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Assessment of Factors Influencing Local Renewable Energy Transition in Small Municipalities; A case study choice of Leeuwarden and Samso Municipalities, Denmark.

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UNIVERSITY OF TWENTE

ACADEMIC YEAR 2017/2018

AUGUST 2018

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Acronyms

RE **Renewable Energy**

LRET **Local Renewable Energy Transition**

ET **Energy Transition**

NGO **Non-Governmental Organization**

ECN **Energy Research Center of the Netherlands**

CBS **Central Bureau of Statistics Netherlands**

EU **European Union**

PV Panels **Photovoltaic panels**

£ **European Union currency**

ABSTRACT

Energy consumption accounts for two-thirds of global greenhouse gas emissions consequently making climate change mainly an energy-related issue. Despite an increase in renewable energy investment in European Union member states, their energy systems still primarily depend on fossil fuels, which are the significant contributors to greenhouse gas emissions. One of the significant challenges for climate change governance is how to shift from conventional energy systems based on the fossil fuels towards renewable sources. Therefore, in order to minimise the greenhouse-gas emission and dependency on fossil fuels, national and international strategies should promote the adoption of renewable energy sources as alternatives. This thesis analyses factors influencing local renewable energy transitions in two small municipalities. Samso island municipality (which has already achieved the 100% goal of renewable energy) and Leeuwarden municipality. High degree of community involvement, innovative energy policy, national and local government support, incentives for actors, willingness to change, economic condition, information, education and awareness creation and energy market and community acceptance emerged as the success factors/drivers of renewable energy adoption in the two municipalities.

Key words: Local renewable energy, energy transition, small cities, energy neutrality

ACKNOWLEDGMENT

I am grateful to everyone who assisted me during the data collection in Leeuwarden and outside Leeuwarden municipals. Mainly I am pleased to Soren Hermansen (Energy Academy Leader) for sharing with me essential documents regarding the Samso Island project that facilitated my desk study. More ever, am thankful to all my interviewees; Erica Zoeraman, Frietema Sybrand, Ronald Van Geiessen, Boew de Boer, Martin Schild, Weestra Roeland, Frans Debets, Gerald Adema and Mr Ruud Paap for providing up to date information concerning the energy transition progress in Leeuwarden municipality. On top of that, many thanks to Mr Alan Laws, from Leeuwarden municipality who provided the Leeuwarden energy agenda/policy document.

Additional, am grateful to my friend Ezekiel Ouwalama who provided great insights and support throughout this project.

Lastly, I am very grateful to my supervisor Dr. Frans Coenen, for his constructive ideas and motivating feedback.

CHAPTER 1: BACKGROUND

1.1 Energy Transition in the Netherlands

Currently, the issue of sustainability is increasing globally and it's considered by many organisations, governments, and companies as the way forward to manage the rapid demographic growth facing the entire globe, (ECN, 2014). This is due to the increasing pollution worldwide as a result of reliance on fossil fuel based on non-renewable resources, (Stigka et al, 2014). To minimise dependency on renewable energy system based on the fossil fuel, a shift to alternative sources of energy is crucial. This process is called energy transition and usually refers to the shifting from the use of non-renewable energy sources to the renewable ones, (Rotmans, 2011).

The Dutch government started the energy transition in early 2001 with a project known as "Energy transition" (Rotmans, 2011). The primary objective of the project was to make the Netherlands sustainable, away from a high reliance on fossil fuels about 95 %, (Ministry of Economic Affairs, 2016). For the past 15 years, the transition to the renewable energy system in the Netherlands has been lagging behind. The present share of renewable energy in the national grid is about 6%, (CBS, 2018). Nevertheless, the Dutch government has the ambition to reach 100% renewable energy by 2050, (SER, 2013). Compared to other European Union member states, the Dutch government was supposed to contribute 20% of renewable energy in 2020, but later changed this goal to 14% as it was measured that the Netherlands government will not be able to reach the target, (ECN, 2014).

Recent studies have illustrated that the share of the renewable energy sources will be between 10.6% to 12.4% in 2020. (ECN, 2014). Unfortunately, this share is not enough to meet-up the European Union target. In spite of having renewable energy technologies to reach the future goals, there are soft non-technical obstacles which dawdling the shift of energy transition in the Netherlands, (Scholtens et al, 2015). These soft bottlenecks explained by some works of literature are business interests in the transition (Scholtens et al, 2015) and focus on technological learning and short-term gains instead of on the institution and cultural change, (Laes et al, 2014).

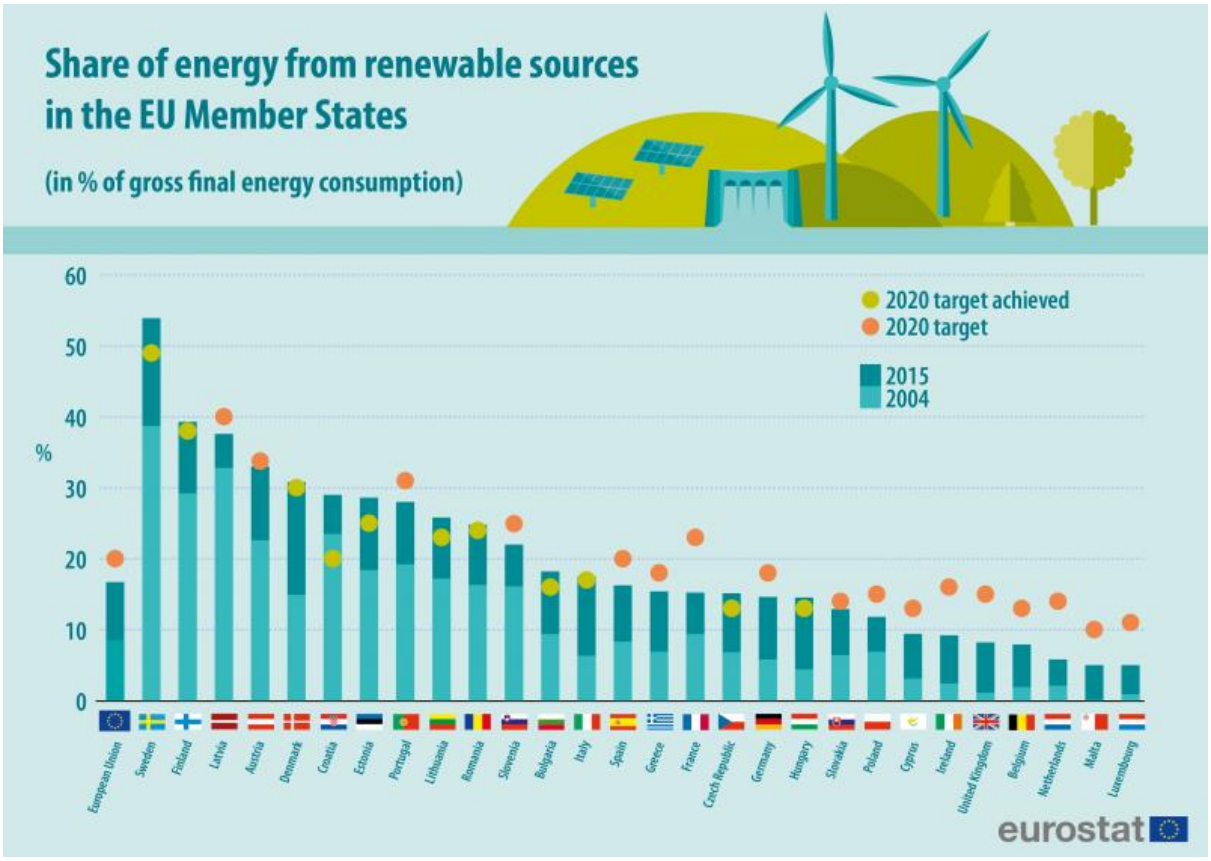


Figure 1: Share of energy from renewable energy sources in the EU member states Sources: Eurostat, 2016. (The Netherlands lagging behind)

1.2 International Energy Transition goals

In early 2015, 195 countries signed the Paris climate change agreement with the purpose of curbing global warming. The convention declared that the total global warming of the 21 century should stay as low as 2-degree centigrade, (Ministry of Economic Affairs, 2016). In order to achieve this carbon emission should be minimised to 80-95% by 2050. Therefore, in order to attain the energy neutrality goal by 2050, the Netherlands and other United Nations member states must commit to renewable energy investment.

1.3 Friesland Energy Transition

Like many other province in the Netherlands Friesland province is also struggling in energy transition process, (Dijkman report, 2015).Despite the fact that Friesland province is one of the leading regions in the Netherlands when it comes to the renewable energy transition, (GS fryslan, 2013). At the moment the total share of energy generated from renewable energy is 7%, (Circular Friesland report, 2015). This figure surpasses the national renewable share which is 6%, (CBS, 2018).Thus making Friesland a leading national target. The Friesland province has set the long-term goal to be free from the fossil fuels by 2050, the energy regeneration and energy savings are crucial things in the Friesland energy mix. Additionally, the Friesland province proposed an energy savings of 20% compared to 2010 and also targets to generate 16% of energy from renewable energy sources in 2020, the province

is expecting the share of renewable energy to grow to 25%, (Friesland Energy Ambitions, 2020). Despite, having all these targets, there is no clear indication on how this goal of free from fossil fuels will be achieved by the year 2020 or 2050, (G.Vinema, 2015). Due to the challenges of the energy transition in the Netherlands, the Dutch government decided to formulate two energy transition approaches. These two approaches have also been adopted by the Friesland province, (Kemp et al, 2008).

1.4 Problem statement

Leeuwarden is a capital city of Friesland; Leeuwarden is the central city within the Friesland province. Leeuwarden has the plan/agenda to become a circular economy, achieve energy savings, and generating more energy from local renewable energy sources by 2020, 2030, and 2050, (Leeuwarden Energy Agenda, 2016-2020). This plan/agenda motivates to select this specific area for research project.

According to (European Union report,2016) the Dutch government compared to other European Union countries such as Germany, and Denmark, is still lagging behind in the realization of the objectives agreed in the European Union to reach 20% of renewable energy target and energy savings by 2020. To accomplish this target then curbing climate change and transition to the alternatives sources of energy in the municipalities' level is highly required; this is because, in order to reach the 2020 and 2050 goal of 100% renewable energy share, the barriers facing the energy transition must be controlled in Dutch municipalities. Therefore, the objective of this research project is to identify the drivers of local renewable energy transition in a small municipalities (Samso and Leeuwarden municipality), and also by learning from other small municipality (Samso municipality) which has already achieved the goal of 100% renewable energy.

1.5 Objective of the study

The main objective of this research project is to identify drivers and obstacles of local energy transition in small municipalities towards 100% renewable energy and energy savings

1.6 Research question

What are the factors influencing the local energy transition in small municipalities, towards reaching the 100% goal of renewable energy target?

1.7 Sub question

1. What are the social, economic, technological, political and consumer behaviour drivers of local renewable energy transition?

2. What are the steps taken and goals formulated by Leeuwarden municipality to reach 100% of renewable energy and achieve energy savings?

3. What were the steps and goals formulated by Samso municipality to promote local renewable energy and achieve the 100% of renewable energy and achieve energy savings?

4. What are the roles played by different actors in local renewable energy transition and energy savings in Leeuwarden and Samso municipality?

5. What are the obstacles/barriers of local renewable energy transition development?

6. What are the comparison of drivers, actor's role and barriers of local renewable energy transition in Leeuwarden and Samso Municipality?

CHAPTER 2: LITERATURE REVIEW

This chapter introduces the theories and model regarding the various concepts related to the research topic and objectives. Section 2.1 discusses the definition of local energy, section 2.2 introduces the definition and phases of energy transitions, and section 2.3 is about carbon/energy neutrality definition, section 2.4 discusses the drivers of renewable energy transition at the local level, and 2.5 discusses the barriers of renewable energy transition at regional and local level.

2.1 Local energy

Is defined as any local energy sources, which rely on locally available renewable energy resources that serve local needs. An excellent example of local energy would be individual homeowner projects for wind Park, solar hot water or PV generated electricity that relies on the sun upon. Local renewable energy can also involve neighbourhood, municipal, educational institutions, small-business, and commercial projects of different types. Therefore, if the resources are locally based and (if possible) locally owned, it qualifies as local energy. A community wind farm, a lone wind turbine that is locally owned and generates electricity for the community qualified to be called the local energy (Craig Pahl, 2013).

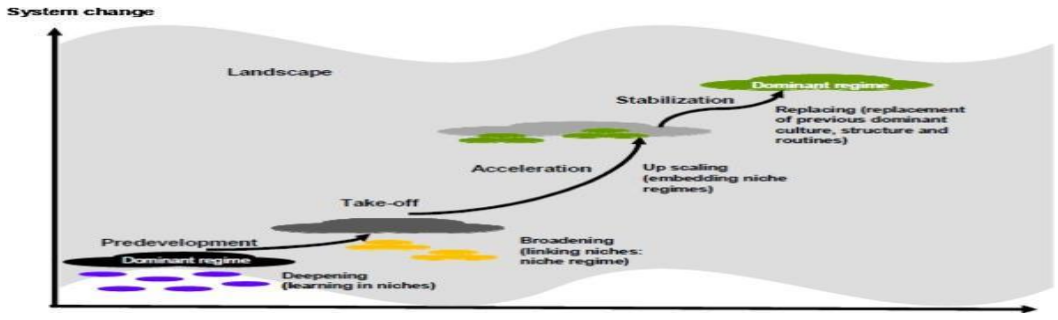
2.2 Energy Transition

Is the transformation process in which the society changes in a rudimentary way over extended period of time, (Kemp and Rotman, 2004). The main purpose of energy transition is to create the sustainable energy network. The key areas of change in the energy transition process are; institutional, technological changes, also change in policy and knowledge perception and lastly changes in the production and consumption (Rotmans, 2003). According to (SER, 2001), energy transition is a radical change that can take more or less thirty to fifty years.

2.2.3 Phases of Energy Transition

According to (Geels et al, 2013) there are four stages of energy transition; pre-development stage, take off stage, acceleration and stabilization

Figure 2: phases of energy transition



Sources:(Geels, 2013)

2.3 Energy/ Carbon neutrality

Carbon neutrality can be described as the action of the organisation, individual, and businesses to remove carbon dioxide from the atmosphere, (Vengie Beal, 2018). The main goal of the energy/carbon neutrality is to attain a zero carbon footprint, (ibid).

2.4 Driving forces of renewable energy transition at the regional and local level

Below are the social, economic, technological, consumer behaviour, geographical and political drivers of local renewable energy transition.

2.4.1 Social cohesion and local people involvement in RE programs

Working together in collaboration with the community provides the chance to communicate and interact with the local community, (Arentsen and Bellecom, 2014, Scholten et al, 2015 and Doci and Vasileiadou, 2014). Participation is a very crucial aspect of local renewable energy transition; because it helps to promotes attitude changes towards the energy sector, (Boon et al, 2012). As reported by, (Avellino et al, 2014), having a high degree of social cohesion in the local community results to higher social acceptance of local renewable energy technologies such as windmills, which are important for the renewable energy transition. Based on these facts, a number of works of literature have emphasized the significance of involvement of local citizen's in the local energy transition process, (Sayifang et al, 2012 and Schippter et al, 2014),concluded that local citizen involvement and participation could boost the local citizens understandings and support towards local renewable energy adaptation, (Walker et al, 2008).

2.4.2 Energy consumer behaviour

This is another major factor that enhances local renewable energy transition. For instance, according to (Rec market, 2017), the majority of electricity consumers in European countries currently prefers renewable electricity for example from local renewable energy sources such as solar PV, wind and biogas, which are cheap and produced close to their homes and businesses. The consumers are comparing and researching whether they can produce electricity locally themselves or buy it from a supplier. Additionally, the COP 21 predicted that in the coming years the consumer behaviour will be a crucial driver of local renewable energy transition (ibid).

2.4.3 Innovative Energy policy

Energy policy is one of the important interventions that favour the development of the energy transition, (A.Bergeik et al, 2000). The effectiveness of the policy regarding the energy transition depends on the following below;

1) **Policy formality**

Type of and level of support for policies vary across different countries are not the same when it comes to the type and level of support. The diverse can be on the tax exemption, cost reducing scheme such as feed-in tariff and certification systems, (M. bihartz et al, 2006). Therefore the policy support leads to the development of a different renewable energy system from the government level to the lower level, (A. bergek et al, and 2011).

2) **Policy conformity**

The regulatory framework and their harmonisation in various regions worldwide also influence renewable energy transitions. This uniformity process which allows a smooth development process could be at international, regional and national levels. The European Union Commission has emphasized the importance of policy harmonisation in the European Union member states, (European Commission report, 1998). But most of the EU member states utilities are still deploying different climate policies and strategies, (Jorse Albors et al, 2014).

3) **Policy stability**

The third factors that promote effective policies as regards the energy transition is related to their technologies long term stability. The way in which the energy company is influenced by consistent and supportive energy policies certainly impacts its future planning. A good example of this is the extremely thriving development of wind and solar power in German and Spain, (Wustehangen R. et al, 2006) and (Del Rio P, et al, 2007).

2.4.4 Incentives for actors

Actor's constellation consists of the private, public, individual or local organisation, universities, industry and research institutes, (R.E.H.M Smiths et al, 2006). All these actors mentioned here have a direct influence on the local community especially when it comes to the local energy transitions. As a result their involvement in the decision-making process will enhance the acceptance of renewable energy technologies at the local level, (M. Burer et al, 2007). On top of that, the involvement of all these stakeholders in defining legislation, formulation of the implementation plans and joint definition of the environmental objectives enhance future commitment and help to decrease political resistance for instance the resistance against wind farms, in the north of Germany, Stuttgart and Cologne, (J.keizers e al, 2000). Therefore the involvement of the local community and other actors in the decision-making process helps to tackle this challenge.

2.4.5 Economic factors

In the energy market, from technological innovation system perspective, the acceptance of the local renewable energy technologies in the market focuses on the institutions, networks, firms and

strategies, (Jaccobson et al, 2008).As a result, small-scale renewable energy for instance solar thermal, micro generator, PV panels and wind turbines follow the perspective of diffusion of innovation, (Wustengane et al, 2007). In the way of social acceptance, consumers take roles as they are directly or indirectly physical impacted. The impacted consumer may consider the concept of market acceptance as a choice to develop a project which will have the local economic impact and will directly impact their livelihood if implemented in their physical surroundings. Moreover according, to (Jacobson, 2000), technological innovation especially the diffusion of local renewable energy can be influenced by the actors engaged in the process and their competence. Such an actor can influence the project technologically, financially and politically.

2.4.6 Management and organisational characteristics

Both (Perish et al, 2010, Hoppe et al, 2015 and Bird et al, 2013), pointed out the significance of having a highly qualified manager with the high level of personal capacity, who can identify the constraints to action and negotiate between actors when the problems occur that need solutions. As mentioned by, (Lepping, 2014 and Hinshelwood 2010), management can bring expectation in the local community on what the technology can deliver, provides flexibility, opportunism, and has the capability to respond to the necessities of the community through capacity building and capacities managers. Additionally, a well-organised management and organisational system is extremely important to uphold momentum and avoid obstacles, and moreover, a business model is the vital determinant factors involved in enabling the local renewable energy project to move ahead independently and succeed (Rogers et al, 2008, Avellino et al, 2014 and Tonen, 2013).

2.4.7 Technology aspects

Through the adoption of new technology, there will be an improvement in local energy demands (Walker, 2008). Regardless the installation needs to be easier as well as manageable. It has been observed that if there is regular maintenance, difficult to install the technology or the technology does not add value to the property this could lead to barriers in the adoption of local renewable technology, (Neame et al 2006).Additionally, trained personnel is required since that the investment of the local renewable energy does not depend on the availability of technology itself but also on trained personnel. It has been noted that the level of the expertise in the local renewable energy needs to increase; hence the market of the renewable energy technology is bigger and subsists for a long time, (Hester et al, 2001). Lastly, (Arentsen and Bellekom 2014) demonstrated that technological improvements have made renewable energy technology more reliable, visible, proven, and providing payback time for investment and encouraging local renewable energy usage.

2.4.8 Government

In the area of institutional aspects, the local energy transition can be promoted or hindered by the political environment in which the transition operates (McEwen et al, 2012). Governments can assist

the local energy transition by providing the information and technology, building institutional capacity, and creating an environment that will encourage investment. Furthermore, the government can improve the local energy transition through providing tax exemption, grants and subsidies, this will help to support the local energy project as the investment of renewable energy project require a large financial investment ,(Neame et al, 2006). Therefore the availability of finance will lower the investment cost as well as energy cost from local renewable energy, (Walker, 2008). Consequently, through the enacted policies the government can promote or obstruct the development of the local renewable energy transition (Painuly et al, 2001 and Van wees, 2006).

2.4.9 Geographical/regional factor

These are attributes that originate in the geography of a region in which technology is expected to function. A very important geographical factor both at national and local level applies to the climatic as well as the abundance of renewable energy sources in the region, such as wide coastlines to harness wave or tidal energy and a large sunshine duration for solar power production, (Anna Darman et al, 2014).

2.4.10 societal political movement and grassroots factors

Social factors play a big role in the development of local energy transition and energy markets. A good example is the willingness of the local community/customers to pay for the electricity which is produced from the local renewable energy sources such as wind Park or solar PV. Moreover, the community participation in various project and movement concerning energy transition at a local level, (Sitko et al, 2015). Lastly, the environmental awareness develops the local support and arouses the development and acceptance of local renewable energy. Under those facts, conserving the environment, communities became free from conventional energy companies and from rising fossils fuels prices (Doci et al, 2014 and Boon, 2012).

2.5 Barriers/Obstacles of renewable energy transition at the local and regional level

Generally, there are a number of barriers facing the development of local renewable energy technologies. Below are some of the main barriers that hinder the development of renewable energy at the regional and local setting.

