POLICY ASSESSMENT OF MUNICIPAL SUPPORT FOR LOCAL RENEWABLE ENERGY COOPERATIVES

The creation of a context-specific policy assessment framework based on TIS theory

Universiteit Utrecht

J. B. de Heer 4012410
dr. F.S.J van Laerhoven (supervisor)
dr. W.J.V Vermeulen (second reader)
j.b.deheer@students.uu.nl

Abstract

Within the Dutch Energy Accord, responsibility to implement the actions needed to attain EU renewable energy goals lies largely with local government. However, municipalities lack the resources and knowledge to effectively complete these actions. In effect, the necessary actions are not adequately taken and the Dutch energy transition is stalling. Decentralized energy production has the potential to account for 30-40% of the country's energy demand. Local renewable energy cooperatives (LRECs) are an instance of decentralized energy production, which can be seen as a bottom-up movement with the potential to have a large impact on the Dutch energy system. This research aims to accommodate municipalities who currently don't know how to interact with LREC(s) in their region or who want to attract and support this phenomenon in order to contribute to their municipal sustainability targets. The research objective is to contribute to the development of municipal policy dealing with the emergence and development of local renewable energy cooperatives by translating concepts from TIS theory to a context specific policy assessment framework, to be used by local policymakers in the Netherlands. A qualitative approach is taken, using expert interviews to understand how structural and functional elements from TIS theory are represented in the context of LRECs. The results show a two part policy assessment framework based on these elements. Besides a comprehensive description of the local system requirements for LRECs, it provides a framework for analysis as well as recommendations for the municipal action perspective. Further research is needed to test the framework presented in this thesis among municipal officers and local policymakers, in order to increase its practicability.

Acknowledgements

This research could not have been conducted without the cooperation of my interviewees, who found the time to talk to me and enlighten me in many ways. Together they represent the most important stakeholders I researched in this sector. In particular, I would like to acknowledge Annemarieke Schwencke for the detailed input. In the two and a half hours we talked, there was hardly not a word that was irrelevant for the research. Besides this, her many contributions to the academic field regarding local renewable energy cooperatives (LRECs) have been extremely valuable. Siward Zomer is another participant that deserve special credit. Because of his active involvement in many fields of the sector, his insights reach in my opinion beyond that of a single interviewee. This reflects in the many quotations I use with his name. He gave not only a bird's eye view of the sector, but also a lot of background information and interesting illustrations. Of course, none of this would have been possible without the brilliant help of my supervisor Frank van Laerhoven. When I was blinded by my own thoughts and ideas, he helped me go on by providing structure and making sense of it all. Thanks for keeping me sane Frank.

Personal note

I would like to open this thesis on a personal note. The subject for this research has not occurred to me out of the blue. In fact, the phenomenon of local renewable energy cooperatives has fascinated me for a few years now. When I first got interested in sustainable development and began to inform myself about it, I was shocked to find that the Dutch perform so shamefully in terms of renewable energy production. To me, a renewable energy based economy is the bottom line for a sustainable economy. It should have been business as usual decades ago. In order to change this, I started to believe we need a green revolution. That is how I got acquainted with transition theory and transition management. Finally, these were academic exercises with a normative message and goal. Then, I stumbled upon the phenomenon of the local renewable energy company. This was the embodiment of so many things that interest me and that I believe this world needs. An idealistic movement driven by democracy, local autonomy, bottom-up influence and taking action, with the goal of overthrowing the carbon locked-in status quo. These cooperatives are in my view managed not just by people, but by local heroes. In my bachelor research I was lucky enough to meet these heroes face to face and interview them. Then I ended up doing an internship with De Windvogel. Now, for my master thesis I focus on LRECS again. This time with the hidden agenda of contributing to the development of this sector. What better way to see how these initiatives can be helped than by trying to start one myself? So that is what I did, with the help of my internship coordinator at De Energiebespaarders. This has been a very exciting as well as frustrating endeavour which has taught me much, some of which I used as input for this thesis. Especially my experience with the municipality of Gouda motivated me to help municipal officers with my research. I observed how municipalities have gotten a lot of responsibility for the implementation of national level ambitions, but are not given the proper means. In result, although they are very eager to make changes, they have a hard time achieving the results they would hope to see.
The lines between my academic, personal and professional life have been somewhat blurred during the period of research. It has been a very interesting time for me, and I am very happy to be able to present the final result to you. Enjoy!

Table of Contents

List of Tables

List of Figures

Chapter 1 Introduction

1.1 The Dutch energy transition

The Netherlands is far behind when it comes to transitioning towards a clean energy system (Boon and Dieperink, 2014). This energy transition encompasses the change from being mainly dependent on fossil fuels, towards depending for the majority on renewables (Beggio and Kusch, 2015). Currently, the Dutch energy system consists for nearly 6% of sustainable energy, making it one of the lowest scoring countries in the European Union (EU), leaving only Malta (4,7%) and Luxembourg (4,5%) behind (CBS, 2016). By 2020, the Dutch percentage should be at 14% according to EU goals that have been set in 2009. This would still be lower than the current European average of 16% and very far from percentages of European frontrunners Sweden (53%), and both Latvia and Finland (39%) (ibid.).

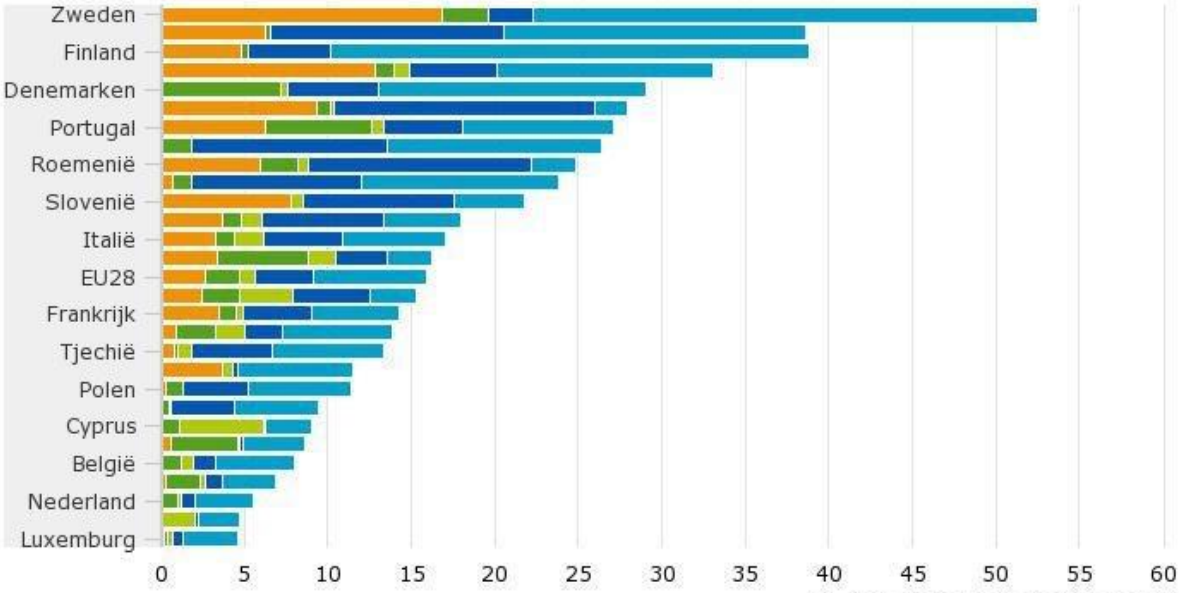


Figure 1: Renewable Energy Share of EU Countries

Since the percentage of renewables has remained nearly constant for the past years, attaining the EU goals seems nearly impossible. Even though the Netherlands is a highly developed country in most respects, it is undeniable that the energy transition has so far been a failure. The reason that this energy transition has not happened so far, is because the Netherlands is perfectly adapted to a fossil fuel economy. The country, with its convenient coastal position and world class sea port is the European gate for large scale import and transit of energy and raw materials, such as oil and oil products (TNO, 2013). This has led to the development of a comprehensive refining industry. In addition, the Netherlands possesses substantial supplies of natural gas, from which gas for domestic use and export is recovered. Another characteristic is the fine-grained and high quality gas, oil and electricity grid (ibid.). These facts all cause the Netherlands to be highly specialized towards fossil fuels. The economic interests of this system are enormous for the state. The majority of the stream of gas and oil products is intended for export. This makes the country a key player in the northern European energy market.

A minor part of the streams is meant for domestic use, which are mostly covered by energy intensive industries such as the chemical industry, transport, greenhouse horticulture and the food industry. These are all major contributors to the Dutch international export position.

Finally, the government budget profits from petroleum and gas in a major way as well. In total, its contribution to the Dutch treasury in 2010 came down to an amount of approximately 50 billion euro annualy, corresponding to a fifth share of the yearly state income (ibid.). This might explain why the transition has been rather slow: the current position is very profitable for the Netherlands.

1.2 Future vision: alternative pathways

As comfortable as the Netherlands currently is, there is a need for a future vision nonetheless. Pressure from international climate accords and threats of imminent fossil fuel scarcity reinforce the need for alternative pathways. As the energy system is currently a big contributor to the nation's wealth, future visions have to make sure this will not be undermined. The future vision for the energy transition, as articulated in the Dutch Energy Accord or Energieakkoord (SER, 2016) therefore has to be system wide, including not only technological issues, but a combination of technological and social innovation, economic activity and societal impact. Important pillars and system requirements in the energy accord are flexibility of coupling and demand, investing in energy reduction and stimulating the energetic society. The energetic society includes local initiatives stimulating innovation and improving social awareness. The transition should also provide new economic activities (SER, 2016).

1.3 Decentralized energy system: LRECs

As becomes clear, an important pillar within the energy accord is saving energy in the built environment and decentralized production of renewable energy by civilians and civil initiatives such as energy cooperatives. Civilians have increasingly ample opportunity to autonomously save energy, as well as produce renewable energy.

The academic literature has identified bottom-up renewable energy initiatives as a promising phenomenon with the potential to not only fuel transitions in the realm of energy, but all aspects of societies related to sustainability (Boon and Dieperink, 2014; Beggio & Kusch, 2015; Zardi, 2015; Karskens, 2016; Mignon, 2016). Seyfang and Smith (2007) highlight the local renewable energy cooperatives (LRECS) as "a neglected site of innovation for sustainability". LRECs differ from the more mainstream market-based innovations that empirical research and theoretical development in transition studies have paid attention to so far (Geels, 2011). These differences include among others, different resource bases, well-defined organisational forms, different contextual situations and motivations (Seyfang and Smith, 2007).

Generating energy close to where it is consumed, could contribute to as much as 40 percent of the national energy demand (Allen et al., 2008; Bergman and Eyre, 2011; Watson et al., 2008). Therefore, this could be a fruitful strategy for the Netherlands to address their laggard position in the energy transition. Boon and Dieperink (2014) describe the phenomenon of the LREC as such a manifestation of generating energy where it is consumed. LRECs are defined as "organizations, initiated and managed by actors from civil society, that aim to educate or facilitate people on efficient energy use, enable the collective procurement of renewable energy or technologies or actually provide (i.e. generate, treat or distribute), energy derived from renewable resources for consumption by inhabitants, participants or members. The latter living in the vicinity of the place where the energy is generated" (Boon and Dieperink, 2014 p. 298).

The 'Lokale Energiemonitor' keeps track of the amount of local energy initiatives. In 2016 the number was 320, a 20% increase compared to 2015. More than 50.000 people are member of

such a cooperative in the Netherlands. The production capacity of cooperatives is about 2.5% of the total capacity of solar and wind. This is still a small amount, but has the potential to increase rapidly. In a city like Amsterdam or Utrecht for example, 30% of the total energy demand could be satisfied with solar panels on the roofs, but perverse incentives in the Elektriciteitswet (Electricity law) cause unnecessary obstacles (FUSE, 2017). Being realistic, community energy is not the only driver for the energy transition, and so far its contribution to the share of sustainable energy remains small. However, the growth of the number of initiatives has been so significant that is has become a societal movement, indicating rapidly growing societal demand for sustainable and 'self-owned' energy. Resulting from this, are potentially significant impacts on the larger energy system (DRIFT, 2014).

1.4 Lack of adequate policy

Since the impact of LRECS is currently very small, one might argue that adequate policy to stimulate these initiatives is lacking. While energy cooperatives are repeatedly proposed as the solution for the failing Dutch energy transition by empirical research, it is explicitly mentioned that this will not be successful under currently unfavourable policies (Karskens, 2016). Previous research has repeatedly identified a consistent and coherent policy framework to be imperative for the creation and development of bottom-up renewable energy initiatives (Zardi, 2015; Karskens, 2016; Mignon, 2016).

"It goes without saying that the policy context is important in explaining the success of community energy projects. Consistent with Seyfang et al. (2014), Seyfang et al. (2013) and Dragoman (2014), a consistent and stable policy context concerning renewable energy at community level is a crucial need. "The most interesting approach to this claim has been proposed by Huijben and Verbong (2013), Oostra and Jablonska (2013), DRIFT (2014), Weismeier-Sammer and Reiner (2011) and Hisschemoller (2012) according to which, most of the current legal conditions, regulations, laws, tax regimes and infrastructures block out RECs, and as a result, legislation limits the spread of renewable energy projects" (Zardi, 2015 p.11).

TU Eindhoven and TNO (FUSE, 2017), paint a picture of the Dutch energy transition and the reasons upscaling has been difficult. Renewable energy technologies are increasingly improving and becoming cheaper, societal support is ample and more and more local sustainable facilities are popping up. The reason that the deployment has not been as widespread as it should be is due to rigidities in the institutional system, which still contains elements of the centralized, tightly controlled past.

1.5 Responsibility for local authorities

In the national Energy Accord, municipalities are asked to take an active role in the design of the 'energetic society'. Examples are the facilitation of initiatives for decentralized production and energy savings in the built environment. In order to reach the targets set for these pillars, active involvement of regional and local authorities is required. On the decentralized production of renewables, the Energy Accord states: municipalities and provinces are to create spatial policy for decentralized production (SER, 2013).

The exact way to achieve that is a topic still being discussed among municipalities. In cooperation with provinces and regional water authorities, they are gladly abiding the challenge. The over coupling organisation for Dutch municipalities, the VNG, realises that the key to the energy transition is to be found at a decentralized level. Municipalities have close ties

with their inhabitants and entrepreneurs, and together with the provinces carry the responsibility for the spatial planning necessary for this transition (Elzenga et al., 2017).

Municipalities recognize many opportunities in these tasks, but at the same time struggle with their own role and the division of the limited means made available by the state to achieve these goals. According to an inventarisation of Royal-Haskoning in 2014, half of all municipalities had no clear understanding of what the Energy Accord would mean to them in terms of practical implications. Local authorities perceived the execution of their assigned tasks within the accord as a great challenge. In 2014 the greatest challenges were the lack of financial and human resources to execute the Energy Accord. Still, municipalities do what they can. But their contribution seems to halt at small-scale community initiatives with a limited potential for regime innovation. However, such a big scale jump is exactly what is ambitioned by the accord. So here we see a dilemma: municipalities have been appointed as the executives of the energy accord, but they are not given the appropriate means to do this and therefore fail (VNG, 2014).

So while LRECs seem to be a suitable option to accelerate the Dutch energy system, currently there is a lack of policy to stimulate these initiatives. The most appropriate level of government to create policy for this would be the local government, but municipalities seem to lack the know-how and resources to take on the responsibilities they have been given by the national government.

1.6 Research outline

1.6.1 Research aim & objective

The goal of this research is to address this gap in knowledge and to accommodate municipalities who currently do not know how to deal with LRECs in their region or want to attract and support this phenomenon in their region in order to contribute to their sustainability targets. In order to create policy for this, municipalities should know what requirements need to be present in their region for the development of local renewable energy and whether these are in fact in place. This research aims to provide a policy assessment framework for this purpose.

The research objective is to contribute to the development of municipal policy dealing with the emergence and development of local renewable energy cooperatives by translating theoretical concepts to a context specific policy assessment framework to be used by local policymakers in the Netherlands.

1.6.2 Research perspective

"Gaining a better insight about which factors determine a successful transition to renewable energy at the community level is vital for policy makers in order to improve the operation and survival of such communities as long term processes, by designing particular policy tools" (Zardi, 2015 p. 6).

The theoretical concepts I use to gain this insight and design this tool stem from the innovation management literature, in particular technological innovation system (TIS) theory. The choice for this theoretical perspective stems from the idea that innovation in the energy system is not hindered by a lack of existence of technological options. Rather, the innovation potential is hindered by structural elements in the system (Suurs, 2009).

Note here that innovation includes, besides new ways of *producing* energy, also new ways of *organizing* energy in a decentralized manner. An innovation system is "a dynamic network of

agents interacting in a specific economic and or industrial area under a particular institutional infrastructure and involved in the generation, diffusion, and utilization of a technology" (Carlsson and Stankiewicz, 1991 p 93).

