Towards the energy transition in Fryslân

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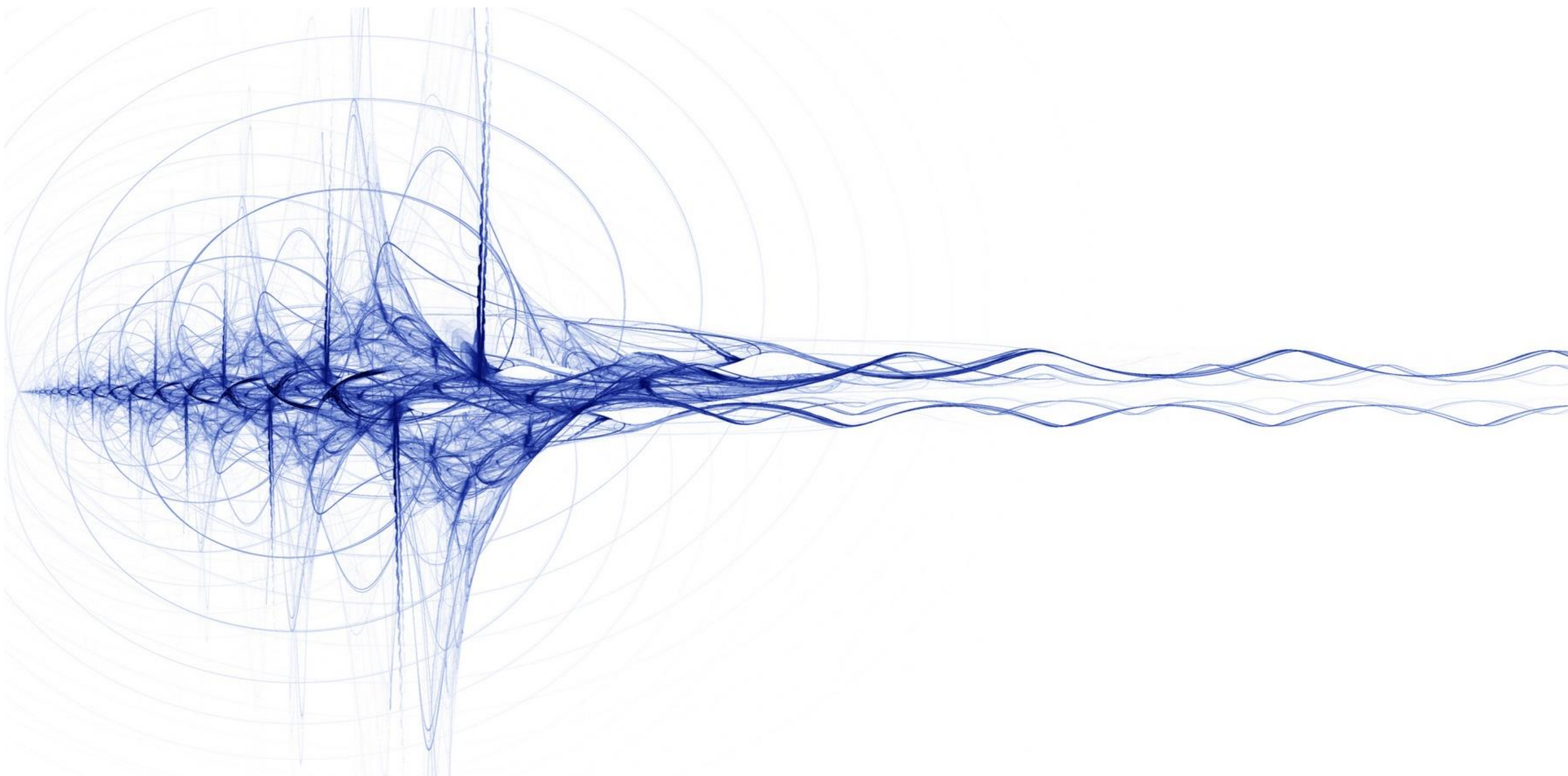

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Towards the energy transition in Fryslân

Investigating the spatial implications of the Frisian energy transition on a local scale

by

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Abstract

Difficulties to come to grips with spatial implications of the energy transition are currently hindering concrete energy transition actions on multiple planning scales. In this research, the spatial implications of the Frisian energy transition on a local scale have been explored through outlining and testing a planning strategy. This testing included inviting local communities to participate in a set of workshops. Exploration of concrete spatial implications is intended to help activate energy transition initiatives on both local and regional Frisian scales. This research shows that the Frisian energy transition on the local scale will mainly cause visual spatial implications within the urban area due to the desired multifunctional use of space. On both the local and regional scale, the exploration performed in this research has led to the undertaking of actions towards the energy transition.

Keywords: energy transition, strategic spatial planning, Local Energy Initiatives (LEIs), workshops, spatial implications

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Summary

Ongoing developments in Fryslân concerning the production of renewable energy has left the province of Fryslân ambivalent regarding how to realize the respective renewable energy transition goal for 2050. Implementation of large scale renewable energy projects seems to be unavoidable. However, these endeavours divide the Frisian population: on one end supporters of and on the other end opponents to the energy transition. The current rapidly developing local course of action, focusing on the production of renewable energy on a local scale, seems instrumental to overcome such polarization of Frisian population, and to be much more supported by local communities. Ongoing discussion concerning the desirability of such local courses of action, however, seems not to consider the respective inevitable weaknesses, that are mostly constituted by the difficulty for local communities to envision the concrete implications that the energy transition will have on their much valued living environment and landscape.

One of the main reasons this gap in the local course of action exists is a difficulty to envision spatial implications of energy transition targets. Getting a grip on such spatial implications – that is, the visual and land-use effects of renewable energy technologies on landscapes – is very important, because the real challenges when talking about energy transition are the related, inevitable and large changes in the environment.

This research intends to deliver instruments for solving this gap, namely envisioning spatial implications of the energy transition by developing an approach focussed on a set of local scale energy initiatives. Such initiatives will herein be referred to as local energy initiatives, or LEIs. The assessment of local spatial implications of renewable energy technologies chosen by local communities in order to achieve specific energy targets will enable a more grounded vision of what the Frisian energy ambition for 2050 would entail on both local and regional scales. As such, this research will help policy makers to evaluate whether the cumulative spatial implications of local initiatives would enable the energy transition in light of the strategic horizon of 2050 consistently, harmoniously and integrally. In this regard, this research adopts a 'local course of action' – focussed on a set of case studies – in order to gain strategic insight into the energy transition on a regional scale. This insight is the main objective of this research, and relates basically to both the set of renewable energy technologies a sample of local communities would opt for to be incorporated in the local landscape after being informed of their corresponding spatial implications (termed the local energy transition perspectives), as well as what the Province of Fryslân could learn from these localized initiatives. These lessons could aid the design of a comprehensive strategy for regional transition towards renewables on the way to 2050's goals.

The methodology in this research revolves around inviting selected local communities to a set of workshops, wherein local energy transition perspectives concerning the Frisian energy transition are explored. Based on the perspective on the energy transition matured in the context of this research, it is concluded that the spatial implications of energy transition on a local scale are relevant, primarily in the participating communities' urban area. These areas offer enough room for multifunctional production of renewable energy needed to cover the majority of demand for heat, electricity and transportation. Because of this predominant, multifunctional installation of renewable energy technologies in the urban area, the energy transition on the local scale will mainly cause visual impacts on individual building plots. However, if any function of current land use on a local scale would have to change, this will most likely be for the renewable production of electricity.

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Abbreviations

LEIs	Local Energy Initiatives
Localized approach	Planning strategy developed and tested in this research
Local course of action	Strategy for facilitating the Frisian energy transition, conducted by local communities becoming energy neutral through local installation of renewable energy technologies
Energy neutral community	Local community (village) that renewably produces the yearly energy demand through the installation of renewable energy technologies on their own local scale
Local energy transition perspective	The manner how local communities prefer to become an energy neutral community
The Province of Fryslân	The provincial administrative body of Fryslân
Fryslân	The working field of this research, comprised of the physical province, the Frisian citizens and their villages

1 Introduction

1.1 The Dutch Energy Transition

For at least the past 15 years, the Netherlands has been working towards altering its energy supply and demand system (Sanders et al. 2014). The intended change is to minimize current dependency on fossil fuels and to establish an energy system based on renewable energy sources. This process is generally known as the energy transition; a goal to which also many other countries and regions worldwide are committed. Predominantly, the energy transition is fuelled through a shared recognition of the adverse social, ecological and climate effects of our current fossil fuel usage (Creutzig et al. 2014; Van Asselt 2014). In the Netherlands, this transition has been approached mostly from a top-down perspective, with a strong focus on international programs (van der Blonk et al. 2013).

Due to our current comprehensive dependency upon fossil fuels, transitioning the current energy system is neither a quick nor an easy process (Sijmons & van Dorst 2012; Stremke et al. 2012). The Dutch energy transition has developed very slowly in the past 15 years. As a result, the current renewable share in the national annual energy demand is around 4.5% (CBS 2014). However, a 100% sustainable Dutch energy provision should be established by the year 2050 (SER 2013). In Europe, only the UK and Luxembourg perform worse in this respect (van der Schoor & Scholtens 2015). This lagging position of the Netherlands is surprising given its reasonably strong performance in recent innovation and competitiveness indexes (Hufen & Koppenjan 2015). Besides, the required renewable energy technologies to achieve future goals are already widely available. This seems to indicate that predominantly 'soft' obstacles underlie the slow progress of the Dutch energy transition (van der Schoor & Scholtens 2015). Examples of these soft issues mentioned in literature are the dominance of business interests in transition policies (Hisschemöller & Sioziou 2013; van der Schoor & Scholtens 2015) and a related dominant focus on technological learning and short term gains instead of focusing on institutional or cultural change (Laes et al.2014).

1.2 Spatial struggles for the energy transition

On their way to energy transition, many western countries nowadays struggle with spatial qualities (Späth & Rohracher 2014). It is the "reintegration of renewable energy provision in the existing environment that people have gotten attached to, value and want to preserve" that proposes itself as a major 'soft' challenge for the energy transition (Stremke & van de Dobbelsteen 2012 p. 4). This transforms the energy transition into a challenge, mainly focused around spatial matters and the surrounding socio-political arena (Sijmons & van Dorst 2012 p. 46). Strongly related is the struggle that many countries have determining on what spatial scale and how close to demand renewable energy technologies should be installed to realize the energy transition (Späth & Rohracher 2014). It can be argued that the spatial (land-use) planning domain can be of particular importance for activating the energy transition as a practice "concerned – in an integrated and qualitative way – with the location, intensity, form, amount, and harmonization of land development required for the various space using functions" (Albrechts 2004 p. 744) such as the production of renewable energy.

1.3 Focussing on the local Frisian scale

This research aims to resolve the spatial struggles surrounding and hindering the Dutch energy transition. It specifically explores spatial implications of the energy transition in a typical Dutch locality (village), because local initiatives, against the background of the poor ET performance on both a national and international level, have become very active in fostering their own local energy transition. In recent years, the number of Local Energy

Initiatives (LEIs) started by citizens and social groups has increased dramatically, putting together ambitious plans to become energy neutral, zero emission or low carbon communities (van der Schoor & Scholtens 2015). More specifically, this research will focus on involving a set of local communities in a set of workshops in the Dutch Province of Fryslân, providing a particular interesting case in and for the Netherlands. By far, Fryslân holds the record for most LEIs initiated per capita in recent years, and their numbers still increase rapidly today (Schöne 2015).

The Frisian energy transition is impeded by the same spatial struggles many western countries face developing towards energy transition. However, this research provides the examination of the specific Frisian case. The focus of this research is on the exploration of the spatial implications – in terms of land-use change and the visual changes of local landscapes – that local communities would generate, based on their preferred courses of action, in order to activate the energy transition. This exploration is intended to contribute to activating the energy transition in Fryslân, as well as to provide insight for energy transition activation strategies on local scales beyond Fryslân's borders. These actions on a local scale are urgently required to fulfil the goals set by the LEIs, and thus to meet energy transition goals in general. As such, the local course of action and its potential for application on a regional level is very important. Especially considering that international and national scales of interventions, meant to activate the energy transition, seem to have been incapable of promoting a sustainable system of energy provision so far (Späth & Rohracher 2014). On top of this, the negative impacts of unsustainable trends of fossil fuel consumption (van der Blonk et al 2013) as well as the spatial implications of the reintegration of renewable energy technologies in the landscape are felt directly on a local scale.

1.4 Fryslân and the Frisian Energy Transition (ET) struggle

The Province of Fryslân claims to be one of the front runners in the Dutch energy transition (GS Fryslân 2013). Currently, a share of 8% in the total yearly provincial energy demand is derived from renewable energy technologies (Ekwadraad 2012). In comparison, the average share of renewable energy in the total Dutch energy demand lies around 4.5 % (CBS 2014). Furthering national ambitions, The Province of Fryslân has set the goal to be independent from fossil fuels by the year 2050. Although the provincial council has set this goal *for* Fryslân, the council is not able nor willing to realize this goal by means of its own legislative power. Also, there is no clear vision on how this transition should be established in between the year 2020 and 2050 (G. Venema, personal communication, January 5, 2015).

This situation is characteristic for the development towards the energy transition in many countries. Despite the fact that the need for an energy transition is supported widely, in many occasions "it is still uncertain where the support and required investments for renewables can come from" (Dóci et al. 2015 p.2). In light of this uncertainty and the challenge of changing the current energy system, the Netherlands has adopted a transitions approach (Kern & Smith 2008; Kemp et al. 2007). This approach is also adopted by the provincial department responsible for realizing the Frisian energy transition.

The transitions approach has specifically been established as a governance model for dealing with persistent problems (Loorbach & Rotmans 2010; Rotmans & Loorbach 2009; Kemp et al. 2007). In short, the approach suggests utilizing ongoing developments when realizing societal goals like the energy transition (Kemp et al. 2007). Focusing on the Frisian energy transition by the year 2050, there are two interesting ongoing developments within Fryslân, namely:

1. a considerate amount of criticism coming from the Frisian population, concerning large scale wind energy production in the Province (Jongedijk-Welles 2014). Currently, this has led to a new spatial policy banning the installation of new wind turbines in Fryslân (Provinsje Fryslân 2015a).

2. the rapid expansion of local scale sustainability initiatives (LEIs), that try to accomplish the shift towards a sustainable society from the bottom up, on a local scale, often focusing on the production of renewable energy (Van der Blonk et al. 2013; NLD Energie 2015).

Important factors that strengthen these developments are the equal distribution of (financial) benefits and burdens, opportunities for improving social cohesion and the spatial implications of reintegrating renewable energy provision in the existing environment. For many Frisians, large scale wind energy production has a too large impact on the open landscape, and is therefore not desired (Jongedijk-Welles 2014). As an alternative, the locality seems to work from the bottom up towards a sustainable society, from and on a local scale (Van der Schoor & Scholtens 2015; NLD Energie 2015).

1.5 Ambivalence for the realization of the Frisian energy transition

The current situation leaves the Province of Fryslân, that seems to be adopting a transitions approach, ambivalent regarding how to realize the energy transition goal for 2050. Although the implementation of large scale wind parks seems unavoidable, working towards the energy transition *from*, *by* and *on* the local scale would seem to encounter stronger support by a larger set of citizens. Additionally, the current rapid development of LEIs is a genuinely interesting development, as their ambition and actions are both in line with and support the ambition of the Province of Fryslân, besides providing a source of investments for renewable energy technologies. Moreover, working towards goals in collaboration with the inhabitants of Fryslân is the highest held goal of the Provincial authority (Provinsje Fryslân 2015). On top of that, it is a typical development considering the Frisian social and cultural context to resolve matters on a local scale whenever possible (Urgenda 2010; Provinsje Fryslân 2013). Besides these substantive arguments pleading for a local course of action, from a practical perspective it seems that at the moment the Province of Fryslân does not seem to have much choice other than to support this trend, bearing in mind that this current rapid development of LEIs is one of the few serious and executable developments aiming to activate and realize the Frisian energy transition.

1.6 Problem statement

It is particularly interesting for the Province of Fryslân to stimulate the current rapid development of LEIs in order to take further steps towards the realization of the Province's energy transition. However, on a provincial level, decisive steps for the utilization or stimulation of LEIs have not yet been made, nor were any other decisions concerning the activation of specific directions towards the Frisian energy transition. This prudence of the Province of Fryslân is in line with the adopted transitions approach (Kemp et al. 2007). As a result however, the Frisian energy transition has developed very slowly over the last years. On top of that, the recent adaptation of a new spatial policy that prohibits installation of new wind turbines (Provinsje Fryslân 2015a) and the fact that half of the renewable energy currently produced originates from the industrial burning of waste (Ekwadraad 2012) does not show signs of an actual Frisian energy transition. A focus on defining and activating specific directions to go for is therefore essential. Although this need is also felt on the provincial level, it seems to be undermined by many uncertainties and daily reality to prefer on focusing on singular cases rather than on the ambition of a comprehensive provincial energy transition.

Interestingly, it is the intangibility of the spatial implications of the very Frisian energy transition on the local scale that seems to cause a 'wait and see'-attitude towards the LEIs on a provincial level (G. Venema, personal communication, February 4, 2015). Gaining insight in the spatial implications that the provincial energy transition would cause when facilitated on the local scale is therefore strongly advantageous for the Province of Fryslân, as it will promote the outline of a strategy and the promotion of necessary actions to further the Frisian energy transition.

Besides the provincial authority, many LEIs (both in Fryslân and in other regions) seem to be troubled by a lack of a clear view of their energy neutral future landscapes (van der Schoor & Scholtens 2015; van der Blonk et al 2013). Although many LEIs are often successful in the initial generation of long term consensus of their desired energy future (Seyfang & Haxeltine 2012), "the further development of organization structures and viable visions for local energy governance is necessary to achieve lasting results" (van der Schoor & Scholtens 2015 p. 674).

What seems to be lacking for many LEIs are realistic and achievable expectations based on a comprehensive local vision where clear energy provision goals convert into equally clear spatial implications (van der Schoor & Scholtens 2015; Seyfang & Haxeltine 2012). This research tackles this problem specifically. That is, filling the gap between the renewable energy provision goals, established on a local scale, and their conversion into comprehensive and detailed visions of the relevant spatial implications.

1.7 Research Objective

Although many countries, regions and communities worldwide are committed to realize the energy transition, in many occasions ambiguities concerning the spatial implications of energy transition are hindering progression (Späth & Rohracher 2014; Sijmons & van Dorst 2012; Stremke & van de Dobbelsteen 2012). The purpose of this research is to contribute to a much needed activation of the Frisian energy transition, helping to get on track by outlining and testing a planning strategy that the Province of Fryslân could adopt to surpass the ambiguities concerning the spatial implications of the energy transition. This research focuses on the preliminary phase of activation of local communities by involving a sample of citizens in a set of workshops during which explicit energy goals will be converted into a comprehensive vision of the relevant spatial implications. The outcome of these workshops and the method adopted – and improved incrementally from one workshop to another – for generating locally considered visions of future 'energy landscapes' will be used for distilling the elements of strategic relevance. The Province of Fryslân could use these results in order to coordinate a comprehensive and consistent transition towards a renewable energy supply on a regional scale up to 2050.

This research is primarily concerned with the preliminary phase of activation of involved local communities. This phase – and the coordination of relevant workshops - is meant to explore the spatial implications when integrating renewable energy technologies in the local landscape, and enables local communities to visualize their effects on their immediate living environment. This exercise of visualization and informed selection and integration of renewable energy technologies will be referred to as the localized approach. Essentially, this comes down to involving local communities in exercises of determining energy goals and visualizing respective spatial implications. As such, it constitutes an interesting direction for outlining a strategy towards the realization of the Frisian energy transition. Additionally, exploring these local energy transition perspectives through the localized approach will help policy makers evaluating whether the cumulative spatial implications of local initiatives would tangibly enable the energy transition on the regional scale and against the strategic horizon of 2050 consistently, harmoniously and in an integral way.

In the exploration performed in this research, renewable energy technologies form the connecting element between the prerequisites for action on both a local and provincial scale. It is on the local scale however that renewable energy technologies and their place in local landscapes constitute simultaneously the precondition and the obstacle for the energy transition on the higher territorial scale. Developing comprehensive energy visions wherein the visual and land-use effects of these technologies can be easily appreciated by local communities is therefore necessary for advancing LEI development and growth (van der Schoor & Scholtens 2015; van der Blonk et al 2013; Seyfang & Haxeltine 2012). At the same time, the construction of these local renewable energy visions may constitute the basis for outlining any first elements of a strategy the provincial authority could adopt to address possible spatial implications in wake of such local initiatives.

In short, this research will therefore contribute to the following:

- The exploration of the spatial implications of the integration of renewable energy technologies (RETs) in local landscapes, by facilitating the formulation of local energy transition perspectives through enabling local communities to visualize the relevant spatial implications in the environment.
- Enabling policy makers to evaluate whether the spatial implications of the energy transition, facilitated on a local scale, would contribute to the energy transition on a regional scale against the strategic horizon of 2050 consistently, harmoniously and in an integral way.
- Advancing LEI development and growth through the development of comprehensive energy visions wherein visual and land-use effects of renewable energy technologies can be easily appreciated by local communities.
- Indicating the first elements of a strategy the provincial authority could adopt to address the possible spatial implications of LEIs in time and environment.