2.5.1 Incoherence policy

The lack of consistent policy and regulatory frameworks to support local renewable energy for example lack of incentives to consumer, difficult zoning and permitting processes have been seen as a bottlenecks to the deployment of local renewable energy, (M.Oliver et al, 1999). In today's world, the energy policy is biased towards fossil fuels and nuclear energy, (Krupa j. 2012).The absence of a proper legal and regulatory framework for the dissemination of local renewable energy or decentralized renewable energy is also an institutional barrier, (Martinot E. et al, 2004). The renewable energy technologies such as the wind, rooftop solar water heater, and photovoltaic

installation, face the resistance from the urban planning agencies because of the lack of the established procedures for sitting and installation of the domestic decentralized renewable energy system, (Martinot E. et al, 2004). The opposition may be in an area of height, noise, aesthetics, and safety, (Beck. F et al, 2004) while the outdated regulation is reported to be hindering the dissemination of local renewable energy, (Owen AD, 2006), the risk of changing the legislation has been affirmed as a major institutional barrier to the diffusion of local renewable energy in South Africa, (Pegels A, 2010).

2.5.2 Lack of information, education and awareness

There seems to be lack of knowledge regarding the measures of climate change and associated impacts, and there is lack of awareness about alternative local energy such as solar, wind, and biomass, which are environmentally friendly. This is the core issue to consider when thinking about local renewable energy transition and the delivery of a solution. Information sharing between the government and local citizen concerning the impacts of the climate change and the benefits of adopting the renewable energy technologies can stimulate the use of local resources. This factor encourages increased use of renewable energy if as well the proper initiatives will be incorporated. For instance, the formation of networks and partnership between the producer and consumer in order to exploit the local resources, (McCormick, 2007 and European Environmental Agency, 2001).

2.5.3 Lack of political support

The lack of political support from the national, regional and local level and know-how of the local citizen as well as the local politician in order to encourage the deployment of local renewable energy. Along with the need to understand the national political sphere, the need of the local government authorities to take actions for the use of local resources are identified as the major obstacle for renewable energy development at local level. Additional, policies which favour the development of small-scale renewable energy technologies can be viewed as common issues for various technologies, (Mendonca, 2007 and Mellon, 2006).

2.5.4 Public acceptance and Environment barrier

These are constraints that can result in a certain renewable energy project being found inappropriate for a specific location. These constrain affects two main actors in the process; the local residents and municipality as well. (Wustenhagen et al 2007) stated that the debate of Not in My Backyard (NIMBY) takes place concerning; wind turbines, factors involved were the visual impact, noise, landscape-visual density and even reflects impacts from the turbine blades, (Gipe, 1995). Moreover, a lack of public acceptance can leads to higher costs, delays and in extreme cases cancellation of the project, (Gonzalenzi, 2016). Therefore this is an area where the consultation and local citizen involvement is vital to succeed in renewable energy deployment at a local and regional level.

2.5.5 Lack of funding and economic condition

The lack of financial mechanism/schemes for instance, incentives, grants, tendering, globally can be perceived as the main barriers to the deployment of renewable energy at the local level. This is enlarged by the present status quo and system of some European Union countries which still rely on fossil fuels for a long period of time. Additionally, the lack of access to and affordability of risk mitigation instrument for instance guarantees, currency hedging instruments or liquidity reserve facilities also hinder the development of LRETs at regional and local level, (IRENA, 2016). However, within the European Union, there is a feasibility change in this process. National economic support schemes have encouraged the developments of renewable energy markets to a larger extent; a good example is the case of windmills in Germany and Spain (Geller, 2003, Mallon, 2006 and Mendonca, 2007).

2.5.6 Infrastructure Barriers

This applies to the availability of needed infrastructure to include the local energy into the energy system, which can involve setback linked to system flexibility and the capability of the power grid to integrate the renewable energy, (IEA, 2016). As the developments of renewable energy deployment spread, challenges to the grid incorporation can as well increase, enlarged by a weak grid infrastructure or a lack of the required upgrade for the transmission and distribution infrastructure. In some countries, this issue can lead to the reductions of power from local energy sources. Furthermore, an absence of district heating or sufficient cooling infrastructure inhibits the development of heating and cooling sector, also the lack of the proper engines in cars hinder the deployment of bio fuels in the transport sector, (IRENA, 2018).

2.5.7 Institution and Administrative barriers

This encompasses lack of institutions and authorities who are fully committed to the local renewable energy technologies. The absence of clearly defined roles, complicated licensing procedures, difficulty with land acquisition and permissions, inadequate planning guidelines and complex, and slow permitting processes also hinder the development of local energy. On top of that other major challenge of local energy are the political, institutional corruption and ant- renewable lobbying as well can hamper the development of local renewable energy, (IEA, 216).

2.5.8 Market Barriers

This employs inconsistent pricing structure that results to demerits for renewable energy technologies, unequal renewable energy products prices, information asymmetries, distortions of market power, fossil fuel and nuclear power subsidies and failures to integrate environmental externalities into the costs. Majority of countries have energy tariffs that are not cost effective and also fossils fuels and nuclear power subsidies that prevent the development of local renewable energy technologies. Low fossil fuel price can as well slow down the development of renewable energy for instance the

renewable heating and cooling and transport sector. Lastly, some countries charge high customs duties for the imported renewable energy technologies. (IRENA, 2018 Accessed on 23/05/2018).

Summary of the Literature Review

To sum up the above discussion answered research question one which says; **what are the social, economic, technological, political, consumer behaviour and geographical drivers of local renewable energy transition?** In a nutshell according to the theories studied the following drivers play a big part in the energy transition at the local level; (1) social cohesion and high degree of community involvement, (2) government aspect, (3) technology aspect, (4)innovative energy policy,(5)actors/stakeholder role, (6)energy market, (7)energy consumer behaviour, (8)management and organisational characteristics, (9)geographical and social-political movement and grassroots factor

On top of that, the discussion answered the research question five which says; **what are the barriers of local renewable energy transition at the regional and local level?** The literature reviewed identified the main barriers as follows; (1) lack of information and awareness at a local level, (2)incoherence policy, (3)lack of political support, and (4) lack of funding and economic condition at the local level and lastly(5) public resistance and environmental barrier.

Table 1: Matrix of Drivers and Barriers of Renewable Energy Transition at local level

Drivers	Barriers/Obstacles
• Economic aspects • Energy market • Social cohesion and local people involvement • Innovation energy policy • Consumer behaviour • Incentive for actors	• Incoherence policy • Lack of political support • Lack of funding and economic condition • Lack of information, education and awareness
• Technology aspects • Government/Political driver • Management and organisational aspect • Social political movement and grassroots factor • Geographical/Regional incentives	• Market barriers • Public acceptance and environmental barrier • Infrastructure barrier

CHAPTER 3: METHODOLOGY

In this chapter the methodology used for selecting, collecting and analysing data is presented. The chapter starts with the elaboration of why Samso case is ideal case compared to Leeuwarden case, then research framework, research strategies and research ethics. The method used to collect and analyse data is explained. The nature of the research is qualitative, meaning all research questions is addressed in qualitative manner.

3.1 Reasons why Samso is ideal case compared to Leeuwarden municipality case

The Samso Island project presented here first in this chapter because it is the best practise case to learn from Leeuwarden municipality case. Cotrarily, Samso municipality island project is the reference material for the analysis of the Leeuwarden municipality case. This is due to the fact that Samso has already achieved the goal of 100% renewable energy, (Go 100% renewable energy, 2018). Additionally, Samso has a progressive renewable energy policy which favour RE especially windmills, the Samso RE policy encouraged the ownership of windmills. About 90% of the windmills in Samso Island is owned by the local people, (Energy Academy, 2018).Furthermore, the Danish energy policy allocated enough fund to support the renewable energy sector. Another factor that made Samso to be the ideal case in contrast to Leeuwarden is the government support to the RE sector, high degree of community involvement, local leader support and actors involvement. All these criteria made the Samso island municipality project to be a best practise case compared to Leeuwarden municipality. The steps and goals through which the success was realised will therefore be thoroughly studied so as to understand the main drivers, main actors, and obstacles that have surfaced and how the problem was solved, in order to come up with the recommendation of other small municipalities or local regions of the developed world.

The research validation stems from an interest to study the necessary drivers and barriers for the development of local renewable energy transition in order to minimise the dependency of fossil fuels. To answer the research question and objective of this research project, qualitative research approach was used and a case study methodology, (Doorewaard et al, 2010).

Firstly, the literature review was conducted. The literature review followed a collection and review of official documents, academic literature, online information and various official statistics concerning renewable energy development at a local level. The literature reviewed assisted to identify the necessary drivers, barriers and key actors who are involved in the renewable energy development.

The objective of this thesis is to identify the drivers and barriers of local energy transition towards 100% renewable energy and energy savings. Contact with major actors in the field was conducted to understand the key factors, initiatives and strategies putting in place for the development of renewable

energy in Leeuwarden and Samso municipality. In the collection of the empirical data the three research strategies were employed, namely; Desk research, Interviews and case study.

First of all desk study method has been used to collect data in the Leeuwarden municipality and Samso municipality, Secondly, interviews with actors/experts were held so as to get the insight of the situation in Leeuwarden municipality. Table.2. shows the respondents who took part in the interview, the organisation they are currently working for and their role in their respective organisations. The interview was conducted via Skype, face to face and email. The respondents were mainly selected because they were recognized as the key players in energy transition in Leeuwarden municipality and outside the municipality.

Thirdly, the study used the qualitative research approaches, which attempt to elaborate the "how" "what "and "why" of the relationship or circumstances which motivate the local renewable energy development within the two localities, (Yin, 2014). Ying argued that two case studies are preferable as compared to a single case study design because more units of analysis lead to more insights of the studied area. Site interview with actors in Leeuwarden was conducted so as to gain more insight into the situation. The interviews in Leeuwarden municipality were conducted through the semi-structured format as recommended by, (Yin, 2014). The interviews were transcribed and analysed and the transcriptions are presented in the appendix part, the results of the interview are shown in a paragraph in different sections. The findings from the secondary data (desk study) in Leeuwarden municipality and Samso Island case study are summarized and included in the report. Additional to complement information concerning the Samso Island, a review of the secondary data was conducted, where pre-recorded interviews were available (a documented video of the project-stukbjaer Leif, (ND), and European Renewable islands. Miljo Media. (DVD), so as to understand the process and how the key actors engaged in the project.

Table 2: Overview of the Respondents

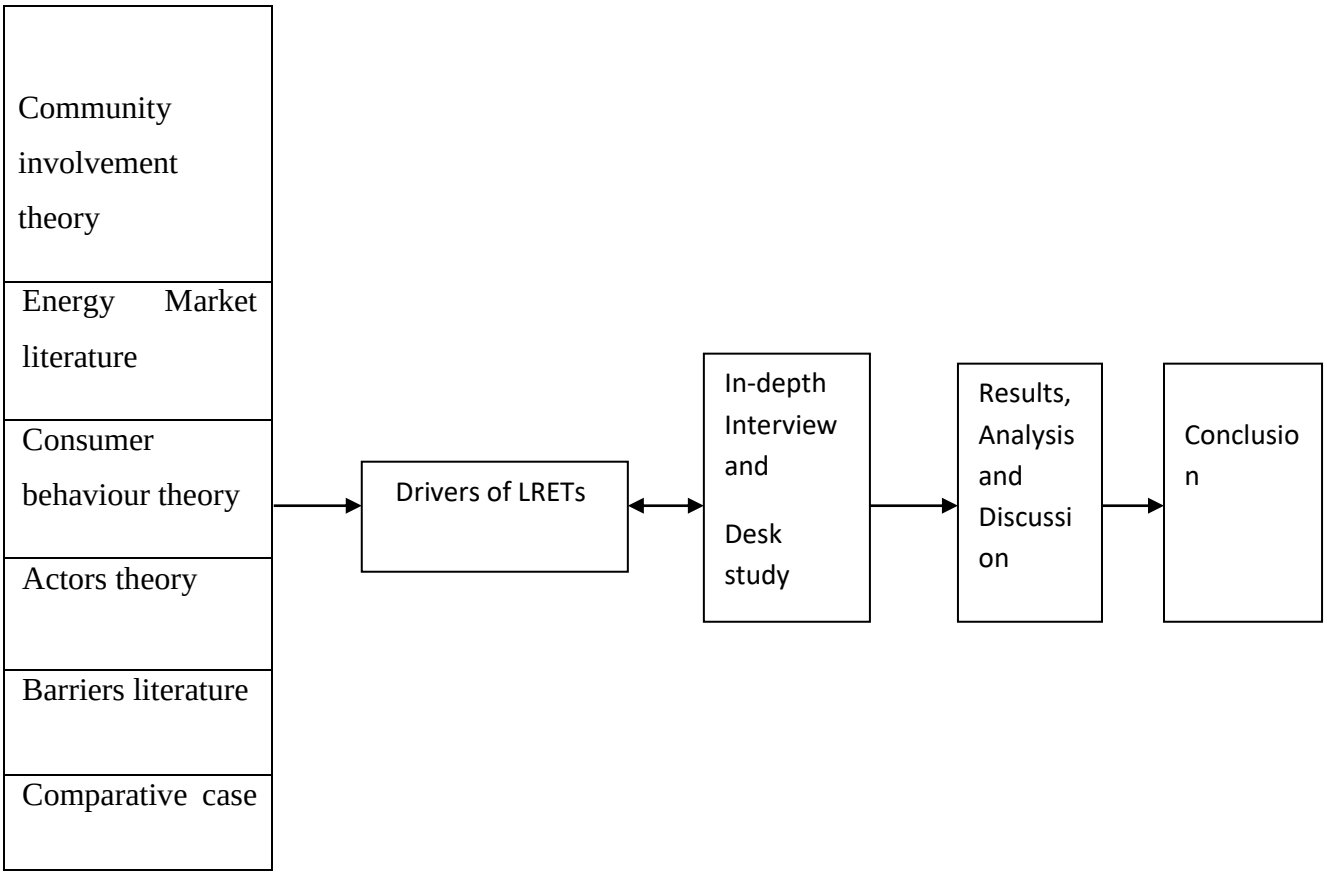
Respondent	**Organisation/Function**
Mr. Saybrand Frietema	Energy coordinator at Energy Workshop Leeuwarden
Mr.Roeland Weestra	Project Manager at Duurzam of Roc Friese Poort Leeuwarden
Mr. Ruud Paap	Business developer at Groen gas Netherlands(Leeuwarden)
Mrs. Erica Zomeraman	Energy expert and Teacher at Energy Academy Europe and Hanze University (Groningen)
Mr. Ronald Van	Energy officer at Us Kooparasje Leeuwarden

Giessen	
Mr. Bouwe d. Boer	Energy Officer at Fossil Free Organisation Leeuwarden
Mr. Gerald Adema	Program Manager Frisian at Friese Milieu Federatie
Mr. Frans Debets	Energy consultant from Utrecht city
Mr. Markus Schild	Green electricity Campaign Manager at Wise Nederland

3.2 Research Framework

As stated in, (Doorewaard et al, 2010) the research framework is a schematic representation of the research objectives. Research framework follows steps-by-steps activity to attain the research objectives as mentioned below: characterizing briefly the objective of the research, determining the research object Step, establishing the nature of the research perspective, determining the source of the research perspective, making schematic presentation of the research framework, formulating the research framework in the form of arguments and checking whether the model require changes.

Figure 3: Research Framework



study

3.3 Research Strategies

Table 3 shows an overview of different research phases and the research strategy, as well as data sources and the way of accessing the data.

Table 3: **Overview of Research Strategies**.

Research Phase	**Research strategy**	**Data sources**	**Accessing method**
1.Theoratical exploration	-Desk research -Literature review	-Scientific literature -Official documents	-Search method -Content analysis
2.Gathering empirical data	-Desk research -Interviews Comparative case study	-Energy Experts/officer -Official documents -Policy documents -Scientific literature -Public data sources	-Search method -Questioning
3.Analysis of results			-Qualitative analysis

3.4 Research Ethics

As far as research ethics is concerned, since this research involved the human as participant/informants in data collection and desk study method, therefore, the information provided by the informants are handled with great care. In addition, the research participants were informed through the email and telephone about what the research project is all about before the start of the data collection. Moreover, data triangulation was applied in the information collected via desk study method so as to minimise bias and ensure accuracy.

CHAPTER 4: RESULTS AND KEY FINDINGS

This chapter presents the research findings based on the data collected via desk study method in the two municipalities and the semi-structured interviews with the key actors and experts in Leeuwarden and outside the Leeuwarden municipality. This chapter answer two sub-questions which assesses; what are steps taken and goals formulated by Leeuwarden and what were the steps and goals formulated by Samso island municipality to reach the 100% goal of renewable energy and energy savings. Also, this chapter covers the main stakeholders/actors role in the two municipalities.

4.1 Reason why Samso Municipality is an ideal case compared to Leeuwarden

The Samso Island project presented here first in this chapter because it is the best practise case to learn from Leeuwarden municipality case. Cotrarily, Samso municipality island project is the reference material for the analysis of the Leeuwarden municipality case. This is due to the fact that Samso has already achieved the goal of 100% renewable energy, (Go 100% renewable energy, 2018). Additionally, Samso has a progressive renewable energy policy which favour RE especially windmills, the Samso RE policy encouraged the ownership of windmills. About 90% of the windmills in Samso Island is owned by the local people, (Energy Academy, 2018).Furthermore, the Danish energy policy allocated enough fund to support the renewable energy sector. Another factor that made Samso to be the ideal case in contrast to Leeuwarden is the government support to the RE sector, community involvement, local leader support and actors involvement. All these criteria made the Samso island municipality project to be a best practise case compared to Leeuwarden municipality. The steps and goals through which the success was realised will therefore be thoroughly studied so as to understand the main drivers, main actors, and obstacles that have surfaced and how the problem was solved, in order to come up with the recommendation of other small municipalities or local regions of the developed world.

4.1.1 Samso Municipality

Samso is situated in the north-west part of the Zealand and east of Jutland covering, covering 114 square kilometres. Samso Island has a population of 3,724, (Samso Municipality, 2017) and its main economic activities are farming, fishing and tourism. The island has a great potential to advance economic benefits and become 100% of renewable energy and achieve a total reduction of carbon emissions, (Jorgensen et al, 2007).The Samso Island municipality mainly relies on the production of fruits and vegetables for the exportation. Additionally, the island receives incomes from the tourism sector, which is estimated to be half a million visitors per year. Hence, the implementation of the project to become 100% renewable energy was started early in 1997, and now the Samso Island has achieved its commitment.

4.2 The goal of the Samso Island Municipality Renewable Energy Project

The significant goal of the Samso island renewable energy project was to demonstrate an integrated energy planning based on the RE sources could be implemented within the limited geographical area, (Samso Energy Agency, 2009).

4.3 Steps taken and goals formulated by Samso to reach the targets of 100% Renewable Energy

Below are some of the key steps and goals formulated by Samso Island to reach the target of 100% Renewable Energy at Local level;

4.3.1 Samso Island Municipality Renewable Energy Strategies

Back in 1997 Samso Island won the prize of becoming an self-sufficient Island based on the renewable energy technologies. The project covered the entire energy sector in the local area such as electricity, heat and transport, (Sperling, 2016). This competition was introduced under the Energy agenda 21 strategic plan of Denmark. This strategic plan seeks to realize targets of 35% renewable energy sources by 2030.

4.3.2 The main Objective of the Samso Island Municipality Strategy

The primary objective of the strategic plan was to develop and employ a locality where the use of local renewable energy technologies can become realism in the community and minimise the emission of carbon dioxide, while at the same time boosting economic and social benefits in the area. Moreover, the strategy involved achieving the goal of 100% renewable energy within the period of 10 years, reducing energy consumption to 10%, ensuring community engagement and finally using effectively form of financing, (Torres Silva report pg.35, 2008).

Having that clear targets/plans presented above, the Samso Energy Company was formulated and presented the plan based on the following renewable energy technologies;

1. Land Based Turbines

The plan of the Samso Energy Company approximated a consumption of electricity of around 29,000MW/h per year after 1997. The study realised by Samso wind energy estimated that installation of eleven 1MW wind turbines was suitable for the needs of the Island, (Jorgensen, 2007). Organisations of the meeting were conducted with the local community around the island, to inform the citizens about the project in order to promote public acceptance of the proposed implementation and convey the knowledge about the significance of adapting the renewable energy technologies. Besides that, the motive of the meeting was to look for the investors and the interested participants in the project (Stubkjer, Leif ND). The project for purchasing wind turbines began and the ownership

structure gave many benefits to the community. (Torres Silva report pg 36, 2008) indicated that the adopted scheme was applied in order to give the public an opportunity to participate in investment as required by the project plan. The plan followed the following structure; nine of the eleven turbines were given to one person per piece, with the condition that they allow space in their land to install two windmills owned by the citizen who buys the share of the remaining turbines. The owner of the land agreed with the proposal and share were given to the public. Participation in the investment required an investment of 3000£ in order to buy the share of the turbines. Thus 430 shares of the wind turbines were sold. On top of that one wind turbine owned by one people got assistance from the Samso municipality for the grant application to the bank. Lastly, according to (Torres Silva report, pg 37, 2008), the interest rate on the loan was very low as the municipality acted as a guarantor.

2. Offshore Wind Turbine

According to (Jorgensen et al, 2007), The Samso Offshore Wind Company was formulated to ensure the ownership of the project. The project that encompassed the 11 turbines was realized by 2003 giving Samso the chance to become 100% renewable energy island where 10 turbines were located, (Torres Silva report pg.38 2008).

3. PV-Panels

As reported by, (Jorgensen et al 2007), the Danish Energy Agency and the Samso municipality provided the subsidies for the implementation of the PV panels. Additionally, Samso Energy Academy incorporated 100 square metres on its roof. The challenges occupied in this technology were the higher prices per kW/h obtained and only those excited in technology as well as the environment are anticipated to adopt the solution, (Ibid). The significant aspect about the PV installation was not that much electricity generated but the Samso municipality offered the technical assistance and know-how to the local community who wanted to adopt the technology.

