Dialectic Tensions Driving Niche Creation – A Case Study of a Local Energy System

Abstract

Local energy systems (LESs), such as energy communities and microgrids, are seen as significant contributors to the energy transition, but their creation requires contested institutional changes to the centralized energy regime. We explore the creation process of a groundbreaking LES project from the multi-level and dialectic perspectives. Our results show a tension-driven institutional change process that includes the dialectic perspective's four principles: institutional contradictions, praxis, social construction, and totality. Based on the learnings of the case study, we highlight the effect of institutional contradictions on incumbent actors' agency, boundary spanners' role in triggering praxis, and tensions in niche–regime interactions. We show with the case study that the dialectic perspective together with the multi-level perspective aid in understanding the creation process and further aid in designing future LES creation processes by providing normative descriptions of contradictions, tensions, and opportune solutions for them beforehand. We also discuss the limitations of the approach.

Keywords: *local energy systems, dialectic process, socio-technical transition, multi-level perspective*

1. Introduction

The energy system is in the midst of a socio-technical transition that includes many change patterns: decarbonizing, decentralization, and sector coupling by combining the electricity, heating, gas, transportation, and telecommunications sectors (Ford et al., 2021; Hiteva and Foxon, 2021). Local energy systems (LESs) have been proposed as a means to achieve these changes and as important building blocks for future energy systems (EU, 2019; Lowitzsch et al., 2020). LESs are emerging socio-technical models, such as microgrids, integrated community energy systems, or energy communities, based on local heat or electrical power generation and consumption, in opposition to a centralized energy system (Ajaz and Bernell, 2021a; Gui and MacGill, 2017; Koirala et al., 2016). The local energy (LE) niche includes a wide range of concepts and solutions, making it hard to define it clearly. Yet, several characteristics can help distinguish it from the incumbent centralized energy (CE) regime.

The main differences between the LE niche and CE regime are related to their governance, operation, asset characteristics, and customers' role (Ford et al., 2021). The incumbent CE regime is a top-down-governed energy system, often based on large-scale fossil fuel plants owned by large utilities (Adil and Ko, 2016; Ford et al., 2021). In contrast, the LE niche is based on locally owned and governed distributed energy resources, such as solar photovoltaics (PV), micro-combined heat and power (CHP) plants, and batteries (Koirala et al., 2016). The LE niche can be further divided into LESs, which can be owned, for example, by local municipalities, and community energy, which emphasizes citizen ownership and grassroots initiatives (Devine-Wright, 2019). The LE niche emphasizes the role of the local policy context, including municipal councils, whereas the CE regime is more oriented toward macro-level policies (Jehling et al., 2019; Ruggiero et al., 2021a). The system operation is also different, as the LE niche extends the centralized top-down coordination and balancing with local level balancing and coordination. Ideally, the LE niche aims to harness flexibilities from different energy carriers (heat, electricity, gas) at the local level on both the supply and demand sides, whereas in the CE regime, different energy carriers are kept separated or combined merely on the supply side in CHP plants (Lowitzsch et al., 2020). In the CE regime, customers are seen as passive energy users, whereas in the LE niche, customers are more active and can also become prosumers. In many LESs, customers are also pooled together for a collective demand response or consumption of self-produced energy. This creates interdependences between customers and incentivizes them to invest in complementary resources locally, which does not exist in the CE regime (Lowitzsch et al., 2020).

LESs have a great potential to help in decarbonizing the overall energy system, but their accommodation into the CE regime is not a straightforward process. The growth in stakeholders and resources must be managed and incentivized in a cost-efficient, environmentally sustainable, and socially just manner. Understanding where, how, and when LESs emerge is therefore critical. Despite the internal and external challenges and complexities of LES creation have been widely studied, few studies look empirically at the whole LES creation process, including how multi-level dynamics challenge and influence the process (Barroco et al., 2021; Mahzouni, 2019; Ruggiero et al., 2021a).

To understand better how LESs are created through internal niche development and interactions with the energy regime, this paper bases its analysis on the multi-level perspective (MLP). It is a central framework for studying the governance of complex sustainability and socio-technical transitions, and it extends the view from mere techno-economic development to institutions (Geels, 2004, 2002; Geels and Schot, 2007). In addition, it helps to recognize relevant questions and problems in a socio-technical transition, which it sees as an interplay among different levels: landscapes, regimes, and niches (Geels, 2012). In short, the MLP assumes that new radical innovations can break into the regime when there is sufficient landscape-level pressure and developed niches. The MLP has been applied in many ways for studying the LE niche, for instance by researching the potential of community energy storage (Koirala et al., 2018b), the emergence of microgrids (Ajaz and Bernell, 2021b), or the transition potential of renewable energy (RE) communities (Dóci et al., 2015). To capture the inherent tensions and different interests included in LES creation and institutionalization (Abada et al., 2020; Genus and Iskandarova, 2020), we apply also the dialectic perspective (Benson, 1977; Langley and Sloan, 2011; Seo and Creed, 2002; van de Ven and Poole, 1995). It represents a promising approach to studying agency in the context of socio-technical transitions as it considers the interplay of two opposing views and the reconciliation of which leads to change (Benson 1977; Seo & Creed 2002).

Hence, using an exploratory case study methodology, this paper aims to answer the research question: *How are LESs being initiated and created amid dialectic tensions?* The case project, located in the southern part of Finland, is seen as an exemplar of the LE niche, which represents an arising socio-technical trajectory in the face of the CE regime. It contributes to the existing knowledge on LES creation processes by empirically exploring what multi-level tensions are included in the process, as well as how they affect it. Through the case study findings, we relate the studied case to previous LES studies, but we also look at the differences and complementarities of the dialectic perspective with the MLP. With this study, business developers, policymakers, regulators and LES founders are better able to structure, foresee, and manage the transition toward LESs, as well as the possible unintended consequences both locally and globally.

