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Article

Local Governments Supporting Local Energy Initiatives: Lessons from the Best Practices of Saerbeck (Germany) and Lochem (The Netherlands)

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Abstract: The social dimension of the transition to a low carbon economy is a key challenge to cities. The establishment of local energy initiatives (LEIs) has recently been attracting attention. It is of great importance to draw lessons from best practices when LEIs have been facilitated by local governments and made a substantial contribution to greening local energy systems. The main research questions in this paper are: What lessons can be drawn from successful local low carbon energy transition cases, and which strategies proved successful to support LEIs? We have used analytical notions from the Strategic Niche Management (SNM) and grassroots innovation literature to analyze two best-practice cases: Saerbeck (Germany) and Lochem (The Netherlands). Data collection involved a set of fourteen in-depth interviews and secondary data. The results show that three key factors from SNM (building networks, managing expectations, and facilitation of learning) are of great importance. However, to a great degree it is also strategic, community serving, responsive, reflexive leadership and proper process management by public officials that spurred success, which would not have been possible without close

interaction and mutual trust between local government and representatives of the local communities.

Keywords: energy transition; civil society; local energy initiatives; low carbon; strategic niche management; leadership; governance; local capacity; grassroots innovation

1. Introduction

The shift to local, renewable or low-carbon energy systems poses a challenge to the mainstream, growth-based conceptions of a highly globalized and industrialized world, where the consumption of great quantities of oil and gas have been associated with wealth and progress [1]. There is mounting evidence to support the claim that system-wide transformations are of key importance in order to address climate change and achieve a low-carbon economy [2–5]; The challenge, however, is that the innovation necessary for systemic change tends to be incremental and (path) dependent on a variety of characteristics that reinforce the incumbent socio-technical regime (e.g., cognitive frameworks, embedded practices, prevailing norms) [6].

Notwithstanding the complexity and challenges that aspects of the prevalent regime create vis-à-vis sustainable innovations, civil society seems to have responded by developing a "do-it-ourselves", localized, grassroots approach to dealing with sustainable development [7]. In the field of energy this has led to the establishment of local energy initiatives (LEIs) in Western-European countries. For instance, more than 300 LEIs have been established in the Netherlands since 2007. Comparable developments can be seen in Denmark and Germany [8]. The establishment of local energy initiatives is not entirely new, however, as the 1970s Oil Crisis set the stage for LEIs to get off the ground (e.g., with citizen-led "thermal insulation clubs" [9]).

Several motives can be found in the literature to explain why LEIs become established e.g., [10–13]; These motives can be generally categorized into four types: social, environmental, economic, and dissatisfaction with central government [7]. In the same vein, Wüste and Schmuck [14] found that the motives for the initiators' commitment to low carbon projects are "multifaceted and mostly determined by a motivation mix" (p. 249). Most commonly, ecological motives apply (*i.e.*, climate change mitigation, natural resource conservation), but they are often linked to economic and social motives (community feeling and making village life more attractive).

Policy makers, advocates of sustainable development, and transition studies scholars view the empowerment of LEIs in smart and effective ways as a key challenge. For this reason, it is very important to study successful cases and draw lessons from them. The main research questions in this paper are: What lessons can be drawn from successful local low carbon energy transition cases, and which strategies proved successful to support LEIs? Two best practice cases—Saerbeck (Germany) and Lochem (The Netherlands)—have been analyzed to answer these questions. Both are regarded as pioneering efforts in their respective countries when it comes to the successful empowerment of LEIs (see for instance [15,16], regarding the Lochem case).

The paper is structured as follows. In Section 2 we present the theoretical background to the paper, addressing Strategic Niche Management [17] and the role of LEIs in low carbon energy transitions.

In Section 3 we introduce the research design and methodology. Section 4 presents the cases of Lochem and Saerbeck and address the results of the case study analysis. In Section 5 we position these results within the ongoing academic debates surrounding the role(s) of LEIs in energy transition. The paper closes with a concluding section in which the main research questions are answered and ideas are given for furthering the research agenda in this domain.

This paper presents results from four research projects (three Dutch, one German). First, the "Governance by Commitment; co-production in transitional change" project, which was sponsored by the Dutch Organization of Scientific Research (NWO) following the NWO "Smart Governance" program. Second, the "Leren van Lochem" project sponsored by RVO.nl following the program "DuurzaamDoor" (on sustainability innovations and awareness raising). Third, "LITRES— Lokale Innovationsimpulse zur Transformation des Energiesystems" funded by FONA (Research for Sustainable Development) of the German Federal Ministry of Education and Research (BMBF). And fourth, the UCF PhD program funded by the Province of Fryslân in the Netherlands.

2. Theoretical Background: The Role of Local Energy Initiatives in Low Carbon Energy Transitions

Although many studies have addressed the conditions the hamper or enable the development of LEIs—e.g., [10,18–23]—less attention has been paid to how to increase the influence of these initiatives on wider energy systems [24]. It is important therefore to try to link the grassroots innovations literature to a literature that focuses on understanding low carbon energy transitions. In doing so, a link can be made to the energy transitions literature (e.g., [25,26]), which [27] has shown how historic regime transformations develop from the accumulation of "niches", or protected spaces where practices differ from regimes and mainstream markets and where innovations can develop and experiments can be performed (e.g., [17,28]). One particular branch of this literature is Strategic Niche Management (SNM), which could be viewed as a framework for managing or governing sociotechnical niches in order to promote desired (sustainable) system change [17,29]. In this paper, we view LEIs as a particular branch of sociotechnical niches that can contribute to the encouragement of low carbon energy transition.

In a recently published article, Seyfang *et al.* [30] show how SNM can be used, shifting its focus from technological to social innovations, making it a suitable conceptual framework for understanding the role of social, grassroots innovations in the emergence and governance of sustainable transitions. As an analytical framework, this approach studies niche emergence and development [31] from the construction of social networks, learning processes, expectations, participation of actors, and resources in emerging niche practices. LEIs, from the perspective of grassroots innovation [6], can be seen as radical innovations that augment the socio-technical regime change inherent in sustainable development.

2.1. Strategic Niche Management

Kemp *et al.* [17] conceptualize SNM as a means through which governments can manage (sustainable) transition as a process. They define SNM as: "The creation, development and controlled phase-out of protected spaces for the development and use of promising technologies as means of experimentation, with the aim of (1) learning about the desirability of the new technology; and (2) enhancing the further development and the rate of application of the new technology ([17], p. 186).

The primary goals of SNM are to stimulate learning about the problems, needs and possibilities of a (given) technology; building actor networks; aligning visions and different interests towards a collective goal; altering the expectations of different actors; and fostering institutional adaptation. Successful niches facilitate the diffusion of innovative practices and systems and theory suggests that niches can influence the regime by enabling replication of projects within the niche, bringing about changes through multiple small initiatives; by enabling constituent projects to grow in scale and attract more participants; and by facilitating the translation of niche ideas into mainstream settings. SNM theorists claim that the successful emergence and growth of niches depends on three key processes: (i) (management of) expectations; (ii) development of social networks; and (iii) learning processes [17]. *Expectations* relate to how niches are presented to the public and whether they live up to the promises they make about performance and effectiveness. Setting expectations is considered a good thing if they are shared by many (niche) actors, and if they are specific and of high quality. In building social networks, niches are best supported when they embrace a wide variety of stakeholders (broad scope), who can mobilize resources to support further niche development (*i.e.*, the network is "deep"). Learning processes contribute to the generation of knowledge and expertise on how to improve innovations from experiments. However, besides this "first order learning", there is also a form of "second order learning", in which niche actors reflect on ongoing niche development and ongoing practices, and critically question the assumptions of regime systems, learning about alternative cognitive frames, and alternative ways of valuing and supporting niche development [17]. In practice, different actors (e.g., state policy makers, local authorities, NGOs, citizen groups, special interest groups) may take the lead in conducting SNM, depending on who is best qualified to take on a specific task within the niche configuration. Niche management, just like any other form of management, is not the responsibility of a single actor but a collective endeavor. Some actors, either an individual person or an organization, are likely to take on larger roles as "niche managers" [17].