4. Central Heating Systems

The main intention of the plans to invest in renewable energy was based on the central heating plants, advocated by active local citizens. (Torres Silva report pg, 38, 2008) indicated that the idea behind these plans is to inspire the communities to change the systems and decrease the cost of heating. The use of the local resources was measured as the main determinant factor for the local farmers in the community who had the chance to supply the straw to the plants. Furthermore, the local community gets profits by minimising the cost of heating by oil boilers; hence the price of the oil had the large impacts on the income of the local community on the island. Lastly, the minimisation of emission from the burning of fossil fuels and the economic gains of the local community forced the local community to adopt the scheme.

5. Heating

Heat production from the alternative energy sources raised from 25% in 1997 to 65% by 2005, (Jorgensen et al, 2007). Majority of an individual on the island had a domestic boiler which runs by fossil fuel and contributes to the CO2 emissions, but after the local community started using renewable sources such as biomass energy and solar power currently the heating coming from these sources account for 70% by 2016, (Agness galama report, 2016).

4.4 External development

Despite the fact that the issue of energy transition is complex and go beyond the municipality limits, external factors influence the Samso municipality approach as well. These follow from the targets and activities at the European, national and municipal level for energy transition.

4.4.1 The European Union

The leaders of the European Union member states proposed and agreed on an action plan with three targets by 2020. These targets are; to reduce the CO2 emission by 20%, to reduce the energy consumption by 20% and to increase the share of renewable energy about 20% in the energy mix, (European Energy Policy, 2007). The idea behind these targets is to mitigate climate change, to ensure the energy security and to encourage the competition of energy market within the EU, (ibid). Therefore, the European Union targets are congruent to the Samso island renewable strategic plan, the Danish renewable energy policy, and the Samso Master plan as elaborated below. In a nutshell, the EU supported the Samso Island project by providing the fund for the development of the Samso Island energy project. (European Commission, 2009).

4.4.2 The Danish Energy Policy

The Danish Energy policy is also similar to the European Union targets as the Danish government want to be independent of fossils fuels (coal, gas, and oil) by 2050. Accordingly, the country must be able to cover its energy use by renewable energy utilisation. In Denmark, the switch to the alternative energy sources is an ongoing process, and if booming it will assist to tackle the climate change and secure the energy supply. In 2006, the RE covered 31% of the final Danish energy use and 54% in the electricity sector taken separately, (Energie statistics, 2016) On top of that, RE will cover the 100% of the electricity and heat supply by 2035 and wind 50% of electricity consumption by 2020, (Olesean J, 2015).

Additional, the Danish support scheme for renewable energies was the key factors for the development of the Samso Island Energy project, (Leteff Robert, 2012). During the early year, the project benefited from the ambitious and the stable promotion policies of the Danish government on

the renewable energy. The owner of the onshore wind farms were guarantees fixed and cost-effective feed-in tariffs of about 8 cents/kWh for a ten years duration. Likewise, the Danish Energy Authority provided Samso with the grants for the establishment of the district heat system, of about 400,000£, (Jorgensen et, al. (2007). According to (Jan Beermann report, 2009), Hermansen who is the executive director of the Samso Energy Academy, clarified that the national support system which was the core driver of the Samso island project was decreased after the general election in 2002, the social democratic government was replaced by a liberal right-wing government was not favouring the renewable energy system. Hermansen mentioned that the whole Samso highland 100% region project was under threat:

"In the first four, five years, it was a flowing process. But then we had a new the government in 2002 and it became more difficult to make projects because the new the government said: 'No, we are not going to support this kind of development, we think that everything should be done on market mechanisms in a liberal economy".(ibid)

As a consequence, much more calculations had to be done and also the research area suffered from a lack of financing. Now the government wants to become "green" again, but they missed out on six, seven years. The project almost broke down because of these developments (ibid).

4.4.3 Samso Municipality Fossil free Master Plan of 2009

In early 2009 the Samso municipality council passed a master plan for becoming fossil free island by 2030. Some of the goals of the master plan are as follows; (1) to increase the renewable energy production, (2) to depend on renewable energy sources on transportation (3) to increase energy efficiency and partnership. Therefore, half of the vehicles on the islands and public transport will be electric by 2020, (Jan Jantzen et al, 2018).

4.4.4 The Covenant of Mayors

The Samso municipality mayor signed the covenant which forces the municipality to realize and even go ahead of the EU 2030 climate and energy targets, which means about 40% less greenhouse gas emission by 2030 and embracing of the joint effort against climate change, (Covenant of Mayors, 2018). By signing the pacts of the islands Samso municipality dedicated itself to go far the EU targets and minimise the CO2 emissions by at least 20% by 2020, (Pact of Islands, 2018).

4.4.5 The central Denmark region strategy of 50% of energy consumption

The central Denmark region which involves also the Samso municipality agreed on the energy strategy and target of 50% of the energy consumption. This means that the all-region by 2025 will be renewable energy, (J.L Olesen, 2015).

4.5 Current state of Energy system in Samso Municipality

1. The primary energy supply on Samso Island for the 2013 and 2030 is shown in the table below;

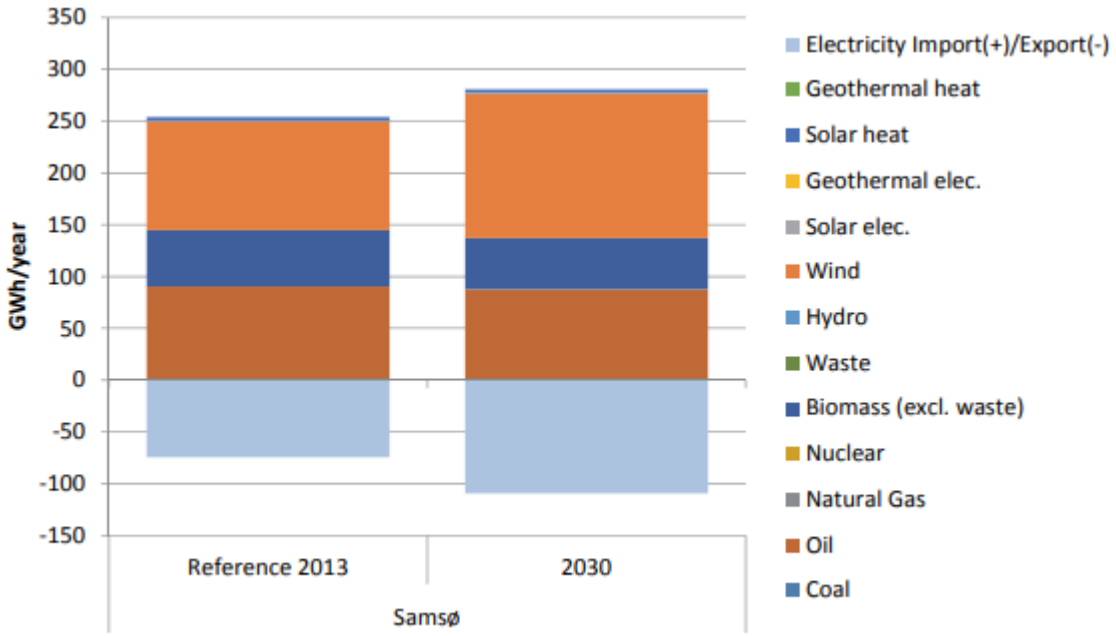
Table 4: **Primary energy supply for the 2013 reference Samso energy system and 2030**

Primary Energy supply /GWh/Year	**Reference 2013**	**2030**
Fossil fuels	**90.4**	**87.8**
Coal	0	0
Oil	90.4	87.8
Natural gas	0	0
Renewable Sources	**165.4**	**193.1**
Biomass (exclude waste)	56.3	49.3
Waste	0.9	0.9
Hydro	0	0
Wind	104.64	139.4
Solar electricity	1.08	1.36
Geothermal electricity	0.0	0.0
Solar heat	3.29	3.29
Geothermal heat	0.0	0.0
Wave and tidal	0.0	0.0
Electricity import(+)(-)	-79	-109
Total	**179.3**	**171.4**

Adopted from Samso Energy Vision, 2030

To a large extent, the primary energy in Samso is influenced by wind power both onshore and offshore production. For that reason, the huge share of the electricity generated is exported outside the Island as presently it cannot be utilised. About 90GWh/year of oil is utilised in the transport sector, household and industry, (Samso Energy Vision, 2030). The contrast between the 2013 and 2030 model is connected to the rise of the RE electricity production from wind power because of the assumption concerning the improved capacity factor for the wind turbines. This goes with the need of replacing the current wind turbines with the new ones prior to 2030. (ibid)

Figure 4: Primary energy supply for the 2013 reference Samso energy system and 2030.

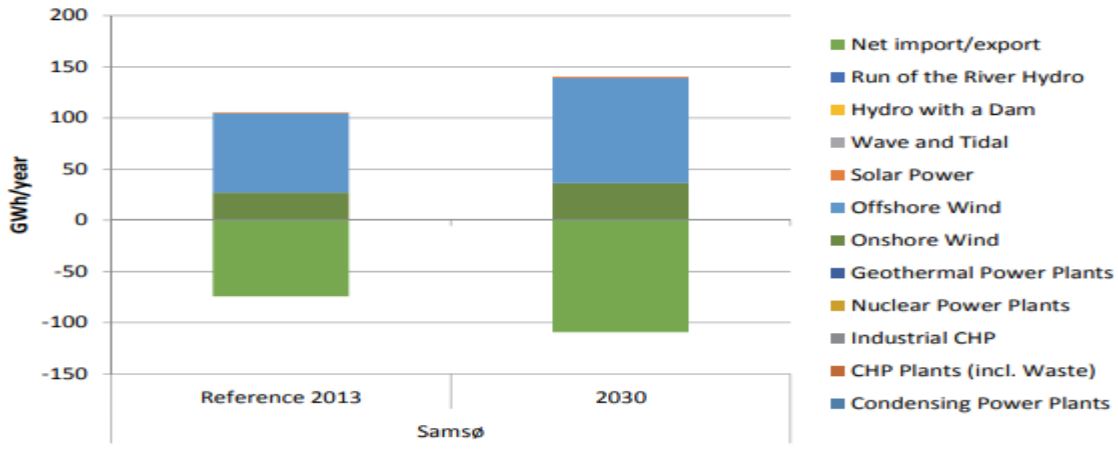


Adopted from Samso Energy vision, 2030

2 Electricity Production and Electricity change

Electricity production on Samso Island involves the only generation from wind power and solar power. Samso export to other areas about 70% of the electricity that is produced in the system in 2013 and around 80% in 2030. (ibid)

Figure 5: Electricity production and Exchange in the 2013 Samso reference and 2030, the electricity production is from RE sources

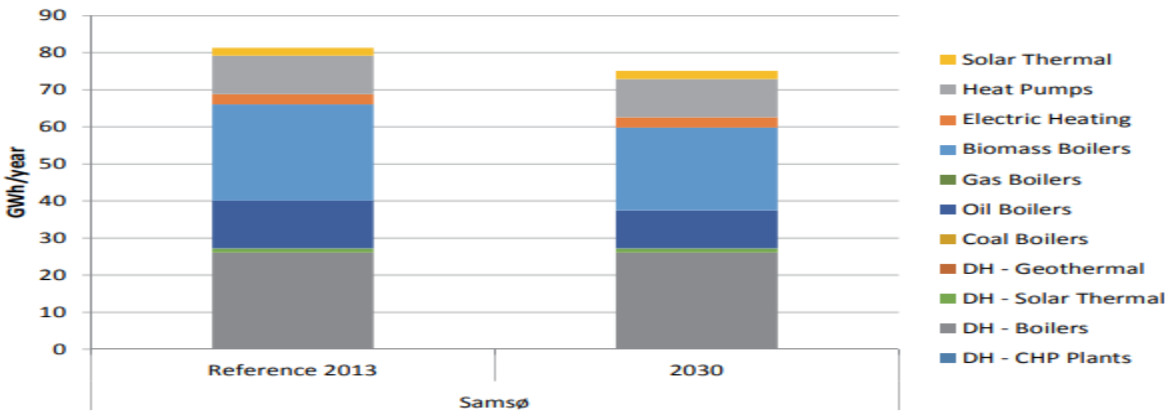


Adopted from Samso Energy Vision, 2030

3 Heat Productions

On the Samso Island, heat production is based on district heating and individual heating solution. In 2013 the district heating system was around 37% of the heat production while it will rise gradually to 40% in 2030. Another source of heat production is mostly from the individual oil and biomass boiler, heat pump, solar thermal and little share of electric heating. Generally, the heating generation decreases in 2013 and 2030 reference as it is roughly calcualated that the boiler efficiencies will recover by 2030. (ibid)

Figure 6: Heat productions in the 2013 Samso reference and 2030 by heat technologies and types (Individual and Collective).

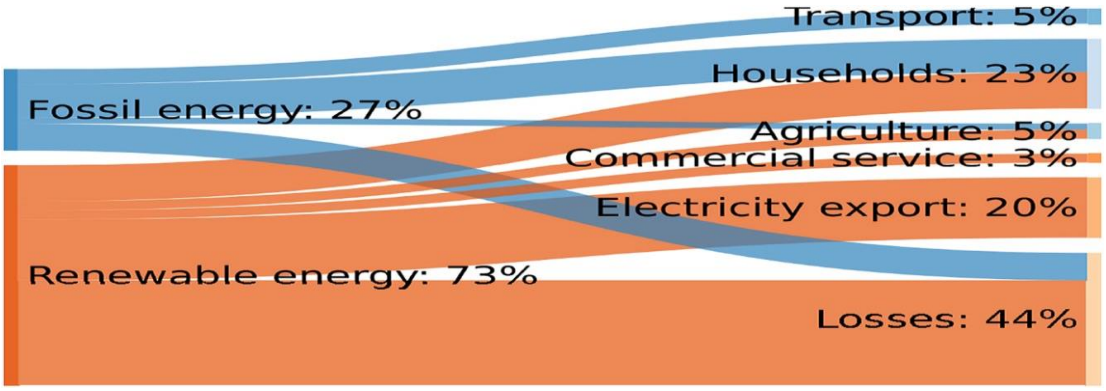


Adopted from Sams Energy Vision, 2030

4. Samso Energy Balance

The Samso municipality energy balance has got an input side- energy supply- and an output side with the different groups of users. In the diagram below the total supply of 901TJ is used by the transport sector, households, agriculture and business. The huge demands are in the transport sector which relies on fossil fuels, (Jan Jantzen et al 2018). Currently, there is a plan of biogas plant installation which will produce green energy for the transport sector (SMILE report, 2017).

Figure 7: Samso energy balance, 2015

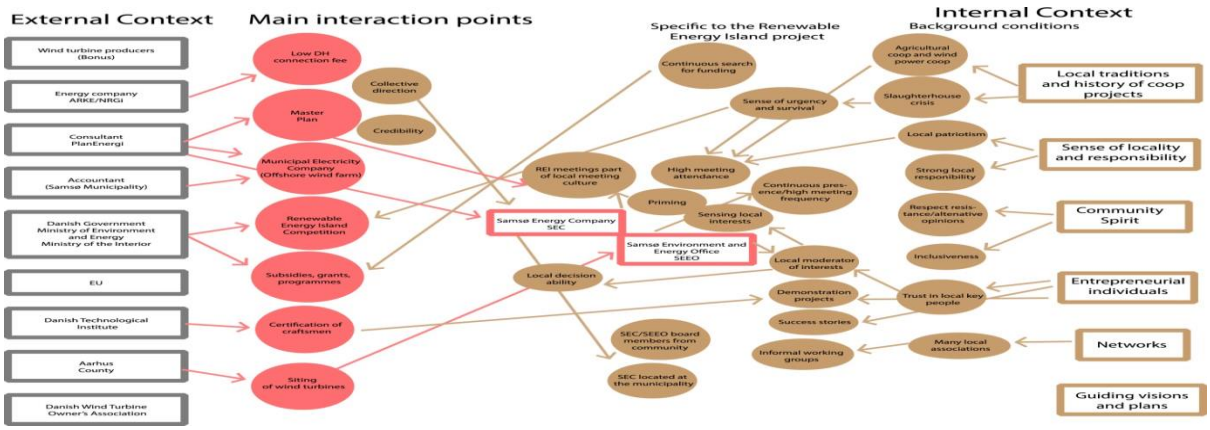


Adopted from Jan Jantzen et al, 2018

4.6 The role played by actors in local renewable energy transition and energy savings in Samso municipality

It is very uncommon for an organisation to act its self in the development activities/initiatives and there are generally multiple actors involved. This actor includes local, national, supranational, social, government bodies, non-profits organisation, local stakeholders and special interest groups. For the case of the Samso Island, there are a number of organisations involved in every level of the project to create the framework to support the island project. This framework consists of the partnership between the organizations, financial support, public involvement, public-private collaboration and policies which authorized the project to develop in a suitable manner. Figure 8 below shows that actors at the local level had a considerable influence on the implementation of the project due to the proximity and investment in the project. According to (Coenen and Hoppe report, 2011) the inclusions of local governments make sense because they can shape the policy related to renewable energy initiatives, and the involvement of local government is crucial for the renewable energy project to succeed. This type of commitment is the same as the one on the Samso Island and the Samso Kommune (municipality) because they were both participated in the project in different ways.

Figure 7: Actors and figure Interaction



Adopted from Karl Sperling, 2016

The Samso Kommune (municipality) facilitated the project primarily through the advocacy of the mayor in 1997. According to (Lettef Robert report, 2012), the mayor worked with other peoples such as Soren Hermansen who is the executive director of Samso Energy Company, and also the government official's example Svend Auken. The municipality bought a shareholder, of five out of ten offshore windmills. The involvement of the Samso municipality from the beginning of the project was very vital as the competition and call for the proposal was coming from the Danish Ministry of Energy. It as well gave the project support through its participation. (Michalena and Angelona report, 2009) declared that in their report that the government support at a local level is essential for many reasons. Firstly, the effective communication between the local government and central government is essential for the sharing of the information between them; Secondly, government participation is fundamental at the time of inspiring social support. And lastly, the government can provide the legislative framework to support the development of renewable energy systems. For instance, on the case of Samso Island, the government provide the investment capital to support the offshore wind turbines.

Many organisations were formulated to assist the coordination of all activities on the Island. The Samso Energy and the Environmental office were opened to help motivate parties for instance farmers, a place where they can find information affiliated to the project. As reported by, (Lettef Robert report, 2012), the office had one employee who worked as an energy consultant and at the same time, he was providing information to the individuals who wanted to take part on the Energy Island project. At the start, this office was powered by the Danish Energy Authority until 2002, (Samso Energy Agency, 2012). The Kommune also formed a council who were responsible in matters related to the energy and the environment, which also work closely to the Energy Academy named Technical and Environmental committee.

A significant contribution of the municipality to the Energy Island Project was the formation of the Samso Energy Academy and fund provision which comes from the municipality owned windmills, (Samso Kommune, 2005). On top of that, the Kommune formulated aboard to supervise the construction to the Energy Academy, the Samso Energy Agency with the motive of coordinating local and international initiatives and to create what will become a Samso Energy Academy. The Samso Energy Agency is a non-governmental organisation which was established via collaborated efforts of Samso municipality, Aarhus County, the Danish Enterprises and Construction Authority under the administration of Danish Ministry of Internal Affairs. Two years later the formation of the Samso Energy Academy was also completed and opened up in 2007 by the Samso municipality mayor.

Presently, the Samso Energy Academy works as a place for coordination of renewable energy efforts on the island and as a meeting point for the people who are fascinated with learning about the Energy Island activities. The centre also facilitates the Samso 2.0 project which aims at the transition of the mobility sector from the fossil fuels to the renewable ones such as the electric cars, buses and powered biodiesel ferries. Lastly, the Samso Energy Academy is not a branch of the municipality but a non-profit organisation started and staffed by the island people.

Another organisation, the Samso Energy Company this company was started with the purpose of coordinating the individual project related to the more massive Energy Island project. The eleven offshore wind turbines, the eleven onshore wind turbines and the four onshore districts heating plants would be financed as well as managed in a number of ways.

The eleven onshore wind turbines would be under nine farmers, each of them owning one turbine, the rest two would be owned by the multiple residents via the establishment of the association, with each member of the union owning a share. Five out of ten offshore wind turbines would be funded by the municipality and managed through the formation of the Samso Renewable Energy Limited. The remaining five offshore wind turbines were financed via a mixture of investment by local farmers, island residence and also two professional investors. Two out of the five are owned by the farmer's organisation, one is owned by the citizen organisation and the last two are owned by the two private companies, (Samso Energy Agency, 2012).

Furthermore, on the Samso Island, there were less official forms of governance at a local level, which were more localised than the municipal government. On the island, there were a total of 24 villages, some of these villages had their village organisation and chairperson, but they were not official that means they were not capable of passing the law and levy tax, but they were able to give the villagers the room for conversation. Since the villages had their own goals and bylaws they still support the idea of Energy Island and the Energy Academy. (Lettef Robert report, 2012) pointed out that one village had the target to have one wind turbines while other village had set a bylaw which supports the renewable energy initiatives on the island and in their own village. According to (Samso Energy

Academy, 2012) one of these villages organization, business owner and the villagers who were tasked for one of the four heat plants ahead of timetable.

These villages become a vital part of the Energy Islands project and some of the villages joined the initiatives to install the district heating plants in a different location on the island (Jorgensen et al, 2007). Initially, when the public meeting was conducted about the plan of the project, these organisations acted as the point of contact in conveying the information. Through working in this framework, a network was created where the community and leaders could make decisions and agreement concerning the project.