2. Theoretical Background

2.1. Socio-technical transitions toward local energy systems

The landscape-level represents broad and long-term cultural, environmental, economic, and political contexts and processes in which regimes and niches act (Geels, 2002). Regarding LESs, there is not only one landscape pressure that is driving them. Ford et al. (2021) recognized climate change, national and international climate targets, net-zero legislation, the security of supply, just transition movements, and economic prosperity as relevant landscape pressures for LES emergence. Furthermore, Ajaz and Bernell (2021) noted the resilience (in the face of cyber-attacks, wildfires, and big storms) and cost decrease of solar PV and storage technologies as landscape forces relevant for microgrid emergence. And even further, Moser et al. (2021) emphasized the role of the urbanization and electrification of heat and transport in the context of urban energy communities. However, these landscape pressures can have a different meaning for niche and regime actors, and various competing discourses and narratives easily create volatility in LESs' institutional legitimacy. For example, in England, political support for LESs has varied between different political parties and institutions, which has led to an unstable political environment, including changing support schemes and rules, for the creation of LESs (Devine-Wright, 2019; Genus and Iskandarova, 2020). While positive discourses emphasize the innovative and problem-solving nature of LESs (Farrelly and Tawfik, 2020; Hoicka et al., 2021), more critical discourses emphasize the avoidance of unintended negative consequences, such as cross-subsidization, free-riding, and the accumulation of welfare to the rich (Abada et al., 2020; Moroni et al., 2019).

Regimes are formed of "semi-coherent set of rules that orient and coordinate the activities of the social groups that reproduce the various elements of socio-technical systems" (Geels, 2011). The regime forms a selection environment that consists of economic and socio-political dimensions (Geels, 2014a). The development of regimes is typically path-dependent and incremental, and incumbents usually have strong positions in networks, which gives them power in political agenda-setting processes (Geels, 2014b). Yet recently, several research articles have emphasized the role of incumbents as active players in regime renewal (Galeano Galvan et al., 2020; Turnheim and Sovacool, 2020). Indeed, renewal is necessary if a regime shows signs of

destabilization, through the accumulation of external pressures, internal performance problems, and weakening commitment to the incumbent regime (Turnheim and Geels, 2012). In the case of the CE regime, these pressures include aging infrastructure, the integration of renewable energy, and the management of an increasing number of stakeholders (Ford et al., 2021).

Incumbents have varying responses to LES diffusion, which also depends on the different LES types (Gui and MacGill, 2017). On the one hand, incumbents have difficulties with their sometimes ambivalent 'non-profit' nature, which contradicts the private sector's market logic (Wittmayer et al., 2021). LESs also contradict the logic of controlling the energy system in a centralized manner (Genus and Iskandarova, 2020). In addition, the business models of LESs are often based on savings of network tariffs, which means that if LESs are poorly implemented, they may increase non-LES customers' burden in infrastructure costs (Abada et al., 2020). On the other hand, LESs also provide incumbents new business and partnership opportunities and ways to increase efficiency (Hiteva and Foxon, 2021; Ruggiero et al., 2021b). In total, LESs require changes in norms and culture (Koirala et al., 2018a; Wirth, 2014); user practices and business models (Koirala et al., 2016; Schot et al., 2016); and, above all, regulations and policies (Adil and Ko, 2016; Campos et al., 2020; Lowitzsch et al., 2020).

Niches are formed around radical innovations that differ from incumbent regimes. They are protected by special market demands or political protections. Niche development includes learning processes, social network building, articulation of expectations, price and performance improvements, and support from powerful groups (Kemp et al., 1998; Schot and Geels, 2008). Often, niche formation involves allocating resources and choosing between competing technologies, which creates tensions both inside and between organizations that can have vastly differing views of the desired future (Bakker et al., 2012; Canzler et al., 2017). Therefore, choosing which niches get protected is a political and contested issue, where the niche must be aligned with political opportunities (Hess, 2016; Smith and Raven, 2012). New LES business and governance models, such as peer-to-peer electricity trading, special local tariffs, and their geographical boundaries, are still typically protected and promoted by different grants, regulatory sandboxes, and other policies (Farrelly and Tawfik, 2020; Galeano Galvan et al., 2020; van der Waal et al., 2020). Consequently, no dominant designs have emerged, and designing and

implementing LESs' internal structures involve tensions and uncertainties (Frantzeskaki et al., 2013; Van Veelen, 2018). Similarly, system relationships between LESs and incumbent energy systems remain uncertain, exemplified in the difficulties and uncertainties in member states' transpositions of recent LES-related EU-level directives (Frieden et al., 2020).

2.2. Dialectics on different MLP levels

Even though the MLP is widely used and its usefulness in identifying essential questions and patterns in socio-technical transitions has been proven, it has also been criticized for several factors that are important in the transition towards LESs. These include its monolithic and inactive view of regimes (Köhler et al., 2019; Turnheim and Sovacool, 2020), neglect of the role of power and interests (Meadowcroft, 2009), lack of attention to tensions and their contexts (Jørgensen, 2012), and underemphasis of agency (Geels, 2020). In addition, the MLP puts little focus on explaining the conditions under which niches emerge in the first place (Hoogstraaten et al., 2020). The MLP's view on niche emergence is similar to evolutionary economics, as it assumes niches are developed external to the regime or in its periphery as 'hidden novelties' (Geels, 2020, 2002). For addressing these issues, we complement the MLP with the dialectic perspective (Seo and Creed, 2002). Previously, The Dialectic Issue Lifecycle model applied a dialectic perspective to the literature of socio-technical transitions (Geels and Penna, 2015; Penna and Geels, 2012), but this model is a macro-level model and is not entirely suitable for studying the multi-level processes in a transition. Dialectics have also been used to explain the innovation capture and translation by regime actors in the upscaling phase (Pel, 2016; Smith, 2007). Our use of dialectics differs from theirs by introducing Seo and Creed's (2002) framework, as well as addressing niche genesis.

Dialectics view the niche creation process as a push-pull dynamic among parties, as they exist in an ongoing dynamic interplay where they exert different levels of power (Hargrave and Van de Ven 2017; Putnam et al. 2016). Van de Ven and Poole (1995) used a thesis-antithesis-synthesis sequence to describe the process. Dialectic processes happen on the organizational (Benson, 1977), inter-organizational (Das and Teng, 2000), and institutional levels (Seo and Creed, 2002). The dialectic perspective explains institutional changes as a process through which institutional contradictions become noticed and that invokes praxis. According to Benson (1977), dialectic

processes have four principles, which Seo and Creed (2002) applied as stages of institutional change: social construction, totality, contradiction, and praxis (illustrated in Fig. 1).

