country and year of study I used the country and year of data collection. The analysis undertaken enabled me to obtain the frequency of each relationship (for each category and year, of the categorical variables and year of study, respectively), together with its X^2 chi-squared statistic and p chi-squared test p-value.

The findings are laid out using figures for the distribution of the independent variables in the studies selected, as well as tables, which provide an overview of the statistically significant

relationships between the success factors and the country, methodology and type of renewable energy (for all the relationships see Appendix B). The tables are presented in a way that we can see how a success factor is distributed between different categories of each of the independent variables, with the frequencies presented in descending order for each of the success factors and categories of the independent variables.

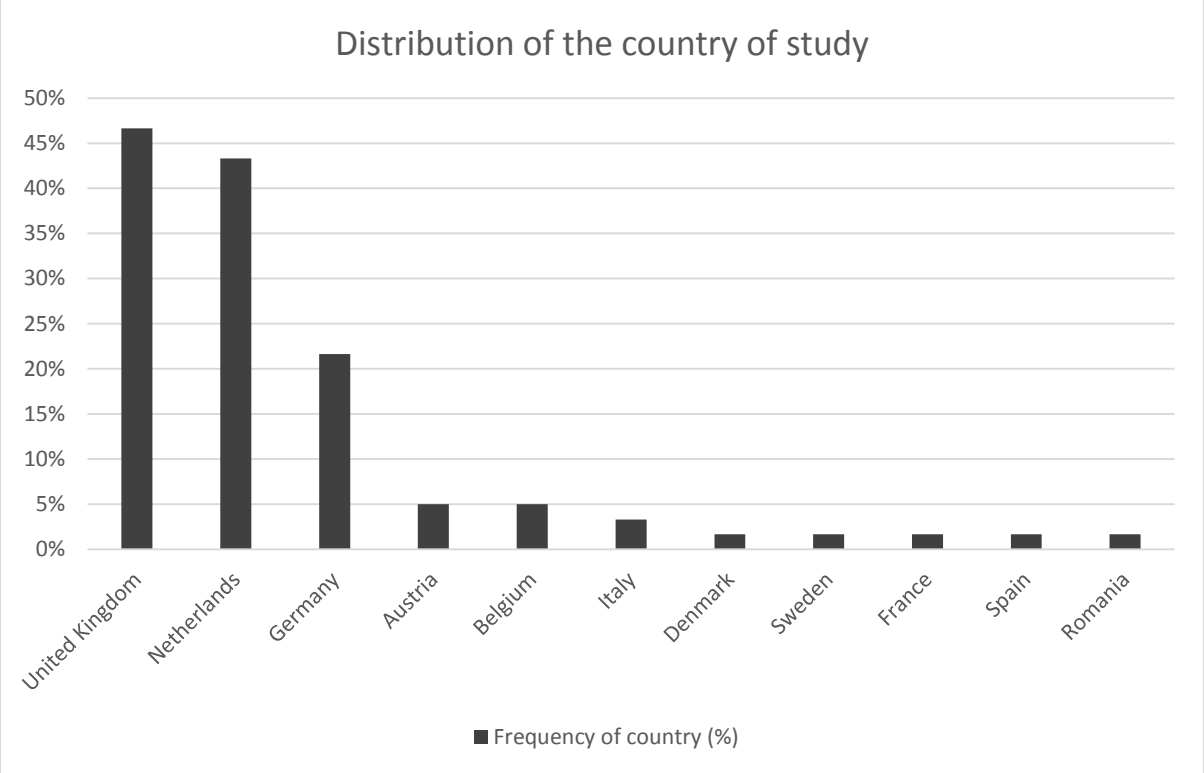

Figure 4.[4] *Distribution of the country of study, across the articles selected. Source: Articles reviewed and meta-analysis carried out using the Stata software.*

Success Factor	Country of study						Pearson's chi-squared statistic (X^2)	Chi-squared test p-value (p)
Stability of RECs	10% *(NL)*	6.6% *(UK)*	5% *(DE)*	5% *(BE)*	1.6% *(FR)*	0% *(AT)*	26.6702	**0.032***

Table 3.[5] *Meta-analytic results for the statistically significant relationships between the success factors and country of study. Please note: "UK", "NL", "DE", "AT", "BE", "IT", "ES", "FR" and "RO", stand for United Kingdom, Netherlands, Germany, Austria,*

[4] *The percentages of all the countries do not add up to 100%, as some studies used more than one country for their data collection.*

[5] *The percentages of all the countries in a row corresponding to a success factor do not add up to 100%, as some studies used more than one country for their data collection.*

*Belgium, Italy, Spain, France and Romania, respectively (the frequencies of each relationship are presented in descending order). Also please note: *, ** indicate statistical significance at 5% and 1% levels (p<0.05 and p<0.01), respectively. Source: Articles reviewed and meta-analysis carried out using the Stata software.*

Turning first to the distribution of the countries of studies across the studies selected, we can see that the United Kingdom, Netherlands and Germany were the countries mostly presented in these studies (47%, 43% and 22% respectively). This is not surprising, as RECs have seen a significant growth in these countries attracting the attention of transition scholars, especially in Netherlands where the number of these communities increased dramatically from 50 in 2011 to 304 in 2015 (a growth of 143.5%) with their number still growing rapidly (Oostra and Jablonska, 2013; HIER opgewekt, 2014). Other countries but less commonly presented in the studies were the following: Austria (5%), Belgium (5%), Italy (3%), Denmark (2%), Sweden (2%), France (2%), Spain (2%) and Romania (2%).

Of all the relationships between a success factor and the country of study, only one of these relationships was statistically significant at the 5% level, namely the relationship between stability of RECs & country (p=0.032). With respect to the frequencies of this relationship, table 3 should be read as follows: each percentage represents the fraction of all the studies selected that had used a particular country for their data collection and identified the stability of RECs as a success factor for RECs. For example, 10% of the studies selected, have found the stability of RECs to be important for the success of RECs in Netherlands. Reflecting on this result, the analysis highlights a key point, which is that the stability of RECs is country-specific, and therefore differs across countries. More specifically, the stability of RECs is more often identified as a success factor in Netherlands but also in the United Kingdom, Germany and Belgium than in the remaining European countries presented in the studies.

