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Original research article

Testing the social, organizational, and governance factors for success in local low carbon energy initiatives

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ABSTRACT

Evidence from academic studies that analyze social and institutional factors that influence success with community energy projects is scarce. To address this, we pose the question: What are the social, organizational, and governance factors that explain success with 'local low-carbon energy initiatives' (LLCEIs)? To answer this question, claims were first established pertaining to three groups of social factors: i.e. (i) those related to the LLCEI itself; (ii) factors related to the interaction between an LLCEI and the local community; and (iii) the presence of supportive governance settings and linkages with local government and intermediaries. These were analyzed using a variable-oriented cross-case design involving fourteen LLCEIs in the Dutch Province of Fryslân. Results show that there is a difference in the sets of factors that positively correlate with various measures of LLCEI success. Factors related to the LLCEI (i.e. internal organizational factors) correlate with collective energy projects and to a lesser extent with individual projects realized. Items related to interactions of the LLCEI with the local community primarily correlate with the customer base and to a lesser extent with individual projects realized. Finally, items related to the governance setting correlate most strongly with individual projects realized.

1. Background

Often referred to in the literature as 'community renewable energy' (e.g. [1–3]) or 'grassroots innovations' (e.g. [4]), local low carbon energy initiatives (LLCEIs) amount to more than the low-carbon energy they generate or the reduction in energy demand and CO₂ emissions they encourage. The true value of LLCEIs as "small scale and bottom-up interventions, lies in more than just the sum of their parts" [5] (p.7541). By their very nature, LLCEIs pursue what is often referred to as 'social innovation' [6,7]. Within the context of the transition towards low-carbon economies and societies, LLCEIs, as processes of social innovation, invoke changes in actor configurations and resource access within the energy system. Rather than a centralized, private-oriented, and integrated energy system, LLCEIs envisage a more localized, community-oriented energy system with more autonomy and a greater role for civic participation and influence [8–10] that seeks to achieve low carbon goals while at the same time increasing the general wellbeing of communities [11].

In their endeavors, LLCEIs seem to bridge the divides between state, market, and civil society because of the hybridity of their operations.

LLCEIs encompass civic initiatives that are involved with private goods (i.e. low-carbon energy applications) in the pursuit of targets that have public value (e.g. climate mitigation, CO₂ reduction). Assessing the factors that contribute to success is therefore a complex endeavor in which the researcher needs to pay attention to the various theoretical concepts, notions, and frameworks that each potentially contribute to understanding LLCEIs themselves and also the elements of the institutional and social environment in which they operate. The various ways in which LLCEIs emerge present another challenge in drawing inferences about the phenomenon. Studies looking into LLCEIs often address only a few pieces of the puzzle of what makes LLCEIs successful.

Many studies have explored or even tested determinants related to forms of success that local renewable energy organizations (LREOs) can have. Boon and Dieperink [12] explored variables that might explain the emergence and development of LREOs. They derived sets of factors for four subsequent stages: occasion to establish an LREO, local perception of an LREO, local support and acceptance of an LREO, and assessment of the applied technology. The explored and validated variables that reflect a mix of social, economic, technical, and governance factors (engaging in local partnerships is a good example of the

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latter). While their paper highlights how certain factors explain the emergence and establishment of local renewable energy organizations, no attention was given to how they fare afterwards, whether they succeed in establishing renewable energy projects, and manage to survive (reflecting their viability).

Other, predominantly quantitative, studies (i.e. surveys) [13–16] have studied factors related to individuals taking action to participate in LLCEIs or changing their behaviors to contribute to LLCEIs achieving their goals (such as lowering carbon emissions through energy savings or adopting renewable energy technology at the household level). In these studies, data are collected on attitude, motivations for membership, membership characteristics, community characteristics, and social involvement in community energy. Many studies address determinants of a person's willingness to participate in community energy action [14,17]. Although they shed light on the role of individuals in LLCEIs and the way they can contribute to their success, they offer little insight into how LLCEIs perform and become successful from a collective perspective.

Haggett et al. [18] analyzed the social factors that influence the success of community energy projects through different stages of development (from conception to operation). They differentiate four sequential stages: the conception stage, the feasibility (assessment) stage, the planning stage, and the operational stage. Results show that the social factors that influence project success differ in the various stages, but reveal the importance of having longstanding community energy development organizations for which carbon saving is the primary motivation (rather than purely financial motivation) that are supported by local councils (highlighting the importance of informal relationships, contacts, and shared agendas between councils and communities), and are located in less deprived areas with high social cohesion. While the study highlights factors related to project success, it pays less attention to organizational factors that influence overall success of community energy initiatives.

Seyfang et al. [19] undertook a comprehensive sectoral study to analyze the objectives, origins, and development of community groups across the UK and their activities, including their networking activities. They also examined strengths and weaknesses, along with the opportunities and threats presented by wider socioeconomic and political contexts. While they provided considerable insight into the forces that influence community energy initiatives on different levels of scale, they did not use a research design to test a set of factors that might determine the success of community energy initiatives.

What these studies have in common is that they reveal the importance of social, organizational, and governance factors, whose combination is perhaps the strength of LLCEIs, such as having a high level of social cohesion and trust between the community and the local government authorities, alongside non-constraining participation of locals in decision-making processes [12,17]. What none of these studies do, however, is provide answers using a categorization of factors suggested in the present academic literature and a research design that allows testing and validation of the relationships between these factors and LLCEI success, in which the focus is on the viability of the LLCEI, its membership base, and the extent to which LLCEIs succeed in realizing renewable energy projects. Rather, they have tended to focus on the emergence, establishment, or development of LLCEIs, or on individual reasons to participate in LLCEIs. Moreover, reported studies often fail to effectively take LLCEIs as their unit of analysis and lack a profound perspective on the governance and politics involved in energy transitions.

This paper addresses this knowledge gap and seeks theoretical elaboration and empirical validation by categorizing a broad set of factors that may contribute to LLCEI success. This paper provides an answer to the following research question: What are the social, organizational, and governance factors that contribute to explaining success of local low-carbon energy Initiatives?

Section 2 presents a literature review and deduces fifteen

propositions worthy of research. In Section 3, the research design and methodology are presented (i.e. a cross-case design of fourteen LLCEIs in the Dutch province of Fryslân). In Section 4, the results of the analysis are presented, and these are then discussed in Section 5. Conclusions, limitations, and opportunities for future research are presented in Section 6.

2. Success of local low carbon energy initiatives and assumed causal drivers

In order to derive further understanding of which factors influence LLCEI success, one first has to understand what 'success' actually means in relation to LLCEIs. For this, one first has to acknowledge the organizations that they are, and the goals that they have. We argue that LLCEIs can be perceived as community energy collectives that pursue renewable energy and low carbon goals while at the same time pursuing local socioeconomic community-building goals that will enhance the wellbeing of local communities [8–11]. As such, 'success' can be viewed as the extent to which LLCEIs succeed in meeting these goals. However, there is also an organizational component to success: the ability to exist or survive over time (i.e. organizational viability). For this, we assume that a few preconditions have to be met, such as having a sound membership base, having sufficient organizational capacity, and operating a sound financial business model, to run one or more (renewable energy) projects that support the financial operations of the organization. Viewing LLCEI success in these terms is in a sense not dissimilar to Haggett et al. [18], who view success as the completion or installation of renewable energy projects.

In order to fully comprehend the factors that influence LLCEI success, one needs to understand their hybrid nature and the relatively immature field of LLCEI research. This demands an analytical approach that is open to conceptualizations and theoretical propositions from multiple relevant disciplines. The hybrid nature of LLCEIs does not automatically mean that one has to start from scratch to arrive at a comprehensive theoretical categorization of the various potential success factors. In attempting to understand the factors that influence the success of LLCEIs, various relevant disciplines and literature streams may be incorporated alongside the existing literature on community energy, in particular LLCEIs. Possibilities include research looking into the social, organizational, and governance mechanisms for business start-up success, social enterprises, social movements, and non-profit and community-based organizations.

This section first discusses the various potential success factors. Second, it addresses the mechanisms at play in the interactions between an LLCEI and its space of dependence. Here, spaces of dependence involve more-or-less localized social relations upon which we depend for the realization of essential interests and for which there are no substitutes elsewhere. They define place-specific conditions for the material wellbeing of people and their sense of significance [20]. Finally, attention is paid to how LLCEIs construct their spaces of engagement to secure the conditions they require in their spaces of dependence. LLCEIs are locally dependent in that their "primary interest is in defending or enhancing the flow of value through a specific locality: the territory that defines for them a geographically circumscribed context of exchange relations critical to their reproduction" [21] (p.310). Cox calls this the process through which the actor involved constructs networks of associations, or 'spaces of engagement', to defend its local interests. Within these spaces, politics unfold that assist in securing a space of dependence. While Cox argues that spaces of engagement are constructed when threats to local interests occur, we argue that LLCEIs also construct such spaces in order to meet their intended goals (see also [22]).

2.1. Categorization of social, organizational and governance factors

Based on the factors reported in the literature, roughly three meta-

Table 1
Categorization of potential success factors of LLCEIs.

