SMART ENERGY TRANSITION

Emerging business ecosystems behind the new energy services in Finland

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Smart Energy Transition project tackles the global disruption of energy markets by creating pathways for Finland to profit from the energy disruption. Smart Energy Transition (314325) thanks the Strategic Research Council (SRC), in collaboration with the Academy of Finland, for their continuing support for the project.

strategic RESEARCH

Abstract

The Smart Energy Transition research project focuses on studying how Finland can benefit from the ongoing energy transition. The energy transition affects Finnish companies operating in the energy field. As the energy industry no longer consists solely of power generation, but also a variety of new subfields such as energy efficiency, demand response and small-scale renewable energy production, it offers companies new ways to benefit from arising business opportunities. The fundamental changes of the energy system also create demand for new niche technologies. As conventional actors such as energy utilities, and niche players of the energy field both tackle the energy transition, new cooperation opportunities and models emerge.

This working paper studies potential *business ecosystems* in the Finnish energy industry. A business ecosystem is an approach to a business environment consisting of interacting and interdependent organizations. These actors might break the traditional industry boundaries and instead of operating as independent actors, they create value for the whole ecosystem. The basis of the study lies on an extensive network analysis of Finnish companies operating in the new energy industry. The network analysis rests on a company database collected in the Smart Energy Transition project. It frames the main analysis which is conducted through seven company representative interviews carried out in October – December 2018.

The findings suggest that the companies are aware of the potential of a business ecosystem and most of them view the ecosystem-like approach positively. Many characteristics of a business ecosystem were found in the current partnership strategies of the interviewed actors. The potential ecosystem is at the birth stage of its evolution since the organizations are still searching for their roles and business models with the partners. Because of this, the structure of the emerging ecosystem remains partly unclear. However, the new energy services seem to be in the core of the emerging ecosystem. Therefore, in this paper the emerging business ecosystem is called *the new energy service package ecosystem*. Together with the niche technology suppliers the incumbent energy companies aim to create coherent and user-friendly energy service packages.

The interdependencies between the actors are clear. The energy companies are dependent on the expertise of the smaller actors. Then again, smaller actors benefit from the customer bases of the large actors as they make their way from niche markets to mainstream markets. Cooperation by the observed companies is multidimensional and it has features of coopetition as well. Even though the incumbent energy utilities increase the robustness of the emerging ecosystem, they are not unambiguously keystone actors of the ecosystem. The study indicates that only some parts of the energy companies are operating in the ecosystem. Innovative functions of the incumbents are the real keystone actors rather than the companies. Additionally, some niche technology providers could play keystone actor roles in the emerging ecosystem as well.

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Introduction

Global energy production and consumption are under a fundamental transition process driven by megatrends like climate change and constantly progressive digitalization. The transition towards a decarbonized society causes the companies in the energy field to undertake new sort of action. Traditionally the energy system has hinged on large energy companies and their value chains including mining, refining and transportation of the fuels and combustion technology manufacturers, through which these incumbents have been able to produce heat and electricity to their customers. However, the energy transition is shifting the position of the energy companies from conventional actors to suppliers of more diverse energy related services. The turn from a centralized to a distributed energy system shapes the energy companies' supply to encompass not only power but also so-called new energy services. Throughout this paper, new energy service packages will refer to niche energy technologies such as solar PV systems, EV charging systems and energy management systems and user services, which are boosting the energy transition. To update their selection of services, the energy companies require the technologies and know-how of agile forerunner companies, such as startups and other niche technology suppliers. Then again, these niche actors can strengthen their positions at the niche technology markets by interacting with the incumbent energy companies. Such collaboration and interaction can be studied using the concept of a business ecosystem that presents the cooperation of companies as a vital instrument for their success.

A business ecosystem is an approach to a business environment that consists of interacting and interdependent organizations (Moore 1993; 1996). In a business ecosystem, new products and services are outcomes of a complex network stepping over the traditional boundaries of a single industry (Annanperä et al. 2015). This working paper focuses on evolving business ecosystems in the energy field in Finland. The study seeks to explore potential business ecosystems based on interviews of energy companies and companies providing new energy services. The major objective of this study is to investigate how do the companies of a different size and position view the potential of a business ecosystem in the light of energy transition, and are there any features of a business ecosystem evolving in the current cooperation models of Finnish energy industry.

The paper starts by shortly describing the theoretical background of the business ecosystem. In order to illustrate the transforming energy field in Finland, the paper will then present a network analysis of potential business ecosystem company actors. After having visualized the network, the study reviews the opinions on the modern cooperation and characteristics of an ecosystem arising from the interview data. The paper aims to find out if any business ecosystems emerge in the Finnish energy industry by observing which characteristics of an ecosystem are described by the interviewed companies. In addition, it seeks to examine what is the role of incumbent actors in relation to the rising niche actors and how the size and position of a company meets the roles of a business ecosystem.

Business ecosystem

The concept of an ecosystem rests on natural sciences, where it refers to a community consisting of interacting organisms and their physical environment. James Moore (1993) initially introduced the business ecosystem metaphor. He defines the business ecosystem as an economic community supported by interacting organizations and individuals, which are the organisms of the business world (Moore 1996). He suggests that the term business ecosystem should replace the traditional concept of an industry since in the modern economic world you cannot divide companies into specific industries (Moore 1993). Like a natural ecosystem, Moore's business ecosystem gradually moves from separate elements to a structured community as it evolves through an entire life cycle from birth through expansion and leadership phases to either a renewal or death (ibid.).

The business ecosystem actors are companies of different sizes, suppliers, producers, financiers and customers. In addition, the public sector, universities and research institutes are usually considered ecosystem members as well (Peltoniemi & Vuori 2004; Annanperä et al. 2015). Iansiti & Levien (2004) define roles for the actors in the business ecosystem. The keystone actors are few in numbers, but they are widely networked with the other actors. Keystones must be able to create value for the entire system by creating a platform, such as services, tools or technologies that enable operations of other ecosystem participants. For example, Apple created a computer design and software, but encouraged its partners to create programs for its device (Moore 1993). Similarly, Microsoft's technologies allow software companies to create programs for the Windows system (Iansiti & Levien 2004). Thus, keystone actors leave the actual value creation to other actors within the ecosystem. Keystone actors are crucial when it comes to the health of a business ecosystem. They enhance the productivity by connecting network participants. Keystones can improve the ecosystem's robustness by incorporating innovations and by pointing out a framework of the operational environment. Moreover, they are in a position to underpin innovation suppliers' position by, for example, offering niche technologies to third parties. Hence, removal of a keystone actor will most likely lead to the collapse of the ecosystem (ibid.).

While keystone actors control the ecosystem mainly in an indirect manner, ecosystem dominators use their power in a more direct and traditional way. A dominator aims to own and control most of the network directly, which makes it responsible for the value creation as well. This is an effective strategy but in a competition against a functioning business ecosystem, a dominator-led ecosystem is in a risk to collapse due the lack of innovations and flexibility (Iansiti & Levien 2004). Alternatively, a dominator might insidiously exploit the value created by the others. The niche players innovate new products or services which differentiates them from the other organizations of the ecosystem. They have several connections to the core of the network and less with each other (ibid.).