2.2. LEIs as Grassroots Innovations to Spur Low Carbon Energy Transitions

Seyfang and Smith [6] use the term "grassroots innovations" to describe the "networks of activists and organizations generating novel bottom-up solutions for sustainable development." These innovations are also solutions designed to "respond to the local situation and the interests and values of the communities involved." Community-led "grassroots innovations" emphasize social innovations developed at the local level. As compared to the (rather general) grassroots initiatives, Hielscher *et al.* [24] claim that local energy initiatives are more effective to spur innovation. They identify multiple reasons for this: using a multi-faceted approach, the ability to change contexts, and a focus on (citizen) engagement. Regarding the multi-faceted approach, community energy projects often aim to combine a variety of activities, from conducting workshops to setting up voluntary initiatives and working groups. Moreover, community-led approaches become innovative in the sense that they aid in the process of people changing their everyday practices together. They also strengthen citizens in their (joint, collective) capacity to change societal structures [24].

A related issue that is encouraged by LEIs and potentially spurs grassroots innovation is citizen participation. This differentiates LEIs from other bottom-up initiatives that address energy-related problems since members can submerge themselves into a project as participants [32–35]. This draws

together people from different backgrounds who can learn from one another. Members are more likely to participate for a variety of reasons, not predominantly for self-interest but rather because of the potential benefits to the community and their sense of duty and importance [24,36]. Participation is often motivated by the desire to create a space where alternative values may be practiced and where experiments with alternative ways of living are enabled [37]. Furthermore, various authors note the relationship between citizen participation and the acceptance of a local renewable energy initiative [19,38–40]. Arentsen and Bellekom [7] argue that local energy initiatives are "seedbeds" for innovation when understood from the Schumpeterian perspective on innovation. Local energy initiatives can be considered as "entrepreneurs" that come up with new combinations of knowledge and resources related to the electricity supply.

According to Smith [9], community-led energy initiatives have a multitude of important roles in relation to energy transition. They can raise awareness among community members and orchestrate consumer boycotts of outdated, "dirty" modes of energy consumption; organize protests and lobby for progressive innovation-oriented regulations; set practical standards and provide counter-expertise to "energy solutions" offered by incumbent regime actors; initiate experimentation with "grassroots innovations" and "citizen science"; and they can spur green consumption. Community-led energy initiatives can be traced to the 1970s, when many were established following the rapid rise of energy prices after the First Oil Crisis, taking for instance the form of community-led "insulation clubs" [9]. Although community-led initiatives have the potential to contribute considerably to energy transition, it should be noted that they suffer from many problems. For instance, they rely heavily on volunteers, and hence lack capacity in terms of professional and skilled workers [10,41,42]. They lack an established infrastructure of assistance, and often fail to grow for lack of institutional support and long-term funding [10,14,20,21,42,43]. Moreover, once they start growing and professionalizing they run the risk of losing popular support from the local citizenry, and alienating their grassroots community [9].

2.3. Conceptualizing Local Energy Initiatives

The literature relevant to LEIs uses a variety of definitions in which the term "community" occurs frequently. On a related note, Boon and Dieperink [44] have stressed the role of LEIs as organizations, calling these initiatives local renewable energy organizations (LREOs). They refer to LREOs as organizations "initiated and managed by actors from civil society, that aim to educate or facilitate people on energy use and efficiency, to enable the collective procurement of renewable energy or technologies, to provide, generate, treat or distribute renewable energy derived from various renewable resources for consumption by inhabitants, participants or members who live in the vicinity of the renewable resource or where the renewable energy is generated". This definition, however, is rather restrictive in scope if one is bound to judge LEIs as LREOs. For instance, restricting LEIs to organizations underappreciates the structural character of LEIs as grassroots networks of local actors. Moreover, it emphasizes renewable energy, but leaves out other ways to limit the consumption of fossil fuels. Finally, Boon and Dieperink [44] assume that community members live in the vicinity of the (renewable) resource or where the renewable energy is generated. In our opinion this does not hold when one is concerned with a set of energy organizations with their roots in the 1980s and 1990s

(see [8]), operating wind farms on remote sites, located far from the places where members of the local energy initiative live.

Nevertheless, we have embedded the term "local" in our conceptualization to include the term community as "communities of place", (It would go beyond the scope of this article to address the conceptual ambiguities related to usage of the term "community", which is why we confine ourselves to communities of place in light of the definition we employ) and to lay down clear demarcations to permit rigorous empirical testing. In this regard, we adhere to the definition by Middlemiss and Parrish [45], who state that grassroots initiatives in low carbon energy transition are typically locally based, non-commercial, small-sized, and rely to a large extent on the engagement and actions of highly motivated people with limited power and limited resources. This description fits the definition used by REScoop (REScoop 20-20-20 refers to an initiative launched by the Federation of groups and cooperatives of citizens for renewable energy in Europe with the support of the Intelligent Energy Europe Program of the European Commission). Twelve organizations in seven countries have joined forces to increase the number of successful citizen-led renewable energy projects across Europe. Cooperatives and other local, non-profit initiatives active (across Europe), aiming to promote the production and consumption of renewable energy (RE) and reduce energy consumption.

2.4. Local Energy Initiatives as Locus for Strategic Niche Management and Grassroots Innovations

In order to appropriately apply the SNM theory to assess the extent to which niche processes occur and to see what they must do to overcome challenges, the question is: do these local energy initiatives constitute a niche? In essence, SNM focuses around one central, technologically oriented set of local experiments that jointly spur R&D and the diffusion of a given innovation (often a technology, such as solar PV or offshore wind power) that has the potential to challenge an incumbent socio-technical regime. In this sense, SNM has a singular mono-innovational, analytical focus, and would not allow the comprehensive nature of LEIs to be characterized as a "niche" entity. Walker and Devine-Wright [46] agree that determining the overall "abstract" niche is not appropriate, considering the diverse characteristics of community energy. Local energy initiatives can differ, for example, in relation to their size, form of organization, type of participation process, resource access due to specific situational settings, their focus on energy efficiency, behavior in the face of change, and even their main source of renewable energy, which can further be subdivided into solar, wind and hydro. However, Raven [47] points out that the distinction between local experiments, niches and the regime with which they share their boundaries are "analytical, and not ontological" (p. 63). Niches exist to provide a way of thinking through the regime, landscape and niche interaction of niche developments. Hielscher *et al.* [24] agree that "it would make most sense to conceive of all the diverse community-led energy initiatives together as one niche, as they share the common focus on 'sustainable energy' (p. 13)". Therefore, we regard it as conceptually acceptable to argue that LEIs whose aim is to spur a sustainable energy transition jointly qualify as a "niche", and hence can be subject to analysis using SNM (as confirmed recently by Seyfang *et al.* [30]).

2.5. Towards an Integrated Framework for Assessing Local Energy Initiatives

The literature on both SNM and grassroots innovations provides meaningful insights into understanding LEIs. It is worth the effort to explore the extent to which the insights can be combined or even integrated with SNM. The literature review permitted five clusters of factors to be distinguished that can be used to analyze LEIs, in particular concerning the empowerment of citizens' initiatives and the relationship to greening local energy systems: (i) drivers for the establishment of LEIs; (ii) envisioning and strategy making; (iii) actors and networks; (iv) learning capacity; and (v) outcome indicators.

Drivers for the establishment of LEIs refer to reasons that citizens have for initiating LEIs. The literature reports a mix of motivations that incentivize citizens to establish or become involved in LEIs. Hoffman and High-Pippert [13] state that social gratification (the enjoyment and excitement of working together and politics as a reward for participation), civic gratification (fulfilling a perceived duty or desire to contribute to the welfare of the community), and the desire to influence policy outcomes are important drivers when starting an LEI. In a similar fashion, Wüste and Schmuck [14] mention the motive of "tackling the problem with verve" (p. 249). This motive involves "the endurance and constant efforts towards the creation of a sustainable and local energy supply associated with the improvement of living conditions in the village, culminating in the transformation of the society" (p. 249). Bomberg and McEwen [48] take social movements theory as their point of departure, and focus on the mobilization of specific resources. In doing so, they distinguish "structural" from "symbolic" resources. "Structural" resources are influenced by wider political structures, such as government, that shape opportunities for the realization of local energy initiatives. "Symbolic" resources come in the form of non-material incentives. Structural resources can either hinder or facilitate community mobilization. Symbolic resources are effective in fostering mobilization. Furthermore, LEIs may emerge because of an aversion of citizens to closed and entrenched policymaking [48]. In a similar vein, Arentsen and Bellekom [7] report the resentment of local communities to the centralization of government authority or globalization in which large-scale industries control the production of goods and services in ways that the citizens consider neither transparent nor reliable. Other motivations found in the literature are religious [49], ecological [36], belief, and (maturing) technology [7]. Various authors note economic incentives as a reason to participate in or initiate LEIs [7,10,12,50,51]. Motivations related to ecology and self-sufficiency are also mentioned in various studies [10,36,43,51].

