Emerging business ecosystems in sustainability transitions: lessons from the Finnish integrated energy services domain

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Abstract

The fields of business and innovation ecosystems and sustainability transitions have become increasingly popular in the study of innovation processes. Yet, only recently has the connection between the two fields been investigated. By analysing the complementarities of these literatures, we analyse the emergence of integrated building energy services and energy service ecosystems in Finland. Using a triangulation of data sources, we highlight how they can complement each other in understanding value creation in the context of socio-technical transitions. Our case focuses on the market niche phase of the transition process, demonstrating that after the niche innovation trajectory has built up through aggregation in protected local projects, focal value propositions become the focus of innovation activities. Despite the rather long history of the energy service company business model in Finland, integrated building energy services ecosystems are still in their emerging state.

Keywords: Sustainability transitions; business ecosystems; innovation ecosystems; energy services; service innovation; value co-creation

1 Introduction

Recent times have seen a rapid change in how businesses operate, for example, in terms of increased specialisation of firms, outsourcing and the importance of inter-organisational projects (Gulati et al., 2012; Manning, 2017). Simultaneously, current global challenges related to climate change and material scarcity necessitate the need for more systemic and service-oriented innovation, better able to promote sustainability transitions. Innovative business models, such as mobility-as-a-service (Mulley, 2017) or integrated solutions for building energy retrofits (Brown, 2018), increasingly require that organisations cooperate and coordinate activities through service integrators to communicate new value propositions to customers. Against these global developments, we propose that examining the emerging concepts of business and innovation ecosystems with the multi-level perspective (MLP) (e.g. Geels, 2005) offers novel insights into the roles that value creation and capture strategies play in sustainability transitions. Novel, transition-oriented business models need to overcome several path dependencies in socio-technical systems, involving regulatory institutions and consumer routines geared around the dominant incumbent system. Therefore, we also argue that taking a socio-technical approach benefits the study of evolving business or innovation ecosystems, and directs attention to the societal benefits that forming new ecosystems may offer.

The sustainability transitions literature (cf. Markard et al., 2012) takes a broad socio-technical approach to understanding the development of innovation, social practices and industries. The core focus of transitions is in understanding the shift from one socio-technical system delivering societal functions (such the provision of water, nutrition, heat, mobility and housing) to another (Geels, 2005), typically oriented to environmental sustainability (Geels, 2011). One of the core meso-level theories in transitions studies, the MLP (Geels, 2005) helps to illustrate and examine the struggle between the emergence of innovations in niches that radically deviate from the slowly evolving socio-technical regime.

Business ecosystem and innovation ecosystem concepts have been connected to innovation system approaches (Gomes et al., 2016; Rinkinen and Harmaakorpi, 2017). Of the approaches, technological innovation systems (TIS) has influenced the field of sustainability transitions. TIS emphasises actors, actor-networks and institutions as the determinants of the development and diffusion of new technologies, with analysis often undertaken to identify key public policy issues and set policy goals (Bergek et al., 2008). In contrast, ecosystem approaches focus on market-driven innovation (Ritala and Almpanopoulou, 2017), placing a greater emphasis on the role of the individual firm and how they can maximise their value by shaping the direction of the actor-networks in which they are embedded (Autio et al., 2014).

Ecosystem concepts have been enjoying popularity since their emergence in the early 1990s (Adner, 2017), specifically in the fields of strategy, management, innovation and entrepreneurship (Gomes et al., 2016). The business ecosystem concept (and to a lesser extent the innovation ecosystem concept) has dominated the management literature (Gomes et al., 2016). Ecosystem approaches focus on how value is co-created through the interaction of participants in situations where no single firm could create value by itself (Adner, 2006); moving from the firm-centric business model approach to a broader 'ecosystem model' to value co-creation (Thomas and Autio, 2012). However, ecosystem *emergence* has received little attention in the literature (Dedehayir et al., 2016), and where transition concepts provide useful insights.

Boons and Lüdeke-Freund (2013, p. 11) suggest that the scope of sustainability transitions studies includes "*the definition of value which brings together actors around an existing or new technology*". Yet, value creation for firms in this literature has been underexplored (Boons et al., 2013; Boons and Lüdeke-Freund, 2013). Furthermore, there has been little work addressing the connections between transition and ecosystem concepts. Connecting the TIS literature, Planko et al. (2014) developed a framework for innovation system building activities by complementing TIS with additional activities derived from the business ecosystem literature. Drawing on strategic niche management (SNM), Walrave et al. (2017) developed a framework to increase the 'external viability' of path-breaking ecosystems with the broader socio-technical regime.

Disruptive innovations surrounding business models to improve energy efficiency and promote renewable energy (e.g. Bolton and Hannon, 2016) have gained some attention in the context of transitions. As non-technological innovations they rely on novel value creation and capture strategies that involve the cooperation of multiple actors across production and consumption. Hence, the ecosystem construct may offer some insights into value co-creation processes in emerging niches that aim at delivering energy services. We focus on the question: *How can transition and ecosystem concepts complement our understanding of the emergence of potentially disruptive service innovations*? To address this, we examine the emergence of integrated building energy services at the intersection of the nearly zero energy buildings and smart energy management niches. Specifically, we investigate why, despite the rather long history of the energy services concept in Finland, the market for integrated building energy services is still in its infancy. We focus on the role of integrated energy service companies (IESCs) in the emergence of actor-constellations centred around similar energy service value propositions. Drawing on MLP and innovation and business ecosystem perspectives we (1) compare and contrast how the approaches address emergence and evolution, coordination of innovation activities, and actor-networks and actor roles; (2) highlight how these approaches can complement each other in understanding value creation in the context of socio-technical transitions, and (3) demonstrate these complementarities by analysing the emergence and evolution of building energy services in Finland.

Our theoretical motivation is to examine how ecosystem concepts can be applied to potentially path-breaking innovations and, thus, focus on the potential benefit ecosystem concepts may provide to our understanding of value creation in niche development. Our empirical motivation is to understand the emergence of integrated building energy services and broaden the current focus on energy services, where the energy service company (ESCo) business model has received increasing interest (e.g. Mahapatra et al., 2013; Nolden and Sorrell, 2016), by focusing on a variety of integrated building energy services, defined as "*holistic energy services which integrate a range of technical, financial and maintenance solutions to improve building energy efficiency and reduce energy demand in a cost-efficient way*" (Kangas et al., 2018).

Section 2 provides a review and comparison of the sustainability transitions literature (focusing on the MLP and SNM), and the business and innovation ecosystem literature. Section 3 outlines our methods and data. Section 4 details our empirical study on the emergence of building energy services in Finland. Section 5 discussed our theoretical and empirical contributions and concluding remarks are presented in section 6.