1.8 Scientific relevance

Besides the normative relevance for progressing energy transition in the Province of Fryslân, aiding the construction of local renewable energy visions is an addition to the scientific literature regarding the energy transition from a spatial planning disciplinary. This scientific relevance of the investigation is evident, since the role of civil society in energy transition processes is rarely taken into account in transition studies (Dóci et al. 2015). Also, changing relationships between energy and the living environment in light of the energy transition has remained underexposed in literature (Sijmons et al. 2014). Lack of concrete descriptions of spatial implications of an energy neutral future in literature might be explained by the fact that there are innumerable possible manners to reintegrate renewable energy provision in the landscape. When considering unpredictable developments in renewable energy technologies, it can be concluded that not a single description of the tangible spatial implications of an energy neutral future is resilient to future developments. The focus in this research is by no means an attempt to construct such resilient spatial descriptions. Instead, these explorations will enable both LEIs and the provincial authority to visualize how local environments could look like, based on current possibilities to transform towards a sustainable energy system, aiming to set in motion both the local and provincial level towards the realization of the Frisian energy transition.

1.9 Related work – kWh/m²

Sijmons et al. (2014) have recently made a good start by describing a relationship between various renewable energy technologies and their spatial demands in *Landscape and Energy, kWh/m²*. This research intends to both elaborate on and relate to these approaches in light of the current developments within Fryslân. This means that the spatial implications of an energy neutral future on a local scale will be determined based on the future local energy demand in kWh and the local organization of energy provision (Sijmons et al. 2014).

Whereas the work of Sijmons et al. (2014) is mainly focused on design challenges for energy transition, this research adopts a perspective based on land-use planning. This can be understood as a practice "concerned − in an integrated and qualitative way − with the location, intensity, form, amount, and harmonization of land development required for the various space using functions: housing, industry, recreation" (Albrechts 2004 p. 744), including (renewable) energy production, attempting to fill the gap between renewable energy provision goals, established on the local scale, and their conversion into comprehensive and detailed visions of relevant spatial implications. The focus in this exploration corresponds with land-use effects and visual spatial changes of local landscapes based on desired locations, intensity, forms, amounts, and harmonization of land development for the implementation of renewable energy technologies in the local landscape, as specified through LEIs in their local energy transitions perspectives.

1.10 Position of the researcher

During this research, the researcher was working as a trainee for the Province of Fryslân, conducting research based on policy goals of the provincial authority. This position made the researcher initially biased in terms of contributing to the realization of the Frisian energy transition. In the role of trainee, this demanded a pragmatic approach focussing on the development of solutions that will aid the realization of the Frisian energy transition. At the same time, in the role of researcher, this asked for a more general focus on the spatial implications of the energy transition. Handling this position, the researcher used knowledge conveyed through spatial planning theory to frame the work of investigation regarding the development of a spatial planning strategy for the Province of Fryslân. It is important to note that the LEI case studies were not chosen on the basis of the theoretical premises of the researcher. Instead they were given to the researcher on the basis of their availability, and consistency with the research goals.

2 Research Question

2.1 Envisioning the spatial implications of the energy transition

At the beginning of this research, the generally perceived difficulties to come to grips with the spatial implications of the energy transition were positioned as a main obstacle for both the development of strategies and the undertaking of tangible actions on both a local and regional scale. In an effort to provide a solution to this problem, the objective of this research is to develop and test a planning strategy that the Province of Fryslân could adopt to surpass the ambiguities concerning the spatial implications of the energy transition. This research will therefore provide an answer to the following question:

What are the spatial implications of renewable energy technologies that would be required on a local scale to facilitate the Frisian energy transition ambition for 2050?

- What are the sustainability ambitions of the Province of Fryslân by 2050 pertaining to renewable energy?
- What localities play a role in realizing this ambition?
- What elements of the regional energy transition should be considered on a local scale, and what approach to a local energy transition do they imply?
- What local energy transition perspectives can be identified on a local scale, and what spatial implications would the envisioned renewable energy technologies have on a local scale?

General questions related to the points above are: has the adopted localized approach empowered LEIs development and growth, and is the localized approach usable for outlining strategies towards the realization of the Frisian energy transition on a regional scale? These latter questions will be discussed in light of the societal impacts and the scientific impacts of the research in the conclusive chapters.

3 Theoretical framework

3.1 Research focus and the positioning of theory

The objective of this research is not generated by current theoretical debate on the energy transition, and will not test any possible theoretical approaches. Instead, it aims at providing solutions for a set of practical obstacles towards the energy transition in Fryslân. These solutions are more specifically provided for promoting the preliminary phase of activation of local communities (LEIs) towards the provincial goal of realizing an energy transition in 2050. This objective has implications for the 'use' of theory in relation to the investigation. In this research, the knowledge conveyed and created through adopted spatial planning theory – that essentially consists of a strategic planning framework – helps to frame the work of investigation regarding the solutions to the highly pragmatic objective of outlining and testing a planning strategy that could apply to a provincial level of planning.

As documented in literature, many LEIs seem to lack both realistic and achievable expectations regarding energy goals and their implications for land use and landscape on a local scale (van der Schoor & Scholtens 2015; Seyfang & Haxeltine 2012). In other words, LEIs operate without a clear vision of the spatial implications of envisioned scenarios, and without considering the implications of the *chosen* scenarios on a higher scale of energy transition constituted by the region as a whole. Whilst LEIs normally rely on "adequate perspectives on what to do and how to develop in the long run" (van der Blonk et al. 2013 p.2), the lack of this comprehensive vision of reference is hindering LEIs in their development and growth (Seyfang & Haxeltine 2012). In order to (re-)activate LEIs and thereby the Frisian energy transition on the local and provincial scales in consistent forms, "the LEIs could strategically concentrate on developing and promoting short term steps towards the long term shared visions. This might be clear, recognisable progress and actions, appealing to potentially interested members of the public, delivering a sense of purpose and achievement" (Seyfang 2012 p.339).

In order for a comprehensive planning strategy to mirror LEIs' visions and expectations, as well as to resolve the current state of uncertainty concerning spatial implications of energy transition on a higher scale of regional planning, elements from both the strategic spatial planning framework and from the design oriented approach in planning have been adopted. The main reason for adapting the strategic spatial planning framework in the case of LEIs in the region is its instrumental role in enabling actions in uncertain local situations, by considering their repercussions on a higher scale of intervention. In other words, the strategic planning framework provides the conceptual structure that enables the interpretation and contextualization of insight derived from local scales of intervention – constituted by specific LEIs in the region – in light of the regional ambition of transiting these local initiatives to the achievement of regional energy targets. On the other hand, because the actual spatial implications are one of the main elements of uncertainty throughout the respective planning process on the local scale of the energy transition, a design oriented planning approach has been adopted in the context of the case studies.
With its focus on "making alternative images of the future and action strategies visible" (Hidding 2009 p. 224), the design oriented approach adopted in the workshops revealed to be a very powerful instrument for enabling members of the participating communities to envision their future energy landscapes. At the same time, it allowed the researcher to gather

insight on how the adopted method of investigation – and the local energy transition perspectives identified – could become an integral part of the strategy the Province of Fryslân could adopt to achieve its targets for renewable energy. As such, this research should not be seen as a strategic spatial planning or design oriented planning exercise in the traditional sense. Rather, this research is a successful example of how elements from both these spatial planning approaches could be distilled and operationalized for the distinct purpose of strategizing a localized approach up to a regional scale of spatial planning in the light of well-defined renewable energy transition objectives.

3.2 Strategic spatial planning and its relevance to the adopted theoretical framework

Strategic spatial planning constitutes a set of spatial planning concepts and approaches developed in western literature over the past few decades (Healy 2006; Albrechts 1992; Faludi 2009; van den Broeck 2008) (as cited in Magni 2013). Conceptually, strategic spatial planning consists of the practice of being *strategic* regarding large scale and long term transformations of the urban and natural environment. Therefore, the underlying idea of *strategy* provides approaches used in the respective planning frameworks with a specific geographical, operational and temporal connotation. In simple terms, planning strategically is “the process trying to develop and implement strategies to reach a specific goal with the available and appropriate means” (van den Broeck 2008 p. 3). Through time, many definitions have been developed on what strategic spatial planning is exactly. Based on these definitions, van den Broeck (2008 p.3) has summarized a number of principles that roughly define the doings of strategic planning, namely:

- a *creative* practice developing possible futures or becomings, represented by an attractive and seducing vision
- a *selective* practice focusing on key issues and interventions
- an action oriented practice linked with programmes and budgets
- an integrative and co-productive learning process aiming at social-spatial innovation
- a non- neutral and relational practice aiming at the involvement, emancipation and empowerment, judgements, argumentation and agreements between actors

Strategic approaches do not automatically include all principles described above (Van den Broeck, 2008). Although there is a general agreement on what the process of strategic planning entails, there is no such agreement on the contents of strategic plans (Magni 2103). What this content will be for the purpose of this research is explained later on.

What elements of the strategic spatial planning approach this research adopts is its typical focus on major spatial development issues that can occur on all planning scales, but are more relevant on regional and national scales (Faludi 2000 p. 299). The renewable energy transition, being the topic of this research, can be seen as such: a major spatial development issue (Stremke & van de Dobbelsteen 2012) and a process of change intersecting local and regional scales of spatial transformation.

This research’s focus on spatial implications of the Frisian energy transition on a local (village) scale is thus not typical for a strategic spatial planning approach. However, this focus on a local scale is typical against the socio-cultural background of Fryslân (Urgenda 2010).

3.3 Strategic spatial planning fundaments

Strategic spatial planning is described by Albrechts as a "public-sector-led socio-spatial process through which a vision, actions, and means for implementation are produced that shape and frame what a place is and may become" (Albrechts 2004 p.747). The strategic spatial planning approach finds its roots in rational styles of planning. These approaches to planning are generally characterized by a process of goal setting and selecting means for its realization (Allmendinger 2009). In literature, a general debate concerning rationality causes a theoretical distinction within these rational approaches to spatial planning. One of the main initiators of this debate, Max Weber, concluded that subjectivity would always be part of rational approaches, thereby keeping the approach away from being truly rational (Allmendinger 2009). It is for this reason that Weber proposed a distinction between formal and substantive rationality thereby separating between facts and values. According to Weber, a formal rational approach focuses on reaching a given end in the most efficient and effective way, whilst substantive rationality is focused on these "ends and their evaluation" (Allmendinger 2009 p. 63). This notion puts the strategic spatial planning approach, with its focus on combining strategic visions with short term actions, in the middle of both substantive and formal rationality.

Substantive rationality is important within strategic spatial planning, as it creates the possibility to surpass the use of past (known) events to deduce a long term vision, thereby sticking to the current situation. Instead, the creation of a vision of a desired long term future results in "inventing a world that would not otherwise be" (Albrechts 2004 p. 750; Healey 2009 p. 440), e.g. a village or a province independent from fossil fuels. Subsequent creation and formulation of strategies for the realization of this world belongs to the realm of formal rationality.

The distinction between formal and substantive rational approaches is also described by Andreas Faludi. Faludi (2000 p. 303) opposes *strategic* plans linked to substantive rationality against so-called *project* plans that are linked to formal rationality. These project plans constitute planning as a technical exercise, describing what to do in order to realize an aspired situation. Concerning both types of plans, Faludi (2000) argues that although many spatial planning challenges seem to be tackled best through the creation of a project plan, complex challenges often characterized by enduring conflict and uncertainties actually demand a strategic plan (Faludi 2000). In a similar line of thought, the Frisian energy transition being in fact a spatial planning challenge characterized by conflicts (Jongedijk-Welles 2014) and uncertainties (Dóci et al. 2015) might also profit from a strategic plan.

3.3.1 Functionality of strategic spatial planning in complex situations

The key role for strategic plans in complex challenges is their guiding function through enabling the 'enacting upon learning' (Faludi 2000**)**. In a similar line, Albrechts (2004) argues that spatial planning of complex challenges could profit from strategic planning approaches through their focus on combining strategic visions for the future development of areas with short term actions (as cited in Carsjens 2009).

Here, the main role of the strategic plan as argued by Faludi (2000 p. 304) is to give guidance and establish mutual learning. Only after mutual learning has taken place, uncertainties and conflicts can be removed and consensus built, that will enable decision-making and action (Faludi 2000). The strategic plan establishes this mutual learning by identifying the implications of diverse courses of action. This information can be drawn from plans "that have predefined courses of action for them and explored the implications" (Faludi 2000 p.304).

3.3.2 Identifying the implications on diverse courses of action

Elaborating the above, identifying the implications of diverse courses of action is considered to be an important element within the planning strategy that will be outlined in this research. This point requires additional attention. It is important to note that through the specific objective of this research distinct demarcations to this point have already been made. The first demarcation concerns the *identification of the implications*. From the spectrum of implications that can be identified for a plan, this research focuses solely on identifying the spatial implications in terms of land-use effects and visual spatial changes of local landscapes caused by installation of renewable energy technologies in the local landscape. This thematic focus on identifying spatial implications links this research with the design oriented view of planning, that will be explained in the next chapter.

The second demarcation concerns the *diverse courses of action*, and this research focuses solely on a local course of action when realizing energy transition. On this particular operational level, local citizens make their own local scale independent from fossil fuels by installing renewable energy technologies within their own local environment. In turn, many different courses of action exist within this local course of action, for example choosing either a wind turbine or solar park, or either opting for energy savings or producing renewable energy.

In order to enable decision-making and action, the focus of exploration within the spatial strategy should be on establishing mutual learning through identifying spatial implications of local course of action. As such, exploring spatial implications of local courses of action will "allow decision makers to learn about what their situation is and what they, individually or collectively, can do about it" (Faludi 2000 p. 304-305).

3.3.3 Strategic spatial planning in this research

Integrating the characteristics of strategic spatial planning as described above with the specific purpose of this research, strategic spatial planning will be referred to as: the act of enabling decision-making on the spatial development of an area, by initiating a discussion between relevant stakeholders within this area, by providing insight on spatial implications of the courses of action that can and must be undertaken when realizing a commonly shared future goal. In this research, strategic spatial planning is:

1. an action oriented practice:
   - dedicated to the development of action strategies for the realization of a defined goal
2. a selective practice:
   - focusing on a defined future goal spanning more than one generation,
   - focusing on a specific course of action, with various possible action strategies,
   - focusing on a defined spatial scale, describing the actual place where the goal should be realized,
   - focusing on a defined population, being the actors operating within the geographical confinement,
   - adopting currently available and appropriate means in strategies.
3. a creative practice:
   - developing possible futures
4. a relational practice:
   - aiming at mutual learning, involvement, open dialogue, argumentation, discussion and consensus building and agreements between actors

3.4 Design oriented view of planning: seeking a direction

As described above, the thematic focus in this research on identifying spatial implications links this research with a design oriented view of planning: "spatial planning should focus primarily on making alternative images of the future and action strategies visible" (Hidding 2009 p. 224) i.e. through "spatial scenarios and map representations" (Carsjens 2009 p.47). This process is also described as identifying tentative directions of developments, which requires two basic steps. The first is "the development of one or more coherent normative premises" i.e. desired futures. The second is "the construction of one or more conceptual or spatial models of the future spatial organization, based on these normative premises" (Carsjens 2009 p. 48).

"These spatial models are not intended as a final picture, but serve as a means for discussing the possibility and desirability of the futures that have been sketched out" (Carsjens 2009 p.47; Hidding 2009) and thereby "to influence the actions of those who shape the spatial organization" (Carsjens 2009 p. 47). In order to facilitate the sought after debate, it is of utmost importance to substantiate the alternatives with their respective consequences. "This is because our initially desired future can appear in a completely different light after we consider the consequences of this development" (Hidding 2009 p.226) "A spatial plan in this respect is thus regarded as a guiding document that describes a future situation" (Carsjens 2009 p. 47), and requires "analysis, design and then analysis of the consequences" (Hidding 2009 p. 226). Based on these characteristics, the design oriented spatial planning process is called 'descriptive' and 'analytical', but all the more 'constructive' and 'action oriented' adopted from Steinenga (1962) (as cited in Carsjens 2009). The above described design oriented planning approach will also be of added value for the Province of Fryslân, that is in fact also 'seeking directions' for realizing the Frisian energy transition.

What this research adopts from the design oriented approach is its focus on creating spatial models of possible futures. This focus is valuable because the actual spatial implications are one of the main elements of uncertainty in the planning process on the local scale of energy transition. These spatial models do not constitute a final picture. Instead, they serve as a means for discussing the desirability of futures that have been sketched out and thereby to influence the actions of those who shape the spatial organization.

The main challenge for 'seeking a direction' is "seeking a development or a situation which can not only be considered to be socially and politically useful, but is also inherently possible to realize" (Hidding 2009 p. 224), towards achieving a preferred long term future. Kleefman (as cited in Carsjens 2009 p. 48) adds that these future spatial organizations cannot solely be derived "from a systematic and projective analysis of the current situation, trends and policies only". What is necessary, according to Kleefman (1985), is a more "holistic and prospective approach of bridging the gap between the present and the future by making leaps into the future. Which require design competencies, especially inspiration, intuition and creativity". When interesting "prospects are found, the consequences of these prospects as well as the opportunity to bridge the gap with the present situation can be analysed and evaluated". The consequent "analysis, design and evaluation are alternating activities in the design oriented view of planning, each requiring specific methods and tools" (in Carsjens 2009 p. 48).

3.4.1 The local course of action as a suitable direction for Fryslân

The focus in this research on the realization of the energy transition on a local scale is the direction that is considered to be socially and politically useful and inherently possible to realize. A local scale is not the typical direction for this type of exploration on the energy transition. However, within the socio-cultural context of Fryslân, this localized direction is suitable (Urgenda 2010).

3.4.1.1 *Localism in Fryslân – a brief review of the Frisian DNA*

Frisian history is steeped in anarchy and insurrections, elements that can still be recognized within Frisian society today. Fryslân is strongly rooted within the local structure of 419 villages, even though some of them have developed more significantly. It suits Fryslân to resolve matters on a local scale when possible; many changes in Fryslân start from the bottom-up. The Frisian DNA is characterised by a type of primal feeling originating not only from freedom and independence, but also the abundance of water, nature and spatiality and their own language, culture and history. This primal feeling of the Frisians expresses itself in individuality and independence, but also in solidarity and small scale.

If one wants to mobilize the Frisians, then he or she should touch upon the Frisian DNA and the underlying primal feeling. The typical *Fries* will not be worried about the 'hard' side of sustainability. However, he/she will be worried about culture, tradition, the landscape (nature and water), space (panoramic views) and language. Only when Frisians will be touched emotionally upon these primal feelings, then they will also be fully mobilized towards change. Thus, when one can build upon the Frisian tradition relating to language, self-sufficiency and a "*we can do it"*-mentality, then one can work towards a sustainable Frisian society. This connection between the Frisian identity and sustainability is based on a small scale, as long as it is meaningful and from pure intentions, identity and wilfulness. Starting to work on the small scale presents an intrinsic motivation as a new drive, enabling the Frisians to be responsible for their communities together. It is at this community level that the sustainable development should be initiated based on a common direction. When on the local level the urgency can be transferred sufficiently clear, then the Frisians can change on their own strength (Urgenda 2010).

3.4.1.2 *Connecting to recent energy transition developments in Fryslân*

Based on the above, it might be argued that recent developments, like the planning of large wind turbine parks within Fryslân, have stirred many Frisians' primal feelings, mainly through their large impact on the open (panoramic) landscape. In this light, the recent rapid development of LEIs within Fryslân might be seen as an initial form of mobilization in reaction to spatial implications of large scale wind energy production. Positioning these large energy projects as not suitable for a region like Fryslân, LEIs in Fryslân seem to propose a more Frisian solution for the energy transition, focusing on the realization of sustainability goals on the community scale.

3.5 Research outcomes: fitting the planning strategy to an age of active citizenship

The benefits of strategic spatial planning for complex spatial planning challenges, as well as the role for planners in the design-oriented view of planning as described above originate from a government perspective on (spatial) policy making. In this type of public management the role of citizens is merely to test policy and to co-produce policy at special determined moments during procedures (van der Blonk et al 2013). Such an approach to spatial planning in which relevant decisions are predominantly made by official authorities and in which citizens are distant, is not in line with current spatial planning practice, nor the role proposed for LEIs towards the realization of the Frisian energy transition in this research. Quite the contrary: this research, as well as many European governments including the Dutch and local Frisian government, currently wish for citizens to be involved in public policy processes as well as in civic initiatives (Boonstra 2015). The mobilization of this 'active citizenry' for the sustainable development is also advised by Dutch environmental assessment agency (PBL) as a possible solution to shrinkage of public budgets (Hajer 2011).

Current spatial planning practice and the proposed role for LEIs in Frisian energy transition is much more in line with a governance perspective on public management that has also made its entry in public policy development in recent years (Bogason & Musso 2006). The governance perspective can be regarded as a democratic reform of the processes of government, more suited for solving current urban problems "that require a level of flexibility, experimentation, political accommodation, and collective intelligence not easily realized within government hierarchies" (Bogason & Musso 2006 p. 14).

3.5.1 Civic initiatives as valuable strategies for spatial development

Up to date, the involvement of citizens in spatial planning processes has mainly been established through participatory forms of planning. An important development over the last years that has implications for the mainly participatory form of involving citizens in spatial planning is the rise and appreciation of civic initiatives in spatial development (Boonstra 2015). Whereas civic initiatives have for a long time just been a "fringe movement, sometimes even a stand in the way of planned urban development, civic initiatives today are increasingly seen as valuable strategies for urban development" (Boonstra 2015 p. 9). Within this research, LEIs in Fryslân are also regarded as civic initiatives that comprise a valuable strategy towards the realization of the Frisian energy transition. This requires a different approach than the prevailing participatory form of involving citizens in creating local spatial strategies based on design oriented plans. According to Boonstra (2015), the spatial planning strategies needed in times of active citizenship are those that:

1. focus on the provision of conditions that do not limit but instead open up possibilities, thereby to mobilize civic initiatives bringing its members into action for change. Here, it is of equal importance for the presence of local (spatial and administrative) conditions and actors able to move along with ideas and dynamics of a civic initiative.
2. involve planners, who do not only facilitate but also pro-actively navigate between civic and other spatial initiatives, as navigators working in a specific direction and towards a specific end goal, but due to their position in a complex and changing environment without a precisely defined end-goal or route.
3. accept the fact that everybody who initiates a spatial initiative is in fact a spatial planner, who despite their inevitable differences adopts similar strategies. (Boonstra 2105 p. 19-20).