Visioning and strategy making refer to the establishment of long term visions, goals, strategies, roadmaps and action plans, linking means to a strategy in order to provoke sustainable system change. What is important in this concept is the way the agenda is set. When setting the agenda—determining goals, visions and actions—it is important to identify who influences the decision making [17]. This involves strategic action, understanding the "rules of the game", manipulation or even instigation of the configuration in which decision making occurs (*cf.* [52]). This also includes taking note of group dynamics, such as groups exercising "group pressure" on individuals to commit themselves to views held in common by the majority of groups, and "groupthink". (Groupthink describes the tendency of some groups to try to minimize conflict and reach consensus without sufficiently testing, analyzing,

and evaluating their ideas [53]). Moreover, the concept refers to the management of the deliberative process of configurations of actors surrounding goal and action setting, and handling expectations.

Actors and networks refer to the actors and actor networks present in the local setting in which LEIs are active. This dimension addresses the assertion of power in how decisions are made and resources are distributed. The distribution of resources is specifically relevant since the literature reports widely on the role of ownership in the processes and conditions involved in successful LEIs. A sense of community ownership is crucial for the success of community initiatives [41], for it delivers a positive public attitude [53], public support [54–56], it fosters social acceptance (or facilitates coping with opposition) [19,38,57–60], and enhances motivation [56]. Moreover, actors and networks cover the institutional dimension of the social and institutional rule that determine how interactions and transactions between actors are shaped (*cf.* "rules of the game"). This notion points to the contributions made by Ostrom [61], whose analytical framework for institutional rules is rooted in local communities managing natural resources locally in a (rather) independent, decentralized fashion. The institutional dimension also includes insight into inter-actor configurations, which is relevant to understanding processes that are relevant to resource allocation, decision-making, and hence power. This notion also touches on the presence of (dominant) coalitions at the local level. This aspect is potentially important since local negative attitudes will not as such impede the implementation of wind power projects, for instance, but there will be a greater impact if such attitudes are represented by a stable actor-network [40]; and whether this network of objectors is balanced by pro-wind attitudes [20]. This touches on the issue of the degree of citizen participation in LEI activities, which is significant in relation to the social acceptance of these initiatives; e.g., [19,38–40].

Another element to take into consideration is the trust citizens may have in the ways LEIs operate and manage things, which is an essential precondition for the development of LEIs [11,48,53,57,62–69]. In addition, this dimension also looks at the implementation of LEI action plans, and the affiliations of niche actors (such as citizens participating in LEIs) vis-à-vis incumbent regime actors, such as electricity grid operators and traditional energy suppliers. Smith [9] mentions the use of "social entrepreneurs" (or other intermediary agents) to spur cohesion between LEI activists and local community members. Moreover, "niche managers" or "process managers" might be needed to manage processes, and negotiate tradeoffs between different local or regional stakeholders in order to spur further niche development of localized green energy systems [16,17]. In summary, the actors and networks dimension covers the agency and structuring of LEIs in local and regional settings. Political scientists would judge this dimension to be determined by the exercise of power.

Learning capacity relates to the degree to which LEIs are capable of learning from experience in trying to attain their goals. Learning is related to SNM [17] and Transition Management [70,71] and addresses lessons learnt from transition experiments, and demonstration projects at the local level, which assume that challenges are actively created to spur development of local energy system niches. Experimentation and running field tests allow actor configurations like LEI networks to learn how to overcome certain barriers, which can have different backgrounds (technical, institutional, social, or financial-economic barriers). Learning from local experiments calls for proper monitoring of the progress of field experiments and critical reflection on the way the field experiments or demonstration projects were implemented. Lessons learnt from experiments might lead to readjusting expectations, or drawing more actors (with additional skills and profiles) and required resources into local networks.

In turn, this allows a new set of experiments to be run. Theoretically, managing learning processes will spur the progress of LEI niche development and will lead to assurance of practices. Learning will help LEIs to professionalize.

If the role of leadership in the public sphere (also referred to in this article as "public leadership") is a key driver for the development of local initiatives facilitated by a niche, then positive group dynamics and trust in the leaders seem to be crucial and are provided by the citizens. An important issue is the interplay between LEI members, citizens and leaders. The willingness to participate in and engage with the local initiative or the circumstances constituting the niche could be covered by second-order (or reflexive) learning in the form of repeated collaborations, citizen participation, dialogs, and local practices (e.g., consultation hours). Questioning the established regime can potentially be understood as shifting the foci for authority from the centralized energy system to the leadership within the decentralized LEI. In summary, second-order learning in this sense largely comes down to a shift of trust.

Outcome refers to different phenomena that can be judged as the results of LEI activities. Whereas Walker and Devine-Wright [46] relate outcome principally to (equal) distributions of financial revenues (or losses) made by LEIs, we deem it necessary to introduce more outcome indicators. First, outcome reflects changes made in the physical environment, such as the construction of wind turbines, the installation of solar PV panels on rooftops of buildings, or the construction and operation of a decentralized combined heat and power plant. These energy generation technologies can be classed according to their total installed capacity. Besides indicating the installed capacity of renewable energy generation, one can also indicate the greenhouse gas emissions avoided, as well as achieved energy conservation, and its monetary implications. Besides outcomes in terms of energy and avoided emissions, LEI activities can also have outcomes classed in terms of (increased) local employment, and the start-up or attraction of new firms, indicating growth in local business [72]. In line with Arentsen and Bellekom [7], outcomes of LEI activities can be viewed as innovations under specific conditions. This can relate to new organizational forms, new business models, "Neuen Kombinationen", "bricolage" of solutions, new social configurations and networks, new products and services, or the establishment of new markets. Moreover, LEI activities might invoke new modes of governance and systemic policy instruments [73–75].

3. Methods

Two case studies were selected for comparison and analysis: Lochem and Saerbeck. Both are considered frontrunners in the wider group of local energy initiatives in their respective countries. Moreover, both can be considered grassroots innovations—examples of a sociotechnical niche in which new social institutions, values and priorities are practiced in a space distinct from mainstream society [1]. A comparative case study approach has been chosen to bring into view the differences and similarities between these initiatives, based on key conceptual characteristics, as mentioned in the literature on LEIs (See Section 2). Because the study compares two frontrunner cases the exercise has only limited external validity, so "managerial lessons" from the two cases cannot readily be generalized to other instances.

Data collection involved a set of fourteen in-depth interviews, secondary data, participation in workshops, and field trips to both Saerbeck and Lochem. Interviews were conducted face-to-face, by telephone and via e-mail (for follow up questions). An overview of the interviewees, their organizations and functions is presented in Table 1.

Table 1. Overview of interviewees.

	Function	Organization	No. of interviews	Case
-	Alderman of Sustainability, Public Works, Greenworks, Historic buildings preservation, and Center of Lochem	Municipality of Lochem	2	Lochem
-	Politician	Gemeentebelangen Lochem (political party)	1	Lochem
-	Social worker and intermediary agent	Independent (but commissioned by the Municipality of Lochem)	3	Lochem
-	(former) Civil servant	Municipality of Lochem	1	Lochem
-	(former) Project leader local climate policy and renewable energy landscapes	Municipality of Lochem	1	Lochem
-	Volunteer	LochemEnergie, and LARE Energie (chair)	2	Lochem
-	Alderman of Spatial Development, Living Spaces, and Lodging of Educational Organizations	Municipality of Lochem	1	Lochem
-	Founder and adviser	LochemEnergie	1	Lochem
-	Party leader	Green Leftist Party, and LochemEnergie (adviser)	2	Lochem
-	Chair	ADEL project	1	Lochem
-	Mayor	Municipality of Saerbeck	1	Saerbeck
-	Project leader	Klimakommune Saerbeck	2	Saerbeck
-	Public relations manager	Klimakommune Saerbeck	1	Sarebeck
-	(former) Resident	Saerbeck community	1	Saerbeck

Interviews were recorded and were then transcribed as text files, which were used for treatment and analysis in CAQDAS, using the Atlas.ti program. This program assists researchers to locate, code, and annotate findings in text files, to weigh and evaluate their importance, and to visualize the complex relations, supporting data analysis (in this case of interview transcripts). The data treatment in Atlas.ti used a coding scheme, consisting of codes resembling the (theoretical) concepts presented in Section 2. The occurrence and meaning of codes were compared between Lochem and Saerbeck. This permitted a systematic, comparative analysis.