2 Socio-technical transitions, business and innovation ecosystems

2.1 Socio-technical transitions

The MLP and SNM are two core frameworks that facilitate the analysis of complex, large-scale, multi-level structural transformations in socio-technical systems. Such structural changes are understood as formed by interactions between a nested hierarchy of the landscape (exogenous context, e.g. natural disasters, global trends, macro-economic and political developments), the regime (the deep structure of the socio-technical system including its semi-coherent sets of 'rules') and niches (protected spaces where radical innovation and experimentation can emerge and replicate) (Geels, 2004).

The focal unit of analysis is the socio-technical system (Smith et al., 2005), for instance, the provision of energy, transportation, food or water. Radical innovation occurs in niches, where passive and active spaces shield innovation from mainstream selection environments (Kemp et al., 1998; Smith and Raven, 2012). Simultaneously, incremental innovation may take place in dominant socio-technical regimes until the regime is destabilised to a degree that allows the diffusion of radical niche innovations (Geels, 2011). Niche innovation ranges from technological (Lovio and Kivimaa, 2012) to social (Seyfang and Haxeltine, 2012) and service innovation (Boons et al., 2013), while the role of business model innovation has been underexplored (Boons et al., 2013; Boons and Lüdeke-Freund, 2013).

Transitions are described as 'multi-actor processes' that go beyond the logic of producers and consumers to include actors, such as firms, industry associations, policy makers, public authorities, social movements, special-interest groups, consumers, media, research institutes, advisory bodies and academia (Geels, 2004). Actors' roles have been associated with different societal realms (government, market and civil society), levels of governance and intermediary actions (Fischer and Newig, 2016). Actors can assume roles at different levels of structuration, taking part in regime activities (regime actors) or niche activities (niche actors), having single roles or a constellation of roles that change over time (Wittmayer et al., 2016). Farla et al. (2012) emphasise that transitions are never dependent on a single type of actor. Issues of power, politics and agency become increasingly important when the proponents of disruptive innovations seek to destabilise the incumbent regime (Wittmayer et al., 2016).

Transition studies focus on the *co-evolution* between different components of socio-technical systems. Early studies depicted transitions originating from niche innovation in phases (Rotmans et al., 2001). Later, various transition paths leading to socio-technical change were outlined (e.g. Geels and Schot, 2007; Smith et al., 2005). At niche level, to build up internal momentum, three development processes have been depicted (Geels and Raven, 2006). Thus, multiple conceptualisations exist on how transitions evolve.

The MLP/SNM literature suggests that potentially disruptive innovation activities, deviating significantly from the dominant socio-technical regime, aggregate in niches. Niches are conceptualised as a series of local experimental projects, shielded from the dominant regime and mainstream market selection environment (Geels and Raven, 2006; Raven et al., 2010). As such, they provide a protective space for new, unstable actor-networks, and sets of rules and institutions that diverge from conventional structures, culture and practices to be developed (Raven et al., 2010). Niches can be technological, enabled by public subsidies (investment grants, tax exemptions) and/or strategic firm investments, or small market niches with selection criteria different from mainstream markets (Geels and Raven, 2006).

A process of niche branching, where technological niches are followed by market niches has been described (Hoogma et al., 2002). Later, initially local niche experiments aggregate into a broader 'global' niche, described as a more abstract and imaginary community accumulating the experiences and learning of local projects pertaining to a same technology or an issue, 'global' used in a sense of covering also national-level developments (Geels and Deuten, 2006; Geels and Raven, 2006). Aggregation occurs through standardisation, codification, model buildings, and formulation of best practices (Geels and Deuten, 2006; Geels and Raven, 2006). Knowledge and vision building feedback to generate new experimental projects contributing to the niche (Martiskainen and Kivimaa, 2017). Intermediary actors and platforms have a key role in the aggregation (Geels and Deuten, 2006) and translation (Martiskainen and Kivimaa, 2017) activities and in the niche-regime interface (Kivimaa et al., 2017b).

As the path-breaking innovations become more robust (through performance improvements and the expansion of actor networks), niches give way to more conventional market niches, the need for protection progressively subsides and innovation begins to compete with and influence the regime (Smith and Raven, 2012). The 'hope' lies in aggregation reaching a scale of structural regime change (Geels, 2011), while such a result depends on the interplay between niches, regimes and landscape.

2.2 Business and innovation ecosystems

Research on 'ecosystems' has grown to encompass a variety of meanings that characterise the concept in terms of aligning and aggregating activities, and actors' positions, links, and roles in an ecosystem (Adner, 2017). Generally, ecosystems are comprised of an interdependent network of cooperating and competing actors (Adner and Kapoor, 2010; Iansiti and Levien, 2004a), typified by the collective goal of value co-creation (Clarysse et al., 2014; Thomas and Autio, 2014). The interaction and combination of ecosystem participants results in value co-creation that could not be possible for individual participants alone (Adner, 2006; Adner and Kapoor, 2010). Thomas and Autio (2012) identify three sources of value: *flexibility* (response to systemic challenges and opportunities), *efficiency* (reducing transaction costs) and *benefits from innovation* (increased innovation and improved technological transfer opportunities).

Ecosystem concepts do not exclude the possibility for radical and disruptive change in technologies, services, platforms, system architecture, and actor networks. However, many studies focus on incremental innovation in high-tech industries, such as software, biotechnology and internet services (Adner and Kapoor, 2010; Iansiti and Levien, 2004a). Most often the type of innovation is not distinguished, and the aim of innovation activity is centred on commercial value. The units of analysis range from firms and platforms (Gawer and Cusumano, 2002; Iansiti and Levien, 2004a) to the whole network (Pulkka et al., 2016).

There has been a lack of clarity and distinction between the various ecosystem concepts (Adner, 2017), leading to contradictory conceptualisations (Gomes et al., 2016). The greatest difference in between the business ecosystem and innovation ecosystem constructs is the source of value creation. Business ecosystems create value by delivering a 'total experience' (Moore, 1996) that addresses end customers' needs (Clarysse et al., 2014) by combining skills and assets (Eisenhardt and Martin, 2000) across a non-linear ecosystem of actors (Iansiti and Levien, 2004a); the joint focus of the ecosystem being the efficient delivery of a product/service (Clarysse et al., 2014; Thomas and Autio, 2012). Instead, the source of value creation in innovation ecosystems is the innovation activity and its external benefits (Autio and Thomas, 2014) structured around the 'economies of complementarity' (Thomas and Autio, 2012). Innovation ecosystems have been depicted as dynamic interactive networks where innovations emerge through cooperation between (local) actors and as a result of a risk-taking entrepreneurial culture (Oksanen and Hautamäki, 2014). In short, the innovation ecosystem strand focuses on value creation, whilst the business ecosystem stand predominantly focuses on value capture (Gomes et al., 2016).