As becomes clear from this quote, the institutional structure cannot be ignored when discussing a technological innovation system. When talking about innovation in the energy system, this consequently does not only apply to the production and consumption infrastructure but also to the societal structures in which that system is embedded: surrounding levels of government, civil society and business. TIS theory uses these concepts in a more practical approach aimed at creating a systemic policy tool, hence this approach will constitute the foundation for this research. The concepts used from it will be described after the presentation of the research questions, in the theoretical outline.

1.6.3 Research questions

The main research question will be as follows:

> *What can municipalities do to stimulate and support the deployment of LRECs?*

The main research question will be answered by addressing the following sub questions:

1) What structural elements should be in place at municipal level to stimulate and support the deployment of LRECs?
2) What are the system function requirements at municipal level to stimulate and support the deployment of LRECs?
3) How can the system requirements be translated into a context specific policy assessment framework for local policymakers?

1.6.4 Research framework

In the following research framework, the steps necessary in order to answer the research questions and complete this research are schematically previewed.
The first phase is desk research, in which TIS theory will be applied to the context of local renewable energy projects in the Netherlands. The desk research findings will be the first input for the preliminary policy assessment framework. This general framework includes the relevant concepts for system development and will be input for the next phase of the research: field work. In initial key-expert interviews the concepts relevant for LRECs will be crystallized and given content, by seeing how they interrelate. Then, interviews with several types of experts in the field will contribute to making the tool context specific and useful in practice.
All in all, an answer will have been given to the main question: how can policy contribute to an increase in the successful deployment of local renewable energy cooperatives?

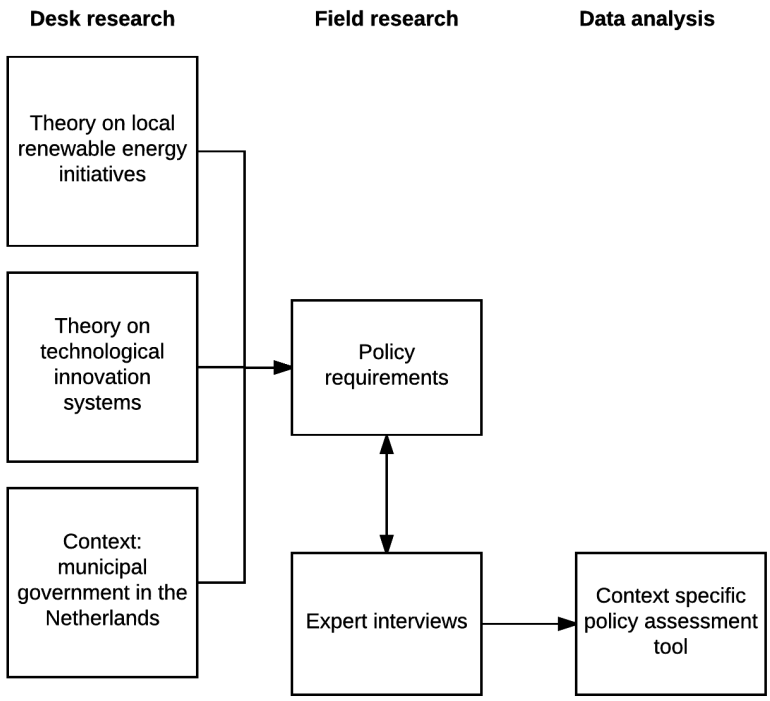


Figure 2: Research Framework

1.7 Scientific and societal relevance

Scientific relevance

The aim of this research is to design a policy assessment framework in order to provide local policy makers with recommendations on how to improve the context for LRECs. This is highly relevant at the societal level. Therefore, this research will naturally be more practically than theoretically oriented. However, as many previous scholars have identified the need for coherent and consistent policy for the sustainable energy transitions, this work addresses that call. It provides a case study on TIS theory in the field of LRECs. Thus, it can distil the relevant elements of this theory for an innovation system that is more socially innovative than purely technical. This way, it expands the knowledge on TIS and creates new knowledge in the field of local renewable energy policy.

Societal relevance

As mentioned, the societal relevance of this work is apparent through its goal to improve governance for sustainable development at the local level focused on the energy transition. The societal relevance is the acceleration of the energy transition by means of supporting decentralization. By understanding blockages in current policy, recommendations can be made to remove these blockages. The work of local policy makers will be alleviated. The successful implementation of LRECs will increase. The bottom-up energy movement will be supported. This includes civil society project initiators, but society at large will benefit from a more decentralized energy system as well.

1.8 Reading guide

So far, the problem at hand has been described, along with the research objective and accompanying research questions. This research is a bit untraditional in the sense that the final outcome somewhat resembles a conceptual framework, something that would usually be presented at the start of a research. Hence, I shall briefly explain how the rest of this thesis will be structured. First, the terms already mentioned in the research questions will be explained in the theoretical outline. Then, in the methods section you will read how I attempted to translate these theoretical concepts to a context specific policy assessment tool. This will be followed by the result section, in which the sub questions are answered. This in fact contains the explanation of the tool and the actual assessment tables. Lastly, the conclusion will briefly answer the main question by reflection upon the main findings. In the discussion, I critically reflect upon my own work and suggest ways to improve what I came up with.

Chapter 2 Theoretical outline

2.1. Theoretical perspective

The objective of this research is to design a policy framework which can help the Dutch energy transition by focusing on municipal policy for local renewable energy cooperatives. Understanding transitions is important in order to design policy that can strengthen these transitions. Filling in the elements of the policy framework will be done by focusing on technological innovation systems theory.

2.1.1 The Technical Innovation System (TIS)

The concept of TIS has been applied successfully to understand innovation processes in relation to societal structures such as governments, universities and NGOs. The TIS approach starts from the perspective of a technological system, which can be considered to cover an intermediate level of analysis between a niche and a regime (Suurs, 2009 p. 25). The bottom-up movement of local renewable energy initiatives influencing the Dutch energy system could be categorized as such. As small as the movement currently is, we can see an exponential growth in the amount of new initiatives starting each year (Lokale energiemonitor, 2016). The initiatives are using a technology that, although it has been around for a while, is still innovative in the sense that it challenges the status quo. The Dutch energy system status quo is a highly centralized fossil fuel based and oriented system. LRECs have a vision of a decentralized energy system that is based on renewables. This emphasis on decentralization is very important, because it illuminates the fact that the most innovative aspect of LRECs is their alternative way of organizing and interacting with society. The organization is based on participation from civil society, and aimed to benefit the local context. Cooperatives do not exist to make financial profits; their profits are meant to reinvest in the community it operates in. It is important to have a clear image on what type of innovation is meant in this thesis. Here, the focus is more on social and organizational innovation rather than the usual focus on technology that might be more common with TIS theory. The realm of this social and organizational innovation is, as explained before, the local community or municipality. Since the LREC action is happening there and since policy is needed here, municipalities are the niche focused on.

2.1.2 Designing a tool

The TIS framework provides a solution for systemic problems such as the incumbent fossil fuel system, by facilitating the design of a policy tool (Wieczorek and Hekkert, 2012). TIS theory is based on the notion that there is a strong need to influence both speed and direction of innovation and technological change. It is important to note that the concept of technological change refers to the development of technology in interaction with the *system* in which the technology is embedded (Hekkert et al., 2007). It is this *interaction* that constitutes the innovation process. This provides an argument for the feasibility of the slightly alternative research approach:

"An innovation can be defined as the successful combination of hardware, software, and orgware, where orgware refers to the various components of the innovation system" (Hekkert et al., 2007 p 414).

TIS approach uses the concept of cumulative causation, which can be understood as positive feedback, to suggest that a TIS can profoundly accelerate its own developmental pace. This is in fact necessary in order to create a rapid build-up for the widespread diffusion of a sustainable energy technology. Recent TIS studies have conceptualized this build-up process in terms of system functions, or key activities. These involve; *Entrepreneurial Activities, Knowledge Development, Knowledge Diffusion, Guidance of the Search, Market Formation, Resource Mobilization and Creation of Legitimacy* (Hekkert et al., 2007; Negro, 2007).

2.2 Structures and functions

According to the authors, the first step in designing a systemic policy tool aiming to innovate an entire technological system is to analyse the systemic problems that hinder the intended developments. For this purpose, TIS provides a combined structural functional analysis. It is this structural functional analysis that will form the basis for the policy assessment framework that will be designed in this thesis. In this initial phase, literature will provide a preliminary analysis of the structural and functional aspects of the TIS of local renewable energy cooperatives. Combined, a clear picture can be provided of the relevant entities operating in this system and their mutual relationships.

2.2.1 Structural dimensions

As for the structural analysis, Wieczorek and Hekkert (2012) find structural dimensions in the innovation management literature relevant for TISs. The four main elements chosen are: (i) actors, (ii) institutions and (iii) interactions, operating within (iv) a specific infrastructure. What these entail will be treated shortly.

Actors

It is inevitable to acknowledge that social systems are made up of actors as individuals, organizations and networks. The literature presents actors either based on their role in the innovation process, or their role in the economic system. Roles in the process are nowadays becoming less clear, since many actors are users and producers at the same time. Therefore Wieczorek and Hekkert (2012) decided to delineate actors on the basis of their economic activity: **civil society, government, non-governmental organizations** (NGOs), **companies** (start-ups, small and medium-sized enterprises (SMEs), multinationals, large firms), **knowledge institutes** (universities, technology institutes, research centres, schools), and **other parties** (legal organizations, financial organizations/banks, intermediaries, knowledge brokers, consultants). These different actors can all fulfil different roles (p. 76). This makes sense in relation to LRECs, because this is an actor that is becoming a producer while simultaneously remaining a user. Therefore, economic activity is a much clearer and more meaningful distinction.

Institutions

This dimension is divided in hard and soft institutions. Hard institutions include the more traditional institutional aspects of rules, norms and strategies. Soft institutions however include the habits, routines and shared concepts adopted by people in repetitive situations following from these hard institutions (Crawford and Ostrom, 1995). These soft institutions describe rules that people use to interact with each other. As becomes apparent, institutions cover a wide range of aspects and are different from organizations such as firms, universities and state bodies. Those file under the dimension of actors.

Interactions
It may seemingly be difficult to pinpoint a dynamic and interactive concept as interactions as a structural element. However, TIS theory does include this element as a representation of connections and relationships between organizations or networks. Depending on the phase of development of a system, this may be in official entities or merely as meaningful interactions between (groups of) individuals (Wieczorek and Hekkert, 2012).

Infrastructure
Infrastructure is defined in many different ways in innovation system literature, but Wieczorek and Hekkert (2012) propose to acknowledge three categories of infrastructure, being: (1) physical (artefacts, instruments, machines, roads, buildings, telecom networks, bridges and harbours), (2) financial (subsidies, financial programs, grants etc.) and (3) knowledge (knowledge, expertise, know-how and strategic information) components of the structure of innovation systems (ibid, p. 77).

2.2.2 Functions of the innovation system
So far the structural elements that are included in the TIS theory. But what distinguishes this particular framework is that these structural elements are subsequently coupled with functional elements. Functional analysis focuses on the processes that are important for innovation systems to perform well (Hekkert 2007; Bergek et al. 2008) . Different scholars identify different functions, but for this research the functions proposed by Hekkert et al. (2007) are used, since these have been carefully selected and formulated out of the available studies.

F1 Entrepreneurial activities
Entrepreneurs are essential for a well functioning innovation system. The role of entrepreneurs is to turn potential into concrete actions: using knowledge, networks, and markets to generate new business opportunities. This can be perceived as experimenting with freshly available combinations of the three. These experiments in turn, lead to the generation of knowledge about the performance of the technology under different circumstances. Entrepreneurs can be either new entrants that have the vision of business opportunities in new markets, or incumbent companies who diversify their business strategy to take advantage of new developments (Hekkert et al., 2007 p 421). The presence of actors is influenced by the performance of the following six system functions and can therefore be used as an indicator of the overall performance of the innovation system.

F2 Knowledge development
In modern societies, knowledge is one of the most important resources, as learning is at the heart of any innovation system. This was illustrated by the previous section on entrepreneurial activity. R&D and knowledge development are quintessential for a TIS. The function of knowledge development encompasses learning by searching and learning by doing.

F3 Knowledge diffusion
Related to the previous system is the importance of the diffusion of knowledge. If knowledge remains contained in a small subsystem it doesn't have the potential to innovate the system at large. Networks have the primary function of exchanging information. Therefore, they are essential for knowledge diffusion. These networks have the biggest potential to benefit

innovations if they are set in a heterogeneous context where R&D meets government, competitors, and market. "Here policy decisions (standards, long term targets) should be consistent with the latest technological insights and, at the same time, R&D agendas should be affected by changing norms and values" (Hekkert, 2007 p 423).

F4 Guidance of the search
This function represents the importance of selection and of steering. Selection relates to focusing on specific technological options out of all the available ones. Steering relates to the direction of technological change. This direction can be aligned with changing preferences in society by influencing R&D priority settings. Applying this to local renewable energy, an embodiment of this function are the long-term goals that are set by different governments to reach a certain share of renewable energy in the future. The Netherlands formulated the ambition to reach a share of 14% renewable energy in 2020. This ambition grants a certain degree of legitimacy to the development of sustainable energy technologies and stimulates the allocation of resources for this development (Hekkert et al., 2007).

F5 Market formation
Naturally, diffusion of new innovations is slow at first. There are initially no obvious advantages of new inventions over existing technologies, because existing infrastructure is still adapted to older technologies. Therefore, it is important to consciously create protected space for new technologies (ibid). An example could be the arrangement of a temporary niche market, where actors can experiment with and learn about the new technology as to manage expectations. Also possible is the construct a competitive advantage by means of favorable tax regimes.

F6 Mobilization of resources
As any system, the innovation system does not function without the input of adequate resources. In this case, the necessary resources for a smooth operation of all system activities are financial and human capital. Allocating sufficient resources is imperative for knowledge production. It is important that the resources are available to the right actors at the right time.

F7 Creation of legitimacy
"In order to develop well, a new technology has to become part of an incumbent regime, or even overthrow it. Parties with vested interests will oppose this force of creative destruction (ibid, p 425)." A vehicle for this force is the formation of interest groups or advocacy coalitions. Lobbying and agenda setting power in favor of the new technology, function as a catalyst and in turn create legitimacy for the new technology. The bigger these coalitions become, the greater their influence.

2.2.3 Coupled structural-functional analysis
Wieczorek and Hekkert (2012) argue that these functions alone do not have ample explanatory power to tackle systemic innovations. An effective policy instrument aiming to induce a systemic innovation will not be successful if it merely addresses functions, since functions can only be changed when structural elements are altered. Therefore, in TIS theory the aforementioned functions will be examined through the perspective of the structural elements discussed before. Hence, the analysis acquires a coupled structural-functional character.

Systemic problems are problems that hinder the development of innovation systems. Within the system studies perspective (Carlsson et al. 2002), a system is made up of: components (operating parts of a system), relationships (links between components) and attributes (properties of the components and relationships). As discussed, an innovation system includes four structural dimensions, being: actors, institutions, infrastructure and interactions. The *components* of this system are the actors, institutions and infrastructure. Interactions are *relationships* or links between the components. All four can have specific *attributes.*

If the innovation system does not function well, indicated by absence or weakness of functions, system analysis inspects why by looking at each of the structural elements in two ways: (1) whether it is because of its presence/absence or (2) because of its properties. This looks as follows:

¢ The presence or capabilities of the actors;

¢ The presence or quality of the institutional set up;

¢ The presence or quality of the interactions;

¢ The presence or quality of the infrastructure.

Combining all these elements, functions and attributes gives us the following framework, which can be used to analyse systemic problems. This framework will be used to analyse the lack of deployment of LRECs within the Dutch energy system. Subsequently, the framework will be used to create a policy tool in order to accelerate the local uptake of sustainable energy technologies in the Netherlands.

System function	Structural element	Systemic problem	(Type of) systemic problem
F1: entrepreneurial activities	Actors	Actors problem	Presence? Capabilities?
	Institutions	Institutional problem	Presence? Capacity/quality?
	Interactions	Interaction problems	Presence? Intensity/quality?
	Infrastructure	Infrastructural problems	Presence? Capacity/quality?
F2: knowledge development etc.	Actors	Actors problem	Presence? Capabilities?
	Institutions	Institutional problem	Presence? Capacity/quality?
	Interactions	Interaction problems	Presence? Intensity/quality?
	Infrastructure	Infrastructural problems	Presence? Capacity/quality?

Figure 3: Systemic problems based on structural-functional analysis of an innovation system (Wieckzorek & Hekkert, 2012).

Chapter 3 Methodology

3.1 Research strategy

Now that the relevant theoretical concepts that will be used to answer the research question have been explained, these must be translated into a context specific policy assessment tool. Because this research zooms in on a specific phenomenon, with the aim of capturing its complexity and translating this into detailed practical findings for a specific audience, this research has a focus on depth rather than breadth. This has some methodological consequences. A qualitative rather than quantitative approach is suitable, as well as a focus on empirical- rather than desk research (Verschuren et al., 2010).