Iansiti & Levien (2004) also name three criteria for the success of a business ecosystem. Firstly, the ecosystem must create value and be productive. In order to survive, a business ecosystem intends to create innovations and new business opportunities and value for all the

members of the ecosystem. Organizations and individuals of an ecosystem combine their resources such as know-how, experiences and technologies to develop new business (ibid.). The emergence of properties such as new services is also one of the features of a complex business ecosystem defined by Peltoniemi & Vuori (2004): "The result of interaction between different units is something, which no one of those units could produce by oneself." Thus, the business ecosystem is always more than the sum of its parts. In addition, members of an ecosystem share the fate and values of the network. They all pursue strategies that improve their ecosystems' health instead of only narrowly furthering their own interests (Iansiti & Levien 2004).

Secondly, the ecosystem needs to be robust to survive internal and external shocks. In other words, a healthy ecosystem is able to transform as the business environment changes. Distributed and flexible decision-making models help to keep the ecosystem vital (Iansiti & Levien 2004). Self-organization is one of the key characteristics of the complex business ecosystem (Peltoniemi & Vuori 2004). In the ecosystem, self-organization appears as the organizations create structures freely in a mutual interaction – without an internal or external leader. Thirdly, the business ecosystem must create opportunities for new businesses and niche players. (Iansiti & Levien 2004). Instead of being protectionist, the ecosystem should be cooperative and open. As the ecosystem co-evolves, the acts of one organization affect the evolution of others (Peltoniemi & Vuori 2004). In addition, the business ecosystem must have a shared vision and goal, and methods to cooperate and actualize their plans (Annanperä et al. 2014).

Of course, a business ecosystem is not the only way for companies to cooperate. While traditional value chains are based on a buyer-supplier relationship, in the business ecosystem interaction between organizations is bidirectional and more multidimensional (Battistella et al. 2013) In addition to monetary capital, the business ecosystem creates social capital. This appears as shared social norms, values and trust amongst actors in business ecosystem. The business ecosystem also partly overlaps with the concept of a business network, but the ecosystem should be understood more widely. As an ecosystem, a complex network "is not simply the implementation of the independent company strategies of one or more actors, but a part of the continuing interaction between interdependent actors, activities and recourses" (Ford & Håkansson 2013, 1019). However, coopetition is clearly present in a business ecosystem unlike in a business network. Competing companies may boost the ecosystem for example by promoting business and technical best practices or lobbying the public sector (Battistella et al. 2013).

Other recognized economic ecosystems are innovation ecosystem (Adner & Kapoor 2010; Oksanen & Hautamäki 2014), entrepreneurial ecosystem (Mason & Brown 2014; Salminen & Mikkelä 2016) and digital business ecosystem (Nachira 2002; Corallo et al. 2007). As in the business ecosystem, in the innovation ecosystem the interdependencies and openness between the actors are essential. The innovation ecosystem stresses novel products and services (Annanperä et al. 2015). In the innovation ecosystem, information produced by universities, research institutes and companies are a particularly valuable resource (Oksanen & Hautamäki 2014). Some consider the innovation ecosystems as the first phase of the life

cycle of a business ecosystem, as innovation is a key element in the ecosystem's emergence (Annanperä et al. 2015). The entrepreneurial ecosystem refers to a local entrepreneurial community in which entrepreneurs, companies, financiers, banks and other organizations, as well as entrepreneurial processes meet and combine (Mason & Brown 2014). In the digital business ecosystem, the focus is on the software services and other Internet-based technologies and the digital business ecosystem enables these "digital species" to interact and evolve (Nachira 2002, 12). Many of the assumptions of the innovation, entrepreneurship, service and the digital business ecosystems are also present in the concept of the business ecosystem. In the context of an energy industry, one should pay attention especially to the innovation ecosystem and business ecosystems and how the new technologies, including artificial intelligence, IoT services and other data related technologies shape the field. Before focusing on the potential business ecosystems in the Finnish energy field, a more general picture of the company connections within the industry must be drawn. Therefore, the paper will next analyze the networks of the new energy field firms.

Network analysis of the actors in the new energy industry

More than two hundred Finnish energy transition related companies have been brought together into a database.[1] These companies have been selected as they either benefit from the business opportunities arising from the ongoing energy transition or they have to face the energy transition in any case since they are the major players in the field. Companies of the database are innovative, significant actors in the field or exporters of energy technologies. This study will now present a network analysis, which includes 97 companies from the database. These companies were chosen on the grounds of keywords[2] so that the analysis covers the following new energy subsectors: wind power, solar power, heat pumps, smart energy management, EV charging, energy storage and the energy companies and grid operators connected to the above-mentioned new energy sectors. The network also involves the main customer groups who are private consumers, public sector, housing companies, farms and companies outside the energy industry. Single companies are linked to other companies or/and the customer groups. These links rest on the information available on the websites of the analyzed firms where they describe their main customer groups. The connections between nodes (companies and their customer groups) create almost 600 links. The analysis is conducted with the Gephi program.[3]

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[1] *www.energiamurros.fi*

[2] The following keywords were used to frame the network analysis: *batteries, solar electricity, solar heating, energy management, energy efficiency services, energy data management, ICT, residential automation, consultation, demand response devices, heat pumps, financing, electric vehicle charging systems, wind power, wind turbines, wind power components, wind power construction, wind power bases, wind power production.*

[3] *www.gephi.org*

The network analysis reveals four business clusters in the Finnish new energy industry. In Figure 1, the small circles represent individual organizations and larger circles stand for the company and customer groups. Wind power (blue), solar energy and heat pump retail (yellow) and smart energy solutions (green) are the most clearly defined clusters. In addition, heat pump manufacturers (purple) stand out as a small separate cluster. The amount of companies in each cluster draws a rough picture of Finnish actors in each subsector (although the database does not necessarily cover all the actors in Finland). Wind power component manufacturers and wind power construction companies are the largest groups. The node of solar PV retailers is also large while solar panel manufacturers and solar heating system retailers are notably smaller groups. Globally, most solar panels manufacturers are located in Asia and on the other hand, the demand for solar heat system technologies may not be as developed and well known as PV system technologies. Similarly, there are more heat pump retailers than manufacturers. Heat pump installations have rapidly increased in Finland, but according to the slight amount of domestic manufacturers, the technology is largely imported. Smart energy management services, energy management systems, IoT services and other energy management platforms, are also a significant a group of significant size. The strong ICT sector in Finland is stated to be a significant driver for the success of this cluster.