National level support involved the public figures and the organisations in the Danish Government were the fundamental drivers in the Samso Island Energy project. These public agency prepared the competition between Islands and provided financial assistance for the specific stages of the project. The competition function as reinforcement while at the same time the financial aid acted as the support mechanism. National level participation besides gave the project credibility. The national support in the form of financial and political is essential to any development project (Plummer, 2002). It is well recognized that the Danish Government has the criteria and guideline which required to be followed, but for the case of the Samso Island municipality project the Danish Government did not interfere anything or direct what to be done. Its participation was the same as that of the local government; in that case, it did not hamper the project or exercise its power over the municipality. This is because the Danish renewable energy policy encourages local ownership as a technique of tackling barriers/constraints for example (Not in My Backyard Syndrome) NIMBY as well as visual pollution. According to the research done by (Meyer, 2004) at the Technical University of Denmark substantiate this and with the regards to the Danish national energy policy says that "the acceptance of wind turbine in Denmark is because that many of the wind turbines are owned by households based on neighbourhood co-operatives" pg. (29). In other European union countries such as Italy where its energy policy did not include this ownership to the private/local community, they usually experience opposition during the implementation of different renewable energy project from the top down (Farinelli, 2004).

At the time of the implementation of the Samso Energy Island project, the Danish national government acted through its Ministry of Energy and Environment. In 2007, the organisation divided into the Danish Ministry of Climate, Energy, and Buildings and the Danish Ministry of the Environment, with the previously as the primary ministry with which the municipality of Samso and Energy Academy would interact. According to (Lettef Robert, 2012), before the division of the Danish Ministry of Energy and Environment, Svend Auken used to act as the liaison between the national and local level involvement. After the ministry becomes the Danish Ministry of the Climate, Energy and Buildings, there were three ministers in this position; one of the ministers called Lykke

Fris visited the Energy Academy. The communication between the minister and the local officials and people of the island symbolised strong collaboration between the local and the national level (ibid).

Additionally, the Danish national government affected how the renewable energy technologies were perceived via the policies leading the municipal and individual use of the renewable energy sources. For instance, the case of the Samso municipality was obliged to reinvest any income collected from the windmills to the project. This revenue was also used in the building of the Energy Academy, (Samso Energy Agency, 2012). If there were no this orders the money revenue would be used for other activities. Besides that, the feed-in tariffs also affected the resident's use of the renewable energy system in their home by influencing the economic viability of that system. On the other hand, the policies changed the electricity produced from the renewable sources such as solar and wind power, sold to the energy companies and this shows how long time it will take to pay off the investment period. Lastly, if the time frame is too long the people would not love to invest in that system (Gagnon et al, 2010).

Moreover, as stated in (Jan Beermann report, 2009), there were the national financing programs which permit the people to apply for the grant if they wish to improve energy efficiency in their households. The financing programs also support the individual who wants to change the oil burning furnaces to the renewable ones. The Samso Energy Academy includes this into their energy plans. Then, they provided information to the people on the island about the availability of this fund, (Jorgensen et al, 2007).

Lastly at the supranational level, the European Union was the sole actor who participated in the Energy Island project. The European Union has targets regarding the renewable energy and energy savings. By 2020 the European Union member's states are supposed to meet the EU targets, with 20% of renewable energy, (Turkenburg et, al. 2004). On the Samso Island, the European Union provided the finance which facilitated the implementation of the project. One source of the financial assistance is from the European Regional Development Fund from 2000 to 2006 and contributed £400,000 to the project, (European Commission, 2009).

4.7 Driving forces of the Local Renewable Energy Transition on the Samso Island.

4.7.1 Local leader support

As reported by (Jan Beermann, 2009), a number of pioneers played a major role in the successful implementation of the energy island project. The project started after Ben Schaloffsky a local engineer from Aarhus County who used to work in Samso, study the information regarding the Danish Energy Island. Jointly, with Samso mayor John Sander, who was excited about the project due to the business

opportunities it will offer to the municipality and other few people from the island Schaloffsky prepared the master plan and submitted.

After Samso Island won the competition a group of supporters come together to implement renewable energy goals. The member of the supporter group includes Birgit, a local politician and ex-member of the European Parliament. Birgit claimed that the group consolidated skills people such as Soren Hermansen a local energy expert who had the capacity to bring people together; Bent and Aagen a local engineer who had the technical knowledge that was needed for the introduction of renewable energy technologies; and Bjorvig who had a knowledge of lobbying and advocacy of policy from local and international level. Bjorvig emphasized that the collaboration within the team was positive; "We had a good group and we liked to work together." Amid, all the pioneers Hermansen were only one who collect salary and later he became the leader of the project. Hermansen ability to bring the local citizen together and the opinion leaders pursued them about the project has been the crucial thing that leads to the success of the Samso Island project, (ibid). One of the local farmer (Morgen Mahler) identified Hermansen as a person who is capable of bringing the trust into the Island people; "He is born and raised on the Island and many people know him, and people recognize that what he is doing is not for himself but for both people on the island." (Putnam et al, 2003) indicated the constraints of implementing the local innovation to the people of different background. But for the case of Samso Island project, Hermansen together with the team was able to control this problem and "bridge the social capital" on Samso. According to, (Jan Beermann report 2009), Birgit provide clear evidence of how Hermansen managed to win the Islanders confidence:

"The reason that we succeeded so much as we have done is that we were successful in changing the people's approach to the whole project. And there, Søren[Hermansen] was fantastic. We had citizens' meetings in all the villages around and most of them were farmers. And when they got a little stubborn, Søren could switch into the local dialect and he just had them". (ibid)

Currently, Hermansen is one of the key supporters of the Samso project. After the projects come to an end in 2005 Hermansen was elected as Energy Academy leader where he advocates renewable energy transition to the politicians, journalist and visitors (ibid).

4.7.2 Community Involvement

One of the critical reasons for Samso Energy Island to win the competition among other area was due to its central concept of community engagement in the local renewable transition, (Jan Beermann report, 2009). The opportunity the people had to participate in the project through public meetings and total or partial ownership of wind turbines made the project successful and unique. (Lettef Robert report, (2012), indicated that the meaningful public engagement of people on the Island was what endorsed the plan to succeed and moving forward. This engagement took different forms and for each

authorized different type of public participation, from the planning process to the mechanism for direct ownership. In 2002 to 2006 sixteen public meeting was held, which integrated agenda items on the Samso Energy Island, (Samso Kommune, 2012).

The significance of the community involvement and the public outreach showed by the Soren Hermansen the Samso Energy Island pioneer was also indicated by, (Lettef Robert, 2012). This illustrates the significance of the competent leadership and its connection to the meaningful public involvement. The public inputs were not about only give information on the proposed plan but also incorporated in the planning process itself. Identifying the sites for the land-based turbines was part of the public involvement and the consensus about the turbines locations has to be reached prior the project started. One expert from the Samso municipal council declared that this process took the better part of the entire winter, (ibid). Public outreach such as notices, local newspaper Samso Posten, and the notices from the municipal council was also included. As reported by (Lettef Robert report, 2012), two respondents declared that they usually learned and followed the Samso Energy island project through these means of communication mentioned above.

4.7.3 Incentive for actors

On Samso Island municipality the local economic actor' has supported the project since the commence of the project. The actors such as the farmers, trade unions, tourist board strictly collaborated with the local leader(supporters) to start both the onshore, offshore wind turbines and the district heating plants. Similarly, the local municipal council also assisted the project. As reported by,(Jantzen report et, al. 2006), initially the right-wing members of the council were more unconvinced than the left wing members, presently the whole members are positive actors in the local renewable energy transformation. The municipality participated in the off shore wind turbines this is by taking the large loan so as to buy the five out of 10 offshore wind turbines. The mayor of the Samso municipality elaborates the motives of this massive investment:

"We decided to finance five turbines, both in order to support the project and get it off the ground, but also to create new job opportunities and know-how. The offshore turbines are now there, and we've invested 17 million £. That's the equivalent of every islander investing 4,000£. But I think every person on Samsø sees this as an exciting project" (Cited from Stubkjaer, 2008).

(Jantzen report et, al. 2006), indicated that the local administration was quite supportive. The only challenge comes to the processing time, but there is no resentment towards the renewable energy technologies.

4.7.4 Economic factor (Island weak economic conditions)

For long-time agriculture and the tourism were the two economic/business sectors on the Samso Island. On the other hand, the island economy has been challenged by the structural changes. Farming has been collapse for years; the local pork slaughterhouse with 70 employees was under duress in the 1990 and ultimately closing in the 1999/2000 and the job losses could not be remunerated by the tourist sector. Accordingly, due to unemployment majority of citizen migrated from the island to the mainland to look for the new job (Jorgensen, 2007).In this period of economic slump, investments in the local renewable energy sector were seen as the opportunity for new jobs and business on the island. As cited in (Stubkjeaer, 2008), "One of the reasons for entering this was to create more employment on Samsø. It's been an incredible help, after the closing of the slaughterhouse. We've kept a lot of people employed." It is hard to find out the exact number of the employees that were generated by project total investment of about the 57 million euro's, (Jorgansen, 2007). As a minimum of 20 employment of local workers was produced in the building of the district heating system as well as wind turbines, that was between 1997 to 2005 (Jakobsen, 2008). Moreover, the blacksmith's carpenters, builders were supplied with extra business and farmers received the good price for their straw. Besides, the local tourism is improving as results of increasing the number of the tourist on the Samso Island (Jorgensen, 2007). Lastly, the number of the workers who arrange and convey the information about the Samso Island has risen from two personnel in 1998 to six personnel in 2007, (Jorgansen 2007). As stated in (Jan Beermann report, 2009), the leader of the Samso Development office (Mette Lokke) believed that the establishment of the Samso Energy Academy would boost the job opportunity particularly for the educated young ones:

"The whole Energy Island project is a focal point, for Samsø in general, not just for renewable energy. That's why we at the Development Office support the project heartily and work towards setting up an academy for renewable energy. An Energy Academy can give us that which we lose in other areas. We gradually lose jobs for people with higher education. But setting up the Academy, in collaboration with the academic world, we can re-establish that area. It gives us a new niche in which we can create new jobs." (As cited Jan Beermann, 2009).

(Jantzen et al, 2006) also claimed that the impact of the local renewable energy technologies has already expanded to the third economic sector on the Samso Island. According to, (Jan Beermann, 2009). The former politician Bjornvig wrap-ups by saying "The project has produced new jobs on the island. The cement factory made the foundations for the eleven land turbines. The blacksmiths have more work. [...] At a time when big is better it's important to prove that smaller entities can survive."(ibid).

4.7.5 Positive collaboration with grid operators/actors

Samso grid is the member of the regional integrated network which grid operator NRGi rents. (Jantzen et al, 2006), claimed that there is no any inconvenience with connecting wind turbines to the grid, as the operator is responsible for taking the energy produced from the renewable energy technologies system. On top of that, Jantzen explained that the more significant thing is the cooperative ownership model of the grid operator:

"NRGi has lots of members, which are us, the users. So the users themselves choose what to do in a general assembly. That is a better thing because it is not top down; it gives us the sensation of being able to decide ourselves. It is not pressed over us from above, from some power company that gets this idea: 'do this or do that" (ibid).

The grid operator allowed the incorporation of local renewable energy sources into the grid and had also involved in the district heating system on the Samso Island. Because the associations with the grid operator are functional, and it would be technically challenging to disengage from the national grid, there have been no discussions on disconnection in the future, (Jan Beermann, 2009).

4.7.6 The Samso renewable energy network

Since Samso municipality was one of the 100% local renewable energy region across Europe, the supporter could not learn or profit from the experiences of other areas with the same comprehensive goal, when the project kicked off in early 1997. Though, Soren Hermansen reveals how the supporter considered the various project in Denmark as well as Germany, (Jan Beermann report, 2009):

"We learned something about wind power; we brought it to Samsø and got it in operation. We learned something about district heating; we brought it to Samsø and got it in operation. So you could say: 'We had the recipes, but all the ingredients, we had from other projects."(ibid)

The Samso Energy Island project was not succeeded from the long history of Denmark of operating wind turbines, but only through the open conversation between different actors such as the politicians, scientist, and bottom-up initiatives that has enabled the large-scale deployment of the renewable energies in Denmark, (Hvelplund ,2005): "This is an old, traditional model of cooperative organization. We modernized it and used it once again."(ibid).

4.8 Renewable Energy Barriers on the Samso Island Municipality

4.8.1 Behavioural changes were not successful

According to, (Go 100% Renewable Energy site, 2018), there was a challenge of changing the oil mainly for the summer houses on the island. The people who own the summer house did not show

the interest to change their system. A number of visits were offered during the project concerning the adapting of the solar heating system but some of the households ignored the initiatives**.**

4.8.2 The Island failed to meet the target of the reduction of energy consumption

When the Samso island project started one of the objectives was to reduce the energy consumption to 10%, but after the project came to an end in 2007, the consumption has not decreased. The evaluation suggests that however, changes in electrical items on the island was a massive part of the implementation, the buying and use of enough devices had an opposite impact on the consumption pattern. The utilization of energy has been stable; about 24,000 MW/year has been used every year since 1997. Therefore the target of minimisation of energy consumption was not achieved, (Jorgensen et, al. 2007).

4.8.3 Other barriers of the Samso island project were; Savings electricity aimed at 15% reduction but completed only 3-4%, the transportation sector planned to minimise the energy consumption of transportation by 5-10% but instead increase by 5% and lastly, heat consumption expected at 25%minimisation, but in real sense ended up with 10% increase, (RE regions, 2010).

To sum up

The above explanation answered research question 3 which say; **what were the steps and goals formulated by Samso municipality to promote local renewable energy and achieved the 100% renewable energy?**

As stated in the literature the most significant steps followed was the Samso municipality RE strategy. The strategy aimed to achieve the goal of 100% RE within 10 years, reducing energy consumption and ensuring community involvement, The Danish renewable energy policy also played a outstanding role in the success of the Samso island project. Other goals are; the European Union goal of 20-20-20 and lastly Samso municipality fossil free master plan for 2030. On top of that, according to the documents reviewed, the primary drivers that contributed to the success of the Samso Island Municipality Energy project were, first all the National support and the innovative ownership structure project proposals supervised by the director of the Samso Energy Academy. The available fund schemes for the community to the adoption of the renewable energy system were also crucial because it helped to reduce the islander's burden during the shift to alternative energy. This was observed through the political support and the subsidies from the Samso municipality. The institutional framework proposed by the municipality was of the particular importance in the progress of the project. This was conveyed to the community on the island through the information awareness campaign and the public meetings. The factors such as, (1) social cohesion and community involvement, (2) renewable energy network, (3) economic measures, (4) political support, (5) local

leader support, (6) technical support and financial assistance from the European Union and the (7) Denmark government support through the ministry of Energy and Environment emerged to be the core drivers in the development of the Samso Energy project as well as protection of the local environment. Samso Island appeared as the best practise case among the renewable energy regions in the developed world, in spite of that the Samso island municipality project experienced some barriers like (1) behavioural changes was not successful and (2) the island failed to meet the target of reducing energy consumption to 10%. The main actors participated in the Samso island municipality project were; (1) farmers, (2) Samso Energy Company, (3) the national actors,(4) the local community, (5) supranational organisation (EU), (6) networks, and (7)Samso environment and energy office. The role of these actors is well explained in the previous chapter.

Table 5: A matrix of the Drivers and Barriers of Local Renewable Transition on the Samso Island

Driving forces of LRETs on the Samso Island Municipality	**Barriers of the LRERs on the Samso Island Municipality**
- Social cohesion and community involvement - Renewable energy network - Economic factor-unemployment - Political support -Local leader support -Technical support -Financial assistance from the Denmark government and European Union	-Conservativeness of some of the local community (Summer house owner) -The island failed to meet the target of reducing energy consumption to 10% -The minor challenge from the right wing liberal

4.9 Leeuwarden Municipality

This segment answer the research subquestion two which discusses, **What are the steps taken and goals formulated by Leeuwarden municipality to reach 100% of local renewable energy and achieve energy savings?**

Leeuwarden is the municipality in the northern part of the Netherlands and the capital of the province of Friesland. According to (Municipality statement, 2018), the Leeuwarden municipality has a population of 108,668 inhabitants. The significant economic sector within the municipality of Leeuwarden is; financial and business services, government and non-profit sector (ibid).

4.10 Leeuwarden Energy Agenda (2016-2020)

The municipality of Leeuwarden wants to be independent from fossil fuels such as oil, coal and natural gas. This ambition means that the energy demand of households, companies and institutions will be generated sustainably. This happens in the municipal boundaries of Leeuwarden and the North Netherlands region, (Energy agenda, 2016-2020). In addition, to water technology and agrifood, sustainable energy is a leading program called 'everyone is Leeuwarden Ljouwert is eltsenien. This leading program is good for jobs opportunities within the municipality. Saving energy plays a fundamental role in the municipality approach to fighting poverty (ibid). The municipality of Leeuwarden works closely with the province of Friesland on these initiatives. For a large extent, this happens within the project assignment called (Green works) and many more programmes within the municipality concerning the sustainable energy and energy savings. The implementation of sustainable energy and jobs within various programs such as Green works contributes to the municipality ambition to be independent from fossil fuels.

Likewise, Leeuwarden municipality plays a modest but not unimportant role in the local renewable energy transition and energy savings. The municipality wants to optimally facilitate the initiatives of market parties, residents and others. Also, the municipality stimulates and connects. The Leeuwarden municipality takes away restrictive regulations regarding local renewable energy technologies deployment. Furthermore, municipality support citizens' initiatives such as local energy cooperatives in the Achter de Hoven and Westeinde districts. Sustainability and the circular economy are the foundation for how the Leeuwarden municipality wants to develop the city further. As Cultural Capital 2018, the Leeuwarden municipality also has an excellent role for Friesland and the Netherlands sustainability offer opportunities for jobs at all levels (Energy agenda, 2016-2020).

4.10.1 Objectives of the Leeuwarden Energy Agenda, 2016-2020

1) **To achieve 20% energy saving in housing construction**

In the duration from 2010 to 2014, there was a saving of 0.28 PJ. From 2015 up to and including 2020, at least 0.33 PJ of energy should then be saved in housing construction. In energy mix ambitions of 2020, the area of focus is on social and private housing. With Municipality approach and role, municipality expects to be able to realize a visible effect for private housing. Housing corporations are on the threshold for social housing. The energy ambitions differ per Housing Corporation. At the same time, they work together on this topic. The Leeuwarden municipality entered into an agreement with the housing corporations, for instance, Elken and Woon Friesland. This agreement is called Public house vision'Nieuw Leeuwarder Bestek 2016 - 2020'. The reason behind this agreement is the construction of energy neutral houses. On top of that, the municipality is working on stimulating energy savings in a social real estate such as schools and community centres and companies, (Energy agenda, 2016-2020).In the transport sector, the authority of the municipality is minimal. The municipality remains committed to the sustainable public transport and the sustainability of municipality vehicle fleet. For example, a municipality does this to the student transport and WMO tax transport. The critical energy transition in mobility lies at national and European levels.

Figure 9: Energy saving mix in housing construction

	Saving in Giga-Joule	Saving in Peta-Joule
Approach Slim Wonen in Leeuwarden (2,550 private home improvement x 63,7 GJ * x 40% savings)	64,974	0.065
Performance agreements for housing corporations (Woon Friesland) with label jumps (5 x 250 social housing x 63.7 GJ x 40 percent ** saving)	31,850	0.032
Use of residual heat via heat conduction	32,000	0.032
Energy-neutral renovation of homes (Elkien) (4 x 250 energy-neutral homes x 63.7 GJ)	63,700	0.065
Autonomous development by, for example, FEP, behaviour, more energy-efficient appliances, smart thermostat	136,000	0.1360
Tot Lal Energy saving mix housing construction Leeuwarden	328.449	0,328

Already saved private individuals 2010-2014	280,000	0.28
Total period 2010-2020:	**608,449**	**0.608**

*: average energy consumption per home
**: 2 label jumps

Adopted from (Energy Agenda 2016-2020)

2) To generate at least 1.41 PJ of renewable energy

This is 16% of the total energy use in Leeuwarden in 2013. Wind energy plays an outstanding role in European member states as well as Netherlands energy mix. But for the case of Leeuwarden a wind park is not allowed in the municipality, thus the municipality has set its own energy mix and see the opportunities in solar power, residual heat, biogas, and geothermal energy to achieve its ambition. In 2016 the municipality was able to install three solar meadows through the assistance from the SDE+ subsidy, (Energy agenda, and 2016-2020). These meadows are suitable for almost 6 MW, and are located in the following area; 4.3 MW Hendrik Algrawei / Newton Park, 1 MW at the Friso construction company and 0.5 MW at Hemriksein / De Haak, (ibid).

Moreover, residual heat and geothermal energy account for 28% of the energy mix. The municipality is working on a sound business case for a heat network. Furthermore, geothermal energy is very promising. At the moment there are two exploration licenses in Leeuwarden by Van Wijnen and DDH Energy and one exploration license is in the application (ibid). 1/6 of sustainable energy produced by Omrin company is involved in the Leeuwarden energy mix as a company which produce sustainable energy by using the municipality waste. This initiative is also practised to the production of biogas from the RWZI water treatment plant, and lastly, the municipality also depends on the Dairy Campus Leeuwarden which is going to build the new biogas digester within the municipality (Dairy campus, 2018). The municipality also relies on the energy campus Leeuwarden which wants to supply sustainable energy within the municipality.

For that reason, in order to achieve the 16% share of local renewable energy in 2020, the municipality has set up its sustainable energy mix which accounts for 1.41 PJ (15.8%).

Figure 8: **Sustainable energy mix**

Excited renewable energy in the municipality of Leeuwarden	Power in GJ	Power in PJ
Wind energy existing windmills (5.18 MW)	42,890	0.043
Solar power - to be installed (75 MW)	237,600	0.288
Heat and geothermal energy: - Geothermal energy (1 source)	280,000	0.280
Energy from biomass: - WWTP (biogas)	27,000	0.027
- Dairy Campus	213,000	0.213
- Cover fermentation dairy farmers (2)	25.200	0.025
- Mono-fermentation dairy farmers (3)	7.913	0.008

- BV Sport and Blokhuispoort		
	15.840	0.016
Total within the municipality of Leeuwarden	849,443	0.850 PJ
Excited renewable energy outside the municipality of Leeuwarden		
Omrin: REC / Ecopark De Wierde		0.31
Purchasing sustainable energy		0.25
Total outside the municipality of Leeuwarden		0.56 PJ
Total sustainable energy mix Leeuwarden		**1.41 PJ**
Excited renewable energy, not considered		
Wind farm in the Ijsselmeer		*0.5 PJ*
Energy Campus Leeuwarden		*0.045-1.1 PJ*
Total disregarded		***0.55-1.6 PJ***

Adopted from (Energy Agenda 2016-2020)

With the implementation agenda 2016-2017, the municipality is looking forward to contributing the desired effect of saving 0.33PJ of energy in the households and generating 1.41PJ of energy in 2020.