The coordination for actors differs depending on how ecosystems are conceptualised. Adner (2017) makes the distinction between two general ecosystem perspectives. 'Ecosystem-as-affiliation' defines ecosystems as communities of associated actor networks that coordinate activities around a central actor(s):e.g. large firms (e.g. Moore, 1993), keystone actors (e.g. Iansiti and Levien, 2004), hub-firms (e.g. Nambisan and Baron, 2013), platform leaders (e.g. Gawer and Cusumano, 2002, 2014) or technology transfer agencies (e.g. Kivimaa et al., 2017a). 'Ecosystem-as-structure' are configurations of activity defined by their focal value proposition, which is the result of mutual agreement among actors in relation to the value proposition (Adner, 2017).

Ecosystem participants *co-evolve* over time maintaining the stability of the ecosystem in a changing environment (Thomas and Autio, 2014). Thomas and Autio (2012) emphasise the 'symbiosis' between participants, specifically their *specialisation*, *complementariness* and *co-evolution.* Increasing specialisation and heterogeneity of participants suggests that that there is simultaneous cooperation and competition (Adner and Kapoor, 2010). Some authors emphasise the role of a central actor (Thomas and Autio, 2012), referred to as platform leaders (Cusumano and Gawer, 2002), keystone species (Iansiti and Levien, 2004a), focal firms (Adner, 2017, 2006; Autio and Llewellyn, 2013; Clarysse et al., 2014) or hub firms (Nambisan and Sawhney, 2011). Such firms have been suggested to be the main proponent of value propositions, and value creation and capture mechanisms, and have been attributed with the abilities to manage innovation coherence, knowledge flows, network membership and stability, and define the degree to which components are decomposed into independent or loosely coupled modules (e.g. Boing's development of the Dreamliner 787) (Nambisan and Sawhney, 2011); and to influence and shape standard setting processes standards (e.g. Intel's role in establishing the USB standard) (Cusumano and Gawer, 2002),

The emergence of ecosystems has received scant attention (Dedehayir et al., 2016), with existing literature focused on established ecosystems or ecosystems with a well-defined scope and orientation (Ahlqvist et al., 2015). One strand of literature suggests that ecosystems emerge and progress through 'life cycle' phases. Several practitioner-oriented frameworks indicate that ecosystems emerge and evolve as the result of strategic ecosystem building actions taken by actors, including: (1) birth, expansion, leadership, self-renewal (or death) (Moore, 1993); (2) analysis, project design deployment, and conclusion or sustenance (evolution and sustainability) (Rabelo and Bernus, 2015); (3) seed, cultivate, and nourish (Hwang and Horowitt, 2012); (4) designing the 'value blueprint', foreseeing risks, determining actor roles, timing of innovation introductions, and dynamic reconfiguration over time (Adner, 2012). However, such frameworks have been criticised for their linear and deterministic approaches (Wallner and Menrad, 2011).

Other literature, with roots in evolutionary economics, draws upon the analogy to natural ecosystems. For instance, Peltoniemi (2006) suggests ecosystems exhibit self-organisation, emerge in the absence of outside forces through decentralised decision making, and evolve through variation, selection and retention as the result of the competitive, mutualistic, and exploitative co-evolution of actors. Teece (2007, p. 1323) notes that ecosystem rules are a "result of co-evolution and complex interaction" between participants. Furthermore, Thomas and Autio (2012) suggest that ecosystem participants co-evolve to provide specialised and complementary inputs to value creation. However, in general, such approaches neglect the external environment; ecosystems appear to exist as a solitary—and rather flat—unit of analysis, with the links to exogenous influences left under-addressed (Walrave et al., 2017).

2.3 Complementarities and divergences of approaches

Transition and ecosystems approaches share some similarities but have significant differences in how they conceptualise innovation processes. Table 1 compares these two approaches in terms of how they conceptualise emergence and evolution, the coordination innovation activities, and actor-networks and roles of actors.

Following the MLP and SNM, disruptive service innovations emerge in socio-technical niches in local experimental projects protected from the socio-technical regime. Within this protective space, through the aggregation of niche activities (standardisation, codification, etc.), as path-breaking innovations can become more robust, the need for protection subsides. When market niches develop, and niche protection diminishes, various value co-creation and capture mechanisms become the focus of experimentation; as the market niche starts to compete with the incumbent regime.

Drawing on Adner's (2017) 'ecosystem-as-structure' approach, we propose *that business ecosystems for transitions emerge in (radical) market niches, around value propositions where value is created through customer/demand side innovation that combines skills and assets (often at the interface of niches and* *regimes) to meet customer needs*. As niche protection diminishes, new actor-constellations may form around focal value propositions, comprising actors from within the broader market niche actor-network. In this process, the focus of coordination guiding innovation activities shifts from project to the focal value proposition (see Figure 1), where value co-creation activities take place.

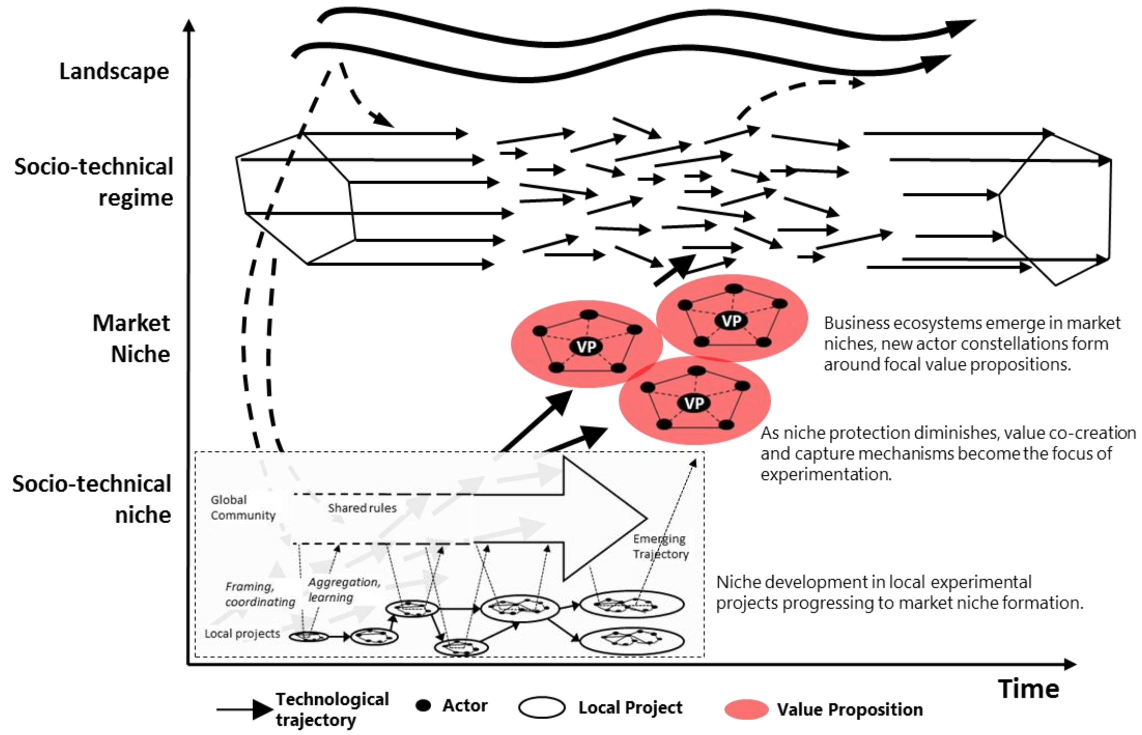

Figure 1: From socio-technical niche projects to market niche focal value propositions