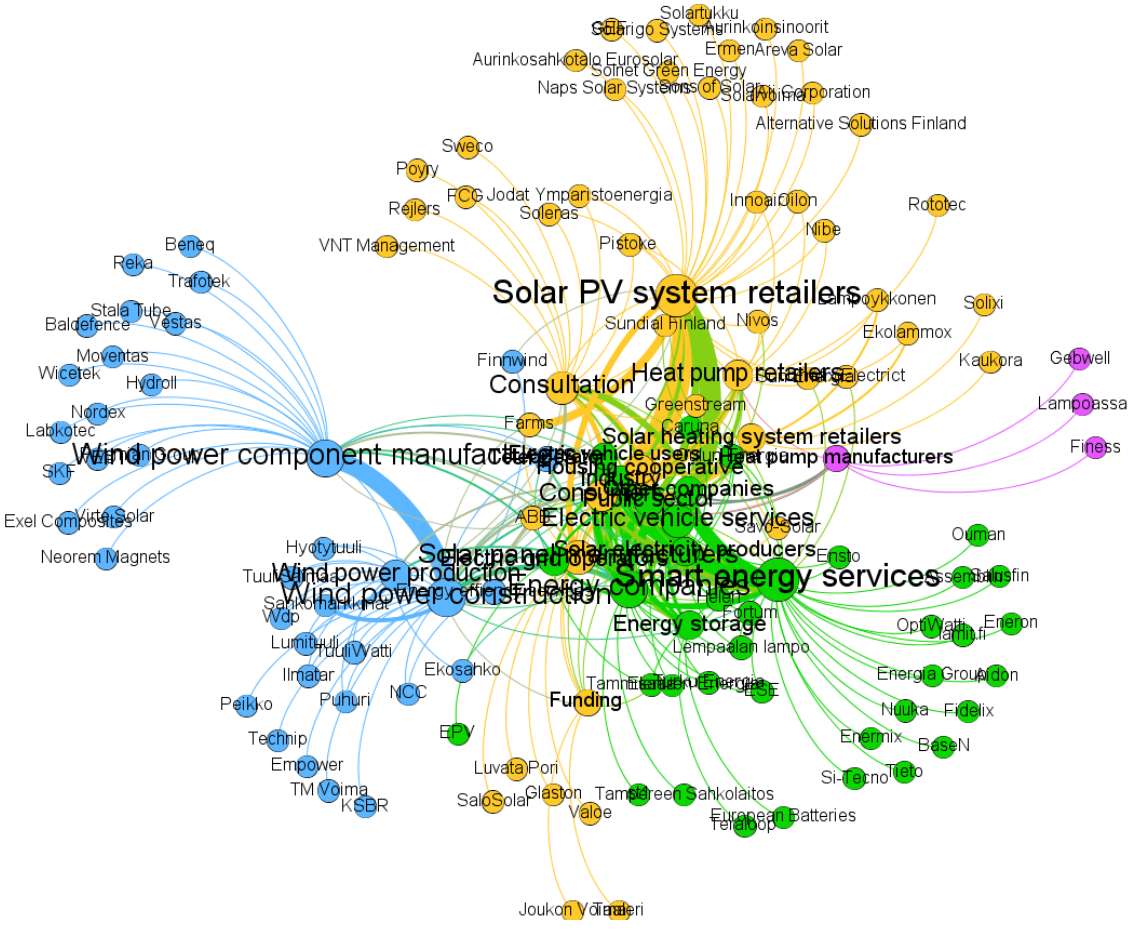

Figure 1: Network analysis of the actors in the new energy field in Finland.

What does the network analysis tell about the new energy actor network? First, the wind power cluster is presented apart from other sectors. This may be due to the nature of wind power production. Even though being a distributed renewable energy source, wind power plants are energy production units just as conventional power plants. Wind turbines are usually located far off from cities and other residential areas. In Finland, large companies typically own the wind power plants. Meanwhile, small community-owned or private wind turbines are not common as only two of the companies in the database offer micro wind turbines. The wind sector seems to have rare connections to smart energy service suppliers. Hence, wind power constitutes a large and robust yet separate cluster in the network visualization.

Meanwhile, the other three clusters seem to be more interlocked. Solar panels, heat pumps, smart energy management systems and EV charging stations are often sold directly to the end-users, such as the public sector, farmers and companies outside the energy industry. These customer groups bring solar and heat pump retailing (colored yellow), smart energy (colored green) and heat pump manufacturing (colored purple) clusters close to each other in the network visualization. However, not only do the customer groups connect these clusters, but they also do a lot of cooperation. For example, several heat pump retailers also offer solar heating systems, and smart energy services and solar PVs can be purchased together in a customer-friendly package. Finnish energy companies (located in the green 'smart energy solutions' cluster) have expanded their supply to encompass not only power but also a set of new energy services. Table 1 will explain in more detail the contents of the network analysis and figure 1. One must note, that the network analysis only gives us a rough idea on how the companies place due to their main customer groups. A deeper review on the cooperation in the energy industry will follow, as the paper will next analyze the potential business ecosystems in the energy field.

Table 1: Company and customer groups and organizations of the network analysis.

Cluster	**Wind (blue)**	**Solar and heat pump retailers (yellow)**	**Smart energy solutions (green)**	**Heat pump manufacturers (purple)**
Company groups	Wind power component manufacturers Wind power construction Wind power production	Solar PV manufacturers Solar PV system retailers Solar heating system retailers Consultation Heat pump retailers Funding	Smart energy services Energy storages Energy utilities Electric vehicle services Solar electricity production Grid operators	Heat pump manufacturers
Customer groups	Teleoperators	Farms Housing companies	Public sector Industry Other companies (outside of the energy industry) Electric vehicle users	-

Organi-zations	BeneQ Oy Bladefence Oy Ekosähkö Oy Empower Oyj Exel Composi-tes Oyj Finnwind Oy Hydroll Oy Ilmatar Windpower Oy Keski-Suomen Betonirakenne Oy Labkotec Oy Lumituuli Oy Moventas Gears Oy NCC Suomi Oy Neorem Mag-nets Oy Nordex Energy GmbH Peikko Group Oy Prysmian Group Oy Puhuri Oy Reka Kaapeli Oy SKF Ab Stalatube Oy Suomen Hyötytuuli Oy Technip Offshore Finland Oy TM Voima Oy Trafotek Oy TuuliSaimaa Oy Vestas Finland Oy VEO Oy Wicetec Oy wdp Finland Oy	ABB Finland Oy Aii Corporation Oy Alternative Solutions Finland Oy Areva Solar Oy Aurinkoinsinöörit Oy Aurinkosähkötalo Eurosolar Oy Ekolämmöx Oy Ermen Oy FCG Finnish Consulting Group Oy Glaston Oyj GreenStream Network OyInnoair Oy Jodat Ympäristöenergia Oy Joukon Voima Oy Kaukora Oy Lämpöykkönen Oy Luvata Pori Oy Naps Solar Systems Oy NIBE Energy Systems Oy Nivos Energia Oy Oilon Group Oy Pistoke RES Oy Pöyry Oyj Rejlers Finland Oy Rocotec SaloSolar Oy Savo-Solar Solardigo Systems Oy Solartukku Oy Soleras Solixi Oy Solnet Green Energy Finland Oy Sons of Solar Sundial Finland Oy Sweco Finland Taaleri Energia Oy Valoe Oyj VNT Management Oy	Aidon Oy Assemblin Oy BaseN Oy Caruna Enefix Electric Oy Enegia Group Oy Eneron Oy Ensto Group EPV Energia Oy Etelä-Savon Energia Oy European Battery Technologies Oy Fidelix Oy Fortum Oyj Helen Lempäälän Lämpö Oy Nuuka Solutions Oy Opti Automation Oy Ouman Oy Salusfin Oy Si-Tecno Oy St1 Tammisaaren Energia Oy Tampereen Sähkölaitos Oy Teraloop Oy Tieto Oyj Turku Energia	Gebwell Oy Lämpöässä Oy Finess Energy Oy

Emerging business ecosystem

The network analysis described above only gives a rough picture of the new energy actors' links based on the information about their customer groups they share in public. To discover if there are any potential business ecosystems in the Finnish energy industry, a more precise review of cooperation between these actors was carried out. A few studies investigating the business ecosystems in the Finnish energy industry have been carried out in the bioenergy sector (Mutikainen et al. 2016) and on the regional level (Kaihovaara et al. 2017). This working

paper seeks to study the business ecosystems connected to the emerging energy services, which are seen beneficial for the energy transition. Before presenting the results of the analysis, the paper will briefly describe the data, and how it links to the network analysis discussed before, and the methodology used in the study.