Narratives and chronologies were established for both the Saerbeck and Lochem cases. The two cases were analyzed using an analytical framework comprising the five key concepts presented in Section 2.5, viz.: (i) drivers for the establishment of a LEI; (ii) visioning and strategy making;

(iii) actors and networks; (iv) learning capacity; and (v) outcome. Additionally, in both cases the key drivers were analyzed that spurred a local green energy transition.

The aim of this study is to identify those factors, distilled from the SNM, grassroots innovations and transitions literature, that best address the factors the drive successful developments in LEIs. Based on these empirical phenomena we then focus on extracting insights on how to enhance the robustness and effectiveness of these factors. By learning from two case studies that are perceived as best practices in their respective countries, this study aims to contribute to the development of the theory to better understand the role of grassroots innovations in the governance of sustainability transitions.

4. Results

Before the cases of Saerbeck and Lochem are presented, general information on LEIs in Germany and the Netherlands is displayed in Section 4.1 (4.1.1 Germany; 4.1.2 The Netherlands).

4.1. General Information on Local Energy Initiatives in Germany and the Netherlands

4.1.1. Local energy initiatives in Germany

A vast and increasing number of LEIs are present in Germany. The growing number of citizens' energy cooperatives (*Energiegenossenschaften* in German; authors' translation) and local energy suppliers (*Stadtwerke* in German; authors' translation) should be viewed against the political and social aspects of Germany's energy transformation (*Energiewende* in German; authors' translation). In large part, the rise of the LEIs is due to local bottom-up initiatives that align with the federal government's energy and climate change mitigation goals [76]. Dating back to the early 20th century, decentralized cooperatives (based on fossil fuel use) came into existence to ensure the provision of electricity in remote areas. The municipal energy companies providing heat and power were initially owned by the municipality, and are now partially privatized or owned by local energy cooperatives, the number of which has risen dramatically, from 136 in 2008 to 888 in 2013, in line with the German public's growing interest in local "green" energy solutions [77]. Projects undertaken by LEIs include solar PV systems on public roofs, biomass-based heating, and biogas production. Although a relatively new phenomenon in Germany, solar cooperatives make up the largest group of cooperatives in the country. Their number has risen drastically in recent years, growing from 4 to 200 in just four years (2007 to 2010). Wind cooperatives (*Bürgerwindparks* in German; authors' translation), on the other hand, form a smaller group but have a longer history of development and a larger installed capacity. There are 45 operational wind cooperatives. In 2010, private citizens and local initiatives owned an estimated 50% of onshore wind turbines [78]. LEIs in Germany embrace a variety of renewable sources and models of participation. Private households own half of the renewable energy production facilities, 40% being owned by cooperatives, and 10% by farmers. Solar powered cooperatives and wind parks have proved most successful and prominent. Such initiatives can be found in both rural and urban areas, even as sustainability is attracting increased attention and urgency in the cities.

4.1.2. Local Energy Initiatives in The Netherlands

With the exception of the 31 traditional wind cooperatives, citizens' energy initiatives are relatively new in the Netherlands. Oteman *et al.* [8] characterize community initiatives in the Netherlands as a young yet rapidly developing phenomenon. LEIs are typically small and lack substantial institutional support from government; nor do they receive substantial support from large-scale industries. There are two types of initiatives in the Netherlands today: the classic wind cooperative and what Oteman *et al.* [8] call the "new style" LEIs ("*Lokale Duurzame Energiebedrijven*" in Dutch; authors' translation). The classic wind cooperatives often have a background in the anti-nuclear and pro-environmental movements. Usually found in rural areas, more commonly near the shore, members of such wind cooperatives collectively own and exploit one or more wind turbines. Of 31 wind cooperatives, two ("*Zeewind*" and "*De Windvogel*") sell energy directly to their members [8]. There are over 200 "new style" local initiatives. These are typically involved in spurring renewable energy (in particular solar PV) in residential areas, and can be found in both urban and rural areas. Most of these initiatives are still in the planning phase, are rather small, focusing on internal organization and professionalization, and are developing sound business plans. These new style LEIs frequently aim to encourage energy savings and private renewable energy production, to facilitate collective renewable energy production, and supply renewable energy to their members. Overall, these initiatives aim to strengthen the local economy through energy savings and revenue from joint projects, and to provide a sustainable environment for their residents [8].

4.2. Case Histories of Saerbeck and Lochem

4.2.1. Case Study: Saerbeck

Saerbeck is a town of 7054 inhabitants in the district of Steinfurt in the state of North Rhine-Westphalia (NRW), Germany. *Klimakommune Saerbeck* (in English: climate community Saerbeck, authors' translation), despite its size, is known in Germany and other countries as a role model for how to organize energy transitions at the local level [79–81] (In 2014, the Environmental Minister of the United Arab Emirates visited Saerbeck, [80], as well as a delegation from Minnesota, United States [81]). The slogan of Klimakommune Saerbeck is: "From the people, for the people, by the people" (authors' translation), which demonstrates its civic engagement. Activities to establish a "climate neutral" town have been continuing for more than ten years. However, it was in only in 2009 that such activities crystallized, after the local council passed legislation in 2008 to switch its entire energy supply to renewable sources [79].

The idea of utilizing green energy was sparked by the residents when citizens approached the mayor, requesting permission to install PV panels on the roofs of municipal buildings. Thanks to these experiences with citizens, energy saving, and renewable energy, the mayor decided to participate in a 2008 Tender competition called *Aktion Klima Plus—NRW-Klimakommunen der Zukunft* (German for Action Climate Plus) organized by the federal state of North-Rhine Westphalia in 2008–2009. "It started with the mayor", as the public relations manager for Saerbeck puts it (personal communication with an interviewee). The mayor—who is not a member of a political party and hence is not tied to restrictions stemming from his political party—invited a team of skilled individuals,

including engineers, scientists and economists, as well as residents from all over Saerbeck to be part of this project. The mayor especially understood the importance of having the residents involved in the development so it would be "a project we could all live with". Concern for climate change, energy security, and resilience in the face of energy price rises formed the motivating factors underlying the Klimakommune Saerbeck's objective of being energy neutral and fully energy self-sufficient by 2030 (*energieautark* in Geman; authors' translation; communications with interviewee) with an intermediate goal of having a "climate neutral municipality" by 2018 [82]. To achieve the 2030 goal the municipality of Saerbeck developed the concept of *Integriertes Klimaschutz- und Klimaanpassungskonzept* (IKKK), which consists of seven spheres of activities and 150 individual measures. In developing this as a concept for the NRW competition, workshops and information evenings were held with the local residents, and a steering group was established. In addition, a video was created in which prominent people in the municipality expressed their enthusiasm about the municipality's climate and energy plans. According to the project manager of Klimakommune Saerbeck, this video was an important factor in convincing the jury of the NRW competition. In order to record the local residents' needs and wishes, a survey (created by secondary school students as part of their geography class) was conducted among all residents of Saerbeck in 2009.

Besides this, the Energy Cooperative (*Genossenschaft* in German; authors' translation) "Energie für Saerbeck" was created in 2009. This "Bürgergenossenschaft" is a local citizen energy cooperative. It has its own supervisory board (*Aufsichtsrat* in German) and management board (*Vorstand* in German), and decisions are formally made during the annual general meeting. The steering committee of the Klimakommune consists of 12 to 14 individuals who were invited by the municipality's mayor to develop the climate change adaptation and mitigation concept. The steering committee includes the project manager, the public relations manager, and the mayor. Besides this a non-profit *Förderverein* (German equivalent of a booster club) was created to support the work of the Klimakommune.