Table 1. Comparison of innovation and business ecosystems concepts

	Multi-level perspective and strategic niche innovations	Business and innovation ecosystems
Emergence and evolution	- Radical innovations develop in protected niches through the articulation of expectations and visions, the building of social networks, and learning process at multiple dimensions (Hoogma et al., 2002; Schot and Geels, 2008); - Interactions between processes at niche, regime and landscape levels result in different transition pathways, e.g. transformation, de-alignment and re-alignment, technological substitution and reconfiguration (Geels and Schot, 2007).	- Ecosystems have defined 'life cycle' phases (Moore, 1993); - Ecosystems emerge and evolve as the result of strategic ecosystem building actions (Adner, 2012; Hwang and Horowitt, 2012; Rabelo and Bernus, 2015); - Focus on the co-evolution of firms in terms of specialised and complementary inputs to value creation (Thomas and Autio, 2012)
Coordination of innovation activities	- Aggregation from local projects to a 'global niche'(Geels, 2011) through standardisation, codification, model buildings, formulation of best practices (Geels and Deuten, 2006; Geels and Raven, 2006). - Knowledge/vision feeding back to generate new projects (Martiskainen and Kivimaa, 2017) - Intermediaries between projects (Geels and Deuten, 2006; Martiskainen and Kivimaa, 2017), and in the niche-regime interface (Kivimaa et al., 2017b).	- Coordination around keystone organisations/focal firms/focal hub firms (e.g. (Adner and Kapoor, 2010; Iansiti and Levien, 2004b; Nambisan and Baron, 2013); platforms (Gawer and Cusumano, 2002, 2014; Iansiti and Levien, 2004b), universities/public research organisations (Kivimaa et al., 2017a), or a focal value proposition (Adner, 2017) through value co-creation (Autio and Thomas, 2014). - Market niches depicted as areas of specialisation providing diversity in ecosystems (Iansiti and Levien, 2004a)
Actor-networks and roles of actors	- Multi-actor processes that go beyond the logic of producers and consumers (Geels, 2004); - Transitions are multi-actor processes, not driven by a single actor (Farla et al., 2012); - Increasing focus on power, politics and agency (Wittmayer et al., 2016).	- Include production and use side participants (Adner and Kapoor, 2010; Gawer and Cusumano, 2002, 2014; Iansiti and Levien, 2004b); - Keystone actors have a central role in coordination (Nambisan and Sawhney, 2011). - Actor networks coordinate around a locus of coordination; actors, platforms or value propositions (Adner, 2017)

3 Methods and context

3.1 Methods and data

An empirical case study (cf. Yin, 2008) was conducted on the evolution and state of the integrated building energy services ecosystem in Finland. We used a triangulation of data sources including 27 interviews, academic literature, and information in company webpages and professional journals. The research progressed in the following phases.

1. A general overview and mapping of companies operating in the energy services for buildings sector was conducted in early 2015. Twenty companies were identified based on existing registers and information on the company webpages. During May-June 2015, semi-structured interviews were conducted with 12 companies and 2 cooperation organisations, while 8 companies did not grant an interview. The questions addressed general policy development, mobilisation of business models, and cooperation and emergence of sectoral organisations.
2. The interview data was complemented with material provided on company webpages and professional journals. An additional round of 5 interviews was conducted during June-August 2017, focusing on recent development and modes of collaboration.
3. The historical perspective was reinforced by using ESCo project database by the energy agency Motiva and earlier dataset of 8 interviews from 2012 (focus on evolution of the ESCo business model and energy service companies in 2000s).

The data analysis was guided by conceptual development (Figure 1 and Table 1) and focused on two central topics: (1) the emergence and evolution of energy services in Finland, drawing from SNM and MLP perspectives (using academic literature, interviews in 2012, and professional journals and blogs, especially *Rakennuslehti* and *Tekniikka & Talous*); (2) the identification of value propositions as the basis of ecosystem development and analysis of actor constellations emerging around these value propositions within the broader building energy services market niche, drawing from ecosystem concepts (using interviews in 2015 and 2017, company webpages and professional journals). Interviews and company webpages provided the basis for identifying how each IESC framed their central value propositions and emerging actor-constellations, which were then clustered into common themes. The complementary journal, webpage and blog data was gathered on the IESCs to provide a contextual understanding of the shifts in business models, company relations and sectoral development. To guarantee anonymity of the interviewees, all the references to the individual companies have been removed.

3.2 Context

3.2.1 Building energy services

In empirical studies on energy services, novel business models, such as the energy service company (ESCo) model, have received increasing interest (e.g. Mahapatra et al., 2013; Nolden and Sorrell, 2016). Foxon (2013) highlights the potentially promising role ESCos can play in low-carbon energy transitions. Such business models imply for instance, that *"rather than simply selling lighting equipment, companies…may provide agreed levels of illumination for a client and take responsibility for the ownership, installation, operation, maintenance, upgrading, replacement and/or disposal of the necessary equipment under the terms and conditions of a long-term contract*" (Nolden and Sorrell, 2016, p. 1405).

The ESCo model normally involves long-term service contracts that contain elements of both finance and guarantees of energy and cost savings (Hannon and Bolton, 2015; Mahapatra et al., 2013). Whilst ESCos are the most common energy service model (Duplessis et al., 2012), a variety of other integrated energy service models exist, for example, 'one stop shops' that do not include financing or guarantee components (Mahapatra et al., 2013) or market intermediary models, where an intermediary actor coordinates the service components from different companies to the consumer (Brown, 2018).

In the new millennium, the interest in ESCos has been framed as "*a new business model to promote energy efficiency in the world*" (Fang et al., 2012, p. 559). However, relatively little attention has been paid to energy services not meeting the ESCo definition in the sustainability transitions literature. We take a broader view on energy services by focusing on integrated energy services. Such services consist of a range of advice, consultancy, design, finance, metering, monitoring, management and optimisation, and the retail of diverse sets of technologies, but exclude single technology oriented services (e.g., only heat pump installation or maintenance) (Kangas et al., 2018). IESCs often act as system integrators that provide design and calculation services necessary to achieve energy savings and combine technical components in unique settings. Integrated energy services have potential to lower the energy demand of buildings. They are business model innovations with the potential to disrupt the established practices and actor-constellations.