Data and methodological premises

The unit of analysis of this study is the functions of the companies on new energy services. In order to review the content and nature of these functions, the paper explores the visions of the companies that operate on the field of new energy services. The research has been conducted by interviewing energy utilities, that offer smart energy management services, solar PVs and EV charging services on the supposition that these new sorts of services are products of cooperation with start-ups or other smaller firms. These specific incumbents were chosen, as they have plenty of links to the different niche technology suppliers which puts them in the center in the network analysis. One of the energy companies is not included in the company database and therefore, not in the network analysis either but it was selected to be interviewed due to its ambitious plans on new energy services. The research data also encompasses interviews of actors from the solar and energy management sectors. All four interviewed technology suppliers are relatively well-known and large actors on their fields in Finland. The network analysis presents the solar actors clearly in one cluster (colored yellow) and energy management system suppliers in another cluster (colored green). Their roles as niche technology providers are quite unambiguous. Altogether, the data of this section consists of seven semi-structured interviews conducted in October – December 2018.

Interviewees were asked about the size of the company (revenue and number of staff) or the size of the operations on the new energy services if the company in question was a large incumbent actor with variety of functions. This enables the paper to draw an overview of the potential business ecosystem, which will be presented in the next chapter. More importantly, the company representatives were asked about their partners during the process of creating and retailing new energy services. Specific questions were made about the roles of each partner, sharing of responsibilities, criteria when choosing new partners, challenges and tangible and intangible benefits of the partnership. Finally, questions were asked about companies' relationship to public sector actors, research institutes and end-users.

The interview data was analyzed by means of theory-driven content analysis. It was categorized in the sections arising from the theoretical background. These sections correspond to the business ecosystem characteristics; value creation, intangible interdependencies and coopetition. These main sectors were divided into smaller sub-categories. All the references to new service packages, business models and system level benefits were sub-categories of value creation. Intangible interdependencies include social aspect sub-categories, such as trust, openness and shared experiences. Then again, coopetition includes all the mentions of competitors. On the grounds of this content analysis, the features of different actor roles –

keystones, dominators and niche players – can be explored. This will finally enable making an indicative representation of the ecosystem structure.

Overview of the potential ecosystem actors

Next, the paper describes the interviewed companies and the key figures of the potential ecosystem. Table 2 summarizes the company information. Three of the interviewed organizations were energy companies, two of them are active in the field of energy management systems and two provide solar PV systems. Most interviewed companies have many partners and networks. Incumbent energy companies have varying amount of technology suppliers in the IoT and solar sectors: depending on the size of the energy company, they either have a few niche technology suppliers as more or less established partners or several partners on each novel sector, such as solar and energy management. Some of the incumbents hold shares of smaller energy service providers, which creates a robust partnership. Those energy companies which do not directly invest on the small companies, retail or promote the novel technologies alongside their other businesses. The networked solar energy actor and both automation enterprises have energy companies, fund management companies and other corporations as holding companies. The amount of partner energy utilities of the networked solar system supplier and energy management system suppliers is around ten. However, their partner networks are much wider than just the incumbents, they also collaborate with other technology suppliers, retailers and installation operators. All of the interviewed companies have also cooperated with universities or other research institutions and some have also participated in a variety of communal projects.

When it comes to the monetary value of the potential business ecosystem, the energy companies do not specify the revenue of their so-called new energy services. They all indicate that the sales of these services are not yet high (compared to their total revenue) but the increment prognoses are high. All four smaller companies imply that their growth numbers are rapid in both turnover and personnel numbers. However, in most cases, the profits emerging from the cooperation are still low – benefits are mostly intangible instead of monetary. Some of the companies also export energy services and technologies abroad or have other international operations. The focus of this study is, however, in the domestic actors.

Table 2: Summary of interviewed companies and their key figures.

Company	***New energy services****	***Value of the new energy services / turnover*** (M EUR)***	***Personnel on new energy services***
A) Large energy company	Variety of solar energy technologies, EV charging system, smart home systems, DR	Not public information, “in the scale of [company] not much yet.”	> 100

B) Large energy company	Solar PV turnkey solutions (retail), EV charging systems (retail), energy market services (DR)	Not public information, "but the growth percentages are high".	15—20
C) Energy company	Solar PV turnkey solutions (retail), EV charging concept, smart home concept (to be launched)	Not public information.	> 1
D) Heating management system company	Heating management system to large buildings.	2017: 4,5 2018: approx. 10	40
E) Electricity heating management system company	Energy management system to electricity heated buildings of different sizes	2017: 0,6 2018: approx. 2,5	30
F) Smart solar PV manufacturer and supplier	Solar PV systems of a different size	approx. 10	40
G) Smart solar PV system supplier	Large smart solar PV systems.	approx. 3	10

* Smart energy services focusing on the scope of this study (excluding bio and wind sectors for example)

** Energy companies were asked for the value of their new energy services, new technology suppliers were asked for their turnover.

Views about the concept of a business ecosystem

The next aim of this paper is to review, whether the companies themselves consider that there is potential for a business ecosystem sort of cooperation. Six of seven interviewees implicate that their companies are or will be in some sort of business ecosystem. They all regard the ecosystem kind of approach positively, and state that the shift towards more cooperation-based strategies is necessary as the industry changes. The main drivers for the ecosystem development are climate issues and digitalization: the more renewable energy technology and smart energy management demand arises the more cooperation of organizations is needed. The networked companies also emphasize, that an ecosystem is the future model of cooperation. Hence, the partner networks will enlarge in the future, when new start-ups emerge, and business becomes more international. This implies, that the business ecosystem on the field of new energy services is at its birth stage. Some say that they are already operating in a business ecosystem, but others are slightly more careful about the timing.

> *"It is sort of a win-win situation, helps both of us and aims particularly in the future. In five years, it might be a very big thing. At the moment it is in a niche sector."*
> *- CEO, Energy Management System Company*

> *"Yes, [we are going towards an ecosystem] but on which time scale – it is further away. Perhaps this kind of an ecosystem can be reality in ten to fifteen years properly. Nevertheless, that way we are going. And the world of the IoT and sensors will be cheaper and there will be a lot of new actors who can measure and on the ground of that, they can manage the energy use for example - -."*
> *- Business developer, Energy Company*

Many of the companies tell that they are actively looking for new partners and negotiating on new business models with them. They find new partners through existing networks, company consortiums, pilots or at events like summits and conferences, for instance. The larger the company is, the better opportunities it has to dedicate personnel on business development and finding new business possibilities, as expected. When searching for a new partner, both large and small companies screen the potential ecosystem members thoroughly. Large companies demand that the start-up or other partner-to-be is robust enough. They do not want to risk their reputation as trustworthy actors by cooperating with a company that lacks on ability to deliver, for example. Small companies, again, want to be confirmed that the energy companies are seriously operating on the new energy subfield. They avoid having such incumbents as partners that only have a technology on their service selection in order to draw a green and responsible picture of their business instead of promoting the new energy service in practice.

