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Starting up a local energy system in Sweden: The story of technological collaboration between an Italian supplier and established Swedish energy company

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Abstract

This paper focuses on the inter-organizational aspects of creating a local energy system in Sweden. Today the Swedish energy system faces a challenge of becoming 100 % renewable in 2040. To be able to manage the transformation the system needs to open up for new actors and new renewable technology. However, to embed new renewable technology into the existing system is difficult because of the already predefined infrastructure and regulations. Hence, there is need to explore how technological collaboration can facilitate the process of embedding new renewable technology into the energy system. Therefore, this study focuses on the technological collaboration between the energy company E.ON and the Italian supplier Loccioni and the embedding of new technology in the shape of a local energy system in Sweden. By relying on the Industrial Network Approach and in particular the resource layer this study aims to explore the impact of the collaboration on three levels; the dyadic level, the project level and the system level.

1. Introduction

This paper deals with the inter-organizational aspects of creating a local energy system in Sweden. Today, 80% of the global energy production is constituted by fossil fuels[1]. Since this type of fuel is the largest contributor of greenhouse gas emissions the European Union has set a goal to decrease its emissions of greenhouse gases with 20% until 2020[2]. For Sweden, working towards an energy sector based on renewable fuels, it has been an important goal resulting in a long-term agreement between the political parties to gradually decrease the use of fossil fuels to zero, and hence to achieve 100% renewable electricity production in 2040[3]. It is recognized that the transformation of the energy system into a system based on renewables requires involvement of a wide range of actors such as public organizations and private actors like municipalities, energy companies, vehicle manufacturers, real estate companies and grid operators, to name a few. Moreover, private non-profit actors such as households and associations are also taking part in the transformation[4]. Hence, the Swedish energy system need to be characterized by a more diverse production structure including both large scale and small-scale renewable production units; adapted to both local and industrial needs[5]. However, to embed new renewable technology into the existing system is difficult due to the already predefined infrastructure. The Swedish energy system has historically been regulated and constituted by a few large actors. More precisely, the energy system's 'top-down' characteristic is a result of strong collaboration over the last 100 years between the Swedish government and a handful large corporations (Fridlund, 1999; Kaijser, 1994).

This new situation put pressure on the established energy companies as their production of electricity must be 100% renewable in 2040. One example is the energy company E.ON which in 2016 separated its fossil fuel electricity production into a separate company called Uniper. Today E.ON mainly focuses on electricity production from nuclear power and wind power as well as distribution of electricity. Looking at the Swedish subsidiary of E.ON (E.ON SE) it only focuses on production of renewable electricity and distribution of electricity. In accordance with the new regulations, E.ON SE was appointed the task of initiating a project to test the possibility to disconnect from the national grid system and thus only rely on locally produced solar and wind power. In 2017 Sweden's first local energy system was built in South of Sweden with help from several actors, such as industrial companies and private house owners. One actor that has been involved in developing the technology in this local energy system is the company Loccioni. This Italian based company works as system integrator in a number of industries such as automotive, home appliances and energy. Loccioni has a previous history of engaging in environmental friendly technology and was the first firm to develop a zero-carbon emission house in Italy (Baraldi, Gregori, & Perna, 2011).

[1] Energimyndigheten, 'Energiläget 2017'
[2] European Commission, 2020 climate & energy package, https://ec.europa.eu/clima/policies/strategies/2020_en
[3] SOU 2017:2, Energikommissionens slutbetänkande, Kraftsamling för framtidens energi
[4] Energimyndigheten, Vägval och utmaningar för energisystemet (2016) p. 75, https://www.energimyndigheten.se/globalassets/klimat--miljo/fyra-framtider/38764_vagval-och-utmaningar-for-energisystemet_webb.pdf
[5] Energiöverenskommelsen 2016, http://www.regeringen.se/498070/globalassets/regeringen/dokument/miljo--och-energidepartementet/energioverenskommelse-20160610.pdf

In this paper we take an empirical point of departure in the local energy system project (hereafter the LES project) and the technological collaboration between E.ON and Loccioni. This collaboration is part of the local energy system project, which in turn is part of the wider energy system.