The aim is to get a grip on the reality of local renewable energy initiatives and the ways in which their development is assisted most by municipal action. This will contribute to the understanding of what factors need to be present in order to stimulate the occurrence and successful development of these initiatives. Therefore, this research will include elements from a general case study, meaning it will focus on a small domain with a small number of research units, derived from a strategic sample. The research units will be subject to intensive data gathering, of which the findings will be compared and interpreted in order to get to a holistic understanding of the phenomenon. Keeping my personal background in mind, this research includes action research elements, in the sense that I -as a researcher- am actively involved in the field I am researching and I cooperate with the people I intend to help with my research (Adelman, 1993). However, the research design does not strictly follow all action research requirements, so the claim that this is an action research thesis cannot and will not be made.

Triangulation of methods will improve the external validity by gathering data in several ways, as will be discussed next.

3.2 Desk research

Literature studies of innovation science literature, local renewable energy literature and local governance form the initial part of the research. This delivers the input for the field research, by providing a general picture of the factors that are of importance for the successful deployment of LRECs. These findings form the basis for the interaction with field experts, by generating the input for a structural functional analysis. This consists of a preliminary framework with structural and functional elements, according to TIS theory as described in the theoretical outline. The method proposed by Wieczorek and Hekkert (2012) will be followed closely, adapted to the context of LRECs.

3.3 Semi-structured interviews

Talking to a variety of expert from the sector will then concretize these general factors. The interviewees are from different backgrounds and represent different interests and experiences.

The preliminary framework has identified the relevant general concepts for the analysis of LRECs. The structural functional analysis that has been made possible by this preliminary framework will be undertaken by doing expert interviews. By talking to people in the field, I will increase the accuracy of this preliminary policy framework. Its elements will be discussed with experts in the field, such as local policy makers, project initiators and entrepreneurs. In this way

I can distil whether the analysis is complete, in the sense that it takes into account all relevant aspects of local renewable energy production.

The participants will be asked questions adapted from Wieckzorek and Hekkert (2012). Their input will fine-tune the policy framework and will provide input for the actual policy analysis.

3.4 Sample selection strategy

As area of research the province of Zuid Holland, the 'Midden Holland' region is chosen. The interviewees should represent a broad range of structural factors of the TIS: the different relevant actors, institutions, infrastructure and interactions. Some actors might fit into overlapping structural aspects. This can actually be an indication of the interactions at play in reality.

Participants have been selected, following the actor distinction made by TIS. The aim is to have an even representation of actors from: civil society, companies, government, LRECs and sector specific organisations. These are selected from organisations within the reach of my own network. Appendix A provides an overview of interview participants.

Initial interviews were held with Siward Zomer and Annemarieke Schwencke. These key actors both have a broad view of the field. Schwencke, an independent researcher of LRECs for several years with multiple publications to her name, is able to give an objective and complete view on the subject. Zomer represents the interests of the sector and provides practical insights, stemming from his active involvement in many if not all branche organizations (Rescoop, Ode Decentraal) as well as being chairman of wind cooperative De Windvogel. Zomer helped to get a more general picture of the sector, its strengths and weaknesses in current policy context. Schwencke helped to see the relevant structural elements and to see how they interrelate with the system functions in detail.

3.5 Interview design

For these and following interviews, the structure of the structural functional analysis was followed. Each participant was presented with a description of the system function, after which several questions adapted from Wieczorek and Hekkert (2012). These questions were adapted to fit the participants' context. Since all participants are Dutch, the interviews have been conducted in Dutch. In the questions, system functions were analysed in terms of the structural dimensions in order to identify the source of potential problems. Depending on the expertise of the participant, some system functions may be given more attention or less. For example, the interview with the knowledge institute HIER opgewekt quite logically focused more on knowledge development and diffusion.

During the interviews, I asked participants about their opinion on blockages limiting the system functions and opportunities to resolve these. This results in a problem assessment as well as input for policy recommendations.

3.6 Data gathering and ethics

In total 10 interviews were conducted. The questions were semi structured in the sense that certain topics and standard questions were asked, with room for elaboration and adaptation of the questions. As more interviews were conducted, knowledge and understanding of the subject grew and increasingly detailed questions could be asked. The duration of the interviews ranged

from 1 hour to 2.5 hours. These were conducted face to face in the 'natural environment' of the participant as much as possible. The conversations were recorded and transcribed. At the beginning of each interview, in the light of informed consent, permission to record was requested. Permission was granted by each participant. None indicated the wish to remain anonymous. Transcripts of the interviews were sent to participants, to provide an opportunity for feedback.

3.7 Data analysis

The transcribed interviews have been coded, using NVIVO Pro 10. Nodes were created according to the 7 system functions. Following, the textual fragments were divided in sub nodes divided in: interpretation, evaluation and recommendations for the system function.

Interpretation covered the context specific interpretation the experts awarded to the system function. So under these nodes, the translation from general TIS theory to context specific findings could be found. Evaluation was the node given to fragments that discussed the performance of the system function. This helped with determining the interrelations between the system functions because experts identified how key activities influenced each other's functionality. Recommendation included more specific function needs and things that must be changed in order to improve performance.

Within these three main nodes, I was able to find patterns by seeing in a clear overview what every actor had to say about the interpretation, evaluation and recommendations for the system functions. Sometimes it was necessary and useful to create sub nodes of sub nodes, but since a relatively small number of interviews was undertaken it was often possible to distill the main findings from these main nodes.

Chapter 4 Results: Structural factors in the assessment- framework

Following the steps in the TIS framework, the first research phase includes an analysis of the structural factors of the innovation system in question. These structural factors include actors, institutions, interactions and infrastructure.

Literature on local renewable energy systems identified the relevant structural dimensions for this field. This is complemented with the input from experts through semi-structured interviews, as well as my personal experience in this field. The preliminary tables have been discussed in detail with independent LREC researcher Anne Marieke Schwencke, in order to arrive at the version to be found below.

These structural dimensions should be in place in order to have the basic elements forming the innovation system. Tis theory elements are adapted in order to fit the goal of this assessment framework: to identify the action perspective of municipalities.

4.1 Actors

The structural aspect of actors is a very important one and quite complex. A short commentary of each of the sub categories is provided below in order to explain the dynamics.

4.1.1 Civil society

This group can be divided in active and passive citizens.

The active citizens are the ones actually making up the bottom up local renewable energy movement. People who initiate projects in their neighbourhoods and cities. People who volunteer for those initiatives. People who invest in those local projects as participants and as members of cooperatives. This is usually a small portion of the inhabitants, as most cooperatives have around 100 members.

Of course there is also the general public who do not participate actively, but who do have opinions. These people are potential active participants, or they simply shape the general opinion and level of support. Of course, local government should be a reflection of the civil society it represents so here we see a potentially interesting interaction: the stronger civil support, the stronger municipal support and vice versa.

4.1.2 Companies

Within this subcategory, again important distinctions can be made. It is especially important to distinguish between energy suppliers, network administrators, and other companies. Local initiatives inevitably come into contact with these parties. The manner of cooperation is very influential.

Energy suppliers & Network administrators

Suppliers and administrators of the net are the parties that deal with the energy infrastructure, both physical and administrative. Network administrators are the party that install the cables from the production facility to the energy grid. Energy suppliers are necessary for so called Postcode Roos (PCR) Projects. Participants in such projects receive a discount on their energy bill. This has to be administered and arranged by the energy supplier, however they are not obliged to do so. Therefore, it is important to choose an energy supplier that is open for cooperation with local initiatives. The network administrator is predetermined per region.

Non-energy related companies
Besides these energy-related companies, companies beyond this sector are important for different reasons as well. First of all, simply because they have roofs. Solar panel projects require large flat spaces, to be installed on. For the efficient use of already limited space in the Netherlands, flat rooftops are ideal substitutes for flat land. Any company with a large roof, ideally with space for minimally 100 solar panels, can be the provider for a quintessential resource for LRECS: the production site. Without ground positions (in this instance: roof positions), there is no possibility to produce local renewable energy.

Non-energy related commercial companies could join together to form a collective with the goal of realising a particular project. For example, companies that are located in an industrial park, could bundle forces and develop a project in the industrial park such as a wind turbine or large scale PV system.
Companies might also be able to support initiatives with their expertise or perhaps financially, but this is highly dependent on the local situation.

Project developers, suppliers and installers
A special case is that of project developers, suppliers and installers. The project developer is specialized in the realisation of (large scale) projects. In this sense, they can be conceived as a competing party. Where LRECs which are starting off have no experience with the realisation of energy projects, project developers are specialized in this task and consequently operate more efficiently. In this sense, LRECS could also learn from this actor. Suppliers and Installers of either photovoltaic systems (PV systems) or wind turbines can either operate individually, or via a project developer. This is a business partner and collaboration is based on the attractiveness of the proposition. It might be a requirement for some cooperatives to work with local suppliers & installers in order to stimulate the local economy.

4.1.3 Knowledge institutes & organisations
This category is a merge between the classic TIS knowledge institutes and NGOs. The go-to knowledge provider in the field of local renewable energy is HIER Opgewekt. This is a non profit platform in which best practices are shared and many informative documents are openly available. The information provided by this platform is useful for project initiators, but also very much so for local policy makers.

Another potentially relevant knowledge provider is a previously successfully realised project in the region. Either the project initiators or the municipal officers that were involved with the project can help with providing practical knowledge for people with similar ambitions but lack of real life experience. Local knowledge platforms exist in the form of local partnerships between cooperatives. Municipal officers should know which platform is active in their particular region.

4.1.4 Government
Even though some actors at higher governmental levels are highly influential and should be considered, they are added separately in Table 1. For the policy assessment framework that will be used by local policy makers, it is not relevant to include these in the analysis of the local context since they are outside the municipal scope of influence. Table 1 can be used for reference, for policymakers to see how far their influence reaches and where other governmental actors take over. Government in its current form in the main assessment Table 2

is thus supposed to reflect the role of the municipality itself. Table 2 clearly shows that national and regional authorities heavily shape the national possibilities. Especially provinces have a big influence regarding spatial planning. Some provinces, for example, have long ago decided not to develop any wind energy in their region and thus the possibilities for renewable energy are extremely limited there.

However, in the interviews the experts agreed on the notion that the municipality indeed has a high potential to create a favourable environment for LRECs. This is, taking into account that the national and regional context do not become less favourable.

The potential capabilities of the municipality are shortly listed in this table, but will be expanded on while discussing the system functions. As one can see, there is potential influence in many important different areas.

Table 1: High- and Midlevel Government Actors

Government level	Implementing organizations	Capabilities
National	RVO, Departments of: Economische Zaken (EZ), Infrastructuur en Milieu (IM), Binnenlandse Zaken en Koninkrijksrelaties (BZK)	All: Voicing ambitions, setting targets, creating policy and regulations regarding the energy system as well as enforcement of these. EZ: availability of finance, subsidies. IM: spatial planning BZK: energy saving
Regional	Provinces, Water boards, Environmental services IPO (dome organization)	Spatial planning for region specific potential project locations and available finances for the specific province.

4.1.5 Other parties

Within this category, two actors have been identified to be highly relevant for project initiators: financial and legal organizations. It is important for municipal officers to keep these in mind when dealing with LRECs.

Financial

Financial parties can provide initiatives with investments for project development and realisation. Depending on the necessary funds, different actors fulfil the need: banks or public organizations (subsidies). See the financial infrastructure section.

Legal

Legal organisations help with the formalization of the entity. For example, the notary helps with the writing of the statutes and other legal documents. For each installation of a new photovoltaic system at a location owned by an external party, the terms and conditions are written in a contract by the notary.

Assessment table

Table 2 below constitutes the framework policy makers can use to identify whether all necessary actors are represented in their local environment. It is especially important for them to focus on the unique capabilities that the actors possess. For each of the structural dimensions, policy makers should identify whether the subcategories are present, and whether or not they possess the adequate capabilities. The two columns on the right provide opportunity for this. Below each table, commentary of the findings.

Table 2: Structural dimensions of the TIS relevant for LRECS: Actors.

Actors	**Analysis of local context by local policy makers**

Subcategories	*General examples*	*Necessary capabilities*	*Local examples Present: yes/ no + description*	*Local capabilities Capable: yes/ no + description*
Civil society	i) Active: Groups of self organizing civilians, participants in local initiatives ii) Passive: General public	i) Initiating projects, forming cooperatives. Participating in projects. Volunteering ii) Shaping the general opinion on LRECS.		
Companies: start-ups, SMEs, large firms, multinational companies	i) Network administrators ii) Energy suppliers, focused on local renewables iii) Project developers, suppliers & installers	i) Coupling energy projects to the grid. ii)Administering tax exemptions of project participants. iii)Commercially developing and installing (large scale) renewable energy projects.		
	Companies of all sorts and sizes.	i) Providing production sites: rooftops, abandoned sites. ii) Business platforms initiating projects. iii) Providing resources: money, knowledge.		
Knowledge platforms & Branche organisations	i)HIER opgewekt,ODE Decentraal, REScoop , Natuur & Milieu federatie ii) Successful projects in the region	i) Providing practical knowledge on project development. Supporting initiatives with advice and knowledge. ii) Sharing region specific best practices.		

Government	Municipality	i) Shaping ambitions & public support ii) Creating policy and regulations. iii) Determining the playing field. iiii) Providing ground positions v) Providing start capital vi) Being a customer		
Other parties: legal organisations, financial organisations/banks, intermediaries, knowledge brokers, consultants	i) Banks & Subsidy providers) ii) Legal organisations	i) Providing capital: Project financing (co financer), work capital ii) Facilitating legal requirements		
(The information in this table was based on the following publications: Schwencke , 2012; Fuse, 2017;)				

4.2 Institutions

The analysis of institutions was narrowed to to the scope of this research. Institutions being a broad term, for this section the hard and soft institutions under the power and influence of municipalities are described.

4.2.1 Hard institutions

The city council has the power to determine the direction of city development, to create local policy, and to monitor the proper implementation of this policy. During talks with Anne Marieke Schwencke, it became clear that specific areas of policy are important for the development of locally produced energy: spatial planning and energy policy. Sustainability targets are categorized as well.

Spatial planning

More and more, the relationship between spatial planning and energy production is being recognized. The Netherlands is a small, densely populated country with a densely built environment. Any addition to, or alteration of this built environment, such as the construction of a wind turbine park, needs to fit existing and future plans and visions. Therefore, area development in general is accompanied by rigorous procedures. Since more and bigger energy production facilities are going to be needed to attain renewable energy targets, plans for these also have to fit the spatial planning visions. These visions are being created by regional governments (provinces), leaving some room for implementation for municipalities. So for any cooperative willing to install a large production facility, such as a solar roof, solar field or wind turbine, the municipal spatial planning policy is of importance.

The amount of suitable locations for such initiatives are limited and have been determined by higher level governments. This relates especially to land for wind turbines or solar fields and therefore decreases the amount of potential production sites significantly. The sites that are indicated as potential locations, are subject to municipal policy. Some might be municipal property and essentially not accessible for citizens. Others are not municipal property, but are subject to procurement policies. The general trend of municipal management of grounds is to allow the market to compete for ground positions. These market forces may be steered by certain conditions set by municipal policy, depending on municipal priorities (Klopstra & Schuurs, 2013). Municipal officers and local policymakers should be aware of the importance of spatial planning in relation to the energy transition, as well as their action perspective.

Local Energy system

Another relevant institutional domain is the regulation surrounding the production and diffusion of local energy: the local energy system. Examples of these forces within this system are energy supply and demand, energy management, energy taxes, as well as laws and regulations. These will not be treated in detail here but can be found in the Agentschap NL rapport of 2011: Wetten en Regels Lokale Duurzame Energiebedrijven.

Sustainability targets
To stimulate the deployment of LRECs in a region, the vision and policy of a municipality regarding their future energy system is of importance. Especially important is thus the articulation of these ambitious visions. From the national government, general targets have been set for renewable energy. The implementation of these has to occur at the so called ground level: the municipality. Therefore, it is important that these general national ambitions are translated into more concrete local plans. It is still dubious whether these ambitions and plans should be categorized as hard or soft institutions (T. de Neeve & E. Nijmeijer, personal communications, July 12, 2017). Although non-compliance of sustainability does not per se lead to negative consequences, respondents are seeing that they are becoming more guiding. And especially if an acceleration of innovation is to be seen, more power needs to be given to these targets and goals. Sustainability goals are now categorized as soft institutions, and shifting them towards hard institutions may very well bring better results. Here, hard institutional sustainability targets are understood to be quantifiable and measurable. Sustainability can besides be embedded in soft institutions.

4.2.2 Soft institutions

Culture
A relevant soft institution within the municipality is the organizational 'culture'. The culture of a municipality is important for the deployment of LRECs in two ways: within the municipality as organization (internal culture) and among the inhabitants of the municipality (external culture).