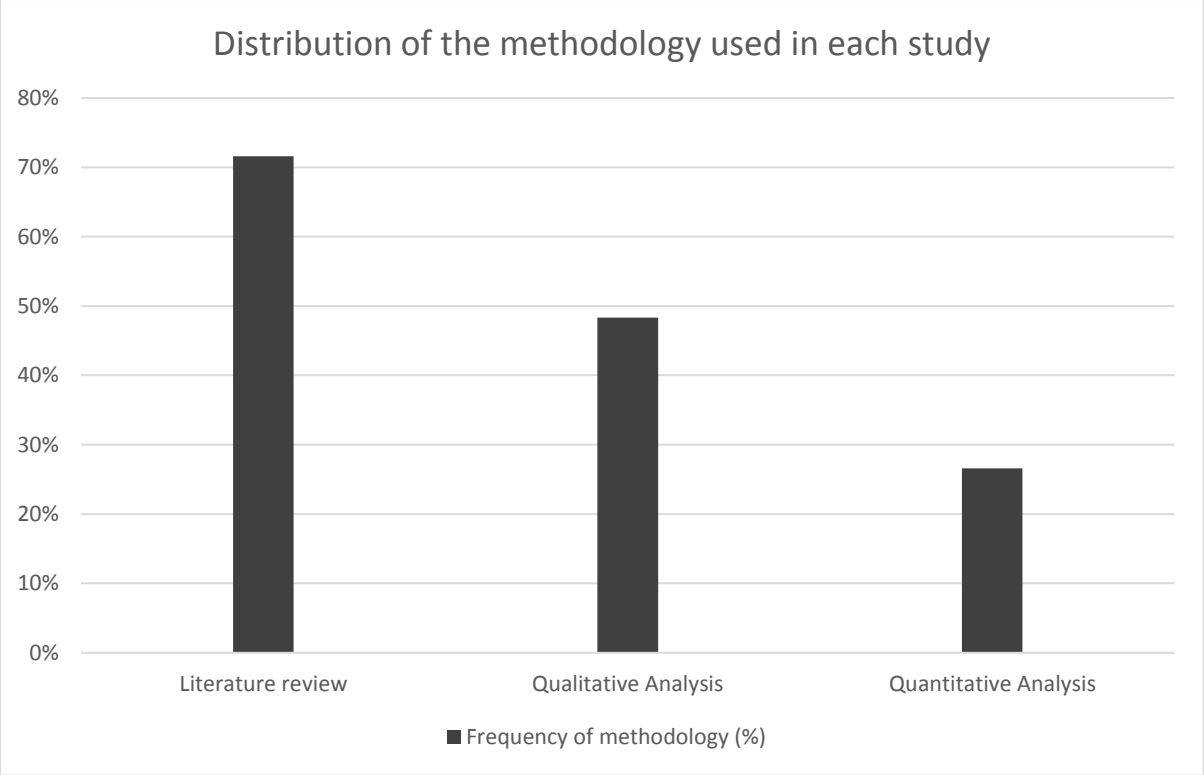

Figure 5.[6] *Distribution of the methodology used in each study, across the articles selected. Source: Articles reviewed and meta-analysis carried out using the Stata software.*

Success Factor	Methodology of study			Pearson's chi-squared statistic (X^2)	Chi-squared test p-value (p)
Support and contribution of regime and niche actors	58.3% *(QualA)*	36.6% *(LR)*	13.3% *(QuantA)*	19.1873	**0.004****

Table 4.[7] *Meta-analytic results for the relationships between the success factors and methodology of the study. Please note: "QualA", "LR" and "QuantA" stand for Qualitative Analysis, Literature Review and Quantitative Analysis, respectively (the frequencies of each relationship are presented in descending order). Please note: *, ** indicate statistical significance at 5% and 1% levels (p<0.05 and p<0.01), respectively. Source: Articles reviewed and meta-analysis carried out using the Stata software.*

[6] *The percentages of all the methodologies used do not add up to 100%, as some studies used more than one methodology.*

[7] *The percentages of all the categories of methodologies in a row corresponding to a success factor do not add up to 100%, as some studies used more than one methodology.*

With respect to distribution of the methodologies used in the articles reviewed, it is noteworthy that the most commonly used methodology in the studies was the literature review, which was used by almost three quarters of these studies (72%), followed by the qualitative analysis that was used by almost half of these studies (48%) as well as a less commonly used methodology namely, the quantitative analysis (27%). This reveals that the majority of the studies selected used mainly the literature review as their methodology in order to identify the key success factors for RECs and to a lesser extent the qualitative and quantitative analysis. However, it would be better if equal weight and emphasis were given on all these three methodologies when identifying the success factors for RECs, as the results will be based on different methodologies and not solely on one of these, resulting in more robust results.

Only one statistically significant relationship between the success factors and methodology of study was found that is the relationship between the support and contribution of regime and niche actors & methodology (p=0.004). As we can see in table 4, well over half (58.3%) of the studies that used qualitative analysis as the methodology of their papers, have cited the support and contribution of regime and niche actors, as a factor for successful RECs. This finding indicates that the support and contribution of regime and niche actors is methodology-specific, suggesting that its appearance in studies depends on the methodology used, and thus it is more likely to be identified in the studies, if the methodology used by a paper is the qualitative analysis.