Hence, the aim of this paper is to start exploring the technological collaboration between E.ON and Loccioni and the impact of this collaboration at three levels:

- Dyadic level.
- Project level (referring to the local energy system level).
- System level (referring to the energy system level).

By relying on the industrial network approach, and seeing the energy system as an industrial network constituted by actors, resources and activities (Håkansson, 1987; Håkansson & Snehota, 1995), we will be able to study how the local energy system as a project is embedded in the energy system. This study will provide insights into how an outside actor (Italian) provides novel perspectives, technologies and aspirations needed to develop a local energy system in Sweden and thereby contribute to the understanding of starting up processes in business networks (Aaboen, La Rocca, Lind, Perna, & Shih, 2017).

2. Methodology

This study is part of a project financed by Swedish Energy Agency with the aim of exploring the process of starting up in the Swedish energy system. Specifically, how new actors bring renewable energy technologies into the system to enable a transformation towards a 100 % renewable energy system. This paper builds on a case study methodology (Flyvbjerg, 2006) and takes its starting point in the collaboration between two firms. One of them is the energy company E.ON and its creation of a local energy system (LES) in southern Sweden. The other one is the Italian company Loccioni who works as a system integrator and develops the battery for the LES project.

Four interviews have been conducted so far. The first interview was made with the director and senior advisor at E.ON Energidistribution (SE) on the topic of E.ON's role in the transformation of the Swedish energy system as well as the creation of the LES project. The second interview was conducted with the communication manager at Loccioni. The aim was to understand Loccioni's involvement in developing the battery and solution. Moreover, a site visit was paid to the LES project in Simris, which included a presentation of each component of the LES project as well as an interview with one of the responsible of the project. Another site visit was paid to Loccioni's head quarter and production facility in Ancona, Italy that also included an interview with the communication manager. In addition, secondary material such as press releases and homepages have been used to further deepen the knowledge of the LES project in Simris.

3. The case of starting up a local energy system in Sweden

3.1 Description of E.ON and its motives for building a local energy system

The German energy company E.ON was established in 2000 and had in 2017 a revenue of ca. 38 000 billion Euro. The headquarter is located in Essen, Germany and the company is operating both in Europe and North America with roughly 43 000 employees. The operations of E.ON are divided into three parts; (1) Energy networks, which includes activities related to power and gas distribution in Europe (2) Customer solutions, which is a platform for working with customers to increase their energy efficiency as part of transforming the energy system, and (3) Renewables, such as wind and solar power[6]. E.ON has initiated a number of different innovation hubs to work proactively towards meeting the future energy related demands. For example, the company is part of a European smart-grid project called InterFlex together with 19 other actors within the EU framework program 'Horizon 2020'. Three demonstration projects are up and running within the InterFlex project and one of them is the local energy system (LES) in Sweden. By running the LES project E.ON wants to test and evaluate how to distribute a stable and reliable electrical energy to its customers from a micro grid system that includes small and weather dependent production facilities.

When the idea of creating a local energy system in Sweden reached the subsidiary company in Sweden (E.ON SE), the company started to look for a suitable location to build the test plant. At that time, it was well known that the small city Dorotea in the northern part of Sweden had a problem of accessing electricity from E.ON. Thus, the project leaders saw an opportunity to deal with this problem while testing a new type of energy utilization originated from user demand instead of the production side. Due to some difficulties in developing the project in Dorotea, focus was put on Timrå and an island called Åstön. However, the people living there opposed the project and while the time started to run out E.ON found a perfect spot in September 2017 in a small village in the south east part of Sweden called Simris. Specifically, it already had a wind mill and solar power plant built by an engaged man in the village[7] and which E.ON had the opportunity to rent. Furthermore, most of the residents were eager to become part of a new and sustainable way to produce and use electricity. As the senior advisor at E.ON expressed: "*We need a positive feeling around the project. The challenge has been so far to anchor the project and create acceptance [among the customers] to test something new*".