Category of factors	Items
<i>Factors related to the LLCEI itself</i>	<ul style="list-style-type: none"> • Project champions • Human capital • Size • Availability of time • Access to funds • Board diversity
<i>Interaction with the local community</i>	<ul style="list-style-type: none"> • Alignment with local values and frames of reference • Alignment with the institutional characteristics of the local community • Visibility • Community involvement • Bonding capital • Bridging capital
<i>Governance setting and linkage to government</i>	<ul style="list-style-type: none"> • Linkage to government • Linkage to intermediaries • Supportive governance arrangement

categories of factors can be deduced that influence the success of LLCEIs: (i) factors related to the LLCEIs themselves (i.e. related to (intra-) organizational issues); (ii) factors related to interaction with the local community; and (iii) factors related to the governance setting and linkages with government. It should be noted here that the factors presented are social factors that mostly play out on the local operational level. The factors identified do not include factors like technology, pricing, and macro-level events. Although they are also important factors they fall outside the scope of factors relevant in the present study. An overview of the three categories mentioned and the sub-items that belong to them is presented in Table 1.

2.1.1. Factors related to the LLCEI itself

2.1.1.1. Project champions. LLCEIs are typically run by volunteers – citizens that are environmentally-minded and who want to make their locality more sustainable by taking action themselves (e.g. [23–25]). More specifically, so-called project champions are important driving forces for LLCEIs. Various studies have argued and provided evidence of the important role of such committed individuals in driving the success of LLCEIs [6,24,26–37]. Project champions are understood as key committed individuals involved in the LLCEI that have a “prominent role in starting, endorsing or carrying out a project” [27]. Various studies have qualified that ‘project champions’ need not be only individuals, but can be core groups of committed individuals that are critical for project success [19,30,32,38]. Therefore, we expect that *the extent to which LLCEIs are managed by a project champion, or a core group of committed individuals, contributes to their success.*

2.1.1.2. Human capital. A relevant stream of literature looks into the role of human capital in entrepreneurial and new venture success, and provides a basis for various propositions that further specify the mechanisms and capacities through which project champions, or other involved volunteers, manage to establish LLCEIs that survive. Several studies note the importance of human capital that suggests the importance of acquiring and using specific competences that are necessary to achieve LLCEI success [3,19,25,32,37,39–43]. However, expertise is often called for that goes beyond what a volunteer organization, such as many LLCEIs, can provide or support [44]. As such, it is expected that *the extent to which LLCEIs have human capital (understood as knowledge and experience in relevant industry, self-employment, or leadership) contributes to their success.*

2.1.1.3. Size. Some studies looking into success factors of LLCEIs specifically highlight the importance of founding and steering group size (e.g. [33]; see also [45] p. 54). Indeed, the importance of a sizeable

group of volunteers becomes apparent since non-profit organizations such as sport clubs, as well as LLCEIs, struggle to retain volunteers and sustain their participation [46]; see also [47,48]. Thus, we expect *the size of LLCEIs to be positively associated with their success.*

2.1.1.4. Board diversity. Wollebaek [48] showed that the survival of local voluntary associations is positively correlated with board diversity (operationalized as diversity in age and profession) (see also [49]). Since some studies have indicated that the LLCEI movement tends to be relatively homogenous with regards to age, gender, and profession (e.g. [24,50–52]), this study understands board diversity as addressing these three aspects, and argues that broader diversity will better represent the local community and broaden the scope of competences and perspectives. Therefore, we expect *the degree of board diversity to contribute to LLCEI success.*

2.1.1.5. Availability of time. Next to factors related to human capital, various studies have highlighted the availability of time as an important factor that contributes to the realization of LLCEI projects [3,19,25,32,33,41,43,53]. Significant investment of time by LLCEI members – who are mostly volunteers – is needed to realize an LLCEI project [54]. Therefore, this study hypothesizes that *the extent to which LLCEIs are led by individuals who have time available to spend on the initiative (i.e. because of their employment or retirement status) contributes to LLCEI success.*

2.1.1.6. Access to funds. The ability to successfully apply for funds as well as the availability of funds are considered important factors related to LLCEI success [3,6,19,25,27,32,33,39–41,54–57]. In terms of getting funding for an LLCEI project, the government is not the only provider of grants. Ruggiero et al. [27] found that some LLCEIs managed to get their projects financed through using start-up capital provided by local communities. This signals the importance for LLCEIs to actively search various avenues for funds in order to eventually gain access to funds. Likewise, in the literature on new venture survival, “financial capital input levels, irrespective of owner education, are strong determinants of small business survival prospects” [58] p. 551; [59,60]. Therefore, we expect that *the extent to which LLCEIs have access to funds contributes to their success.*

2.1.2. Interaction between the LLCEI and the local community

2.1.2.1. Bonding capital. Various scholars have highlighted social capital as an important resource on which LLCEIs draw to successfully realize community low-carbon energy projects [2,14,32,35,36,56,61]. Social capital is found to be an important component for the economic development of local community business [62,63], and also for sustainable community development [38]. Definitions of social capital generally center on networks of social relationships that are governed by social norms, trust, and reciprocity, and which can be put to use [64–67]. Importantly, social capital not only involves the number of social ties but also the resources that can be mobilized by drawing on those social relationships. The resources that can be accessed through social ties as well as other advantageous features are assumed to vary depending on the strength of these social network ties. Granovetter [68] distinguished weak from strong ties, which were later complemented by the notion of vertical ties [38,69–71]. The strength of a tie is determined by the frequency of contact, emotional intensity, the degree of intimacy, and reciprocal commitments that characterize the tie [68](p. 1361). Strong ties, or ‘bonding social capital’, involve strong social networks between homogenous groups, which spring from repeated personal contacts. Trust, reciprocity, social norms, and values arise from these social networks. Strong ties are able to provide joint problem-solving opportunities, trust, and the transfer of tacit, fine-grained and complex knowledge [72]. Furthermore, strong ties have also been argued to be important for start-up ventures [73].

2.1.2.2. *Bridging capital.* Conversely, weak ties, or 'bridging social capital' [74], refer to social networks between heterogeneous groups that result from outward-oriented distant ties and connect or cut across different groups or communities [75]. Weak ties provide actors with new information and ideas by 'building bridges' between two previously separated actors or network clusters [68,76]. Bridging social capital has the potential to provide additional opportunities, information, and resources that do not come from bonding social capital [68,76]. Studies have argued for the importance of a mix of bonding and bridging ties specifically for grassroots organizations within communities [28,35,38,56,77]. On this basis, we expect *the extent to which LLCEIs are able to draw on a mix of bonding and bridging capital contributes to their success.*

2.1.2.3. *Alignment with institutional characteristics of the local community.* As social capital can be considered a key resource for LLCEIs, there will also be other, more structural features of local communities that shape their operations and influence their success. These structural features and their impact on organizations can be viewed through institutional theory, which appears to be able to substantiate the intricate relationship between LLCEIs and their local communities. Nootboom [78] argues that social capital is partly based on institutions and may also contribute to their development. Institutional analysis focuses on the ways in which LLCEIs can align their actions with their local communities.

Alignment with local community institutions is also an important means through which organizations can harness their performance. Marquis and Battilana [79] argue that the influence of community-level social and normative features is achieved mainly through two mechanisms: connectivity of firms with local organizations and the presence of community institutions. Together, they refer to local relational systems that are expected to have socio-normative effects on firm behavior. The two mechanisms facilitate the spread of information and put firms directly in touch with social needs. Translated to the context of LLCEIs, Allen et al. [80](p. 277) suggest that community low-carbon energy projects should be located in public locales, such as schools, to maximize community engagement and foster a snowballing effect. In a similar vein, Forrest and Wiek [32] found that involving the community parish council could legitimate the ideas of the community project, which helped the latter to get off the ground. For these reasons, we expect that *the more LLCEIs engage with key actors in their local community (e.g., local village council, village church, local schools), and the extent to which LLCEIs align their actions to the institutional features of their local communities, the better their success.*

2.1.2.4. *Alignment with local values and frames of reference.* Cultural-cognitive pressures influence organizations through locally shared frames of reference and identity that provide methods, ideas, practices, and the like that amount to taken-for-granted assumptions that are widely accepted within the community in which they operate [79]. Factors related to geography, history, and tradition create variation in the frames of reference across localities (*ibid.*). Organizations that accommodate these widely-held beliefs and assumptions acquire legitimacy and access to resources [81]. For example, Wirth [82] found that cultural-cognitive forces (i.e. the community spirit and cooperative tradition of South Tyrolean communities) influenced the scale, site, and organization of the biogas cooperatives. Other studies have also observed the influence of such institutional forces on community energy mobilization and initiative development [14,36,37,83–85], see also [45,86]. Recruitment strategies for, and incentives to sustain, participation in community energy initiatives are found to be more successful when they are sparked by a connection to, and an appreciation of, place [47]. Moreover, Haf and Parkhill [84] observed that Scottish and Welsh community renewable energy initiatives particularly sought to rekindle and sustain cultural traditions (language use, traditional practices,

repatriation of historical knowledge, and reclaiming the relationship between people and land. It is therefore expected that *the degree to which LLCEIs align their operations with values and frames of reference related to the local community's geography, identity, history, traditions, and culture will contribute to their success.*