3.2.2 Energy and building regimes

The building energy services are located at the intersection of energy and building regimes, which face multiple landscape-level pressures, including climate change, changing statuses of fossil and renewable energy sources, limitations in natural resource availability and global development in information technologies.

The energy regime in Finland is governed by a stable and narrow elite consisting of central ministries, large energy producers and advocacy associations (Ruostetsaari, 2010). The political focus has been production-oriented, industrial electricity demand growing steadily (13 % increase during 1990-2015) (Eurostst, 2016). The key aims of energy policy have altered little over the years, focusing on the provision of inexpensive energy for industry, energy security and management of environmental impacts (Kivimaa and Mickwitz, 2011). Finland's energy efficiency policy for buildings traces back to the 1970s, having been fairly consistent and positive in the development of the policy mix during the last decade (Kern et al., 2017).

The building regime is not limited to new construction, but includes building management, refurbishment and demolition. The construction industry in Finland is dominated by five large companies: Lemminkäinen, YIT, Skanka, NCC and SRV, and organised under two unions (representing firms and employees). A chain of subcontracting is typical. Approximately 60% of buildings are owned by householders directly or through housing cooperatives, making them a significant actor deciding on investments regarding the renovation of buildings and being a potential market for integrated energy services. Compared to other countries, Finland has a relatively energy-efficient building stock (IEA, 2013). Measures such as triple glazing, minimum efficiency performance standards for building components and the use of fuel-efficient district heating are part of the existing regime (Kern et al., 2017). Yet, the development of innovative low-energy housing in Finland has been ambivalent (Pässilä et al., 2015).

4 Empirical Study: the emergence of integrated building energy services in Finland

4.1 Emergence of the energy services niche in Finland

4.1.1 The emergence of ESCo energy services in Finland

While some energy service experimentation was taking place in Finland in the 1980s (by firms such as TAC Finland and ABB), the ESCo business model was not introduced until around 2000 and has experienced quite moderate success since. The emergence of the ESCo was partly influenced by changes to the energy regime (the deregulation of the electricity market in 1998), a long history of rather consistent policy development in support of energy efficient buildings (Kern et al., 2017), and the global ESCo niche that was mainstreaming in the USA and Canada in the 1990s and later in Europe (Kivisaari et al., 2004). Niche experimentation specifically focused on the ESCo model through a national technology programme addressing the mitigation of climate change (Climtech), funded by the Finnish Funding Agency for Innovation Tekes (Kivisaari et al., 2004). Early projects remained detached and experimental (e.g. Heiskanen and Lovio, 2010) until the social embedding of the approach to municipal practices by the Technical Research Centre of Finland (VTT) and the emergence of the government energy agency Motiva (Kivisaari et al., 2004). Motiva has been recognised as an active intermediary for the ESCo concept in Finland (Bertoldi and Boza-Kiss, 2017), sharing information on ESCo services, publishing contract templates, displaying examples of ESCo projects, and maintaining an ESCo project register (Pätäri et al., 2016).

4.1.2 The decline of the ESCo

ESCo activities in Finland have remained moderate in contrast to, for example, strong growth in Denmark (Bertoldi and Boza-Kiss, 2017). To qualify for government funding, ESCo projects have been required follow Motiva guidelines. During 2000-2009, 58 projects were documented in the official project register, ranging from multi-million euro industrial projects to small installations in public premises (Figure 2). Several ESCos were purchased by regime actors or liquidated by the end the 2000s as the growth of energy services was lower than expected: global energy technology brand Schneider Electric purchased TAC Finland in 2003; construction incumbent YIT purchased the most active ESCo start-up Inesco in 2007 (the activities ceasing soon after); and the ESCo pioneer Enespa was liquidated after years of inactivity in 2012. After experiencing a short vibrant phase, ESCo activities were merged into regular activities of regime actors. There has been a high turnover but the number of companies providing integrated energy services has remained low, circa 8 during 2010-2013 (Bertoldi and Boza-Kiss, 2017). According to the interviewees, this has been a result of, *inter alia*, complexity of ESCo contracting, change in the EU accounting regulations (that disabled companies to exclude energy investments from their books) and, later, the 2008 global financial crisis. As a consequence, Motiva's activities as an intermediary supporting ESCo diminished substantially.

Most interviewees had a rather negative view on the ESCo concept promoted by Motiva due to its focus on saving guarantees and bureaucratic implementation. One interviewee stated that "*the kind of ESCo model that Motiva has defined is completely impossible to realise*". The number of IESCs identified in this study is higher than the number of ESCos, indicating that ESCos represent only one kind of business model and value proposition in the broader energy service market.