Internal culture
The internal culture of the municipality relates to the internal organizational approach. How the different departments interact and whether people work on a project base or not.
Another relevant aspect of internal culture is the openness and flexibility of the municipal officers towards new things (M. Hildebrand, personal communication, August 23, 2017). LRECs are an alternative way of citizen participation, with a more professional approach than usual citizen groups. More professional because their object of interest is more complex: influencing the energy system. This calls for an open minded and serious approach from municipal officers. Together, the citizen initiative and the municipality should examine new opportunities.
Relevant within the internal culture for LRECs is the municipal vision of the future of their energy system and collaboration with citizen initiatives.

Municipal vision of the local energy system & citizen participation
The specific sustainability targets voiced by municipalities have already been mentioned with the hard institutions. These have to be accompanied however with a more soft holistic municipal vision on certain matters. While these specific ambitions are usually voiced by a sustainability department, a relevant aspect is the integration of the sustainability vision within the other municipality departments as well. The substance of this policy determines the way the municipality interacts with local initiatives. As much as being a renewable energy initiative, energy cooperatives are a form of citizen participation. Therefore, it is of equal importance how a municipality has envisioned collaboration with such initiatives. This can be determined by official policy or a more flexible vision.

Different roles the municipality can take on
Klopstra & Schuurs (2013) distinguish five different roles a municipality can adopt when dealing with an LREC. These roles depend on the level of ambition of the municipality regarding the two sections above, as well as the motives and level of development of the LREC. These roles change over time as well. In short they include the following: coach, facilitator, service provider, participant and co producer.

Municipal officers can take on the role of *coach (1)*, when an initiative first comes to them for support. In this phase, an LREC is still defining itself and a coach can help by asking critical questions in order to sharpen the project plan. Further down the road, the municipality can act as a *facilitator (2)* by providing access to their facilities so that the initiative can develop, without requiring risky investments by the municipality. This comes down to providing space for meetings, ads in the local paper and providing expertise. The role of *service provider(3)* requires more action from the municipality, since here they support the initiative in what way they can within their power and duty. The *participant(4)* covers the role of the municipality once it actually participates in the initiative, as launching customer or investor. Finally, *co-producer(5)* is the most intensive and equal cooperation between municipality and LREC. This means that the municipality commits itself to the initiative as a collaborative partner of common objectives.

External culture
The external culture of the municipality refers to the customs, common habits and routines obtained by the inhabitants of a municipality. The way they think about energy and how it affects their lives, influences the way they will regard LRECs. The level of overall awareness related to the climate crisis will play a role in their choice of energy source. Besides knowledge on renewable energy, knowledge on local energy is also important. If people do not know about LRECs, they will be more sceptical than if they would be familiar with it. Although policymakers do not have direct influence on the general awareness of inhabitants of their region, they do have influence on information they publicly provide.

For all of these aspects, municipal officers should be aware of their existence and importance and of ways they can have positive influence.

Table 3: Structural dimensions of the TIS relevant for LRECS: Institutions.

Institutions			**Analysis of local context by local policy makers**	
Subcategories	*Examples*	*Capabilities*	*Local examples Present*: + description*	*Local capabilities Capable**: yes/ no*
Hard: rules, laws, regulations, targets and instructions (City council)	Spatial planning: 'grondbeleid' and 'omgevingswet' Energy tax: ' Elektriciteitswet' Sustainability targets	Determining what is legally and lawfully possible. Providing opportunities.		
Soft: customs, common habits, routines, established practices, traditions, ways of conduct, norms, expectations	Internal culture, i)vision on local energy system & ii)vision on citizen participation. iii)Different roles the municipality can take on regarding LRECs.	Providing an action framework for the municipality.		
	External culture: Ways people usually organize their energy, level of awareness, level of flexibility.	Determining what is 'normal' and what is socially/ societally possible and desirable.		
Schwencke , 2012; Fuse, 2017; personal communications mainly with A.M. Schwencke and other experts.				

*Presence: policymakers should identify which specific rules and regulations and other hard institutions relate to local renewable energy production. **Capability: this can be interpreted as the capability to alter these institutions for the benefit of LRECs.

4.3 Infrastructure

The infrastructure of an innovation system consists of physical, knowledge and financial aspects (Wieczorek and hekkert, 2012).

4.3.1 Physical & digital environment

The physical infrastructure is very defining for the development of renewable energy. It is a technology that gets embedded into the built environment: on existing buildings, in new structures and also via cabling that goes into the national grid. Renewable energy comes down to building new production facilities: PV systems, wind turbines, geothermal, bio-energy (S. Zomer, personal communication, July 31, 2017). On the other hand, an important new kind of infrastructure is the digital environment surrounding renewable energy. Software enabling a smart grid, coupling demand and supply is becoming increasingly important in shaping the energy transition (FUSE, 2015). 'Ideally we would have a modular renewable system, where it is possible to get energy from your neighbor's supply system. And where you can choose each month whether you want solar or wind or geothermal etc. Perhaps blockchain technology could help with this' (T. de Neeve, personal communication, July 12, 2017).

4.3.2 Knowledge

The knowledge infrastructure includes: knowledge, expertise, know-how and strategic information (Wieczorek and Hekkert, 2012). Based on conversations with field experts, the knowledge necessary for the development of LRECs was divided in four subcategories: Financial, legal, technical, organizational and communicative knowledge (T. Wentink, personal communication, August 14, 2017). This is important for initiators of any project to possess, even though the specific knowledge differs per goal of the entity. Different knowledge is necessary for solar projects, energy reductions and wind.

Financial knowledge includes the ability to calculate a business case, understanding the different tariffs used in the energy system and making future projections for a project. Also writing a project plan in order to attract external financing. *Legal* includes the necessary steps to be taken with a notary, how to safeguard risks and arrangements with stakeholders. *Technical* covers knowledge of the energy grid and of the different renewable energy options. Which option fits best in the local context, the technological choices you take and the consequences for the project. *Organizational* refers to the knowledge and skills necessary to run an organization, to make things happen in a professional and efficient way. It covers the structure internal cooperation in the organization. *Communicative* becomes more important once the local community becomes involved with the project. Enthusing inhabitants for the project, persuading them to join, informing them of the consequences.

This knowledge can either be relevant for project initiators, but also to some extent for municipality officials. Municipal policy makers should first of all be familiar with the term 'cooperative' and understand the meaning of citizen participation. The municipality should be able to understand the spectrum of cooperatives: the different phases initiatives can be in and the different goal they can have. Following, they should be able to distinguish between the quality of initiatives. Here is when the previously mentioned knowledge comes in. Municipal officers should be able to see if all the necessary knowledge is present or can be attained within the initiative that they encounter with.

Besides this, thorough knowledge should be present - or accessible- about the general functioning of the energy system. An understanding of the different parties involved, the arrangements and regulations.

4.3.3 Financial infrastructure

The financial infrastructure relates to subsidies, grants and programmes (Wieczorek and Hekkert, 2012). Three national arrangements are very important for the development of local energy: SDE+, the Postcode Roos Regeling (PCR) and salderen. These are incentive arrangements, which help to strengthen the business case of projects once they are developed.

PCR (Regeling Verlaagd Tarief) allows participants of collective energy production sites a discount on the energy tax. SDE+ is a compensation granted per produced KWH for larger production facilities. 'Salderen' is about re-delivery of self-generated power to the grid for the same fee at which energy is usually taken out of the system, this is more relevant for private homeowners. However, before projects can use such arrangements, there are several phases that have to be conquered. All of these phases need different types of financial support: start, process and investment capital

Start capital

In the initial startup phase of an LRECS, relatively small funds are necessary for development. This can be covered by a maximum of 10.000 euros, to be used for such things as a professional website, a member campaign and writing the project proposal.

Process capital

Later on in the process, funds are needed for a professional and expert deployment of the project. Experts are needed to provide their knowledge for the successful and efficient development of projects. See knowledge infrastructure for details on the necessary expertise.

Investment capital

This is not per se necessary for smaller projects, such as solar roofs, where adequate funds can be collected by project participants. Wind turbines however, where millions of euros are concerned, are usually covered for 10% by participants and 90% by external parties.

Table 4: Structural dimensions of the TIS relevant for LRECS: Infrastructure

Infrastructure			**Analysis of local context by local policy makers**	
Subcategories	*Examples*	*Capabilities*	*Local examples Present*:*	*Local capabilities Capable**: yes/ no*
Physical: artefacts, instruments, machines, roads, buildings, networks, bridges, harbours	The energy grid, (Renewable) Energy production facilities. The built environment. The digital environment (smart grid).	Physical: What is physically possible in the (built) environment. Software: What is digitally possible. Coupling supply and demand. Insight in energy usage.		
Knowledge: knowledge, expertise, know-how, strategic information.	Financial, legal, technical, organizational and communicative knowledge.	The know how to start and implement projects successfully.		
Financial: subsidies, fin programs, grants etc.	PCR, SDE+, Salderen Local subsidies & grants.	Incentive arrangements Start, process and investment capital to initiate and develop projects successfully.		
(The information in this table was based on the following publications: Schwencke , 2012; Fuse, 2017;)				

* Where to find them?
** Accessibility?

4.4 Interactions

This category describes the connections and relationships between organizations or networks (Wieczorek and Hekkert, 2012). The structural dimension of interactions in itself seems hard to grasp, but it does determine the functioning of many system functions (ibid.). Connectivity betweens actors facilitates the exchange of knowledge, informations, best practices. This connectivity takes place naturally within networks. For the development of local renewable energy within a municipality, it is important for municipal officers to be able to share knowledge and best practices with experienced partners in this sector. This might take place in networks at national, regional and local level. The municipality should identify these networks and determine how well connected they are to the networks.

4.4.1 National networks

HIER opgewekt

One organization that was mentioned in every interview was HIER opgewekt. This is a free and open platform with a very extensive knowledge base. Knowledge and best practices for every type of project goal and project phase can be found online. HIER opgewekt also organises workshops and an annual conference. In this way, this platform functions as a network. Its objective is to increase the accessibility of knowledge and not to assist particular projects.

Inter-municipal networks

Another way to build capacity within a municipality, is to learn from success cases elsewhere. There are many successful LRECS in the Netherlands, which can share their knowledge with inexperienced municipalities. In the Netherlands, the G32 is a network that connects 32 Dutch cities. One of the goals of this platform is to facilitate the exchange of knowledge.

4.4.2 Local & regional networks

Something that came up often during the expert interviews was the role of local networks. These can range from networks focused on business, sustainability or a network of local cooperatives. Such networks can all learn from each other in different ways in order to stimulate the local energy transition as well as support the LREC. These can exist at the regional level, within the province as well as smaller local networks just covering one city or town.

4.4.3 Individuals

According to experts, the development of knowledge would ideally take place by working closely with somebody who in the past had already successfully developed a local renewable energy project, to develop the new project. This way, knowledge is being generated while it is applied. This is more efficient than if an individual would initially learn everything on his or her own and then apply it (S. Zomer, personal communication, July 31, 2017).

Table 5: Structural dimensions of the TIS relevant for LRECS: Interactions

Interactions			**Analysis of local context by local policy makers**	
Subcategories	*Examples*	*Capabilities*	*Local examples* *Present: yes/ no* *+ description*	*Local capabilities* *Capable: yes/ no* *+ description*
At level of networks	Networks with knowledge about and experience with LRE: i) national networks ii) local & regional networks: local sustainability platforms, local business platforms	Connecting stakeholders: sharing knowledge and information, cocreation, exchanging skills and best practices.		
At level of individual contacts	Knowledgeable and experienced or interested people regarding LRECS.	Sharing knowledge and information.		
(The information in this table was based on the following publications: Schwencke , 2012; Fuse, 2017; personal communications)				

Chapter 5 Results II: System functions in the tool

Focusing only on the structure of the LREC TIS as described above would provide an insufficient analysis (Hekkert et al., 2007). Following, TIS-theory provides seven 'functions of innovation systems' (system functions) which incorporate the overarching activities of the system. These must perform in a certain way in order to facilitate the successful deployment of a technological innovation. These functions and what they entail have been described in the theoretical chapter. Now, they will be applied to the context of local renewable energy cooperatives and a description will be made of their mutual interaction in this system.

Hekkert et al (2007) propose several ways in which the system functions can relate to each other. One of them resonates most with the setup of this research. Renewable energy technologies have been around for quite a while, but recently have gained more interest in the light of the 2015 Paris accord and national targets that follow. This is described by *guidance of the search (F4)*. Specific societal issues are pinpointed by governments, and goals related to the technology are set to limit environmental degradation. According to the authors, this can be an input for the *mobilization of new resources (F6),* in turn augmenting *knowledge development (F2)* as well as *knowledge diffusion* (F3) for the technology.
In figure 1, various ways in which the system functions interrelate are visualised. If change is triggered by guidance of the search, it related to motor C according to the image. As can be seen, the increased expectations in turn influence the *entrepreneurial activities (F1), which influence legitimization(F7) and finally market formation (F5).* Therefore, we will adopt this sequence of the system functions, corresponding to the relationships that are found in the field of LRECS. In this chapter, I will explain how each system function was interpreted by the experts.

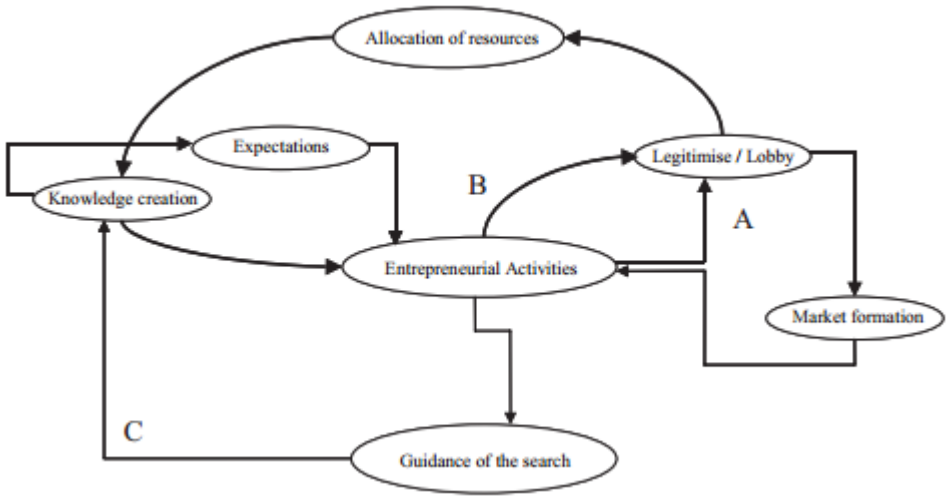


Figure 4: Motors of change proposed by Hekkert et al. (2007)

5.1 Guidance of the Search

5.1.1 General TIS interpretation

According to general TIS-theory, governments can provide guidance of the search by setting short-term and long-term policy goals in relation to the technology and by expressing positive expectations about the technology (Bergek, Hekkert, and Jacobsson , 2008). Van Alphen et al. (2010) emphasize the value of regulatory flexibility around demonstration projects as well as the importance of standard setting. In general TIS literature, guidance of the search can be done by: Setting standards, setting targets, taxing negative externalities, subsidising positive externalities, eco-labeling and other voluntary approaches, and tradable permits (Hekkert et al. (2007), Torres Silva (2008)). Municipalities do not have the power or means to do many of these things, so I will look at measures more relevant for local governments.

5.1.2 Context specific interpretation

Similar to the theory, guidance of the search was interpreted by the participating experts to be 'government initiated steering of the development of local renewable energy'. An important nuance is that, in this case, the focal point was the ability of the municipality to steer the development at the local level. Since municipalities have no (short term) influence on the decisions made on national and regional levels of government, multiple ways were discussed in the interviews where the municipality can directly influence guidance of the search. Experts interviews confirmed several recommendations from literature, and expanded upon these. These will be accommodated per structural dimension.

5.1.3 Function requirements

1. Actors

For the adequate guidance of existing and new LRECs in the municipality, an energy ambassador with the necessary knowledge and skills should be present within the municipality. Many of the problems related to a lack of sustainability actions taken by municipalities are ascribed by the experts to a lack of manpower within the municipality. Quite often, the subject of sustainability is an add-on to the work package of policy makers for other fields and not their sole priority. Therefore, it is understandable that time spent on this subject is limited (A.M. Schwencke, personal communication, August 10, 2017). Experts mentioned that if municipalities are serious about their climate goals, they should create extra FTEs to support this (M. Pohlkamp, personal communication, September 7, 2017). This position should be filled by a person who supports initiatives and guides them throughout the process, as well as being a general advocate for the decentralized energy movement by providing information education and awareness inside and outside the municipality as an organization.

2. Infrastructure

Before writing a vision for the local energy transition, first of all it is important that the municipality should have a clear idea of their local energy situation.

"Municipalities are currently quite unaware of their local energy situation. How much energy is used, how much is produced and in what way are not always clear. When the realistic current situation is mapped, then the next step can be taken" (F. Schelleman, personal communication, august 11, 2017).