2.1.2.5. *Community involvement.* An important mechanism for the success of LLCEIs that is underscored in many studies is the degree of community involvement. Marquis and Battilana [79] stress that community-level social and normative features convey an evaluative component, i.e., "What is it right to do around here?". Certainly, studies have shown that motivations for establishing community energy projects (that can be considered as successful LLCEIs) are strongly connected to community interests and needs, rather than global climate change issues [32,36,87]; see also [56,86,88]. This is underscored by findings that show that a lack of public engagement and interest is perceived as a threat by community renewable energy initiatives, and that community support is crucial for success [4,19]. The degree of local participation in the LLCEI as such is crucial for its acceptance. One way to ensure that community interests and needs are represented in the LLCEI is to enable the participation and involvement of the locality. Researchers have observed the positive influence of enhanced participation in the planning process for low-carbon energy installations. More specifically, high levels of participatory planning are often associated with enhanced social and public acceptance of low-carbon energy projects [89–97]. Moreover, participatory governance is increasingly seen as a way for local citizens to engage in decision-making processes regarding community-level energy transitions, although the degree of actual participation in decision-making is still placed on a rather low rung of Arnstein's Ladder [98,99]. Therefore, we expect that *the extent to which LLCEIs enable the local community to become involved (information, consultation, participation) contributes to their success.*

2.1.2.6. *Visibility.* Alongside aligning with local institutions and relational systems, another means to acquire legitimacy is to demonstrate success and enhance the visibility of the LLCEI. Zimmerman and Zeitz [81] propose that visibly addressing norms and values (such as operating profitably or, specifically in case of LLCEIs; demonstrating success such as realized projects) endorsed by the societal environment relevant to the new venture has positive effects on legitimacy. For instance, visible low-carbon energy technologies promote awareness and have positive effects on attitudes towards such technologies [3,100–102]. Additionally, being physically present allows community action groups to extend their networks into the wider community [103]. Visibility can also be interpreted as sharing success stories in the formal media and on social media [19,24,29,32,33]. These studies show that having visible actions or projects can add to the legitimacy of an LLCEI and can grant the LLCEI various benefits. It is therefore expected that *the extent to which LLCEIs are visible within and beyond their communities contributes to their success.*

2.1.3. Governance setting and linkage to government

2.1.3.1. *Linkage to intermediaries and local government.* Another set of linkages that influence the success of LLCEIs is their linkages with local government and so-called intermediaries. Intermediaries are actors that create "new possibilities and dynamism within a system" [104] (p. 726) and create "spaces and opportunities" [105](pp. 296–297) for others. These linkages can be conceptualized as the linking of social capital. Linking social capital helps actors to mobilize political resources and power beyond their own social network. Indeed, ties between an LLCEI and local and/or regional government actors [19,24,34,106,107], as well as ties with intermediaries [27,108], appear to be essential for LLCEI success. Within these spaces and dynamics, intermediaries "mediate, they work in-between, make connections, and enable a relationship between different persons or things" [109](p. 1408).

Therefore, we expect that (a) *LLCEIs that have linkages with local government are more likely to be successful*, and (b) *LLCEIs that have linkages with intermediaries are more likely to be successful*.

2.1.3.2. Supportive governance arrangements. In addition to the above, rather proactive, linkages of LLCEIs with intermediaries and local governments, the broader, but still local, governance arrangements also influence LLCEIs. Government and affiliated organizations are central in molding the governance arrangements of policy domains [110]. Evidence suggests that the national government plays an important role in shaping the general supportive policy framework for LLCEIs [31,37,111]. There is also a specific role for subnational governments as they seem to be critical in providing institutional support to LLCEIs when there is a lack of institutional fit at the national level [112]. Numerous studies show that the support provided by local [27,29,111,113–115], regional, and state governments [24,112,116] contributes to the development and the creation of success conditions for LLCEIs. However, there are also studies that show community energy groups encountering several challenges related to democratic governance within their projects, and the way governments are involved in them [52].

Governance arrangements can be similar for different types of LLCEI. Various studies have shown that governance arrangements for decentralized energy and climate change action tend to be at the local level (e.g. [117,118]). The relevance of looking at local governance arrangements for LLCEIs is confirmed by various studies (e.g. [111,114,119]). As such, the extent to which the governance arrangements can be considered supportive can be derived from various loci. Aspects of governance arrangements that can be considered unsupportive may involve, among other things, unsuitable spatial planning regimes [120,121], instable and uncertain policy frameworks [27], funding schemes that are difficult to access for community energy groups or do not match their aspirations or plans [27,121–124], limited political support [31,39,112], and limited access to policymakers and key decision-making forums [37,112,120]. Furthermore, proxy indicators identified for the degree of supportiveness of the governance arrangements are the capacities present within local government for climate change action such as the presence of local catalysts [29,125,126], the presence of a full-time expert, as well as the municipal sustainability budget. On the basis of these studies, it is argued that *the extent to which the governance arrangements are supportive of LLCEIs will positively affect their success*.

3. Research design and methodology

A variable-oriented cross-case research design [127] has been used to investigate fourteen LLCEIs. Using this design, we aimed to analyze the fifteen claims detailed in Section 2 through both within-case and cross-case analyses. The case study method is particularly appropriate for an in-depth investigation of a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and the context are not clearly evident [128]. The cases included in this study are LLCEIs, which we consider to involve the bottom-up initiating and managing of a project, or series of projects, involving the generation, stimulation, and/or facilitation of low-carbon energy and/or energy efficiency by citizens/actors from civil society on a local scale.

3.1. Operationalization and measurement

The operationalization and measurement of the theoretical constructs that are expected to influence the success of LLCEIs, as well as the operationalization of success, are presented in Appendix 1. These reflect the theoretical constructs presented in Section 2. In order to measure success (the dependent variable), four indicators are used that involve output and outcome indicators. The first indicator is *customer*

base. This concerns the extent to which an LLCEI has succeeded in recruiting a sizable customer base to which it sells green power from a regional low-carbon energy supplier (of which the LLCEI is a shareholder through its membership of regional umbrella cooperatives), with the LLCEI taking an intermediary role. This indicator reflects the outreach an LLCEI has in its surrounding local community, whilst at the same time providing information on its financial income base, which appears essential in order to maintain a feasible business case. The second indicator is the *number of customers relative to the number of households in the locality* to account for differences in the sizes of local communities. The third indicator is the number of realized low-carbon energy and energy efficiency projects for individual households. The fourth indicator is the *number and capacity of collective low-carbon energy projects that have been realized* (See Appendix 1 for indicators and measurement). When taken together, these four indicators provide an overview of the results that LLCEIs have realized from their actions within their local communities. By including all four indicators, a more comprehensive image is generated of LLCEI performance (and hence success) than by focusing on a single indicator.

This operationalization of success was also compared with the ways that the LLCEIs themselves perceive success. All the LLCEIs that were contacted for the present study were found to have the same intention: to make their localities more sustainable. They did, however, differ in their approach to achieving their ambitions. While some LLCEIs considered it important to invest the money generated in revitalizing the local community, others first focused on awareness raising before starting projects that would have a physical impact, or aimed to realize large renewable energy projects to raise awareness. Nevertheless, their ambitions were found to be rather similar whatever the strategy adopted.

Furthermore, by becoming a member of a regional umbrella cooperative of LLCEIs (i.e. Ús Koöperaasje), the LLCEIs chose to conform with the established institutional infrastructure and to accept the cooperative goals set by the federation. These goals are: putting residents more in control of the energy they consume, standing up for the energy interests of residents while seeking to become independent of energy multinationals (who are accused of greenwashing), and contributing to a sustainable future for the region (i.e. Fryslân) [129]. The institutional infrastructure used by Ús Koöperaasje benefits those LLCEIs that recruit customers.

3.2. Case selection

In our study, the case selection is twofold and pertains both to geographical demarcation and to the selection of LLCEIs as cases.

3.2.1. Geographical demarcation

In this study, only LLCEIs in the Dutch province of Fryslân are selected. When compared to other Dutch provinces, it has rather favorable conditions for the empowerment of LLCEIs including regional socioeconomic development programmes that include community support and the presence of multiple intermediary organizations. Geographically, Fryslân is one of the northernmost provinces and is characterized by having a rural landscape, with a high level of dairy farming, and a strong regional culture and identity, including a native language of its own. The Frisian identity includes considerable self-organization and collective action by local communities [130]. Fryslân is home to over 50 LLCEIs (there are over 400 in the Netherlands), with the highest LLCEI per capita figure by province in the country [131]. The province of Fryslân also has above average installed capacity of renewable energy (in particular solar energy) when compared to other Dutch provinces. Based on these figures, Fryslân can be viewed as a high performing, maybe even as an 'extreme', case [127].