Of the 60 participating municipalities in NRW, the municipality of Saerbeck won the previously mentioned 2008 tender competition and received 1.1 million Euros and the title "Klimakommune". (The city of Bocholt also won and received 2.2 million Euros). During the competition and afterwards, the mayor set things in motion (e.g., goal-setting, defining projects, initiating, organizing and supporting the LEI, purchasing the former munitions depot from the Bundeswehr (the German Federal Armed Forces) to establish a Bioenergy Park—after a well-played bargaining game that can be traced back to the early 2000s—and hiring a project manager. As a result of winning the NRW competition, Saerbeck caught the attention of the media and was able to progress towards achieving its goals. This enabled the Klimakommune to receive more subsidies (e.g., the staff costs for a project manager were paid by the Federal Environmental Ministry) as well as to win other prizes. (For instance: Deutscher Nachhaltigkeitspreis 2013, Energiekommune 2013, Georg-Salvamoser-Preis 2014, KWK Modellkommune for combined heat and power plants in 2014.) Besides this, Saerbeck attained the status of "gold municipality" from the European Energy Award, the highest award given for municipal energy and climate protection activities at European level (certification in 2010 and re-certification in 2013) [83]. In the Solarbundesliga, a ranking of solar energy production per inhabitant in cities and municipalities in Germany, Saerbeck holds the first place in the state of NRW [84].

Since 2009, three key projects have been implemented: (1) "the sunny side of Saerbeck", which involves the installation of PV panels; (2) a transparent central heating system (Two large wood pellet

boilers feed the central heating system, which supplies heat to most municipal buildings, including the schools and the sports center. Wood pellets from forest residues are used instead of fossil fuel.) and the energy-experience path in the town center; and (3) the "Bioenergy park" (the name is somewhat misleading, since, as well as a bioenergy plants the park also hosts wind and solar parks). The Bioenergy Park is the core project of "Klimakommune Saerbeck" (KKS) and was constructed in 2011 on the site of a former German Federal Army munitions depot located 3 kilometers from the town center. This was purchased by the municipality for a reasonably low price. Producing a total of 29 MW of renewable energy, the Bioenergy Park is host to seven wind turbines (3 MW each), two biogas plants, a biomass fermentation plant, and 6,030 kW_{el} of installed capacity of PV panels mounted on the rooftops of former munitions bunkers [82]. Currently the Bioenergy Park produces 275% more renewable energy than Saerbeck actually needs. Annual per capita CO_2 emissions have decreased from 9 to 5.5 tons [83].

One of the wind turbines is owned by Saerbeck's citizens. The up-front investment was financed by crowd funding. Making citizens co-investors in the Bioenergy Park and generating a profit on these investments increased community acceptance of the park. The municipality of Saerbeck's electricity grid is managed by the communal utility company SaerVE. KKS supports SaerVE, and the latter is 60% owned by the Saerbeck municipality. By supporting the communal utility company the municipality avoids the involvement of large-scale market companies in local energy projects.

Within the town of Saerbeck many private households have installed solar panels (totaling 9892 kW_{el}). Moreover, multiple schools in town (from elementary to high schools) now have solar PV panels installed. In fact, total installed capacity of solar PV in town exceeds installed capacity of solar PV in the "Bioenergy Park". The town center houses the *Gläserne Heizz*entrale (An interviewee mentioned that the transparent glass building is an integral part of educating their residents on this kind of technology. He further explained, "We want people to see that this is normal technology and works just like any normal heating system—it is nothing to be intimidated of.") (English: transparent central heating system; authors' translation). This serves as the LEI's main administrative office, (The "Energiestammtisch" meetings also take place here.) it is the place where tourists are informed about KKS, and it is home to the communal wood fired-heating facility that produces and distributes heat to multiple public buildings in town, including a high school and the parish church of St. Georg.

Saerbeck has also hosted a set of experiments with innovative energy storage technologies. Other initiatives by KKS include offering education to the town residents, both old and young community members (Including the kindergarten where a solar shower has been installed to teach the children how warm water use is facilitated.), in particular on energy and on reasons to avoid climate change. KKS allows the collective procurement of renewable energy by its residents and is constantly looking for new ways to fully exploit these resources. In relation to the role of civil society, it is also important to highlight that it was the residents of Saerbeck who developed the contents of the Energy Experience Path, ranging from local kindergarten children to the local football team, and even the church. KKS's reputation for spurring the local green energy transition is not only known all over Germany but has gained worldwide attention. KKS attracts more than 7,000 "energy tourists" annually, who want to learn how LEIs successfully manage a local energy transition, and succeed in becoming "climate neutral". Moreover, the reputation of KKS has attracted companies that focus on sustainable energy technologies: e.g., EnviTec Biogas and Saertex.

In summary, the case of Saerbeck shows a striking integration of the LEI into the municipality. In this sense, it mirrors the approach of "Integriertes Klimaschutz- und Klimaanpassungs konzept" (German for integrated climate-change and climate-adaption-concept; authors' translation). This is especially true of the way multiple societal stakeholders (business firms, local government, residents, the planning office, and farmers) are interwoven with the municipality, when addressing traditional municipal competences such as education, tourism, support of local clubs and associations, as well as public finances and administration. The planning office, in this sense, has a special role (This entails expert knowledge, the role of the "translator" in wider civil society and quasi-governmental organizations such as dena (Deutsche EnergieAgentur) or BWE (Bunderverband WindEnergie), 'material flow management' in social contexts (integrated approach), and the technical dimension.). Despite an overlap in the social dimension between the municipality and the Klimakommune the close connections between actors and structures also facilitate successful material flow management, which is observable in technical dimensions: a local business firm, for example, dehydrates the biomass (waste) streams from the fermentation plant and aims to sell the residues as dry pellets as mulch for sod grass. By such means as this, knowledge, money, and added value are retained locally.

4.2.2. Case Study: Lochem

The town of Lochem, with a population of 33,227, is located in the province of Gelderland in the Eastern part of the Netherlands. It consists of seven villages, four hamlets, and a central town. Lochem is the home of "LochemEnergie" (LE), a citizen-led energy cooperative that fits the description of "new style" LEI as described by Oteman [8]. Founded in 2010, it now has over 500 members and 200 clients purchasing locally produced renewable energy (in the form of electricity generated from solar PV panels). LE and the Municipality of Lochem have recently gained national attention for their innovative approach to energy transition, and the empowerment of civil society [16]. Prior to 2010 Lochem was not known its (renewable) energy goals. Sustainability initiatives had been undertaken in Lochem's rural communities but were rather small in scope (in the hamlets of "Almen" and "Armhoede").

Developments took off in 2006 after a new public official (an alderman from the Green-Leftist party with a background in environmental NGOs) took a seat on Lochem's municipal board. He analyzed the local configuration and the situative roles of civil society and local government. By personally engaging with community members, using the local social infrastructure (via community councils), he learnt about the local setting, identified problems, and invited citizens to come up with solutions. First in the domain of poverty, and later in the field of (renewable) energy. Through the process of engaging with local citizens the alderman was informed about local sustainability initiatives, one of which concerned an initiative in the hamlet of "Armhoede", sited directly outside the town of Lochem. A citizens' collective was attempting to develop a local "sustainable energy landscape" (looking for ways to install bioenergy and solar PV plants). In collaboration with the municipality, the citizens' collective requested a subsidy from central government (*Innovatieprogramma Klimaatneutrale Steden* or "IKS-2"; Innovation Program on Climate Neutral Cities in English; authors' translation) to explore the potential for renewable energy options and set up a co-creation process. (Particularly on the project's (spatial) planning). The proposal was granted, and

the Armhoede project—thenceforth called "ADEL" (abbreviation for "Armhoede sustainable energy landscape"; authors' translation) was established.

The ADEL project would be very important to the process that led to greening the local energy system in Lochem. First, it spurred active citizen participation, and second it started a process of organizational transition in the municipality, focusing on how the municipality could engage and support LEIs in novel ways, stressing the role and interests of citizens (and not the municipal organization itself). Moreover, it spurred the view that although citizen-led initiatives could potentially achieve many good things, this would only be possible if they are adequately supported by local government. In this sense the local government was to "give citizens confidence", in the sense that the public could in principle manage things on its own, but in urgent cases could fall back on local government support. This insight (and lesson) led to drafting the (formal) vision document *Regisserend Lochem* ("Directing Lochem" in English; authors' translation), advocating a novel approach to the co-creation and support of citizens' initiatives (addressing more issues than energy only). This required an organizational transition within the municipal organization. In this process the alderman was supported by change-oriented, daring, and supportive civil servants who would raise support for the alderman's strategy at different levels of the municipal organization. Although supported by citizens and (a handful of) civil servants, the alderman encountered a lot resistance in the municipality, in particular from staff members in the traditional departments (using narrow policy silo frameworks for doing their job), who feared change (and more generally, loss of their jobs).