3.2 The local energy system in Simris

When the local energy system was put into operation in October 2017 around 150 customers, including private households and businesses, were enrolled in the project. The idea is to provide the customers with renewable electricity from a micro grid disconnected from the conventional grid system every fifth week during day time. When running on 'island mode'

[6] E.ON Annual report 2017, https://www.eon.com/content/dam/eon/eon-com/investors/annual-report/EON_GB17_EN.pdf
[7] Miljömagasinet, issue 27 (2013), https://www.miljomagasinet.se/artiklar/130703-sol-ola-har-byggt-sveriges-storsta-solpark.html

the electricity is generated from the windmill and the solar panels. As E.ON has an obligation to deliver electricity at any time during the day, the micro grid includes a battery and a backup power unit that help in covering up the missing amount of electricity those day the electricity use is peaking or the weather does not allow electricity production.

Several actors are involved in developing the different components in the micro grid system. Firstly, there is a battery developed to be able to, on one hand, store the energy during the days where there is too high production of electricity and, on the other hand, supply energy when the production is low. The battery is developed by the Italian company Loccioni and its partner Samsung. Secondly, there is the backup power unit run on hydrogenated vegetable oil, which is a type of bio diesel fuel, to cover the missing amount of electricity during those days when the use of electricity is peaking. E.ON developed the backup power unit together with the company Coromatic and it consists of an engine run on renewable fuels, a fuel tank and a generator to produce electricity. Thirdly, there is a control and automation system developed by Encorp, Netcontrol and Holtab to enable communication between the different components and facilitate a smooth deliver of electricity to the battery, customers and the conventional grid system.

Not only the companies play an important role in the project but also the customers. In addition to the technical parts in the micro grid system, 25 out of the 150 customers have agreed upon letting E.ON adjust the temperatures in their water heaters to balance the level of energy production and usage. Moreover, a couple of customers have also agreed on installing subsidized solar panels on their rooftops and heat pumps to produce their own electricity. Their only counter performance is to have a WIFI connection and participate in customer surveys. Today the energy is basically coming from wind turbines with installed capacity of 500 kilowatts (kW), photovoltaic panels with 440 kW, and supported by a battery system with 800 kW capacity.

During the project it has become evident that running a local energy system is not easy. For example, some days the production of renewable electricity has only reached 20 % of the total amount of electricity used during the day. The initial battery also had a too low level of storage capacity. Hence, soon a new battery will be installed that has a capacity of 1600 kW to complement the existing battery from Loccioni.

3.3 Description of Loccioni and its engagement in environmentally friendly technology

Loccioni is an Italian family firm founded in 1968 by Enrico Loccioni and Graziella Rebichini. It is a *system integrator* company which develops technologies to improve the quality and the efficiency of complex products and processes for its customers. Loccioni's turnover in 2018 reached about 100 million Euros and it employed roughly 400 people. In the last five years the company has received good international reputation, which has led to the opening of four subsidiaries in USA, Germany, China and Japan.

Since the 1990s Loccioni core vision has been to take care of the wellness of the planet and people, thus facing environmental issues experienced by several industries. For example, the

company has developed technical solutions to control the polluting processes – such as emission analysis instruments for incineration plants – together with international partners and started to get into this business as a supplier of solutions for supporting customers in reducing and controlling their environmental impact. However, very soon Loccioni realized that beyond the supply of those solutions, it was much more relevant for customers to understand the 'green issues' at more systemic levels. Consequently, Loccioni started to study the connections between technology and nature. Thanks to the competence of measure it was possible to measure how much we actually impact on the environment, how much of nature's gift we waste and how to balance human comfort and wellness with the safeguard of the planet. In 2007 the company coined the concept of 'Leaf Community': *"The goal of this project was to create a community in which it would be possible to live in a zero-carbon emission house ('Leaf House'), use electric cars and work in eco-friendly buildings"* (Perna and Baraldi, 2014: pp. 95).