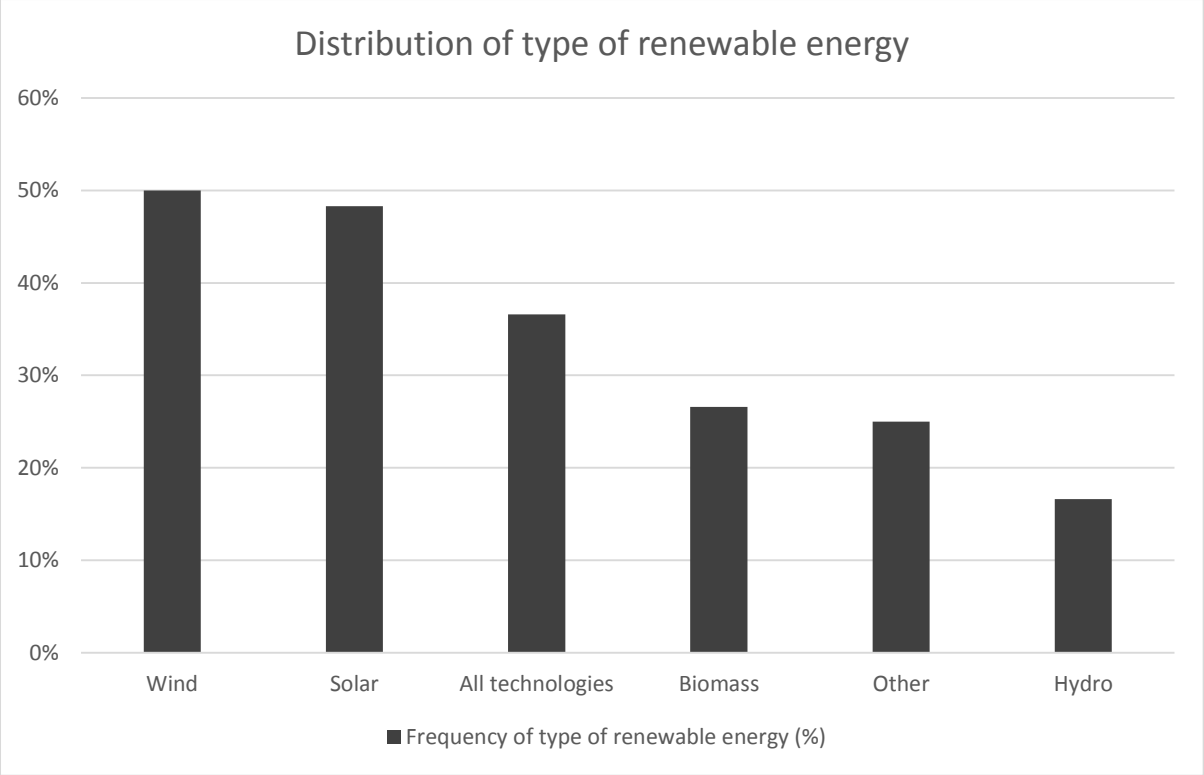

Figure 6.[8] *Distribution of the type of renewable energy, across the articles selected. Source: Articles reviewed and meta-analysis carried out using the Stata software.*

Success Factor	Type of renewable energy						Pearson's chi-squared statistic (X^2)	Chi-squared test p-value (p)
Resources of RECs	36.6% *(Wn)*	36.6% *(A)*	31.6% *(Sl)*	18.3% *(Bm)*	15% *(Hd)*	13.3% *(O)*	29.5543	**0.020***

Table 5.[9] *Meta-analytic results for the relationships between the success factors and type of renewable energy. Please note: "Sl", "Wn", "Bm", "Hd", "A" and "O" stand for Solar, Wind, Biomass, Hydro, All technologies and Other, respectively (the frequencies of each relationship are presented in descending order). Please note: *, ** indicate statistical significance at 5% and 1% levels (p<0.05 and p<0.01), respectively. Source: Articles reviewed and meta-analysis carried out using the Stata software.*

[8] *The percentages of all the types of renewable energies considered in the papers do not add up to 100%, as some studies looked into more than one type of renewable energy.*

[9] *The percentages of all the categories of types of renewable energy in a row corresponding to a success factor do not add up to 100%, as some studies looked into more than one type of renewable energy.*

As shown above (see Figure 6), wind and solar energy were by far the most commonly considered types of renewable energy in the studies (50% and 48%, respectively). The next common types of renewable energies were: all technologies (37%), biomass (27%), other (25%) and hydro (17%).

Interestingly, looking at table 5, only one statistically significant relationship was found to exist between the success factors and type of renewable energy, which is the relationship between the resources of RECs & type of renewable energy (p=0.020). As depicted in table 5, over one third (36.6%) of the studies that looked into the wind energy or all technologies as the type of renewable energy considered in their paper, identified the resources of RECs as a success factor for these communities. Correspondingly, 31.6% of the studies that instead used the solar energy in their papers, have also found the resources of RECs to be a success factor. In line with these observations, the resources of RECs are type of renewable energy-specific, varying across different types of renewable energy, especially for wind energy, all technologies and solar energy. Therefore, the resources of RECs are more frequently identified if the types of renewable energy are wind energy, all technologies, or even solar energy. In addition to the previous observations, the relationship also suggests that more resources (e.g. specialist skills, knowledge, financial and material resources) are required, depending on the type of renewable energy, especially if this type is wind energy, all technologies or solar energy.

Figure 7. *Number of each success factor identified divided by the total number of articles, for each year of data collection. Source: Articles reviewed and meta-analysis carried out using the Stata software.*

The final independent variable I consider relates to the year of study. Only one statistical significant result was achieved in this case, but it is not possible to draw any conclusions about it. Accordingly, I wanted to have an overview of the trend of the significance of the success factors identified over time. The figure above (Figure 7) presents the number of each of the success factors divided by the total number of studies for each year of data collection. However, a word of caution relates to the year used in this figure. The year used in the horizontal axis corresponds to the year of data collection and not the year of publication of

the studies and thus, in most cases the year of data collection is two years prior to the publication year of the studies (see Methodology section).

When looking at the table, it is very clear that there are two identifiable periods: 1999-2009 and 2009-2013. One of the things to note is that the fluctuations observed in the trends of success factors within the first period cease to exist in the second period. This is related to the considerable growth observed in the number of studies on RECs, within the second period, in contrast to the first period. Additionally, it can be clearly seen that the six success factors that were found to be the most frequently identified in the REC literature, were those that dominated over the last three years. Out of these six factors, the resources of RECs, the support and contribution of regime and niche actors, and the policy context remained relatively stable within the last three years, while two of the least frequently identified success factors namely, the stability and profitability of RECs were more often cited over this period. On the other hand, the remaining success factors identified (social cohesion and involvement of citizens in RECs, network, cooperation and collaboration of RECs, environmental protection and awareness, transparency and trust in RECs, management and organisational structure of RECs, market incentives and heterogeneity of RECs) were less commonly cited within the same period. These observations indicate that all of the success factors identified, except the resources of RECs, the support and contribution of regime and niche actors, and the policy context, were all of them year-specific (changing) over the last three years, but they followed an opposite trend; while the profitability and stability of RECs were more often identified during these three years, the remaining ones were less commonly identified.

4.4 Is the number of success factors dependent on the country of the study, the methodology of the study, the type of renewable energy or the year of the study?