At the same time, the alderman set things in motion regarding the start-up of citizen-led LEI. He did this in a very strategic way, preparing matters in a disguised manner, avoiding spreading the word, contacting the media, setting high expectations, and risking falling short of expectations and facing the political consequences. The alderman set profile attributes that the potential LEI pioneers should match (particularly having the capacity to inspire and persuade the larger community to support the LEI and initiate a set of local projects). After the first attempt failed (with a manager who could not do the job, as he failed to develop a plan that was supported by the local community), the alderman found six people who matched the profile attributes he had in mind. A few of these had a background in the (previously mentioned) "Almen" community-led initiative. Some of them had work experience in international environmental NGOs, and had established anti-centralist, decentralist, pro-local beliefs. Other motivations of these LEI pioneers included: managing utilities and collective services locally by the grassroots population, as well as seeking technological challenges, and entrepreneurial activities. These six pioneers—most of them entrepreneurs—and the alderman agreed that it would be in the best interest of the community to establish a LEI. In addition, so the citizens' energy organization "LochemEnergie" was born.

In order to attract attention and increase membership, a festival was organized in the central town's church (in which the alderman's wife was the church community's minister) on Sustainability Day (*Dag van de duurzaamheid* in Dutch; authors' translation). To attract more attention, famous speakers advocating sustainable development were invited (*cf.* Michael Braungart and Wubbo Ockels).

In support of LE the municipality decided to provide a start-up subsidy of 20,000 euros to develop a sound business plan. The funding was used to hire a consultancy (with matched funding in kind). Although the resulting business plan turned up not to be quite sound, the (social) process of developing it catalyzed inter-personal dynamics and the professional development of LE. In essence, it formed a

necessary precondition for the establishment of the LEI, in particular regarding decisions about its legal-organizational form as a citizens' cooperative [85]. The goal of the cooperative was to strengthen the local economy by redirecting the money that local citizens spent on energy towards maintaining—or even improving—the local community's living standard. This was to be coupled to the goal of reversing the adverse effects of climate change. In achieving these objectives, the organization came to be preoccupied with a number of projects: supporting households by installing PV panels on their roofs, creating a collective solar PV park on top of the town hall; participation in the "Slim Net"("Slim Net" project (Smart Grid in English; Lochem is one of the twelve pilot projects in the Netherlands) ; renting out electric cars; engaging in further technological research on wind and hydro power; and conduct social and behavioral research on ways to stimulate public participation [86]. By 2014, LE had managed to install 110 solar panels with a total capacity of 1MW on the town hall roof (This provides energy for 200 households) (ibid, 2014). Many of these projects, particularly "ADEL", "Sluis Eefde" and "Slim Net", can be considered innovative niche experiments that were started to manage transition at the local level.

Learning occurred by seeking solutions for problems that occurred in the experimental projects mentioned above. In the "ADEL" project, for instance, citizens involved in the design project of a renewable energy landscape wanted to contract an innovative consultant using central government subsidy money (in this case the previously mentioned IKS-2 subsidy budget). However, they encountered resistance when they were confronted with the policy rules the municipality's civil servants used for purchasing advisory services (*i.e.*, consultants). The rules proved difficult to overcome, and the alderman had to intervene and suggest an innovative solution to solve the problem, using an exemptive stipulation, and re-defining purchasing of advisory services for "innovative projects" (allowing larger purchasing budgets once a project was framed as "innovative"). In hindsight, the alderman stated that the experiments were deliberately designed to evoke challenges to existing structures (*i.e.*, regulations, rule interpretation by civil servants, and standardized work procedures). Another barrier was the LEIs inability to construct the solar energy project because it could not establish a feasible business case. A key reason for this was unfavorable tax schemes for businesses (Despite the benefits offered by 2013 Energy Agreement policy schemes designed to support business activities by LEIs).

Due to its front-running and professional status, LE started to earn an income by advising other LEIs and sharing expert knowledge. LE also became involved in a local "Smart Grids" field experiment, in which it collaborates with the University of Twente, regional grid operators, an energy company, the municipality and local households. The project was part of a prestigious set of field experiments and demonstration projects on various aspects of Smart Grids (called the IPIN-program: *Innovatie Programma Intelligente Netten*; Dutch for Innovative Program of Smart-grids; authors' translation). In this project the LEI and the municipality collaborate with "incumbent" energy actors such as a DSO and an energy company. Having these parties involved in the local experiment was considered an important asset by both the municipality and the LEI.

Besides the previously mentioned project, Lochem was home to three demonstration projects on sustainable energy landscaping: "ADEL" (mentioned previously), and later on "VEDEL" (*Verwolde duurzaam energie landschap*; Verwolde sustainable energy landscape in English; authors' translation), and "Sluis Eefde". The innovative character of the "ADEL" project and its clear relation to the guiding

philosophy adopted by National Environmental Assessment Agency (PBL) of *Energieke samenleving* (Energetic society in English; authors' translation) drew national attention, and served as a model for adaptive local government policy supporting civil society in an active way [16].

An important source of inspiration and the diffusion of novel insights that proved useful in Lochem was the alderman's and the LEI's position in political, policy and business networks at the national level. The alderman, who had a seat at the National Energy Agreement (NEA) discussions, "copied" these ideas to the local level, and hence created the "Lochem Energy Agreement". He did this in close collaboration with local stakeholders. Moreover, in this sense a local partnership with public and private organizations in the housing sector (housing associations, construction companies, architects, engineers, real estate officers, and the municipality) was established using an integrated value chain approach to spur energy efficiency improvements in local dwellings.

Although developments appeared promising, some challenges remained. At the time of writing, LE, which seeks memberships of at least 2,000 Lochem inhabitants, is still facing the challenge of increasing its membership. In other words, citizen support is still modest. In part this is related to the issue of how LochemEnergie was to allocate the revenues made from their project activities (either spending it directly on collective goals like care for the elderly, or creating sound financial reserves for their organization). Moreover, community members claimed that LochemEnergie during its professionalization process has drifted away from the original views and interests of its grassroots community. In order to mediate between the LEI and the community, an intermediary agent (or rather, a network manager) was employed by the municipality. This agent has played an important role in mediating between the three parties (in particular the ADEL and VEDEL projects), and was also viewed as having an important role in locating and identifying problems that occurred, and needed solving in relation to inter-stakeholder dynamics. The intermediary agent sometimes used the alderman as a mediator and high-level problem solver when stalemates occurred in the decision making.

4.3. Results of the Comparative Analysis

The results of the comparative analysis are presented in Table 2, which presents key information on the Lochem and Saerbeck cases along the five dimensions of: (i) reasons for establishment of the LEI; (ii) envisioning and strategy making; (iii) actors and networks; (iv) learning capacity; and (v) outcome. In addition, the key drivers for change are also presented.

5. Discussion

Comparison of the Saerbeck and Lochem cases shows some striking commonalities that spurred success in the greening of local energy systems. Common drivers for the establishment of LEIs in both the Saerbeck and Lochem cases were ecological, security of supply, pro-local community, and anti-centralization motivations (in line with [7,10,43,48]). Besides these motivational reasons, however, there was a clear influence by local government and subsidies that spurred activity into the actual establishment of local energy cooperatives. Phrased in Bomberg and McEwen's terminology [48], both "structural" and "symbolic" resources triggered the establishment of LEIs in Saerbeck and Lochem.

In both cases, the establishment of the LEIs was to a large extent initiated by public officials. This is rather surprising when one reflects on the literature on LEIs and LREOs, which typically claim that these

organizations are bottom-up, often small-sized, non-commercial citizen initiatives only; *cf.* [7,9,45,46,87]. Both cases show that success in large part was due to active, involved public leadership. For both cases it can be claimed that success (in various terms of outcome) would have been less or maybe even zero, if the relevant public officials had not displayed active, engaged, and innovative forms of leadership. This would, however, been in vain, if the members of the LEIs (in their multiple roles as cooperative members, consumers, citizens, and so on) had not been triggered by the incentives offered by the public officials. Hence, the ability to examine public leadership—an often forgotten factor in the grassroots innovations literature—was of eminent importance in both the Saerbeck and Lochem cases. In both cases, the public officials engaged in thoughtful, strategic ways to manage transition; first by engaging citizens, drafting action plans (but avoiding going public with them too soon), using their professional networks (which went beyond the local scope) for acquiring (higher) government (subsidy) funding, starting local experiments, and using the successful results to attract attention and gain even more resources via national and regional networks.