Leaf Community was conceived as on open air lab for sustainability, both open to university and research centres, and to customers and partners. The goal was to integrate ideas and technology in order to reduce CO2 emissions and improve the quality of life. Loccioni's headquarters thus became the first smart micro-grid in Italy integrating efficiency, production of renewable energy, storage and control/management of energetic fluxes; and measuring it all. Soon other companies and customers wanted to follow this sustainability path and today the number of 'Leaf Players' is approximately 50 companies.

3.4 The technological collaboration between E.ON and Loccioni

One of Loccioni's main customers in the energy sector has always been ENEL (Italian Energy Carrier), also a partner in the development of the Leaf Community concept. Following the vision to work with customers perceived as world leaders in their specific sector, Loccioni got in contact with EON Italy in 2009. Soon after a contact was established with E.ON Germany and finally with the Swedish team engaged in the LES project. E.ON was very interested in the Leaf Community project and the possibility to work with a system integrator with good experience. When the LES project in Simris was conceived the first thing the E.ON project team did was to come and visit the Leaf Community in Italy. E.ON could then see something very similar to what they wanted to achieve with the LES project. Furthermore, they had the possibility to rely on an experienced system integrator.

Consequently, Loccioni was asked by E.ON to develop and integrate the storage system for the LES project. The system was implemented in 2017, where Loccioni was in charge of the configuration and installation of the battery and of the entire intelligent system. After over one year, Loccioni's measurement and control system can state that the quality and reliability of the renewable energy delivered by this system is higher than the conventional grid system.

4. Initial analysis and ideas for next step

To contribute to the aim, we illustrate and conduct an initial analysis at the three levels by exploring and mapping the actors and resources involved in the LES project. Figure 1 below shows the actors involved in the LES project at the three levels.

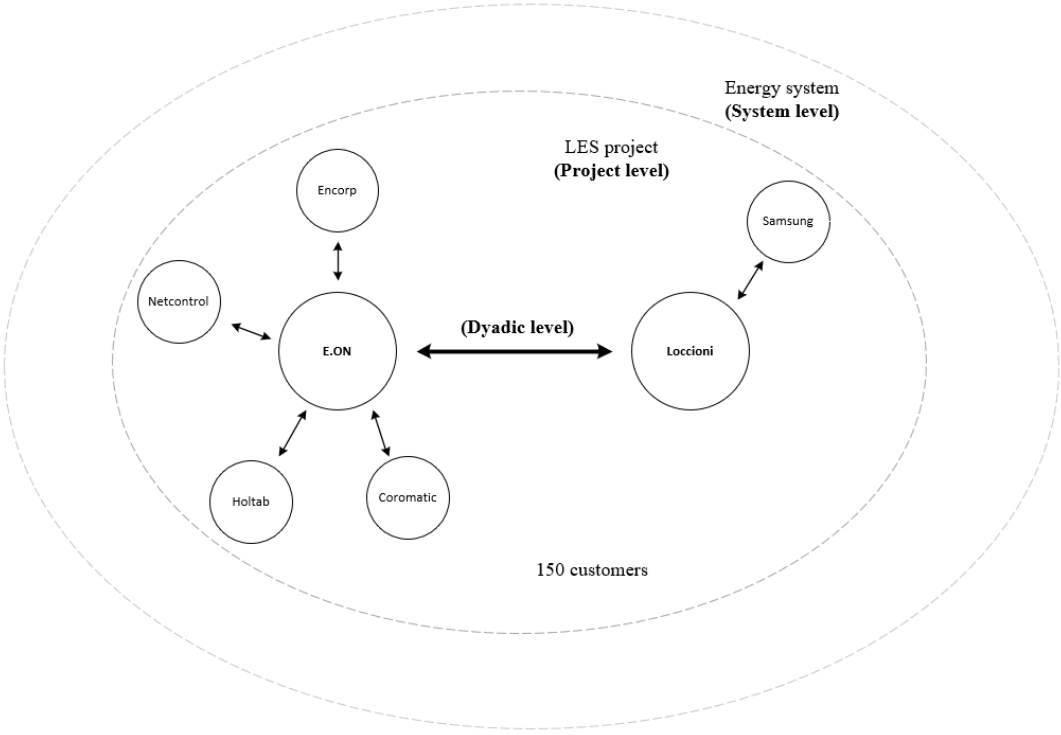

Figure 1. The actors involved in the LES project.