Having examined the most often cited success factors for RECs as well as the relationships that exist among them and relationships that are created between these and other variables, we turn our focus to the dependency of the number of success factors identified in each study on the categorical variables and year of study. As stated in the methodology section, to test the relationship between the number of success factors and the categorical variables, I performed one-way ANOVAs (to compute the F-statistic and F-test p-value), while a correlation and chi-squared test were carried out to test the dependency of this number on the

year of study. Similarly to the previous subsection, the country and year of data collection were used to indicate the country and year of study, respectively

As Appendix C shows, none of these relationships reached statistical significance, either when the independent variable was the country, methodology, type of renewable energy, or year of study. These results indicate that the number of success factors that each study identifies is not the same across countries, methodologies used in these studies or types of renewable energy, but instead it differs across these categorical variables in a random way. Consequently, the country, methodology used in these studies and type of renewable energy do not determine the number of success factors in a statistically significant way. This in turn implies that whether the studies use a different methodology (e.g. literature review, qualitative or quantitative analysis), or concentrate on a particular country or type of renewable energy rather than on to another, these approaches do not create a difference between the number of success factors that each of these studies will identify.

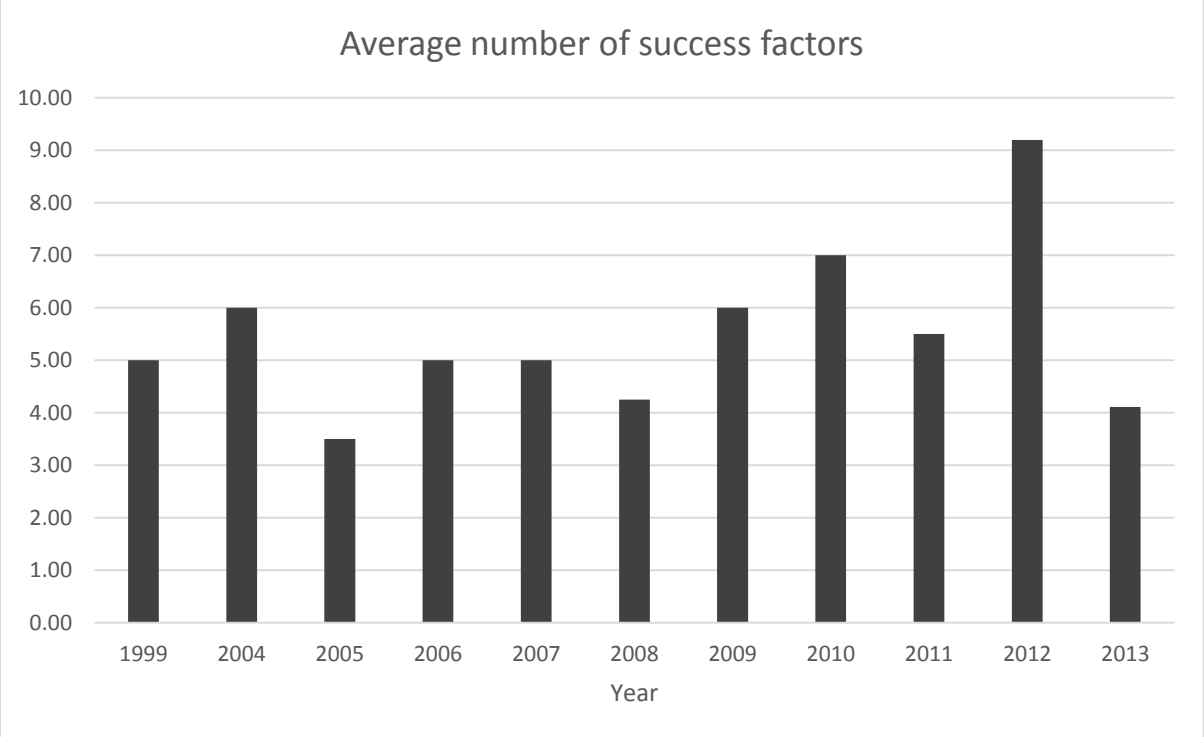

Figure 8. *Average number of success factors over the years. Please note: the year used in this graph is the year of data collection and not the publication year of the studies. Source: Articles reviewed and meta-analysis carried out using the Stata software.*

In addition to the analysis above, it would be interesting to see whether over time there are more success factors identified. Therefore, since in my study I build on previous research, it is expected that more success factors will exist on average. Figure 8 clearly indicates that despite the fluctuations in this number and the substantial fall in this number for 2013, the average number of success factors tends to increase over time. This observation reveals that the average number of success factors identified in the studies is year-specific and thus, it differs over time. Additionally, this observation indicates that more factors are identified on average over the years, suggesting that more success factors are becoming important over time.

5. Discussion and Conclusions

This paper started by identifying a key problem that, whilst RECs may be critical in developing solutions to sustainability problems, these communities also often face profound challenges in simply surviving, let alone in growing and diffusing more widely. Hence, in order for RECs to overcome these challenges but also to enhance the contribution of their production to the national supply, it is important to gain a better understanding of the most commonly cited factors in the literature that enhance the success of "grassroots innovations", and thereby social niches by using in this study the example of RECs. As a result, the aim of this paper was to investigate which factors determine the success of investing in renewables at community level, by applying and further developing the analytical framework of the multi-level perspective. To do so, a systematic analysis of the complementary, or even contradictory success factors coming from different studies was conducted. However, parallel to the main research question, the analysis as well as the data of the study allowed me to introduce three additional sub-questions related to the success of RECs. These questions examined whether there are any relationships between any of these factors and as a result interactions between the there socio-technical levels upon which the energy transitions and REC success rest, whether the success factors of these communities depends on the country, type of renewable energy and methodology used in studies, as well as if we can draw any conclusions regarding the trend of these factors over time. Finally, further tests were performed to see whether these categorical variables also influence the number of success factors that the studies identify.