The planning strategy that will be developed in this research will incorporate these elements described above. The strategic spatial planning approach and the design oriented plans will be employed in such a way that it will incorporate the elements necessary to deal with the LEIs

4 Research Design

4.1 Lessons for outlining the spatial planning strategy – enacting upon learning

Both the strategic spatial planning approach and the design oriented planning approach describe important elements that will be included in this chapter's planning strategy. Following the acquired insight, the main role of the planning strategy should be to enable enacting upon learning. In general, enacting upon learning is realized by identifying the implications of diverse courses of action (Faludi 2000).

It is important to realize that through the specific objective of this research, distinct demarcations to this point have already been made. First, this research will solely focus on identifying the spatial implications in terms of land-use effects and visual spatial changes of local landscapes, as a result of the proposed installation of desired and required renewable energy technologies. Second, this research only describes a local course of action, meaning the energy transition is realized by citizens making their own local scale independent from fossil fuels through the installation of renewable energy technologies. This local course of action has been identified to comprise an interesting direction towards the realization of the Frisian energy transition.

4.1.1 The local course of action

As identified in the chapters above, the local course of action currently presents itself as a both socially and politically useful development making it prone to realize the Frisian energy transition. The local course of action implies that the Frisian energy transition will be established on community level, leading to energy neutral communities. Considering the regional scale of the Province of Fryslân and the related energy transition ambitions, a localized approach implies that all 419 villages in Fryslân produce their own yearly energy demand through the installation of renewable energy technologies on a local level by the year of 2050. As a sum of its parts, the local approach thereby enables the realization of the strategic provincial goal for an energy transition in the year 2050. The division of Fryslân into local communities, officially termed 'dorpsgebieden', is illustrated in the figure below:

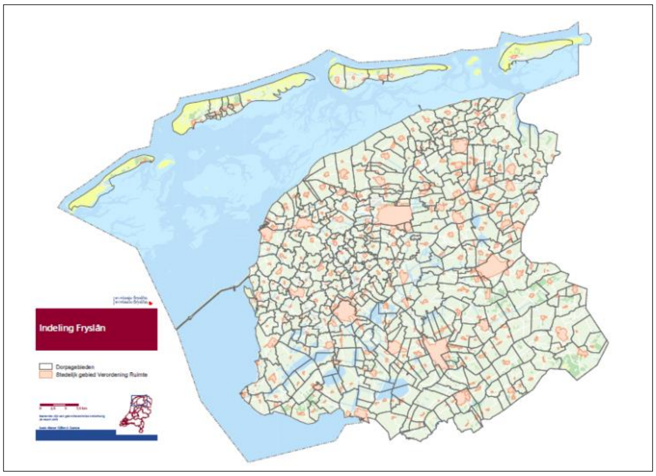


Figure 1: Division of Fryslân in local scales

This practise of applying the provincial ambition for an energy neutral situation in 2050 on the local scale can be regarded as a normative scenario. Basically, there are countless possibilities for the Province of Fryslân to work towards and realize an energy transition. All these different approaches or scenarios would relate to different spatial implications of the Frisian energy transition. Because this research does not attempt to provide a comprehensive set of scenarios, other possible direction on the provincial scale will not be explored. The focus on a local course of action in this research fixates the provincial approach as well as the approach of local scales themselves to the realization of the energy transition on the local scale.

4.1.2 Elements of the regional energy transition that should be considered on the local scale

In this research, the energy demand on the local scale consists of three pillars, knowingly the energy demands for electricity, heat and mobility. In an energy neutral community, the total local yearly energy demand for heat and electricity will be derived from renewable energy technologies installed on the local scale. Because of the fact that mobility has a predominant locally transcendent character, it has been decided in the case of Fryslân that although the local yearly energy demand for mobility will also need to be derived from renewable sources, renewable production of these sources cannot solely take place on a local scale. In the local course of action, the yearly energy demand for transportation can be made sustainable by using sustainable vehicles, being either electric or green gas cars. If local communities decide to keep current fossil fuel driven cars, then related energy demand will have to be compensated through installation of renewable energy technologies within the local scale. By switching to electric vehicles, half of the yearly energy demand for these vehicles will have to be produced renewably in the form of electricity on the local scale, because approximately half of the electric vehicles will be charged on different locations then where they are registered (e.g. place of work). The related energy demand for switching to green gas cars will not have to be compensated by the installation of renewable energy technologies on a local scale, as the provision of a network of fuel stations providing green gas for transportation is perceived to be a provincial responsibility. The choices made by the LEIs concerning transportation will also provide insight for the Province of Fryslân.

4.1.3 Selection of LEIs

Given the limitations of this research, an important delineation has been made to select three LEIs from the set of LEIs that were given to the researcher by the Province of Fryslân for the conducting of workshops. The LEIs have been selected based on three main requirements:

- Participation in the energy neutral communities program
- Geographical placement of the initiative on one of the three main soil types within Fryslân: clay, peat and sand
- A figuratively clean slate regarding the actual realization of renewable energy projects

Participation of the LEI in the energy neutral communities program ensured that there is already an actual goal in place to become energy neutral in the near future. In total, nine LEIs joined this energy neutral communities program, run by organisation *Doarpswurk*. *Doarpswurk* is financed by the Province of Fryslân and has a similar normative perspective to this research concerning the energy transition. By selecting LEIs from this program, locally held ambitions are in line with the energy neutral communities approach adopted in this research.

The second requirement was included in order to correspond with general landscape types as well as typical economical activities in Fryslân (Urgenda 2010). The underlying thought for this selection is the assumption that on different landscape types and within economical activities, different energy transition perspectives might be present. This could eventually cause different spatial implications on the different soil types in the year 2050. By selecting one local energy initiative from the energy neutral communities program on each of these three general soil types in Fryslân, this research will also make an attempt to include these possible differences within Fryslân.

The third requirement for the selection of LEIs enabled the exploration of desired organizations for energy supply. The underlying reason is that the absence of already established large projects will enable the LEIs within the workshop to specify what they really want. In these cases the future of the local scale is more or less a blank canvas that can be filled in by contemplating different choices. When large renewable energy projects have already been established on the local scale, this canvas would already have been filled in to a certain extent, thereby reducing the specification of what is actually desired with what is already there (desired or not). Additionally, this third requirement was also chosen because the amount of LEIs increasing is a fairly new trend in Fryslân. Therefore, it is expected that many of the current LEIs, and those still in the making, have not yet realized large renewable energy projects. As a result, the majority of the spatial implications of an energy transition facilitated through a localized approach, resulting from the installation of renewable energy technologies, will still have to occur, and will thus mainly be based upon the currently and future held desires regarding renewable energy technologies and their spatial application. Some of the LEIs joining the energy neutral community program have already realized large projects on their local scale, such as the realization of wind turbines. These LEIs were therefore excluded from this research.

On the basis of the requirements above, the following three LEIs were selected: Baard (clay), Heeg (peat) and Harkema (sand). The three LEIs and their position on available soil types in Fryslân are indicted in the figure below:

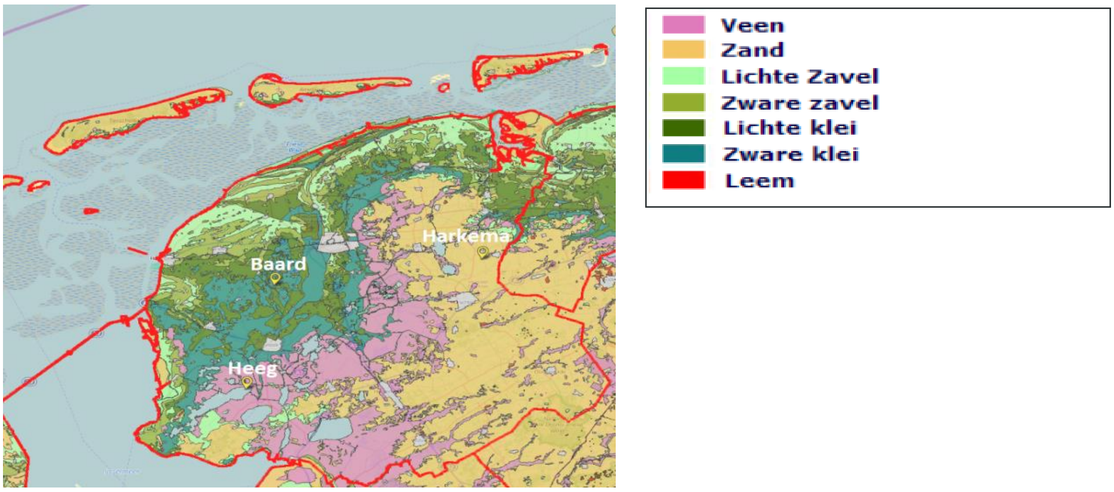


Figure 1 Soil types in Fryslân and the selected villages

4.2 Exploring local courses of action

Following the insights from the theory section, the outline of a planning strategy that will enable the enacting upon learning within this local course of action should:

- allow the construction of diverse courses of action on a local scale
- substantiate the alternative courses of action with their respective spatial implications
- facilitate a debate on the possibility and desirability of the discussed courses of action
- construct a shared course of action for achieving the energy goal based on this debate

Based on the above, a type of staged approach becomes evident. First, different courses of action will be constructed that will subsequently be substantiated with their spatial implications. Second, these spatially substantiated courses of action are the subject of debate, resulting in a shared course of action.

In the following, it will be explained how substance will be given to these four elements within the planning strategy.

4.2.1 Demands for facilitating active citizenship

Because LEIs in Fryslân are regarded as civic initiatives posing a valuable strategy for the Frisian development towards its energy transition, both planning approaches should be customized to fit the current age of active citizenship. The needed customization should mainly focus on allowing and enabling current LEIs in Fryslân to act as planners of their own local energy neutral future. Basically, this requires changing the predominant participatory form of involving citizens into actually acknowledging them as planners of their own local environment. In order for this to succeed, the relevant information that allows these decisions to be made, should be made accessible and operational for all local planners through the strategic spatial planning approach and the design oriented view of planning. This will enable citizens to create more developed local energy visions. The relevant information that should be provided for this purpose will be explained in the following sections.

The planning strategy constructed in the following section relates to the three demands for planning strategies in times of active citizenship as described above by Boonstra (2015). First, this research will focus on aiding current LEIs in creating a more developed local energy vision, identified as fundamental in the mobilization and development of LEIs towards the realization of their own goals (van der Schoor & Scholtens 2015; Seyfang & Haxeltine 2012; van der Blonk et al. 2013). Second, this research in itself is already considered to proactively navigate between civic initiatives by exploring the potential role of LEIs in Fryslân in the wider regional Frisian ambition of an energy transition in 2050. Third, this research acknowledges the members of LEIs to be spatial planners of their own energy neutral future and will align with the ideas and dynamics of civic initiatives within the local strategic spatial planning process.

The researcher will deliberately move away from the role as director, and instead becomes one of the many performers of spatial planning. The researcher acknowledges that his focus on local course of action might be against the ideas of the LEIs. However, as has been explained in the sections above, it is on a community level in Fryslân that widespread support for the energy transition can be initiated (Urgenda 2010). In line, most of the current LEIs in Fryslân are organized and focusing their ambitions on a local scale. However, the focus on energy neutral communities in this research is not considered to impede LEIs to develop in different directions, for example to include multiple villages or only (a) certain district(s).

Also, these LEIs could create a better developed local energy vision with the help of the strategy introduced in this research, by simply scaling the approach appropriately. However, fixation is deemed necessary in order to gain insight on the possible spatial implications of a current course of action adopted by many LEIs.
As this research adopts a normative planning perspective focusing on the transformation of Fryslân into a society making full use of renewable energy sources, perspectives opposed to this development will not be taken into account. Also, there is no sign of parties being explicitly against the Frisian society running on renewable sources.

4.3 Allowing the construction of diverse local courses of action

This research focuses solely on a local course of action. Here, the energy transition is brought about by citizens making their own local scale independent from fossil fuels through the installation of renewable energy technologies on a local scale. Allowing the construction of local courses of action means that citizens may construct their own energy neutral solutions, and there are numerous ways for citizens to do this. The common factor in all these local courses of action is that they consist of a set of renewable energy technologies that are subsequently positioned in the local landscape. The concrete spatial implications are in turn dependent on the specific characteristics of the local scale in combination with choices made by citizens.

Allowing the construction of these diverse courses of action by citizens themselves should therefore facilitate option generation and morphogenesis. The different courses of actions explored in this way should not be considered as scenarios; nevertheless they are successful in supporting decision-making (Salewski 2012). This research identifies three fundamental elements to facilitate option generation and morphogenesis by the LEIs. Combined, they are the local energy visions:

1) current and future energy demand of the local scale, constituting the renewable energy goal
2) the available renewable energy technologies and their productivity constituting options for realizing the energy goal
3) positioning of renewable energy technologies in local landscaping constituting the morphogenesis of the energy neutral community

4.3.1 The renewable energy goal

The first step in enabling LEIs in the construction of more developed local energy visions is helping to identify the energy goal. The main function when determining the energy goal in 2050 is to specify required quantities of desired renewable energy technologies in order to become an energy neutral community. Essential is knowledge on the current yearly energy demand of the local scale for electricity, heat and mobility. This demand constitutes the reference measurement, constituting the amount of energy to be produced or saved on the local scale. Thereafter, it is up to the LEIs to install as much of the renewable energy technologies needed to cover the demand 100%.

The current energy demand of the local scale consists of private as well as business related energy consumption in terms of kWh electric, m³ of natural gas and litres of transportation fuel. Both the quantities of kWh electric as well as the m³ of natural gas consumption on the local scale in 2014 has been derived from *Energie in Beeld*: an initiative of the local (energy) grid operators in order to help local governments towards their sustainability goals (Energie in Beeld 2015). The amount of litres of transportation fuel that has been consumed on the local scale has been derived from the *Klimaatmonitor* of *Rijkswaterstaat* (Klimaatmonitor 2015).

This data is only available on a municipal level with the most recent year being 2012. Therefore these numbers were locally scaled, relating the total municipal energy usage on traffic and transportation to the number of inhabitants within the selected local scales. Therefore, the amount of transportation fuel consumed represents a local share within the total municipal fuel consumption.

4.3.2 Available renewable energy technologies and their productivity

A fundamental part of local energy visions are the renewable energy technology options available for realizing the energy goal. Besides a spatial boundary, focusing on energy neutral communities also provides a boundary for renewable energy technologies that are applicable on this local scale. Through a focus on local scale, technologies such as e.g. *blue energy*[1] automatically fall out of the equation, as it is not applicable on the local scale in Fryslân. The renewable energy technologies that are applicable, as well as their energy productivity, have been fixated within this research.

In order to specify renewable energy technologies that can be applied on the local scale towards the year 2050, this research has made use of scientific literature as well as practical expert opinions. In their exploration of routes for realizing the Dutch energy transition, the PBL & ECN (2011) conclude that the renewable energy technologies that should mainly be taken into account for the Netherlands up to 2050 are those that generate energy from the sun, wind, biomass and collect from or store energy in the soil. This ‘rather broad’ description has subsequently been fixated into specific renewable energy technologies and their productivity, based on the work of Stremke & Oudes (2014), Spruijt (2015) and in collaboration with Edgar van der Staay and Sjef van der Lubbe, both energy experts working for the Province of Fryslân.

Both the available renewable energy technologies as well as their fixated future productivity, as adopted in this research, are listed in the table below. Focusing on the local Frisian scale, it has been decided to exclude geothermal energy, as this is a (too) expensive technology to be applied, in relation to the generally low energy demand density on this local scale.

Table 1 Available renewable energy technologies and their productivity in kWh

Technology	**Spatial application per**	**Production/saving in kWh**
HCS thermal storage system	House	17,000
Air water heat pump	House	17,000
Pellet stove	House	17,000
Wood stove	House	13,000
LED lighting	House	350
Isolation (Label C to A++)	House	10,000
Solar collector	house (10 m^2)	13,000
Solar boiler	house (3.2 m^2)	1,000
Solar PV	house (14 m^2)	2,800
Solar PV collective	ha contiguous (+/- 3ha in field set-up)	2,000,000
Home wind turbines	piece	500
Roof ridge turbine	House	2,500
Village wind turbine (≤1MW)	Piece	2,000,000
Large wind turbines (3MW)	Piece	6,700,000
Mono-digester electric	Piece	312,000
Mono-digester gas	Piece	364,000

[1] Blue energy is the renewable energy available from the difference in salt concentration between sea and river water

Biomass (wood/chips) burning	Piece	2,000,000
Electric cars	Piece	7,000
Cars on green gas	Piece	7,000

4.3.3 Positioning the selected renewable energy technologies within the local landscape

The last step for completing the construction of local courses of action is to explore the desired placement of selected renewable energy technologies required for realizing the energy goal. This final step can be considered as the morphogenesis or the formation of the local energy landscape. As with the selection of the desired renewable energy technologies, it is up to the LEI to decide where the selected renewable energy technologies are placed in the local landscape. Although some renewable energy technologies are for example more or less bound to a certain positioning, e.g. at a house or in the field, there is still a lot to choose from.

4.3.4 Dealing with shortcomings

Allowing the construction of local courses of action is essentially an effort of enabling LEIs to explore and visualize what their future local energy landscape could be, based on the interaction between the preferences, certainties and abilities available today for changing the local landscape. This focus is useful in the current situation, as LEIs are eager to, or are already working towards, their energy transition goals. Besides, widespread energy transition action in Fryslân is also needed, because the dominant *"wait and see"*-attitude will definitely not be capable to spur energy transition.

Although a focus on the certainties of today is thus very useful for activating the energy transition, it is acknowledged that resulting local energy visions are not resilient to future developments. There are many developments and uncertainties that might cause the local energy visions produced through this research inadequate in the near future, such as technological and market development or changes in population sizes. However, this research is not meant to provide scenarios to deal with the many uncertainties surrounding the energy transition. Instead, it will focus on exploring tangible actions essential to activate the energy transition on a local scale (van der Schoor & Scholtens 2015; Seyfang & Haxeltine 2012). Once activated, uncertain crystallization of specific developments can, instead of being an impediment to change, be approached with an open attitude, possibly providing new opportunities for realizing energy transition. As such, new development can be incorporated within and simultaneously alter the existing local energy visions, keeping the energy transition activated and self-sustaining.

4.4 Substantiating alternative courses of action with their respective spatial implications

Alternative courses of citizen's actions should be substantiated with their spatial implications. The spatial implications substantiated in this research are the land-use effects and visual spatial changes of local landscapes based on desired locations, intensity, forms, amounts, and harmonization of land development for the implementation of renewable energy technologies in the local landscape.

4.4.1 Substantiating land-use effects

Substantiating the land use effects is essentially a simple step. While planning local courses of action, specific choices have been made on renewable energy technologies to use, their quantity and their placement in the local landscape. Land use change of these local courses of action can then be substantiated by relating chosen renewable energy technologies with their spatial dimensions.

Although such a step by step approach would indeed enable the substantiation of the constructed courses of action, it would be preferable to gain insight in the land-use changes of specific choices beforehand. This would improve the quality of the constructed spatial models, as it will allow the comparison and selection of different renewable energy technologies based on land-use change. In order to facilitate the construction of spatial models based on the substantiation of related land-use changes, an Excel model has been created: the energy mix model. This Excel based model is inspired by the Energy Transition Model (Quintel Intelligence, 2015) and the work of Frank Debets[2] in collaboration with Edgar van de Staay.

4.4.2 The energy mix model

In the energy mix model, an interactive combination has been established between the renewable energy goal and available renewable energy technologies (table 1). This model indicates the desired amount of different renewable energy technologies, and stacked bars below and to the side show the realized renewable production or energy savings, by relating the renewable energy goal to the energy productivity of the individual renewable energy technology. Because monetary arguments are also important, determinants for specific decisions, or the cost prize of the individual technology per kWh, have been included in the model. This information is based upon base rates in the 2015 SDE subsidy scheme (Lensink & Zuijlen 2015), and has been calculated in collaboration with Edgar van der Staay[3] for those techniques not assigned SDE subsidy (mainly those for small household usage). For more information on the exact workings of the model, see annex 1.

The model has multiple (4) stacked bars, one overall bar indicating the total share of renewable energy within the total energy demand, and one for each of the individual energy demand sources: gas, electricity and transportation. This separation is necessary, because different renewable energy technologies also produce or save different types of energy, knowingly thermal (gas), electricity and transportation (fuel). The energy mix model is not intended to describe the future situation in detail. Instead, it is a method to allow participants to imagine/visualize what would roughly be necessary to achieve their goal of energy neutrality and to make choices based on (new) insights provided by the model.

4.4.2.1 *Land-use change of renewable energy technologies*

The energy mix model incorporates renewable energy technologies based on their typical spatial application (see table 1), mainly in order to make it both more accessible and operational for the citizens and to avoid getting bogged down in debate concerning exact details. Available renewable energy technologies have been divided in the spatial application *per piece* and *per house*. This distinction separates renewable energy technologies on an individual building scale *(per house)* from renewable energy technologies that produce renewable energy for a plurality of individual buildings *(per piece)*.