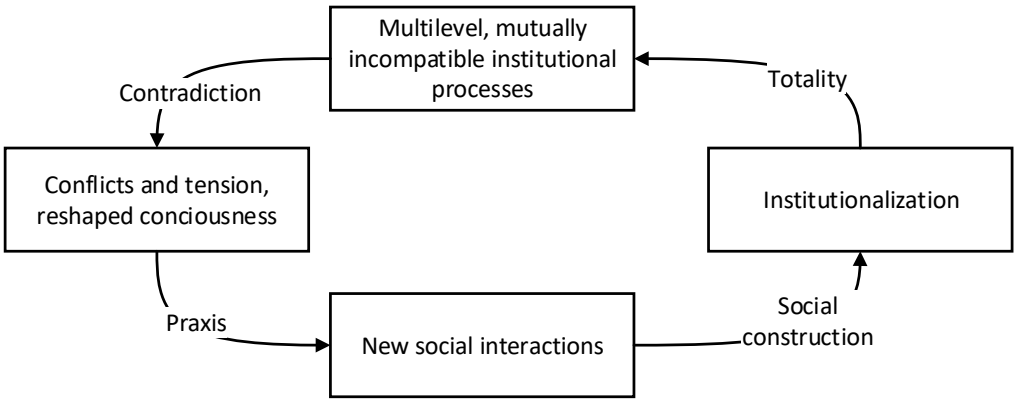

***Fig. 1**. Processes of institutional change from a dialectic perspective* (Seo and Creed, 2002)

Dialectics happen within and between different levels of the MLP. Usually, transitions begin with landscape pressures, which the dialectic perspective sees as institutional contradictions. These can be triggered by certain critical exogenous events (Hoffman, 1999; Sine and David, 2003) or gradual developments internal to the regime. According to Seo and Creed (2002), tensions may arise due to the legitimacy that undermines functional inefficiency; non-adaptability to changes in the external environment, inter-institutional incompatibilities, such as mishandling of the plurality of institutional logics; or actors' misaligned interests and power asymmetry.

The MLP states that niche breakthroughs happen during 'windows of opportunity', which open when tensions internal to the regime intensify, yet the MLP literature still debates how agency should be studied as a part of transitions (Geels, 2020; Huttunen et al., 2021). The concept of praxis can contribute to this discussion. It refers to situations in which people become aware of the contradictions of current social patterns and mobilize their reconstruction (Putnam et al., 2016). This agency is triggered by increased awareness and understanding of existing conditions' limitations in relation to one's own interests and needs (Seo and Creed, 2002). The probability of praxis increases when changes in technology, the economic situation, or other contextual elements are present (Barley and Tolbert, 1997). The dialectic perspective's emphasis on institutional contradictions suggests that praxis emerges from the intersection of multiple institutional logics or the periphery of an institutional field (Seo and Creed, 2002). This aligns with

the recent discussion in the MLP literature on boundary spanners and intermediaries (e.g., Kivimaa et al., 2019; Smink et al., 2015).

Praxis leads to social construction, which is defined in the dialectic perspective as "social processes through which orderly, predictable relations are produced and reproduced" (Seo and Creed, 2002). Existing social structures, people's ideas, interests, histories, environmental constraints, and power relations steer how people reproduce or transcend established institutional patterns (Benson, 1977). The dialectic view on social construction aligns with the MLP studies emphasizing the power and political orientation of socio-technical transitions (Ampe et al., 2021; Avelino et al., 2016; Geels, 2014b; Hoffman, 2013). These studies explain how power plays between niche and regime form dialectic process, through which incumbent regime actors use their power to resist the change but translate at least some parts of niche innovations to the regime (Pel, 2016; Smith, 2007). Here, the two theoretical approaches align in describing the transition as a hybridization of different institutional logics. For example, Fuenfschilling and Truffer (2014) and Smink et al. (2015) used institutional logics perspective in explaining challenges and drivers in niche-regime interactions. The dialectic perspective does not make the niche-regime distinction but presumes similarly that restructuring of social structures happens by exploiting the recognized institutional contradictions and mobilizing pre-existing institutional logics and resources (Seo and Creed, 2002). Furthermore, the institutional logics perspective has been used for creating a better understanding of socio-technical transitions as a multi-actor process rather than a process of opposing parties (Avelino and Wittmayer, 2016).

The ongoing and 'partially autonomous' social construction processes tend to produce interrelated but incompatible institutional arrangements, which Seo and Creed (2002) conceptualize as 'totality'. Loose couplings between systems may produce conflicts and tensions that appear if connections between them strengthen. Applying the concept of totality in the MLP potentially reveals the interconnectedness of different regimes, niches, and landscape pressures. In that sense, institutional incompatibilities, and therefore sources of praxis, can exist on all MLP levels.

3 Research methodology

3.1. Case description

The case project studied is a LES situated in the southern part of Finland. It is an industrial and commercial area that aims at energy self-sufficiency through RE sources and energy storage. It combines the use of energy networks of electricity, gas, heating, and cooling, and it includes a mixture of technologies, specifically megawatt-sized resources of solar PV, gas motors, and lithium-ion energy storages; fuel cells; and exploratory electric grid management solutions. The local municipal utility initiated the project officially in 2017, and the construction ended in 2019. Its total budget was 18 million euros.

The main stakeholders and their primary activities in the case study are illustrated in Figure 2. Some actors' ownership structures and general ambitions are relevant to understanding the case study. The municipal utility is a subsidiary of a municipality with a population of approximately 20 000 habitants. Before the case study project, the utility operated in gas and district heating businesses, but not electricity grid, which is monopoly-owned by the regional distribution system operator (DSO). Its main energy sources are biomass, biogas, and natural gas (NG). An important element in the Finnish CE regime is the large role of CHP plants, which are coupled with district heating networks. District heating accounts for 46% of residential and commercial buildings' heating (Energiateollisuus, 2021). Therefore, the municipal utility was originally an incumbent actor embedded in the CE regime by its heating and gas businesses, and electricity and heat pumps can be seen as increasingly salient competitors for the utility as they are gaining a significant share in the heating market.