If a municipality knows how much renewable energy their region currently generates, informed and realistic ambitions for the future of the energy system can be formulated. According to the experts, most municipalities have some form of a sustainability ambition. However, these are often quite general. Almost all municipalities have the ambition to be energy-, CO2- or climate neutral by a certain year, ranging from 2020 to 2050. However, these ambitions are not accompanied by specific steps of how to go about reaching such drastic goals (Mul, 2015). First of all because municipalities do not realise how drastic these goals in fact are. Initial mapping can be done by using the climate monitor (www.klimaatmonitor.nl), an online tool made available by Rijkswaterstaat (Ministry of Infrastructure and Environment). This could be placed under physical infrastructure generating the necessary knowledge for system development.

3. Institutions

Hard institutions: goals and targets

The next step is to create a roadmap towards this goal. This roadmap should consist of very specific goals and targets for specific timeframes, as well as the steps necessary to attain these. This will contribute to reaching the overarching goal within the time limit. Since goals and targets are identified as hard institutions by Wiekczorek and Hekkert (2012), this roadmap is placed here in the tool.

'Of course, to know whether the municipality is on the right track, systematic and thorough monitoring should be in place' (A.M. Schwencke, personal communication, August 10,2017). Again, the climate monitor can be of help.

Soft institutions: vision and ambitions

Parallel to these ambitions related to renewable energy, the municipality should create a vision regarding the energetic society. The role citizen participation, local initiatives and local energy can play in attaining the goals related to renewable energy should be articulated. Currently this is not the case in most municipalities according to the experts (Zomer, Schelleman, Schwencke). This is closely related to the (lack of) knowledge about these initiatives within the municipality. Logically, in the case of no existing policy or vision on energy cooperatives, municipal officers are completely in the dark when it comes to dealing with these initiatives. Hence, it is important that ideas are crystallized beforehand. How can LRECS support the municipality in attaining her goals and how do we as a municipality support LRECS in return?

4. Interactions

The manner in which the local vision for the energy transition is shaped, should be co-created with the relevant stakeholders. This way, mutual responsibilities can become clear and parties can express their needs. Therefore, it is important that there is an open interaction between the municipality and relevant stakeholders in the municipality. This might be measured in a physical or digital place where these parties can meet and discuss (M. Pohlkamp, personal communication, September 7, 2017).

5.1. 4 Assessment table

Table 6: Guidance of the Search Assessment table

F1- Guidance of the Search			
Function requirements	Measured how:	Presence: Yes/No + description	Capability/ Quality: weak -, moderate +/-, strong +
Actors Adequate manpower within municipal organization to support local energy transition: energy ambassador	Amount of FTEs available for a local key actor advocating community energy initiatives by providing information, education and awareness.		
Infrastructure Mapping and monitoring of local energy situation.	Klimaat Monitor: i) Energy produced (how much and how) ii) Energy consumed (how much and how)		
Institutions Hard: Goals and targets related to energy transition. Soft: Vision related to energetic society	Hard: Implementation program with measurable targets and deadlines. Vision and policy on collaboration between municipality and LRECs, as well as other relevant partners.		
Interactions Open interaction between local government and initiative.	Physical or digital place for stakeholders to meet and discuss.		
Sources: IRENA (2013); Hekkert et al. (2007) ; Torres Silva (2008), (Westley et al. (2013), Bergek, et al. (2008), Van Alphen et al. (2010), (Meelen & Farla, 2013).			

5.1.5 Action perspective municipality

This system function is all about the municipality influencing steering and selection of local renewable energy production. Table 6 provides different areas where this can take place. Once the policy makers have filled in this table to their fullest potential, weaknesses in the local system should become clear. For each of the structural elements within this system function, the policymakers should take a critical look at their performance and dedication.

If there is a lack of FTE' s dedicated to sustainable development and the energy transition, logically one of the first steps to be taken is increasing the amount FTE's. This person can start performing the next necessary steps: voicing a mission and vision regarding the future of the local energy system, including the partners that will assist the municipality in this. This creates mandate for the next step which resembles hard institutions: mapping the current energy situation and formulating specific new goals and targets in the municipality implementation program. All the while, the municipality should obtain an open attitude, allowing stakeholders to participate in the formulation of local policy and assisting initiatives proactively, with a flexible and creative mind-set.

5.2 Mobilization of Resources

5.2.1 General TIS description

Resources are the means or assets required to start-up and operate an enterprise or organization and to ensure that they function effectively (Zardi, 2015). Having sufficient resources in terms of the necessary specialist skills, knowledge and experience, have been shown to be critical for the success of LRECs (Seyfang et al., 2013; Seyfang and Smith, 2007; Rogers et al., 2008; Hinshelwood, 2001; Middlemiss and Parrish, 2010; Vandevyvere and Nevens; 2015 as cited in Zardi, 2015). According to Meelen and Farla (2013), the provision of resources is a general activity to support the other functions.

5.2.2 Context specific interpretation

Walker (2008) states that establishing a community energy project involves many complexities, whichever model of development is adopted. Complexities include for example the legal conditions under which organisations or projects can operate, establishing a scheme's economic and technical viability (Dunning and Turner, 2005) and the need for extensive liaison (Hinshelwood, 2001). It is essential to have expert advice and support and to learn from previous experience (Adams & Berry, 2008). This finding corresponds with the findings of the expert interviews. During the interviews, it became apparent that different resources are needed during different phases of development. It is also important to make the distinction between different types of energy cooperatives: focusing on energy reduction strategies or producing renewable energy (wind or solar).

Through the interviews, the resources needed for energy production are identified as: finance, knowledge, time, information provision and ground positions. Even though different resources are needed during different phases of the project, all of these can be met by financial resources. Money buys services, time and expertise, all essential to the development of high quality local renewable energy projects.

5.2.3 Function requirements

1. Infrastructure

In the structural element section of infrastructure, the different kinds of capital necessary for system development have already been briefly described. Now, I will relate how the accessibility to these funds was valued in the interviews.

Financial infrastructure

Start capital

According to the experts, there is a need for external finance for activities in the initial phase of a project, since cooperatives do not have any cash flow in this phase yet. Hours are put in voluntarily to design a project plan, generate publicity and become a formal entity.

It was not uncommon that these costs are covered by local or regional funds, in the form of subsidies. However, what was missing according to some key actors, was some form of compensation for hours put into the project by the initiators. This is in line with findings from Seyfang et al. (2013), arguing that time to carry out the project work, which if sufficient, is essential for the success of these communities. Following from this, the authors found that a lack of time to carry out projects was seen as an overarching barrier. Schelleman and Zomer,

indicated in their interviews that in their experience, a lack of access to start capital was the largest barrier to development.

Process capital
As described, process capital is needed in order to strengthen the project with external expertise. For a cooperative without any money, it is impossible to hire such expensive professionals. However, this would very much increase the chances of success of projects (R. Feddema, personal communication, August 23, 2017). Profitability is a crucial factor for successful RECs. In order for the RECs to succeed in the future, they need to be feasible and profitable (Arentsen and Bellekom, 2014; Huijben and Verbong, 2013; Doci and Vasileiadou, 2014; Oteman et al., 2014). A rational payback scheme and a suitable return on investment support this (Oostra and Jablonska, 2013; Doci and Vasileiadou, 2014). In order for a project to be profitable, both costs and benefits need to be taken into account and allocated effectively, meaning that project managers have to make a precise calculation of the expected costs (Walker, 2008; Hinshelwood, 2001, Vandevyvere and Nevens, 2015; Hisschemoller, 2012). The input of external expert knowledge can improve these aspects of the project, thus not only increasing the technical feasibility but also the financial feasibility and therefore the success of the projects and the sector at large.

Process capital for this purpose could be provided by local or regional funds. In the province of South Holland, a new subsidy arrangement was opened during the period of research, which intends to cover exactly these costs. Evaluations of the arrangement will have to prove whether it serves its purpose. However, already during interviews with experts, it came forward that a weakness of the arrangement is the lack of opportunity to subsidize the input of voluntary hours by members of the cooperatives.

Investment capital
In the case investment capital is necessary, for the realization of very large (wind) projects, banks are the designated party for this. Banks can also help out with funds to increase the attractiveness of the business case, by decreasing the payback time of participant investments.

Physical infrastructure
Ground positions

For the development of local renewable energy, a unique resource that cooperatives need is that of ground positions in the form of a location where the renewable production facility can be installed or built. For PV systems these can be large rooftops or empty fields or terrains. For wind, a large area is needed to build the wind turbine, the location of which is usually predetermined by higher level governments. Therefore, these are more scarce than locations for solar.

2. Institutions
The previous section already mentioned cases of local government providing funds in some cases. This is something that was mentioned very often as a positive input for system development. Of course, whether a municipality will be able to provide these funds depends on their institutional arrangement. This has to be embedded in policy regarding the local energy transition and citizen participation. Regarding the role of the municipality, the most appropriate one differs per development stage of the initiative. As the professionalism of the initiative grows so must the professionalism of the relationship between initiative and mutually grow as well.

3. Actors

Different actors can be the providers for the resources LRECs need. This can be derived from the actor information in the structural elements chapter. Public actors for 'free money' in the form of subsidies. banks for loans on investment, civil society for financial project participations and companies and public actors for ground positions.

4. Interaction

The frequency and intensity of interaction between LRECs and partners which can provide them with resources, increases the accessibility to these resources. The municipality might be able to facilitate these interactions.

5.2.4 Assessment table

Table 7: Mobilization of Resources Assessment table

Mobilization of resources			
Function requirements	Measured how:	Presence: Yes/No + description	Capability/ Quality: weak -, moderate +/-, strong +
Infrastructure Start capital Process capital Investment capital Ground positions	Identify where and whether these different funds can be acquired by the LREC in your local context (available grants and subsidies, satellite images of municipal region.)		
Institutions Policy on providing funds and ground positions for LRECS A clear role distribution	Content of municipality policy programme. coach, facilitator, service provider, participant and co producer.		
Actors Public, financial, commercial and civilian actors willing to provide resources	Identify whether such actors are available in the region. Use local platform.		
Interactions Open and frequent interaction between actors	The accessibility of abovementioned for LRECs.		

5.2.5 Action perspective municipality

The experts explained that the problem with the mobilization of resources is not so much the amount of money available for system development. In total this was estimated to be around 1 billion euro (S. Zomer, personal communication, July 31, 2017). The problem, however, is the accessibility of this money.

The municipality can play a role in alleviating this issue. Not every municipality currently has a large budget available to supply the start and process capital needed. However, some municipalities do have capital available that is currently unused. Others could take a critical look at their available budget, and increase the funds for the energy transition by rearranging priorities.

If the municipality is serious about the goals it has set for themselves under 'guidance of the search', this should be accompanied by an appropriate increase in available budget.

Besides this, the municipality can be a guide for the LREC, assisting them in the quest for funding from the different subsidy options available and when applying for these.

Regarding ground positions, the municipality must also ascertain to what extent it can increase the accessibility of this resource. Perhaps within their own property or in different ways. This will be elaborated on under market formation.

5.3 Knowledge development & Knowledge dissemination

5.3.1 General TIS description

'Knowledge development can be stimulated by financing and facilitating R&D (Negro, Hekkert, and Smits 2008) and by learning from (niche) experiments (learning-by-doing) (Negro, Hekkert, and Smits 2008; Van Alphen, Hekkert, and Turkenburg 2009). Van Alphen et al. (2010) advise demonstration of technologies on a commercial scale to trigger learning-by-doing instead of learning-by-planning' (Meelen & Farla, 2013 p. 961).

5.3.2 Context specific interpretation

Since the cooperative sector is not profit driven, the system functions of knowledge development and knowledge dissemination occur in a different manner than is described by general TIS literature. While knowledge development is traditionally accounted for by investing in R&D, cooperatives do not own the necessary funds. According to the experts, the cooperative sector develops knowledge by sharing it. Therefore, the system functions knowledge development and knowledge dissemination are intertwined.

"What's interesting about cooperatives, is that they all operate locally or maintain a vision that one should cooperate with local initiatives and hence be area-oriented. Nobody holds the intention to take over the world. Your locally acquired knowledge might as well be given away to another cooperative, since they are carrying out the same thing but in a different place. So now you see that knowledge development is becoming almost open source (S. Zomer, personal communication, July 31, 2017).

5.3.3 Function requirements

In the structural factors, the necessary financial, legal, technical, organizational and communicative knowledge to successfully start and manage an LREC is described.

During the interviews, it was discussed whether this knowledge is available and whether anything is being done to develop knowledge. Since the object of study is the municipality, this question was adapted to that scope.

1. Actors

Knowledgeable actors

For the performance of this system function, it is important that the people active within a LREC possess adequate knowledge and skills. Although a large responsibility for this lies with the project initiators themselves, a lot of knowledge is very specific and cannot possibly all be present within the LREC. The municipality can assist by knowing where to find the knowledge that might not be available within the LREC. This is supported by literature stating that: a lack of information and knowledge regarding applicability of RE alternatives can be a potential barrier. Therefore, at the local level, if the government should provide the necessary information to know how to invest in a RE solution, the possibility for citizens to get involved and invest in RE can be realized (Torres Silva, 2008).

A good way to develop knowledge according to several experts (Feddema, Hildebrand, Zomer, Schelleman) was to work together with an experience expert to develop new projects. In this way, knowledge is being shared and generated while it is applied.

2. Institutions

A culture of sharing knowledge

Although knowledge development can hardly be influenced by setting rules and regulations, this can be stimulated within the culture of the municipal organization. During talks with the Province of South Holland, it was discussed how lecture style presentations on the energy transition intended for a variety of employees helped to raise awareness and enthusiasm within the whole organization. This stretched over multiple departments and actually connected the different subjects covered by the departments, through the subject of energy. Such a culture of continuous development and learning for all employees could also be very fruitful for municipalities. The municipality should also stimulate external stakeholders to join in this culture of learning because currently the norm seems to be: what's in it for me rather than what's in it for us (P. Van Norden, personal communication, August 7, 2017).

3. Infrastructure

Presence of necessary knowledge within municipal organization

Something that came up repeatedly during the expert interviews, was the perceived lack of knowledge within the municipality as an organization. From almost all participants, ranging from different backgrounds, this same perception was prevalent. Municipalities lack the knowledge to adequately respond to the needs of a local renewable energy system. This was a general conclusion rather than a negative judgement towards municipalities. Municipalities lack the capacity to include people with this knowledge and the existing workforce lacks the time to re educate themselves adequately.

However, it was seen as a huge barrier to system development. In many municipalities, the term local renewable energy cooperative hardly rings a bell. Especially if such an entity is not present within municipality borders already. Since 'unknown makes unloved', the first step towards system development is the general understanding of what an LREC is and what it can do for a community.

Besides that, the general knowledge about the energy system was also deemed to be inadequate. Although opinions were somewhat divided on this subject. On the one hand, the municipal officers do not need to possess very in depth technical knowledge about the energy system. On the other hand, they do need to have a realistic understanding of the interplay between actors in the field and steps that need to be taken in order to achieve energy related goals defined during guidance of the search. So although expertise can also be hired, the urgency of the problem needs to be understood. Otherwise the realisation that expertise is necessary will not occur in the first place.

4. Interaction

For this sector, the natural way to develop knowledge is by sharing it: knowledge dissemination. Access to information has been found to be a critical requirement for the establishment of LRECs and thus, for their success (Hinshelwood, 2001; Seyfang et al., 2013; Oostra and Jablonska, 2013; Seyfang and Haxeltine, 2012). Local networks critical for local energy affect the form, foundation and establishment of LRECS (Doci et al., 2015; Seyfang et al., 2013). Cooperating with other stakeholders in the field allows LRECs to share social capital, information and experiences and thus allows them to learn from each other and act as a collective (Seyfang et al., 2014; Seyfang and Haxeltine, 2012). The cooperation with local authority and business in particular, stimulates the achievement of goals and increases LRECs embeddedness in the electricity supply system, thereby safeguarding their continuity and survival (Hisschemoller, 2012; Hinshelwood, 2001; Doci and Vasileiadou, 2014; Seyfang and Haxeltine, 2012; Arentsen and Bellekom, 2014).

According to the interviews, this sharing of knowledge can take place in several ways: national networks, local and regional. This is described under the structural element of interactions. Within HIER opgewekt it was unclear whether municipalities know their way to the platforms. Municipalities in which a LREC was already active did seem to know about HIER opgewekt, but whether they do when an initiative was not yet present was unknown (T. Wentink, personal communication, August 14, 2017). This would be an excellent place for knowledge development not only for people active within LRECS, but also local policy makers.

The interviewees were doubtful whether there currently is a strong connectivity between municipalities. There seems to be a barrier to pick up the phone and call a municipality with no previous connections to ask how they realised their local renewable energy project (A.M. Schwencke, personal communication, August 10, 2017). Naturally, this could potentially be a fruitful way to stimulate the diffusion of knowledge.