Renewable energy technologies that are typically installed per piece are home wind turbines, village wind turbines (≤1MW), large wind turbines (3MW), mono-digester electric, mono-digester gas, biomass (wood/chips) burning, electric cars and cars on green gas. Also, the collective installation of solar PV panels is considered a *per piece* technology; it has been set to be installed in stretches of 1 ha. Within the energy mix model, the renewable energy production of a mono-digester has been related to a farm that houses 100 cows. This is the

[2] Energy consultant for renewable energy - http://debetsbv.nl/index.html
[3] Edgar van der Staay is the provincial expert on renewable energy technologies.

average amount of cows on farms in Fryslân, specified in correspondence with Sjef van der Lubbe.

Renewable energy technologies that are typically installed per house are HCS thermal storage systems, air water heat pumps, pellet stoves, wood stoves, LED lighting, isolation (label C to A++), solar collectors, solar boilers, solar PV panels and roof ridge turbines. These renewable energy technologies are related to the average yearly energy consumption of houses in Fryslân (around 2,000 m^3 or 17,000 kWh of natural gas and 3,500 kWh of electricity). Renewable energy technologies that produce heat have been specified to renewably produce all the yearly heat demand (17,000 kWh) of an average house in Fryslân. An exception is the wood stove, that is typically used to provide only a share of the yearly heat demand per house. Renewable energy technologies that are typically installed on roof surfaces (solar PV panels and collectors) have been related to the average roof surface of houses in Fryslân. In correspondence with Edgar van der Staay, it was specified that a normal house in Fryslân supports an average of 14 m^2 of solar PV and 10 m^2 or 3.2 m^2 in the case of a solar boiler).

Following the steps of the Trias Energetica, the renewable energy technologies have been listed in order of energy saving technologies first, followed by renewable production technologies. In the blue column (*aantal*) the amount of these technologies can be filled in. For some of the renewable energy technologies, a maximum amount has been set, relating to physical maxes such as a number of buildings or available roof surface. These numbers differentiate for all individual local scales and can be delineated with the use of ArcGis.

4.4.3 Substantiating visual change of the local landscape

Substantiating visual changes in the local landscape will be visualized, so the participants are provided with the opportunity to actually see the changes induced when realizing their own energy neutral community. These actual induced changes in the physical landscape (and the surrounding socio-political arena) have been identified to form the main challenge for the energy transition (Sijmons & van Dorst 2012 p. 46). However, as the researcher is lacking the competence to adequately visualize local landscape change, the Province of Fryslân hired a landscape architect to visualize the initially desired futures, providing relevant pictures and 3D images. It is practically impossible to also directly substantiate the local courses of action with their visual spatial implications. It is therefore inevitable to organize two workshops on each local scale.

4.5 Facilitating debate on possible courses of action

Results of the previous steps, being the spatially substantiated courses of actions, serve as a means for discussing the desirability and possibility for the possible futures (Hidding 2009; Carsjens 2009). The main function of this discussion is “to influence the actions of those who shape the spatial organization” (Carsjens 2009 p. 47). In the selected local course of action, the citizens of a LEI shape the spatial organization of local landscapes. This discussion should therefore take place amongst the inhabitants of the local scale.

4.6 Constructing a shared course of action

The attempt to construct a shared localized course of action is a fine method for starting the required debate on spatially substantiated courses of action. By trying to construct a shared course of action, all the citizens on the local scale participating in the workshop will form opinions. It is unlikely all participants will unanimously agree on one specific course of action. However, finding those elements all can agree upon, with or without a discussion, is valuable as it might form the base for tangible actions towards the realization of local energy transition.

The shared course of action that results from this debate will be referred to as the **local energy transition perspective.** Developing local energy transition perspectives together with the tree selected villages enables a comparison between local energy transition perspectives. Gained insight can be valuable for the provincial authority and may result in broader strategies formulated on a provincial level.

5 Outlining the localized approach

5.1 Combining the requirements

Combining the four elements described above creates a strategy the Province of Fryslân could adopt to surpass the ambiguities concerning spatial implications of the energy transition hindering tangible energy transition actions (Späth & Rohracher 2014; Sijmons & van Dorst 2012; Stremke & van de Dobbelsteen 2012).

This planning strategy consists of two workshops concretizing the local energy transition perspectives. Van der Blonk et al. (2013) argue that workshops are suitable for the explorations of such opinions on local energy production. The researcher will herein have the role of a participatory observant. The outline of these workshops will be explained in the following section.

5.2 Workshop 1

The first workshop consists of three main exercises: 1) the introductory information supply, 2) creating the own local Renewable Energy (RE) mix, and 3) the deployment of this mix in the local community.

5.2.1 Introductory information supply

The introduction aims to provide participants with a contextual background allowing for more substantiated choices within the planned exercises. This contextual background will be provided by informing the participants on:

- the energy neutral communities approach
- the current energy demand of the local scale/ the renewable energy goal
- how to work with the energy mix model
- the available renewable energy technologies up to 2050 and their performance
    - type of energy produced (thermal, electricity, mobility)
    - the visual appearance of these renewable energy technologies
    - comparison of different renewable energy technologies and their spatial demand
    - the associated costs per kWh

In order to properly convey this information, the researcher will start each session with a 30 minute PowerPoint presentation, explaining the points above (see annex 2). Next, participants construct their preferred courses of action for becoming an energy neutral community. These specifications are considered to be the preliminary local energy transition perspectives. In order to allow for their substantiation, two exercises have been developed.

5.2.2 Exercise 1 create your own mix

In this first exercise, participants will be divided into groups, each tasked with creating their own renewable energy mix with the use of the 'create your own mix'-model. Each group will be provided with a laptop on which the 'create your own mix' model is already installed.

Participants are asked to fill in the amounts of the desired renewable energy technologies until the overall bar at the bottom of the model changes from grey to completely green. Here, green and striped green indicate that production or savings is fully realized with renewable energy technologies Although it was advised the three stacked bars on the side of the model also changed from grey to green, this was not an obligation within this first exercise.

Group work is intentional, as this will result in different mixes and thus the inclusion of different energy transition perspectives. The amount of groups is dependent on the number of participants joining. The preferred minimum is four participants in each group up to a maximum of eight. The groups have approximately 45 minutes to create their own mix.

The model will only be generally introduced to the groups, in order to minimize the influence of any individual ideas participants may have. Additionally, this allowed participants to 'play' with different energy mixes, and also provided a check for usability and comprehensiveness of the model. Several people of the Province of Fryslân, including the researcher, were available to answer any emerging questions. The created renewable energy mixes in this first exercise form the input for the second exercise.

5.2.3 Exercise 2 positioning the mix within the local scale

During the second exercise, the groups will be asked to deploy the mix they just created in their own local scale. For this purpose, all groups are provided with a scale 1:5000 format map of their own local scale, allowing for the identification of individual buildings and objects. The different renewable energy technologies chosen in the mix will be represented by different round coloured stickers. A legend was created for different stickers (see annex 5). For this exercise, there are two main difficulties that need to be tackled.

The first difficulty concerns the size of the sticker in relation to the scaling of the map and its size in A0 format. The smallest size of stickers that would still be usable is 9 mm in diameter. Given the scale of 1:5000 on the maps, this sticker relates to a surface of around 1,600 $m^{2.}$ Relating this to the application of solar PV panels on roofs for example, this would imply that a 9 mm sticker would cover 100 houses with 16 m^2 of solar PV panels. For an average village in Fryslân with around 1,000 houses this would imply that 10 round 9 mm stickers on the A0 format map would cover all the rooftops in the village. As this would fail to give a representative image of the spatial implication when using solar panels (or other techniques), one 9 mm sticker will represent application of a certain technique on 10 houses.

The second difficulty concerns the number of colours representing individual renewable energy technologies. The model contains 20 different renewable energy technologies, but a corresponding amount of different coloured stickers was deemed impractical, due to colour similarities. Therefore, five different colours will be used, grouping renewable energy technologies with similar spatial implications. Besides, the size of stickers differs for larger renewable energy technologies (wind turbines, solar fields and mono-digesters). For these technologies, an 18 mm round sticker has been chosen, corresponding to around 6,000 m^2 of ground surface solar panels, subsequently relating to half a hectare of solar PV panels in field setup for practical purposes. The groups will be given 45 minutes to deploy their mix in their local scale.

Following this exercise, all maps are placed next to each other on one table. One person will be asked to present specific choices made in their local organization of energy supply. Other participants will be kindly asked to comment. These presentations, and their evaluation, serve to identify courses of action that are supported by local communities prior to seeing the visualizations of these courses of action.

5.3 Workshop 2

Main goal of the second workshop is to initiate a discussion on initially desired futures as conceptualized in the first workshop. This discussion will be based on substantiation of spatial implications. The second workshop consists of four exercises: informing on the local landscape and its spatial quality, presenting the spatial models and visualizations, discussion on the desirability of local energy transition perspectives and simultaneously shaping the final local energy transition perspectives.

5.3.1 The local landscape and its spatial qualities

Informing on local landscaping serves two purposes. First of all, it enables participants to make more substantiated choices when shaping their local energy transition perspectives (similar to the information provision in the first workshop). Second, spatial quality has both an important place within sustainable energy landscapes as well as in current provincial policy in the form of the structure plan (structuurvisie) *Grutsk op'e Romte* (Proud of our Environment) (Provinsje Fryslân 2014). Because this second workshop is especially dedicated to the (desirability of) spatial implications of local energy transition perspectives, this information matches the main topic of this workshop.

Information on the local landscape is provided during a 10-15 minute PowerPoint presentation. Starting from the landscape typology as described within the structure plan, geologic and historic processes/events determining the formation of the village is explained. For this purpose, historical maps of different eras show the development of the locality (chronologically). Subsequently, this will lead to a description of characterizing elements and elements of spatial quality (including buildings).

5.3.2 Presenting the spatial models

Following the first section of information supply, visualization of the 'initially desired futures' created in the first workshop are presented, and the resulting energy mixes of the first workshop will be handed to the participants printed on an A4 paper. The visualizations include mainly 3D street view as this perspective matches our experience of the landscape best. In order to present an overview of the spatial implications of different energy mixes and combinations between renewable energy technologies, a bird's eye perspective or aerial photograph is also included in the presentation. First, the present situation is shown, followed by a photo shopped visualization of the future situation after deploying local energy transition perspectives.

Based on the results of the first workshop, the goal of these energy mix visualizations is merely to indicate general landscape changes, instead of designing detailed differences between them. Often, only slight differences in chosen renewable energy technologies exists.

5.3.3 Discussing desirability of the spatial models

Based on insight provided by the visualizations, a discussion will take place concerning the desirability of the different local energy transition perspectives. Goal is to achieve one or more final local energy transition perspectives. First, participants of the workshop are informed of the specific setup of this final exercise: producing one or more final maps of the desired local organization of energy supply (similar to the first workshop). Forming a (semi-)structured group, a discussion will take place focussing on the desirability of the visualizations of initially desired futures. Next, participants will be asked to gather round a central table with a large, blank map (in A0) of the local scale. The 'create your own mix'-

model will be presented on a large screen, forming a central element in the discussion in order to maintain a direction as well as a subject.

In order to start the discussion, participants will be asked to fill in the 'create your own mix'-model together until a 100% renewable provision of energy has been reached. For practical reasons, the researcher will fill in the model objectively based on the group's input (discussion). Because there are different local energy perspectives present (as shown in the first workshop), participants are asked to start with those renewable energy technologies they agree on unanimously. If it turns out this method will not initiate a dialogue, the individual listed renewable energy technologies will be discussed one by one. After the group has agreed on the desirability of implementation of a specific technology and its quantity, they are asked to put these renewable energy technologies (represented by stickers) on the map of the local scale. This working method repeats itself for as long as the group can agree on specific renewable energy technologies. If the discussion reaches a point where two or more different local energy transition perspectives are relevant, another map of the local scale will be included to allow the inclusion of these different perspectives within the final local energy transition perspectives.

This working method is intended to help LEIs in their own quest of reaching an energy neutral future; starting with measures all can agree upon may help the LEI combining short term actions with realizing their desired long term future. The researcher's role in this discussion is to provide guidance ensuring that participants do not stray too far from the assignment, that is to design a further - and for this research final - concretization of the local energy transition perspective. Points raised in the discussion will be noted and the discussion will be voice recorded.

In this research, decisions made as a result of the discussion are of special significance. Of additional interest are differences between the final local energy transition perspectives and initially desired futures. As the main goal of the workshops is to explore the local energy transition perspectives, this research will primarily focus on these final local energy transition perspectives as well as their spatial implications on a regional scale.

5.4 Characteristics of the proposed strategy

Local energy transition perspectives are primarily qualitative data, formed by thoughts, desires, preferences and opinions of inhabitants of the villages and (thereby) participants of the local energy initiatives, concerning the desired local organization of energy supply. It is important to note that this approach does not aim to stimulate a debate and thereby to influence LEIs on the basis of spatial models from a specific expert or outside opinion. Instead, the workshops are specifically designed to enable LEIs to construct their own preferred courses of action, also termed the local energy transition perspectives. Such an approach is suitable spatial planning in times of active citizenship (Boonstra 2015).

The workshops will be organized as free thought experiments (albeit confined within the boundaries described above). This implies that participants are not restricted in their choices by e.g. current policy or financial restrictions. The workshops are organized in collaboration with local energy initiatives and are open to everyone with a connection to the village. Invitations for the workshops are both sent by local energy initiative and published on the local website and the village magazine. In some cases, invitations are also posted on social media. The civil servant of the municipality working in the fields of renewable energy and spatial development will also be invited to join the workshops. A minimum number of 15 participants was set for the first workshops.

6 Sustainability ambition of Fryslân by 2050

6.1 Ambition for 2050

The ambition of the Province of Fryslân is to be independent from fossil fuels by the year 2050 (Provinsje Fryslân 2013). This is an interesting ambition as it is both very clear whilst at the same time also very ambiguous. It would seem that this ambiguity is caused by the combination between the words ‘independence’ and ‘fossil fuels’, which in turn demands a detailed insight in the current fossil fuel dependence of the region. For example, a question that immediately comes to mind when reading this ambition is: are products that include fossil fuel consumption (e.g. steel or regular plastics) included in this ambition? A possible debate would therefore revolve around the purity of view concerning this ambition.

In response, the ambition of the Province of Fryslân has been specified in collaboration with the program manager *sustainable innovations* for the purpose of this research. Independence from fossil fuels will be understood as deriving the total yearly energy demand for heat electricity and mobility from renewable sources (G. Venema, personal communication, February 4). Mobility, electricity and heat in the form of natural gas are the three main pillars of fossil energy usage in Fryslân (Provinsje Fryslân 2010). The specification on these three pillars coincides with the currently held targets and calculations of the Provine of Fryslân (Provinsje Fryslân 2013).

In 2050 the Province of Fryslân will derive the total yearly energy demand for *heat, mobility and electricity* from renewable energy technologies

6.2 Current energy demand of Fryslân

Figure 4 shows the energy demand of Fryslân for heat, mobility and electricity over the course 25 years. Numbers indicated with a (white) arrow show the total energy demand for the year 2012 for all three energy usage pillars. In the year 2012, the total energy usage in Fryslân for heat, mobility and electricity was around 62 Peta Joule (PJ) (*Klimaatmonitor* 2015). In current guiding policy documents, the Province of Fryslân uses this 62 PJ as status quo to form current goals up to 2020 (Provinsje Fryslân 2013), expecting a discount on energy consumption with future energy saving techniques (Ekwadraad 2012).

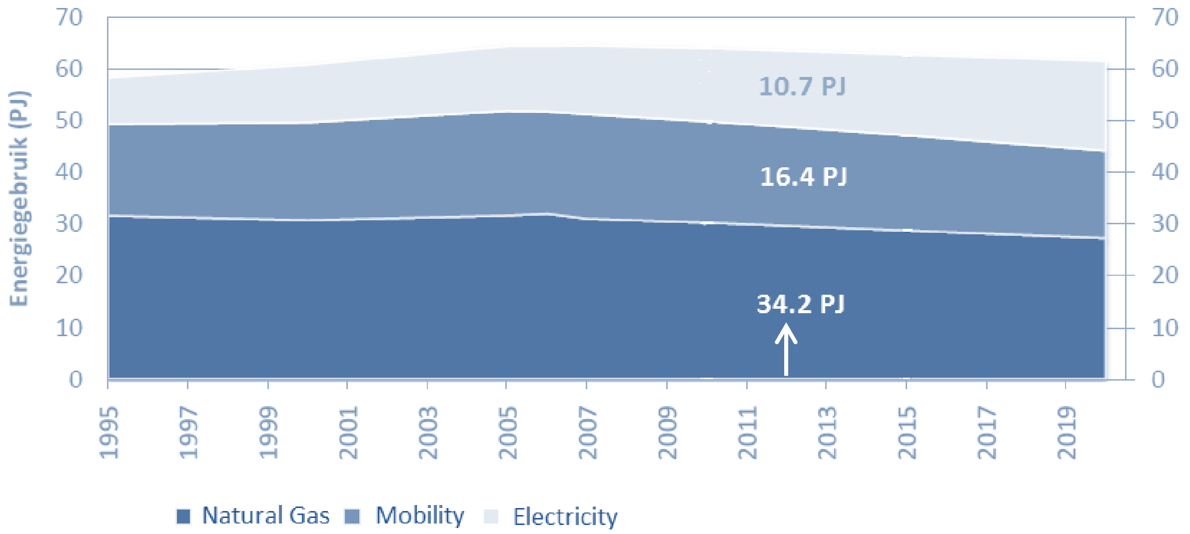


Figure 3 Energy usage Fryslân 2012 + prognoses

Of these 62 PJ, currently an amount of 4.8 PJ is produced with the use of renewable energy technologies. This coincides with a current renewable share in energy demand of 8%. Table 2 gives an overview of the currently existing renewable energy technologies in Fryslân and their respective production in PJ. In order to realize future goals, the engagement of all proven renewable energy technologies is necessary. This is termed the sustainable energy mix (Ekwadraad 2012).

Table 2 Renewable energy production in Fryslân

Renewable source	Production in PJ in 2012	Energy mix 2020 in PJ
Solar (thermal/PV)	0.05	1.98
Wind (on land)	1.4	5.67
Waste incineration	2.5	2.5
Biogas	0.5	1.5
Wood (biomass)	0.2	
Residual heat	0.1	
Geothermal	0.0	
Total renewable production Fryslân	4.8 = 8%	11.65 = 18.8%

6.3 Contribution of the local course of action to the Frisian energy transition

Figure 5 indicates the total yearly energy demand of Fryslân, encompassing the energy demand for heat, electricity and mobility. On a local course of action, it was specified that the total yearly energy demand for heat and electricity will be derived from renewable energy technologies installed on the local scale. This relates to energy demands for urban environment (43%), energy, waste and water (16%), agriculture (4%) and heat (4%) in figure 5 below. Moreover, the yearly energy demand for transportation can be made sustainable by switching to sustainable vehicles, run either electric or on green gas. Half of the yearly energy demand for the electric vehicles will have to be produced renewably on the local scale. When all the current vehicles in Fryslân would be changed to electric vehicles, 16.5 % of the energy demand for mobility will be produced renewably on the local scale. The switch to cars on green gas does not have to be compensated by renewable energy technologies on a local scale. All put together, it becomes clear that the local course of action can contribute to a maximum renewable share of 83,5% in Fryslân and to a minimal renewable share of 67%. In this case, all current vehicles will run on green gas instead.

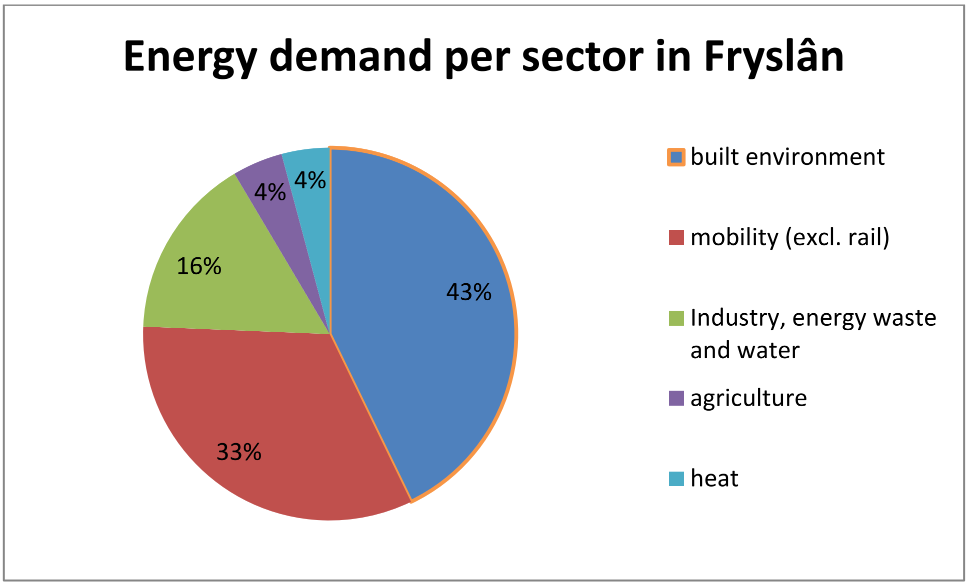


Figure 4 Energy demand per sector in Fryslân in 2014

6.4 Implementation program 2014-2020

The process of realizing the energy transition has been split up in several stages. The current stage of the Province of Fryslân leads towards a renewable production share of 16 % (or 9.9 PJ) of the total provincial energy demand, while 20 % of energy savings is to be realized by the year 2020. Thus the implementation program sustainable energy is in force. The concrete objectives for the above mentioned sustainable energy mix is displayed in table 2.

The implementation program shows that although the Province of Fryslân has set specific ambitions, they are mainly dependent upon other/external parties to realize these ambitions. In line, envisioned main roles for the Province of Fryslân. are also encouraging and facilitating initiatives emerging from society. This requires a Provincial authority that perceives citizens and businesses as producers of energy, with a balanced set of instruments meeting society's demand (Provinsje Fryslân 2013). This is also in line with the adopted transitions approach and influenced by the perceived arena, knowingly *the energetic society* in which the Province of Fryslân takes part (Hajer 2011).