> "*For [the energy company] the reputation is so important that the partners must be able to meet the requirements. The criteria are that the partner must be trustworthy and competent. We are not looking for the cheapest option but the most trustworthy one. Of course, the price will matter if the options are fully comparable - -.*"
> *- Business developer, Energy Company*

> *"The essential thing is that the partner, whether it is an energy utility or something else, is taking this seriously. - - All the energy companies we have [as partners] are really investing in this. They have an executive level strategy on how these new things should be looked at. - - All the energy companies that are close to us have full-time solar sector personnel."*
> *- Sales manager, Solar PV Supplier*

Business ecosystem characteristics

As stated, nearly all of the interviewed actors have adopted a positive attitude to the ecosystem-type cooperation. The follow-up question is whether the existing partnership models of the companies meet the concept of a business ecosystem. To review, which features of a business ecosystem evolve in the current cooperation strategies, the paper will next focus on analyzing the main features of a business ecosystem; value creation, intangible interdependencies and coopetition. Mapping the ecosystem features allows analyzing the actor roles and the ecosystem structure. First, the paper measures the ecosystem's ability to create value by comparing the products and services of a single technology supplier to the products and services arising from the cooperation of niche and incumbent actors. After having evaluated the monetary benefits of coopetition, the study will pay attention to the emerging intangible interdependencies. Paper will then briefly present the coopetition models that the interviewed companies bring up. Finally, the paper will examine which features of keystone actors, dominators and niche players there are in the emerging business ecosystem. This enables making an indicative representation of the emerging ecosystem structure.

Value creation

A critical question when analyzing a potential business ecosystem, whether the companies create together something that none of the actors would not be able to create by itself. Therefore, the products and services the actors produce independently are separated from the input of their partners. Table 3 summarizes the new products that emerge through cooperation between the new energy technology suppliers and energy utilities. These products (and services connected to them) were selected and emphasized as they were key functions of the interviewed technology actors. Energy companies have a bigger mass of energy products and services but the selection of technologies and services in this context are limited to solar and energy management sectors – as it is the framing of the study. The partnerships of niche technology suppliers and incumbents are especially interesting as they aim to be more than a stretch of a value chain.

> *"The essential element is the synergy benefit. - - the real partnership arises along with the additional value. When it comes to the energy utilities, they get more to offer and internal benefit by retailing the solution of ours. In my opinion, it is not a right kind of a partnership. I think there should be a bigger and higher goal at all the times, something concrete to achieve."*
> *- Developing manager, Energy Management System Company*

Table 3: Products and services that create additional value for the ecosystem.

Case	***Input of the technology actors***	***Input of the energy companies***	***Third party actors***	***System level benefits***
1	Heating management system to large buildings	User-friendly applications, feedback systems and reporting services, demand response of district heating.	Installers, property maintenance, property management companies, component (sensors, meters etc.) manufacturers.	Demand response, energy efficiency.
2	Energy management system to electricity heated buildings of different sizes	Compatible electricity contracts, demand response operations.	Installers, component (sensors, meters etc.) manufacturers	Demand response, energy efficiency.
3	Solar PV systems of a different size	A more comprehensive package, "a richer customer experience". Use for the data collected from the solar. Promise to buy the surplus energy.	Installers, component manufacturers	Increase of distributed renewable energy capacity.
4	Large solar PV systems	No cooperation with incumbents.	-	Increase of renewable energy capacity.

Value creation of the energy management system suppliers

Energy management system companies provide digital systems that improve indoor climate and the energy efficiency of buildings of different sizes. There are services for both, buildings with electric heating and buildings within a district heating network. These companies trade their products independently to large energy users: the heating management system firm focuses on large real estate owners and the electricity heating management system supplier has a wider customer scale including, for example, individual households, public premises and accommodation companies. However, they both cooperate with the energy utilities. The input of energy companies on energy management systems is various. The general goal appears to be to be able to offer as customer-friendly packages as possible. Energy utilities might add user-friendly applications, feedback systems and reporting services, for example. These all-inclusive packages are clearly something that neither an energy company (due the lack of technology) nor an energy management system supplier (due the lack of marketing and other resources) could produce independently. However, both of the interviewed digital service companies do active business also by themselves – in that sense, their value creation is not necessarily dependent on the energy utilities and the emerging ecosystem.

It is noteworthy, that for energy companies it is important to maintain their core business, electricity sales or district heating, within the new energy management package. Hence, rather often they sell their partners' products with a compatible electricity or district heating contract.

> *"We will be a sort of energy service company in the future. There are new business opportunities and, by implication, new customers. But electricity retail stays in a way there at the bottom. Not necessarily in every single occasion, but as it is our basis, we should take care of it."*
> *- Business developer, Energy Company*

> *"In a way, the energy is there with but the service package - -, is offered to a customer in a different way. There will be more options for the customer and the actual electricity has vanished there, but it is there in the complex."*
> *- Business developer, Energy Company*

> *"Smart home or something like that, - - there we must find our own role, how we can naturally add services to our own existing supply with other products and partners providing them. They can be technology suppliers, cloud services or digital service development, for example. There we need different kind of experts and actors to do it."*
> *- Business developer, Energy Company*

When a sufficient amount of energy management systems has been installed, actors are able to contribute to the demand response in both electricity and district heating, which helps to balance the system during peak hours – and creates new value. Demand response is also important in the sense of financial benefit creation: it could benefit all attending actors, including the customers, yet the business models have not yet become established and to whom the financial benefits go remains unsolved. Another system level benefit could be the increasing energy efficiency, which the interviewed energy companies regard positively.

Value creation of the independent and networked solar actors

In the solar sector, two fundamentally different kinds of cooperation strategies were recognized. In the independent strategy, the company does not cooperate with energy utilities or other actors. Alternatively, in the networking strategy, the company does intensively collaborate with the incumbents. Both interviewed solar companies provide solar PV systems independently focusing only on large electricity users, such as industry, office buildings and commercial premises. However, the company that has adopted the networking strategy, is able to reach other customer groups through its partners, such as energy utilities. Hence, the networking strategy advances the company's market position. The networked solar company describes its role as "a business extension" or "an external solar department" of the incumbent actors. The networked solar company also collaborates with energy management system companies in order to sell integrated systems in the future, which is seen to be more reasonable than selling solar PVs and management systems separately. In addition, the more ecosystem oriented solar company has a retail and installation network through which they sell their solutions to consumer customers like households. Understanding the principles of shared workload is important in the networking strategy:

> *"We have partners, we do our own share. We do not do everything and no one else does everything. - - There are no functional monoliths in our trade. - - those are the only ones that are able to operate without an ecosystem mindset."*
> *-Sales manager, Solar PV Supplier*

In the independent strategy, the company has no retailers. They operate in a value chain in which there are component or technology suppliers, the final service supplier and customers. Having adopted the independent partnership strategy, a company prefers using its own installers instead of cooperating with external installation networks.

The most concrete system level benefit of the cooperation between solar actors and energy utilities is the increasing amount of distributed renewable energy. The sales of the independent solar PV supplier raise the share of solar electricity as well. Though, the customer groups of these companies are different. As the independent company focuses on large building owners, the networked company can offer its services to subjects of a different size. Enabling companies outside of the energy field and private consumers attend the small-scale solar energy production is a process, which will most probably require both technology suppliers and well-known and stable energy companies. This presumption and the challenges considering the shift from niche markets to mainstream markets will be discussed in the next chapter.