3.2.2. Selection of LLCEIs

To maximize the variation between cases in terms of the dimensions of degree of success, as well as their spaces of dependence and

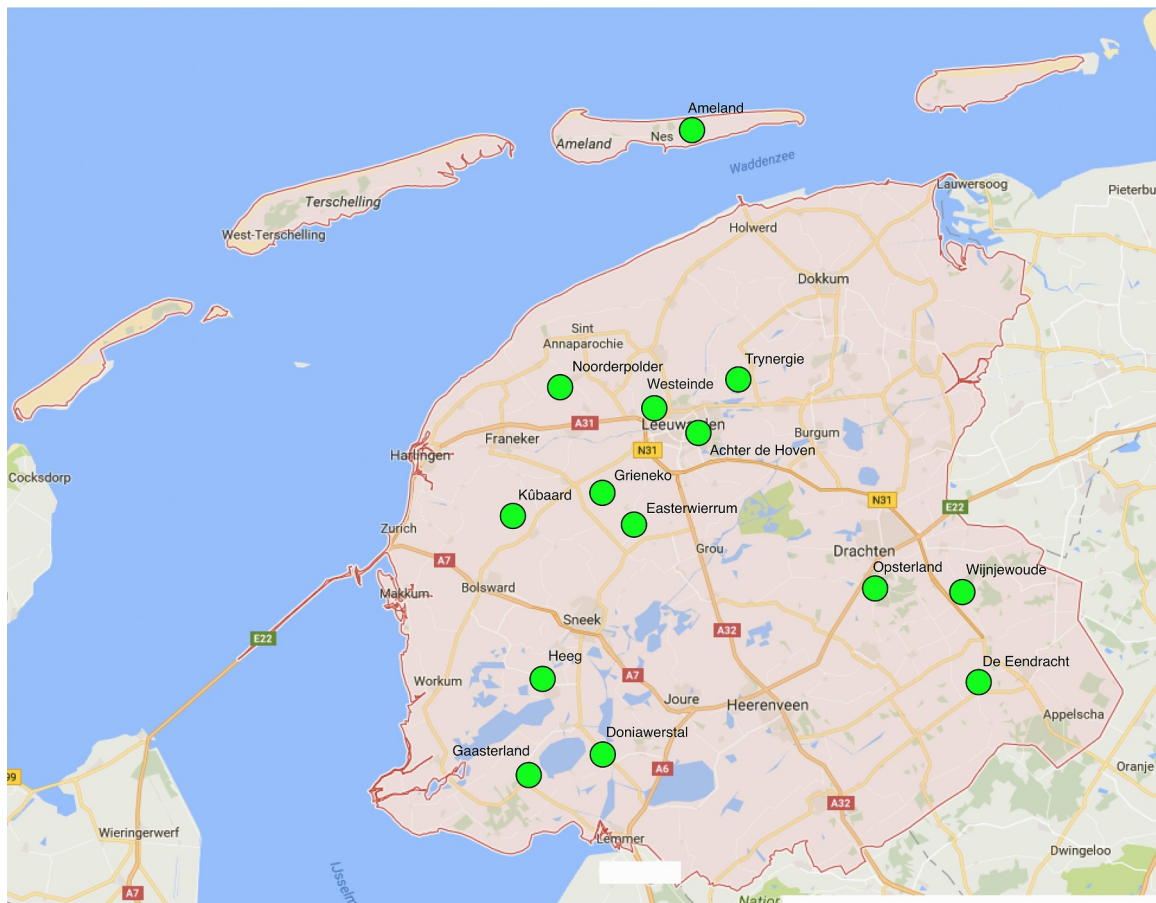


Fig. 1. Locations of the LLCEI cases selected within the Province of Fryslân.

Table 2

Overview of selected cases, their spaces of dependence, and names used to refer to them.

LLCEI	Spaces of dependence	LLCEI in text referred to as
<i>Amelander Energie Coöperatie</i>	Island	Ameland
<i>Trynergie</i>	Multiple villages	Trynergie
<i>Energie Coöperatie Gaasterland</i>	Multiple villages	Gaasterland
<i>Westeinde</i>	Urban district	Westeinde
<i>Doniawerstal-Energie</i>	Multiple villages	Doniawerstal
<i>Energzjy Koöperaasje Om (de) Noorderpolder (EKON)</i>	Multiple villages	EKON
<i>Grieneke</i>	Multiple small villages	Grieneke
<i>Energie Kûbaard</i>	Small village	Kûbaard
<i>Energzjy Koöperaasje Easterwierrum</i>	Small village	Easterwierrum
<i>Coöperatie “Duurzaam Heeg”</i>	Village	Duurzaam Heeg
<i>Wijnjewoude Energie Neutraal</i>	Village	Wijnjewoude
<i>Energie Coöperatie Achter de Hoven</i>	Urban district	Achter de Hoven
<i>Lokale Energie Coöperatie Opsterland</i>	Municipality	Opsterland
<i>Energie Coöperatie “De Eendracht”</i>	Municipality	Eendracht

geographical distribution across the Province of Fryslân, fourteen LLCEIs were selected. Using maximum variation as a case selection criterion has the advantage that shared patterns that cut across cases will be significant because they emerge out of heterogeneity [132] (p. 235). Moreover, using this case selection technique will provide a case sample with variations that will allow analysis of the assumed causal patterns and avoid the danger that conclusions are drawn based on a single or few cases that are poorly representative. Fig. 1 presents a geographical map of the Province of Fryslân, and the locations of the

selected LLCEI cases within this province. Table 2 presents an overview of the selected cases, their spaces of dependence, and the names used to refer to them in the rest of this paper.

3.3. Data collection

The sources of evidence used in data collection are semi-structured in-depth interviews, documentation (websites, policy documents, white papers, statutes, and minutes of meetings), direct observation (e.g. attending workshops, meetings, and field visits), and physical artifacts (e.g. low-carbon energy installations and community centres). In total, 44 interviews were conducted in the period from January 2016 to November 2018. Interviewees included board members of LLCEIs, local and provincial government civil servants, and advisors active in the community energy field.

3.4. Data treatment

The interviews were recorded and stored on a password-protected device only accessible to the main researcher (first author). The recordings were then manually transcribed. Case description were made for each case combining the empirical evidence from multiple data sources. In the process of establishing the case descriptions, specific excerpts that could be conceptually related to the theoretical constructs were extracted from the various data sources. Subsequently, for each of the factors assumed to be of influence, values were assigned using a five-point scale. This ordinal scale ranges from ‘- -’ for a poor manifestation to ‘+ +’ for a strong manifestation of the independent variable in each case. Qualitative descriptions are provided to support the assignment of one of the five values (- -; -; +/-; +; + +) to the independent variable indicators in each of the fourteen cases. The values assigned for each of the variables and indicators, and for each case were

Table 3
Descriptive statistics (N = 14).

Category of factors	Minimum	Maximum	Mean	Std. deviation
<i>Factors related to the LLCEI itself</i>				
<i>Project champions</i>	1	5	3.93	1.207
<i>Human capital</i>	3	5	4.50	0.760
<i>Size</i>	1	5	4.00	1.301
<i>Availability of time</i>	1	5	3.64	1.447
<i>Access to funds</i>	2	5	4.36	1.008
<i>Board diversity</i>	1	5	2.57	1.342
<i>Interaction with the local community</i>				
<i>Alignment with local values and frames of reference</i>	1	5	3.43	1.697
<i>Alignment with the institutional characteristics of the local community</i>	3	5	4.64	0.745
<i>Visibility</i>	2	5	4.57	0.938
<i>Community involvement</i>	3	5	4.64	0.633
<i>Bonding capital</i>	2	5	4.07	1.141
<i>Bridging capital</i>	2	5	4.29	1.069
<i>Governance setting and linkage to government</i>				
<i>Linkage to government</i>	1	5	3.64	1.216
<i>Linkage to intermediaries</i>	2	5	4.43	0.938
<i>Supportive governance arrangement</i>	1	5	2.86	1.351
<i>Success factors</i>				
<i>Success: customers</i>	1	5	3.29	1.684
<i>Success: customers relative</i>	1	5	2.57	1.910
<i>Success: individual</i>	1	5	2.79	1.762
<i>Success: collective</i>	1	5	3.79	1.122

based on an interpretation of the case descriptions. Detailed qualitative descriptions on how the cases performed in terms of each factor (sub-item) can be found in the Supplementary Material file ‘Qualitative confirmatory analysis’.

The scores were subsequently inserted in a data matrix containing the assigned values for each of the independent and dependent variables (plus four indicators in the case of the latter), for each individual case (See Appendix 2). In assigning values for the data matrix, the main researcher of the present study went through an iterative process that started by assigning values to the variables for each case. These values were then discussed extensively with the co-researchers. Moreover, interviewees were contacted again if there were missing values or uncertainty about the value assigned, and finally to confirm the scores given.

External factors such as wealth have been taken into consideration in the study. However, given that all the cases are from the same region, most socioeconomic and demographic background factors are broadly similar. For example, the share of home ownership in the province of Fryslân (61.8%) is relatively high when compared to the national average (56.8%), except for the Frisian capital, the City of Leeuwarden (51.6%). The municipalities in which the LLCEIs are located have on average close to 70% home ownership [133].