The study has contributed to the existing literature on RECs in different ways. First and regarding the research question, this study using meta-analytic techniques uncovered twelve factors that according to the REC literature lead to REC success. The main point put forward by this paper has to do with the fact that in order to ensure that RECs will survive in the long run, a particular emphasis should be given on the niche level. Niche level, as it has been argued in this paper provides the protective spaces necessary for innovations to thrive. Specifically, six of the most frequently identified success factors were found to be the following: the resources of RECs, including not only the financial capital, in order to start-up or maintain a community buy also the necessary specialist skills, knowledge, experience as well as time to carry out a project, whose exchange enhances the social cohesion that is necessary for the establishment and operation of these communities, the financial and ideological support, as well as the contribution of regime actors, in a number of forms

including subsidies, grants or other governmental support that help to reduce the transaction costs of these communities along with the support and contribution of niche actors that become involved in ways that mobilise widespread social and environmental legitimacy, the social cohesion and involvement of citizens as a way of increasing the communication and interaction with the community, and hence, with the society throughout the lifecycle of RECs, the network, cooperation and collaboration of RECs with various organisations, REC activities that affect their form, foundation and establishment of these communities, the management and organisational structure of RECs, which can raise expectations on what the technology can deliver, providing among others, flexibility and the ability to respond to the necessities of the community and overcome obstacles, as well as the policy context, which as an element of the regime, if consistent and stable can facilitate the spread of RECs. It is also worth highlighting other factors that the analysis revealed to be identified in the existing literature contributing to successful RECs but to a lesser extent. These include the transparency and trust in RECs in the way that the implications and benefits are clearly presented and equally distributed in a community, but also that members can trust, the profitability of RECs, where the community needs to be profitable and feasible, the heterogeneity of RECs, the market incentives and characteristics, such as the existence of competitors in the energy sector and the renewable energy prices compared to the conventional ones, which are mainly driven by the interrelation of the supply of and demand for renewable energy, the environmental protection and awareness within the society, and the stability of community-based renewable projects and thus, of RECs that helps decrease the investment risk with a direct positive influence on the profitability of these communities.

Second, it should be noted that this was the first study of its kind in the area of RECs, to systematically account for the most frequently identified factors that explain mostly the successful RECs, by building on earlier work and drawing conclusions from the existing but growing literature on RECs. It therefore contributes knowledge to the survival and spread of RECs highlighting the most and least frequently identified factors for REC success. As such, it provides fertile ground for the policy makers, which as important players in the survival and spread of RECs can find this study quite useful, in order to develop specific and more effective policy instruments and tools to support these communities, as well as help increase community self-reliance and market share of renewables. Moreover, the findings of this study also provide the relevant information for the government, and all the support institutions that are involved in the establishment and operation of these communities. Thus, besides

contributing to the literature on RECs, the study comes up with practical implications that prove particularly helpful when looking toward enhancing the success of RECs in reality. Further still, the ability of the methodological approach of this paper to build on earlier work, makes this study able to summarize the findings of REC literature and provide an overview of all the factors, as demonstrated in the existing literature around RECs, as contributors to the success of these communities, so that scholars that seek to conduct further research in this area can build on this study, or even extend its findings.

Third, the study has shown that MLP theory can be usefully applied in the context of RECs, generating useful insights about how a transition can occur but also how REC success can be enhanced. In order for a transition to occur and the REC success to be enhanced, the MLP theory suggests that the interplay between processes at the three socio-technical levels are a prerequisite. In this regard, the findings of this study found several interactions to exist between the niche, the regime and the landscape. More specifically, the niches of RECs were found to become stronger, being able to overcome the compelling influence of regimes in an attempt to establish and branch out, as a result of four interactions observed within this level between the resources of RECs & support and contribution of niche actors, social cohesion and involvement of citizens in RECs & transparency in RECs, and profitability of RECs & management and organisational structure of RECs. Similar to these interactions within an identical level, an interaction within the regime level that is capable of creating windows of opportunity where radical innovations from niches can break through, spread in the regime more easily and survive, was found to exist between the policy context (policy mechanisms used to promote renewable energy technologies) & support and contribution of regime actors. In addition to interactions within the regime level, windows of opportunity are also generated by mismatches that occur at the landscape level that put pressure on the regime and influence the niche. In this regard, growing environmental protection and awareness within the society was found to influence the policy context, the market incentives and characteristics, the support and contribution of regime and niche actors as well as the profitability of RECs. Nevertheless, the need for niches to overcome the dynamic structure of the regime, is exceptionally crucial if they are to seed a transition and survive. On this matter, the RECs as social niches were found to influence the regime through four interactions: social cohesion and involvements of citizens in RECs & market incentives, support and contribution of niche actors & policy context, profitability of RECs & policy context, profitability of RECs & market incentives, and resources of RECs & support and contribution of regime actors.

Aside from contributing to the literature around RECs as well as providing clear definitions for RECs and their success, the paper has also revealed a number of key points regarding the success factors of RECs that deserve attention. Overall, our results suggest that the majority of the success factors identified in the studies are year-specific, while only one forth of them are either country-, methodology-, or type of renewable energy- specific. Specifically, the analysis has shown, that two of the most frequently identified success factors in the studies namely, the support and contribution of regime and niche actors and the resources of RECs vary across different methodologies and types of renewable energy, respectively. In line with this observation, it is more likely that the support and contribution of regime and niche actors will be cited in a paper as a factor contributing to the success of RECs, if the methodology used in the studies is the qualitative analysis, while in the case that the type of renewable energy considered in a paper is the wind energy, all technologies or solar energy, then there is a high probability that the resources of RECs will be identified as a success factor. It is worth noting however that these two factors together with the policy context were not found to be more or less frequently identified in the studies during the last three years of data collection, suggesting that they are not year-specific. On the other hand, the profitability of RECs and the stability of RECs, which was found to be country-specific, are more frequently identified over the years, while the remaining success factors are less often identified. With respect to the number of success factors that each paper identifies, the analysis has revealed that this number is not the same across countries, methodologies used in the studies or types of renewable energy, but instead it differs across them in a random way. Finally, since this study is building on earlier work, I argued, as it was expected, that more factors contributing to REC success are cited on average over time, pointing toward the fact that more success factors are becoming important over the years.

Even though in this paper I provided an overview of the most and least commonly cited factors for successful RECs contributing to the REC literature in different ways, I have specifically focused on European countries without looking into RECs in countries other than the European Union; this remains a point for further research. A second limitation of the present study arose because of the languages spoken by the author of this research, where only studies that were written in English were included. Further work is necessary here to investigate the factors contributing to the success of RECs, but this time, including papers written in languages other than English, which may reveal other factors not found by this study. As final remark, I have to note that this study has examined the interactions between

the three socio-technical levels relating to the success of RECs, but it has not looked whether these interactions are expected to change when taking into account the country, methodology or type of renewable energy. This is particularly important, as according to Oteman et al. (2014), RECs vary in occurrence and variety across countries, which may suggest that different interactions may be observed to exist in each country. Consequently, further work can go deeper and clarify whether the interactions at these levels differ across countries, methodologies or types of renewable energy.