Intangible interdependencies

Besides concrete interdependencies behind the value creation described above, intangible interdependencies between the potential ecosystem actors were reviewed. Companies mention several non-material benefits emerging from a business ecosystem. First, making way for a niche energy service in a status quo is a prevalent challenge among the new energy service

providers. Thus, ecosystem members must consider thoroughly how to encounter the new customer groups. When it comes to the branding and white labels, two different kind of strategies were recognized. If a technology or software supplier has already gained recognition in the new energy technology markets, it finds it more profitable and cost efficient to sell the products under the original name. For an energy company (or other technology retailer), it requires plenty of resources to create a completely new brand for a product that is not familiar to the customers at the first place. Additionally, the whiter labels there are, the more the company has responsibility on guarantees, customer service and so forth. Therefore, retailing solar EVs and electricity or heat management systems on their initial brands keeps the incumbents' organization structure lighter. However, some large and well-known energy companies prefer selling the products at least partly under their own brand. Some have settled on the solution somewhere in between to make the retail customer-friendly:

> *"As long as [branding to our own name] is necessary for a consistent customer service experience. From the point view of responsibility, we cannot put our logo on the solar panel since it is not our technology. We could not answer for it, if we do not precisely know what it is. But in the digital services it is necessary for the sake of consistent customer service."*
> *- Business developer, Energy Company*

Second, sharing service networks and communication and marketing resources are benefits of a networked business. In addition, sharing intangible resources and social capital such as know-how and experiences is crucial. Especially from a large energy company point of view, learning from the smaller companies is highly appreciated:

> *"We do learn a lot from small businesses, and we can go to the new industries where they [small companies] already have next level skills and knowledge. It opens many new worlds."*
> *- Business developer, Energy Company*

> *"The [energy] industry is under a transition and new solutions appear, so in a way, the know-how and operations models in the new market share is kind of silent knowledge. - - learning these operations models and insight knowledge and all this, is about half of the whole model after all. - - how the whole process is organized from where the customer contacts us and how it goes forward and how it is delivered to the customer."*
> *- Business developer, Energy Company*

> *"How to get a customer interested and which kind of phases there are. This is all new for us. This has not been done before - -. If our people have been selling electricity for their whole careers, it is different now when we start to do solar PVs, EV charging and everything else. It calls for a new mind-set and it is good that there are new people."*
> *- Business developer, Energy Company*

Some other forms of social capital arise, such as openness, trust and shared values. These factors either define with whom they start to cooperate or make the existing relationships more functioning.

> *"I like that we are open. It benefits both of us. - - I want us to experience strongly that we are partners and we do things together. What we discuss stays with us and benefits both of us. I am not afraid that [a partner] will use this [shared information] against me. I do not want a mind-set like that, rather one based on trust."*
> *- Business developer, Energy Company*

"- - the shared values related to this [ecosystem], if we talk about climate or other issues, it defines the role of the partnership. This is a bit sort of activity of like-minded actors, we are open, and we are able to work as a network."
- Developing manager, Energy Management System Company

Of course, within one industry in a small country like Finland, personal networks are often the initiatory factors of a new partnership. On the other hand, not only personal contacts and trust are enough but both, large and small companies call for legal contracts – usually on the early stage of the partnership. This implies that both social and legal norms and the financial factors are important in an ecosystem construction. There are, naturally, also some challenges in the cooperation of small and large actors. The most commonly arisen conflict is the different understanding of time. Small companies tend to be much more agile while decision-making in a large company takes usually a long time.

Coopetition

Cooperation with competitors is one of the key elements of a business ecosystem. The interviewees described two kinds of coopetition. In the first one, the relationship with another company varies between cases:

"In one case you are working with someone as a partner and in the next case as a competitor. This is the contemporary world where you can be a partner and a competitor simultaneously. It really is a varying situation - -."
- CEO, Energy Management System Company

"The same companies might be our customers, suppliers or in some cases even competitors. Especially our shareholder companies, sometimes they are our customers, sometimes they supply us services or even products and sometimes we do a deal together with them and sometimes, as a matter of fact, we compete with them."
-Sales manager, Solar PV Company

Coopetition is not always proper business, but rather loose collaboration. The relevance of intangible cooperation is particularly important in this specific context, as the energy industry is going through a transition and niche markets and technologies attempt to become mainstream.

"Of course, on the executive level, energy company managers share their views but common business we do not have."
- Business developer, Energy Company

Absolutely [we do loose cooperation with our competitors] when it comes to regulation, standardization and things like that, which benefit the whole industry."
- Business developer, Energy Company

The transition in the energy field also affects how energy companies view their competitors. Within an ecosystem, they can be energy service suppliers – they can create innovative technologies together with their ecosystem networks without having their own know-how on the specific technologies. Outside of an ecosystem, an energy company would remain as a heat

and electricity supplier without being able to compete with the new actors in the energy industry.

> *"Now when we think about the energy transition, the other energy utilities are not necessarily our main competitors, but the competition comes from the technology industry. They will produce products, which can produce, use or manage energy. And we are not a technology company. Absolutely, [our products] would remain unborn without partners. We do not have the technology to manage heat as an independent product, for example."*
> *- Business developer, Energy Company*

Actor roles

Demonstrating the roles of the actors in the evolving business ecosystem in the Finnish energy industry proved to be slightly complicated. Both incumbent energy companies and energy management system providers show signs of being crucial actors for the emerging business ecosystem. Their positions seem to depend whether the perspective is robustness or value creation of the ecosystem. Therefore, the scope of the study was focused on the individual features of the companies instead of reflecting a company as a whole. Review on the actor roles within an ecosystem is useful, as it enables the paper to finish the analysis with an indicative picture of the emerging business ecosystem on the new energy services.

Keystone actors

The large energy companies could be regarded as keystone actors, since they are a few in numbers and they are widely networked with the niche technology suppliers. In addition, the energy companies are usually large and some of them are city or state owned, meaning that they have tools to affect the environment and on the other hand, predict the environmental changes, like taxation and energy substitutes. Investing on start-ups and other small companies is one way for incumbents to enable innovations enter the ecosystem, which is important for evolution of the ecosystem. In addition, as large, financially stable and incumbent actors, energy companies are in a position to improve the robustness of an ecosystem and navigate its operations.

However, energy companies' roles remain obscure when it comes to value creation. If power production was a crucial element of the value creation of an ecosystem, energy companies' keystone role would be distinct. However, since solar PVs and energy management systems can be sold – and to a great extent are sold – without an input of an energy utility, the criteria of the keystone actor as a value creation enabler is not necessarily met. The same question appears in the smart energy management field and specifically in demand response, which could at least in theory be controlled by independent aggregators instead of energy companies. Hereby the reader should bear in mind that the new energy services only cover a slight portion of the business activities of an energy company. In fact, the core business, heat and electricity production, are not in an ecosystem but the new services that develop around them. Therefore, the new functions of the incumbents may take the role in an ecosystem rather than the whole company.

Many of the company representatives emphasize that the ecosystem is a future model of co-operation. As discussed earlier, while the energy transition proceeds, the energy companies have interests to become energy service suppliers instead of remaining just power plant operators. In other words, energy utilities' long-term goal may be to be able to sell solar PVs, energy management systems, EV charging systems, energy storages and technologies to come, on one counter. This takes the focus back to the network analysis, which represents the different customer groups in the core of the network. Compared to the traditional role of the incumbents that only produce power to distant customers, as energy service companies they state that they will have to consider customers' needs much more deeply than before.