When discussing renewable energy production, this program lends special attention to local initiatives. The corresponding paragraph states: "Fryslân is characterized by many small communities and levels of organization both on the countryside as well as in larger cores. We believe in the strength of the Frisian people. Therefore, we also choose for a Frisian approach with attention to local initiatives" (Provinsje Fryslân 2013). For this development, the Province of Fryslân envisions a facilitating role.

7 What localities play a role in realizing the Frisian ambition

7.1 LEIs in Fryslân

Currently, there are 71 active local energy initiatives (LEI) in Fryslân (Doarpswurk, 2015). These local energy initiatives display different levels of spatial organization. The figure below shows that the majority (45) of the LEIs are organized primarily on and for the own village level, followed by (22) initiatives that include multiple villages. Additionally, there is a small group (4) of initiatives mainly situated in and around the larger cities in Fryslân, mainly operating on district level. Annex 4 shows the complete list of 69 LEIs in Fryslân. This list makes clear that a large number (31) of local energy initiatives is organized in the form of energy collaborations. This specific form of organization can be related to the establishment of the NLD energy, a northern energy company.

7.2 Northern Energy Company and Energy Cooperations

In order to speed up and support the sustainability ambitions of local initiatives in the northern part of the Netherlands, the region started its own northern non-profit energy company: NLD Energy. NLD is an abbreviation of Northern Local Sustainable, and is cooperatively owned and initiated by three umbrella organizations facilitating the local energy cooperations of not only Fryslân but also Groningen and Drenthe. (Ús Koöperaasje 2015). This umbrella organization, called *Ús Koöperaasje* in Fryslân, is essentially a Frisian energy cooperation, dedicated to energy interests of all Frisians giving them more control over their energy on their way to (energy) self-sufficiency by providing domestic and local energy independent from other large energy companies. The delivery of natural gas (CO2 compensated) and (renewable) electricity has started mid 2014.

The main indicated advantage of this approach is that money spend on energy is kept within Fryslân and can be invested directly into local society. This process is facilitated through a cooperation structure. *Ús Koöperaasje* helps local energy initiatives to establish their own energy cooperations, and are subsequently invited to join (and thereby gain a voice within the organization) and sell energy from NLD. This makes a local energy cooperative reseller of NLD energy. The profit of energy sales through NLD, an estimated € 75,- per customer per year, flows back into the local energy cooperative. Additionally, it is possible to sell locally produced renewable energy to the NLD (Ús Koöperaasje 2015). The cooperative structure is displayed in figure 6.

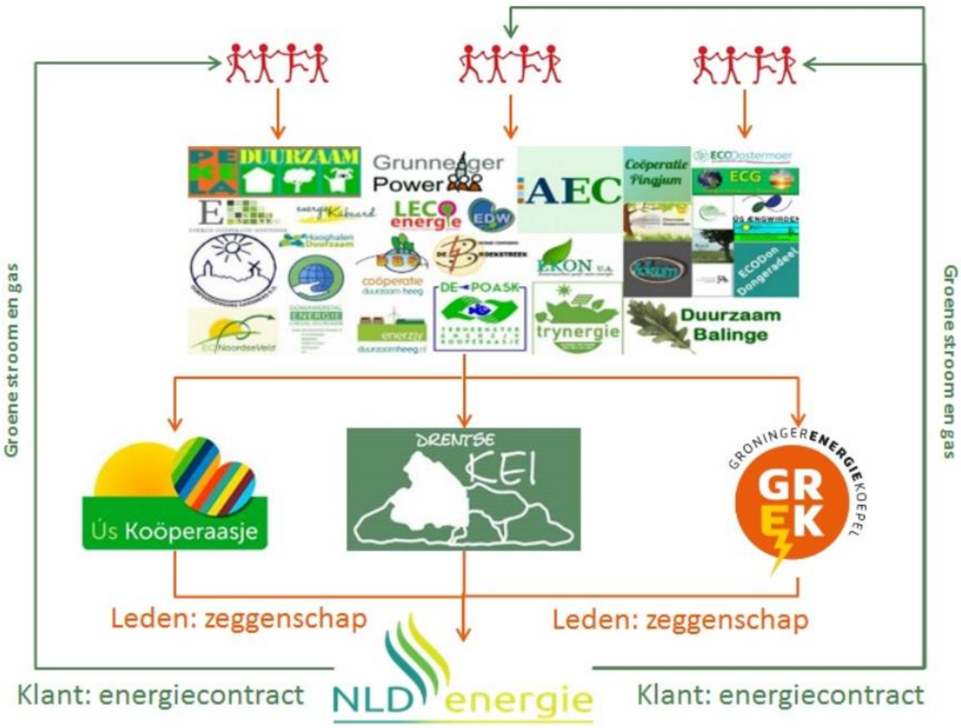


Figure 5 Corporation structure of the NLD

Currently, 26 local energy initiatives have joined *Ús Koöperaasje* and a total number of 1,200 customers receive their energy (gas and electric) from NLD in the three northern Provinces. *Ús Koöperaasje* expects a strong growth in joining initiatives as well as resellers of NLD energy for the coming year(s) (Ús Koöperaasje 2015).

Thus, the NLD provides a win-win situation for local energy initiatives, enabling evolvement to the next level of energy transition. Agreeing on energy delivery from the NLD will instantly increase the sustainability of the village through the provision of green gas and electricity at competitive rates, whilst at the same time yielding money available for investment by local energy initiatives.

7.3 Energy neutral communities

Nine villages have recently (25th of March 2015) joined the project named energy neutral communities, initiated by EWP Energy Workshop Fryslân. In this process, a select group of Frisian front running local energy initiatives have adopted the ambition to become energy neutral. EWP offers these joining local initiatives process support, renewable energy potential exploration, renewable energy technology experts and the development of business cases. This whole process comprises of characteristics of a strategic planning approach. Annex 3 shows the invitation send by the EWP to the LEIs in Fryslân for joining the energy neutral communities programme. As energy neutrality is a very wide concept, the joining initiatives are given the opportunity to define what energy neutrality would imply for their village, followed by some relevant examples. This leaves the initiatives with the opportunity to (albeit within margins) establish their own vision. This research has received an external supporting role within this process, through assessing spatial implications of sustainability ambitions for three of the included initiatives, being Heeg, Baard and Harkema.

8 Sand - Harkema

Harkema is a village within the municipality Achtkarspelen, situated in 'the woody' North-east of Fryslân. It is a young 'streekdorp' or linear village which has grown significantly in recent times. Harkema has been established in the mid-19th century upon the heatherfields along the main road between Drogeham and Augustinusga. These heatherfields are in turn situated upon former peat bogs which were excavated in the centuries before. It is upon these heatherfields that the early inhabitants settled themselves in small heathland cabins also called 'spitkeet'. From these cabins the inhabitants tried to survive with the performance of day or seasonal labor within the area, hoping to earn enough money to survive the winter. Fuel was gathered from so-called 'bulten' which were the remains of the earlier presence of peat.

It is this type of colonization, leading to a settlement characterized by loosely dispersed self-built cabins upon the heather fields that characterizes the mentality and atmosphere within Harkema. After a period of severe poverty in the beginning of the 20th century, Harkema's population started to grow rapidly. This growth was accompanied by the many building activity within the village. As the self-designing and building of the own house is a relative common practice within Harkema, the inhabitants have mainly formed the appearance of the village themselves. Since this strong population growth the structure of the village, which was mainly characterized of buildings along dispersed laying roads, has become more dense and compact.

Currently approximately 4300 people the village of Harkema spread out over around 1800 houses. The past of the heathland village can still be experienced in two places in Harkema. In its original setting at the 'Mûntsegroppe' where a series of workers houses from 1919 are situated along a sand road. And further south at the 'Betonwei', where theme park the 'Spitkeet' has been realized. This theme park inspired by the present reclamation farm which were constructed in the year 1912, shows how the former living upon the heatherfields within turf huts took place (Karstkarel 2005).

The area surrounding Harkema is situated in an area called the Northern Frisian Woods. A description of the landscape typology of the area surrounding Harkema can be found in table 3.

Table 3 Landscape typology Harkema and surroundings)

Main Landscape	Heathland reclamation (Heideontginning)
Description	Heathland reclamations are fairly young (late 19th, early 20th century) and occur especially along the drier edges of the Drenthe plateau and on the higher grounds along the middle sections of stream valleys. Because of different land-uses these areas have developed very diverse.
Soil and geology	heathland land reclamations with excavated raised bogs
Size and scale	small scale
Structures	local remains of open heathlands, locally forested, confined spaces, locally scattered dwellings and some consolidation at village formations
Villages	heathland villages (scattered dwellings), linear villages along roads
Farmyards	Dispersed along neighborhoods
Roads	Intensive road access , basis for reclamation; planting along roads
Water	Remains of waterways
Parcelling	straight to square plots (especially square plots in heathland reclamation villages)
Vegetation	Alder avenues as a boundary around plots, planting along roads; in most heathland reclamation towns presence of alder avenues
Particularities	alder avenues, and 'forest cabins' woudhuisjes

The heathland reclamations in the 'Northern Forests' Noordelijke Wouden are densely built. This characteristic village structure is called heathland villages, which are characterized by scattered buildings in block-like structures such as Zwaagwesteinde, Broeksterwoude, Houtigehage and Harkema.
These areas are characterized by square-like structures. The main land use besides yards and horse meadows is grassland, often bordered by alder avenues

8.1 The Local Energy Initiative

The local energy initiative of Harkema has just very recently started as a part of the village interest group. The main reason for starting to work towards energy savings and sustainability for Harkema is for the simple reason that it is good for the own wallet and local economy. At current there are a number of houses which have already installed renewable energy technologies. However, a collective (village) approach in order to become an energy neutral village has not been started up yet. The initiative was spurred by a network meeting for municipalities with north-east Fryslân. In here energy neutral communities was brought up for the discussion. Also a civil servant of the own municipality Achtkarspelen that indicated to be willing to support such an initiative within Harkema aided in the establishment of the initiative.

The local energy initiative approaches energy neutrality in the broadest sense of the word. Besides the energy demand of buildings this also means that sustainable transportation methods are addressed. The LEI describes itself as ambitious as well as realistic. This means that all forms of sustainability will be addressed but in such a manner that it will also be beneficial for the inhabitants of Harkema instead of only costing money.

A specific time horizon for the realization of the ambition to become an energy neutral community has not been set. However when looking at other practical examples of villages striving to become energy neutral the first thoughts are in the realm of 25 years from now. This would mean that by the year 2040 Harkema will be an energy neutral community.

The LEI sees many opportunities within Harkema, possible first measurers are the insulation of houses and the installation of solar PV panels upon many of the houses. The installation of several wind turbines would also contribute greatly to the realization of the goal, however the LEI realizes that this technology can be quit controversial within the village. In the coming period the LEI will make an effort to create support within the village and to hold an inventory of what is possible within the village but also what the inhabitant are willing to do. The main perceived benefit of the measurers taken in order to become an energy neutral community is their effect on the local economy. Harkema is a village of working people, many of them are employed in construction works, which has suffered some significant blows in the past years. It are especially sustainability measurers such as insulation or the production of the own renewable energy that might profit these people (Doarpswurk 2015).

8.2 Workshop 1

8.2.1 Description

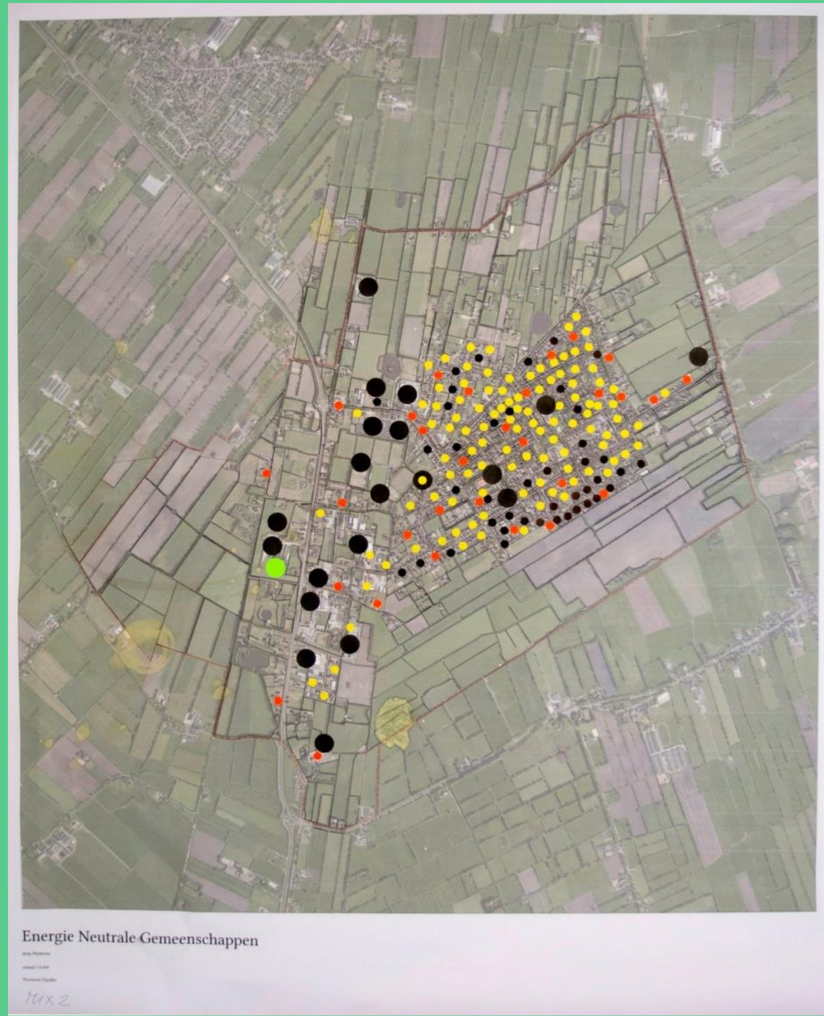
The first workshop with Harkema was held at Monday evening the 22nd of June 2015. The workshop was organized as a standalone public start event of the LEIs and was organized in the local meeting centre/pub ´de Boemerang' in Harkema. 28 people participated in the workshop. After the introductory presentation the participants were divided into 4 groups. Following, these 4 groups completed exercise 1 and 2 as explained within the methods section. The workshop started around 19.30 and was finalized at around 22.30 hours. The findings from the workshop will be presented and discussed below.

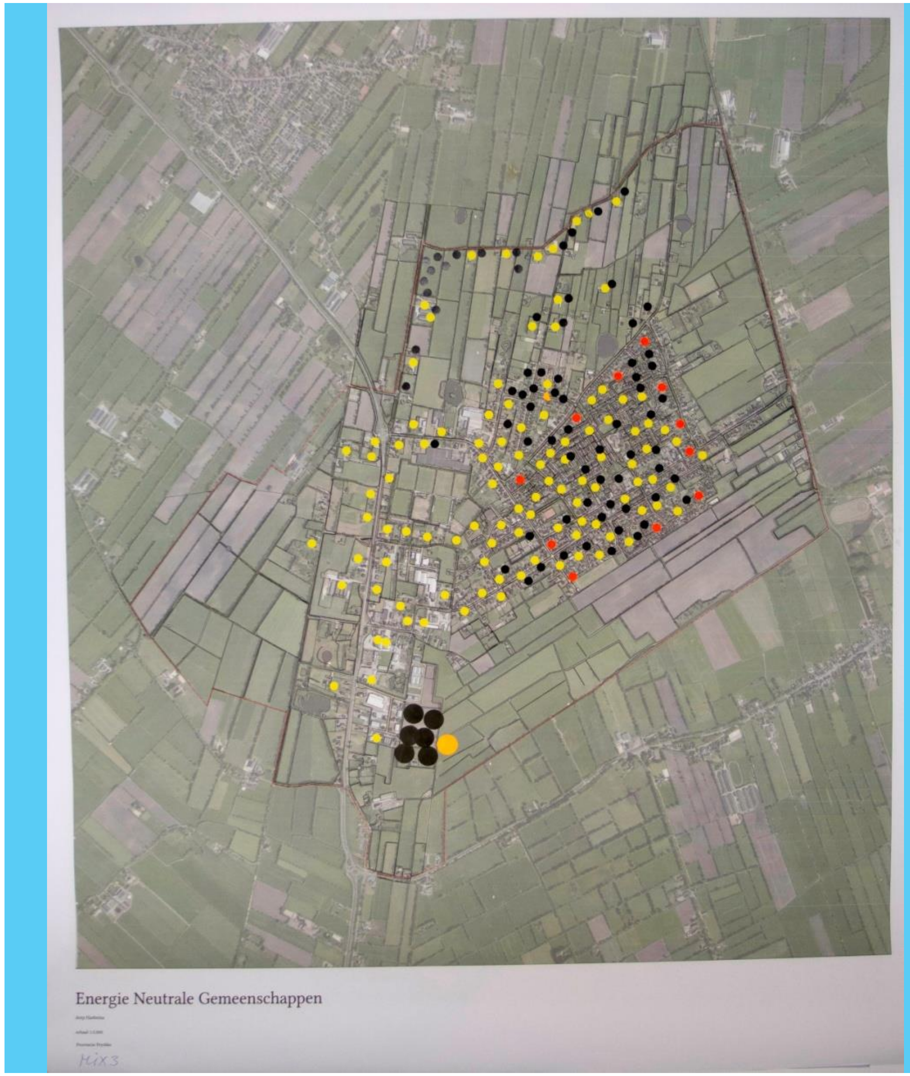
8.2.2 Results

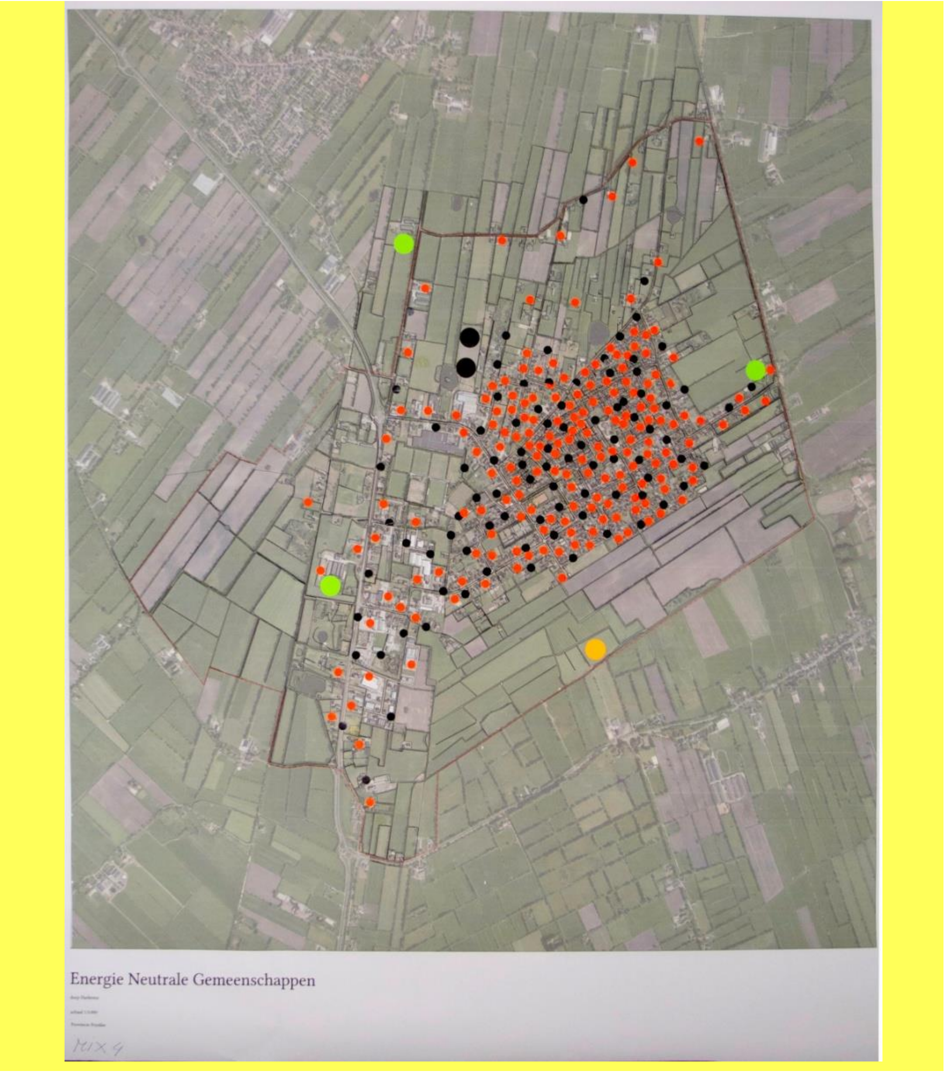
8.2.2.1 *Exercise 1 - create your own mix*

			Mix 1	Mix 2	Mix 3	Mix 4
Besparing						
	warmtepomp WKO	per huis	1000	300	10	
	warmtepomp Lucht	per huis		700	4	
	pellet CV kachel	per huis		50	500	
	hout kachel	per huis	250	100	550	
	led-verlichting	per huis	1000	1800	1500	1550
(vb. label C naar A++)	isolatie/triple glas	per huis	1000	1200	1600	1250
Zonne-energie particulier	Zonnecoll. Therm.	per huis (10m2)		100	60	1800
	zonneboiler	per huis (3.2m2)	1000	200	50	
Productie	zonnecellen PV	per huis (14m2)		500	700	900
Zon PV collectief op dak	zonnecellen PV	per **ha.**		10	2	1
Zon PV collectief in veld	zonnecellen PV	Per 3 **ha.**	5,0		1	
Windturbines	huis turbines	per stuk		1	4	
	daknokturbine	per huis			4	
	dorpsmolen	per stuk	5		1	
	grote turbine	per stuk				1
Biomassa	vergister elek	per stuk				
mono-vergisting	vergister gas	per stuk	10	1		3
verbranding excl. warmtenet	hout/snippers	per stuk	2			
Verkeer en vervoer	elektrische auto's	per stuk	750	2500	3350	2356
	groen gas auto´s	per stuk	750	250	0	1000

8.2.2.2 *Exercise 2 - positioning the mix in the local scale*




Energie Neutrale Gemeenschappen
Mix3


Energie Neutrale Gemeenschappen
Mix4

8.2.3 Preliminary findings Harkema

8.2.3.1 *Mix 1*

Mix 1	
In the Harkema of 2050 there will be:	
1000	houses with a HCS thermal storage system
250	houses with a woodstove
1000	houses fitted with LED-lighting
1000	houses with improved Isolation (e.g. Label C to A++)
1000	houses with a solar boiler
5	ha of solar PV panels in contiguous field setup
5	village wind turbine (≤1MW)
10	mono-digester producing Gas
2	biomass combustor (wood/chips)
750	Electric cars
750	Green Gas cars

The spatial implications of the energy mix as created by group 1 are summed up in the figure on the right. Within the desired future as described by group 1, five village wind turbines have been installed within the area called the 'Wide Pet'. This area is currently a meadow bird reserve, but the group believes that the installation of the windturbines will not cause any harm to these birds. The area has specifically been chosen, as it offered the opportunity to place the wind turbines far away from the village along a main road. Besides the implementation of wind energy the group has also chosen to install 5 ha. of solar PV panels on the roof surfaces of the industrial area (which was marked in the model as 5 ha in contiguous field setup). Additionally, each farmer within the local scale of Harkema has installed a mono-digester on his farm. In order to make use of the energy potential of the large amounts of manure present at livestock farms.