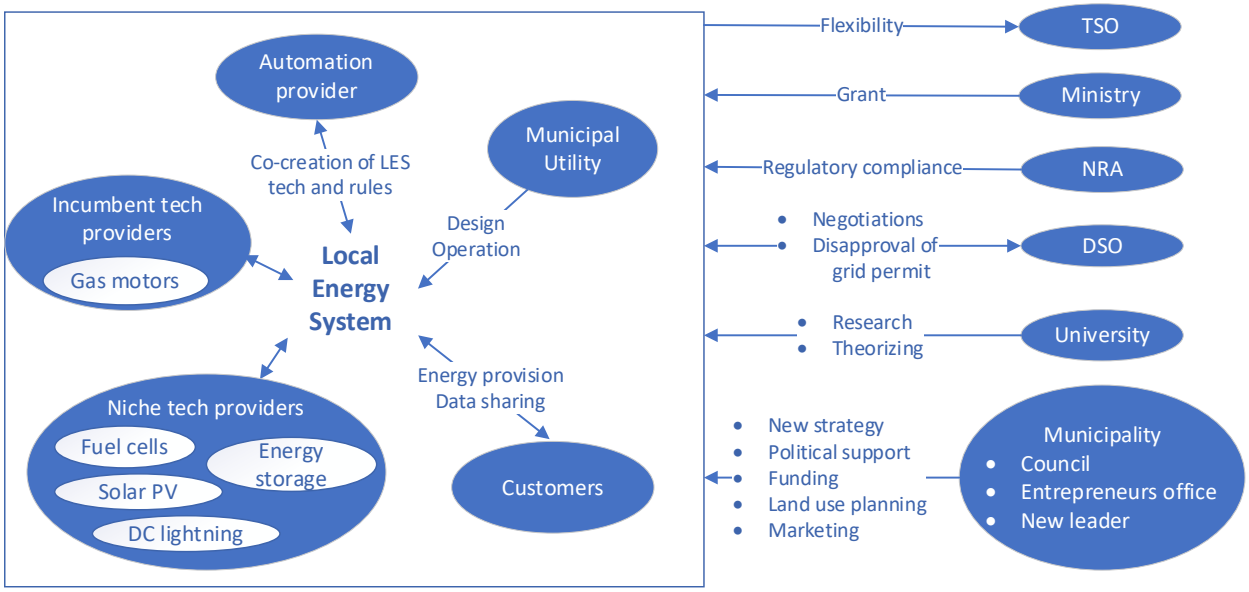

Figure 2. Setting for the LES creation process: stakeholders operating within the LES area (on the left) and other stakeholders influencing the LES creation process (on the right).

The DSO is a large and well-known actor in the Finnish electricity regime and is owned by foreign capital investors. It is active on national and EU-wide policy arenas. The National Regulatory Authority (NRA) is an independent regulator that manages the implementation of regulations and markets. It operates under the same Ministry that implements the funding schemes for demonstration projects, such as the case LES project. The transmission system operator (TSO) operates the electricity transmission nationally and manages the system balance via so-called frequency markets.

3.2. Methodology

To answer the question of how LESs are being initiated and created amid internal and external dialectic tensions, we used a single longitudinal case study with a process perspective. Single case studies and their rich data reveal underlying dynamics and processes in depth (Siggelkow, 2007) and are appropriate for studying phenomena that are rarely examined or somehow revelatory (Eisenhardt and Graebner, 2007). Process studies aim to discover "how and why things emerge, develop, grow or terminate over time" (Langley et al., 2013). Process studies can be divided into studies that explain process outcomes in a backwards-oriented way and event-based studies that concentrate on the observed sequence of events and their underlying forces (Van de Ven and Engleman, 2004; Van de Ven and Huber, 1990). Given that our research question aims at

answering how the LES creation process proceeded, we adopted an event-based process approach, which intends to explain the temporal order of unfolding change events through a narrative. This approach helps to reveal the particular circumstances, contingencies, and generative mechanisms behind institutional change (Hargrave and van de Ven, 2006). In addition, within the socio-technical transitions literature, there is space for systematically constructed process explanations with explicit causalities (Köhler et al., 2019).

3.3. Data collection

We chose to study events from 2010 to 2020 that are related to the LES project. This period was chosen because the interviewees saw events during this period as important to the creation process of the case LES. First, we began by gathering secondary data related to the project and the area where the LES was located. These data included newspaper articles, websites, municipality meeting notes and strategy papers, project announcements, relevant tweets and videos on Twitter and YouTube, a book on the municipal utility's history, stakeholders' reports and sales brochures, theses conducted for the project, and the project's grant application attachment. In addition to the case project material, academic and practical discussions of the LES's regulatory framework were intensively studied via academic articles, discussion papers, position papers, and reports on the national, European, and international levels. Second, we used 19 semi-structural interviews, transcripts from two seminars presenting the project, a field trip to the project site, and several hallway discussions with the central stakeholders in the project. We also participated in a project planning meeting. Twelve interviews were conducted face-to-face, and seven were performed online. Sixteen of the interviews were recorded and transcribed. Extensive notes were taken on three other interviews. A list of the interviews can be found in Appendix 1. The interview questions for the first interview round were structured to account for the temporal order of the project: (1.) the initial motivations for the project or how the organization joined the project, (2.) the planning of the project, (3.) the implementation of the project, and (4.) the commissioning and future of the LES.

3.4. Data analysis

To analyze the dialectic tensions in the process, we applied process research principles (van de Ven, 2007). We began by recognizing the main watershed moments, episodes, and key events.

In this paper, watershed moments are understood as changes in the context that activated or diminished certain social processes. Then, we used visual mapping (Langley, 1999) to find relationships between actors and events in a similar approach used by Gehman et al. (2013), that is, by placing each stakeholder's activities on a swimlane graph. Recognizing the watershed moments of the project enabled us to divide the process into episodes (Langley, 1999). To increase the reliability of the data analysis, two researchers analyzed the data separately. The independent results were compared. No major discrepancies were detected, but minor issues were found, resolved, and combined.