Other Renewable energy and energy savings instruments formulated by the Leeuwarden municipality is as follows:

4.11 North Energy agenda switch

This is the north answer to the National energy agreement of 2013. The ambition of the switch is that by 2020 at least 21% of the final energy consumption on land will be sustainably produced. Leeuwarden Energy Agenda is a contribution to the North Agenda switch. SWITCH is an initiative of four Northern provinces and six municipalities to expand the share of sustainably generated energy in Northern Netherlands from 8.4% now to 21% in 2020. The Northern authorities and the Energy Valley Foundation, together with the business community, knowledge institutions and NGOs, have selected four themes that fit the core qualities and specific challenges of the region. These themes are as follows; energy savings and decentralised generation, energy storage, smart grid and gas in transition, bio-based energy and LNG in transport, offshore energy: offshore wind and energy from water, (Energy Valley, 2014).

4.12 Leeuwarden-Fryslan Energy now project 2018

Leeuwarden is in 2018 Cultural Capital of Europe. Energy now project is implemented by the Leeuwarden municipality in collaboration with the Fryslan province. The Leeuwarden municipality wants to investigate how Energy Now project will contribute to its ambition of sustainable energy and energy savings in 2020. This project also serves an important link to local initiatives; through this program, others can learn and take part in the energy transition. Lastly, the reasonbehind this project is the need of the municipality to explore the possibilities of European subsidies. Bottom-up initiatives, innovations and international cooperation are also starting points of this implementation agenda, thus making an important contribution to the energy transitions that Leeuwarden and Fryslân advocate for, (Energy agenda, 2016-2020).

4.13 Smart Living Leeuwarden

The municipality normally provides coaching to the citizens, institutions, mobility, and business sector about the energy saving and adapting of renewable energy. According to (Omrop Fryslan, (2017), 300 families have already signed up for energy advice to receive coaching. The energy coaching started in November 2016, with the objective of giving energy saving tips. For a great extent, this program helps the local communities in the municipality, for instance at the moment the household's member are more aware of the consumption of energy and they also save real money on the energy bill, (Leeuwarden Municipality2018). This is due to, for example, training of the community to use LED Lumps and drafting stripes. The municipality of Leeuwarden now desires to make the installation and use of solar panels available to people with a lower income. Furthermore, the Leeuwarden municipality is participating in the REFURB programme which involves 13 European countries; the main motive of this programme is to encourage households owner to move a step further with their energy renovations and achieve zero renovation (Frisian-NZEB market, 2018).

4.14 Groen Werkt

Green work was established to cater for a large shortage of qualified employees within the installation of local renewable energy technologies sector. Additionally, on the grounds that the RE industry is faced with an increasing degree of sustainable innovation within installation techniques, the Municipality of Leuwarden, Province Fryslan and ROC Friese Poort Bedrijfsopleidingen have developed an innovative work-learning training program called 'Groen Werkt' with the purpose of (re) educating job seekers for the installation branch for the Mechanic Installations; (Roc fries poort, 2017). The project assignment Groen works is a logical continuation. The approach Green Works focuses on jobs for both the young and old. It concerns jobs in all layers of the workforce. This involves maintenance jobs, new jobs and apprenticeships. Meanwhile, Groen work also contributes to the municipality ambitions in the area of water technology, agrifood and sustainable energy, (College

programma, 2014-2018). Lastly, the Groen werkt program has a target to create 300 jobs within the sustainable energy field, water and agri-food (Energy Agenda, 2016-2020).

4.15 External development

On the grounds that the issue of energy transition is complex and goes beyond the municipality limits, external factors influence the Leeuwarden municipality approach as well. These follow from the targets and activities at the European, national and provincial level for energy transition.

4.15.1 European Union goal of 2020

The European Union goals influence the Leeuwarden municipality targets on energy transition and energy savings. European Union member states have agreed to reduce carbon emission with the 20-20-20 targets for all European Union member states by the year 2020. This means 20% less carbon emission, 20% of less energy consumption and 20% of sustainable energy in 2020, (European Union, n.d).

4.15.2 National Energy Agreement 2013

In 2013 the Dutch National Agreement was finalised. Forty-seven organisations participated in the signing of an agreement for sustainable growth. This involved the participation of Dutch municipalities (including Leeuwarden), (National Energy Agreement, 2013). The Dutch Energy Agreement has the following targets; saving energy consumption by an average of 1.5 percent per year; or 100 pet joules of energy saving by 2020, an increase in the share of RE generation from 4.5% in 2013 to 14% in 2020, a further increase of this share to 16% in 2023, 15,000 full-time jobs extra in the field of RE and energy saving in 2020, (ibid).

4.16 Current state of Energy System in Leeuwarden Municipality

According to (klimaarmonitor, 2018), the total of RE in Leeuwarden municipality is 246TJ.

4.16.1 Wind Energy

Wind energy plays a small role in the Leeuwarden energy mix. This is because the provincial government of Friesland prohibits the expansion of onshore wind energy; a reason for the absence of the wind energy related initiatives in the municipality, (Energy Agenda, 2016).

4.16.2 Solar Energy

In Leeuwarden municipality solar power is an interesting alternative for the local energy initiatives, private homeowners and the companies. Leeuwarden municipality encouraged the organisation and companies to use the SDE+ subsidy scheme to invest in solar energy. Additionally, the Leeuwarden

city worked with the different initiators in the installation of solar power, for instance FSFE (Fûns Skjinne Fryske Enerzjy), financed the installation of 500 solar panels at ice hall in Leeuwarden, Energy Agenda, (ibid).

4.16.3 Biomass

Biomass is also promising in the Leeuwarden city. The biogas generated from the Dairy campus Leeuwarden provides sections of the city with heat and electricity. The municipality also is planning to construct new digester which will be run by roadside grass from the city. The municipality also aims to supply biomass to the new power plant at Blokhuispoort, and the centre of Leeuwarden 2018 will be heated by sustainable energy. Moreover, the new building of Wetsus and Fier Fryslan will be heated with biogas from wastewater treatment at wetterskipp Fryslan. The municipality is besides expecting for manure (mono fermenter) to increase. Lastly, the municipality is as well working with Green gas NL in biogas generation. So far the biogas produced by this company is used in some public office in the municipality (ibid).

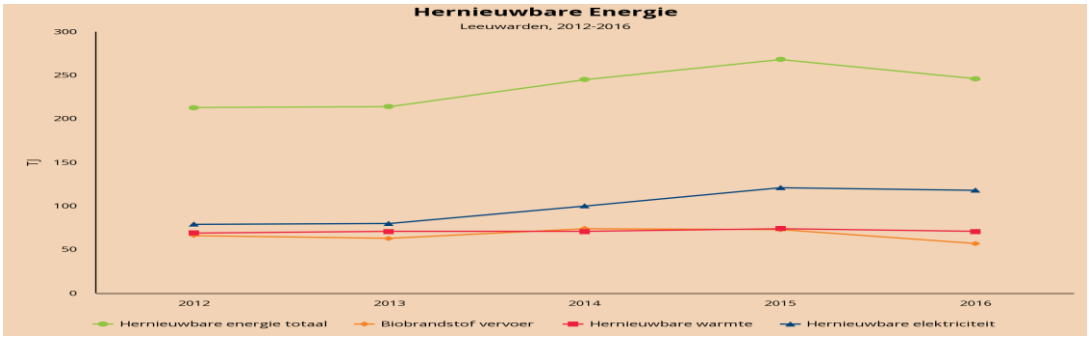
4.16.4 Residual heat

Residual heat can also play a large part in the heat supply in the Leeuwarden city. Some places in the municipality are already connected to the residual heat; an example of this place is camminghaburen. Currently, the municipality is conducting exploration for the building of Leeuwarden- Zuid thermal Network, (ibid).

4.16.5 Geothermal Energy

For the geothermal power, presently two areas have been identified and given a licence for exploration. Geothermal requires the high investment of the fund, and the municipality is hoping for the business case for the one source in Leeuwarden city, this will depend on the involvement of stakeholders (ibid).

Figure 9: **the total renewable energy system in Leeuwarden municipality**



Source; (klimaarmonitor, 2018)

4.17 The role played by actors/Stakeholders

This segment presents the role played by different actors/stakeholders in Leeuwarden municipality to enable the local renewable energy transition.

4.17.1 The Leeuwarden Municipality

Leeuwarden municipality wants always to inform and connect its community, companies and institution regarding the fund availability to run the different sustainable energy project, (Gemeente Leeuwarden 2018). As reported by, (Leeuwarden energy agenda, 2016-20209), the Leeuwarden municipality planned to involve the municipality stakeholders in sustainable energy management and energy savings through organising regular meetings and persuading them to participate in the sustainable energy activities. To some extent, the Leeuwarden municipality is active in a matter pertaining to sustainability for instance, the construction of sustainable infrastructure and real estate. A good example of this is the building of the almost energy-neutral Elfstedenhal and sustainable new construction at Water Campus Leeuwarden. Furthermore, the taxis for student transport WMO transport, city buses and a huge part of the municipal vehicle fleet run on green gas. (ibid)

Additionally, the Leeuwarden municipality provides space for the development of energy and innovation. This is done by adjusting the policies and regulations. For instance, is the Leeuwarden municipality providing space for the construction of the Energy campus Leeuwarden. Energy campus Leeuwarden planned to offer a room for innovation, knowledge and experiments in a field of energy transition, circular economy and water technology. Last but not least the municipality assists in removing obstacles such as for permit, fees and laggards in the implementation of sustainable energy projects, (Energy agenda, 2016-2020).

Finally, the Leeuwarden municipality provides limited subsidies to support the sustainable energy project and is already using a revolving fund and loans with a low-interest rate. An excellent example of this subsidy schemes is the Leeuwarder Duurzaamheidslening, the Frisian energy premium, Leeuwarden green innovation fund, and the Iepen Mienskip Fûns, (ibid).

4.17.2 Local energy initiatives (Organisations in Leeuwarden)

On the other hand, local energy initiatives have been playing a fundamental role in the Friesland and Leeuwarden energy transition. The province had around eighty local energy communities in residential areas or villages by 2016, (Province of Friesland, 2016). Four so-called umbrella organisations play a critical role in facilitating these local energy initiatives and cooperatives. These organisations are Energiewerkplaats Fryslân; Nooderlijk Lokaal Duurzaam(NLD); Ús Koöperaasje and the Friese Milieu Federatie (FMD). The Energiewerkplaats Fryslân wants to accelerate the Frisian energy transition, mainly by connecting people, initiatives and project with each other. NLD is

cooperation and a supplier of sustainable energy; it basically matches supply and demand. Ús Koöperaasje also wants to accelerate the Frisian energy transition. They contribute in many ways, but their primary task is to provide advisory and financial support for new energy initiatives. FMD is nature and an environmental organisation that wants to conserve the Frisian landscape. Therefore, FMD is favouring sustainable energy and at the same time cautious about the impact of sustainable energy on the landscape and the biodiversity, (Friesland Energy Circularity report, 2018).

Moreover, in Friesland, there are already more than 30 villages and districts which are generating and saving energy. In the municipality of Leeuwarden, for example, the village of Reduzum and the districts Achter de Hoven and Westeinde are very active. These initiatives play a crucial role in the energy transition. They are a good addition to the existing activities. The Municipality encourage local energy cooperatives. To do this, the Municipality set up an E-team within the framework of Switch. The municipality goal is 15 Leeuwarder energy cooperatives in 2018. And 3,000 households take energy from Noordelijk Lokaal Duurzaam (Energy Agenda, 2016).

4.17.3 Academia (Knowledge Institutes)

The academic institutions in Leeuwarden municipality also play a significant role in energy transition; a good example is the Energy Academy Europe, NHL University of applied science in Leeuwarden. The above-mentioned institutions provide training regarding the energy education to the institution/colleges within the Leeuwarden municipality. The colleges which normally receive training from these two energy colleges in Leeuwarden are the Roc Friese poort, Friesland College, and the Nordwin, College, (Energy Academy Europe 2015). Moreover, the idea behind the Energy College in the Northern Netherlands is to provide vocational training especially in areas of installation of local renewable energy technologies and also raising awareness to the student about the energy transition and creation of more jobs within the sustainable energy sectors, (ibid).

4.17.4 Energy Companies

Leeuwarden municipality also works with the number of companies in order to facilitate the local renewable energy transition and reach its ambitions of 2020 and 2030. Examples of these companies are Energy campus Leeuwarden, Friesland Campina, Omrin Leeuwarden, Dairy campus Leeuwarden and Groen gas NL. According to (Energy agenda, 2016-2020), Omrin is included in the Leeuwarden energy mix as a company which produces energy sustainably from the municipal waste. The municipality also hopes to boost the share of energy in its energy mix from the biogas generated at the Rioolwaterzuiveringsinstallaties RWZI water treatment plant in Wetterskip Fryslan. Dairy campus Leeuwarden, the dairy campus Leeuwarden is constructing a new manure digester and the Leeuwarden municipality is looking forward to the opportunity of mono-fermenter from this company to reach its targets. Energy campus Leeuwarden wants to not only supply sustainable energy

in the Leeuwarden municipality but also offer a room for innovation, knowledge and experience example within the field of local energy transition, the circular economy as well as water technology (ibid). The Green gas NL (Leeuwarden), the company wishes to contribute to the municipality ambition of a 16% share of RE through producing biogas from manure and wastewater treatment plant. Currently, the gas produced by this company is used in some of the public building's offices within the municipality of Leeuwarden, (Groen gas Nederlands, 2018).

4.17.5 Networks

Leeuwarden municipality is the member of different networks of local renewable networks. The example of the main one is called Freonen fossil free. Freonen fossil free fryslan connects the companies, students, government, schools, organisations and villages that are working together in fossil-free Friesland. Currently, in Friesland, there are 100 sustainable energy initiatives that are linked to this platform, and additionally, they are working in partnership to reach the Leeuwarden municipality ambition and the province one. Finally, the sustainable vehicles, electric boats, energy neutral houses, fossil-free companies, energy cooperatives and the solar boat race that are using energy are all considered in this network,(Freonen, 2018).

4.17.6 Housing cooperatives

The Leeuwarden municipality entered into an agreement (Public house vision'Nieuw Leeuwarder Bestek 2016 - 2020') with the house associations such as Elken and Woon fryslan. The reason behind this greement was the construction of the 20, 000 energy neutral house within the municipality in the coming 15 years, and half of this house is going to be erected in the Leeuwarden municipality. Lastly, housing cooperatives are accountable for the awareness creation concerning energy saving initiatives in the municipality, this goes hand in hand with the improvement of energy management, (Energy Agenda, 2016).

In spite of, the above targets/implementation plan of the Leeuwarden municipality regarding the local energy transition and energy savings. The Leeuwarden municipality has failed to meet its targets due to the number of reasons. The interview conducted with some of the actors in Leeuwarden municipality revealed why the implementation plan is failing as discussed below;

4.18. Barriers of Local Renewable Energy Transition in Leeuwarden Municipality

According to Mr Paap Ruud form the Green gas Leeuwarden social acceptance (lack of public acceptance) play a big role in the lagging behind of local renewable energy technologies developed in Leeuwarden municipality and also in the Netherlands in general:

"The technology is not a problem but one of the major problems is societal acceptance. Dutch people complain a lot. If you want to realise biogas installation, wind energy parks or solar PV field almost people living next doors always not happy about this, therefore, they always complain about this, therefore, a lot of times they try to stall the permit procedure. Therefore, the societal acceptance is the big thing here in the Netherlands it doesn't help the project getting realised, but technology is not much problem." (Ibid)

Frietema Sybrand also narrated that windmills are not allowed in Leeuwarden and Friesland in general due to the majority of people in the province are against windmills. Not only windmills but also people are against the larger solar fields in the Leeuwarden and Friesland province, people are worried about the visual impacts, loss of the land and destruction of landscape:

"Four years ago there as enormous discussion and politician In Friesland were afraid of some angry people who were really making a lot of noise that they do not want to see windmills in our country. Because the province of Friesland is flat people were worried about the vision on the landscape will be too much polluted with windmills. This is not happening only in Friesland but also Leeuwarden municipality as well, but a lot of people think that the new government in the province will decide to leave the burn then it will be possible to install the windmills again. Small windmills are perfect for the local communities. Example, Leeuwarden Municipality small village Raduzum they have got small windmills, solar panels for the schools and they were not allowed to have new windmills because the province and Leeuwarden people are very angry with it. The strange thing is if it's for your own then it's okay, then if it's for the local community its okay, we have no problem with the solar or smaller wind turbines. But if it's owned by the foreign investors then we do not want that equipment nearest. Presently in Friesland, there is a lot of angriness on very big solar field's more than 50 acres and local community are afraid that their vision on the landscape will be affected and they do not want it and they get some time angry."(ibid)

Energy poverty, according to (Leeuwarden energy agenda 2016-2020) about the 15% of the population within the Leeuwarden municipality has a low-income rate. It is estimated that 30% of these people live in the owner-occupied home; these people cannot afford to invest in their home themselves and they are not good financial to pay for their energy prices and rising rents. This symbolises that some community in the municipality of Leeuwarden experience energy poverty to meet their energy bills, a good example is stipulated by Mr Weestra Roeland below:

"Poverty, yes there is a symptom of energy poverty here because we have the food bank here people who do not have the money go there and collect food. When you are working here in my country you have everything here cars, good house etc but when you are not working here then you have some money from the government but not a lot. When you have no work you can not pay

energy bill, so there are people who can not afford to pay an energy bill in Leeuwarden, Friesland and in our country."(ibid)

People are not willing to change behaviour due to lack of awareness and information, Frietema Sybrand from the Energy workshop Leeuwarden explained that some people are not aware because the municipality/government does not provide the necessary information concerning the impacts of non-renewable energy resources. That is why the majority of people in the Leeuwarden municipality and Netherlands, in general, keep on using it:

"The government does not give them a warning that's why people do not care in using non-renewable energy resources. I will heat my house with the gas then I do not care that will be a problem. Every house in the Netherlands needs to move away from natural gas, we have to use other means to heat our home, our problem is most people do not get it."(ibid)

Frietema Sybrand also reiterated that people who have knowledge about sustainable energy and energy savings in the Netherlands act themselves and not collectively which is the problem:

"Some people who are aware do themselves not collectively, an example in Denmark small community are connected to the central heating systems owned by the community. It works perfectly there, I was in Denmark and I asked some Danish people there that how do you do this and they told me we have a cooperation and the cooperation provide all this, I told them in the Netherlands we do this all ourselves, every individual home have got gas insulation and they looked at me and said you are stupid its expensive then you have to do it collectively, in the Netherlands we don't have that collectively feelings anymore."

On top of that Mr Debets Frans (Energy expert) argued that still in the Netherlands majority of people lack basic knowledge about the energy habit and system, also the people receive the wrong communication regarding the energy management from the government.

The Political point of view, according to the Mr Frietema Sybrand the politician in Leeuwarden municipality and Netherlands, in general, are worried to tell the citizen about the adoption to the sustainable energy, they are concerned about losing their chance in the government:

"Politicians are afraid to tell people to switch to the sustainable energy they do not dare to tell the people then they will not act that's the main problem."(ibid)

Likewise, Mrs Zomeraman Erica argued that the local policy which supports the sustainable energy is determined by the politics, for instance: "When you have more the right-hand side parties then the economic factor is important for them than sustainable energy. They will say we can do much more on renewable energy but we can not afford it then we have to think about our economy."

Furthermore, Mrs Zomeraman Erica mentioned that with regards to energy the municipalities have the facilitating roles. “Some of the municipalities in the Netherlands are used to the ways they used to work ten of years already, therefore it could be a barrier because they do not know how to change and how to do it differently.” Lastly, she also added that many municipalities do not have a roadmap for the next decade and make a customised plan to engage the local community for each neighbourhood, (ibid).

Limited fund allocation according to (energy agenda 2016-2020), the Leeuwarden municipality is allocating minimal fund to support some of its sustainable energy programs. The municipality highly depends on the external support such as the SDE+ subsidy scheme from the Dutch government, European subsidies and provincial government support like Frisian energy premium.

Lastly, some people in the Leeuwarden municipality do not want to invest in sustainable energy because they think economically and not the climate/Mother Nature. Mr Weestra Roeland explained during the interview as follows:

“We have one obstacle, the market its self-create the obstacles and what’s the obstacle? When you have the solar panels and when they are having a conversation with me I told them when you buy solar panels and you invest for example 10,000£ (we make a calculation) within 6 years and 10 years you earn back your investment and then people say when I earn back in five years then I will do it. So it’s about investing time and earn time, but I think it’s an obstacle because when I buy a car I spend maybe 15,000£ and there is no one ask the car seller in how many years I will earn my money back. Therefore, some people say they do not want to have an investment in a sustainable house because they can invest like 25,000£ but when do they earn 25,000£ back? Hence when we think like that we never make our house sustainable and I think it’s not about the money it’s about our children and climate, do we want to save the world or do we want to battle the climate change, we have to invest because of a living world but a lot of people think economic and not our climate, therefore, a lot of people including myself have no sustainable steps for a houses.”(ibid)

4.19 Reasons why ET and energy savings is not happening in Leeuwarden Municipality

Besides the barriers elaborated above, some of the interviewees in Leeuwarden municipality argued that ET is happening while other claimed that ET is not happening in Leeuwarden municipality due to the following reasons.