Table 2. Results of the Lochem and Saerbeck cases on six indicators for analyzing LEIs in relation to local low carbon energy transitions.

Criterion	Lochem	Saerbeck
Reasons for establishment of LEI	-*Motivations:* anti-centralist, ecological, technical, security of supply, local politics (civic management of utilities), entrepreneurship, backgrounds in international NGOs, previous involvement in small-scale civic organizations *in situ*. -*Instrumental*: public official (alderman) selected people having a set of profiles to start a community-led cooperative.	-*Motivations:* security of energy supply, anti-globalization, climate change, profile formation of the municipality. -Instrumental: The mayor took the initiative, and the Saerbeck municipality participated in the NRW Klimakommune competition, and later won the 1.1 million euro prize. This was used as a means by the municipality to spur citizens' motivation and start off a LEI. A project manager was hired, and people were selected to start a community-led cooperative.
Visioning and strategy making	-Until 2010 a policy "sheltered" approach was taken, avoiding raising high expectations. -After 2010 the citizen's cooperative and municipality made clear they were jointly to strive for "2030 climate neutral" goals. -After 2010 several strategies and White papers were drafted (including informal multilateral agreements, and local integrative partnerships. -The alderman used a 'human centered' and shrewd, strategic approach to support decision-making processes.	-After winning the 2009 NRW prize Saerbeck aimed to be energy neutral and fully energy self-sufficient by 2030 ("energieautark" in German; translation by authors). -The concept of Integriertes Klimaschutz- und Klimaanpassungs-konzept (IKKK) is developed, which consists of seven spheres of activities and 150 individual measures. -Key roles in setting goals and strategic plans rest with the mayor and the planner, who are advised by local citizenry.

Table 2. *Cont.*

Criterion	Lochem	Saerbeck
Actors and networks	-Niche manager: public official of municipality (alderman). -LEI: LochemEnergie (cooperative) with multiple sub-firms to manage professional business operations. -Important role for network/process manager as liaison officer between municipality, LEI and citizens. -Collaboration with incumbent energy system actors (energy company and DSO) in demonstration projects. -Affiliated key actors: LEI, university, DSO, energy company, local citizens, industrial partners (e.g., Eaton Industries, Trianel BV), REScoop, municipality. -Both the municipality (via alderman) and the LEI have excellent national networks which are used to attract attention and funding. -Green-Leftist alderman (and later a mayor) with great indirect influence. However, the municipality has taken the stance to only 'support' civil society, and does not intend to have the final say in decision making.	-Niche manager: mayor of municipality and city planner. -LEI: Bürgergenossenschaft Energie für Saerbeck (citizens' cooperative). -Important role for project manager as liaison officer between municipality, LEI and citizens. -LEI and municipality decided to organize and manage matters themselves (e.g. leading to citizen-owned grid operator SaerEV). -Hardly any collaboration with incumbent energy system actors in demonstration projects. -Affiliated key actors: LEI, university of (technical) applied sciences, REScoop, local church, local sport clubs, local schools, municipality, planning office (the latter having a key intermediary role in the actor network). -Klimakommune Saerbeck has an excellent national networks which are used to attract attention and funding, and local associations such as the Fremdenverkehrsverein or the Förderverein. -KKS organizes field trips and workshops for energy tourists on a daily basis. -The municipality (mayor) has the final say in decision making. Public leadership is of great importance to KKS (although the mayor is not affiliated to any political party). -Hardly any opposition to plans municipality.

Table 2. *Cont.*

Criterion	Lochem	Saerbeck
Learning capacity	-Local experimentation: solar park(s) electrical vehicles, Smart Grids, hydro power (sluice), social acceptance of RE and smart metering. -Local experimentation with new financing modes: crowd funding. -Adaptive capacity municipal organization (second order learning) -Learning (and adapting) from policy dynamics at national and regional level and at the same time, being a source of change for other levels of government and LEIs. -Learning to overcome multiple challenges: technical barriers, tax policies, social resistance, organizational resistance (municipality), slow growth in memberships of LEI cooperative, communication with local community. -Persistence to achieve ones goals. -Insight of need for multi-skilled LEI managerial team.	-Local experimentation: solar power, wind power, bioenergy; persuasion techniques to attract memberships for LEI, and funding for up-front investments -Local experimentation with new ways of financing: crowd funding. -Managing grid locally (and not by incumbent DSO). -Involvement of civil society in different branches and silos: elementary school, high school, church, sport and youth clubs. -Establishment of 'Energiestammtisch' to support expert meetings and information exchange, and Energy Experience path and "Gläserne Heizzentrale" for multi-generational education. -Coping with regulatory barriers and solving them in incentive rich ways.
Outcome	-Over 500 LEI members. LEI in need of more members. -LEI professional organization with earning capacity. -Several spin-off firms. -1 MW installed capacity of RE production (solar PV energy). -Solar park on rooftop of town hall. -Pilot with Smart Grid and electrical vehicles. -Three sustainable energy landscape projects (ADEL, VEDEL, Sluis Eefde) -Collaboration with energy system incumbent actors. -Many innovative policies; e.g., multilateral agreement with local stakeholders to attain 2030 climate neutrality goals. -International project with German LEIs and university. -The use of revenues of the LEI is subject to a critical debate: investment in local community goals *vs.* creating sound financial reserves for professionalizing energy cooperative.	-389 LEI members. LEI wishes to have more memberships. -LEI civil organization supporting (design and implementation) processes. -Spin-off firm SaerVE to manage and operate local grids. -29 MW installed capacity of RE production (solar, wind, bioenergy). -Bioenergy Park. -Pilot with energy storage and district heating. -Education program. -Little collaboration with energy system incumbent actors. -Attracting RE firms from outside Saerbeck. -Revenues of LEI activities are used to invest in collective goals.

Table 2. *Cont.*

Criterion	Lochem	Saerbeck
Key drivers for change	-Arrival of new alderman in 2006. -Strategic, human-based, "silent" policy approach 2006–2009. -Selection of key persons for LEI board via profile matching (by the alderman). -Support by local government for local energy cooperative (e.g., in up-front investment business case design, allowance for LE to construct solar park in top of the town hall) and other grassroots movements). -Subsidy by central government for social innovations program and sustainable energy landscapes (IKS-2) in 2009, catalyzing the ADEL project. -Subsidy by central government for Smart Grid project (IPIN; Slim Net). -Changing, supportive role of local government emphasizing citizens rather than the municipal organization, following the "Regisserend Lochem" White Paper. -Use of intermediary (liaison) officers in implementation of LEI strategy. -External networking of alderman and LEI to attract funding and innovative ideas to implement locally.	-10 years history of renewable energy ambitions by local community. -Mayor was responsive to community needs and was able to participate in the NRW Klimakommune competition. -Municipality wins competition, starts making vision and plans, gains the necessary money and starts up an LEI by inviting a group of skilled, motivated citizens. -NRW Klimakommune prize attracts national attention which is used to draw more attention, collect additional funding, and win more prizes. -Municipality purchases the former Federal Army's munition depot premises sited 3 kilometers from town center. The Municipality purchases the premises in 2009 and starts running a Bioenergy Park *in situ* in 2011. -Local support campaigns to persuade local citizens to (crowd) fund RE generation plants. Implements a multi-generational awareness raising and funding campaign. -Construction of 21 MW wind park and 5 MW solar park (at Bioenergy Park site), establishment of SaerEV attracting (even more) attention throughout Germany (and the world). -Integration of a planning office and hence availability of expert knowledge.

This approach resembles the strategies that public officials and politicians have used to manage system innovations successfully in other domains and at other levels of government (*i.e.*, at EU and central government level) [27]. Moreover, in both cases the public officials proved successful in advocating a new decentralized green energy system, developing social cohesion and support for their (rather radical) plans, managing (decision-making) processes wisely, and using their networks to the utmost. They displayed many aspects of being a "niche manager" [17], "change agent" [88], "process manager" [89], "network manager" [90], or "system toppler" ("kantelaar" in Dutch; authors' translation; [91]), all at the same time.

Both the Saerbeck and the Lochem case also showed the importance of having process and network managers available to mediate between local stakeholders: in particular the municipality, citizenry and the (professionalizing) local energy cooperative. Besides the public officials themselves, this also applies to intermediary agents in local level projects (hired by local government). This result is in line with those reported by Smith [9], who stresses the importance of having "societal entrepreneurs" available to negotiate and mediate between actors when problems occur that need solving.