After obtaining inductively a good overview of the project's events, episodes, and watershed moments, we studied the case deductively from the theoretical perspectives. First, following the call by Köhler et al. (2019) and Svensson and Nikoleris (2018), we translated the process description into MLP concepts (landscape, regime, niche). Second, we coded the research data through the principles of institutional contradiction, praxis, social construction, and totality and sought dialectic stances on important topics. The theoretical constructs were identified by comparing the descriptions presented in the previous chapter and the events and actors on the event timeline. For coding, we used the ATLAS.ti software. We also performed a second round of verification interviews in which we illustrated and explained the findings of the study to the project initiator and a central actor in the formation process. Through this approach, we were able to have a dialogue and reach a consensus on the causalities involved in the process (Miles, Huberman, and Saldaña, 2014, 309).

4. Results

4.1. Sensemaking of institutional contradictions destabilizing the centralized energy regime

The LES project's champion is a rather typical Finnish municipal utility that serves district heating and NG to its customers. The utility started using NG in the 1980s, and since then, it has decreased the municipality's usage of oil for heating. The utility's use of NG increased until 2010, when the Finnish government decided to steadily increase taxes for NG as a part of landscape-level decarbonization efforts. Overall, these tax increases forced a reconsideration of the future of the

utility and its assets: “For sure, this large gas network has to have some use. It could not stop in 2010 when it was said that taxes up and use of natural gas down […] so bells started ringing that this cannot go like that!” (Utility repr. A). Nationally, the tax hikes increased many utilities’ biomass usage in district heating, but they also incentivized customers to switch to electric solutions, such as heat pumps.

From the utility’s perspective, institutional contradictions can be divided into three elements that became more prevalent in the following order. The first contradiction is the regulatory change of increasing NG taxation (from 2010 onward), which categorized NG as “the bad guy” (Gas association repr.). It conflicted with the utility’s experiences of NG’s ability to reduce emissions and its expectations of the investment lifecycle. It also challenged the gas industry with declining market shares. The national gas industry association began to consider alternative strategies, which included using hydrogen and offering flexibility to the electric grid. The case utility was interested in these visions and accordingly sought to introduce fuel cells to its territory already in 2013. One potential location was a swimming hall, which was being planned in the municipality.

The second institutional contradiction was related to functional inefficiencies and divergent interests (Seo and Creed, 2002) between gas and electricity infrastructures. Policies regarding the electricity regime, which can be seen as utility’s competitor, were also changing during this period. In 2011, Finland faced sudden landscape pressure via heavy storms, which led to political pressure to improve grid reliability. In 2013, the government introduced stringent measures for DSOs, which led to significant underground cabling investments across Finland. From the utility’s perspective, these investments in the electric infrastructure were contradictory to the uncertain future of the gas infrastructure. The utility’s experience was that gas pipelines can transfer energy securely and cost-efficiently, and its expectation was that the gas industry could also support the overall decarbonization of energy systems. “The basic principle is that with even very small gas pipe we can meet the large energy needs in the industrial area” (Utility repr. A).

The third contradiction was the disconnect between society’s electrification, the associated increasing need for power capacity, and its decreasing availability in the energy system, both

nationally and locally. The electricity mix became increasingly inflexible and volatile, as the number of CHP plants was decreasing due to decreasing profitability, and wind power was gaining ground due to feed-in tariffs set in 2010. According to the municipal utility, the general discussion on the energy system's future put too much emphasis on RE volumes instead of available power capacity, which would risk the security of the supply in the long run. "It starts to distort the picture […] in the end, we cannot just close everything for one month if we don't reach the power balance" (Utility repr. A). The national TSO's discussion paper warned of the potential for power capacity issues and the need for energy market reforms in 2016. Later, the utility used this paper as an argument when justifying the LES plan to the municipal council. At the same time, regulations, such as nearly zero energy buildings and the diffusion of heat pumps, incentivized optimizing energy usage on an individual building level. For the municipal utility, this kind of decentralization leads to the sub-optimization of energy resources on a neighborhood level, especially when the existing district heating and gas infrastructure could be used; eventually, the customer will pay the cost. "I am worried about the ordinary customer […]. We should give a clear picture of where the energy comes from. It's not just that you start digging holes into the ground and the electricity just comes from somewhere. Then, we miss the wider picture, and it leads to sub-optimization, in my opinion" (Utility repr. A). Electrification of heat also contradicted the utility's expectations for and vision of the future of district heating, which was based on many different sources, such as excess heat from data centers, ice hockey arenas, and cold storage warehouses.

4.2. Praxis initiating niche creation

The first watershed moment for the LES creation process and a trigger for praxis occurred following a change in municipal leadership. The new leader initiated a municipal strategy creation process, which included boundary-spanning discussions of the municipality's future plans among different municipal actors, such as the utility, the entrepreneurs' office, urban planners, and the municipal council. "I started as a leader in 2015 and then started to discuss with different municipal actors what is going on and how they see our challenges and opportunities" (Municipal leader A). The municipality wanted to differentiate itself from other municipalities, and the cornerstones of the new strategy were to become a strong frontrunner, listen to local citizens

and companies, and become an entrepreneurial municipality. These political goals were connected to the plans for a new industrial area, and this was how the concept of an energy self-sufficient industrial district was created. The idea was that investing in RE would attract new businesses by differentiating the municipality from other municipalities.

The new leader had experience with the governmental energy project funding scheme, which was launched a few months before the municipality's strategy creation. This project funding scheme covered up to 30% of project costs and supported national energy policy targets and cleantech exports. "The scheme is planned for new technology. And we are looking a bit further […], we are also interested on the replicability, first in Finland but also as a reference to be used abroad" (Ministry repr. A). The municipality understood that the grant would make even more experimental LES projects worthwhile for the municipality.