Mr Weestra Roeland (Project Manager at Roc Fries poort), declared that energy transition is happening in Leeuwarden city due to the number of the initiatives which is going on now like the European cultural city 2018 and Fossil free event. But he complained that these initiatives still lack the government support to reach the targets:

"I am happy that we are struggling because we are active, we have cultural capital city 2018 event and there is a number of energy initiatives like fossil free organisation. The young people will showcase that we can move on the road or water without fossil fuels that are a challenge and when we want it we can make it happen. Therefore, there are a lot of companies and initiatives with the right people to make the house sustainable. Our government said in 2020 we have to be the energy neutral, it's easy to say that but how do we do it? What kind of technique required for that? that's a struggle too."

Mr Weestra Roeland also elaborated that the reason of why energy transition is not happening in Leeuwarden city is the lack of awareness. Some people do not see the importance of changing behaviour in serving energy due to the abundance of resources available in the country to produce electricity:

"People think that there is no need of changing behaviour, we are spoiled. We think that there is no need to switch off the light because electricity is abundance also because we have enough water people think that we do not need to save energy." (Ibid)

Similarly, the energy expert from the Energy Academy Europe Mrs Zomeraman Erica declared that ET is happening in a small scale but the main problems are lack of awareness among the community, people are not willing to adapt to the new sustainable energy technologies:

"Energy transition is happening, because we do not often see it like in technical way or physical structure but the core of transition is there. There are lots of things happening on a very small scale and that's what we call experiment or innovation and there are theories on it saying maybe now transition on research that needs experiment a lot before you try to grow this kind of innovation, and a lot of experiment on innovation will end because they will not grow to the distance because they are just not making it, because they are expensive, people are not willing to adapt to the new technology but there are some that will grow and I think awareness of people need to start. That is because people who are aware are willing to change something. There are different types of groups, some people want to acts themselves and some people want to help other people in investment but they don't want to get involved very much so they are a bit passive. When you look at transition there is a small-scale innovation currently happening, and I think there is a move now in energy transition, a technological transition because there is a lot of techniques already to fulfil this challenge and they are available and there is a lot of moves needed. I think when you look on the social part and then awareness part and you want to create awareness and you want people to talk about the problem nobody will want to create awareness." (ibid)

Mr Bouwe de Boer (energy expert from the Fossil free organisation) declared as well that the energy transition is happening in Leeuwarden municipality but still the local community lack information about it due to the most of the information regarding energy transition is on municipality website.

Mr Weestra Roeland also mentioned that the availability of cheap fossil fuels in the Dutch municipalities including Leeuwarden for heating, cooking and lighting, is also a factor why many Dutch municipalities are struggling in energy transition:

"There are cheap fossil fuels in my country, for stance every month I paid 150£ for electricity and gas for cooking, shower, heating as well." (Ibid)

Mr Frietema Saybrand from the Energy workshop Leeuwarden also stated that energy transition is not happening because of the cheap electricity from the non-renewable resources and he mentioned that every house in the Netherlands is well connected to the natural gas infrastructure and people think that it's all right to keep using it:

"We have a natural gas surplus and we have the fantastic infrastructure for natural gas, every house in the Netherlands is connected to the gas. It's quite cheap to get the gas, we use it for electricity generation, heating and cooking. Therefore every house is connected with cheap gas and cheap electricity and people think there is no need to do something on their own." (ibid)

As reported by, Mr Paap Ruud form (Green gas Leeuwarden), energy transition is not happening in Leeuwarden and other Dutch municipalities because of the national subsidy scheme (policy). The policy has a limited amount of money/fund to support the local renewable energy sector at the local level that's why Dutch municipalities are lagging behind in energy transition:

"It has to do with the national subsidy scheme (policy) because we have the policy to stimulate the renewable energy production and this policy has the limited amount of money and this policy has been in place since 2008. Because there is a limited amount of money in this subsidy regime and there is more potential for sustainable energy it's not certain if you will get the subsidy or not. Therefore there is more potential than money basically not all the potential has been used at the moment, I think also subsidy system is very complex for project developer so you have to invest a lot of money before then on your own risk and then you have to wait if you get the subsidy or not. If you get it then its okay you have a business case, if you do not get the subsidy all the money you spend is for nothing. If you want to realise a larger scale digester for instance you may have spent over one million euro in advance and then still you are not sure that the project will be approved for subsidy or not so the risk is huge and of course this reduces the appetite for investors to start these kinds of the projects." (Ibid)

Moreover, Mr Van Giessen Ronald from the Us Koopasje Leeuwarden, as well testified that the Leeuwarden municipality is lacking funds to power its energy transition programs. “The municipality is only waiting for the fund from the central government and provincial government to develop its own local renewable energy transition programs.” (ibid)

“The Dutch government is making a lot of cash from the non-renewable energy resources while at the same time the government spends a lot of money on fossil fuels. That is because fossil fuels are also getting support from the government (tax reduction for the larger industrial gas user) close to 6 billion euro’s a year so it’s costing a lot of the Dutch government money”, noted from Mr Paap Ruud interview. On top of that Mr Paap Ruud, reiterated that he is not sure whether this is the reason behind the lagging behind of energy transition in the Netherlands but the Dutch government really does not have the options to do so. “This is because of the European policy then they have to comply with it and if they don’t do so there will be sanctions. Therefore, I do not think that they do not want to comply but I think they are battling to find the subsidy and policy in place to promote renewable energy production and at the same time not over stimulating it but it’s not over stimulated.” (ibid).

Likewise, according to Mr Frietema Sybrand, the Dutch government is not serious enough in the area of renewable energy transition that’s why its municipalities are also struggling. A good example is stipulated by Mr Frietema Sybrand during the interview he explained the following:

“The Dutch government is not serious about energy transition, the Dutch municipality and province used to have utility but they sold it to Germany, England, Sweden, France and England. A few years ago there is coal power in the Netherlands and non in Germany and Germany buys coal in the Netherlands, that’s why we end up with new coal power plant. Friesland currently has the better opportunity to provide the Dutch people with the renewable energy companies. On top of that, the Netherlands have good technology companies that can provide a good renewable energy solution but we do not really use them.” (ibid)

Moreover, Mr Frietema Sybrand argued that the government does not put much consideration in the climate and environment management and set aside innovative policy to guide renewable energy sector:.

“The government do not care about the environment and climate if you want to use coal nobody cares. Something strange is if you look England used to be number one coal country in Europe and the Dutch were gas people, but a few years ago we were using more coal than England, we used to import. That means we do not have the right legal governmental environment to create the better perspective for the renewable energy.” (ibid)

Lastly, Mr Debets Frans, an Energy consultant from the Utrecht city clarified that there is no strict regulation in the Dutch government that's why the Netherlands municipalities are not doing well in energy transition. Mr Debets Frans also added that the government could not rely only on bottom-up energy initiatives in realising the energy transition and energy savings, he additional argued that if the Dutch government want really to save energy they must start up with for instance big industries and companies that consume the high amount of energy and not only the households. He also calls upon the Netherlands government to impose a high tax on the industry and mobility sector that consume the high amount of energy for instance:

"There is a cheap flight to Barcelona from Amsterdam because the company that is operating in that route does not pay much tax that's why there is a cheap flight. Therefore the government need to impose a high tax in this area because the mobility sector uses the high amount of energy compared to the households sector." (ibid)

4.20 Key Driving forces of Local Renewable Energy Transition in Leeuwarden Municipality

The actors/stakeholders in Leeuwarden municipality also unveiled the key driving forces for local renewable energy transition in Leeuwarden municipality as follows;

Some of the interviewees such as Mr Paap Ruud from the (Groen gas Leeuwarden) and Mr. Van Giessen Ronald,(Energy coordinator from Us Koopasje) identified the necessity of incorporating people in the different renewable energy project at the local setting as a way of minimising the resistance from the people in the realising energy transition:

"Incorporating people living next door, it does not matter if its windmills, solar field and biogas installations. If you start building it and people living next door note/find that somewhere they will benefit from it then, of course, it's far easier to be convinced that it's a good idea. If just installation is there and they have no benefits from it but only problems then, of course, it's a recipe for societal unacceptance. If you can find a way to make the surroundings people benefit from the installation then it's a good thing to do".

Mr. Paap Rud believes that doing this at the local level will reinforce the majority of the local surroundings to accept and adopt the new technology and get things done for local households. Mr Van Giessen Ronald also pointed out that "public-private partnership" in the area local renewable energy transition is very crucial.(ibid)

Mrs Zoeraman Erica (Energy expert) from the Energy Academy Europe and Debets Frans (Energy consultant from the Utrecht city) mentioned the willingness to change among the community is also another critical driver of local renewable energy transition at local setting; that is because presently at the local level there is a growing number of cooperatives/bottom up movement which is enthusiastic

and motivated to generate their own energy independently. Mrs Zoeraman Dorica also insisted that these people who start this cooperative and bottom-up movement feels with their community that they want to be more sustainable, they want to create more sustainable life and they want to do something within their local setting as well regarding the sustainable energy. Moreover, Mr Debets Frans (energy consultant) argued that the majority of local communities' energy initiatives in the European countries nowadays started these kinds of local energy initiatives as the way of saving their money from the mainstream energy companies. In addition, he added that technology and innovation also play a major role in the local renewable energy transition. Finally, according to the interview with Mr Weestra Roealand, (Project manager Duurzaam of Roc Friese poort Leeuwarden), Weestra also revealed the willingness to change in the local community in an area of energy management as follows:

"I have the program in another city here in Friesland the local community there has the passion for sustainability, especially in making their house sustainable. The house owner talks to each other and they inspire each other". (ibid)

Moreover, another significant drivers mentioned by the interviewees are the communication campaign, Mr Bouwe de Boer (energy expert from the fosslyfree fryslan), indicated that communication campaign is the core thing need to be taken into account especially at local level. That is because through the dissemination of information to the local community the local community will be able to recognize the importance of adapting to the sustainable energy project and take part in the different projects:

"Promotion is best to do with the information campaigns; this could be done much better. We have as a municipality a very bad website, so a lot of people in the city do not know what is happening. Only people who are involved." (ibid)

Fund allocation and permit provision, according to Mr. Frietema Sybrand (Project coordinator at Energy workshop Leeuwarden), the municipality of Leeuwarden provides the means for local energy community. The support they provide is in terms of the permit and limited financial assistance. Similarly, Mr Van Giessen Ronald (Energy Coordinator at Us kooparasje), argued that the municipality provide only limited fund (loan) and its interest rate is very high and the procedure to get is very difficult:

"I am a chairman of the local energy community here in our village and four villages we are working on energy neural housing; we have a project in this small community but we do not get support from the local government and municipality, we do not get anything from them, they are positive in the office but nothing is happening."

Besides that Mr Van Giessen Ronald also indicated that the financial situation of Leeuwarden is too bad because many proposals and initiatives for sustainable energy do not get the financial backup. Additional, Mrs Zoeraman Erica (Energy expert from the Energy Academy Europe and Hanze University lecturer), argued that incentives are very crucial in promoting the local renewable energy development but at the same time she mentioned that incentives are limited to get here in the Netherlands.

Another point is mentioned by Mr Frietema Sybrand, who insisted that the municipality should act as a leader in the local renewable energy transition so that the local community can emulate them and adopt the renewable energy technologies:

"The municipality must show a good example to the rest of the people in using renewable energy, because still some municipalities including (Leeuwarden) in the Netherlands buy cheap electricity from the non-renewable sources such as coal and natural gas. Otherwise, you can not ask people to do things which you can not do it yourself."(ibid)

Lastly, Mrs Zomeraman Erica from the Energy Academy Europe described how the good interest rate can work on energy cooperatives and trigger off the majority of local people to participate in the deployment of renewable energy:

"You have to say in what type of renewable energy will be realised and then you can take loan in financial investment so that you say I want to invest in solar field near the village or city and then when you invest you get some kind of interest from it, I think people will feel much more connected to the project." (ibid).

4.21 External support

The Dutch government supports different program within the Leeuwarden municipality through the provision of a financial instrument called SDE+. The Leeuwarden municipality used this fund in the installation of the solar meadows in 2016, this meadows has the capacity of 6MW. Similarly, the Friesland province also offers a number of financial supports to the Leeuwarden municipality to run various sustainable energy programs. Example of financial instruments is the Fryslan Fûns Skjinne Fryske Enerzjy (FSFE), and the Frisian energy premium. In brief, the Friesland province together with the Dutch government offers a number of instruments to support the Leeuwarden sustainable energy approach, (ibid).

To sum up, the above discussion answered the research question 2 which says, **what are the steps and goals formulated by Leeuwarden municipality to reach 100% of local renewable energy and achieve energy savings?** Some of the steps and goals formulated are: (1) the Leeuwarden energy agenda (2016-2020), (2) external factors such as national energy agreement of 2013, European Union

goals of 2020. Other instruments formulated are: (1)north agenda switch, (2) Leeuwarden-Fryslan energy now project, (3) smart living in Leeuwarden approach, and (4) Green work program.

Also the discussions answered the question number 4 which says, **what are the role played by actors in local renewable energy transition and energy savings in Leeuwarden municipality**? some of the RE actors in Leeuwarden municipality are; (1)Leeuwarden municipality, (2)local energy initiatives, (3)academia, (4)energy companies, (5)housing cooperatives and (6)Networks, (their role are well explained in the previous chapter). This segment also covers the necessary drivers of ET in Leeuwarden municipality. Some of the main drivers the actors identified are; (1) incorporating the local community, (2) willingness to change, communication campaign, (3) permit and fund allocation, and municipal must act as a leader and (4)government support such as SDE+. The actors also revealed why ET is not happening in Leeuwarden municipality due to the numbers of reason as follows; (1) lack of awareness, (2) people are not willing to change, (3) lack of information, cheap fossils fuels, (4) policy-limited fund, (5) lack of government support and (6) lack of strict regulation. Lastly some of the barriers mentioned by the actors are; (1)social acceptance, (2)energy poverty, (3)lack of knowledge and awareness, (4)politics, (5)less fund allocation and (6) finally people think economically and not mother nature/climate .

Table 6: **A matrix of Driving forces, and Barriers of LRETs and reason why Energy transition is not happening in Leeuwarden municipality**.

Driving forces of LRETs in Leeuwarden Municipality	**Barriers of LRETs in Leeuwarden Municipality**
• Incorporating the people • Willingness to change • Communication campaign • Fund allocation and permit • Good interest rate of investing in LRETs • Municipality must act as a good leader	• Social acceptance • Energy Poverty • Lack of Knowledge and awareness • Political point of view • People don't want to change • Limited fund allocation • People think economically and not climate

Reasons why Energy Transition is not happening in the Leeuwarden Municipality

Lack of awareness**,** people are not willing to change**,** availability of cheap fossil fuels in the Leeuwarden municipality, lack of information**,** lack of government support and strict regulation,

limited fund from the national subsidy scheme, cheap electricity**,** people think economically and not the climate/mother nature.

CHAPTER 5: COMPARATIVE ANALYSIS

This chapter covers the comparative analysis between the two cases; the chapter answers to question number six which says; **what are the comparison of drivers, actor's role and barriers of local renewable energy transition in Leeuwarden and Samso Municipality**?

The Samso Island project was started in 1997 as results of the competition between the islands in the Samso municipality, (Energy agenda 21). The goals of this project were the reduction of fossil fuels on the island while at the same time increase employment opportunities, increasing renewable energy share to 100% by 2007 and to at least save 10% of energy consumption by 2007. The approach used was very unique which is community involvement on the Island, and this leads to the success of this project among another project who submitted their proposals. Unlike the Leeuwarden, energy agenda was introduced to reduce the dependency of fossil fuels such as oil, coal, and natural gas. The Leeuwarden energy agenda did not cover much about the community involvement like the Samso project, but the expanding share of renewable energy to 16% by 2020 and 20% of energy savings by 2020 was the main priority of the agenda. Leeuwarden energy agenda is a short time project (2016-2020) while the Samso project was a ten years project, which was from 1997 to 2007. Other key things in the Leeuwarden municipality agenda are the energy demand for households, companies and institution to be generated sustainably.

5.1 The current energy system in the two municipalities

Furthermore, in area of current state of renewable energy system between the two cases, the Samso case is a reference case where Leeuwarden want to go. The two cases differs in starting point and different phase of RE transition. The Leeuwarden municipality depends heavily on RE sources such as solar power, biomass, and residual heat, geothermal, to meet its municipality ambition of 16% share of renewable by 2020. In Leeuwarden, there is no action for wind energy as the Friesland province does not allow the municipality to install the new wind turbines, (Energy agenda, 2016). In that case, the Leeuwarden municipality relies on the solar energy, biogas, residual heat for a small part and one source of geothermal power which was discovered in the city to reach its target, (ibid). In contrast to Samso Island, the current state of the energy system is further ahead the Leeuwarden municipality, as a result about 100% goal of RE has already achieved, (Go 100% renewable energy, 2018). To a great extent, the wind energy (both onshore and offshore turbines) enabled the Samso Island to reach its goal of 100% of RE. The surplus of the electricity about 70% produced from both offshore and onshore turbines are exported outside the municipality. The reason behind the development of windmills on the island is the direct ownership system on the island advocated by Danish RE policy as a way of tackling public opposition from the local community, (Meyer, 2004). Finally, the local community in Samso uses a central heating system which is powered by biomass

(straw) to heat their house. Solar power is also used on the island for heating, and lighting, (Agness galama report, 2016).

Table 7: Comparative analysis of Samso and Leeuwarden municipality Energy Strategic plan/ Agenda

Samso Strategic plan/Agenda	Leeuwarden agenda
-To become 100% renewable within the period of ten years, by implementing land based turbines, offshore turbines, solar PV and central heating. -Reduce energy consumption by at least 10% by 2007 -Ensure community involvement -Use of innovative forms of financing	-To increase renewable energy share from 8% at the moment to 16% by 2020 -To achieve 20% of energy savings in housing construction by 2020 -To support citizen initiatives -Encourage the use of National scheme SDE+.

Another critical significance factors incorporated in the Samso Island proposal is the distribution of the benefits, this can be seen in the Samso Island, where the innovative schemes gave the great part of the population on the island the opportunity to participate and receive benefits from the projects. But for the case of Leeuwarden energy agenda, this was not included.

5.2 Driving forces similarities and differences of LRET between the two Municipalities

5.2.1 Community involvement

This approach to transmitting the project to the citizen creates the public discussion concerning the future plans in the municipality and can lead to the improvement of the project. Hence, this approach of disseminating the information to the local people represents essential elements of adoption/acceptance and necessary path to minimise the barriers at the local setting, for example, public acceptance as elaborated in the literature part. On top of that, it provides new ideas and engages local actors who want to participate in the project and reduce the C02 emissions.

In Samso Island these necessary elements were used to provide information to the local people about the Samso Island 100% renewable energy project. This means providing the opportunity to find the principal actors and investors on the island. Consequently, the interested actors and investors participated in the project. Unlike in Leeuwarden municipality, the public involvement in the local renewable energy transition is very minimal. Mr Bouwe de Boer proved this during the interview, he

said that “most of the information regarding the renewable energy transition is on the municipality website”, as a results of this the majority of the local people in the municipality lack understanding of what’s going on regarding the local renewable energy transition in the municipality, only personnel who are working in the municipality have an idea of what’s going on. On the other hand lack of community participation in the local renewable energy transition in the Leeuwarden municipality and Friesland, in general, leads to the public resistance of local renewable energy technologies such as Wind Park and solar fields, as elaborated in the previous chapter.

5.2.2 National support

The public figures and organisation in the Danish government were very influential in the development of the Samso municipality island project. These agencies organised the competition and provided financial assistance to the winner, which was the Samso Island project. The financial aid was in the form of the support mechanism. According to, (Plummer, 2002), the national support whether in the form of political or economic is the key to any local project. Not only that but also the other support was the Danish national renewable energy policy, the Danish RE policy motivates the local ownership as a means of preventing challenges such as NIMBY and visual pollution. This policy assisted the highest acceptance of windmills in Denmark, (Meyer report, 2004). In comparison to the Leeuwarden case, national support in an area of renewable energy is minimal as clarified by Mr Paap Ruud that the main barrier of energy transition in the Dutch municipalities and Leeuwarden, in general, is national subsidy scheme (policy), the policy has limited fund to support the renewable development at local level. “He also argued that the national subsidy scheme called SDE+ does not have enough fund to support the local renewable energy.” (ibid)

5.2.3 Incentives for actors

As explained in the literature part actors such as business, firm, individual or local organisation, universities and research institutes plays a considerable role in the local renewable energy transition. Thus, the involvement of these actors in defining legislation and formulation of the implementation plan, and joint definition of the environmental objectives will bring a good future commitment and minimise the political resistance of renewable energy development, (Burer et al 2007).

In Leeuwarden municipality, there are a different number of actors/initiatives who are working in the RE field but still their contribution to the municipality ambition is meager. The Leeuwarden municipality itself allocate limited fund to support the renewable energy at a local level, (Energy Agenda, 2016-2020). According to, Mr Van Giessen Ronald (Us Kooparasje), the municipality only provide loans with a high interest rate and the loan have difficulty procedures for the local people to secure the loans. Mr Van Giessen Ronald argued that in the Leeuwarden municipality and the local government does not provide much assistance to the local energy project, he added that the

municipality is only good in the office, (ibid). Energy companies somehow plays a pivotal role for instance, Omrin produce biogas from municipality waste, Green gas NL (Leeuwarden branch) as well produce biogas from manure and wastewater treatment and the biogas is used in several municipality buildings, Dairy campus has the plan to construct digester and lastly the energy campus Leeuwarden want to supply energy to the Leeuwarden municipality, (Friesland Energy Circularity report, 2018). The academia also plays a vital role of educating the people about energy education and training the youth on how to install the renewable energy technologies, an example of this academia is Energy Academy Europe, Roc Friese Poort and Friesland College. Unlike the Samso Island, there were a plenty of active actors who assisted the Island to succeed for instance the farmers, the Samso municipality, Samso Energy Company, Samso Energy and Environmental office, national actors and supranational actors (European Union), as mentioned in the previous chapter. The Samso municipality took a loan and invested in the wind farms on the island, also the local administration and mayor were very supportive, and nevertheless, the European Union provided the fund to support the Island project. Therefore, the involvements of a more important part of the interests of the community suggest it could be a reason to assist in creating the community acceptance for the implementation of the Samso Island project, (Torres Silva report, 2008).