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Appendices

Appendix A

Relationship among success factors	Frequency (%)	Pearson's chi-squared statistic (X^2)	Chi-squared test p-value (p)
Resources of RECs & Social cohesion and involvement of citizens in RECs	60%	1.8639	0.172
Resources of RECs & Policy context	43.3%	1.6151	0.204
Resources of RECs & Support and contribution of regime and niche actors	66.6%	4.0000	**0.046***
Resources of RECs & Network, cooperation and collaboration of RECs	48.3%	0.2137	0.907
Resources of RECs & Environmental protection and awareness	13.3%	0.0960	0.757
Resources of RECs & Profitability of RECs	26.6%	0.0154	0.901
Resources of RECs & Transparency and trust in RECs	25%	1.5000	0.221
Resources of RECs & Management and organisational structure	51.6%	3.4751	0.062
Resources of RECs & Market incentives	21.6%	3.3191	0.068
Resources of RECs & Heterogeneity of RECs	18.3%	0.2981	0.585
Resources of RECs & Stability of RECs	13.3%	0.2353	0.628
Social cohesion and involvement of citizens in RECs & Policy context	36.6%	1.4703	0.225
Social cohesion and involvement of citizens in RECs & Support and contribution of regime and niche actors	51.6%	0.0257	0.873
Social cohesion and involvement of citizens in RECs & Network, cooperation and collaboration of RECs	45%	3.0127	0.083
Social cohesion and involvement of citizens in RECs & Environmental protection and awareness	13.3%	0.7548	0.385
Social cohesion and involvement of citizens in RECs & Profitability of RECs	20%	0.3442	0.557
Social cohesion and involvement of citizens in RECs & Transparency and trust in RECs	31.6%	9.8588	**0.002****
Social cohesion and involvement of citizens in RECs & Management and organisational structure	43.3%	2.4009	0.121
Social cohesion and involvement of citizens in RECs & Market incentives	20%	4.4081	**0.036***
Social cohesion and involvement of citizens in RECs & Heterogeneity of RECs	16.6%	0.0808	0.776
Social cohesion and involvement of citizens in RECs & Stability of RECs	11.6%	0.4365	0.509
Policy context & Support and contribution of regime and niche actors	46.6%	13.9043	**0.000****
Policy context & Network, cooperation and collaboration of RECs	33.3%	2.6105	0.106

Policy context & Environmental protection and awareness	13.3%	4.8187	**0.028***
Policy context & Profitability of RECs	21.6%	4.4929	**0.034***
Policy context & Transparency and trust in RECs	15%	0.1335	0.715
Policy context & Management and organisational structure	25%	0.5584	0.455
Policy context & Market incentives	15%	2.9022	0.088
Policy context & Heterogeneity of RECs	8.3%	1.1644	0.281
Policy context & Stability of RECs	11.6%	3.6760	**0.055**
Support and contribution of regime and niche actors & Network, cooperation and collaboration of RECs	46.6%	1.1200	0.290
Support and contribution of regime and niche actors & Environmental protection and awareness	16.6%	4.0000	**0.046***
Support and contribution of regime and niche actors & Profitability of RECs	28.3%	3.1065	0.078
Support and contribution of regime and niche actors & Transparency and trust in RECs	21.6%	1.6000	0.206
Support and contribution of regime and niche actors & Management and organisational structure	43.3%	0.0905	0.764
Support and contribution of regime and niche actors & Market incentives	20%	2.6514	0.103
Support and contribution of regime and niche actors & Heterogeneity of RECs	20%	1.1180	0.290
Support and contribution of regime and niche actors & Stability of RECs	13.3%	1.0893	0.297
Network, cooperation and collaboration of RECs & Environmental protection and awareness	13.3%	2.3177	0.128
Network, cooperation and collaboration of RECs & Profitability of RECs	18.3%	0.0022	0.963
Network, cooperation and collaboration of RECs & Transparency and trust in RECs	13.3%	0.0343	0.853
Network, cooperation and collaboration of RECs & Management and organisational structure	36.6%	1.3109	0.252
Network, cooperation and collaboration of RECs & Market incentives	16.6%	2.3596	0.125
Network, cooperation and collaboration of RECs & Heterogeneity of RECs	15%	0.2662	0.606
Network, cooperation and collaboration of RECs & Stability of RECs	10%	0.3025	0.582
Environmental protection and awareness & Profitability of RECs	10%	4.4519	**0.035***
Environmental protection and awareness & Transparency and trust in RECs	5%	0.0600	0.806
Environmental protection and awareness & Management and organisational structure	6.6%	1.3575	0.244
Environmental protection and awareness & Market incentives	8.3%	5.6759	**0.017***
Environmental protection and awareness & Heterogeneity of RECs	5%	0.2981	0.585

Environmental protection and awareness & Stability of RECs	1.6%	0.2353	0.628
Profitability of RECs & Transparency and trust in RECs	11.6%	0.1540	0.695
Profitability of RECs & Management and organisational structure	11.6%	4.4502	**0.035***
Profitability of RECs & Market incentives	16.6%	15.7080	**0.000****
Profitability of RECs & Heterogeneity of RECs	6.6%	0.0808	0.776
Profitability of RECs & Stability of RECs	6.6%	0.7989	0.371
Transparency and trust in RECs & Management and organisational structure	20%	0.1357	0.713
Transparency and trust in RECs & Market incentives	11.6%	3.1424	0.076
Transparency and trust in RECs & Heterogeneity of RECs	10%	0.7453	0.388
Transparency and trust in RECs & Stability of RECs	3.3%	0.5882	0.443
Management and organisational structure & Market incentives	10%	0.7469	0.387
Management and organisational structure & Heterogeneity of RECs	11.6%	0.3305	0.565
Management and organisational structure & Stability of RECs	8.3%	0.0053	0.942
Market incentives & Heterogeneity of RECs	8.3%	2.1232	0.145
Market incentives & Stability of RECs	3.3%	0.0019	0.965
Heterogeneity of RECs & Stability of RECs	5%	0.5919	0.442