The ideation about potential technologies was influenced by a recent report on the municipality's RE potential, networking with companies, and specificities of the local context. The report on the municipality's RE potential was started in 2015 and finished in 2016. The main recognized possibilities for increasing the municipality's RE were biomass and biogas in district heating and solar PV for electricity. The utility translated these ideas into the grant application. Local niche technology providers' interest in the LES idea surprised the municipal leader: "When we started the project we rather thought about the customers' benefits […] Yet after announcing the project everybody started calling me and utility on can we talk, we can offer this and that, and could we be a part of the project." In addition, the local context and geography enabled praxis to emerge. Next to the LES's location is a large shopping center with a large cave underneath that has gone unused for a decade. The municipality has been interested in building a data center on the property because it offers a cool and safe location for it. The municipality's entrepreneurs' office representatives described how another Finnish municipality benefited from a similar case: "Their [internet service company] excess heat is in a way part of the municipal economy there and energy is tightly connected to municipality's industrial policy" (Municipal entrepreneurs' office repr. A). Not only did the data center provide jobs for that municipality, but it also met a large part of the municipality's heating needs with a low-carbon solution.

4.3. Social construction of the niche amid regime pressures

The planning process of the LES was based on solving the institutional contradictions the utility sensed. The primary purpose was to invest in RE while guaranteeing a constant power balance in the LES. Following the municipal RE review and for being maintenance-free, solar PV was chosen as the main RE resource. A constant power balance was planned to be achieved with batteries due to their rapid response time and with gas motors for longer duration needs. The gas grid offered a back-up for the local optimization and energy trading of variable RE. The area already had a gas infrastructure; therefore, utilizing it as a basis for LES planning was simple. The utility chose fuel cells for providing a stable baseload to the LES, but acquiring them helped with developing the field domestically. Fuel cells and gas motors were originally planned to use biogas, but this plan was discarded, as it did not fit the Ministry grant's boundaries. Two batteries were planned, and their roles were configured so that one would handle electric power quality and the other grid balancing. These plans were tested in a feasibility study, which was financed by the regional council. During the planning process, the utility negotiated with the different technology providers on possible ways to use direct current (DC) power in hybrid with alternating current (AC) power, integration grid automation system with building automation systems, especially in the case of legacy systems, and the operating order of energy carriers (i.e., heat and electricity).

The secondary purpose was to create conditions and incentives for local energy sharing so that the LES's members could save network costs by optimizing the usage of local energy production, participate in demand response programs, and utilize the excess heat from industrial processes. To create incentives for this, the utility and its automation system provider studied novel peer-to-peer energy trading models and started in cooperation with the local technical university exploring and designing special LES tariffs. Yet, there were no clear benchmarks or dominant models to be replicated. The utility's basic idea was to build the energy networks and IT systems ready and then sell the solution to potential energy-intensive customers who would benefit from local energy sharing economically and through a smaller carbon footprint. "It would be interesting to get that kind of a firm here that would enable discussions with existing customers of what kind of value it would give them if we could get demand patterns in overall as flat as

possible." (Utility repr. A). The main issue to solve at this point was convincing potential customers of the benefits of the LES. As the entrepreneurs' office representative said, "We should have information on existing buildings and then we could just set the things we need [in a simple marketing tool]. In that way, the customers get much more insight when there is some sort of a calculation." The municipality's representatives said that convincing real estate investors to invest in automation and energy efficiency was clearly a challenge. The utility also discussed the legal form of the LES with potential future customers, yet no legal form was decided when conducting the research: "Would it be a cooperative or something else, then it would be its own organizational structure and then we would have open balance sheets. […] And then they (customers) would be able to influence the price also in the future." (Entrepreneurs' office repr. A).

The abovementioned aims were linked to the question of whether the LES could own the electric grid. The LES ideation coincided with general increases in network tariffs in Finland at the beginning of 2016 after the NRA increased the profit margins allowed for DSOs. The municipality thought that local energy production transferred locally could give savings from these tariff increases and increase the LES's economic value for its potential future customers. The utility's thesis was a hybrid ownership model with the local DSO, which has a monopoly on operating the electric grid in the region. Yet, the negotiations between the utility and the DSO did not lead to a solution as the DSO was skeptical of whether the LES solution would be beneficial for it or the electricity distribution system in general. "Traditional distribution network business is a regulated monopoly business and is based on equal pricing and non-discriminatory services for all customer in the area, and this would collapse (with LESs)" (DSO repr.). In addition, the DSO did not believe the LES project would be able to proceed because, from their viewpoint, the optional regulatory model was not applicable to the LES. In the ex-post interview, the DSO's representative said, "It is a weird thing that they got ministry money because, at the moment, they are breaking the law as they are building electric grid on another DSO's area without a permit." After the unsuccessful negotiations over a hybrid model, the LES project team ended up with an uncertain regulatory model called a closed distribution network (CDN), which would give the utility permission to operate the LES overall, including the electric grid. The CDN model is meant for systems with a

specialized nature to their operations (e.g., hospitals, industrial sites, airports; EU, 2019), and it had only been used in a couple of locations in Finland, such as in an oil refinery area.

4.4. Totality: How the CE regime accommodates the LES?

The second watershed moment of the LES creation process was a national governmental grant awarded to the project. This grant made the project economically viable and therefore shifted the niche creation process from ideation and planning to implementation. When analyzing the linkages the LES has with different sub-systems, it can be said that it aligns well with many of them. It acts as an integrator of different energy carriers: electricity, gas, and heat. This was also a strong argument for receiving the grant from the Ministry. “Solar panes, intelligent lighting or gas motors individually don’t have novelty value, […]. The dimension of being able to run the system as a whole in island-mode with gas motors, solar PV… I think there is the novelty value.” (Ministry repr. B). The LES supports the electricity regime by investing in RE and offering flexibility to stabilize the electric grid with an increasing amount of variable wind and solar power. In cases of blackouts, it also provides security of supply locally. The LES supports the heating regime by developing models for sharing excess heat in a local community. It supports the gas regime by investing in fuel cells, which gives information on their functioning and role in an LES configuration. The LES is also a way for the local municipality to brand itself, attract new businesses to the area, and participate in decarbonization. On the national level, the LES is also seen as a means for developing solutions and technologies for export markets.

However, the question of the grid permission remained a challenge. In 2017, the utility applied for the CDN permission. Meanwhile, the potential models for LESs were handled by both the Finnish Smart Grid Working Group and the European Commission, which introduced directive proposals for “Local Energy Communities.” These directives enabled local energy sharing among different stakeholders, and CDN was mentioned as one way the member states could implement them in industrial and commercial areas. The municipality and the utility saw that the LES model was in alignment with these upcoming directives and that exploring the models would be beneficial overall. They saw that the LES worked, at least as an experiment, which could inform policymakers about the implementation of European directives. “We learn as we go, and as far as I know also the ministry wants to know where the collisions between legislations happen […].