The specific choices made by group are based on their opinion that becoming energy neutral on the local scale can best be achieved in the form of a cooperation. As this cooperative structure will also enable the minima within the village to join and profit from the production of renewable energy.

8.2.3.2 *Mix 2*

Mix 2	
In the Harkema of 2050 there will be:	
300	houses with a HCS thermal storage system
700	house with a air water heat pump
50	houses with a pelletstove
100	houses with a woodstove
1800	houses fitted with LED-lighting
1200	houses with improved Isolation (e.g. Label C to A++)
100	houses with 10m2 of solar collector (heatpipes) each
200	houses with a solar boiler
500	houses with 14m2 of solar PV panels each
10	ha. of solar PV panels on large roof surfaces.
1	house fitted with a home wind turbine
1	Mono-digester producing Gas
2500	Electric cars
250	Green Gas cars

The spatial implications of the energy mix as created by group 2 are summed up in the figure on the left. Within the desired future as described by group 2 there are no solar PV panels placed in the field. Instead, the solar PV panels are placed as much as possible on large roof surface like those at the industrial area and on barn roofs. Additionally, many solar PV panels and air water heatpumps are installed in/on the houses of the housing organization. As especially these organizations are able to take large steps and to obtain subsidies. Besides solar PV panels, a mono-digester has been installed at a large farmer within the local scale. It has specifically been chosen not to install a wind turbine, first because a large wind turbine would produce too much energy and second because the local scale of Harkema is not very well suited for a wind turbine. Harkema is located within a category two area for wind energy which means that in general there is a lower wind speed in Harkema and surroundings. Wind turbines could therefore better be installed at those places with higher wind speeds, such as around the coast. The choice for different renewable energy technologies has mainly been affected by the perceived sustainability of these technologies themselves. Within the desired future as described by group 2 those renewable energy technologies which can also be produced sustainably in terms of material have been applied.

8.2.3.3 *Mix 3*

The spatial implications of the energy mix as created by group 3 are summed up in the figure on the right. Within the desired future as described by Group 3 a sort of 'Energy Park' has been established upon an undeveloped plot at the south of Harkema. On this terrain a village wind turbine as well as 3 ha of solar PV field is installed. Within the village, mainly solar PV panels and wood- and pelletstoves are installed in and upon the houses. These technologies have specifically been chosen as group 3 beliefs that solar thermal systems are less popular amongst the inhabitants of the village.

Mix 3	
In the Harkema of 2050 there will be:	
10	houses with a HCS thermal storage system
4	house with a air water heat pump
500	houses with a pelletstove
550	houses with a woodstove
1500	houses fitted with LED-lighting
1600	houses with improved Isolation (e.g. Label C to A++)
60	houses with 10m2 of solar collector (heatpipes) each
50	houses with a solar boiler
700	houses with 14m2 of solar PV panels each
2	ha. of solar PV panels on large roof surfaces.
1	ha of solar PV panels in contiguous field setup
4	houses fitted with a home wind turbine
4	units of 8 meter roof ridge turbine
1	Village wind turbine (≤1MW)
3350	Electric cars

Group 3 beliefs that energy neutrality can best be pursued on the individual scale as in this way one will gain the direct benefit of the investments made. As such the inhabitants will have more zest for working towards energy neutrality. (Although this belief is not clearly reflected in the created mix).

8.2.3.4 *Mix 4*

Mix 4	
In the Harkema of 2050 there will be:	
1550	houses fitted with LED-lighting
1250	houses with improved Isolation (e.g. Label C to A++)
1800	houses with 10m2 of solar collector (heatpipes) each
900	houses with 14m2 of solar PV panels each
1	ha. of solar PV panels on large roof surfaces.
1	Large wind turbines (3MW)
3	Mono-digester producing Gas
2356	Electric cars
1000	Green Gas cars

The spatial implications of the energy mix as created by group 4 are summed up in the figure on the left. Within the desired future as described by Group 4 the aim was to disturb as little as possible. Therefore group 4 has installed one large wind turbine as this produces much more energy compared to a large solar PV field. Solar PV panels are installed on a large number of house roofs within the village. Also a solar field of 3ha is installed behind a large company which will shut its doors in the near future (which was indicated within the model as solar PV on large roof surfaces). As the group does not expect any new company to settle within the building, the solar field can be connected to the current electricity connection present within the firm, which was also the reason for the specific placement of the solar field. Besides solar PV panels on half of the houses within Harkema, all houses within the local scale of Harkema have installed 10 m^2 of heatpipes for the production of heat. This technology is specifically chosen above wood- and pelletstoves as these technologies rely on the import of biomass into the local scale.

Group 4 beliefs that in order to become energy neutral as a village cooperation should be established for the achievement of this goal. Additionally, the electricity produced should also be stored within the local scale e.g. by means of batteries. As such the own produced energy can also be consumed thereby allowing a state of energy neutrality on the own local scale (off-grid)

8.2.4 General reflection

The four described desired futures all have their own distinct spatial implications on the local scale. Throughout the four energy mixes different perspectives concerning the specific application of individual renewable energy technologies seem to be present. Although within all the desired futures, electricity is produced collectively through the installation of large surfaces of solar PV panels, there seem to be two different perspectives concerning the spatial application of these solar fields. These differences revolve around the installation of PV panels upon large roofs surfaces or within the field.

Other differences within the described futures seem to revolve around whether (mix 1,3,4) or not (mix 2) to install a wind turbine. Within the groups who have chosen to install a wind turbine there is also a difference in opinion present on the related size, number and placement of these wind turbine(s). Within here two groups (mix 1,3) have chosen for the ‘smaller’ village wind turbine with a hub height of around 55 meters and a tip height of around 77 meters. Whereas one group (mix 4) has chosen for a ‘larger’ wind turbine with a hub height of approximately 90 meters and a tip height of 150 meters. Additionally, whereas group 1 has chosen to install five wind turbines along a main road, group 3 and 4 have chosen to implement only one wind turbine. Of which one is also situated along the same main road (mix 4) whereas the other is installed on the south edge of the village (mix 3).

Similar differences in the preferred quantity of renewable energy technologies can also be found for the implementation of mono-digesters at livestock farms. In here, group 3 has chosen not to install a mono-digester whereas the other three groups have actually chosen for this technology, albeit in diverging quantities. Group 1 and 4 have implemented a mono-digester at all the livestock farms present within the local scale. (Although, from the difference in numbers it becomes clear that there might be some ambiguity on the number of livestock farms present within the local scale.) Group 2 has implemented a mono-digester at only one farm. The main difference in the perspectives seems to revolve around whether to install a mono-digester at all livestock farms, or only at a particular farm(s), or not to install mono-digesters at all.

Following, when looking at the created maps, two main differences become apparent between the described desired futures of the built-up area of the village. The first difference concerns whether (mix 2,3,4) or not (mix 1) to install solar PV panels upon the houses within the village. The second difference concerns whether (mix 1,2,3) or not (mix 4) to install HCS systems, air water heat pumps, pellet- and woodstoves in/on the houses within the village. In here group 4 has argued to be specifically against wood- and pelletstoves as these systems rely upon the import of biomass into the local scale. The group has decided to install 10m2 of solar collector (heatpipes) at all houses present within Harkema as the only technology for the provision of heat. It is also this group 4 who wants to work towards an off-grid energy neutrality, which can be related to the opposition against pellet- and woodstoves. Within the groups who have chosen to install HCS systems, air water heat pumps, pellet- and woodstoves in/on the houses within the village (mix 1,2,3) there is a variation within the choice for specific renewable energy technologies. In here group 3 has chosen to mainly install pellet- and woodstoves whereas group 1 and 2 have chosen to mainly install HCS systems and air water heat pumps.

8.3 Visualizations Harkema

Farm Harkema

Farm with mono-digester

Farm Harkema

Blauwhuisterweg

Blauwhuisterweg with village wind turbines and solar PV panels

De Wide Pet Harkema

Wide Pet Harkema Large wind turbine and heatpipes

De Wide Pet meadow bird reserve

De Wide Pet meadow bird reserve with Village wind turbines


Huuskes


Huuskes with solar PV panels, roof ridge turbine and air water heat pump

Kammingastrjitte

Kammingastrjitte solar PV panels, air water heat pumps and roof ridge turbines

Haadstrjitte

Haadstrjitte solar PV panels, air water heat pumps and heatpipes

End industrial area

End industrial area with solar PV upon roofs and in field

Aerial photograph section Harkema

Aerial photograph section Harkema solar PV field, mono digesters and heatpipes

Aerial photograph section Harkema Village wind turbines, mono-digesters and heatpipes

Aerial photograph section Harkema Large wind turbines, mono-digesters, heatpipes and solar PV panels

8.4 Workshop 2

8.4.1 Description

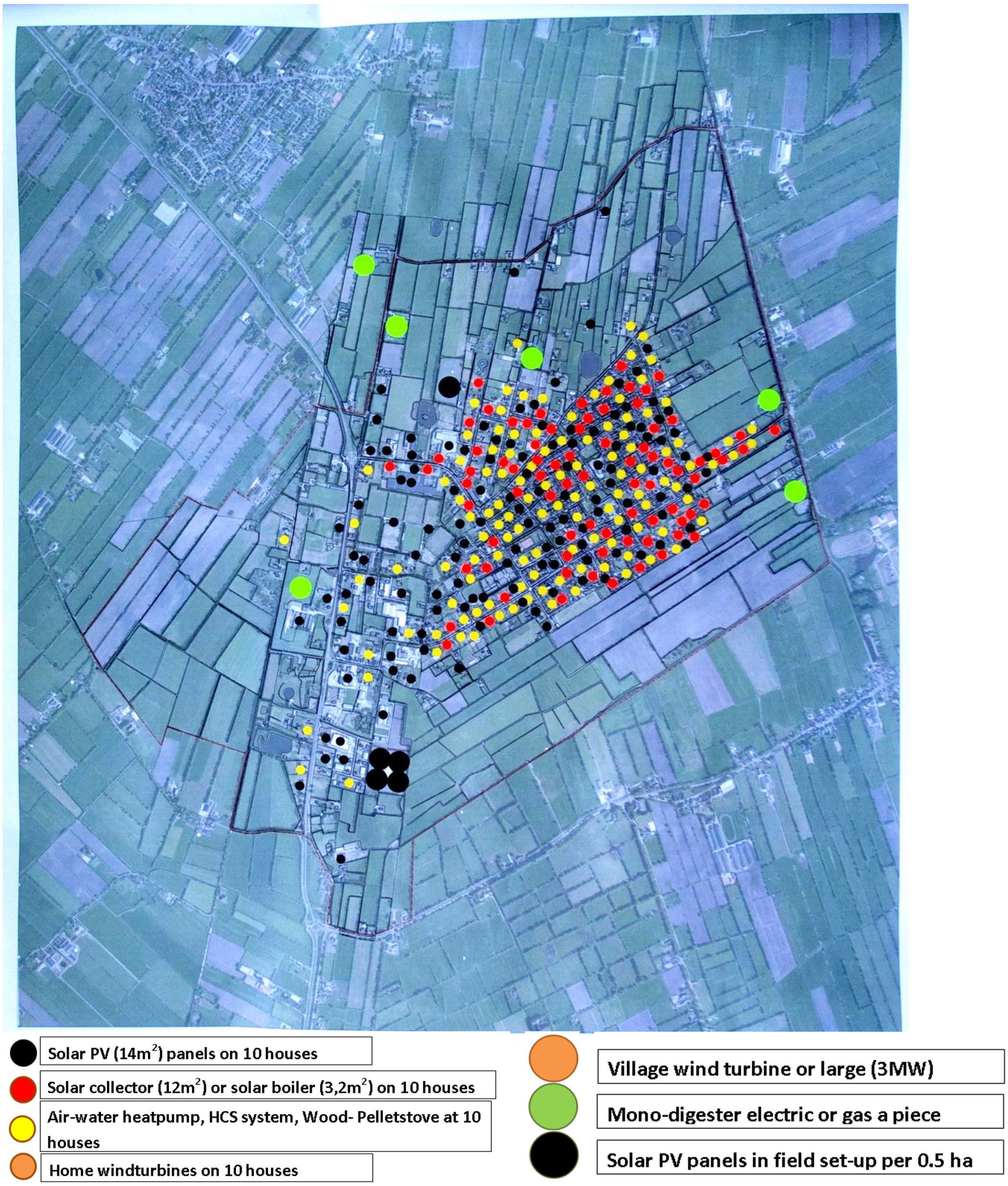
The second workshop with Harkema was held one week later at Monday evening the 29th of June 2015. The workshop was organized at the same location, the local meeting centre/pub ´de Boemerang' in Harkema, 15 people joined this second workshop. First, a short word of welcome was provided and following the intent and structure of the workshop was explained. After this short introduction the word was given to the designer Erik Overdiep, who had prepared a short presentation of 10 minutes on the local scale of Harkema and its main spatial qualities. This presentation merged into the presentation of the visualizations (above) of the initially desired futures as created in the first workshop, which also took around 10 minutes. Following, the participants were asked to gather around the central table displaying a blank map of the local scale. At the same time the 'create your own mix model' was projected on the big screen. In order to familiarize with the results of the first workshop and for any 'new' participants the maps created in the first workshop were also displayed on the table. For each of the mixes one representative was asked to shortly explain their considerations. Following the discussion was opened by asking the participants their reaction to the visualizations as well as to fill in the model starting from those renewable energy technologies on which all could agree. The workshop started around 19.30 and was finalized at around 22.30 hours. The findings from the workshop will be presented and discussed below.

8.4.2 The final energy mix Harkema

			Final Mix Harkema
Besparing			
	warmtepomp WKO	per huis	**300**
	warmtepomp Lucht	per huis	**700**
	pellet CV kachel	per huis	**50**
	hout kachel	per huis	**100**
	led-verlichting	per huis	**1800**
(vb. label C naar A++)	isolatie/triple glas	per huis	**1000**
Zonne-energie particulier	Zonnecoll. Therm.	per huis (10m2)	**300**
	zonneboiler	per huis (3.2m2)	**500**
Productie	zonnecellen PV	per huis (14m2)	**1150**
Zon PV collectief op dak	zonnecellen PV	per **ha.**	**3,0**
Zon PV collectief in veld	zonnecellen PV	per 3 **ha.**	**1,3**
Windturbines	huis turbines	per stuk	**0**
	daknokturbine	per huis	**0**
	dorpsmolen	per stuk	**0**
	grote turbine	per stuk	**0**
Biomassa	vergister elek	per stuk	**6**

mono-vergisting	vergister gas	per stuk	**0**
verbranding excl. warmtenet	hout/snippers	per stuk	**0**
Verkeer en vervoer	elektrische auto's	per stuk	**2000**
	groen gas auto´s	per stuk	**1100**

8.4.3 Placement of the mix within the local scale



8.4.4 Preliminary findings

The spatial implications of the final energy mix as created by the participant in the workshop of Harkema are summed up in the figure below.

Final Mix	
In the Harkema of 2050 there will be:	
300	houses with a HCS thermal storage system
700	houses with an air water heat pump
50	houses with a pelletstove
100	houses with a woodstove
1800	houses fitted with LED-lighting
1000	houses with improved Insulation (e.g. Label C to A++)
300	houses with 10m2 of solar collector (heatpipes) each
500	houses with a solar boiler
1150	houses with 14m2 of solar PV panels each
3,0	ha. of solar PV panels on large roof surfaces.
1,3	ha. of solar PV panels in contiguous field setup
0	houses fitted with a home wind turbine
0	units of 8 meter roof ridge turbine
0	Village wind turbine (≤1MW)
0	Large wind turbines (3MW)
6	Mono-digester producing Electricity
0	Mono-digester Gas
0	Biomass (wood/chips) burning
2000	Electric cars
1100	Green Gas cars

8.4.5 Creation of the final mix

In the second workshop with Harkema one final energy mix has been created and placed within the local scale. In the debate leading to the creation of this mix the following elements were present. Starting filling in the model with the renewable energy technologies all can agree upon first, it was decided that all farmers present within the local scale of Harkema should install mono-digesters. At first site, four livestock farms were located within the local scale of Harkema, all of which were given a mono-digester. The following technology upon which all could agree was the installation of solar PV panels on the large roof surfaces present at the industrial area and the insulation of houses. First, the insulation of houses was discussed in which the main point of discussion focussed on the amount of people/houses that actually would improve the insulation of their home. During this discussion another farm was 'found' within the local scale of Harkema, making up a total of five mono-digesters.

Meanwhile within the discussion on insulation it was not perceived to be realistic that all house owners would improve the insulation of their house. Therefore a number of a 1000 house owners, more than half of the houses in Harkema, were set to improve their insulation in the coming years. In reaction to this, a cooperative thought was explained/proposed/promoted in which a still to be established local energy cooperation would enable the offering of an ‘energy package’ to individual home owners. Such an energy package, including for example an energy check of the house, corresponding insulation measurers, LED-lighting, solar PV panels and a heat pump could then be pre-funded by the local energy cooperation and then leased to individual home owners. These will subsequently pay a monthly rate to the energy cooperation whereby they will become the owner of the complete ‘energy package’ in e.g. 12 years. This could also help in creating more incentive to individual home owners to invest in renewable energy technologies.

Such an ‘energy package’ is in principle considered to be beneficial and desirable to all participants. However, on the basis of the visualizations some participants raise objections concerning the accompanying ‘in sight’ installation of solar PV panels upon all the individual houses within the village. As this would result in an ‘ugly’ streetscape. Although some argued that generally not all houses within a specific street are suitable for the installation of solar PV panels. A discussion follows on the desirability of the ‘in sight’ installation of PV panels upon houses, in relation to the streetscape. It should be noted that none of the participants are actually against the installation of solar PV panels, however opinions differed on their specific placement/installation. Several solutions for this are proposed within the discussion that follows:

When moving through Harkema one can notice that many houses in Harkema have sheds at the back (which are typically larger than the living house). This might prove a solution to maintaining the current streetscape by choosing to place solar PV panels only ‘on the back’ on the roofs of the sheds and on the large roof surfaces of the industry. As such solar PV panels would not be installed at the individual level but divided upon these roof surfaces where they can be placed out of sight. The produced electricity would subsequently be divided amongst all houses. Instead of PV panels on the roof one could also decide to install a ‘solar PV pole’ in the garden. Such a pole, on which approximately 14m2 of solar PV panels (9 panels) will be installed at a height of around 3 meters, rotates along with the direction of the sun. The main advantage of such a ‘solar PV pole’ is that it typically has a higher production than roof bound PV panels as it will be able to collect all available sun light. Opinions on the installation of such poles in the back garden of houses are mixed. However, most agree that they could well be placed in the municipal green for example on roundabouts.

As no clear decision was made in the discussion, the question was asked if there are any specific street/places within Harkema that should be protected from the ‘in sight’ installation of solar PV panels. Two historical parts (de spitkeet (historical outdoor museum), de bulten) are named where there should not be placed solar panels in sight. Apart from these areas there should not be made any restrictions upon the placement of solar panels upon houses within Harkema.

The conclusion of the discussion concerning the installation of solar PV panels is that beforehand there will not be any streets/areas that will be excluded from the in sight installation of solar PV panels. This is because first off all solar PV panels will/cannot be installed upon all the houses within Harkema. Additionally, it is expected that when solar panels will be installed, naturally one would first install solar PV panels out of sight as much as possible e.g. on the sheds of the houses. This decision is also supported by the argument that in principle no one should be excluded from the production of their own energy. And related to this, that it is characterizing for the inhabitants of Harkema to do things on the own property (e.g. the installation of solar panels) themselves. Especially when there is a profit to gain every inhabitant of Harkema will be in favour of this development.