Table 1. *Meta-analytic results for the relationships among success factors. Please note: *, ** indicate statistical significance at 5% and 1% levels (p<0.05 and p<0.01), respectively. Source: Articles reviewed and meta-analysis carried out using the Stata software.*

Appendix B

Success Factor	Country of study						Pearson's chi-squared statistic (X^2)	Chi-squared test p-value (p)
Resources of RECs	43.3% *(UK)*	31.6% *(NL)*	16.6% *(DE)*	5% *(AT)*	5% *(BE)*	1.6% *(IT)*	20.0856	0.169
Social cohesion and involvement of citizens in RECs	33.3% *(UK)*	28.3% *(NL)*	13.3% *(DE)*	3.3% *(AT)*	3.3% *(BE)*	3.3% *(IT)*	13.0352	0.600
Policy context	26.6% *(NL)*	21.6% *(UK)*	8.3% *(DE)*	5% *(BE)*	1.6% *(AT)*	1.6% *(IT)*	17.0717	0.315
Support and contribution of regime and niche actors	36.6% *(UK)*	35% *(NL)*	15% *(DE)*	3.3% *(AT)*	3.3% *(BE)*	1.6% *(IT)*	13.7469	0.545
Network, cooperation and collaboration of RECs	28.3% *(NL)*	25% *(UK)*	8.3% *(DE)*	3.3% *(AT)*	3.3% *(IT)*	1.6% *(BE)*	14.8437	0.463
Environmental protection and awareness	11.6% *(NL)*	6.6% *(DE)*	3.3% *(AT)*	1.6% *(UK)*	1.6% *(IT)*	1.6% *(ES)*	24.1765	0.062
Profitability of RECs	23.3% *(NL)*	8.3% *(UK)*	6.6% *(DE)*	3.3% *(BE)*	5% *(AT)*	1.6% *(IT)*	24.3228	0.060
Transparency and trust	18.3% *(UK)*	15% *(NL)*	8.3% *(DE)*	3.3% *(BE)*	1.6% *(IT)*	1.6% *(RO)*	19.5983	0.188
Management and organisational structure	30% *(UK)*	20% *(NL)*	15% *(DE)*	5% *(AT)*	3.3% *(BE)*	1.6% *(IT)*	14.3071	0.502
Market incentives	16.6% *(NL)*	3.3% *(DE)*	3.3% *(UK)*	1.6% *(BE)*	1.6% *(IT)*	1.6% *(RO)*	22.0566	0.106
Heterogeneity of RECs	11.6% *(UK)*	10% *(NL)*	1.6% *(DE)*	1.6% *(IT)*	1.6% *(RO)*	0% *(AT)*	9.3980	0.856
Stability of RECs	10% *(NL)*	6.6% *(UK)*	5% *(DE)*	5% *(BE)*	1.6% *(FR)*	0% *(AT)*	26.6702	**0.032***

Table 2.[10] *Meta-analytic results for the relationships between the success factors and country of study. Please note: "UK", "NL", "DE", "AT", "BE", "IT", "ES", "FR" and "RO", stand for United Kingdom, Netherlands, Germany, Austria, Belgium, Italy, Spain, France and Romania, respectively (the frequencies of each relationship are presented in descending order). Also please note: *, ** indicate statistical significance at 5% and 1% levels (p<0.05 and p<0.01), respectively. Source: Articles reviewed and meta-analysis carried out using the Stata software.*

Success Factor	Methodology of study			Pearson's chi-squared statistic (X^2)	Chi-squared test p-value (p)
Resources of RECs	56.6% *(QualA)*	45% *(LR)*	23.3% *(QuantA)*	5.8457	0.441
Social cohesion and involvement of citizens in RECs	50% *(QualA)*	35% *(LR)*	20% *(QuantA)*	4.9404	0.551
Policy context	38.3% *(QualA)*	23.3% *(LR)*	10% *(QuantA)*	7.5036	0.277
Support and contribution of regime and niche actors	58.3% *(QualA)*	36.6% *(LR)*	13.3% *(QuantA)*	19.1873	**0.004****
Network, cooperation and collaboration of RECs	45% *(QualA)*	28.3% *(LR)*	16.6% *(QuantA)*	7.1608	0.306
Environmental protection and awareness	15% *(QualA)*	5% *(LR)*	3% *(QuantA)*	3.8914	0.691
Profitability of RECs	25% *(QualA)*	13.3% *(LR)*	8.3% *(QuantA)*	4.6433	0.590
Transparency and trust	28.3% *(QualA)*	18.3% *(LR)*	10% *(QuantA)*	12.9321	0.044
Management and organisational structure	40% *(QualA)*	31.6% *(LR)*	18.3% *(QuantA)*	5.5171	0.479

[10] *The percentages of all the countries in a row corresponding to a success factor do not add up to 100%, as some studies used more than one country for their data collection.*

Market incentives	16.6% *(QualA)*	10% *(LR)*	8.3% *(QuantA)*	4.1945	0.650
Heterogeneity of RECs	18.3% *(QualA)*	10% *(LR)*	6.6% *(QuantA)*	3.4206	0.755
Stability of RECs	13.3% *(QualA)*	8.3% *(LR)*	0% *(QuantA)*	5.4342	0.489

Table 3.[11] *Meta-analytic results for the relationships between the success factors and methodology of the study. Please note: "QualA", "LR" and "QuantA" stand for Qualitative Analysis, Literature Review and Quantitative Analysis, respectively (the frequencies of each relationship are presented in descending order). Please note: *, ** indicate statistical significance at 5% and 1% levels (p<0.05 and p<0.01), respectively. Source: Articles reviewed and meta-analysis carried out using the Stata software.*

Success Factor	**Type of renewable energy**						**Pearson's chi-squared statistic (X^2)**	**Chi-squared test p-value (p)**
Resources of RECs	36.6% *(Wn)*	36.6% *(A)*	31.6% *(Sl)*	18.3% *(Bm)*	15% *(Hd)*	13.3% *(O)*	29.5543	**0.020***
Social cohesion and involvement of citizens in RECs	33.3% *(Sl)*	33.3% *(Wn)*	28.3% *(A)*	20% *(Bm)*	18.3% *(O)*	13.3% *(Hd)*	16.3646	0.428
Policy context	25% *(Sl)*	23.3% *(Wn)*	20% *(A)*	13.3% *(Bm)*	13.3% *(O)*	11.6% *(Hd)*	14.2739	0.578
Support and contribution of regime and niche actors	38.3% *(Wn)*	31.6% *(Sl)*	28.3% *(A)*	18.3% *(Bm)*	16.6% *(O)*	11.6% *(Hd)*	16.6511	0.409
Network, cooperation and collaboration of RECs	30% *(Wn)*	26.6% *(Sl)*	21.6% *(A)*	15% *(O)*	13.3% *(Bm)*	8.3% *(Hd)*	13.1693	0.660
Environmental protection	8.3% *(Sl)*	8.3% *(O)*	6.6% *(Wn)*	6.6% *(A)*	5% *(Bm)*	3.3% *(Hd)*	16.7906	0.399