If they want to introduce energy communities, they must have researched them on that level…" (municipal leader A). As a part of the Smart Grid Working Group, the NRA published in 2017 a study on energy communities' legal issues, which the utility interpreted as enabling the CDN model for the case LES. The local DSO notified the NRA that it opposed the CDN permit for the LES for reasons mentioned previously.

Even though the directives were discussed in the EU and Smart Grid Working Group during the project implementation, the NRA evaluated the project based on existing CDN legislation. The application process was long, as the utility's first application was sent in 2017 and the final decision was made in 2020, as the NRA decided not to issue the CDN permit after assessing the level of technical and safety requirements. Subsequently, the case LES's process continues by modifying the system to meet regulations but also in the political sphere as the implementation of the EU directives continues. In this sense, the NRA's decision set out a new institutional contradiction to be answered by municipal praxis. The main events, episodes, and watershed moments are illustrated in Fig. 3.

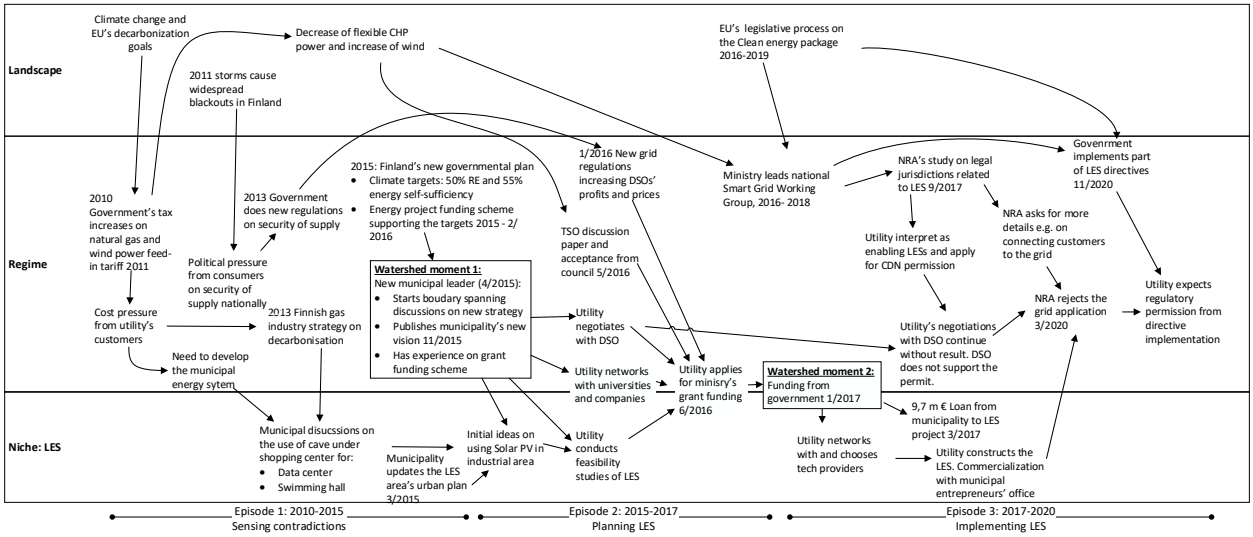

Fig. 3. Timeline of episodes, watershed moments, and events.

5. Conclusions

The MLP is a heuristic for studying transitions, but it accommodates auxiliary theories to explain the causalities behind processes (Geels, 2011). In our case, we used the dialectic perspective to

study how LESs are being initiated and created amid dialectic tensions. First, institutional contradictions stemming from the landscape level and internally in the energy regime led to the utility's niche ideation. Our case's landscape context has many similar elements to other LES studies, including extreme weather events putting pressure on security of supply, developing regulatory landscapes on LESs and net-zero targets, and decarbonization via electrification (Ajaz and Bernell, 2021a; Farrelly and Tawfik, 2020; Ford et al., 2021). In many previous studies, formal and informal institutions have been seen as important preconditions for LESs (Mahzouni, 2019; Ruggiero et al., 2021a; Wirth, 2014), yet the role of institutional contradictions has been less studied in the LES context (e.g. Galeano Galvan et al., 2020). The importance of handling institutional contradictions will increase in the future as the private and public sectors aim for decarbonization at the same time as utilities have to write down or modify their fossil fuel-based assets (Markard, 2018). However, once institutional contradictions are recognized and analyzed, they can also be solved, for instance by blending state, market, and community logics together (Wittmayer et al., 2021).

Second, praxis internal to the local niche emerged with regime-level support from the national level, political changes in the municipal strategy, and an expanding business area next to suitable infrastructure. As in a case study on energy communities by Ruggiero et al. (2021a), it was vital that there was a boundary-spanning person who knew the administrative process of applying for the grant. In addition, as in the case of Samso island's LES (Sperling, 2017), the knowledge and enthusiasm of individual entrepreneurs to develop the technology was a critical enabler in the process.

Third, tensions within the niche but especially across the niche and regime led to a build-up and eventually halt in the creation process, as the NRA rejected the grid permission. This situation offers a new institutional contradiction, leading to a subsequent praxis by the municipality. This case's tensions related to the electric grid monopoly; customers' new active role, incentives, and potential interdependences between customers; sensemaking of the LES's organizational structure; and technical compatibilities have been seen in previous LES cases (Becker et al., 2017; Ford et al., 2021; Hentschel et al., 2018; Palm, 2021). The special character of this case was the

interplay between the LES project, the ministry, who gave the grant to the project, and the independent regulator, as well as ongoing discussions on regulatory development.