3.5. Data analysis

The cross-case analysis involved identifying bivariate correlations between selected independent variables and indicators of the dependent variable. As a correlation measure, Spearman's Rho was used. This was selected for two reasons. First, because the independent variables have ordinal scales. To enable a statistical analysis, the scales ranging from “– –” to “+ +” were transformed into numeric categories ranging from 1 (“– –”) to 5 (“+ +”). Second, because the descriptive statistics (See Table 2) show that a number of the variables are somewhat skewed, and are not normally distributed. However, the correlation analysis, and thus the cross-case analysis, is not based solely on the strength and significance of the statistical correlations. In a complementary step, and for confirmatory reasons, the correlations were reflected upon alongside qualitative insights from the case studies using rich qualitative interpretations and case illustrations to provide in-depth insight into the relationships between the independent and dependent variables. As such, the cross-case analysis can be interpreted as a triangulation of qualitative and quantitative research methods.

4. Results

This section presents the results of the analysis. First, Section 4.1 provides an overview of how the LLCEIs perform in terms of each of the independent variables. Section 4.2 then presents the results of the cross-case analysis by illuminating the bivariate relationships between the theoretical predictors and the dependent variable ‘LLCEI success’.

4.1. Performance of the individual LLCEI cases

An overview of the performance of the fourteen LLCEI cases in terms of the theoretical predictors can be found in Appendix 2. Table 3 shows the descriptive statistics of the independent and dependent variables. A few noteworthy observations can be made. First, the LLCEIs involved in this study are largely run by, or can draw on, competent individuals (mean score of 4.50 (out of 5) for human capital). The same is true for institutional embeddedness (mean = 4.64). The reason for this is that many of the LLCEIs started as working groups of their village councils or district councils and that the LLCEIs also widely use these councils as a communication channel to present their ideas and recruit customers or participants. For most of the LLCEIs in this study, the target group is their local community, which is reflected in the high statistical mean for this variable (mean = 4.64). For the remaining twelve independent variables, the LLCEIs show significant variations. Despite these variations, a fairly high average performance (mean > 3.00) is seen for thirteen of the fifteen independent variables. The variables which display relatively low means are board diversity (mean = 2.57), and supportive governance arrangement (mean = 2.86).

Turning to the dependent variable (success), some LLCEIs do not perform well, particularly in terms of the number of customers relative to the total number of households in the locality and in terms of the realized projects for individual households (the means are respectively 2.57 and 2.79). The low mean for the relative number of customers can largely be explained by the scale of the locality in which an LLCEI is active. LLCEIs that target a large locality need to have recruited a large number of customers to perform well on this indicator. That is, the LLCEIs that did score well on this indicator of success are situated in relatively small localities (Ameland is an exception). In terms of individual household-level projects, there are some LLCEIs that have decided to pursue only collective projects and customer recruitment, and therefore score poorly on this indicator.

4.2. Results of the cross-case analysis

4.2.1. Results of the statistical analysis

Table 4 presents the results of the statistical analysis of bivariate correlations, with statistically significant results indicated using asterisks. A few results are significant at the 99% confidence level (**) and several at the 95% level (*). In the next Section 4.2.2, the correlations are illustrated with qualitative interpretations and case illustrations to provide in-depth insights into the relationships between the independent and dependent variables. A more comprehensive table, including inter-item correlations between independent variables, is presented in Appendix 3.

The most prominent correlations are discussed in the two sections below (4.2.1 and 4.2.2). Section 4.2.1. addresses results related to the customer base (i.e. the indicators ‘customers’ and ‘customers relative’). Section 4.2.2. discusses results related to renewable energy projects (i.e. the indicators ‘individual/household level projects’ and ‘collective renewable energy projects’).

4.2.2. Factors correlating to LLCEI success in terms of customer base

The results of the statistical analysis revealed, not surprisingly, that success in establishing a sound customer base is primarily related to the way in which LLCEIs interact with local communities. This is highlighted by the significant positive and fairly strong correlations between three items and the relative customer base: i.e. alignment with local values and frames of reference ($\rho = 0.728$; $p = .002$), bonding capital ($\rho = 0.649$; $p = .006$), and bridging capital ($\rho = 0.608$; $p = .010$). Two other factors just failed the significance test: i.e. alignment with institutional characteristics of the local community ($\rho = 0.434$; $p = .060$) and visibility ($\rho = 0.433$; $p = .061$). Except for access to funds ($\rho = 0.557$; $p = .019$), no significant correlations were found between items belonging to the ‘Factors related to LLCEI itself’ and ‘Governance setting and linkage to the government’ clusters and customer-related success factors (i.e. ‘Success: customers’ and ‘Success: customers relative’). Two further items just failed the significance test: i.e. linkage to government ($\rho = 0.378$; $p = .091$) and supportive governance arrangement ($\rho = 0.395$; $p = .081$).

4.2.3. Factors correlating to LLCEI success in terms of setting up renewable energy projects

Here, it makes sense to differentiate the results from the statistical analysis in terms of individual projects (those attempting to persuade households to adopt energy conservation measures or renewable energy technology) and collective projects (with local community members investing in collective solar PV projects).

The former category (individual projects) revealed a number of significant and positive predictors from three different clusters. For the ‘Factors related to the LLCEI itself’ cluster, both. project champions ($\rho = 0.660$; $p = .005$) and availability of time ($\rho = 0.566$; $p = .017$) were significant predictors. Both alignment with institutional characteristics of the local community ($\rho = 0.545$; $p = .022$) and community involvement ($\rho = 0.657$; $p = .005$) were significant predictors in the ‘Interaction with the local community’ cluster. Finally, in the ‘Governance settings and linkage to government’ cluster, both linkage to government ($\rho = 0.803$; $p = .000$) and supportive government arrangement ($\rho = 0.492$; $p = .037$) were significant predictors. Three further items, from the first two clusters, nearly passed the significance threshold.

Turning to the collective projects, only the ‘Factors related to the LLCEI itself’ cluster provided significant predictors: i.e. human capital ($\rho = 0.519$; $p = .029$); availability ($\rho = 0.467$; $p = .046$); access to funds ($\rho = 0.721$; $p = .002$); and board diversity ($\rho = -0.504$; $p = .033$). Surprisingly, the last of these is a negative relationship: having a diverse board is more likely to lead to an unsuccessful project. A plausible explanation found in the qualitative analysis is that LLCEIs with less diverse boards (some of them all male) often possessed a high

degree of relevant knowledge and experience. In particular, these relatively homogenous groups were found to have a relevant skillset and knowledge base that fulfilled an important role in the planning and realization of collective renewable energy projects. More diverse boards did so to a lesser extent. One further factor, linkage to intermediaries from the ‘Governance setting and linkage to government’ cluster was nearly significant ($\rho = 0.399$; $p = .079$).

5. Discussion

The cross-case analysis revealed a few general findings. First, it showed that items related to the LLCEI itself (i.e. internal organizational factors) are positively correlated with collective energy projects, and to a lesser extent with individual projects, realized. Second, it showed that items related to interaction with the local community primarily correlate positively with customer base (adjusted for community size) and to a lesser extent to individual projects realized. Thirdly, the analysis showed that items related to the governance setting and linkage to government correlate positively with individual projects realized.

In contrast to the study on the realization of renewable energy projects by Hagget et al. [18], our study found no evidence supporting claims that it is social factors (interaction with the local community) that work in favor of developing and realizing such (collective) projects. Rather, the present study’s results support claims that it is an LLCEI’s (intra-)organizational factors (and to a lesser extent its linkage to intermediaries) that positively influence the successful development of collective renewable energy projects. Nevertheless, the present study did find some significant predictors (from the social factors cluster) that resemble social cohesion, but only in relation to successful individual (household-level) energy projects and not to collective energy projects. The significant and positive relationship found between three of the social factors (items) and the customer base are in line with Boon and Dieperink’s [12] analysis that a high degree of social cohesion and a fair participation of local inhabitants boosts support and acceptance of local renewable energy organizations.

Furthermore, the analysis also revealed interesting results on a more detailed, sub-item level. These will be discussed in Sections 5.2–5.4, including in relation to ongoing academic debates regarding community energy and grassroots energy initiatives. First, however, we will discuss LLCEIs vis-à-vis the spaces they engage in from an empirical reflective perspective (Section 5.1 below).

5.1. Reflections on LLCEIs and spaces of engagement

When reflecting on the ‘spaces of dependence’ and ‘spaces of engagement’ concepts presented at the start of Section 2 [20,21], the results of the present study have implications that can to an extent be presented as a narrative on the way LLCEIs develop and the ways they succeed. This has some similarities to Boon and Dieperink’s analysis on the development and establishment of LREOs [101]. Since LLCEIs are highly dependent on their local social environment, they first need to engage with it to establish a sound customer base. This is necessary to generate sufficient income for their organizational business model. Some LLCEIs then engage in small-scale (and therefore less risky) individual energy projects, persuading households to adopt specific energy technologies. As our study showed, in order to succeed, LLCEIs need organizational capacity (especially project champions with time available), social involvement and support from the local community, and a sound linkage to government and supportive government arrangements (such as subsidies available to households). Finally, once an LLCEI has a sufficient degree of organizational capacity (in terms of projects champions and human capital, available time, and access to funds) and linkages to intermediaries for support, they are able to develop and install collective renewable energy projects, which are usually of a more complex and risky nature. To summarize, LLCEIs

Table 4
Results of cross-case analysis (Spearman's Rho; N = 14) of bivariate correlations between the theoretical predictors and indicators of success.