5.3.4 Assessment table

Table 8: Knowledge Development and Diffusion Assessment Table

Knowledge development & diffusion			
Function requirements	Measured how:	Presence: Yes/No + description	Capability/ Quality: weak -, moderate +/-, strong +
Infrastructure financial, legal, technical, organizational and communicative knowledge	Test whether all fields of knowledge are covered within the initiative and the municipality (backgrounds and experience)		
Institutions Culture of developing and sharing knowledge	Internal lectures, courses, workshops on the subject		
Actors Knowledgeable initiators and municipal officers External experts	Background of initiators and municipal officers Identify experts with additional knowledge		
Interactions Access to networks of information	Connectedness to municipal networks (G32, IPO)and energy related networks: (Rescoop NL , HIER opgewekt, ODe)		

5.3.5 Action perspective municipality

The findings from the interviews revealed two essential areas of knowledge development: knowledge for LRECS through the municipality and knowledge about LRECS within the municipality. Note that the municipality as organization is meant here. The municipality should ensure the they have the necessary knowledge to deal with LRECs. This can be done by taking a look at the knowledge present within the employees of the municipality. If knowledge lacks, hire the right people (guidance of the search). Also, they must help LRECS with getting access to knowledge when it is lacking. There should be a culture of openness to new information and ideas, learning for the collective. This includes good connectivity with experienced stakeholders in networks and the participation to workshops on the subject.

5.4 Entrepreneurial activities

5.4.1 General TIS description

The role of the entrepreneur is to turn the potential of new knowledge, networks, and markets into concrete actions to generate–and take advantage of–new business opportunities. Entrepreneurs can be either new entrants that have the vision of business opportunities in new markets, or incumbent companies who diversify their business strategy to take advantage of new developments (Hekkert et al., 2007). The experimentations of entrepreneurs are the input of many forms of learning about the system (Wieczorek and Hekkert, 2012). Entrepreneurial activities will result when the other functions are stimulated (Hekkert et al. 2007). However, it is acknowledged that entrepreneurs should be more involved in innovation policy-making because their interests are often neglected (Hekkert, 2010).

5.4.2 Context specific interpretation

Before many of the previous system functions can be fulfilled, people have to have joined together with the goal to develop a local energy project. They have to cooperate, make a plan and be willing to take risks together (P. van Norden, personal communication, August 7, 2017). This system function was interpreted differently within this sector, as it was in the general TIS literature. Where technological innovations usually take place within capitalistic systems, the cooperative energy sector is not driven by profit but rather a social purpose. Hence, the entrepreneurs in this sector are initially and essentially volunteers.
Siward Zomer (personal communication, July 31, 2017) explained that capitalistic companies borrow value from the future by means of big bank loans, with the goal of repaying this with value they will create in the future. These initiatives begin their existence 'in red numbers' . Only if they turn out to be successful, the debt will be repaid. If they fail, the investors lose their money. This creates an endless 'boom and bust' cycle within the economy.

Cooperatives, on the other hand, wish to remain independent. Therefore, they cannot rely on bank loans and they have to rely on people within their local economy to invest. Since this is a relationship built on trust, the cooperative will not take any risks when it comes to paying back their investors. Hence, the cooperative will avoid taking loans as much as possible. The result is that much work is done voluntarily in the beginning, and the entity starts out in 'black numbers', with a steady continuous economic growth rather than consecutive boom and busts.

This paradigm difference has consequences for the entrepreneurial activities taking place within the system. People willing to invest time in an energy cooperative, have to be driven not by a desire for profit, but by idealism. They must be willing to work voluntarily for the most part. They must also be able to do this. Idealists are rare, and especially idealists with the right knowledge and skills to be an innovative entrepreneur. Volunteers are even more rare and idealistic volunteers with the required skill set are the most rare of all.

5.4.3 Function requirements

1. Actors

So this presents a challenging proposition for the entrepreneurial activities system function. What this system needs is a large inflow of entrepreneurs, with opportunities to experiment and learn. The experimentation leads to potential innovation. The more people actively experimenting, the larger the innovation potential (Wieczorek and Hekkert, 2012). From expert talks we find that the amount of initiators in the cooperative energy sector is growing exponentially, but in total it is still a relatively small amount with 313 cooperatives and 50.000 members (Lokale energiemonitor, 2016). Also, the people active in cooperatives are usually somewhat older white men, often retired with a technical or economical background (T. Wentink, personal communication, August 14, 2017).

What is needed for system development, is a larger inflow of initiators who possess the right qualities, skills and knowledge. Also a younger and more diverse demographic would be beneficial for growth.

'You need the right mix of people, an entrepreneur; a storytelling leader who can enthuse people and technicians who can organise it. Of these you need a good balance within your organization' (S. Zomer, personal communication, July 31, 2017).

2. Institutions

Hard institutions

In their regulations and also soft policy, the municipality can do several things to activate more initiators. The work that these people do, contributes to municipality and national government goals. If the Netherlands is serious about the energy transition, they have to acknowledge the value of these people and reward it appropriately.

'The biggest barrier is the usual: lack of manpower and resources. Especially financial resources. You would be able to put in more time when part of it is being compensated. You need be able to sufficiently deploy people in order to have reach and impact' (F. Schelleman, personal communication, August 11, 2017).

The municipality could stimulate and attract more people to become active in an LREC if they would provide some sort of financial compensation. There is no need nor wish for full compensation of hours, because the idealism and voluntary aspect of this sector is what sets it apart from the commercial sector and what gives it the potential to create social innovation besides technical innovation. However, multiple interviewees indicated that a compensation would definitely improve the amount of hours that can be spent on this, as well as being a fair reward for the amount of work contributing to municipal goals being done by volunteers (Schwencke, Schelleman, Feddema) Some said it might be a good way to attract younger people (M. Pohlkamp, personal communication, September 7, 2017). The possibility to provide this compensation and details on the conditions should be taken up in local policy.

Soft institutions

Once a group of people is willing to initiate a local energy project, the municipality should encourage and reward them. The encouragement can be done by guiding them in the process, providing the necessary information and celebrating wins. Individuals who are meaningful in a particular neighborhood in relation to the execution of RE projects, should be granted extra

flexibility and freedom regarding some bureaucratic arrangements (M. Pohlkamp, personal communication, September 7, 2017).

3. Infrastructure

Logically, people have to be aware of the possibility to join an LREC. Therefore, what's at the bottom of this system function is dissemination of knowledge regarding LRECS. This happens naturally when successful projects get media coverage and spread information and enthusiasm. General marketing campaigns regarding local renewable energy were not seen as the right way to attract new people. Another way that might be fruitful, according to several interviewees was to target people more precisely. This comes down to the ability of different stakeholder within the municipality to find and connect with each other, share social capital and act as collective. It will therefore be described in the following section under interactions.

4. Interaction

Target location

Something that came up during talks with HIER opgewekt, the province of South Holland and Municipality of Gouda was the idea to externally promote the start an LREC in a location at a moment that many things are already changing in that area. For example, in Gouda a neighbourhood was completely turned upside down due to pipeline replacements. This was taken as moment to consult the neighbourhood about their wishes for the development of the area (E. Ten Cate & P. van Norden, personal communication, August 7, 2017). Besides the replacement of pipelines, things such as the development of green and the possibility to produce renewable energy were discussed with the inhabitants. Such moment are excellent trigger points for the development of LRECs. A group of people that care about their neighbourhood gets together, is being asked for their ideas and input and are given the chance to improve their surroundings. As a municipality, the possibility and upsides of a local energy project can be explained at moments like this. A similar trigger point would be when a neighbourhood is being cut off from the gas supply, as is going to have to happen in many places in the near future. This calls for energy alternatives and the need to save energy. An LREC can take on both (T. Wentink, personal communication, August 14, 2017).

Target groups

Another way to engage more people with LRECs is to target social groups that already have strong relationships and mutual trust, and to add the element of renewable energy later. For example, the municipality could propose to a local sports club to initiate a solar project on one of their buildings. This brings the usually distant subject of energy closer to home (R. Feddema, personal communication, August 23, 2017).

5.4.4 Assessment table

Table 9: Entrepreneurial Activities Assessment Table

Entrepreneurial activities			
Function requirements	Measured how:	Presence: Yes/No + description	Capability/ Quality: weak -, moderate +/-, strong +
Actors A larger, younger and more diverse inflow of initiators who possess the right qualities, skills and knowledge.	Map and monitor initiative groups and identify potential new LREC groups (see knowledge).		
Institutions Stimulate initiators in your policy programme:	-Compensation - Guidance - Regulatory flexibility		
Infrastructure Targeted knowledge provision	Identify target locations and target groups		
Interactions Enable different stakeholder within the municipality to find and connect with each other, share social capital and act as collective.	Stimulate the emergence of RE projects in target locations/ with target groups. By meeting en engaging with them.		

5.4.5 Action perspective municipality

LRECs have so far usually emerged in a natural way, when a group of neighbours or members of a club take up the idea to start producing energy for the community together. However, the need to accelerate the Dutch energy transition is pressing. Therefore it is important that the municipality should be proactive when it comes to stimulating initiators. Usually, municipalities are more passive and wait for initiatives to come to them. There should be a realization that these initiatives can significantly contribute to municipal goals and ambitions. Therefore, there is much to win if the municipality actively stimulates entrepreneurial activities in this regard. What can be done in this respect is to track potential initiator groups, approach them at the right time with the right information and keep guiding and supporting them along the way.

5.5 Creation of Legitimacy

5.5.1 General TIS description

'The creation of legitimacy can be supported by changing institutions (laws, rules, routines, etc.) in order to make them more compliant with the technology of the TIS (Bergek, Hekkert, and Jacobsson 2008). Also, open communication about a technology can help creating legitimacy for the technology (VanAlphen, Hekkert, and Turkenburg 2009). Hudson, Winskel, and Allen (2011) argue that setting technology-specific targets may increase legitimacy and that technology-specific (trade) organisations may be used to focus and unite interests" (Meelen and Farla, 2013 p. 961).

5.5.2 Context specific interpretation

According to all interviewees, legitimacy has grown in recent years among general public and government officials. Reasons for this are thought to be increasing environmental awareness and the growing importance of cooperation between stakeholders in general. Cooperatives are increasingly recognized as a useful partner in the energy transition (M. Hildebrand, personal communication, August 23, 2017).

The added value of cooperatives lies especially in their ability to augment civil support (E. ten Cate, P. Van Norden, M. Pohlkamp, F. Schelleman, T. Wentink, M. Hildebrand, S. Zomer; personal communications july-september 2017). HIER opgewekt phrases it as follows: "It is important to have a clear idea of the role an LREC can play in the energy transition at municipal level. That is indeed the involvement of citizens, but also giving people a say in their own energy supply. Having influence on the choices that still have to be made. And taking initiative in the process. As energy co-operation, you are going to make a vision with citizens: in the future this is how we see our energy. That's different from the municipality asking citizens what they think is important. Coops are very good for the support, the involvement of people" (T. Wentink, personal communication, August 14, 2017).
Especially wind projects have become almost impossible to execute without local support (S. Zomer, personal communication, July 31, 2017). So the legitimacy of LRECs derives from their ability to generate local support. And in return we see that support for LRECS is growing.

5.5.3 Function requirements

In order to increase LREC legitimacy, three main strategies have come forward during the interviews: increase knowledge about LRECs, showcase successful projects and portray the numerous smaller initiatives as one bigger movement. Of course, an increase in legitimacy will follow naturally once all other system functions are accounted for.

1. Actors

Meelen and Farla (2013), underline the importance of lobbying when it comes to the creation of legitimacy. Translating it to this sector, we can interpret this as having actor groups that actively advocate the development of local renewable energy. In the Dutch local renewable energy sector there has been seen such a trend (S. Zomer, personal communication, July 31, 2017). It is described under interactions because what was observed was coalition forming of multiple smaller groups advocating the merit of the sector into a few organizations standing as one. Torres Silva (2008) proposes that coalitions must be formed among the main actors in the community in order to not undermine the interests of all the community. In this way, coalitions

can reinforce political support, work to combine multi-stakeholder benefits and find solutions to barriers. ODE Decentraal, the biggest Dutch interest association for -especially local and decentralized- renewable energy producers includes energy cooperatives as well as large producers, banks, public authorities and commercial partners in its members (www.duurzameenergie.org). This seems to cover many important stakeholders, but no government parties such as municipalities or provinces are present. This might increase the potential to reinforce political support even more.

Besides these national coalitions, which are present, the TIS literature talks about coalitions within important stakeholder groups. Translating this, would mean to have advocates of LRECs in important stakeholder groups within the municipality. 'To have supporting advocates in the city council is as important if not more important as having support in civil society' (A.M. Schwencke, personal communication, August 10, 2017). This support should not only be felt, but also explicitly mentioned in policy (ibid).

2. Institutions

As discussed under guidance of the search, it is important for a municipality to voice a clear vision on the role of local renewable energy cooperatives in the local energy transition. This automatically creates legitimacy for these initiatives by embedding them in local policy. This is in line with general TIS recommendations (see 5.6.1).
Important contents of this policy, should be the pledge by the municipality to support the development of projects. The realisation of such initiatives will be made easier by providing resources and increasing flexibility of regulations surrounding local energy production.

3. Infrastructure

In terms of infrastructure two things are pertinent when it comes to knowledge: general knowledge about LRECs and knowledge about successful projects. It has been stressed by theory and interviewees that knowledge about this sector is quintessential to its development. If people do not know about it, they will not participate in it or support it. The best way for people to get this knowledge according to the experts, is by having many successful projects showcased.

"I think that having good exemplary projects will increase people's enthusiasm. It works like a snowball effect. As soon as you can successfully realise one or two projects locally, I expect other businesses and parties to become eager to provide their roofs for projects as well. Neighbors see that people have invested in projects in a fun [lucrative] way. You need to reach a certain threshold before it really takes off" (F. Schelleman, personal communication, August 28, 2017).

S. Zomer and T. Wentink also proposed having good exemplary projects as the best way to resolve resistance. HIER opgewekt is already doing this to some extent, but realises that their audience consists mostly of people who are already familiar with the sector (T. Wentink, personal communication, August 14, 2017). So the municipality might be the right party to showcase a project locally for new audiences as well.

HIER opgewekt has developed an information providing tool called 'Storytelling', which includes several storylines regarding LRECS. Depending on the audience, different storylines can be selected. Some people are more susceptible to the financially interesting aspect of LREcs, while other appreciate the local, social or sustainable aspect more. As an initiative or as a municipal officer aiming to increase the legitimacy of LRECs, tools as these can be used to appeal to several audiences (T. Wentink, personal communication, August 14, 2017).

4. Interaction

"Five years ago, there were only individually operating energy cooperatives. Everyone did their own thing. Nothing big happened and people did not take them seriously. There were some representative parties, but they were not functioning properly. Three years ago we decided to form a coalition: ODE Decentraal. This was a lobby organisation for energy cooperatives. Now, all parties working on this are joined together. Now we can be easily recognized as the energetic society" (S. Zomer, personal communication, July 31, 2017).

This is in line with general TIS theory as a valuable strategy to increase legitimacy: 'wider circles of more powerful niche actors becoming involved in ways that mobilise widespread social and environmental legitimacy is the greatest determinant of niche success' (Schot, 1998). At a local level this can be interpreted as the importance of forming coalitions with the parties who are active in this field. And for them to join in with existing networks.

5.5.4 Assessment table

Table 10: Creation of Legitimacy Assessment Table

Creation of Legitimacy			
Function requirements	Measured how:	Presence: Yes/No + description	Capability/ Quality: weak -, moderate +/-, strong +
Actors Multi stakeholder coalitions	Advocates for LRECs within relevant stakeholder groups: - municipal board, business, civil society.		
Institutions LRECS embedded in local policy	Policy granting active municipal support in the realisation of new projects (with resources and flexibility)		
Infrastructure Exemplary projects to spread awareness and enthusiasm	Appropriate information about successful projects available for new audiences (storytelling) through public media supported by municipality.		
Interactions Coalition forming between initiatives	Membership of interest associations.		

5.5.5 Action perspective municipality

Policymakers willing to improve the deployment of LRECs should find advocates for LRECs within relevant stakeholder groups and allow them to strengthen each other's positions. First of all, important actors within the city council should be explicit about their support for LRECs. This should be taken up in policy too, in the form of pledged municipal support regarding the development of projects. The municipality should join coalitions of commercial partners, civil society and other relevant actors acting as interest associations. Regarding information provision, the municipality should use public media to showcase successful projects and use storytelling to appeal to a varied audience.

5.6 Market Formation

5.6.1 General TIS description

As Wieczorek and Hekkert (2012) describe, initially there are no obvious advantages of new inventions over existing technologies, because existing infrastructure is still adapted to older technologies. This makes any innovation slow at first. Therefore, it is important to consciously create protected space for new technologies. An example could be the arrangement of a temporary niche market, where actors can experiment with and learn about the new technology as to manage expectations. Also possible is the construct a competitive advantage by means of favourable tax regimes (ibid).

5.6.2 Context specific interpretation

The local renewable energy market involves many different actors. These are described under structural dimensions. A better understanding of the dynamics, capabilities and agenda's of such actors would further aid the progress and development of renewable initiatives.