> *"To start with, a customer is not very interested in these things. If we think about electricity, they want it, but they do not want to use time or money on it. - - in a way, we must create a very effortless and easy [service]. Easiness, understandability, and the information they need must appear very quickly. - - We need to package [the services]."*
> *- Business developer, Energy Company*

> *"The cohesion of the customer experience [is the goal]. What does it mean in practice? They will log in to a service and see all the essential information at once. It simply means that the customer experience is not very coherent, if they had five applications on their phones, which have nothing to do with each other."*
> *- Business developer, Energy Company*

If an energy company put together service packages, including a bunch of new energy technologies tailored for different customer groups, would it create value for the entire ecosystem in the way keystone actors should create? Obviously, it would help their smaller partners to take the shift from niche markets to the mainstream markets as the energy companies have well-known brand and a large customer base (as discussed in the chapter on *Intangible Interdependencies*). A functioning energy service package is more or less comparable to the services or platforms offered by companies like Apple and Microsoft, the earlier typical examples of business ecosystem keystone actors. Having the energy service package as a core platform of an ecosystem, an energy company could allow other firms to create technologies that complement the service package. Perhaps to make their roles more like those of a keystone, the energy companies try to make their role more important and create those crucial services:

> *"In the era of digitalization, whatever you purchase – a washing machine for instance – you can connect it with your phone, but the business logic is a more complex question. How can one offer a service on top of that? We could offer some sort of alarm system or water metering in a housing company - -. The more coherent it is, the better it works."*
> *- Business developer, Energy Company*

Besides that, the fact that energy utilities strive to have the power retail somehow connected to the new services (as stated in chapter Value Creation) may imply that the energy utilities aim to legitimatize their roles as key actors.

Dominators

Since self-organization is one of the key characters of a business ecosystem, the ecosystem dominators that use direct power on their partners change the dynamic of the network rapidly.

If an energy company holds shares of a smaller company, the cooperation is overbearing and financial rather than equal, co-evolving and ecosystem-like. Some signs of a dominator kind of approach were recognized:

> *"In the digitalization, the word of today, small companies are so much ahead. We do not have that many resources on that side, so it is more reasonable to either buy the whole start-up or to cooperate at first and then see if it is interesting to buy the company or just keep cooperating."*
> *- Business developer, Energy Company*

Another example is a case, where a partner start-up is in the verge of bankruptcy and a large company ends up buying it. This increases the robustness of an ecosystem, but the more domination the large company has the more skewed the decision-making models are. On the contrary, some actors underline that the collaboration between large and small actors needs to be equal. An equal network will more likely deliver the self-organization criteria of the business ecosystem.

Niche players

There are also several niche players in the emerging business ecosystem. Besides the interviewed technology suppliers (excluding the one independent solar PV company), the energy utility representatives listed several other niche technology partners they have. Here, I must note that the solar PV is not necessarily a niche technology anymore, but companies offering them still operate in the niche markets in Finland. Moreover, even though a solar PV is a well-developed technology, the more automation, metering and data collecting is integrated a more efficient and safer technology package will shape up.

The role of the niche players is to innovate new products and services that separate them from the other organizations of the ecosystem. Especially the interviewed energy management system suppliers have managed to create (to some extent) unique products, as they state that no other company provides similar technology to the same target groups.

Then again, some of the technology suppliers describe their ecosystem, as if they were the keystone actors in it. On one hand, these niche technology players supply their technology to the energy utilities, which construct their new energy service ecosystems. On the other hand, especially for the interviewed heat and electricity management system companies, it is an option to build an ecosystem of their own, in which their technology is the core and their partners' roles are crucial in finishing the product. This sort of a partnership refers more to the innovation ecosystem or the digital business ecosystem.

> *"Somehow I would see that in the beginning we are the key actor. We set the first wheel, the [energy] management of the building, in motion. But when we discuss about the next steps, like how one could use the data from the buildings and what one could do with it, - - and how the energy chain will be operated in its entirety, these things start to move to the partner. - - the further we go the bigger the role of our partners becomes."*
> *- Development manager, Energy Management System Company*

Ecosystem structure

Differences in the roles of the interviewed companies are highlighted in table 4. Since the new energy services and business models around them are yet developing concepts, the roles of the companies in the emerging ecosystem remain slightly unclear. As stated, energy companies have characters of a keystone actor, but they do not meet all the criteria. Two of three energy companies also have some features of a dominator: they might aim to have control over the smaller companies, and, for instance, they quite typically buy the startups with crucial innovations and knowhow. This way, the energy company dominates the ecosystem and is responsible for its value creation alone instead of only enabling value creation for other actors.

Smaller actors, the energy management system suppliers and the networked solar sector firm are all considered as niche players. Energy management system companies have niche technologies but as the data use becomes more general and profitable, they might actually be in the position of enabling other actors (energy companies, customers) to create value. Hence, energy management system suppliers have also (digital) business ecosystem keystone characteristics. Solar PV is a material technology (unlike IoT services), which creates a clear supplier-retailer relationship between a solar sector actor and energy utilities. Nevertheless, the networked solar PV supplier is clearly an ecosystem niche player, as it operates in a multidimensional, interdependent and changing network.

Table 4: Reasoning of the ecosystem actors' roles.

Company	***Role***	***Reasoning***
A) Large energy company	Dominator / keystone	Very wide networks, partners also from outside of the energy industry. Has financially strong position, potential to improve ecosystem robustness. Has control over smaller actors: aims to buy startups instead of equal cooperation. Through acquisitions has the crucial technologies and know-how of their own.
B) Large energy company	Keystone / dominator	Wide networks. Is interdependent on its partners, has not got its own new energy service technology (e.g. solar PVs). Can create value for its partners through its stable customer base (not through crucial technology). Aims to become an energy service package supplier. Slight control over other actors, but in most cases the cooperation is equal.
C) Energy company	Keystone	Networked with niche technology suppliers. Aims to build a diverse ecosystem and operate itself as a service package builder. No remarkable control over other actors.
D) Heating management system company	Niche player / keystone	Networked with energy companies and other niche players. Has a crucial technology and enables other actors to create value.
E) Electricity heating management system company	Niche player	Does cooperate with energy utilities and other niche players. Benefits from the energy companies that help to fight against the status quo and energy companies benefit from the demand response.

F) Smart solar PV manufacturer and retailer	Niche player	"Niche" here refers to the markets instead of to some extent established solar PV technology. Is a technology supplier within a wide and changing company networks.
G) Smart solar PV system retailer	Non-ecosystem actor	Operates rather in a value chain than in an ecosystem.

The roles of the emerging ecosystem remain undefined and so does the structure of the ecosystem. However, examination of the emerging services and ecosystem roles reveals that instead of having a core actor of an ecosystem, there is a core function. As the new energy service packages are (or will be) the vital "platform" of the ecosystem, they should be placed in the core of the ecosystem. Figure 2 draws an indicative picture of the emerging new energy service ecosystem. Niche players, such as solar PV, energy management system and other technology suppliers innovate new solutions while energy companies (or their new energy service departments) aim to navigate the whole value creation process and put the final touch to the service package. Then there are technologies, that are excluded of the current study, but will be important part of the new energy service packages as well. For example, EV charging systems will be integrated to a smart home concept in the future.

On the external circle, there are actors that are loosely or indirectly connected to the new energy service package creation. Universities and research centers are important in the innovation phase. Those energy companies which hold shares of the niche technology firms are important investors, but some independent finance companies are also operating on the new energy service business ecosystem. Interviewees stress that the regulation, as it is based on the traditional centralized energy system, follows slightly behind as the field goes through a rapid transition towards a more distributed system. Yet the companies see that the direction of regulatory changes is correct. In addition, energy companies are often owned by the municipalities or the state, linking the public sector even more firmly to the ecosystem. State and municipalities also create experiment arenas for new energy technologies. Component manufacturers could be seen as blocks of a traditional value chain. Nevertheless, they play a crucial role in finishing the energy service package. So do the installation networks, which are traditional service providers but on the other hand, flexible and mobile actors. New actors on the outer circle refer on the organizations that have not traditionally operated on the energy industry but are becoming more and more important service providers in pursuance of breaking the boundaries of traditional industries. Competitors are also crucial as discussed in the chapter coopetition.