At the *dyadic level* we see that the Leaf project at Loccioni was an important resource foundation for starting the technological collaboration between Loccioni and E.ON. The previous experience and knowledge helped Loccioni to not only attract E.ON but also physically integrate the battery in the resource structure of the LES project. Through the interaction at the dyadic level, both Loccioni and E.ON learnt that the battery could deliver better quality of the electricity than the conventional grid system. However, it also became clear that the capacity of the battery was too low, and this resulted in another battery to be installed at the project site. Looking at the resources on the *project level*, the control system is a core resource that need to interact with the other resources of the project to balance the demand and supply of electricity. Figure 2 shows an initial mapping of the resources building up the LES project. Looking from a resource level, the project level is currently rather separated from the *system level*. Indeed, the solar cells and the wind mill belong to the energy system per definition, however, the project is physically disconnected from the physical resource structure every fifth week.

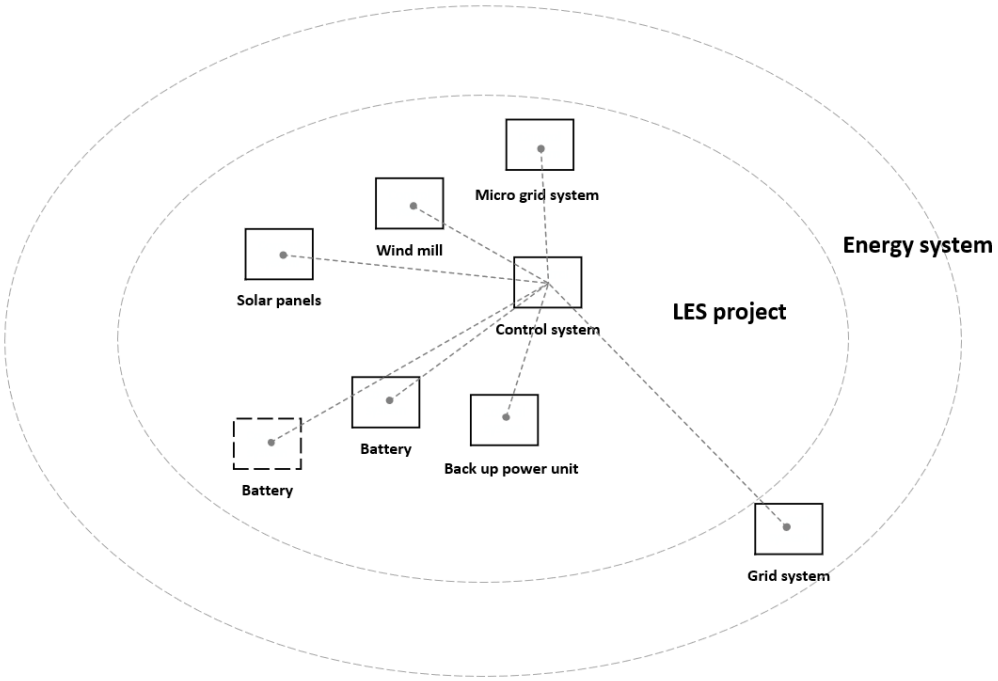

Figure 2. Initial mapping of the resources building up the LES Project.

Relying on the industrial network approach and the resource interaction framework (Håkansson & Waluszewski, 2002; Håkansson & Waluszewski, 2007; Baraldi et al., 2012), we plan to analyse the resource development in more detail. The collaboration between Loccioni and E.ON has been important for both parties in different ways and for the project as a whole. Hence, it will be interesting to further discuss how this collaboration not only led to resource development within this project but also how this collaboration has led to other effects outside this particular project. Loccioni entered a totally new setting and the resource interactions that took place led to new resource features that may be useful in the future. This new collaboration and new project thus enable us to study the starting up processes of the Italian firm as well as the established firm, E.ON.

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