What can be seen is that the creation of the Postcoderoosregeling, unintendedly created a protected space for renewable energy cooperatives. This is an arrangement that increases the business case attractiveness of LRE projects, but does not create an adequately attractive business case for commercial partners. So commercial parties did not attempt to realise such project with the use of the PCR. Now it is the terrain of cooperatives exclusively. Therefore it allowed this sector to experiment, learn and grow (A.M. Schwencke, personal communication, August 10, 2017).
However, this arrangement has also kept the sector operating within a small niche. Beyond this, the local renewable energy market is not very accessible for cooperatives due to competition with commercial parties. In order to be able to develop, a cooperative needs to acquire ground positions. However, they cannot compete with commercial developers in tender procedures. In those situations, LRECs always lose to parties with more resources, skills and experience. This is not a level playing field (S. Zomer, personal communication, Juli 31, 2017).

However, Zomer also explained why it is interesting for municipalities to have an LREC in the region. All the profit made by project developers from renewable energy projects, enriches the company. The only effect the municipality will have is potential negative effects. Thus, the community will only suffer the burden and not the benefits. However, if the production facility is owned by the community they will have both. The profit resulting from the project remains in the community, strengthens the local economy and will be reinvested within municipality borders. This not only increases legitimacy, but also is more financially attractive for the municipality (ibid).

5.6.3 Function requirements

Overall it was thought that the municipality has a potentially large influence on increasing market accessibility and thus system development. What it comes down to is allowing the establishment of a level playing field. LRECS should be able to compete, but the municipality needs to assist in this.

1. Actors

A prerequisite for market formation, is that one or more LRECs are present within municipal borders. The section on entrepreneurial activities discusses ways in which the amount of actors could be increased. Other partners must be present as well, and they must be willing to work with LRECs. The municipality could keep track of trustworthy partners for LRECs and make sure they stick to their agreements. This would look like a list of certified partners for LRECs. When these actors neglect their agreements with LRECs, the municipality could use their power, influence and objectivity to change the appointed partner's behaviour (M. Pohlkamp, personal communication, September 7, 2017).

2. Institutions

In this section, requirements for policy content will be described. This belongs to hard as well as soft institutions. Two fields of policy are of importance for LRE market formation: spatial policy and procurement policy.

Spatial policy

Ways to adjust spatial policy for the benefit of LRE were discussed by Schelleman, Pohlkamp, Wentink, Feddema, Zomer and Schwencke. This can be done in two main ways:

First of all, if the municipality owns ground positions, they could simply give these to the LREC. This way there is no unfair competition with commercial parties. The LREC can develop a project on municipal property.
Second, the other possibility is to allow commercial parties to compete for the grounds and set certain requirements the parties must meet. This could be that the winning party must cooperate with the local cooperative, or give a share of the project to the coop. This way, the project will be developed professionally, but local support will be included as well. The municipality does not voice specific preference for one party, but simply requires whoever wins to cooperate with the local party.

Procurement policy

A.M. Schwencke stressed the potential beneficial effect of a change in procurement policy as well. This is a novelty but becoming increasingly popular. The municipality can set requirements for their own energy procurement in their policy. A requirement can be that the energy has to be locally produced from renewable sources. This creates demand and opens up the local market (personal communication, August 10, 2017). Buying directly from the local energy cooperative can strengthen its business case. The municipality can thus act as launching customer.

3. Infrastructure

As mentioned, ground positions are essential for LRECS to participate in the local renewable energy market. How the municipality can improve accessibility to these for LRECs is described

above. In this system function, infrastructure and institutions are somewhat merged.

4. Interaction

Relating to the spatial policy requirements, interaction between commercial parties and LRECs should improve, so there can be a mutually beneficial relationship. As described under spatial policy, a closer relationship between project developers and LRECS could be very beneficial for the development of projects. This is an interaction that is relatively unpopular, because the two seem to have opposite goals. However, if they can work together this would increase the efficiency and legitimacy of renewable energy projects greatly.

5.6.4 Assessment table

Table 11: Market Formation Assessment Table

Market formation			
Function requirements	Measured how:	Presence: Yes/No + description	Capability/ Quality: weak -, moderate +/-, strong +
Actors LRECS present + trustworthy partners	List of certified partners		
Institutions Create a level playing field for LRECs	Procurement policy and spatial policy adapted to accommodate LRECS		
Infrastructure Ground positions for LRECS	Procurement policy and spatial policy adapted to accommodate LRECS		
Interactions Cooperation between commercial parties and civil society	Partnerships between LREC and project developers. Recurring and transparent communication between the two?		

5.6.5 Action perspective municipality

The municipality is perceived to have potentially large influence on increasing market accessibility. Currently, there is no level playing field for commercial parties and citizen initiated parties willing to produce local renewable energy. Since LRECs increase legitimacy and strengthen local economy, there is a real incentive for municipalities to use this influence. This they can do in their policy in two major ways: procurement policy and spatial policy. The municipality can create demand for LRE, by requiring themselves to run completely on LRE. Besides this, they can have influence regarding ground positions. Any positions owned by the municipality can be given to LRECs. Any positions that will be open for tender procedures, can be accompanied by the requirement that any winning developer must in some way cooperate with the local LREC. This increases interaction between commercial parties and civil society. Another way this can be improved is by providing a list of trustworthy and reliable partners for LRECs, by keeping track of a list of municipally certified partners.

Chapter 6 Discussion

This research is the first attempt at designing a context-specific policy assessment framework for policymakers who are interested in the introduction or development of LRECs in their region. The research has been unconventional in some senses and therefore its implications as well as limitations must be discussed carefully.
To begin, the outcome of this research must be seen as a preliminary version of the final tool to be used in practice. This thesis has been a theoretical endeavour in the most part. Further research must test the final framework with municipal officers, policymakers and LREC experts in the field. This would be easier if the framework would be converted to a digital tool. This digital tool could then be used to verify the system requirements and to elaborate upon them. Besides this, it would increase the practicability by allowing municipalities to fill in ways to measure the identified and verified system requirements.

Currently, the system requirements must be measured by local policymakers with preconditions that are in large part to determined by themselves. This makes it a context specific tool, because municipalities are highly heterogeneous and therefore it is difficult and perhaps limiting to predetermine the exact conditions that need to be present in the local situation. The drawback of this flexibility is that the reliability and outcome of the tool is highly dependent on context and on the individual conducting the assessment. Perhaps it is too demanding of municipal officers lacking any prior knowledge or experience whatsoever. On the other hand, the information provided by the framework will substitute this knowledge, and information on context specific requirements beyond provided in this thesis can always be acquired at the initiative of the municipal officers. The fact that this framework demands some active participation of users is not a negative in itself. Moreover, it is an incentive for municipal officers to take a more active stance in their community in general. The passive and facilitating approach that is currently favoured by municipalities does not seem sufficient to bring about the changes needed for the energy transition.

Something that must be kept in mind is that this tool includes external factors that are of importance to the success of LRECs. During the research process, I have been active to initiate my own LREC. During this process I found that internal factors might be of equal importance for the success of LRECs, especially the initial phase. By internal factors I mean the interactions within the LREC: mutual trust, organizational quality and social cohesion. I found that lack of these led to the slow and painful death of my own initiative. However, internal factors have been left outside the scope of this research, since municipal officers do not directly have influence on this. However, it has been identified as being very important not only by myself but also by the academic literature. In the final version of the tool, perhaps an element of internal factors should be added to the assessment framework.

As I was operating in the field while doing my research, but not always per se for the goal of my research, I acknowledge that I might have been somewhat biased. I gained a lot of knowledge outside of my research activities and thus some relationships between findings are obvious to me while this might not be the case for people lacking similar knowledge and experience. Paradoxically, my prior experience -which I perceived as a benefit- has limited me in doing my research in a structured manner and this might in turn limit the controllability and reproducibility of the research. However, this aspect also adds depth to the thesis since it adds an action perspective element and unique observations.

Bearing such things in mind, let' s discuss the implications of this research. First of all, the practical relevance of the TIS approach has been illustrated. The structural and functional elements of the approach have proved sufficient in describing and explaining the dimensions of real life innovation systems. In the interviews, I always asked participants whether they felt like the topics we discussed adequately covered the reality and they always agreed. This means that this thesis illustrated that it is possible to attune TIS theory, usually covering a regime level, to a smaller scale. The LRE sector is also different in the sense that it includes an idealistic and voluntary aspect, yet still TIS theory was able to structure the real life dynamics here. It is interesting to know that TIS theory can be applied to a range of innovations.

As for practical implications, no conclusive assumptions can be made about the content of the tool in terms of which function requirements are the most important. Luckily, this chapter provides opportunity to discuss such matters non-conclusively. Some observations made by multiple participants are worth exploring in further research. For instance, I see a relationship between resource mobilization and entrepreneurial activities in a wider sense than was described for the purpose of answering the research questions.

Overall, it is quite hard to come by qualified initiators and active participants. Currently, participating in an LREC is seen as a voluntary act. As the system is designed right now, the ideal initiator of an LREC is a pensioner. They have already acquired knowledge and skills in their life, as well as having made their money and therefore are able to invest a lot of time and energy into voluntary work such as the creation and management of LRECs without getting paid for it. However, younger people are not able to do this and therefore are absent from the voluntary sector for the most part. They are off earning their money somewhere else, even though they might prefer to work more in line with their ideals. Imagine the boost it would give this sector if enthusiast young people would be contributing to it by the masses. Multiple interviewees identified the need for some sort of national fund that provides money for start capital, including a compensation fee for LREC initiators. This should be created by the government, accompanied by the realization that the LRE sector contributes to society in such a way that it should not be dependent on volunteers alone. This fund could in turn be used to provide young people with a small fee for participation in LRECs. This could solve the problem of scarcity of active participants in this sector, as well as providing young people with life experience and a sense of societal responsibility. In effect, the deployment of LRECs would be strongly stimulated.

Chapter 7 Conclusions

This research addressed the need for local policy aimed at stimulating the development of local renewable energy initiatives. Local government has been given much responsibility in the execution of national goals and ambitions related to the energy transition. The current lack of policy is due to an inadequacy of knowledge and capacity within municipalities to respond to questions regarding the energy transition. This brought forward the following overarching research question:

> *What can municipalities do to stimulate and support the deployment of LRECS?*

Often, a comprehensive understanding of the local energy situation and energy needs is missing. This research aims to stimulate the development of local renewable energy by creating a context specific policy assessment framework for local policymakers to assess their municipality in terms of socio-technological innovation conditions. Following the theoretical framework available for such analyses, the research was conducted by answering three sub questions addressing the structural system needs, functional system needs and the translation necessary for a practical use of the tool. Together they aim to answer the research question and so each will be treated shortly.

> 1) What structural elements should be in place at municipal level to stimulate and support the deployment of LRECS?

Technological Innovation System (TIS) theory as it was used in this research, delineates between structural and functional elements of the innovation system. Certain structural elements need to be in place in order to have a smooth functioning of the key activities or system functions within a system. The system studied here is the local renewable energy sector in the Netherlands. To answer this sub question, a thorough understanding of structural elements was gained by doing desk research. This was then specified towards relevant elements for the system in question. The four structural categories used are actors, institutions, infrastructure and interactions. These are all divided by various subcategories.

Actors for example are divided by economic activity of actors relevant for system development. Translated to LRECs, many of the subcategories remained relevant. However, civil society and companies become somewhat merged because the entrepreneurs in this system, are initiators from civil society. Their goal is more socially oriented than the traditional entrepreneur and they identify as civil society rather than business. In this way, each of the subcategories is adapted to fit the complexities and relationships present in the local renewable energy sector. For each, there is an explanation describing the interactions as found by literature and expert interviews.

Institutions described hard and soft institutions required for system innovation. Hard institutions cover rules, regulations, targets and norms. Soft institutions include, habits, routines and shared concepts: rules people use to interact with each other. Hard institutions was understood to be the unavoidable rules a municipality sets for spatial planning and energy as well as specific quantifiable sustainability related goals and targets municipalities adopt. Soft institutions include the internal and external culture. Internal covering overall ways of conduct and flexibility within the organization, the different roles a municipality can take on regarding LRECs and the vision on the energy transition, citizen participation and the energetic society

adopted by the municipality. External culture covers ways of thinking and conducting outside of the municipality as organization, in the community.

Infrastructure covers physical, financial and knowledge infrastructure needed for system development. Physical relates to the actual hardware needed for technological development including the built environment, while financial explains what kinds of funds need to be present and knowledge covers the expertise skills and know how necessary for innovation.

Interactions is understood to be the connectivity between relevant actors in the system. networks are used to make meaningful assumptions about this. National networks, regional and local networks relevant for LRECS are identified. HIER opgewekt was found to be extremely important as a knowledge provider. Networks of municipal officers are seen as potentially relevant for the exchange of experience. Sometimes, the availability of certain individuals can also be meaningful.

All in all, a description of currently important structural factors was given. Added to by what is deemed important by interviewed experts. The structural factors can be seen as constant pillars that need to be present as a baseline in order for the system in question to be healthy. Second, the system functions that need to be present in order for the system to innovate have been described by answering the following sub question.

> 2) What are the system function requirements at municipal level to stimulate and support the deployment of LRECS?

The research has provided a comprehensive description of what the system requirements for each of the seven system functions entail. It was found that each of the functions influence each other greatly. In *guidance of the search (F1)* local policymakers influence steering and selection of the new intended activity being local renewable energy production. This is where a sense of urgency for the local energy transition can be created. This is done by giving it a prominent place in the policy programme and making targets and ambitions measurable. This is accompanied by such things as an increase in available FTEs and a proactive approach taken by municipal officers. Once this sense of urgency and prioritization of goals is established, it has positive consequences for the rest of the system functions. It creates legitimacy for actions taken by the municipality to support LRECS.

What was described under results next is *mobilization of resources (F2).* Various types of resources are necessary in different phases of development. The gateway resource to get access to each is money. The municipality can improve the accessibility of financial resources by providing capital in some ways and by guiding initiatives through the process of attracting external funds. In this way, the other resources necessary for system development such as expertise and information provision can also be accounted for.

Once the funds necessary for development are secured, the project can start to be developed. And what is necessary to do that successfully, is knowledge. The particular knowledge requirements are discussed in the section on *knowledge development and diffusion (F3 & F4).* This was interpreted as knowledge within the municipality about LRECS and for LRECS. Knowledge about should be present with the municipal officers working with these initiatives, so that they can be properly managed and guided. The municipality would also help development if they would direct initiatives to places where they can acquire the knowledge and expertise they need to develop successful renewable energy projects.

Now that urgency, money and knowledge are present, what the system needs are people willing to invest time in running an LREC, as discussed under *entrepreneurial activities (F5)*. The number of entrepreneurs needs to rise in order to have a big impact in terms of Kwh. What the municipality must do is act more proactive regarding finding groups of people who can initiate new projects and to support existing ones with all means available.

The next system function discussed is *creation of legitimacy (F6),* where means to strengthen the position of LRECs and embed them in the system at large are discussed. Some main findings were that explicit support in city council is essential and that should be reflected in policy and participation in national networks. The most important way to increase legitimacy according to interviewees, was to showcase successful projects in order to increase enthusiasm. Appropriate storytelling should be used to appeal to a varied audience.

Finally, after legitimacy has been increased, the road is paved for significant municipal influence in *market formation (F7).* The main objective of the municipality should be to contribute to a more level playing field for commercial parties and LRECs. This can most evidently be done by altering spatial policy and procurement policy. The goal is to open the market up to LRECs, where previously this was difficult.

Already in the system function findings, the action perspective of the municipality is explicitly mentioned. The final sub question attempts to make these findings even more useful in practice.

> 3) How can the system requirements be translated into a context specific policy assessment framework for local policymakers?

This research has attempted this by summarizing the findings in tables, to be used by policymakers.

In the structural elements, each table represents a structural element: actors, institutions, infrastructure and interactions. Each is divided by five columns. the first one is subcategories, the second general examples of these and the third includes the capabilities this must have. The final two columns are present for the analysis. The first one provides opportunity to mark whether and in what form an equivalent of the subcategory is present. The final column allows policymakers to note whether this entity has the right capabilities. In a yes or no judgement as well as a short description why.

In the functional elements, each table covers a system function and is divided by structural elements. This makes a practical structural functional analysis possible. The first column of each table includes the main system function requirements, as textually described for each functions. The second column includes a way for policymakers to measure whether this requirement is met in the local context. The third row provides opportunity to mark whether the requirement is present and to give a brief description of the measure that covers this. This description helps with the completion of the final column, in which the policymaker has to ascertain whether the quality or capability of the identified measure is weak, moderate or strong.

In this way, policymakers can analyse each key activity that needs to be present in the local system in order to support the development and innovation for LRECs. The tables of structural and functional elements can be compared to identify weaknesses in the local innovation system surrounding LRECs.

Under each of the system function tables, a section called *action perspective municipality* is written. This involves recommendations for the municipality. It is a conclusion of the main findings from the section, distilled to the most relevant points of action for the municipality. It

also serves as a brief explanation of the tables and what should be done in case any gaps are identified.