Another observed commonality between the two cases, which is important to greening local energy systems, was the receipt by the municipality of a large subsidy to spur project activities locally. (Toke *et al.* [20] (2008), Khan [39] (2003) and Strachan and Lal [38] (2004) agree that national policy measures ought to be appropriate and synchronized with the demands at the local level). Moreover, in both cases the LEIs had excellent networks at the regional and national levels, which were used to attract attention and collect resources. In terms of experimentation and learning capacity, in both the Saerbeck and Lochem cases a wide array of innovative experiments were conducted locally (in line with SNM and TM theory). LEIs quickly learned to overcome challenges, and to professionalize rapidly. This resulted in innovations in different fields, in particular new organizations (*i.e*., SaerEV as local citizens' and municipality owned grid operator in the Saerbeck case), novel business models and partnerships, innovative funding strategies (crowd funding), and novel insights and instruments that local governments can deploy to facilitate LEIs. Due its successful approach, Searbeck managed to attract new businesses, specializing in sustainable energy production and services. In both the Saerbeck and the Lochem cases the interplay of municipality, local citizenry, and the energy cooperative formed a "seedbed for innovation" (in line with the claim by Arentsen and Bellekom [7], 2014). It should be stated, however, that "seedbed of innovation" is not limited to the local energy cooperatives only. A related issue is that due to their achievements the LEIs, particularly LE, have professionalized considerably and rapidly. This is contrary to the view held by Middlemiss and Parrish [45] that LEIs are typically "small-sized, non-commercial, citizen-led initiatives".

Although many commonalities between the two cases were observed, a few differences also need attention. Whereas the development of the local energy cooperatives was to a large extent catalyzed by public officials in the respective municipality, the Lochem case shows that decision making was considered much more a matter for the citizens' energy cooperative (rather than the municipality), than it was in Saerbeck, where the municipality (particularly the mayor) maintained its influence on decision making. The integrated concept in Saerbeck—supported by the close social interweaving of citizens and local government—laid the foundation for a willingness to agree on rather formal hierarchies (with the mayor having the last word) in decision making. As compared to Lochem, there seemed to be a great emphasis on involving all branches of the local citizenry: sports clubs, church,

and youth clubs. This spurred action, with school teachers raising awareness about energy use among school children.

Whereas learning in both Saerbeck and Lochem involved learning from technical, economic, institutional and social challenges, the two cases show different styles of learning. Saerbeck emphasizes learning by educational campaigns, and use of the *Energiestammitisch* as a local venue for the exchange of problems, insights, multidisciplinary ideas, and solutions. In contrast, in Lochem learning is expressed best in terms of the adaptive role of the municipality in relation to local civil society, becoming more actively involved in energy management. The municipality displayed a rare degree of responsiveness to societal developments. In both cases it is important to address the role-model functions of social leaders: teachers, people running successful businesses, people having a formal (possibly elected) function in the administration, and elected members of the local council who identify with this idea. This can be viewed as vital for second-order (reflexive) learning.

Although both cases are considered frontrunners in their respective countries, Saerbeck has achieved much more installed capacity of decentralized renewable production than Lochem (29 MW to 1 MW). In part this is due to the less favorable institutional setting in the Netherlands compared to Germany (notably renewable energy innovation policies and taxing schemes; see also [8]). Moreover, Saerbeck had the advantage of having the Federal Army's munition depot nearby, which could be transformed and used for establishing the Bioenergy Park, a factor that was absent in Lochem and that reduced "entry costs" for Saerbeck. This is a striking example of changing the functional use of an existing site for projects by local energy initiatives [57]. Jobert *et al.* (2007) specifically mentioned the function of former utilization of the site (*i.e.*, set-aside land or appealing natural scenery) in fostering project acceptance.

A final striking commonality between the two cases is the LEI's lack of membership. Despite more than four years' activity of both LochemEnergie and Bürgergenossenschaft Energie fur Saerbeck, both citizens' cooperatives have not managed to increase their memberships among local citizens up to the numerical goal they had set initially. According to our interviewees, in the Lochem case this is to some extent related to group dynamics, in particular "group think" [92] that developed during the professionalization of the citizen cooperative, and led to a distancing of the LEI's management board from the views, goals, and approach considered worth pursuing amongst its grassroots community members [9]. An overview of commonalities between the two cases of government support of LEIs is presented in Table 3.

A key difference between the two cases is niche involvement of incumbent regime actors. Whereas the latter were involved in local experimentation and projects in Lochem, they did not participate in local project and experiment configurations in Saerbeck. Information from interviewees on the involvement of incumbents in the Lochem case reveals that Dutch institutional conditions make it necessary for LEIs to get regime incumbents involved in local projects. Experiences with incumbents' involvement in Lochem projects were considered positive (this is confirmed in other Dutch case studies; e.g., [15]). In relation to the existing literature, the collaboration of niche actors with incumbent-regime actors seems to counter a key assumption that applies to theorists of MLP ([25,28], TM [70], and SNM [17,29], who all essentially claim that regime-actors only interact with niche actors to slow down or deactivate niche activities. Whereas their involvement in the Lochem case spurred (niche) developments (and hence counters this argumentation), the Saerbeck case (more successful in

terms of outcome) verifies this theoretical claim. From another perspective, the Lochem case shows that the niche-regime boundaries are not entirely clear and tend to shade into each other, which is in line with a claim by Smith [31]. Further research using evidence from a larger number of cases is needed to shed more light on this issue.

Table 3. Commonalities between the Lochem and Saerbeck cases concerning local government support of LEIs.

• Important role of municipality (public official) in establishment and support of a LEI. Public official invites citizens with certain profile attributes to establish a LEI.
• Active, (community) involved, reflective form of public leadership.
• Public official uses prudent, receptive, resourceful, strategy. In the beginning a hidden agenda is used until agreements with local stakeholders have been made. Only when the first actions have proved successful are ambitious goals publically announced.
• Public officials (but also the LEIs themselves) show off local successful actions, attract media attention, and use national and regional networks to attract resources.
• Local government supports LEI in organizing awareness raising activities to attract more memberships from citizenry.
• A subsidy, granted by regional or central government, supports building capacity, and is used by local government to empower LEIs and jointly run renewable energy projects.
• Local government supports local experiments with renewable energy technology. Some experiments are designed to challenge established rules and regimes. As such, creative solutions and "seedbeds of innovation" are established.
• Intermediary agents and social entrepreneurs are used to manage processes and networks locally.
• Learning capacity is created; local governments and LEIs learn from challenges and setbacks. (Local government supporting management of energy utilities by citizens, and involving multiple civic groups in awareness raising activities and campaigns (Saerbeck); by adapting the role of local government to become more supportive of citizens' initiatives (Lochem)).

6. Conclusions

This paper started with the two main research questions: What lessons can be drawn from successful local low carbon energy transition cases, and which strategies proved successful to support LEIs? Two best-practice cases were studied: Saerbeck (in Germany) and Lochem (The Netherlands). The results show that three key factors from SNM (building networks, managing expectations and facilitation of learning) are of great importance. However, to a large degree it is also strategic, community serving, responsive, reflexive leadership and the proper management of expectations, local networks and processes by public officials that spurred success. Without close interaction, and a sound degree of mutual trust between local government (public officials, civil servants and intermediary agents) and representatives of the local communities this would not have been possible.

From a managerial perspective it is important to note that the public officials in both Saerbeck and Lochem played their roles strategically, cautiously taking account of the local playing field. They did so in a stepwise manner: first by engaging with local citizens, giving, gaining and receiving trust. Second, by developing an action plan (but avoiding going public with it too soon). Third, by using professional networks (that go beyond the local scope) to acquire (higher) government (subsidy)

funding, starting local experiments, and using the successful results to attract attention and gain even more resources via national and regional networks. In a sense, this approach resembles TM [71], but the way the public officials interact with both the local actor-configuration, and their professional networks at national and regional level, and "get things done" there provides an incentive to call for greater attention to the role of public leadership and the agency of local energy transitions, and not just focusing solely on citizen-led energy cooperatives or LREOs. A call can be made to look for ways to connect with the literature on climate change governance in cities [5], network management [91] and process management [90] on coping with complexity in cities and regions. Furthering the research agenda in this direction would be of great interest to politicians, public officials and policymakers who face the challenge of greening local energy systems of the future, particularly in the realm of cities.

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Conflicts of Interest

The authors declare no conflict of interest.

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