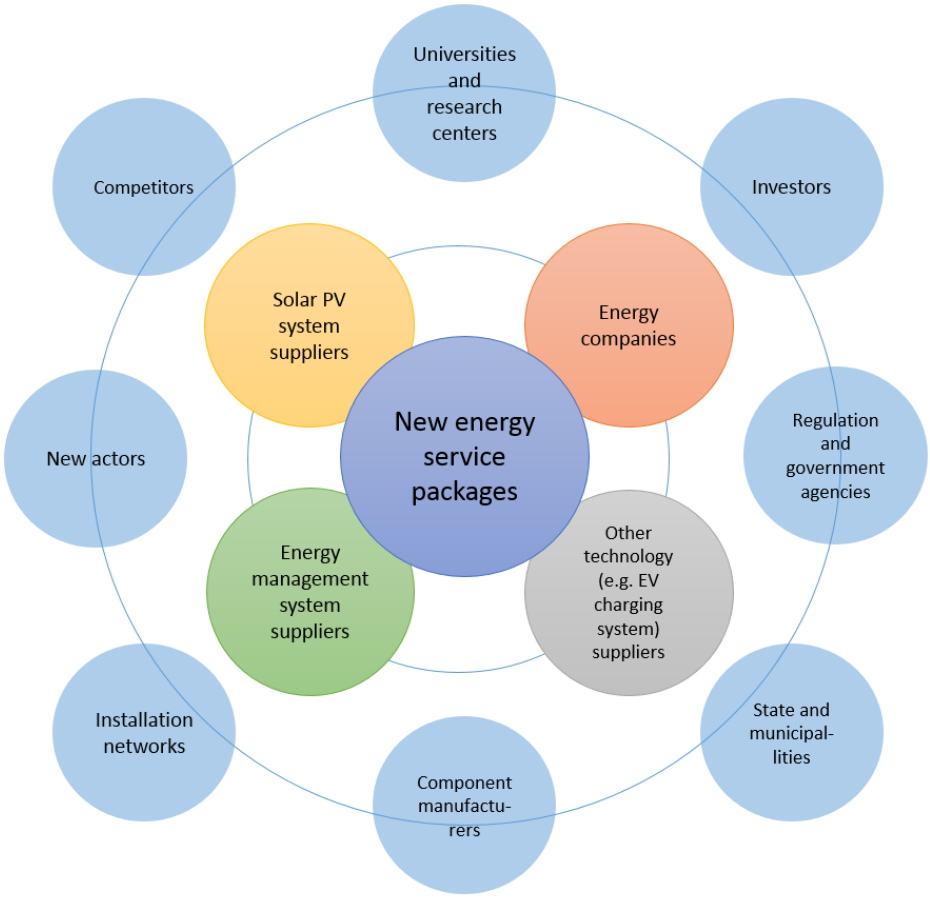

Figure 2: Indicative representation of the new energy service ecosystem

Conclusions

This working paper maps the potential business ecosystems in the Finnish energy industry. The final chapter presents some concluding remarks on how companies regard the idea of a business ecosystem and which of the features of a business ecosystem can be seen evolving in current cooperation models. The key findings were that six out of all seven interviewed companies were a part of an organizational network, which is more interdependent and diverse than a value chain or a company network. These six companies, including energy companies and new energy service suppliers, have positive views on a business ecosystem and they consider an ecosystem as a modern or future way of collaboration. They disagree, however, on how long it will take for an ecosystem to become a reality. In any case, the results suggest that business ecosystems are emerging in the Finnish energy industry and – whether there is one large ecosystem or several small ones – they are at the birth stage of the ecosystem life cycle.

In this paper, the emerging ecosystem was identified as a new energy service package ecosystem. In the visions of the interview companies the new energy service package consist of

new technologies, additional services that improve the usability and adaptability of these technologies, and whenever possible, suitable electricity or district heating contracts. The simplest example of such a package is a smart home concept for private customers, but obviously it is in the interest of the companies to sell integrated and comprehensive solutions for B2B customers as well. New energy service packages for clients to be bought from one counter and controlled through one application do not necessarily exist yet. This emphasizes the future oriented nature of the emerging ecosystem. Since the business ecosystem is still finding its form and its members are looking for strategies on how to create value with the new partners, the actor roles may change in the future. A valued new energy service package is not enough for an ecosystem to survive, as it must also have resources to scale up and survive environmental changes. At the moment, the energy companies have stable positions and they boost the robustness of the ecosystem, which supports their roles as keystone actors. Removal of an energy company would affect the ecosystem dramatically, since the energy companies are significant investors as well.

The results of the study indicate, however, that only some parts of the energy companies are vital for the ecosystem to survive. In fact, only the departments or business operations that focus on the new energy services are a part of the emerging business ecosystem. Therefore, it may be that in fact that the innovative functions of the incumbents are the real keystone actors rather than the companies. This notion is supported by the finding that the energy companies are actively looking for new niche partners and aiming to establish their roles as crucial service packagers. Without any acts towards being a new energy service provider, the incumbent is in a risk of being left behind in development, while simultaneously allowing new actors in the energy field take advantage of the emerging energy service markets.

Then again, energy management system suppliers have crucial technologies that enable other actors' value creation. This can happen through demand response, for instance. In the light of both the marginal markets they are operating in and the newness and status quo of their technologies, they could still be seen as niche players of the ecosystem. However, as the markets enlarge, niche players may achieve the role of a key actor. The ecosystem oriented solar company does not only provide the necessary technology (especially for those energy companies that do not want to have machines of their own), but also valuable information for the energy companies stepping into the niche markets. Sharing know-how and innovating new solutions applies to the partnerships of energy management companies and energy companies as well.

The given description of the emerging ecosystem summarizes the visions of the interviewed company representatives. Of course, there are major differences in the business models of each partnership. This then affects the appearance of the ecosystem. From a dominator point of view, the structure of the emerging ecosystem would be more incumbent centered, for example. The indicative representation of the ecosystem should, therefore, be viewed as an average of the visions of the interviewed companies. Now, as the data of this paper is limited to seven companies, a comprehensive review of the cooperation between organizations in the Finnish energy industry cannot be provided. A future study investigating the ecosystem roles

of the heat pump retailers and EV charging system suppliers, for example, would be very interesting. As the network analysis indicates, there are plenty of actors in the field of new energy, but not all of them necessarily operate in an ecosystem – as the freestanding solar plant company proves. In addition, some third-party actors such as installers and component manufacturers do relatively traditional service or product business with the energy companies and niche technology suppliers. Even if they did not directly attend in diverse and interdependent ecosystem-like cooperation, they are still essential actors in the service production.

Intangible interdependencies between the partners stand out in the early stage of the ecosystem evolution as the actors aim to enlarge the markets together. This implies that the ecosystem members do not only create monetary benefits but also social capital. The coopetition that arose, reflects the diverse and flexible nature of an ecosystem. Prominent cooperation with the public sector, research institutes and newcomers of the energy field also describe the wide networks of ecosystem actors. Within the ecosystem, there might arise several smaller ecosystems, which can be either local or have features of an innovation ecosystem or a digital business ecosystem (substantial notion in the context of IoT and other data management actors). Taken together, the results of this working paper suggest that a new energy service package ecosystem is emerging, and it is a large and diverse whole. However, the roles and value creation models are still developing and thus, the final picture of the ecosystem structure remains indicative.

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