All in all, the results of this thesis are a first outreach to municipalities in the Netherlands struggling with their newfound responsibilities regarding the goals of the energy transition. Although my context specific policy assessment framework is not perfect, it is a handy tool for policymakers and municipal officers to analyse their region in a structured way. Besides a comprehensive description of the local system requirements for LRECs, it provides a framework for analysis as well as recommendations for the municipal action perspective. This contributes to the systematic deployment of LRECs from the bottom-up, as municipalities create the ideal breeding ground for these initiatives. As such, LRECs and municipalities can cooperate and strengthen each other's goals and ambitions while in the meantime accelerating the Dutch energy transition.

Reference list

Adams, S., & Berry, S. (2008). Low carbon communities: A study of community energy projects in the UK.

Adelman, C. (1993). *Kurt Lewin and the Origins of Action Research, Educational Action Research, 1*(1), 7-24, doi: 10.1080/0965079930010102

Agentschap NL. (2011). *NL Energie en Klimaat: Wetten en regels lokale duurzame energiebedrijven.* Retrieved from https://www.rwsleefomgeving.nl/publish/pages/91334/wetten_en_regels_ldeb__oktober_2011.pdf

Allen, S.R., Hammond, G.P., McManus, M.C. (2008). Prospects for and barriers to domestic micro-generation: a United Kingdom perspective. *Applied Energy 85,* 528–544.

Arentsen M. & Bellekom S. (2014). Power to the people: local energy initiatives as seedbeds of innovation? *Energy, Sustainability and Society 4*:2.

DRIFT. (2014). *The (Self)Governance of Community Energy: Challenges & Prospects.* Rapport. Retrieved from https://drift.eur.nl/wp-content/uploads/2017/03/PracticeBrief_CommunityEnergy_DRIFT_2014-1.pdf

Beggio, G., & Kusch, S. (2015). Renewable energy cooperatives: Main features and success factors in collectively implementing energy transition. *Proceedings of The 3rd Virtual Multidisciplinary Conference.* doi:10.18638/quaesti.2015.3.1.208

Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S. & Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. *Research Policy, 37*, 407–29.

Bergman, N. & Eyre, N. (2011). What role for microgeneration in a shift to a low carbon domestic energy sector in the UK? *Energy Efficiency, 4,* 335–353.

Boon, F. P., & Dieperink, C. (2014). Local civil society based renewable energy organisations in the Netherlands: Exploring the factors that stimulate their emergence and development. *Energy Policy, 69* , 297-307. doi:10.1016/j.enpol.2014.01.046

Carlsson, B., Jacobsson, S., Holmen, M. & Rickne, A. (2002).'Innovation systems: analytical and methodological issues. *Research Policy, 31,* 233–45.

Carlsson, B. & Stankiewicz, R. (1991). On the nature, function, and composition of Technological Systems. *Journal of Evolutionary Economics 1*(2), 93-118. doi:10.1007/BF01224915

Crawford, S. E., & Ostrom, E. (1995). A Grammar of Institutions. *American Political Science Review, 89*(03), 582-600. doi:10.2307/2082975

Dóci, G., & Vasileiadou, E. (2015). Let' s do it ourselves: Individual motivations for investing in renewables at community level. *Renewable and sustainable energy reviews, 49*, 41-50.

Dragoman, M. C. (2014). *Factors influencing local renewable energy initiatives in different contexts: comparative analysis Italy, Romania and the Netherlands* (Dissertation). Retrieved from http://essay.utwente.nl/65836/1/Dragoman_MA_European%20Studies.pdf

Dunning, J., & Turner, A. (2005). Community-owned wind farms—aspirations, suspicions and reality. *Power UK, 131,* 42-45.

Elzenga, H., Schwencke, A. M., Hoorn, A. (2017). *Het handelingsperspectief van gemeenten in de energietransitie naar een duurzame warmte- en elektriciteitsvoorziening* (1955). Den Haag: Uitgeverij PBL.

FUSE. (2017). Verduurzaming in eigen hand . Rapport. Retrieved from http://www.fuse.eu/FUSE.pdf

Geels F., W. (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental Innovation and Societal Transitions 1*, 24-40.

Hekkert, M. P. (2010). *De innovatiemotor.* Uitgeverij Van Gorcum.

Hekkert, M. P., Suurs, R. A., Negro, S. O., Kuhlmann, S., & Smits, R. E. (2007). Functions of innovation systems: A new approach for analysing technological change. *Technological forecasting and social change, 74*(4), 413-432.

Hisschemoller, M. (2012). Local energy initiatives cannot make a difference, unless…. *Journal of Integrative Environmental Sciences, 9*(3), 123-129

Hinshelwood, E. (2001). Power to the People: community-led wind energy–obstacles and opportunities in a South Wales Valley. *Community Development Journal, 36*(2), 96-110.

Huijben, J. C. C. M., & Verbong, G. P. J. (2013). Breakthrough without subsidies? PV business model experiments in the Netherlands. *Energy Policy, 56,* 362-370.

IRENA. (2013). *Renewable Energy Innovation Policy: Success criteria and strategies.* Retrieved from http://www.irena.org/publications/2013/Mar/Renewable-Energy-Innovation-Policy-Success-Criteria-and-Strategies

Karskens, J. (2016). *Utopia Renewed: Transition to Renewable Energy in the Netherlands: a new solution, a new agent, a new pathway* (Master Thesis). LUCSUS Lund University, Lund.

Klopstra, A., Schuurs. R. (2013). *Handreiking: de rol van gemeenten bij lokale duurzame energie-initiatieven.* Rijkswaterstaat Ministerie van Infrastructuur en Milieu.

Mignon, I. (2016). The impact of systemic factors on the deployment of cooperative projects within renewable electricity production - An international comparison. *Renewable and sustainable energy reviews, 65* , 478-488.

Meadows, D. H., Meadows, D. L., Randers, J., & Behrens, W. W. (1972). *The limits to growth.* New York, 102.

Meelen, T., & Farla, J. (2013). Towards an integrated framework for analysing sustainable innovation policy. *Technology Analysis & Strategic Management, 25*(8), 957-970.

Mul. P. (9 dec 2015). *Gemeenten op koers voor co2 doelstellingen 2020.* Royal haskoningDHV. Retrieved from https://www.royalhaskoningdhv.com/nl-nl/blog/urban/gemeenten-op-koers-voor-co2-doelen-2020/5255

Negro, S.O., Hekkert, M.P. & Smits, R.E.H.M. (2008). Stimulating renewable energy technologies by innovation policy. *Science and Public Policy 35,* 6. 403–16.

Oostra, M., & Jablonska, B. (2013). *Understanding local energy initiatives and preconditions for business opportunities.*

Oteman, M., Wiering, M., & Helderman, J. K. (2014). The institutional space of community initiatives for renewable energy: a comparative case study of the Netherlands, Germany and Denmark. *Energy, sustainability and society, 4*(1), 11.

Schot, J. (1998). The usefulness of evolutionary models for explaining innovation: the case of the Netherlands in the nineteenth century. *History and Technology 14*(3), 173-200.

Schwencke, A. M. (2012) Energieke bottom-up in lage landen: De Energietransitie van Onderaf Over vrolijke energieke burgers, zon- en windcoöperaties en nieuwe nuts. Retrieved from http://asisearch.nl/wp-content/uploads/2016/11/2012-ESSAY-Energieke-BottomUp-in-Lage-Landen-Schwencke-21082012-FINAL.pdf

Schwencke, A. M. (2016). Lokale energiemonitor 2016. RVO. nl. Retrieved from https://www.hieropgewekt.nl/sites/default/files/hier_opgewekt_monitor_2016.pdf

SER. (2013). Energieakkoord voor duurzame groei [rapport]. Sociaal Economische Raad, Den h aag. ISBN 978-94-6134-057-3

SER (2016). *Energieakkoord voor duurzame groei, Voortgangsrapportage 2016.* Commissie Borging Energieakkoord.

Seyfang, G. & Haxeltine, A. (2012). Growing grassroots Innovations: exploring the role of community-based initiatives in governing sustainable energy transitions. *Environment and Planning C: Government and Policy 30*, 381-400.

Seyfang, G., Park, J. J. & Smith, A. (2013). A thousand flowers blooming? An examination of community energy in the UK. *Energy Policy 61,* 977-989.

Seyfang, G., Hielscher, S., Hargreaves, T., Martiskainen & M., Smith, A. (2014). A Grassroots Sustainable Energy niche? Reflections on Community Energy in the UK. *Environmental Innovation and Societal Transitions 13*, 21-44.

Seyfang, G. & Smith, A. (2007). Grassroots Innovations for Sustainable Development:Towards a New Research and Policy Agenda. *Environmental Politics 16*(4), 584-603.

Suurs, R. A. A. (2009) *Motors of sustainable innovation, towards a theory on the dynamics of technical innovation systems* (Dissertation). Retrieved from https://dspace.library.uu.nl/handle/1874/33346

TNO (2013). *Naar een toekomstbestendig energiesysteem voor Nederland*. Retrieved from https://www.tno.nl/media/3063/naar_toekomstbestendig_energiesysteem_nederland_tno_managementsamenvatting.pdf

Torres Silva, C., E. (2008). *Factors Influencing the Development of Local Renewable Energy Strategies: The cases of Lolland and Samsø Islands in Denmark* [master thesis]. LUMES, Lund University. Retrieved from http://www.lumes.lu.se/sites/lumes.lu.se/files/eduardo_torres.pdf

Vandevyvere, H., & Nevens, F. (2015). Lost in transition or geared for the S-curve? an analysis of flemish transition trajectories with a focus on energy use and buildings. *Sustainability, 7*(3), 2415-2436.

Verschuren, P., Doorewaard, H., & Mellion, M. (2010). *Designing a research project (Vol. 2).* The Hague: Eleven International Publishing. ISO 690

Westley, F., Tjornbo, O., Schultz, L., Olsson, P., Folke, C., Crona, B., & Bodin, Ö. (2013). A theory of transformative agency in linked social-ecological systems. *Ecology and Society, 18*(3). doi:10.5751/ES-05072-180327

Walker, G. (2008). What are the barrier sand incentives for community-owned means of energy production and use? *Energy Policy 36*, 4401-4405.

Walker, G. & Devine-Wright, P. (2008). Community renewable energy: What should it mean? *Energy Policy 36*, 497–500.

Watson, J., Sauter, R., Bahaj, B., James, P., Myers, L., Wing, R., 2008. Domestic microgeneration: economic, regulatory and policy issues for the UK. *Energy Policy 36,* 3095–3106.

Wieczorek, A. J., & Hekkert, M. P. (2012). Systemic instruments for systemic innovation problems: A framework for policy makers and innovation scholars. *Science and Public Policy*, *39*(1), 74-87.

Zardi, C. (2015). *Success Factors for Renewable Energy Communities: A Theoretical and Meta-Analytic Review of the Scientific Literature [Master Thesis].* VU, amsterdam

Non- scientific references

Aardgas in Nederland (nda). Aardgas en de economie. Retrieved from http://aardgas-in-nederland.nl/nederland-aardgasland/aardgas-en-de-economi e/).

CBS. (2016, 26th May). Verbruik hernieuwbare energie toegenomen naar 5,8% .

Retrieved from https://www.cbs.nl/nl-nl/nieuws/2016/21/verbruik-hernieuwbare-ene rgie-toe genomen-naar-5-8-

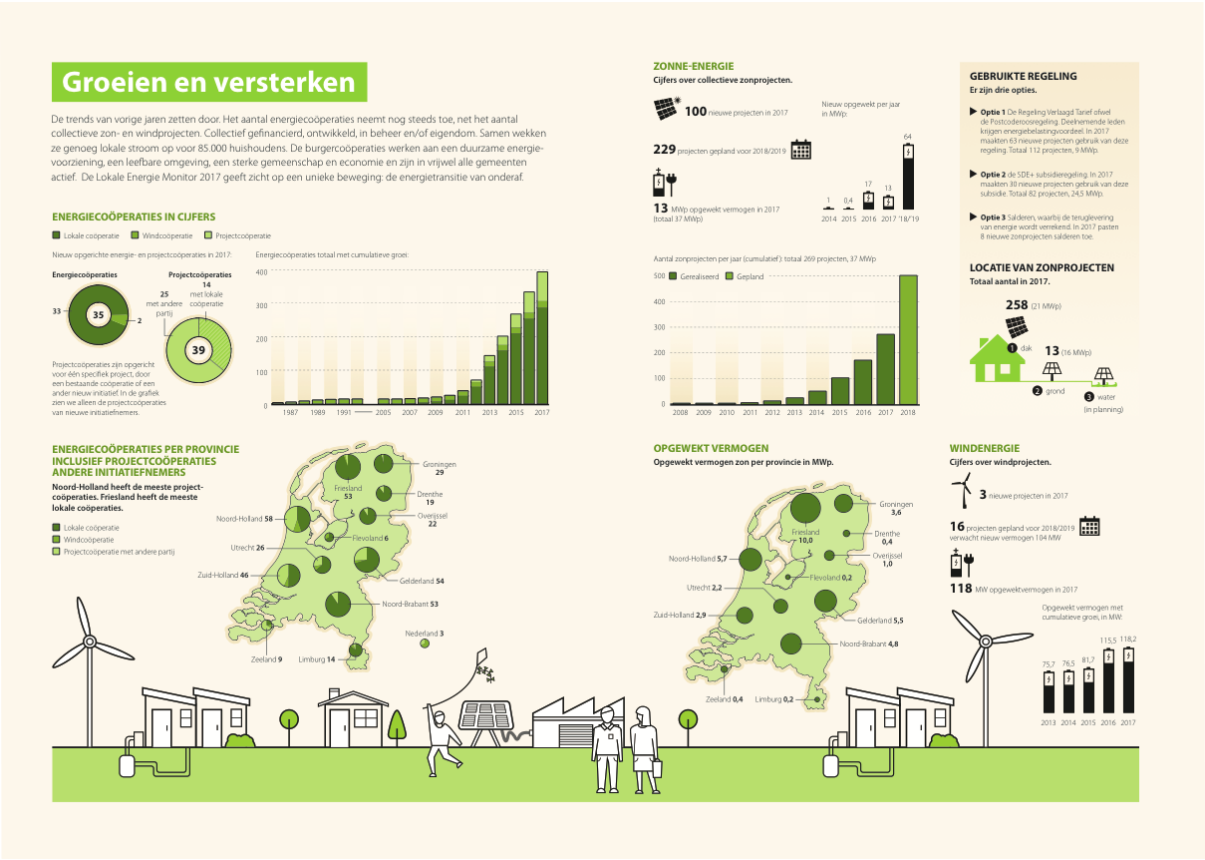
CBS. (2016, 31st March). Nederland voorlaatste op ranglijst eu hernieuwbare energie.

Retrieved from https://www.cbs.nl/nl-nl/nieuws/2016/13/nederland-voorlaatste-op-ranglijst- eu-hernieuwbare-energie

VNG. (June 17, 2014). *Gemeenten zoekend naar rol in uitvoering energieakkoord.* Retrieved from https://vng.nl/persberichten/14-06-17/gemeenten-zoekend-naar-rol-in-uitvoering-energieakkoord

Appendix

A



B

Table 1. List of interview participants including position and expected insights

	Name	Position	Insights
1	Siward Zomer	Chairman wind coop De Windvogel, REscoop EU, ODE decentraal (representing organised civilians + supporting organisations).	General understanding of local renewable energy sector and the interplay between functions.
2	Annemarieke Schwencke	Independent researcher ASI-Search / expert local renewable energy (representing science).	Detailed insight in structural elements, system functions and municipal action perspective.

3	Evelien ten Cate	Municipality of Gouda - sustainability manager (representing local government).	Understanding of municipal standpoint and action perspective.
4	Pauline van Norden	Municipality of Gouda - sustainability manager (representing local government).	Understanding of municipal standpoint and action perspective.
5	Thijs de Neeve	Aspiring initiator of local renewable energy coop in Gouda (representing civilians/ business).	General understanding of structural elements & Understanding of system needs according to (more commercially oriented) emerging entrepreneurs.
6	Eelke Nijmeijer	Aspiring initiator of local renewable energy coop in Gouda (representing civilians/business).	General understanding of structural elements & Understanding of system needs according to (more commercially oriented) emerging entrepreneurs.
7	Martin Pohlkamp	Initiator of local renewable energy coop in Gouda (representing civilians/business).	Understanding of system needs according to (more socially oriented) emerging entrepreneurs.
8	Martijn Hildebrand	Program manager energy transition Province of South Holland (representing	General understanding of system functions and mid-level government standpoint & view

		mid level government).	on municipal action perspective.
9	Rob Feddema	Team member energy transition Province of South Holland (representing mid level government).	General understanding of system functions and mid-level government standpoint & view on municipal action perspective.
10	Ferd Schelleman	Initiator of cooperative in Alpen aan de Rijn.	Understanding of system needs according to experienced LREC entrepreneurs.