Category of factors	Success: customers	Success: customers relative	Success: individual projects	Success: collective projects
<i>Factors related to the LLCEI itself</i>				
Project champions	Rho Sig. (1-tailed)	-0.026	0.660**	0.443
Human capital	Rho Sig. (1-tailed)	0.465 0.041	0.005 0.372	0.056 0.519*
Size	Rho Sig. (1-tailed)	0.445 -0.096	0.095 0.380	0.029 0.364
Availability of time	Rho Sig. (1-tailed)	0.373 -0.093	0.090 0.566*	0.101 0.467*
Access to funds	Rho Sig. (1-tailed)	0.376 0.260	0.017 0.337	0.046 0.721**
Board diversity	Rho Sig. (1-tailed)	0.185 0.013	0.119 -0.190	0.002 -0.504*
	Rho Sig. (1-tailed)	0.482	0.258	0.033
<i>Interaction with the local community</i>				
Alignment with local values and frames of reference	Rho Sig. (1-tailed)	0.728**	0.123	0.071
Alignment with the institutional characteristics of the local community	Rho Sig. (1-tailed)	0.002	0.337	0.404
Visibility	Rho Sig. (1-tailed)	0.434 0.060	0.545* 0.022	-0.024 0.467
Community involvement	Rho Sig. (1-tailed)	0.433 0.061	0.385 0.087	-0.298 0.151
Bonding capital	Rho Sig. (1-tailed)	0.321 0.132	0.657** 0.005	-0.134 0.325
Bridging capital	Rho Sig. (1-tailed)	0.649*	-0.005	0.358
Linkage to government	Rho Sig. (1-tailed)	0.006 0.608*	0.493 0.106	0.105 0.173
Linkage to intermediaries	Rho Sig. (1-tailed)	0.010 -0.076	0.359 0.803**	0.277 0.179
Supportive governance arrangement	Rho Sig. (1-tailed)	0.398 0.052	0.000 -0.104	0.270 0.399
	Rho Sig. (1-tailed)	0.430 0.176	0.362 0.492*	0.079 0.197
	Rho Sig. (1-tailed)	0.274	0.037	0.250

* Correlation is significant at the 0.05 level (1-tailed).

** Correlation is significant at the 0.01 level (1-tailed) N = 14.

depend on, and engage with, local communities to create the social and organizational conditions (including a sound customer base) in which the likelihood that the project they develop succeeds increases.

5.2. Factors related to LLCEIs

In line with previous research (e.g. [27,28,30,33]), project champions appear to play a crucial role in the success of LLCEIs. What this study adds to the body of knowledge is that they also have a role in ensuring the continuation of the LLCEI. Furthermore, LLCEIs that are successful tend to be managed by a core group of committed individuals rather than one person [19,30,32]. The present study also provides additional evidence of the importance of human capital for the realization of collective community energy projects [3,19,25,32,37,39–42]. The role of human capital becomes apparent in situations where it is insufficient. We saw that LLCEIs lacking this capital failed to initiate or complete collective projects because they missed the key expertise, skills, and knowledge.

What this study also confirms is that the volunteers involved in LLCEIs tend to represent a relatively homogenous group of people, namely highly-educated, white males of above average age [24,50–52]. In terms of gender equality, inclusiveness, and representativeness this can arguably be regarded as a weakness of the LLCEI community. It can also be considered to be a manifestation of the more structural female underrepresentation in organizations within energy systems [134,135].

In line with other studies [3,19,25,32,33,41,43,80], this study has shown that LLCEIs with volunteers who can be flexible in the time they spend on the LLCEI (i.e. retired, self-employed, or unemployed individuals) are more likely to be successful in realizing low-carbon energy projects.

5.3. Interaction between the LLCEI and the local community

This study showed that institutional embedding matters during the start-up phase of an LLCEI, when it is seeking to establish a connection with its spaces of dependence. Institutional embedding was found to be important in individual household-level projects which tend to be the initial focus of LLCEIs. Many in our study started with projects focused on stimulating and assisting in the purchase of solar PV panels for individual households before moving on to pursue collective projects. During this start-up phase, linkages with a local council can be seen as an important way to gauge whether an LLCEI's envisioned space of dependence overlaps with its 'true' spaces of dependence. This finding shows that institutional embedding is intimately linked with the configuration of the spatial settings of the locality in which an LLCEI is situated (see [86,136]).

In terms of cultural heritage, we saw that LLCEIs take landscape values into consideration and refrain from low-carbon energy applications that are likely to garner opposition, such as large-scale wind farms, when seeking support in the community. Cultural heritage also plays a role in the sense of how used communities are to organizing themselves. This is in line with the findings of Wirth (2014). LLCEIs situated in local communities that already had a tradition of grassroots organizing were able to swiftly recruit a sizeable number of participants and were well rooted in their locality. The study found that LLCEIs whose initiative is at least partly driven by community interests appear to be more successful (in line with [32,36,56,86–88,137]). Furthermore, LLCEIs took on the role of informing the community about the possibilities related to low-carbon energy and energy efficiency applications by organizing information sessions and energy cafés (see [28]). The study also included some LLCEIs that put effort into enhancing the acceptance by local communities of renewable energy projects that have considerable impact on the landscape (e.g. [90,138]).

In line with other studies [2,14,32,35,36,56,61], the present study showed that bonding social capital makes an important contribution to the success of LLCEIs. Through bonding social capital, LLCEIs recruited volunteers, customers, participants, investors, and roof-owners. Bonding social capital predominantly worked through three mechanisms: i) increasing the trustworthiness of the initiators; ii) establishing

personal relationships that provided access to resources; and iii) granting access to the tightly knitted social structure of the community. The trustworthiness of the initiators was an important factor that contributed to the success of our sample (see [2,4,139]). The study also showed that bridging capital enables LLCEIs to garner useful information [107]. However, we found no instances where LLCEIs collaborated in order to take on larger projects [112]), nor can we conclude that bridging capital is crucial for LLCEI success (cf. [27,33,112]).

5.4. Governance setting and linkage to government

The importance of the linkage with local government actors often depends on the type of project being pursued by the LLCEI. The success of LLCEIs that pursue collective, grassroots low-carbon energy projects is more dependent on a positive linkage with government actors than LLCEIs that pursue individual household-level low-carbon energy applications or LLCEIs that seek only to expand their customer base. As soon as a low-carbon energy installation requires changes to the zoning plan, a connection to the grid, or a spatial permit, governmental actors become important allies. The present study showed that the perceived trustworthiness of the initiators influences the interaction between the LLCEI and government actors, as initiators are often 'usual suspects' that are already known by civil servants and public officials [140].

The local and regional governance arrangements found in the studied empirical cases were generally not supportive of LLCEIs. Some of the successful cases (Ameland, Westeinde) were situated in configurations that had a particularly supportive governance arrangement. For individual household-level projects, governance arrangements were found to be reasonably supportive in terms of sustainability loans and subsidies issued by local governments. In general, LLCEIs that focus on individual household-level projects experience a supportive governance arrangement that contributes to their success. As LLCEIs often struggle to develop feasible and profitable business cases, supportive governance arrangements could be established that target LLCEIs running financial healthy business models' (see also [19,123]). For example, the provincial government sought to alleviate this financial issue by providing LLCEIs with grants to cover the costs incurred before a project reaches the realization stage. This approach has also been observed in Scotland [56].

What can also be learnt from the present study is that although local governments can be an important player for an LLCEI, their capacities influence the degree to which they, and the governance arrangements in which they are involved, can be supportive. In some of the cases studied, LLCEIs perceived themselves to be in a 'governmental void' due to upcoming mergers between municipalities in their space of dependence. In other instances, local government had not been very receptive to LLCEIs because the issues of climate change and sustainability were not yet integrated as accepted policy domains within the municipal organization.

Finally, contextual factors, such as whether low home-ownership rates translate into low participation [3], were not easy to assess in the present study. Except for one case, all our LLCEIs were located in rural communities with residents who were predominantly homeowners (close to 70%). However, the one case located in an urban area (with a significantly lower level of home ownership – 52%) did perform below average in terms of the success indicators used in the present study, apart from in terms of the individual projects realized. Regarding the context, the present study also revealed that collective renewable projects are more likely to be started in less deprived areas than in areas of higher deprivation (supporting a finding by Hagget et al. [18]). In our Fryslân study, no instances were found in which renewable energy projects were developed in the more socioeconomically deprived regions (such as Northeast Fryslân) with the exception of Tietjersteradeel.

6. Conclusions

This study set out to answer the following research question: "What are the social, organizational, and governance factors that contribute to

explaining the variation in success of local low-carbon energy initiatives?" As a first step to answering the research question, a categorization of potential success factors was conceived (See Section 2).