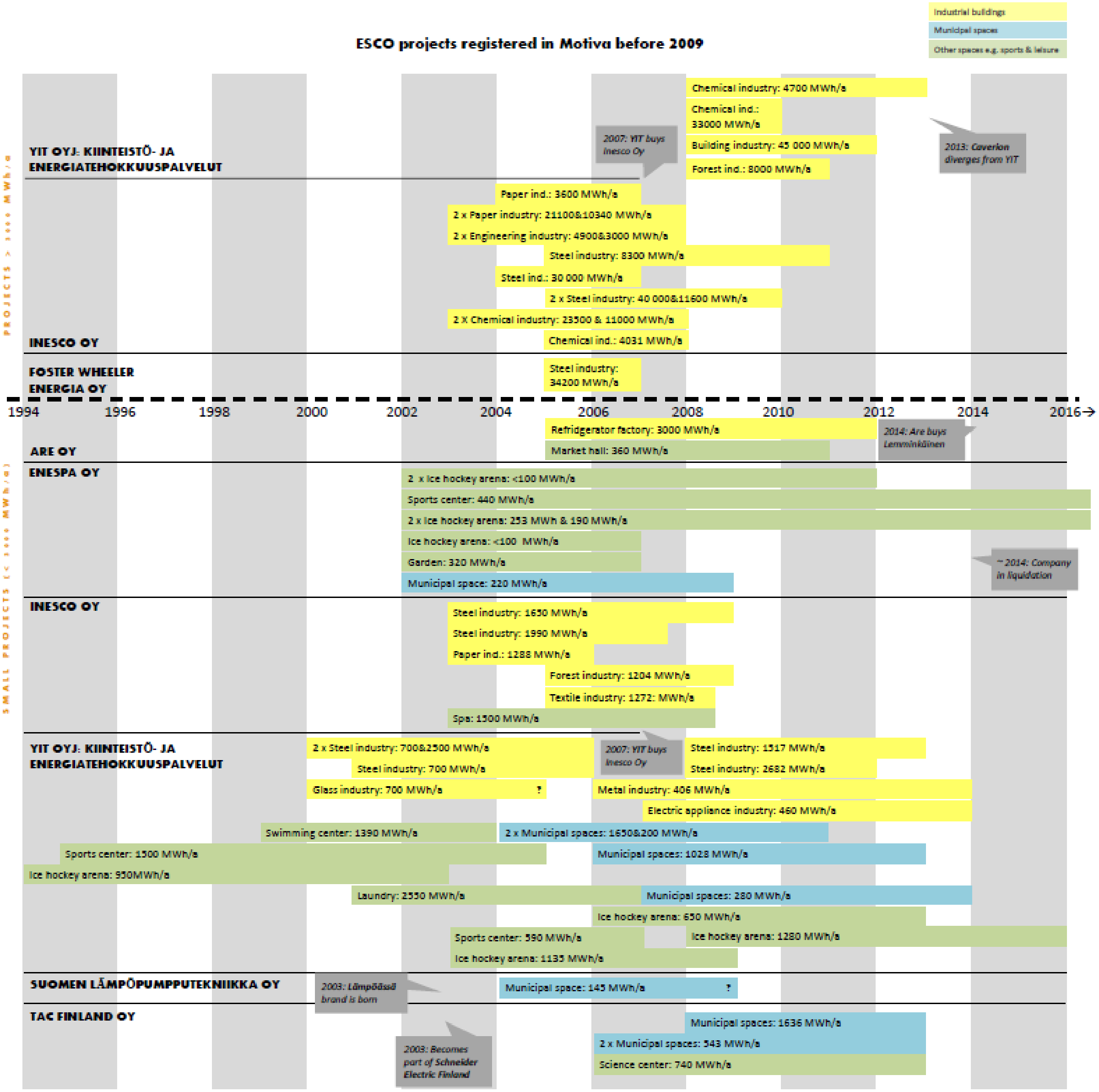

Figure 2: ESCo projects documented in Motiva's project register

4.1.3 Reorientation toward an integrated building energy services trajectory

According to the interviews, public-sector demand for energy service improvements has remained stable but relatively low. The focus has, thus, shifted towards professional building maintenance in business premises, office buildings, retail sector and large apartment buildings, with large energy saving potential. This has also led to the diversification of contract rules, service designs and value propositions provided by the IESCs. One interviewee remarked that Finland's overall energy services market offers "*15 billion-euro savings potential*" annually, whilst another highlighted that activities only "*operate at 10% of the potential*". The value propositions provided by the IESCs build on untapped financial savings, but also on disruptive rhetoric towards incumbent actors in the construction and energy regimes, especially continuous political attention on energy production at the cost of efficiency improvements (see Section 4.2).

Integrated building energy services have emerged at the intersection of two co-evolving socio-technical niches, the smart energy management (SEM) niche and the nearly zero energy buildings niche (NZEB) (Figure 3). The Finnish NZEB niche is strongly driven by EU Directives and the global NZEB niche (e.g. Kivimaa and Martiskainen, 2017; Mlecnik, 2012), with the vision of reducing the net-energy use of buildings to ‘nearly zero’. This niche is in the early stage of emergence. In 2015, legislative preparation towards NZEB for new buildings commenced as a specific project in the Ministry of the Environment, implying its gradual empowerment, supported by a project initiated by the construction and HVAC industries. However, in 2016 multiple ministries and other stakeholders opposed legislation supporting NZEBs (Rakennuslehti, 2016). Moreover, definitions of ‘near zero energy’ in Finland have been argued to be very far from zero (YLE, 2016).

In contrast, the SEM represents a more conventional market niche. Building on activities developing around smart grids and building energy management systems (e.g. Bolton and Foxon, 2010; Verbong et al., 2013), the SEM market niche couples smart meter data with energy management system and building control systems to allow IESCs to offer services, including remote energy management and demand side management. This has been enabled by the roll-out of smart meters, following changes to the electricity regimes rules.

The intersection of these niches is fragmented, since the requirements of end uses (industry, public, businesses and residential) differ from one another as do building renovations and new construction. There is no unified profile of IESCs. The companies differ in service and product portfolios, market niches aand scale of operations (e.g. global, European, Nordic, national, regional). Most actors involved in the development of innovative services have roots in building and energy regimes but have shifted towards service business as technologies and markets have matured.

Based on the intersecting niches, the IESCs can be divided into three groups. Five companies are located within the NZEB niche, providing energy efficient HVAC services, auditing and/or technology retail for building renovations or new building designs. Two companies have specialised in energy management and monitoring development, providing energy-related maintenance services and digital-platform development. The remaining five companies can be positioned at the intersection of the two niches; their focus is on system integration based on calculation, modelling and life cycle assessment.

4.1 Coordination of building energy service innovation activities

The tension between incumbent regime actors and the innovative service providers was well-documented in the data. For example, the IESC interviewees negatively framed the technical capacities of building maintenance companies, the interests of construction companies, and the ‘greenwashing–orientation’ of some energy companies. Most interviewees emphasised the role of regime actors as ‘gatekeepers’ at the project level, where the design of energy solutions is often considered too late. In contrast, most IESCs positioned themselves as system innovators with capacity to reorient the ways in which buildings are designed. Furthermore, the IESCs studied shared a common approach of offering multiple rather than single solutions to reduce energy demand.

Three emerging actor-constellations that assemble around focal collective value propositions can be identified (Figure 4). The value propositions form the basis of coordination between the companies and direct the orientation of energy efficiency improvements, while also communicating demands for regime change