All participants can agree on the installation of solar PV panels on all public buildings (ground school, sports hall etc). These public buildings usually have larger roof surfaces available than normal houses, the related size was estimated to around 2000m2 which is equal to around 150 houses with solar panels in the model. Additionally, the participants expected that around a 1000 houses spread over the local scale would install solar PV panels.

Staying on this individual house level the remaining heat demand was decided to be produced through the installation of air water heat pumps, solar boilers, HCS systems, solar collectors and wood- pelletstoves in order from most to least installed renewable energy technologies. These technologies will be installed spread throughout the individual houses of Harkema. Air water heat pumps were perceived to be a more feasible option than HCS storage systems as the purchase price of this technology is much lower than that of the HCS systems. Wood- and pelletstoves were perceived as the least desirable options as they rely upon the import (purchase) of biomass. It was mentioned that in principle this involves the same system as buying gas or electricity and was therefore not perceived as a sustainable solution. Especially as it also leads to the emission of CO2.

Through the installation of these renewable energy technologies the yearly heat demand in kWh for the local scale of Harkema is renewably produced. As every participant had agreed form the start to make use of the large roof surface available at the industrial area, the next step was to fill in this available roof surface with solar PV panels, which constitutes around 3 ha. As this 3ha. of available roof surface could not deliver the total electricity demand it was also decided to install a solar PV field on a 3.5 ha undeveloped plot at the south of Harkema. Additional room of 2 ha (which was also indentified in the first workshop (mix4), adjacent to the north of the village was also deemed suitable for the installation of a solar field if this would be necessary.

It was decided that on both of these areas solar PV fields would be installed in order to be able to locally produce the yearly energy demand. The need for both these locations was strongly related to the initial perception amongst many participants that within Harkema not all the transportation methods would change to sustainable fuels (green gas and electricity). As such only a moderate number of a 1000 electric and a 500 green gas cars was initially filled in the model, out of the total of 3350 cars present. Due to the specific calculation rules within the model in combination with the assignment to locally produce the yearly energy demand. This meant that technologies (such as solar fields) other than transportation means needed to compensate/produce the associated remaining ‘grey’ energy demand of transportation. Before this was explained to the participants this resulted in a quest for desirable renewable energy technologies which could ‘fill in’ the remainder of the energy necessary.

During this discussion it was opted to install two village wind turbines which would be able to fill in the gap. However, the opinions concerning the installation of wind turbines varied in which a number of participants was in favour whereas as a majority of the participants was against the installation of wind turbines. This resistance against wind turbines was caused by the visualizations of the wind turbines in and around Harkema, as well as the argument of one of the participants that wind turbines were a less sustainable technology than solar panels. Nevertheless, during the first workshop, in three of the four mixes wind turbines had been installed. As many of these proponents for wind turbines were not present during this second workshop it was decided to keep wind turbines as a valid option which can potentially be interchanged with the solar PV fields. However, it was decided by the group that these wind turbines would for now not be included in the final mix. Also in the light of current provincial policy which strongly opposes the implementation of new wind turbines within Fryslân.

Additionally, it was mentioned that there should be installed more mono-digesters at the farmers. In a final search one new farm was situated within the local scale of Harkema, thereby resulting in a final total of six mono-digesters. Also roof ridge turbines were mentioned as suitable renewable energy technologies for the application on the houses within Harkema. These roof ridge turbines were perceived to provide a solution for those houses which were not suitable for the installation of solar PV panels. But could as well be installed on the houses which do already have solar panels. An initial number of 1000 of roofridge turbines was specified by the participants. But as this addition would still not lead to a 100% renewable energy supply and the participants became a little 'reluctant' to fill in more renewable energy technologies, it was (again) explained that this gap could also be filled with the specification of more green vehicles within the model. As a result the participants specified a number of 2000 electric vehicles and 1100 green gas vehicles.

Now, a surplus of green energy was produced, which meant that the renewable energy technologies that were included to fill the previous gap, the roofridge turbine and around 3000m2 of solar field became superfluous and have therefore been removed from the final model. As the participants initially agreed on their installation it might be expected that these renewable energy technologies will also be installed within the future. Finally, it was discussed whether the energy produced locally should also be stored on the local level. All participants were in favour of the storage of energy. However, opinions concerning the organization of energy storage differed. Some participants wanted to store all the energy on the local scale with the use of batteries alike those newly produced by Tesla. Others felt that such storage could better be realized on a much larger scale.

8.5 Main differences workshop 1

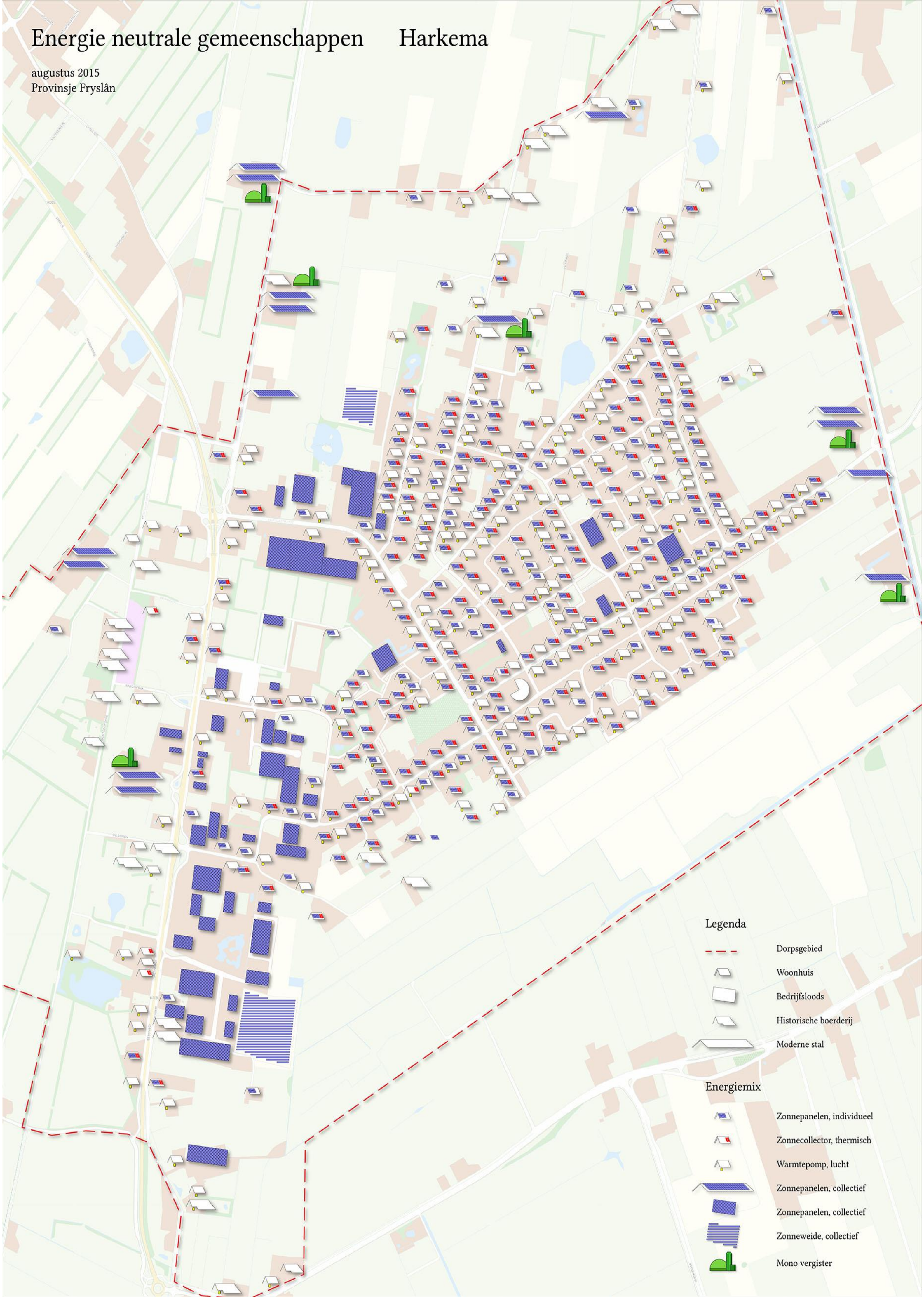
The most striking difference with the first workshop is that it has been chosen not to include wind turbines in the final energy mix of Harkema. However, wind turbines are still kept as an option which can be interchanged with the solar fields, as many of the earlier proponents were not present during the second workshop. Based upon the visualizations, arguments concerning the mutual sustainability of the renewable energy technologies and current provincial policy it was decided that (for now) the installation of solar PV fields was preferred above wind turbines. As such solar PV panels have received a more dominant role in the final energy mix.

Another difference concerns the installation of mono-digesters at the livestock farms within the local scale. Whereas in the first workshop, mix 2 had not installed a mono-digester and mix 3 had installed a mono-digester at one farm. Within the final mix it was explicitly chosen to install a mono-digester at all livestock farms present within the local scale. As these mono-digesters are perceived to fit very well with the industrial character of the livestock farms, where there are already silo's present.

Looking at the renewable energy technologies that are installed on the individual houses it becomes clear that the initial four mixes have been more or less blended together. Except for the installation of wind turbines at houses (with a possible exception for roof ridge turbines) it seems that there are no specific objections against the installation of these technologies. Compared to the previous mixes a relative more important role has been given to the installation of solar PV panels upon houses and the installation of air water heat pump.

Energie neutrale gemeenschappen Harkema

augustus 2015
Provinsje Fryslân



9 Peat - Heeg

Heeg is a typical water(sports) village established upon a modest church terp. Heeg is mentioned as Haghekercke in sources originating from 1132. At those times the main activities in the village were fishing, shipping and trade. The village itself had originated much earlier on the on the junction of several waterways. In between ‘de Syl’ the main artery of the village and the church, linear building developed along the ‘Harinxmastrjitte’ which gradually became more and more compact. Thereby giving the village a small city like appearance (kleinsteeds). Although in recent times there have been many development for the benefit of water recreants, the history of fishing, shipping and trade can still be recognized within the spatial structure and character of the buildings with the village center of Heeg.

In 1846 Heeg created a good connection to the hinterland with the improvement of the horse road to ‘Osingahuizen’ to a highway. Along this road many buildings/houses were developed (on the ‘Schatting’) Before the second World War the remainder of the undeveloped plots to the north of the main street were built-up. After the war several large new neighbourhoods were developed to the north of the village in a number of different phases. In the meantime also the banks and ports for the recreational boating had been developed. And the industrial area was expanding gradually on the north-east side. As a result Heeg has developed to a large village with varying characteristics. The old 18th and 19th century buildings can be found in the old city center including several prominent houses.

Heeg forms part of the recently formed municipality Súd-west Fryslân. The adjacent Hegerlake south of the village is one of the largest inland lakes of Europe. The Hegerlake attracts lots of tourists mainly in the summertime and is also called the watersports Eldorado of south-west Fryslân. Around 2300 people live in the village in around 1200 houses (Karstkarel 2005).

The area surrounding Heeg is also generally termed the lower middle. A description of the landscape typology of the area surrounding Heeg can be found in table 4.

Table 4 Landscape typology Heeg and surroundings

Main Landscape	peatland areas (Veenweidegebieden)
Description	Low-lying, moderately accessible peatlands often in use as grassland, largescale open areas with straight parceling, relatively little buildings present.
Soil and geology	water, peat and thin clay cover on peat
Size and scale	large to very large scale, in which the reflection of the lakes gives an extra dimension to the broadness
Structures	large scale water structures of large lakes to ponds, canals and waterways, large scale open space, moderately accessible area, high variety of large and small scale agricultural units
Villages	scarcely present, some linear villages and some water oriented villages
Farmyards	Widely dispersed, most often coupled to linear and land reparceling roads
Roads	sparse accessibility, often with dead-end roads, major infrastructure A7 and provincial roads presence
Water	variety of small lakes and ponds to very large scale lakes, canals and waterways
Parcelling	in large blocks arranged regular and irregular straight and locally fanning parceling
Vegetation	around livestock farms and villages and recreation areas, small forests along lake shores and wetlands, very sporadic planting along roads
Particularities	Access through water still dominant, presence railroad, historic livestock farms directly on the water, mills, cemeteries with belcages, dredging depots with small forests

Within Heeg the local interest group has placed sustainability high on the agenda for the future of the village. Sustainability is approached in a broad sense, based upon a Swedish model an own method has been developed. This method called ‘5Xbeterbezig’ refers to 5 sustainability rules which. These rules of thumb refer to matters such as care for each other, room for nature and working smart and non-toxic with materials, water and energy. Two workgroups have been created to work towards the ambition of Heeg to become an example sustainable village. One of these workgroups is specifically focusing on energy issues (LEI). This group has the responsibility to work towards the ambitious goal to become an energy neutral village or even energy producing by the year 2025. This Local Energy Initiative has specified several activities that they (will) employ in the coming time, examples of these activities are:

Figure 6 Logo LEI Heeg

- The establishment of an own energy cooperation, which delivers energy through NLD-energy. Local customers can join this cooperation and choose to receive energy (gas and electricity) from NLD- energy via the cooperation. For every customer the cooperation will receive 75€ which they can subsequently use to make Heeg more sustainable (Veldhuis 2015). The group has calculated that on a yearly base around 1.2 million euro’s flows out of the local scale, to mainly foreign large energy suppliers. The LEI would like to keep this money within the Heeg or at least within the Northern Provinces it is also for this reason that they have joined the NLD- energy.

- The making available of six energy meters through which inhabitants of Heeg can get insight in the specifics of their electricity consumption. These meters can be borrowed for a period a two weeks.

- Organization of an insulation action through which inhabitants of Heeg can carry out simple insulation measures at low costs with a payback time of 2 to 3 years.

- The organization of an energy market at which the inhabitants of Heeg can get lots of information on different renewable energy technologies and their possibilities.

- Researching the possibility for the realization of an own solar energy power station. As not everyone will be willing or able to install solar PV panels upon their roof the possibilities for the collective purchase and placement of solar PV panels upon one or more locations within Heeg will be researched as a possible solution. The energy produced by the ‘solar energy power plant’ can then be delivered to the NLD.

- Starting a poll for the purchase of an electric sharing car. Sustainable transport is an indispensable part of sustainable way of life. Whereas the bike could be used for the smaller distances a car might useful for the longer distances. People are asked indicate their interest in such a sharing car. When there is enough interest this car can be purchased right away.

9.1 Workshop 1

9.1.1 Description

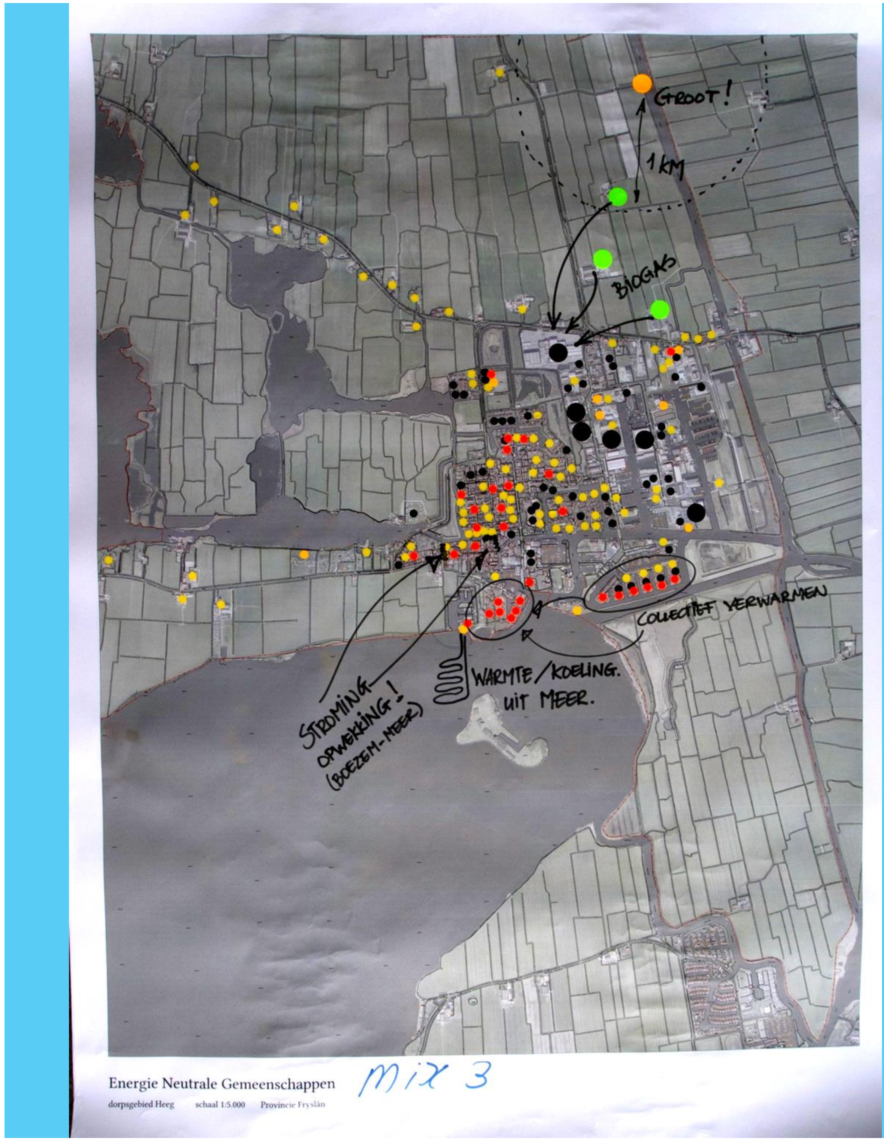
The first workshop with Heeg was held at Wednesday evening the 3rd of June 2015 in ´het Heechhús´ in Heeg. The workshop was held following the members meeting of the LEI, which was specifically chosen to ensure adequate participation within the workshop. 23 people participated in the workshop. After the introductory presentation the participants were divided into 4 groups. Following these 4 groups completed exercise 1 and 2 as explained within the methods section. The workshop started around 20.30 and was finalized at around 23.00 hours. The findings from the workshop will be presented and discussed below.

9.1.2 Results

9.1.2.1 *Exercise 1 - create your own mix*

			Mix 1	Mix 2	Mix 3	Mix 4
Besparing						
	warmtepomp WKO	per huis	200	80	150	300
	warmtepomp Lucht	per huis	200	80	100	300
	pellet CV kachel	per huis	250	0	200	100
	hout kachel	per huis	50	100	500	75
	led-verlichting	per huis	1200	1200	1100	600
(vb. label C naar A++)	isolatie/triple glas	per huis	1000	600	300	1000
Zonne-energie particulier	Zonnecoll. Therm.	per huis (10m2)	100	700	300	300
	zonneboiler	per huis (3.2m2)	600	300	100	300
Productie	zonnecellen PV	per huis (14m2)	900	600	500	600
Zonne-energie collectief	zonnecellen PV	per **ha.**	4	3	3	3
Windturbines	huis turbines	per stuk			50	100
	daknokturbine	per huis	100	15	50	100
	dorpsmolen	per stuk		1		
	grote turbine	per stuk			1	
Biomassa	vergister elek	per stuk			1	3
mono-vergisting	vergister gas	per stuk	1	10	1	3
verbranding excl. warmtenet	hout/snippers	per stuk			1	
Verkeer en vervoer	elektrische auto's	per stuk	600	1800	1100	800
	groen gas auto´s	per stuk	1200		700	500

9.1.2.2 *Exercise 2 - positioning the mix in the local scale*


GROOT!
1 KM
BIOGAS
COLLECTIEF VERWARMEN
WARMTE/KOELING.
UIT MEER.
STROMING
OPWEKKING!
(BOEZEM-MEER)
Energie Neutrale Gemeenschappen
dorpsgebied Heeg schaal 1:5.000 Provincie Fryslân
mix 3


Energie Neutrale Gemeenschappen
dorpsgebied Heeg schaal 1:5.000 Provincie Fryslân
Mix 4.

9.1.3 Preliminary findings Heeg

9.1.3.1 *Mix 1*

Mix 1	
In the Heeg of 2050 there will be:	
200	houses with a HCS thermal storage system
200	house with a air water heat pump
250	houses with a pelletstove
50	houses with a woodstove
1200	houses fitted with LED-lighting
1000	houses with improved Isolation (e.g. Label C to A++)
100	houses with 10m2 of solar collector (heatpipes) each
600	houses with a solar boiler
900	houses with 14m2 of solar PV panels each
4	ha. of solar PV panels on large roof surfaces.
100	units of 8 meter roof ridge turbine
1	Mono-digester producing Gas
600	Electric cars
1200	Green gas cars

The spatial implications of the energy mix as created by group 1 are summed up in the figure on the right. Within the desired future as described by group 1 eye-catching renewable energy technologies have been implemented as little as possible. It is also for this reason that group 1 has explicitly chosen not to implement large technologies such as a solar field or wind turbines in the field (setup). Instead, the group has made use of the large roof surface available on the industrial area of Heeg. By the installation of four ha. of solar PV panels upon these large roof surfaces. Additionally, on (many of) these large roofs also roof ridge turbines have been installed over the complete length of the ridge. In the outer area of Heeg solar PV panels have been installed on a number of barn roofs as well as one mono-digester. Within the village all the 'housebound' renewable energy technologies except for the home wind turbine have been installed spread throughout the houses of the village. An exception was however made for the historical part of the village where only less visually prominent renewable energy technologies such as wood- and pellet stoves were installed. It has specifically been chosen not to install solar PV panels within this historical part of Heeg.