5.2.4 Population and geographical conditions

According to, (Samso municipality 2017). Samso Island has a population of 3,724 inhabitants this is a minimal number of population. The Samso geographical conditions played a large part in the achievement of 100% of renewable energy on the island. This is because the islands have a potential area for the installation of windmills both offshore and onshore. Moreover, the less population on the island was also a contribution to the success of the Samso Island project, thus, the supporter was able to reach a big number of local population on the island and persuade them to support and take part in the project. Whereas in Leeuwarden municipality the situation is different because the municipality has a huge number of inhabitants about 108, 668, (Leeuwarden municipality, 2018), but less land to realise different local renewable energy technologies such windmills and solar field. On top of that the local community in the Leeuwarden municipality and the Friesland province always are against the installation of the new onshore windmills and solar fields as the worried they that will lose their land.

5.2.5 Willingness to change

As stated by Mr Weestra Roeland (Roc Friese Poort), the majority of people in the Leeuwarden municipality want to change and adopt the sustainable energy technologies. Mr Weestra Roeland also said that he has the project in another city of Friesland and people there have the passion for investing in the sustainable house, he argued that the house owner talks to one another concerning the sustainable energy house. Moreover, Mr Debets Frans (Energy expert) argued that in Europe a lot of people want to generate their own energy independently. Additional Mrs Zomeraman Erica (Energy

Academy Europe) indicated that the increasing number of energy initiatives (bottom-up movement) in Friesland and Leeuwarden is a reason that local community wants to become sustainable. Furthermore, one of the important things in the Leeuwarden energy agenda is the creation of the 300 jobs in the area of installation of sustainable energy technologies, the municipality also see this as the contribution to its 2020 energy ambition, (Energy Agenda, 2016-2020) While in the Samso Island the pioneer there and local municipality decided to invest on the sustainable energy as a way to fight highest unemployment rate which was forcing people to migrate from the island to look for new opportunity on the mainland, (Jorgensen et al, 2007). After the Samso municipality invested in local renewable energy on the island the number of employments was created such as carpenters, blacksmiths, and builders, these people assisted in the building wind turbines as well as constructing of district heating systems, (Jackobsen, 2008).

5.2.6 Positive collaboration with the grid operators

In the Samso municipality, the energy which is produced from the wind turbines is coupled to the grid without any problems. There was an agreement between the grid operator and Samso island that obliged the operator to take energy produced from the renewable energy technologies, such as windmills and solar power. For the case of Leeuwarden, the energy agenda and other documents reviewed does not cover anything about the energy generated from local renewable energy to be connected to the grid. Mr Paap Ruud, (Green gas NL) only mentioned that the biogas which is produced from the wastewater treatment and manure is used in some of the public offices in the Leeuwarden municipality.

5.3 Barriers similarities and differences of LRETs between the two Municipalities

5.3.1 Social acceptance

As explained in the literature part the social acceptance is the main aspect that determines the deployment of local renewable energy technology. In Leeuwarden there is no action for wind power, the municipality is not allowed to introduce the new windmills by the province. According to Mr Paap Ruud, in Leeuwarden and Friesland there is generally public opposition regarding the deployment of the larger solar field, biogas and windmills; Dutch people value the aesthetic beauty and thus are sceptic about the potential destruction of the visibility, landscape pollution and potential lose of land. (De Boer et al, 2014) argued that the local population in the Northern Netherlands does not resist the wind power but they found it unfair. Unlike the Samso Island case, there is no public resistance of the RE technologies on the island such as solar, wind, and biomass. This is because of a higher level of awareness of the Samso community regarding the sustainable energy technologies, and also the ownership of the windmills by some of the community on the island reduces the resistance.

5.3.2 Incoherence policy

Lack of consistent legal and regulatory framework to support the local renewable energy, for instance incentives to the consumer and permitting has been seen as the main problems, (M.Oliver et al, 1999). Currently, most of the energy policy in Europe and globally is biased towards the fossil fuels and nuclear power, (Krupa j, 2012). This is similar to the Netherlands whereby as stated by, Mr Paap Ruud "the Dutch government is making a lot of tax money on the non-renewable resources and likewise spending a lot of money there because fossil fuels are getting government support (tax reduction for the larger industrial gas user) like 6 billion euro a year." On top of that, the energy policy is not strong enough to deal with the public resistance of RE technologies such as windmills, solar fields and biomass for instance in Leeuwarden municipality and other Dutch municipalities. Unlike, in Denmark, the Danish renewable nergy policy is strong enough and it does not favour the non-renewable resources. The inclusion of the local ownership of windmills and the long-time support of wind energy made the Samso island project and Denmark, in general, to succeed in the deployment of local renewable energy technologies and without public opposition, (Meyer, 2004). The Danish government encourage the community ownership of windmills as a way of fighting the NIMBY syndrome as well as visual pollution, (ibid).

5.3.3 Energy poverty

As explained by, (European commission website 2018) energy poverty is the situation whereby a person fails to obtain the necessary energy in his or her home to meet the basic needs because of the inadequate resources or living conditions. As reported in, (Leeuwarden energy agenda 2016-2020), about 15% of the Leeuwarden community live under low income. 30% per cent of these people live in occupied homes and they cannot manage to invest in the sustainable house and pay the monthly energy bill. Mr Weestra Roeland proved this in the earlier chapter that the majority of these people normally go to the food bank to collect the food for themselves and their families. Unlike the Samso Island, energy poverty is not mentioned to any of the documents reviewed; only unemployment was mentioned and triggered the local municipality there to invest in renewable energy resources so as to tackle the problem and migration of people to the mainland.

5.3.4 Lack of funds

As clarified by (IRENA report, 2016), lack of fund such as subsidies, incentives and tendering is the main problem hindering the deployment of local renewable energy. (The Leeuwarden energy agenda 2016) substantiate this, as the municipality located limited funds to support the local renewable energy, they depend mostly on external sources from the province level and central government (SDE+ subsidy scheme). Mr Van Giessen Ronald from the Us Koooparasje stated that the "Leeuwarden municipality finance is insufficient to support the renewable energy sector at the local

level. He also added that the municipality tried to write several proposals but they failed to secure the funds." (ibid) This challenge is exacerbated by some of the European countries who still rely on the fossil fuels and consequently spend a lot of money in it (ibid). Unlike the Samso island project, the Island didn't experience the lack of funds as the project received financial assistance from the Danish Energy Authority about 400,000£ through the competition organised by the Danish Ministry of the Environment, (Jorgensen et al, 2007). The island as well received funds of about 400,000£ from the European Union through the European Regional Development Fund, to boost the project, (European commission, 2009). Moreover, the Samso municipality supported the project by taking the loan from the bank and investing in the windmills. Hermansen the (project leader) declared that the financial assistance they received together with municipality support was the reason why the Samso project succeeds, (Jan Beermann report, 2009).

The Samso Island project suffered a bit in 2002 after the democratic government replaced by the right-wing liberal; the right wing opposed the renewable energy. They advocated for a liberal economy. The Samso Island was a bit affected especially because of lack of adequate research fund, but after a while, the Liberal government decided to invest in the green economy, (ibid).

5.3.5 Lack of political support

(Mendonka et al, 2007) argued that sometimes the requisite for local government authorities to take action for the use and support of the local resources could be found as a significant issue for renewable energy development at a local level. In Leeuwarden the situation is different, a nice example is stipulated by Mr Van Giessen Ronald (Us Kooperasje); "I am a chairman of the local energy community here in our village and four villages we are working on energy neural housing; we have a project in this small community but we do not get support from the local government and municipality, we do not get anything from them, they are positive in the office but nothing is happening." (ibid)

Mr Frietema Sybrand also added that in Leeuwarden and other Dutch municipalities the politician does not dare to tell the community to switch to the sustainable energy as most of them are worried that doing so they will lose the important opportunity in the government. In comparison with the Samso Island project, the project there received a lot of support from the Samso municipality mayor, the local leader, politician, and the municipality itself invested on the windmills. In addition, the local government authorities (village organisation) worked tirelessly in Samso to ensure that people are switching to the alternatives energy. According to, (Jorgensen et al, 2007), the villages played a key part on the energy island project, and they participated in the installation of the district heating plants in different part on the island. Lastly, the local government at Samso assisted the Energy Island in conveying the information to the local community there about the project, (ibid).

5.3.6 Market barriers

According to, (IRENA report, 2008), some countries within the European Union are still having fossils fuels and nuclear power subsidies that prevent the deployment of the RE technologies at a local level. Again, the low fossil fuels price can decelerate the development of RE such as the renewable energy heating, cooling as the transport sector. This is similar to the Netherlands situation for instance; Mr Weestra Roeland pointed out that in Leeuwarden and Netherlands, in general, there is availability of cheap fossil fuels to meet the daily needs such as mobility, cooking, heating and lighting: "There are cheap fossil fuels in my country, for example every month I paid 150£ for electricity and gas for cooking, shower, heating as well." (ibid). Mr Frietema Sybrand also argued that there is cheap electricity from non-renewable resources like gas and coal; he added that in the Netherlands every house is well connected to the natural gas infrastructure. In comparison with the Samso Island, before the start of the island energy project people used to use domestic oil boiler which was powered by fossil fuels. But after the energy island project started people started using the central heating system (powerd by biomass) and solar power in heating their houses, the reasons which forced the people on the island to switch to the central heating system at that time is the oil price was very high, (Torres Silva report, 2008).

To sum up

What is similar between the two cases; (1)both cases wanted to achieve the 20-20-20 European Union goal, (2)willingness to change, (3)both the energy plan comprised of the plan to increase the renewable energy share and achieve energy savings, (4)community involvement- actors in Leeuwarden identified this as the key approach for the development sustainable energy project, and (5)lastly conservativeness of the people was observed in both cases (a good example is explained in the previous chapter).

What is the difference between the two cases: the two cases differs in starting point and different phase of RE transition. The Samso island municipality have a big chance of producing renewable energy than the Leeuwarden case. Other differences are: (1) high degree of community involvement, (2) activeness of the actors, (3) Denmark RE innovative policy (which provides enough funds to favour RE rather than non-RE), (4) political support, (5) public acceptance, (6) national support, (7) number of the population and geographical conditions.

Lastly, the above discussion answered the research question 6 which says; **what are the comparison of drivers, actor's role and barriers of renewable energy transition in Leeuwarden and Samso Municipality**? the Samso case is a reference case where Leeuwarden want to go. In addition the Samso case is an ideal case for Leeuwarden case as the factors elaborated above shows one case

(Samso municipality) has already achieved the 100% of RE goal whereas another case (Leeuwarden municipality) is still on the way to meet its targets and goals.

CHAPTER 6 CONCLUSION AND RECOMMENDATION

The objective of this research is to identify the necessary drivers of local energy transition and energy savings in small municipalities, (with Samso and Leeuwarden Municipality as case examples). This chapter brings the most important results of the research together. The concluding remarks are presented below which addresses and integrates the research questions answered in the previous chapters. These conclusions form the basis for recommendations for local energy transition in municipalities of the developed world.

6.1 Conclusion

To address the main research question on the factors influencing the local energy transition in small municipalities, towards reaching the 100% of renewable energy, six sub-questions were answered. In the first sub-question, the research sought to identify the social, economic, technological, and political and consumer behaviour drivers of local renewable energy transition from the literature and as can be found in two empirical cases. In the literature we found the significant factors in the deployment of RE at a local level that are relevant to all regions in the world. Based on the factors from the literature, the research found as main factors for the development of RE at local level in the two case (Leeuwarden and Samso municipality) are as follows; (1)social cohesion and community involvement, (2) innovative energy policy, (3) government support, (4) incentives for actors, (5) geographical factor, (6) local leader support, (7) management and organisation characteristics, (8) desire to change, (9) economic factors-(energy markets), (10) technology support, and (11) lastly social-political movement and grassroots factor).

The second sub-question aimed at assessing the steps taken and goals formulated in Leeuwarden municipality to reach 100% of renewable energy and to achieve energy savings. Crucial steps for these goals, in the Leeuwarden municipality is the energy agenda 2016-2020. The main purpose of the Leeuwarden energy agenda is to be free the municipality of fossil fuels such as coal, gas and oil. Additional, another goal taken by Leeuwarden municipality is to implement the Dutch national energy agreement of 2013 which intended for saving energy consumption, to boost the share of renewable energy and creating green jobs. A further goal of Leeuwarden municipality energy agenda is to realise the European Union targets of 2020 which aimed at less carbon emission 20%, less energy consumption 20% and increase share of renewable energy to 20% by 2020. Moreover, other key instruments as explained in details in chapter 4 are; (1) green work, (2) north agenda switch, (3)smart living in Leeuwarden, and (4) Leeuwarden-Fryslan energy now project.

The third sub-question aimed to identify the steps and goals formulated by Samso municipality to promote local renewable energy and achieve the 100% goal of renewable energy. It comes out clear in the research that, Samso had a strategic plan which aimed at becoming 100% of RE for ten years by

implementing offshore wind turbine, onshore wind, PV panels and central heating system. Other goals of the plan were to reduce energy consumption by 10%, to ensure civic engagement and using effective forms of financing. Under those circumstances, Samso emerged as 100% RE in Denmark in 2007. Other instruments enabled the success of the island were the Danish renewable energy policy which provided enough fund for the project and encouraged local ownership of the windmills and the European Union, the EU provided a fund to support the Samso Island RE project. Other key strategies plan with the purpose of reducing CO2 emission and increasing renewable energy share is the; (1) Samso municipality master plan of 2030, (2) the covenants of mayors and (3) the central Denmark region strategy of 50% of energy consumption by 2025. Chapter 4 page 24 elaborated in details about these strategies.

Sub-question four aimed at identifying the roles played by different actors in the local renewable energy transition and energy savings in Leeuwarden and Samso municipality. In chapter four this research found the key actors in the two municipalities. Some of the main actors in Samso municipality were; (1) farmers, (2) the Samso energy company, (3) the local community, (4) Samso environmental and energy office, (5) Samso municipality, and (6) supranational organisation such as the European Union. For the case of Leeuwarden, the actors are; (1) local energy initiatives, (2) academia, (3) energy companies, (4) housing cooperatives and (5) Leeuwarden municipality. The roles of these actors are explained in page 26 and 44.

Sub-question five intended to assess the obstacles/barriers of local renewable energy transition development. This analysis revealed that the main barriers to RE transition in the two municipalities are as follows; For Samso municipality the main barriers were:

(1) Behaviour change was not successful

(2) Samso failed to meet the target of reducing energy consumption to 10%

(3) The Samso municipality experienced the minor challenge from the right wing leader who was against the renewable development.

In Leeuwarden municipality the barriers are:

(1) Energy poverty

(2) Limited fund allocation

(3) The social acceptance-public resistance of renewable energy sources such as wind and solar field

(4) Lack of knowledge and awareness

(5) And lastly, the conservativeness of the community.

These barriers are explained in more detail in chapter four.

Sub-question 6 aimed at comparing the two municipalities (Samso and Leeuwarden municipality) in the area of drivers, barriers, and actor's role in RE transition at the local level. This thesis found that the Samso municipality has already achieved 100% of RE goal while the Leeuwarden municipality is still on the process to achieve the targets and goals of 100% renewable energy and to achieve energy savings. Some of the similarities between the two cases are:

(1) The community in the two municipalities was willing to change,

(2) Both municipalities have the same target of increasing the RE share, reducing CO2 emissions and to achieve energy savings.

Some of the differences observed are:

(1) The two case differs in starting point and different phase of renewable energy transition

(2) Samso island municipality managed to generate 100% of RE goal

(2) Danish innovative energy policy,

(3) A high degree of community involvement and public acceptance of renewable energy.

Lastly, the main question this research aimed at identifying the factors influencing the local energy transition in small municipalities, towards reaching the 100% of renewable energy target. In the final analysis the research found the most prominent factors as follows:

(1) Community involvement

(2) Innovative energy policy

(3) Information, awareness, and education sharing at the political and local level

(4) National and local government support

(5) Actors involvement

(6) Economic factor and energy market.

6.2 Recommendation

As a result of the findings in chapter four the two municipalities, (Leeuwarden and Samso) this research found out that the Samso case can be seen as a best practise case compared to the Leeuwarden case. The goal formulated and steps taken in Samso have resulted in the realization of 100% of renewable energy goal in Samso municipality.

Therefore, the Leeuwarden municipality and any region in the developed world have a lot to learn from this best practise case, as learning from Samso is the learning from the ideal case. In view of the fact that, Leeuwarden has the same targets and goals like the Samso case but according to the findings from the Leeuwarden municipality it seems that it will take sometimes to accomplish its targets and goals regarding the renewable energy, this is due to the setbacks facing the Leeuwarden. It also depends on the starting situation and possibilities for creating renewable energy (land use) and government support. For this reason, in order for the Leeuwarden municipality and any other region in the world which consider to develop the RE programs and reach the goals and targets of 100% and achieve energy savings by 2020, 2030 and 2050, it is highly recommended to take into account the following steps as the Danish case did:

(1) Firstly it is recommended to involve the local community within the municipality in renewable energy project and programs

(2) Political support is highly recommended, this is both at the national and local level, and this support can be in the form of information sharing, knowledge and economic assistance

(3) The municipalities should carry along all the major stakeholders in the renewable energy sector

(4) It is advisable to promote the local ownership and invest in windmills as a way of realising the goals and targets proposed

(5) It is hugely recommended to promote the education and awareness campaign at the local level, this will assist to tackle the public opposition of renewable energy technologies such as windmills, biogas and solar fields

(6) It is advised that municipalities should increase the RE fund and cheap loans which does not have tough procedures to secure the loan.

(7) The municipalities are recommended to promote the behaviour change; this will assist to achieve the energy savings and adoption of the renewable energy technologies

(8) It is advised to strengthen policies that guide the local renewable energy so as to prevent the NIMBY sydrone and increase the adoption of renewable energy.

(9) It is recommended that the government should focus in reducing the energy consumption in larger sector such as mobility sector rather than relying on the small sector (bottom up initiatives)

(10) The municipalities have to show an excellent example in adapting the renewable energy for instance, the use of green electricity this will persuade the local community to emulate them.

(11) It is advisable to create a local plan with motives of utilisation of local resources for energy purposes

(12) The communities should adapt the collectively way of heating their houses, called the central heating system like the one in Samso island provided by the cooperation rather than the individual system.

6.2.1 Further work

More research is needed to be conducted in Leeuwarden municipality especially in the area of renewable energy transition and energy savings at the local level so as to understand the trends of RE transition, particularly at the local level. Since at the moment, there is limited research publication concerning the energy transition and there is a lack of attention on energy savings at the municipality level.

Finally, more research needed to be done in the area of energy poverty in Leeuwarden municipality, as a result, this research found out that there is a symptom of energy poverty in the Leeuwarden municipality. That means some people within the municipality fail to meet their energy bills. Not only that but also more research is needed in knowledge and awareness of people regarding the RE and energy savings, more research is as well needed in the area where there is a scarcity of land to generate the renewable energy, particularly the Leeuwarden municipality. On top of that more study needed to be conducted in the area of population decline in Samso renewable energy island because even after the 100% RE project completed in 2007, the population of Samso is still descending.

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Note: All respondents agreed their name to appear in this thesis report

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APPENDIXES

APPENDIX 1: Green Gas Transcribed Interview

Interviewee; Ruud Paap

Position; Business developer

How does the Green Gas Assist Leeuwarden city in Energy Transition

Well, we are working with some of the projects that concern the production of biogas in the city of Leeuwarden, there is a couple of projects one is waste water treatment plant in Leeuwarden where biogas is been produced and used in neighbouring buildings offices. The other biogas plant is south of the city basically just outside the city where dairy farm biogas is been produced from manure mainly and there is the big project been developed right now in the city of the Leeuwarden which is going to produce a lot of biogas. We have been doing this for ten years especially the energy coalition.

Why Leeuwarden and Dutch Municipalities is Struggling in Energy Transition

It has to do with the national subsidy scheme (policy) because we have the policy to stimulate the renewable energy production and this policy has limited amount of money and this policy has been in place since 2008. Because there is a limited amount of money in this subsidy regime and there is more potential for sustainable energy its not certain if you will get the subsidy. Therefore there is more potential than money basically not all the potential has been used at the moment, I think also subsidy system is very complex for project developer so you have to invest a lot of money before then on your own risk and then you have to wait if you get subsidy or not. If you get it then it's okay then you have a business case, if you don't get the subsidy all the money you spend is for nothing. If you want to realise a larger scale digester for instance you may have spent over one million euro in advance and then still you are not sure that the project will be approved for subsidy or not so the risk is very big and of course this reduces the appetite for investors to start these kind of projects.

The Dutch government is making a lot of tax money on non-renewable resources but at the same time the government spend a lot of money there as well because fossil fuels are also getting government support (tax reduction for larger industrial gas user) close to 6 billion euro's a year so it's costing a lot of money as well. I don't believe this is the reason why we are lagging because the Dutch government doesn't have a choice to do so because its European policy then they have to comply because there will be sanctions so I won't think they don't want to comply but I think they are struggling to find the right way to get the subsidy and policy in place in stimulating the renewable energy production and at the same time not over stimulating it Lastly, Netherlands is a densely populated country therefore there is no a lot free space where you can do larger scale energy production without people complain about it. I think country like Norway, Sweden, and Switzerland they have a lot of mountain opportunity to generate electricity with water reservoirs while us we don't have these things so all energy produced must come from wind, biomass and solar.

Challenges/Barriers

Societal acceptance- the technology is not a problem but one of the main problems is societal acceptance, Dutch people complain a lot. If you want to realise biogas installation, wind energy parks or solar PV field almost people living next doors always not happy about this therefore they always complain about this therefore a lot of times they try to stall the permit procedure. Therefore the societal acceptance is the big thing here in the Netherlands it doesn't help the project getting realised, but technology is not much problem.