The theoretical contribution of this case study is a better understanding of the relationship between the MLP and the dialectic perspective. Through a case study, we were able to identify some of the differences and complementarities between the two perspectives. The explicit description of institutional contradictions by Seo and Creed (2002) was helpful in pinpointing landscape and regime pressures that invoked agency. As in studies by Galeano Galvan et al. (2020) and Ruggiero et al. (2021b), the niche initiator was an incumbent actor who was positioned in the midst of sector-level changes. This aligns with the notion that regimes are not homogenic (Turnheim and Sovacool, 2020), and central positions in organizational fields expose organizations to institutional complexity (Greenwood et al., 2016). Further studies could look how generalizable this situation is, especially in incumbent-lead transitions. Similarly, the concept of praxis included many aspects considered useful when looking at the initiation of the niche creation. In the MLP literature, a similar situation is described as a 'window of opportunity,' which emerges when pressure on the regime grows strong enough and the niche is sufficiently developed (Geels and Schot, 2007). Yet, the MLP merely describes the regime-level change, such as changing regulations or new market needs. Here, the dialectic perspective goes deeper to micro-level changes that trigger the niche creator's agency.

Applying the dialectic perspective's concepts of social construction (i.e., social processes through which orderly, predictable relations are produced and reproduced) and totality (i.e., interrelatedness and complexity of social constructions) in relation to the MLP framework deserves special attention. Our case study showed how linkages between regimes differ in not only their interest alignment but also their importance. However, in practice, applying these terms to the analysis requires a careful conceptualization of the terms. The difficulty is distinguishing actors' interest-driven reasonings of social construction from the evaluation of the totality (Benson, 1977; Seo and Creed, 2002). In our process study, we solved this by categorizing macro-level activities by the Ministry, the regulator, and the EU bodies under 'totality' and other actors' interest-driven assessments of totality, such as the arguments used in the negotiations between the utility and the DSO, under 'social construction.' Conceptualizing the interplay

between totality and social construction is important because it helps theorize and identify the (un)intentional structures resulting from social construction activities and their influence on totality.

Overall, the dialectic perspective gives a more nuanced picture of niche–regime interactions, which goes beyond the traditional linear model, in which new niche actors emerge from the periphery and break into the regime. The transition pathway is shaped by niche maturity and landscape pressure intensity (Geels and Schot, 2007), but actors' different strategies to engage in dialectics also play a critical role. Dynamic and interest-driven interactions between different actors can lead to unintended consequences, making the governance of socio-technical transitions challenging (Meadowcroft, 2009; Shove and Walker, 2007).

Transferability of this study's results to other LES cases is influenced by the project's unique contextual features, such as ownership structures, existing infrastructure, the LES's location, and national innovation policies, such as the grant scheme. It is also good to note that LESs' institutionalization levels and types may differ across countries; therefore, the main niche–regime interactions can differ (e.g., Kooij et al., 2018; Wirth, 2014). For instance, the interactions may be much more implicit, including more normative or cognitive elements, such as customers' and financiers' understanding of the system. Transferability to other contexts is limited by the energy sector's highly regulated nature, with national differences in terms of market liberalization and smart grid diffusion, for example.

The methods of this study are transferable to other contexts, yet their reliability must be analyzed. This case study was longitudinal and mostly retrospective, as the interviews were conducted only during the three last years of the studied process. Discovering tensions ex-post is, of course, different compared to real-time exploration because of recall bias, survivorship bias, and hindsight (Davidsson and Gruenhagen, 2020). In addition, the interviewees may share only non-sensitive thoughts. Triangulation of the interview data by available secondary sources improves the validity, but studying the LES emergence process via ethnography would certainly complement the used methods. Naturally, access to negotiations could become a major barrier in this approach. In addition, even though the analysis of the data was done carefully and several

times, and even though interpretations were discussed with important actors, there is always a possibility for biases in the analysis.

Despite its limitations, this single case study reveals many micro-level dynamics that are discussed in the LES literature using the MLP only on a more general level. Limitations of this study could be mitigated by using a multiple case study method across different contexts and introducing ethnographic methods. Other future studies could elaborate on the theoretical connection of the MLP with the dialectic perspective, which seems a highly fruitful pathway based on this case study. This could help in studying the energy transition's next phases, where cross-regime and cross-system interactions become more prevalent (Markard, 2018; Rosenbloom, 2020).

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Appendix: Interviews

	Interview Date	Time	Interviewee 1	Other Interviewees
1	3.10.2018	50	Municipal utility representative A	
2	8.10.2018	45	Municipal leader A	
3	8.2.2019	45	DSO representative A	
4	12.10.2018	50	Fuel cell provider representative	
5	17.1.2019	35	Solar PV provider A representative	
6	21.1.2019	35	Solar PV provider B representative	

7	23.1.2019	45	Automation provider representative A	Automation provider representative B
8	24.1.2019	75	Direct current lightning firm representative	
9	25.1.2019	45	Battery provider representative	
11	26.1.2019	60	Municipal entrepreneurs office representative A	• Municipal entrepreneurs office representative B • Municipal utility representative A
12	4.3.2019	45	Gas motor provider representative	
13	20.5.2019	50	Ministry representative A	Ministry representative B
14	15.11.2019	55	NRA representative	
15	17.3.2020	26	Municipal utility representative B	
16	3.4.2020	31	Automation provider representative	
17	26.5.2020	90	Professor, University	
18	2.5.2020	50	Municipal utility representative	
19	8.10.2020	42	Finnish Gas Association representative	
	Seminars Date	**Time**	**Event**	**Speakers**
1	22.11.2017	2h	Project planning meeting	• Automation provider representative • Municipal utility representative A
2	11.3.2019	3h	Energy seminar	• Ministry representative B • Municipal leader B • Municipal utility representative A • Automation provider representative B • TSO representative • DSO representative B
3	23.1.2019	20min	Energy networks fair	Automation provider representative A
4	4.2.2020	2h	Meeting and a guided tour in the area	• Municipal utility representative C • Municipal utility representative A

Table 1. Overview of data sources and their purpose in the study

Source	**Amount**
Participating in a project meeting	1h 45min
News articles	26
Municipal strategy papers and council meeting notes	13
Stakeholders' announcements, websites, reports and marketing material	Stakeholder websites, 27 announcements and reports
Netnography (Twitter, Youtube)	96 tweets or re-tweets, 4 videos
Interviews	19 interviews, 12h 14min
Seminars on the project	2 seminars, 3h 20min, 7 presenters
Field trip	2 h
Miscellaneous	2 theses, 1 history book of utility