[11] *The percentages of all the categories of methodologies in a row corresponding to a success factor do not add up to 100%, as some studies used more than one methodology.*

Profitability of RECs	18.3% *(Wn)*	16.6% *(Sl)*	10% *(O)*	8.3% *(Bm)*	8.3% *(A)*	3.3% *(Hd)*	12.2715	0.725
Transparency and trust	18.3% *(Sl)*	18.3% *(Wn)*	15% *(O)*	11.6% *(A)*	11.6% *(Bm)*	5% *(Hd)*	13.8692	0.608
Management and organisational structure	26.6% *(Sl)*	26.6% *(Wn)*	21.6% *(A)*	11.6% *(Bm)*	10% *(Hd)*	8.3% *(O)*	20.1910	0.212
Market incentives	11.6% *(Sl)*	11.6% *(Wn)*	6.6% *(A)*	6.6% *(O)*	5% *(Bm)*	1.6% *(Hd)*	10.6260	0.832
Heterogeneity of RECs	11.6% *(Wn)*	8.3% *(Sl)*	8.3% *(A)*	3.3% *(O)*	1.6% *(Bm)*	1.6% *(Hd)*	14.6043	0.554
Stability of RECs	8.3% *(Wn)*	6.6% *(Sl)*	6.6% *(A)*	5% *(Hd)*	5% *(O)*	1.6% *(Bm)*	17.8610	0.332

Table 4.[12] *Meta-analytic results for the relationships between the success factors and type of renewable energy. Please note: "Sl", "Wn", "Bm", "Hd", "A" and "O" stand for Solar, Wind, Biomass, Hydro, All technologies and Other, respectively (the frequencies of each relationship are presented in descending order). Please note: *, ** indicate statistical significance at 5% and 1% levels (p<0.05 and p<0.01), respectively. Source: Articles reviewed and meta-analysis carried out using the Stata software.*

Success Factor	**Year of study**						**Pearson's chi-squared statistic (X^2)**	**Chi-squared test p-value (p)**
Resources of RECs	23.3% *(2012)*	21.6% *(2011)*	13.3% *(2010)*	11.6% *(2013)*	6.6% *(2008)*	5% *(2009)*	5.6057	0.847
Social cohesion and involvement of citizens in RECs	20% *(2012)*	16.6% *(2011)*	13.3% *(2010)*	8.3% *(2013)*	6.6% *(2008)*	3.3% *(2009)*	9.9762	0.443
Policy context	15% *(2012)*	13.3% *(2011)*	11.6% *(2010)*	8.3% *(2013)*	3.3% *(2008)*	1.6% *(2009)*	9.9412	0.446
Support and contribution of regime and niche actors	20% *(2012)*	18.3% *(2011)*	13.3% *(2010)*	11.6% *(2013)*	6.6% *(2008)*	5% *(2006)*	4.7238	0.909

[12] *The percentages of all the categories of types of renewable energy in a row corresponding to a success factor do not add up to 100%, as some studies looked into more than one type of renewable energy.*

Network, cooperation and collaboration of RECs	21.6% *(2011)*	16.6% *(2012)*	15% *(2010)*	5% *(2013)*	3.3% *(2009)*	3.3% *(2008)*	24.3592	**0.007****
Environmental protection	6.6% *(2012)*	3.3% *(2011)*	3.3% *(2010)*	1.6% *(2013)*	1.6% *(2006)*	0% *(2009)*	5.0514	0.888
Profitability of RECs	10% *(2011)*	8.3% *(2012)*	6.6% *(2013)*	5% *(2010)*	1.6% *(2006)*	1.6% *(1999)*	9.3270	0.501
Transparency and trust	8.3% *(2011)*	6.6% *(2010)*	5% *(2012)*	3.3% *(2013)*	3.3% *(2008)*	3.3% *(2007)*	9.6286	0.474
Management and organisational structure	18.3% *(2011)*	15% *(2012)*	10% *(2010)*	8.3% *(2013)*	5% *(2008)*	3.3% *(2009)*	8.8882	0.543
Market incentives	8.3% *(2012)*	6.6% *(2011)*	5% *(2010)*	1.6% *(2006)*	0% *(2013)*	0% *(2009)*	9.4973	0.486
Heterogeneity of RECs	5% *(2011)*	3.3% *(2012)*	3.3% *(2010)*	3.3% *(2007)*	1.6% *(2013)*	1.6% *(2009)*	9.2724	0.506
Stability of RECs	5% *(2013)*	3.3% *(2012)*	3.3% *(2010)*	1.6% *(2011)*	1.6% *(2009)*	1.6% *(2008)*	8.8702	0.544

Table 5. *Meta-analytic results for the relationships between the success factors and year of study. Please note: the frequencies of each relationship are presented in descending order. Also please note: *, ** indicate statistical significance at 5% and 1% levels (p<0.05 and p<0.01), respectively. Source: Articles reviewed and meta-analysis carried out using the Stata software.*

Appendix C

Relationship between the number of factors and categorical variables	**F statistic**	**F-test p-value (p)**	
Number of factors & Country	1.06	0.4150	
Number of factors & Methodology	1.40	0.2325	
Number of factors & Type of Renewable energy	0.95	0.5269	
Relationship between the number of factors and year of study	**Pearson's chi-squared statistic (X^2)**	**Chi-squared test p-value (p)**	**Correlation**
Number of factors & Year of study	75.6179	0.861	0.0249

Table 6. *Meta-analytic results for the relationships between the number of success factors and categorical variables, including the year of study. Please note: *, ** indicate statistical significance at 5% and 1% levels (p<0.05 and p<0.01), respectively. Source: Articles reviewed and meta-analysis carried out using the Stata software.*