Measure to tackle the problem

The government should change their permit procedure; of course project developers still have to make sure they are not creating problems for their neighbours. That of course has to be taken care of but nowadays people living next to the project can basically make sure the project has to wait for 1, 2, 3 years because they can lodge an appeal against all kinds of different government decisions to try to stall the project I think the local citizen have too much power to influence renewable energy so I think that's should be limited

Lesson Learnt from experience to promote Local renewable energy transition

One of the lessons is to try to incorporate people living next door, it doesn't matter if its wind mills, solar field and biogas installations. If you start building it and people living next door note/find that somewhere they will benefit from it then of course it's far easier to be convinced that it's a good idea. If just installation is there and they have no benefits from it but only problems then of course it's a recipe for societal un acceptance. If you can find a way to make the surroundings people profit from the installation then it's a good thing to do.

Another lesson is you need to do with the local biomass preferably biomass you own yourself, then if you are a farmer and you have a dairy farm you can use your own manure. If you are a waste processor like Omrin in Friesland and you can use waste that you collect yourself then it's cheap, if you have to buy feedstock to use for your installation then it's expensive. You have to be independent on fluctuating market price because otherwise it's very difficult for you to make a profit every year. If you can use your own biomass then I think it's a big plus.

APPENDIX 2: Transcribed Interview

Energy Workshop-Leeuwarden

Interviewee: Frietema Sybrand- Project Coordinator, 5 people organisations- part timework

Organisation role

1) Giving local community vision of energy transition, Helps local village to formulate their own goals and means they want to produce and reduce energy needs and help local community to decide do what they want

2) Reducing energy collectively not individual (energy savings) we assisting the local community in securing finance for the renovation of their houses.

3) Energy production- Due to the fact that the wind mills is prohibited in Friesland and Leeuwarden as well then we are helping the local community with the installation of solar fields and roof top solar.

Why wind mills is not allowed in Leeuwarden and Friesland

Four years ago there as enormous discussion and politician in Friesland were afraid of some angry people who were really making a lot of noise that they don't want to see wind mills in our country. Because province of Friesland is flat people were worried about the vision on the landscape will be too much polluted with wind mills. This is not happening only in Friesland but also Leeuwarden municipality as well, but a lot of people think that the new government in the province they will decide to leave the burn then it will be possible to install the wind mills again. Small wind mills are perfectly for the local communities. Example, Leeuwarden Municipality small village ratusum they have got small wind mills, solar panels for the schools and they were not allowed to have new wind mills because of the province and Leeuwarden is very angry with it. The strange thing is if it's for your own then its okay, then if it's for the local community its okay, we have no problem with

the solar or smaller wind turbines. But if it's owned by the foreign investors then we don't want that equipment nearest. Presently in Friesland there is a lot of angriness on very big solar field's more than 50 hectors and local community are afraid that their vision on the landscape will be affected and they don't want it and they get some time angry. Again, I have example of the place where the local community have decided to put solar panels collectively near the Leeuwarden city, example is the bestanden and we help them with big solar fields near the bestanden and there is no complain from the people because it's their own solar fields, they own it. Another example the south of the Friesland.

Mechanism/ Support from the Municipality

The program I am working with receive fund from the province but not much to help the local community energy. The municipality of Leeuwarden provide the means for local energy community, the support they provide are in terms of permit and the financial assistance. Some municipality say if its local energy the community doesn't need to pay the permit fees. I think within 1, 2, 3 years the municipality will provide more fund to the local energy community because they believe it's more useful in the energy transition.

Why Leeuwarden and other Dutch municipalities is struggling in energy transition

Because we have a natural gas surplus and we have fantastic infrastructure for natural gas, every house in the Netherlands is connected to the gas. It's quite cheap to get the gas, we use it for electricity generation, heating and cooking. Therefore every house is connected with cheap gas and cheap electricity and people think there is no need to do something on their own. The Dutch government is not serious about energy transition, the Dutch municipality and province used to have utility but they sold it to Germany, England, Sweden, France and England. Few years ago there is coal power in the Netherlands and non in the Germany and the Germany buys coal in Netherlands, that's why we end up with new coal power plant. Friesland currently has the better opportunity to provide the Dutch people with the renewable energy companies. On top of that the Netherlands have good technical companies that can provide a good renewable energy solution but we don't real use them.

The Dutch government is making a lot of money out of non renewable resources

The government don't care about the environment and climate if you want to use coal nobody cares. Something strange is if you look England used to be number one coal country in Europe, and the Dutch were gas people, but few years ago we were using more coal than England we used to import. That means we don't have right legal governmental environment to create the better perspective for the renewable energy.

Barriers of Renewable Energy Transition

We need people to change the behaviour; the government doesn't give them a warning that's why people don't care in using non renewable energy resources. I will heat my house with the gas then I don't care that will cause a problem because every house in the Netherlands need to move away from natural gas we have to use other means to heat our home, our problem is most people don't get it and politician are afraid to tell people to switch to the sustainable energy they don't dare to tell the people then they won't act that's the main problem.

Moreover, some people who are aware do themselves not collectively, example in Denmark small community are connected to the central heating systems owned by the community. It works perfectly there, I was in Denmark and I asked some Danish people there that how do you do this and they told me we have a cooperation and the cooperation provide all this, I told them in the Netherlands we do this all ourselves, every individual home have got gas insulation and they look at me and said you are stupid its expensive then you have to do it collectively, in the Netherlands we don't have that collectively feelings anymore.

Solution of the barriers

-We need help from the municipality to focus on community and not individual

-The municipality must provide finance and cheap loans to create heat solution and energy production solutions.

What are the key lessons learnt from your experience to promote local renewable energy transition and energy savings in small cities?

-The municipality must show a good example to the rest of the people in using renewable energy, because still some municipalities in the Netherlands buy cheap electricity from the non renewable resources such as coal and natural gas. Otherwise you can't ask people to do things which you can't do it for yourself.

-Get people to understand clearly example of what is to be done

Has there been a need for shift in government policy to enable the renewable energy transition?

Yes, the government must make a policy that provides better solutions to the community not only for energy but also climate, mobility and food. I think we will have a better policy in the next decade.

APPENDIX 3: Transcribed Interview

Interviewee name: Erica Zomeraman

Position: Research and teacher at Hanze University and Energy Academy Europe

Drivers of local renewable energy transition in small cities like Leeuwarden

There are several drivers and they real differ per each municipality, because it's local thing so it's not standard. There is a growing number of energy cooperatives and we call it bottom up movement, it start with the few people two or three who are enthusiastic and high motivation to try to get more renewable energy at local level and that's also I think is one of the drivers. That people feel with their community they want to be more sustainable, they want to create more sustainable life or sustainable feelings and that they want to do something's at the local level. I believe those people are motivated from in strict ways to change so I think that's one of the motivations.

Another core motivation is often also seen that when you meet more people than in energy cooperatives to try to be independent from energy companies and other type of players in the field. The group of people try to get arrange things the way they wants and not to be dependent anymore.

The third driver is to fulfil the target from the local policy or local government or municipality. The municipality have the targets that need to be performed and they are looking forward for ways to fulfil this so they just need to. These are the key thing that's most important.

Mechanism followed by small cities to promote local renewable energy transition

Incentives are important but on the other hands incentive is quite limited

Loans is also an options to make it attractive because at the moment the interest rate is very low in the Netherlands

Another mechanism I think is to try to get some more collective arrangement, well when I look at my own house and neighbourhood house and I want to invest then I don't want to hassle, get much trouble, and I don't

want to spend too much time, a lot of people do want to do something then they want to have better insulation in the house and then solar panels. I think one of the initiatives could be on the local scale, and then we can make arrangement which is very attractive because you can make a kind of collective budget agreement, municipality can as well facilitate and ask companies who provide this type of product and services to make attractive offer and also you can say then well we have a nice package now and you can choose your model in the package and there is one party who arrange everything so you don't have to go to the company A for insulation and B for solar panels and C for heat pump. I also think to take away problem in realizing it or to make people clear to make order this model and to arrange to people no hassle, very transparent way of organising it I think that's a good mechanism as well.

The last mechanism works well on energy cooperatives so that you have to say in what type of renewable energy will be realised and then you can take a card in financial investment so that you say I want to invest in solar field near the village or city and then when you invest you get some kind of interest from it, I think people feel much more connected to the project.

Why Energy Transition is not happening in Dutch Municipalities

It's happening, because we don't often see it like in technical way or physical structure but the core of transition is there. There are lots of things happening on a very small scale and that's what we call experiment or innovation and there are theories on it saying may be now transition on research that need experiment a lot before you try to grow this kind of innovation, and a lot of experiment on innovation will end because they will not grow to the distance because they are just not making it, because they are expensive, people are not willing to adopt to the new technology but they are some that will grow and I think awareness of people need to start. That is because people who are aware are willing to change something. There are different types of groups, some people wants to acts themselves and some people want to help other people in investment but they don't want to get involved very much so they are a bit passive. When you look at transition there is a small scale innovation currently happening, and I think there is a move now in energy transition, a technological transition because there is a lot of techniques already to fulfil this challenge and they are available and there is a lot of move needed. I think when you look on social part and then awareness part and you want to create awareness and you want people to talk about the problem nobody will want to create awareness.

Energy transition is not happening because of lack of awareness, when you are not aware you are not going to change for stance when you want to stop drinking Coca-Cola and humbugger you need to change your habit or to do something in a different way .

Measures

This awareness is just starting and growing a little bit its one of the experiments and this is one of the things that are needed and the municipality can facilitate by organising events or information desk where you can go and questioning and then this is one of the aspects that will help adoption of the renewable energy technologies. Other things when you look at the policy and permit, municipality could make a permit shorter and easier so that you can get permit much quicker that will be very helpful. Therefore, there is a legal aspect on it. Next to that the societal aspect what you need to look forward is important for the local people not in terms of energy but in terms of safety and nature and where they want to spend the spare time, I know that is what they did in Samso island. They didn't start talking about energy but they start talking about the migration of young people from the island and they have the problem, it wasn't attractive enough t stay on the island because of the unemployment then they say they want to create more jobs because it's good for the economy. So this are the things which are specific in the village or part of the village, it might be a problem then you try to connect it with the energy topic to it and sometimes it can be safety, to have a better light on the road because its dark in the evening then you can do it in a sustainable way.

Also in energy transition a lot of thing can be done without involving people actively, the municipality can try to give incentive or hard taxes on things you want to decrease especially non renewable resources, doing that the sustainable things will be more attractive.

Barriers of RE in Dutch Municipalities

With regards to energy the municipalities have the facilitating roles. Some of the municipalities are used to the ways they use to work ten of years already, therefore it could be a barriers because they don't know how to change and how to do it differently so that can be a barrier.

Political point of view- It is very important because the local policy is determined by the politics eg. When you have more the right hand side parties then economic factor is important for them than sustainable energy. The will say we can do much more on renewable energy but we can't afford it then we have to think about our economy.

Income generations from the non renewable energy resources such as coal, natural gas etc, at the national policy these kind of the non renewable resources mentioned above generate a lot of money for the Dutch economy

Infrastructure- many municipalities doesn't have a road map for next decade and make a customised plan to involve local people for each neighbourhood.

Has there been a need for shift in government policy to enable the renewable energy transition?

Yes, there are a national targets we want to have zero carbon emission in 2050 and then when you look at the national targets specific local government every local government need to contribute to the national government so they have to, there is a need and to do more actively we must involve important stakeholders. This is because municipality is one of the important stakeholders and then influences what will be the choice of each part so then you have the higher acceptance in the end for residence or company when they are involved. That's what we see in our research as well, when people are involved at early stage and also real heard some time there participation evening for citizen but the government don't do anything with information, they just do like involvement of participation but it's not really we need to have a good participation and listen to people and hear what they think it's important may be its more important for people to be independent.

What are the key lessons learnt from your experience to promote local renewable energy transition and energy savings in small cities?

Creation of awareness is of important things

To find out what are people value and design something for the future

Education for young people will help to phase out fossil fuels- young people and the children are the decision maker of the future, so everything that is new or a bit unsure for adopt are not new to the young people because they are used to it example, for my children its very normal that they see a lot of wind mills in the Netherlands and they can't imagine a country without a wind mills because when we go to other place they just surprise how they generate electricity without a solar panels or wind mills so they have a different way of thinking that's normal to have the renewable energy and why are we using fossil fuels and they don't know we have a huge energy systems based on fossil fuels.

APPENDIX 4: Transcribed Interview

Organisation name; Roc friese poort college Leeuwarden

Interviewee name; Roeland Westra

Position: Project Manager Duurzaam of Roc friese poort

How your organisation work in area of sustainable energy and Leeuwarden municipality

Our college provide vacation training especially for the young people and the local community in area of technical education, installation of renewable energy technologies and ICT. The college also provide the regular education program. On the other hand we are working with the municipality of Leeuwarden in area of sustainable building (energy neutral) to realise its ambition of 20% of energy savings by 2020. On top of that, the roc Friese College offers education program to make the house sustainable (how do I make my house sustainable) and we coach the local community to make sustainable house. But before making the house sustainable we advice people to have the plan which is trias energitica. In this model there is saving of energy, generating renewable energy and using fossil fuels efficiently when necessary.

Drivers of local renewable energy transition in Leeuwarden city

I have the program in other city here in Friesland the local community there have the passion for sustainability, especially in making their house sustainable. The house owner talk to each other and they inspire each other. Another driver is the fund allocation by the municipality, actually the municipality doesn't facilitate us but they are part of the cooperation. But in some ways the province and municipality support us otherwise there won't be a centre for sustainability here.

Why Energy transition is not happening in Leeuwarden Municipality

I think it's happening here, and I am happy that we are struggling because we are active, we have cultural capital city 2018 event and there is a number of energy initiatives like fossil free organisation. The young people will show that we can move on the road or water without fossil fuels that's a challenge and when we want it we can make it happen. Therefore, there are a lot of companies and initiatives with the right people to make the house sustainable. Our government said in 2020 we have to be the energy neutral, it's easy to say that but now do we do it? What kind of technique required for that? that's a struggle to.

People think that there is no need of changing behaviour, we are spoiled. We think that there is no need to switch off the light because electricity is abundance also because we have enough water people think that we don't need to save energy.

Cheap fossil fuels in my country, for stance every month I paid 150 Euros for electricity and gas for cooking, shower heating as well.

Barriers of renewable energy and energy saving in Leeuwarden municipality

Energy poverty yes there is a symptoms of poverty here because we have the food bank here people who don't have money go there and collect food. When you are working here in my country you have everything here cars, good house etc but when you are not working here then you have some money from the government but not a lot. When you have no work you can't pay energy bill, so there is people who can't afford to pay energy bill in Leeuwarden, Friesland and in our country

We have one obstacle, the market its self create the obstacles and what's the obstacle? When you have the solar panels and when they are having a conversation with me they say when you buy solar panels and you invest for example 10,000£ we make a calculation and within 6 years and 10 years you earn back your investment and then people say when I earn back in five years then I will do it so it's about investment time and earn time but I think it's an obstacle because when I buy a car I spend may be 10,000euros and there is no one ask the car seller in how many years I can earn my car back, so some people say they don't want to have

investment in a sustainable house because I invest 25,000£ but when do I earn my 25,000£ back, and when we think like that we never make our house sustainable and I think it's not about the money it's about our children and climate, do we want to save the world or do we want to battle the climate change , we have to invest because of a living world but a lot of people think economic and not our climate therefore a lot of people including myself have no sustainable steps for a houses

What are the key lessons learnt from your experience to promote local renewable energy transition and energy savings in small cities?

The municipality are suppose to facilitate the investment and people must inspire each other

Has there been a need for shift in government policy to enable the renewable energy transition?

To invest more money on sustainable energy and to make existing building sustainable

To improve the technique and make the house sustainable

APPENDIX 5: Answered Direct interview question (Us kooparasje)

1. What is the general drivers/mechanism of renewable energy promotion in small cities like Leeuwarden?
    a. Leeuwarden is not the city in the foreground of durable initiatives. The city facilitates households to upgrade their houses (insulation, efficient heating etc). But only through a website. T
    b. The financial situation of Leeuwarden is quite bad. Many proposals or initiatives, on itself very valuable, dot not get any financial back-up
    c. The city Leeuwarden tries to follow the provincial initiatives (The Friesian Energy Strategy) but is a follower on a distance.
    d. Some local cooperatives (private,the members are households in parts of Leeuwarden) facilitate solarpanels on the houses, on smaller pieces of land or roofs of industry-complexes in town. These coops and all other local coops cooperate Friesland wide in UsKooperaasje. Many initiatives are initiated and facilitated by this organisation.
    e. Industry in Leeuwarden is very active but jointly with others in the Province of Friesland (Circulair Friesland, Fryslân Fossyl Frij and others)

2) According to your experience, what do you think why energy transition and energy savings is not happening in Leeuwarden municipality?
    a. See my answers above
    b. My idea is that Leeuwarden waits for provincial and/or Dutch initiatives and finances

3)What is the role played by your organisation to enable renewable energy transition and energy savings at local level in Leeuwarden municipality: Local coops in Leeuwarden are member of UsKooperaasje.

4)What are the barriers/obstacles of renewable energy and energy savings in Leeuwarden Municipality?And what do you think the municipalitycan do to tackle the problem?
    a. It is mostly the financial situation but also their mindset. The coalition is not fully focussed on these items (some say: too difficult for us)
    b. Other municipalities (like SudWest) are very active and facilitate a lot.

5) Has there been a need for shift in government policy to enable the renewable energy transition?
    a. The mindset should change and finances put in place
    b. There are only 2 local coops active in Leeuwarden. In the province Friesland around 50.

6) What are the key lessons learnt from your experience to promote local renewable energy transition and energy savings in small cities?
Involve local citizens in small communities per street/couple of streets to get things done for local households
Public/Private partnerships are crucial

APPEDIX 6: Answered direct interview question (Fossil Free Leeuwarden)

1) What are the general drivers/mechanism of renewable energy promotion in small cities like Leeuwarden? we think we are a big city! promotion is best to do by communication about campaignes. This caould be done much better. Wehave (as municipallity) a very bad website, so a lot of people in the city do not know what is happening. Only people who are involved.

2) According to your experience, what do you think why energy transition and energy savings is not happening in Leeuwarden municipality? ???? it is happening! Leeuwarden is one of the leading Municipalities, but people do not know!

3)What is the role played by your organisation to enable renewable energy transition and energy savings at local level in Leeuwarden municipality we are : the friends of fossilFree Fryslân. Independant organisation! We work hard on a program and do special projects like: two weeks of fossilfree driving in the first two weeks of july in the whole provence.

4) What are the barriers/obstacles of renewable energy and energy savings in Leeuwarden Municipality?And what do you think the municipalitycan do to tackle the problem? We do a lot, so we (also the municipality) are working hard. We could talk about this a long time, but first you should know a lot more about Leeuwarden, because: a lot is happening. But you did not fin dit!

5) Has there been a need for shift in government policy to enable the renewable energy transition? No, it is already years and years the same. And that works very good!

6) What are the key lessons learnt from your experience to promote local renewable energy transition and energy savings in small cities? Too hard to tell in short way. It is not hard to do. Just make it policy and do it!

APPENDIX 7: Answered direct interview question

What is your name and what is your role in this organisation?

Gerard Adema. Program Manager Frisian Climate Change

What is the role played by your organisation to enable renewable energy transition and energy savings at local level in Leeuwarden municipality?

To create awareness (citizens and organisations),support (full width) local initiatives in the field of local energy transition plans, energy saving and renewable energy production, develop innovative approaches and concepts on savings and renewable, advise about appropriate governmental instruments

Why energy transition is not happen in Leeuwarden?

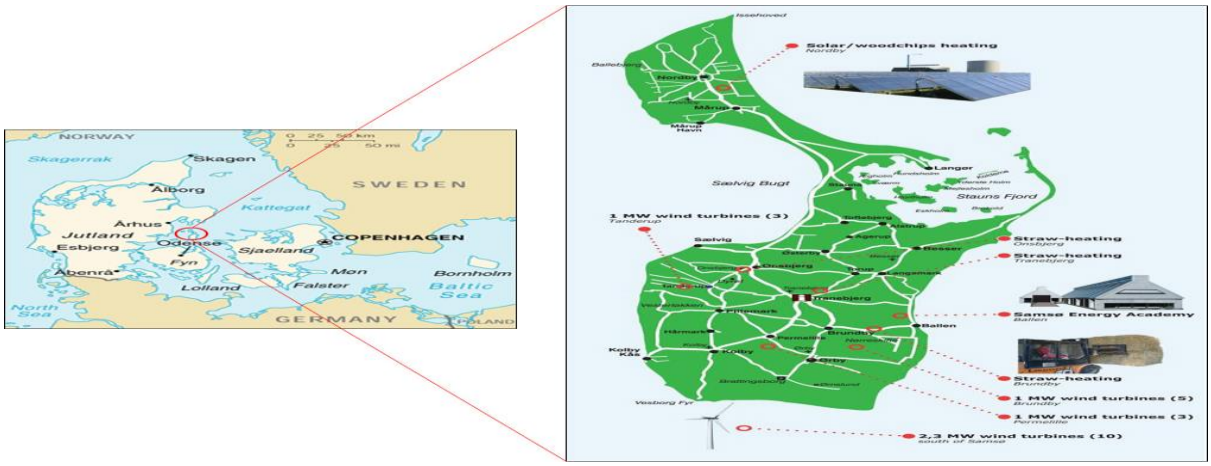
Is that so? Can you specify?

What are the barriers/obstacles of renewable energy? And what do you think the municipality and government can do to tackle the problem?

-Especially in the municipality of Leeuwarden the affordability of the necessary transition is an issue and needs smart solutions.

Has there been a need for shift in government policy to enable the renewable energy transition?

Not necessary a (significant) shift but much more effort need to been addressed to the challenge (speed and scale up).



APPENDIX 8: **Map of Samso Inland with RE installation Source; International study of RE Regions, (2018)**

APPENDIX 9; **Map of Leeuwarden municipality. Sources; Weather-forecast. com 2018**