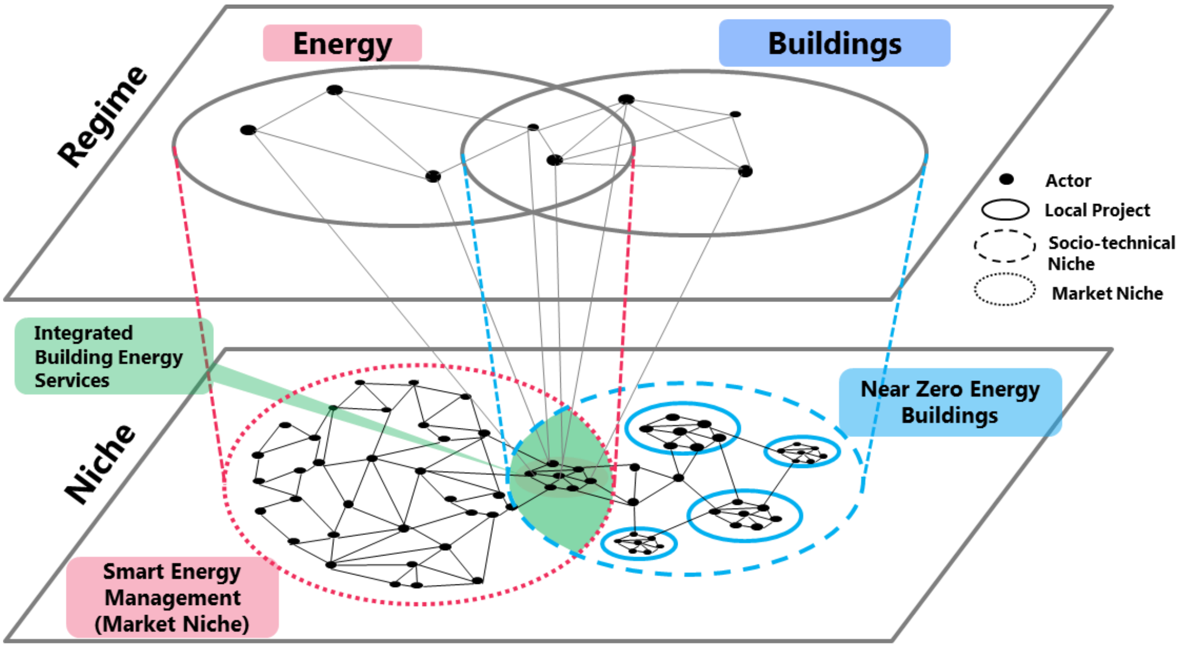

Figure 3: Integrated building energy service activities in Finland

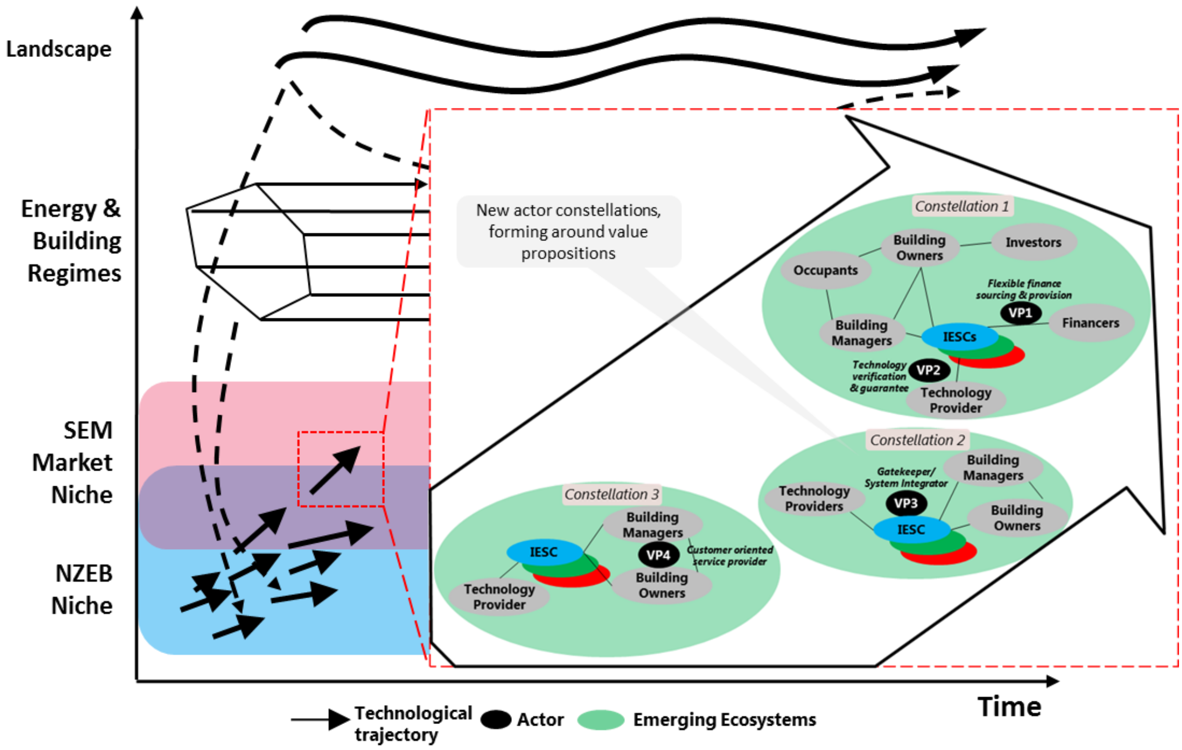

Figure 4: Emerging building energy service business ecosystems

4.1.1 Actor-constellation 1: The building (owner) at the centre of the constellation

Several interviewees framed their core activities from the perspective of building users, building managers, investors and building owners. The focal point is the emergence of building energy performance as a central concern in professional building investments and maintenance. However, even professional building maintenance companies have overlooked the field of energy expertise or failed to integrate it in their business models, creating the business case for IESC. As stated by one IESC offering energy monitoring services: "*The energy issues remain quite often neglected issues in the maintenance organisations; they are often handled besides the actual job. Now that the role of energy increases, they need external services to guide process in the right direction*." Moreover, "*these services are important, because the systems become more demanding and complex, so it demands professional skills and understanding to get the building perform up to the standards*." Thus, the integrated building energy services are framed as a necessary component in the constellation that unfolds around building construction, renovation and maintenance.

Regarding the building owner, there are two specific value propositions that the IESCs provide. First, the sourcing and provision of financing provides *flexibility* to the actor-constellation, as the energy efficiency investments are not in direct competition with building owners/investors other investment priorities. The constellation, thus, further expands to involve financing actors. In practice, the costs are usually covered through fixed-term contracting, where the terms are agreed on a case-by-case basis. Second, the saving guarantees and technical verification are designed to increase *efficiency* by simplifying investment activities and reducing transaction costs. This value proposition is enabled by the IESC's mediating position between technology providers and end-users. However, the guarantees are complex ventures that are problematic to codify into standards and thus communicate towards potential customers. Most IESCs have distanced themselves from saving guarantees and utilised alternative arguments, as framed by an interviewee: "*What kind of funding does the contract include? What kind of promise about savings and how it is verified? The verification depends on technical choices and the funding might involve multiple components*." More recently, alternative arguments have become the core of value generation and network building.

4.1.2 Actor-constellation 2: Networking around technological development

The second constellation is around the technological developments in energy efficiency, micro-generation and energy management. Some IESCs frame themselves as natural collaborators with technology developers, acting as 'gatekeepers' of the building energy efficiency market: "*We are the potential sellers of technologies, since it is really difficult to think of any other way of selling it.*" Some IESCs mentioned that they contribute to developing technologies and components, because the integration in building systems necessitates trials that include calculation, design and adjustment operations carried out by the IESCs. Thus, the constellations are not evolving around individual technologies, but technological trials more generally.

The central value proposition relates to the *efficiency* that the IESCs can provide through their technological expertise; they act as system integrators introducing multiple novel technologies to the building stock. Many IESCs also emphasise their independence towards individual technology providers as they occupy a neutral position between technology providers and end-users. The system integration is also a central component in the aggregation of knowledge in the global technological niche. In practice, the system-design is a multidisciplinary affair and to enable technological work, companies have formed expert organisations that include e.g. service and financing expertise in addition to engineering skills.