The core proposition of the present study is that the success of LLCEIs depends on three sorts of potential success factors: i) those related to the LLCEI itself (organizational); ii) factors related to the interaction between an LLCEI and the local community (social); and iii) the presence of supportive governance settings and linkages with local government and intermediaries (governance). The results of the cross-case analysis reveal that there are differences in the sets of predictors that positively correlate with different measures of LLCEI success. In essence, items related to the LLCEI itself (internal organizational factors) correlate positively with collective projects realized, and to a lesser extent to individual projects realized. Items related to interaction with the local community primarily correlate positively with customer base (adjusted for size of the community) and to a lesser extent with individual projects realized. Finally, items related to the governance setting and to linkage to government correlate positively with individual projects realized.

Based on the results of this study, it can be concluded that LLCEI success is influenced by multiple factors belonging to these three categories. In other words, even if an LLCEI performs well internally, it still requires some support from governance settings and a fruitful connection with the local community. An LLCEI that is well embedded in the community is still dependent to a certain degree on support from the governance arrangements and needs to have sufficient capacity to act. Similarly, an LLCEI that finds itself in a supportive governance arrangement still needs links to the community and a certain degree of organizational capacity in order to be successful.

The study has also revealed that LLCEIs differ greatly in the approaches they take. This inevitably means that there is no one-size-fits-all approach for a successful LLCEI. LLCEI success is context-dependent and, as the study showed, is also strongly dependent on socio-spatial settings and configurations. It is hard to manipulate the pool of resources (such as social capital, human capital, project champions, and cultural heritage) that a local community can tap into in order to establish an LLCEI with the capacity to act.

6.1. Limitations and suggestions for future research

Several limitations of this study need to be considered. The first relates to the number of cases in relation to the number of potential success factors. The number of cases is high in terms of qualitative case study analysis, but low in terms of statistical power. Second, although the researchers have carefully assigned scores to each case for the various factors through an iterative process, it remains a somewhat subjective process and could have implications for the conclusions and cast doubts on the reliability of the study if there are differences in the understanding of certain measures between the researchers and practitioners. Future research could adopt a more systematic and reliable value-assignment approach. One option would be to have multiple researchers independently assigning values, and involving participants or experts in this process, including to validate the dataset generated and, at a later stage, validate the overall results of the study. Third, the LLCEI cases were studied in a single institutional, geographical, and administrative context, albeit with some unique rural socioeconomic and demographic regional characteristics. This limits the theoretical generalization of the study's findings. Fourth, although the four-aspect operationalization of LLCEI success does provide a broad assessment of their performance against the actions taken, other success indicators could have been used as well. For example, membership base, shares

issued to LLCEI members, satisfaction of members with the LLCEI's governance and leadership, financial-economic performance, and democratic legitimacy of the LLCEI's decision-making practices could all have conceivably been included as success indicators. If future research were to adopt these indicators to measure LLCEI success, it could lead to identifying other significant predictors alongside those found in the present study. The final limitation identified concerns the locality in which an LLCEI is situated. The present study demonstrated that locality can, to some extent, be seen as a choice that LLCEIs can make. LLCEIs that focus on a locality that can be considered as a system of local social relationships will be better placed to realize their projects through these relationships. Therefore we would recommend future research to look into the mechanisms of such place attachment for low-carbon energy developments that have a limited impact on the landscape while, at the same time, also taking into account criticism of the notion that local projects are often, by their very nature, considered fair or likely to be successful (see also [141–143]).

In the present study, a variable-oriented cross-case comparison of fourteen cases was used to test possible explanations for the variation in the success of LLCEIs. Using this research design to test a set of claims regarding potential success factors is new to research in the community energy research domain. Future research could use a similar research design, with the same clusters of factors, but in other countries to see whether the relationships identified in the present paper hold in other institutional settings. In addition, we would encourage researchers to elaborate on the clusters and sets of factors used in this paper by conducting systematic exploratory research to identify individual factors and clusters that go beyond the social, organizational, and governance clusters used in the present study. In addition, we see value in more in-depth research into one or more of the concepts (factors) presented in this study. Given the comprehensive categories of factors presented in this paper, their descriptions were rather general, and could readily be expanded and studied in greater depth.

6.2. Recommendations for policymakers

The study showed that LLCEIs are highly dependent on government, and especially on local government. However, the present study revealed that local governments were largely unsupportive. Further, they were found to be more supportive of small-scale household-level projects than of larger collective renewable energy projects. With larger projects, local governments often demand a convincing business case, which LLCEIs and the partners find difficult to deliver. What could be a useful lesson here for policymakers is to continue to support projects targeting households but, at the same time, to become more proactive, willing, and resourceful in supporting LLCEIs wishing to undertake collective renewable energy projects. However, this touches upon problems that local governments themselves face such as a lack of capacity and a lack of appropriate governance arrangements and policy instruments that would enable them to take a more proactive role. Central government has a task here to support local capacity building, and to formulate and implement policy instruments that local governments can use to more effectively facilitate LLCEIs. In this light, the Revised Renewable Energy Directive of the European Union of June 2018 [144] assigns prosumers and energy communities, such as LLCEIs, more rights and an improved legal framework. However, this still requires a sound translation into Member States' legislation, redesigning legal and policy frameworks while taking into account the specific roles, authorities, and capabilities that local government has in its important role in relation to renewable energy communities, and in particular towards LLCEIs.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.erss.2019.101269.

Appendix 1. Operationalization and measurement of theoretical constructs

Concept	Indicator	Measurement
The LLCEI itself		
<i>Project champion</i>	Individual or core group of committed individuals that have a prominent role in carrying out a project.	The larger the group of core committed individuals, the higher the ordinal value assigned.
<i>Human capital</i>	Knowledge, skills, and experience with high degree of task-relatedness (such as in the relevant industry, self-employment, or leadership experience).	The more individuals with specific knowledge and skills, the higher the ordinal value assigned.
<i>Size</i>	The size of the group of volunteers that the LLCEI can draw on.	The larger the size of the group of volunteers, the higher the ordinal value assigned.
<i>Availability of time</i>	The degree to which the core group of volunteers are able to spend their time flexibly (e.g. because of self-employment, retirement, unemployment/in-between jobs).	The more individuals that can spend their time flexibly, the higher the ordinal value assigned. Retired individuals are more flexible than self-employed or unemployed individuals.
<i>Access to funds</i>	The extent to which the LLCEI is able to raise funds and has a stable flow of income.	The more funds the LLCEI is able to generate and the larger its stable flow of income, the higher the ordinal value assigned.
<i>Board diversity</i>	The degree of variation in age and gender of the board.	The greater the variation in gender and age of the board, the higher the ordinal value assigned.
LLCEIs and the local community		
<i>Alignment with local values and frames of reference</i>	Usage of regional language in communications and marketing, alignment of the LLCEI with traditions and identity of the locality.	The more cultural markers the LLCEI uses and the more the activities of the LLCEI align with the cultural heritage of the locality, the higher the ordinal value assigned.
<i>Alignment with the institutional characteristics of the local community</i>	Ties with community organizations (e.g. village council, associations, schools, churches).	The more ties with community organizations, the higher the ordinal value assigned.
<i>Visibility</i>	Participating in community events, organizing energy markets/cafés, personal contact with residents, up-to-date website, activity on social media, attention in local/regional media, physical signs in the locality.	Physical measures of visibility (e.g. signs, personal contact, participation in community events) receive a higher ordinal value than (social) media coverage. Overall, the more individual activities the LLCEI engages in, the higher the ordinal value assigned.
<i>Community involvement</i>	Extent to which LLCEIs inform (e.g. organizing meetings, distributing flyers), consult (e.g. sending a survey to assess what sustainability measures community members are interested in taking, or asking the residents how income generated by the LLCEI should be spent), and involve (in ownership and financial participation) the local community.	Involvement scores more highly than consultation, and the latter receives a higher score than informing the community. The more activities for community involvement LLCEIs engage in, the higher the ordinal value assigned.
<i>Bonding social capital</i>	Use of relationships within the local community to access resources (such as new customers and financial capital).	The more resources (human capital, financial capital, customers, participants) the LLCEI accesses through strong ties, the higher the ordinal value assigned.
<i>Bridging social capital</i>	Ties with other LLCEIs, local firms, organizations, and parts of the locality	The more resources (e.g. knowledge, human capital, customers) the LLCEI accesses through weak ties, the higher the ordinal value assigned.
LLCEIs and governance settings		
<i>Linkage to government</i>	The degree to which an LLCEI has had contact with local government actors and the extent to which resources were accessed through this linkage.	The more resources accessed through the linkage with government, the higher the ordinal value assigned.
<i>Linkage to intermediaries</i>	Ties with intermediaries and the extent to which this linkage has provided access to resources	The more the LLCEI has benefitted from the linkage with an intermediary, the higher the ordinal value assigned.
<i>Supportive governance arrangement</i>	Capacity at local government: local catalyst, budget for sustainability, presence of a full-time expert, ambition.	
Supportive policy: subsidies, spatial planning, financial and fiscal measures. Other (semi-)governmental or private actors that provide support to the LLCEI's project(s).	The larger the capacity of the local government, and the more supportive the measures of (semi-) government and/or private actors, the higher the ordinal value assigned.	
LLCEI success		
<i>Success: customers</i>	Number of customers of the regional energy supplier.	The larger the number of customers, the higher the ordinal value assigned.
<i>Success: relative customers</i>	Number of customers relative to the total number of households in the locality	The larger the number of customers relative to the number of households in the locality, the higher the ordinal value assigned.
<i>Success: individual household projects</i>	Number of households with energy efficiency measures or total number of solar PV panels realized for individual households.	The larger the number of households with energy efficiency measures or number of solar PV panels for individual households, the higher the ordinal value assigned.
<i>Success: collective projects</i>	Number of solar PV panels realized by means of collective projects (that is with multiple local financial participants).	The larger the number of solar PV panels realized by means of collective projects, the higher the ordinal value assigned.