4.1.3 Actor-constellation 3: Service innovation as ecosystem development

The third constellation is coordinated around service business models. Since the technological applications of energy monitoring have matured and become an integral part of building management, the business case for integrated energy services has been articulated as a spatially expansive and potentially global business niche. Especially, digitalisation and internet-of-things applications open up a global market niche for building energy services, as framed by an interviewee: "*We are in the cloud more and more as the devices and control units communicate with one another. The monitored building can be located in Helsinki or Beijing and it can be also partially controlled from anywhere*". Though several IESCs interviewed have contributed to the development of platforms, they frame their core business activities in terms of service provision, rather than competing in the digital energy management platform market.

This value proposition places the customer in the centre, where smart feedback mechanisms and automated control can enable tailored solutions in real-time. To be successful, the service needs to be easy to purchase and seamless to run. What it actually includes is secondary, emphasised in several interviews. Larger

IESCs have increased the scope of the energy services they offer by making them an integral component of their regular activities, for example, by providing an energy efficiency angle on HVAC renovations or building maintenance activities as opposed to 'add on' services. Overall, emerging platforms have contributed towards the diversification of service business models (e.g. electricity monitoring, air quality management, and heat recovery) as the operations are less place and project specific. However, the integration of different and often competing platforms remains underdeveloped.

5 Discussion and conclusions

The sustainability transitions literature has paid rather little attention to how the definition of value can bring together actors, new technologies and services, and the role that value creation and capture plays in the early stages of transitions (Boons and Lüdeke-Freund, 2013), especially in the shift from experimental niches to market niches. In turn, the ecosystem literature neglects the broader context (the socio-technical regimes) (Walrave et al., 2017), the degree of disruptiveness of the innovations generated, and temporal dynamics; including how ecosystems emerge and form around focal value propositions. Whilst the exogenous context is typically outside the scope of ecosystem studies, it is crucial in understanding the emergence of business ecosystems, their potential disruptive capacities, and the interplay between niche and value proposition emergence. Thus, our aim was to draw from these two very different literatures to address the above shortcomings and draw upon their complementarities to understand how the integrated energy services in Finland and their associated business ecosystems have emerged.

In contrast to the deterministic (cf. Moore, 1993; Rabelo and Bernus, 2015) and inward, firm-oriented (cf. Peltoniemi, 2006; Teece, 2007) approaches of ecosystem emergence, our conceptualisation of business ecosystems in transitions illustrates how business ecosystems coordinate around value propositions in market niches that emerge from an attempt frame novel value propositions as a solution to tensions within the dominant socio-technical regimes. This kind of value co-creation incorporates an ecosystem of cooperating and competing companies that focus their efforts on new market creation. This collaboration may also extend to activities aiming to institutionalise specific market niches or to disrupt the dominant regimes. Simultaneously, the companies continue to compete for specific projects and customers, particularly when niche protection is low and actors establish new connections around focal value propositions.

We have illustrated how transition and ecosystem concepts (through their focus on endogenous and exogenous aspects) are complementary in making sense of the emergence and evolution of integrated energy services for buildings in Finland. Our findings show that an initial failure to create a new ecosystem can lead to subsequent ecosystem emergence, supported by a more far reaching network of actors. The processes are influenced by landscape and regime events, and the support and resistance of niche and regime actors. Empirically, we observed that the building energy service business ecosystems have emerged at the intersection of two socio-technical niches: the Smart Energy Management niche and Nearly Zero Energy Buildings niche. Our case focused on the phase of transition where niche protection is low and innovations face greater exposure to mainstream market selection. It has demonstrated that after the niche innovation trajectory has built up through aggregation in protected local projects (Geels and Deuten, 2006), *a focal value proposition* can become the focus of coordination for innovation activities and new actor-constellations (Adner, 2017).

In the domain of integrated energy services for buildings in Finland, the number of companies is small and the business models are heterogeneous. The companies in the emerging ecosystems connect to different regimes, some leaning more towards the building regime and others to the energy regime. Interestingly, while the companies operate in the same ecosystem and benefit from similar policy developments, their perspectives differ regarding the degree to which the current institutional regime is satisfactory (Kivimaa et al., 2017c). Our case may be considered the start of a *reconfiguration* pathway (Geels and Schot, 2007), where landscape developments have caused openings for disruptive service innovations that can reconfigure regime rules, specifically related to cognitive rules concerning the position of energy efficiency in the building regime (brining energy concerns forward in the planning process) and the normative practices of monitoring and controlling energy performance. Whilst a small number of regime actors have been open to these developments, to date they have had a minimal effect due regime lock-in.

Our study shows how multiple actor-constellations, built around focal value propositions, are part of the broader ecosystem built around business model innovation for integrated energy services. In practice, the actor-constellations could be viewed from different angles. On the one hand, the building and technology-centred networks follow the traditional *vertical trajectories* of building owners as enablers of business opportunities, technology providers as innovators and contractors as practical implementers. The IESCs are positioned in the middle and hold the network together and potentially contribute to regime shift from within. On the other hand, the service-centred networks offer *horizontal alignment* of different actors providing links among complementary and competing business models, moving beyond the logic of producers and consumers (Geels, 2004). Furthermore, the service-centred logic carries disruptive potential that diverges from conventional structures and practices (Raven et al., 2010). However, fragmentation and high level of specialisation have made the construction regime resilient towards such changes (Pulkka et al. 2016).

Finally, our analysis illustrates that despite the rather long history of the ESCo concept, the market niche for integrated building energy services is still emerging. Increasing EU NZEB regulation, national attention on energy renovation, and the development of smart building technologies add demand for new business ecosystems. Simultaneously, the ecosystem development is slowed down by path dependencies in the building and energy regimes.

Our approach opens up several avenues for future research. First, we have contributed to an emerging discussion (Planko et al., 2014; Walrave et al., 2017) on the cross-fertilisation between transition and ecosystem perspectives, providing a novel angle of ecosystem emergence at the intersection of socio-technical niches. Following this trajectory—applying concepts such as value co-creation, and ecosystem models of value co-creation and capture—can help inform discussions related to transition processes in the context of weak niche protection; how actors connect value creation and capture to windows of opportunity in socio-technical regimes; the role of value creation and capture in transition pathways; and micro processes of firm co-evolution, value co-creation and capture. Ecosystem approaches can also draw on concepts from transition studies to better understand the exogenous context in ecosystem emergence and evolution, and place a greater focus on multi-actor processes. Empirically, transition literature related to the building and energy regimes has, to a large extent, been dominated by a technology focus. Yet, we demonstrate that greater attention should be directed to the wide range of service innovation in the field.

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