Note: The logic behind the success indicators is as follows: (i) receiving an annual fee from the regional energy supplier for each customer provides the LLCEI with financial capacity to undertake new projects; (ii) a high proportion of customers in the locality signals the embeddedness of the LLCEI, which is particularly relevant in accounting for the variance in the spaces of dependence of LLCEIs; and LLCEIs that have realized installations with greater capacity (size; number of solar PV panels, or measures taken) and on a (iv) collective (and perhaps as well as an individual (household level (scale) are more successful than LLCEIs that have installations with lower capacity and solely individual-level household measures (iii)

Appendix 2. Performance of LLCEI cases per item

	Ameland	Trynergie	Gaasterland	Westeinde	Doniawerstal	EKON	Wijnjewoude	Duurzaam Heeg	Grieneko	Easterwierrum	Kilbaard	Achter de Hoven	Opsterland	Eendracht
<i>Project champion</i>	++	++	+	++	++	+	++	+	+	+/-	+/-	--	+/-	+/-
<i>Human capital</i>	++	++	+	++	++	++	++	++	++	+/-	++	+	+	+/-
<i>Size</i>	++	++	+	++	++	++	++	++	+	+	+/-	--	+	+/-
<i>Time</i>	++	++	+	++	++	++	++	++	++	+	-	--	+	-
<i>Access to funds</i>	++	++	++	++	++	++	++	++	++	+/-	++	+/-	-	+
<i>Board diversity</i>	+/-	+/-	--	--	+/-	--	+	+/-	--	+	+/-	++	--	++
<i>Alignment ... reference</i>	++	++	+/-	-	++	+	+	++	++	++	++	++	--	--
<i>Alignment ... community</i>	++	++	++	++	++	+	++	++	++	++	++	++	+/-	+/-
<i>Visibility</i>	++	++	++	++	+/-	-	++	++	++	++	++	++	+	+
<i>Community involvement</i>	++	++	++	++	++	+/-	++	++	++	++	++	++	+	+
<i>Bonding capital</i>	++	++	+	+	+	++	++	++	++	++	++	-	-	+/-
<i>Bridging capital</i>	++	++	++	++	++	++	+/-	++	++	++	++	-	+	+/-
<i>Linkage to government</i>	++	++	++	++	++	++	++	++	++	+/-	+/-	++	++	++
<i>Linkage to intermediaries</i>	+	++	++	++	++	++	+/-	++	++	++	++	-	++	++
<i>Supportive governance arrangement</i>	++	+	+	++	-	-	++	++	--	+/-	+/-	+/-	--	+/-
<i>Success: customers</i>	++	++	++	--	++	-	++	++	+	+	+	--	--	+
<i>Success: customers relative</i>	++	--	+	--	--	--	++	+	++	++	++	++	--	--
<i>Success: individual</i>	++	++	++	++	++	--	++	++	+	++	++	++	--	--
<i>Success: collective</i>	++	+/-	+	++	+	++	+/-	+	++	--	+	+/-	+/-	+

Appendix 3. Inter-item correlations (Spearman's Rho)

	Rho	Project champion	Human capital	Size	Time	Funds	Board	Cultural heritage	Institut. Embed.	Visibility	Commu. Involvem.	Bonding capital	Bridging capital	Linkage govern.	Linkage intermed.	Support. Gov. arrange.
Project champion		1.000	.732**	.818**	.816**	.624**	-.0191	.062	.409	.000	.349	.312	.180	.716**	.276	.096
	Sig. (1-tailed)		.001	.000	.000	.009	.256	.416	.073	.500	.111	.139	.269	.002	.170	.372
Human capital		.732**	1.000	.709**	.625**	.736**	-.0274	.296	.405	-.011	.158	.473*	.157	.393	.415	-.0013
	Sig. (1-tailed)	.001		.002	.008	.001	.171	.152	.076	.485	.295	.044	.296	.082	.070	.482
Size		.818**	.709**	1.000	.669**	.620**	-.0029	.140	.331	-.0187	.055	.459*	.111	.639**	.235	.205
	Sig. (1-tailed)	.000	.002		.004	.009	.461	.317	.124	.261	.426	.049	.353	.007	.209	.241
Time		.816**	.625**	.669**	1.000	.459*	-.0456	.076	.063	.058	.048	.275	.303	.525*	.305	.014
	Sig. (1-tailed)	.000	.008	.004		.049	.050	.398	.416	.422	.435	.170	.147	.027	.144	.481
Access to funds		.624**	.736**	.620**	.459*	1.000	-.0372	.357	.403	-.0139	.157	.645**	.343	.479*	.614**	.368
	Sig. (1-tailed)	.009	.001	.009	.049		.1000	.105	.077	.317	.296	.006	.115	.042	.010	.098
Board diversity		-.0191	-.0274	-.0029	-.0456	-.0372	1.000	.033	.079	-.0065	.111	-.0066	-.0407	.041	-.0682**	.023
	Rho	.256	.171	.461	.050	.095		.455	.395	.412	.353	.412	.074	.444	.004	.469
	Sig. (1-tailed)	.062	.296	.140	.076	.357	.033	1.000	.530*	.458*	.264	.823**	.529*	.018	.049	.287
Alignment ... reference		.416	.152	.317	.398	.105	.455	.530*	.026	.050	.180	.000	.026	.476	.434	.160
	Sig. (1-tailed)	.409	.405	.331	.063	.403	.079		1.000	.525*	.823**	.356	.216	.554*	-.0054	.351
Alignment ... community		.073	.076	.124	.416	.077	.395	.026	.525*	.027	.000	.106	.230	.020	.427	.109
	Sig. (1-tailed)	.000	-.0011	-.0187	.058	-.0139	-.0065	.458*	.027	1.000	.501*	.043	.563*	.164	-.0118	.265
Visibility		.500	.485	.261	.422	.317	.412	.050	.027	.000	.034	.442	.018	.287	.344	.180
	Sig. (1-tailed)	.349	.158	.055	.048	.157	.111	.264	.823**	.501*	1.000	.075	.117	.583*	-.0202	.313
Community involvement		.111	.295	.426	.435	.296	.353	.180	.000	.034	.075	.400	.345	.014	.245	.138
	Sig. (1-tailed)	.312	.473*	.459*	.275	.645**	-.0066	.823**	.356	.043	.400	1.000	.571*	.093	.377	.244
Bonding capital		.139	.044	.049	.170	.006	.412	.000	.106	.442	.400	.016	.016	.376	.092	.200
	Sig. (1-tailed)	.180	.157	.111	.303	.343	-.0407	.529*	.216	.563*	.117	.571*	1.000	.059	.553*	.353
Bridging capital		.269	.296	.353	.147	.115	.074	.026	.230	.018	.345	.016	.420	.420	.020	.108
	Sig. (1-tailed)	.716**	.393	.639**	.525*	.479*	.041	.018	.554*	.164	.583*	.093	.059	1.000	-.0059	.554*
Linkage to government		.002	.082	.007	.027	.042	.444	.476	.020	.287	.014	.376	.420	.420	.420	.020
	Sig. (1-tailed)	.276	.415	.235	.305	.614**	-.0682**	.049	-.0054	-.0118	-.0202	.377	.553*	-.0059	1.000	-.0013
Linkage to intermediaries		.170	.070	.209	.144	.010	.004	.434	.427	.344	.245	.092	.020	.420	.482	.482
	Sig. (1-tailed)	.096	-.0013	.205	.014	.368	.023	.287	.351	.265	.313	.244	.353	.554*	-.0013	1.000
Supportive government arrangement		.372	.482	.241	.481	.098	.469	.160	.109	.180	.138	.200	.108	.020	.482	.482
	Sig. (1-tailed)															

Note: The analysis of inter-item correlations reveals that four of the six items within the 'Factors of the LLCEI itself' cluster (i.e. human capital, size, time availability, and access to funds) have high and positive inter-item correlations (i.e. with rho values above 0.6). Further, three of the six items of the 'interaction with local community' cluster also reveal significant and positive inter-item correlations (i.e. alignment with local values and frames of reference, alignment with the institutional characteristics of the local community, and visibility). Access to funds appears significantly and positively correlated to bonding capital, linkage to government, and linkage to intermediaries. Size appears significantly and positively correlated to bonding capital and linkage to government. Alignment with local values and frames of reference appears significantly and positively related to both bonding capital and bridging capital.

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