9.1.3.2 *Mix 2*

Mix 2	
In the Heeg of 2050 there will be:	
80	houses with a HCS thermal storage system
80	house with a air water heat pump
0	houses with a pelletstove
100	houses with a woodstove
1200	houses fitted with LED-lighting
600	houses with improved Isolation (e.g. Label C to A++)
700	houses with 10m2 of solar collector (heatpipes) each
300	houses with a solar boiler
600	houses with 14m2 of solar PV panels each
3	ha. of solar PV panels on large roof surfaces.
15	units of 8 meter roof ridge turbine
1	Village wind turbine (≤1MW)
10	Mono-digesters producing Gas
1800	Electric cars

The spatial implications of the energy mix as created by group 2 are summed up in the figure on the left. Within the desired future as described by group 2, energy is produced collectively in the form of 3 ha of solar PV panels on the large roof surfaces of the industrial area of Heeg. Additionally, northwards, a village wind turbine has been installed at a large distance from the village. All the farmers within the local scale of Heeg have also been given an important energy production role, via the installation of a mono-digester for the production of green gas. Within the village mainly solar thermal technologies (heatpipes, solar boilers) and solar PV panels have been installed spread throughout the houses of the village. As well as, woodstoves, air water heat pumps and HCS systems although to a lesser extent.

9.1.3.3 *Mix 3*

Mix 3	
In the Heeg of 2050 there will be:	
150	houses with a HCS thermal storage system
100	house with a air water heat pump
200	houses with a pelletstove
500	houses with a woodstove
1100	houses fitted with LED-lighting
300	houses with improved Isolation (e.g. Label C to A++)
300	houses with 10m2 of solar collector (heatpipes) each
100	houses with a solar boiler
500	houses with 14m2 of solar PV panels each
3	ha. of solar PV panels on large roof surfaces.
50	houses fitted with a home wind turbine
50	units of 8 meter roof ridge turbine
1	Large wind turbines (3MW)
1	Mono-digester producing Electricity
1	Mono-digester producing Gas
1	Biomass (wood/chips) burners
1100	Electric cars
700	Green gas cars

The spatial implications of the energy mix as created by group 3 are summed up in the figure on the right. Within the desired future as described by group 3 a large wind turbine has been installed north of the village. Such a large wind turbine has been chosen as it produces a lot of energy (electricity) compared to the other renewable energy technologies. Besides a large wind turbine, electricity is also produced collectively with the use of solar PV panels on the large roof surfaces of the industrial area. Upon a number of these roofs roof ridge turbines have also been installed. Two farmers in the outer area of Heeg have also installed a mono-digester of which one produces gas and one produces electricity. All the housebound renewable energy technologies have been installed spread throughout the houses of the village. Within the desired future as described by group 3 the burning of biomass has received an relative important role. A biomass burner for collective energy provision has been installed on the outside of the village and more than half of the houses within Heeg have installed a wood- or pellet stove.

9.1.3.4 *Mix 4*

Mix 4	
In the Heeg of 2050 there will be:	
300	houses with a HCS thermal storage system
300	house with a air water heat pump
100	houses with a pelletstove
75	houses with a woodstove
600	houses fitted with LED-lighting
1000	houses with improved Isolation (e.g. Label C to A++)
300	houses with 10m2 of solar collector (heatpipes) each
300	houses with a solar boiler
600	houses with 14m2 of solar PV panels each
3	ha. of solar PV panels on large roof surfaces.
100	houses fitted with a home wind turbine
100	units of 8 meter roof ridge turbine
3	Mono-digester producing Electricity
3	Mono-digester producing Gas
800	Electric cars
500	Green gas cars

The spatial implications of the energy mix as created by group 4 are summed up in the figure on the left. Within the desired future as described by group 3 there is no place for wind turbines. Besides the installation of 6 mono-digesters at livestock farms no other technologies have been installed in the outer area (apart from those installed at houses). Electricity is produced collectively through solar PV panels on the large roofs of the industrial area. In total three ha. of solar panels are installed on this roof surface. All the housebound renewable energy technologies have been installed spread throughout the individual houses of the village in more or less equal proportions. In here pellet- and woodstoves as well as home wind turbines are present in a lesser extent than HCS systems, air water heat pumps, solar thermal systems and solar PV panels.

9.1.4 General reflection

The four described desired futures all have their own distinct spatial implications on the local scale. When looking at the four described futures it becomes clear that there is a difference in perspective in whether (mix 2, 3) or not (mix 1,2) to install a wind turbine in the surroundings of Heeg. Both groups who are in favour of the installation of a wind turbine have more or less appointed the same site for its installation, northwards of the village. However, between these groups there seems to be a difference in opinion on the desired size of such a wind turbine. Apart from the difference concerning the desirability of a wind turbine, the futures described by the four groups all comprise similar characteristics. The characterizing element in here is that all the groups have installed large surfaces of solar PV panels on the large roofs of the buildings on the industrial area of Heeg. Additionally, all groups have also chosen to install mono-digesters at livestock farms. The difference in perspective for this technology seems to revolve around whether all farmers, or only one/a couple should install such a mono-digester. The installation of mono-digester is in mix 2,3 and 4 the only energy production function added to the livestock farms, in these mixes no solar PV panels have for example been envisioned on the barn roofs. This might be explained by the fact that the large surface of roof available at the industrial area already facilitates the production of the needed energy demand. Following in all the mixes the available house bound renewable energy technologies have been installed spread throughout the individual houses of the village (with the exception of home wind turbines in mix 1,2).

Solar PV panels as well as heatpipes (both in the form of solar collectors or solar boilers) are an important element within the village area in all the four mixes. Throughout the created mixes one in every two houses (50 %) will have these renewable energy technologies installed. An exception should be made for mix 3 which has a relative stronger focus on the burning of biomass. In this mix every one in three houses will also have these renewable energy technologies installed. Mix 2 has actually laid a stronger focus on solar thermal technologies than the other mixes, which implies that in here almost every house (83%) will have heat pipes installed. The related spatial implications of these renewable energy technologies are focused on the visual changes of the roofs of houses within the village.

9.2 Visualizations Heeg

Farm Heeg

Farm with mono-digester

Street Heeg

Street Heeg with air water heat pumps

Current housing in Heeg

Current housing in Heeg with roof ridge turbines, heatpipes and solar PV panels

Industrial site Heeg

Industrial site with solar PV panels on roofs

New housing Heeg

New housing Heeg with heatpipes, air water heat pump and roof ridge turbine

Earlier housing Heeg

Earlier Housing with solar PV panels, heatpipes and air water heat pump

Water restaurant

Water restaurant solar PV panels

Historical part Heeg

Historical part Heeg roof ridge turbines, heatpipes and solar PV panels

Housing Heeg

Housing Heeg solar PV panels and heatpipes

Other end of same street

Other end of same street roof ridge turbines, heatpipes and solar panels

End of village

End of village roof ridge turbines, solar PV panels and heatpipes

Elderly home

Elderly home solar PV panels

Harbour and boat docks

Harbour and boat docks solar PV panels

Aerial photograph Heeg solar PV and heatpipes on houses and large roof surfaces

Aerial photograph Heeg heatpipes on houses, large wind turbine and mono-digesters


Viewing on the outer area


Viewing on the outer area with village wind turbine, mono-digester, solar PV panels and roof ridge turbine barn roof


Viewing on the outer area with large wind turbine, mono-digester, solar PV panels and roof ridge turbine barn roof


Viewing on the outer area with mono-digester, solar PV panels and roof ridge turbine barn roof

9.3 Workshop 2

9.3.1 Description

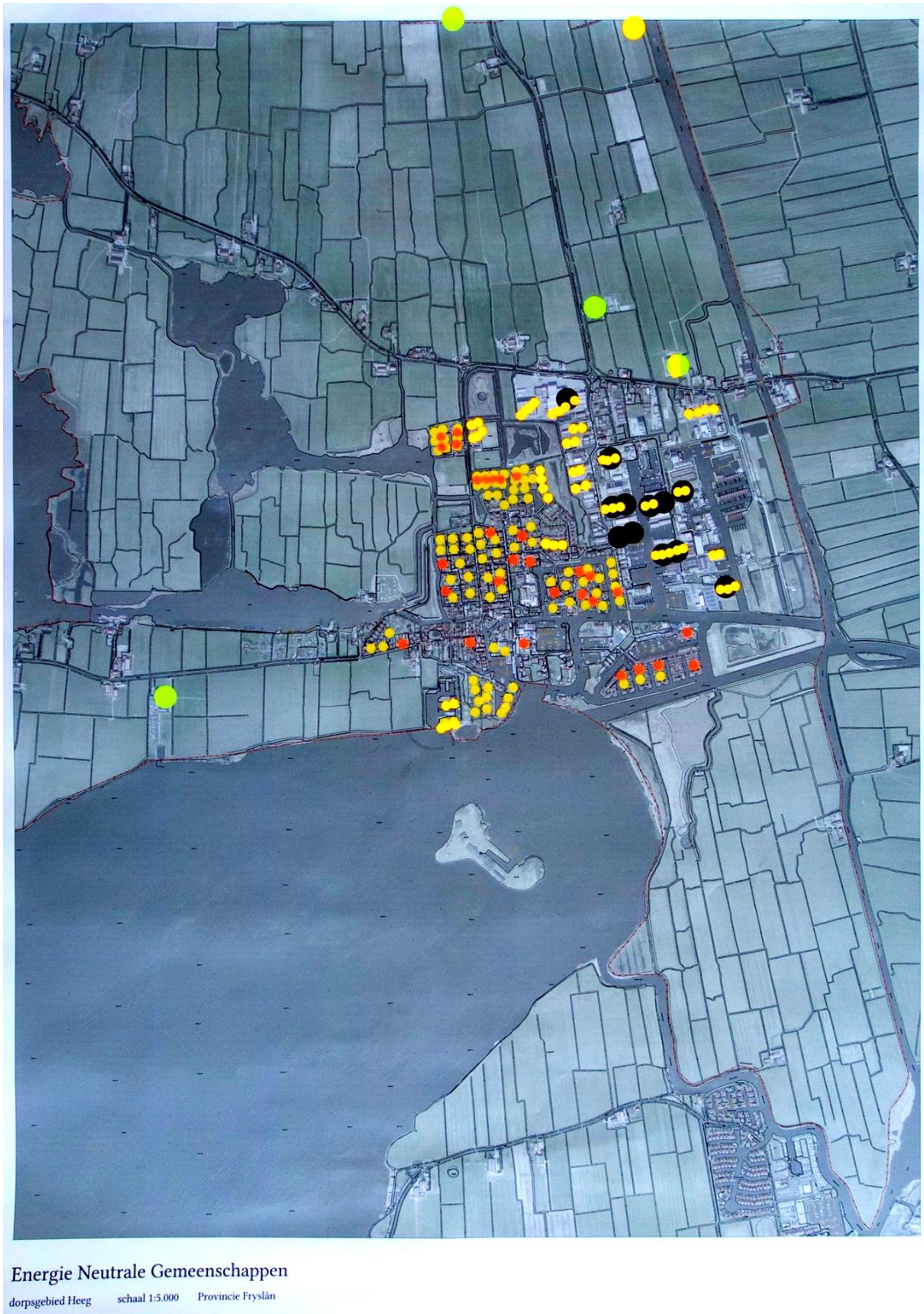
The second workshop with Heeg was held at week later at Tuesday evening the 30th of June 2015. The workshop was organized at a new location, the 'Stille boot' in Heeg, 12 people participated in this second workshop. First, a short word of welcome was provided and following the intent and structure of the workshop was explained. After this short introduction the word was given to the designer Erik Overdiep, who had prepared a short presentation of 10 minutes on the local scale of Heeg and its main spatial qualities. This presentation merged into the presentation of the visualizations of the initially desired futures as created in the first workshop, which also took around 10 minutes. Following, the participants were asked to gather around the central table displaying a blank map of the local scale. At the same time the 'create your own mix model' was projected on the big screen. In order to familiarize with the results of the first workshop and for any 'new' participants the maps created in the first workshop were also displayed on the table. For each of the mixes one representative was asked to shortly explain their considerations. Following the discussion was opened by asking the participants their reaction to the visualizations as well as to fill in the model starting from those renewable energy technologies on which all could agree. The workshop started around 19.30 and was finalized at around 22.30 hours. The findings from the workshop will be presented and discussed below.

9.3.2 The final energy mix Heeg

			Final Mix Heeg
Besparing			
	warmtepomp WKO	per huis	**100**
	warmtepomp Lucht	per huis	**400**
	pellet CV kachel	per huis	**0**
	hout kachel	per huis	**300**
	led-verlichting	per huis	**1000**
(vb. label C naar A++)	isolatie/triple glas	per huis	**600**
Zonne-energie particulier	Zonnecoll. Therm.	per huis (10m2)	**300**
	zonneboiler	per huis (3.2m2)	**0**
Productie	zonnecellen PV	per huis (14m2)	**0**
Zon PV collectief op dak	zonnecellen PV	per **ha.**	**5,000**
Zon PV collectief in veld	zonnecellen PV	per 3 **ha.**	**0,000**
Windturbines	huis turbines	per stuk	**0**
	daknokturbine	per huis	**600**
	dorpsmolen	per stuk	**0**
	grote turbine	per stuk	**0**
Biomassa	vergister elek	per stuk	**4**

mono-vergisting	vergister gas	per stuk	**0**
verbranding excl. warmtenet	hout/snippers	per stuk	**0**
Verkeer en vervoer	elektrische auto's	per stuk	**1000**
	groen gas auto´s	per stuk	**800**

9.3.3 Placement of the mix within the local scale



- Solar PV ($14m^2$) panels on 10 houses
- Solar collector ($12m^2$) or solar boiler ($3,2m^2$) on 10 houses
- Air-water heatpump, HCS system, Wood- Pelletstove at 10 houses
- Home windturbines on 10 houses
- Village wind turbine or large (3MW)
- Mono-digester electric or gas a piece
- Solar PV panels in field set-up per 0.5 ha

9.3.4 Preliminary findings

The spatial implications of the final energy mix as created by the participant in the workshop of Harkema are summed up in the figure below.

Final Mix	
In the Heeg of 2050 there will be:	
100	**houses with a HCS thermal storage system**
400	**houses with an air water heat pump**
0	**houses with a pelletstove**
300	**houses with a woodstove**
1000	**houses fitted with LED-lighting**
600	**houses with improved Insulation (e.g. Label C to A++)**
300	**houses with 10m2 of solar collector (heatpipes) each**
0	**houses with a solar boiler**
0	**houses with 14m2 of solar PV panels each**
5,000	**ha. of solar PV panels on large roof surfaces.**
0,000	**ha. of solar PV panels in contiguous field setup**
0	**houses fitted with a home wind turbine**
600	**units of 8 meter roof ridge turbine**
0	**Village wind turbine (≤1MW)**
0	**Large wind turbines (3MW)**
4	**Mono-digester producing Electricity**
0	**Mono-digester Gas**
0	**Biomass (wood/chips) burning**
1000	**Electric cars**
800	**Green Gas cars**

9.3.5 Creation of the final mix

In the second workshop with Heeg one final energy mix has been created and placed within the local scale. In the debate leading to the creation of this mix the following elements were present. The first step on which all can agree upon is the installation solar PV panels on the large roof surfaces. The participants mention that there is a very high degree of support for this development amongst the inhabitants of Heeg. As all these large roofs are present than why not cover them with solar panels, is the main line of thought. In total 6 ha of large roof surface is available on the large roof surfaces on the industrial area. This 6 ha. can provide all the electricity that is consumed on a yearly base within Heeg. At first sight this would mean that electricity is thus only produced collectively on the industrial area. However, it was explained that when the choice would be made for the production of heat with renewable energy technologies which use electricity such as HCS systems and air water heat pumps this situation might change. As more electricity would then be consumed on a yearly base. The collective production of electricity through the installation of solar PV panels upon large roofs was perceived as desirable by the participants. Also it was mentioned that when people also wanted to realize solar panels on their houses this would only be regarded as a plus/bonus.

The LEI has had conversations with the farmers in the surroundings of Heeg. Many of these farmers are willing to help in realizing the goal of the LEI, to become an energy neutral community. Farmers have indicated that their roof surface is available for the placement of solar PV panels or that a wind turbine can be installed on their land. Mono-digesters have not been discussed but as there is a lot of enthusiasm amongst the farmers the participants think that the farmers will be willing to install mono-digesters. Especially as this technology works by only using the manure of the cattle and no other products have to be purchased. Based on the size of the farmers within the area initially 7 mono-digesters can be installed within the local scale. The choice for the production of electricity or green gas with these technologies was left open first as this depended on the remaining energy demand after the technologies which will be applied at the individual houses have been filled in the model. For convenience the mono-digesters were first specified to produce Gas.

Therefore the step was made to the renewable energy technologies which are applied on the individual houses. The first measure that was discussed was the application of insulation. Although insulation was perceived as a very desirable measure, the discussion concerned the amount of houses (home-owner) that would actually improve their insulation in the coming years. A first number of 600 houses was set to do so. Following all houses present within the local scale of Heeg were set to use efficient lighting within the future.

Then, when looking at the model it was explained that the yearly electricity demand was renewably produced locally. However, still a large part of the yearly heat was depending on ‘grey’ natural gas consumption. It was therefore opted to focus on the renewable energy technologies which produce heat first. However, the participants decided to first focus on transportation as a shift towards electric cars would increase the yearly demand of electricity. First it was decided that in the future there would be around a 1000 electric cars. Then a debate followed on the future expectation of these green vehicles. One of the participants was convinced that hydrogen cars, which were not included in the model, would become an important element within future transportation. Other participants agreed with this participant and mentioned that green gas cars would not be important within the future transportation, although they are currently widely used by e.g. governments or parcel delivery. Nevertheless, the participants argued that within the future there would be no green gas cars. As the main goal behind the inclusion of green vehicles was to find out whether the participants wanted to change their current transportation system towards a system based on renewable fuels and renewable energy technologies. The question was asked, leaving the green gas cars behind, whether the future transportation in Heeg should be driven by green technologies such as hydrogen cars. All agreed that this should be the case therefore a number of 800 green cars were filled in for the green gas cars as these other technologies were not included within the model. Additionally, it was mentioned that there would always remain a small number of fossil fuel driven cars such as old-timers etc. within the village.

What remained within the model was that a large part of the heat demand was still depending on ‘grey’ natural gas consumption. Between the different renewable energy technologies for the production of heat air water heat pumps were mentioned first as a desirable technology by the participants, as they could be placed out of sight around the house (e.g. within shrubbery) and painted in a an inconspicuous colour (green). A number of 500 air-water heat pumps were set to be installed spread through the village. Following the HCS systems are discussed, as there are no visual spatial implications of this technology the participants also perceive this technology as desirable. Also because it is possible to install such a HCS system collectively for a larger number of houses and there already a number of houses that have installed this technology. Due to the higher purchase price of these renewable energy technologies as well as the restriction on the number of these systems due to the influence of these system on each other when placed in vicinity a lower number of these renewable energy technologies was chosen than air-water heat pumps. 200 HCS system were set to be installed throughout the village. Then woodstoves were also perceived as a technology that would be applied within the future as they are already present within the area. 300 woodstoves of which also a share might actually be pellet-stoves were set to be installed spread throughout the village.

With these renewable energy technologies all the energy consumed yearly on the local scale for electricity, heat and mobility is produced locally, and thereby the assignment for workshop two was ‘in principle’ completed. However, a discussion was started on whether these were the most preferred renewable energy technologies and whether the current mix comprised all renewable energy technologies that should be installed within the local scale. One participant raised a point on the exclusion of wind energy in the form of roof ridge turbines the current mix. These roof ridge turbines could namely very well be installed on the roof ridges of the industrial building along with the solar panels. It was therefore suggested to go through the model ones again to ensure that all desired renewable energy technologies have been selected. One participant suggested to run through the model again thereby looking at the cost prize per generated kWh. As such the cheapest renewable energy technologies can be selected. Additionally this participant mentioned in the form of an open question that the currently selected air-water heatpumps also demand a lot of extra electricity thereby questioning whether that is a preferable to for example solar collectors.

In the light of energy availability it is argued by another participant that it would be preferable to install as many different renewable energy technologies as possible. Other participants agree with this mentioning wind energy as an important element that is missing in the current mix. Besides the roof ridge turbines it is also mentioned by some participants that a wind turbine should be installed in the local scale of Heeg. An additional benefit named for such a village windturbine is that it can create a sense of community. Within the following discussion it is explained that one village windturbine is proportionate to at least 1ha of solar panels on roofsurface. Opinions concerning the installation of a windturbine differed in which half of the participants are favour and half of the participants are against. Proponents argue for the importance of installing renewable energy technologies producing energy from the wind in these cases when there would not be (enough) sunshine and that wind turbines produce energy both day and night. Additionally, a windturbine is perceived to suit the character of the ‘windy’ village of Heeg, which is strongly oriented at water and sail sports. When it would be decided to install a wind turbine than a large turbine was preferred above a smaller one, because of its higher production capacities. However, for this workshop the proponents of a windturbine let go of this idea mainly in relation to current provincial and municipal policy and the ‘fuss’ which generally surrounds wind turbines. This windturbine was however kept a possible option, its preferred place of installation is indicated on the map far north from the village.

As both groups could find themselves in the installation of roof ridge turbines it is decided that these renewable energy technologies should be installed on the roof ridges at the industrial area as well as on the houses present within Heeg. It was decided that an equivalent of 600 houses with 8 meters of roof ridge turbines should be installed, in which they are preferably installed on the large roof ridges of the industry. It was decided that approximately one quarter of the houses within Heeg should have such a roof ridge turbine installed. The addition of this technology meant that a smaller surface of solar PV panels would be necessary, this surface was subsequently adjusted to 5 ha.

Following it was mentioned that solar thermal technologies were not installed in the current energy mix. The participants did however expect that these renewable energy technologies will also be installed within Heeg, especially as there might be some inhabitants who want to disconnect from the gas grid. Visually these solar collectors were not perceived as a problem and also the low costs per kWh attracted the participants. It was decided that around 400 houses would also install around 10m2 of solar collector.

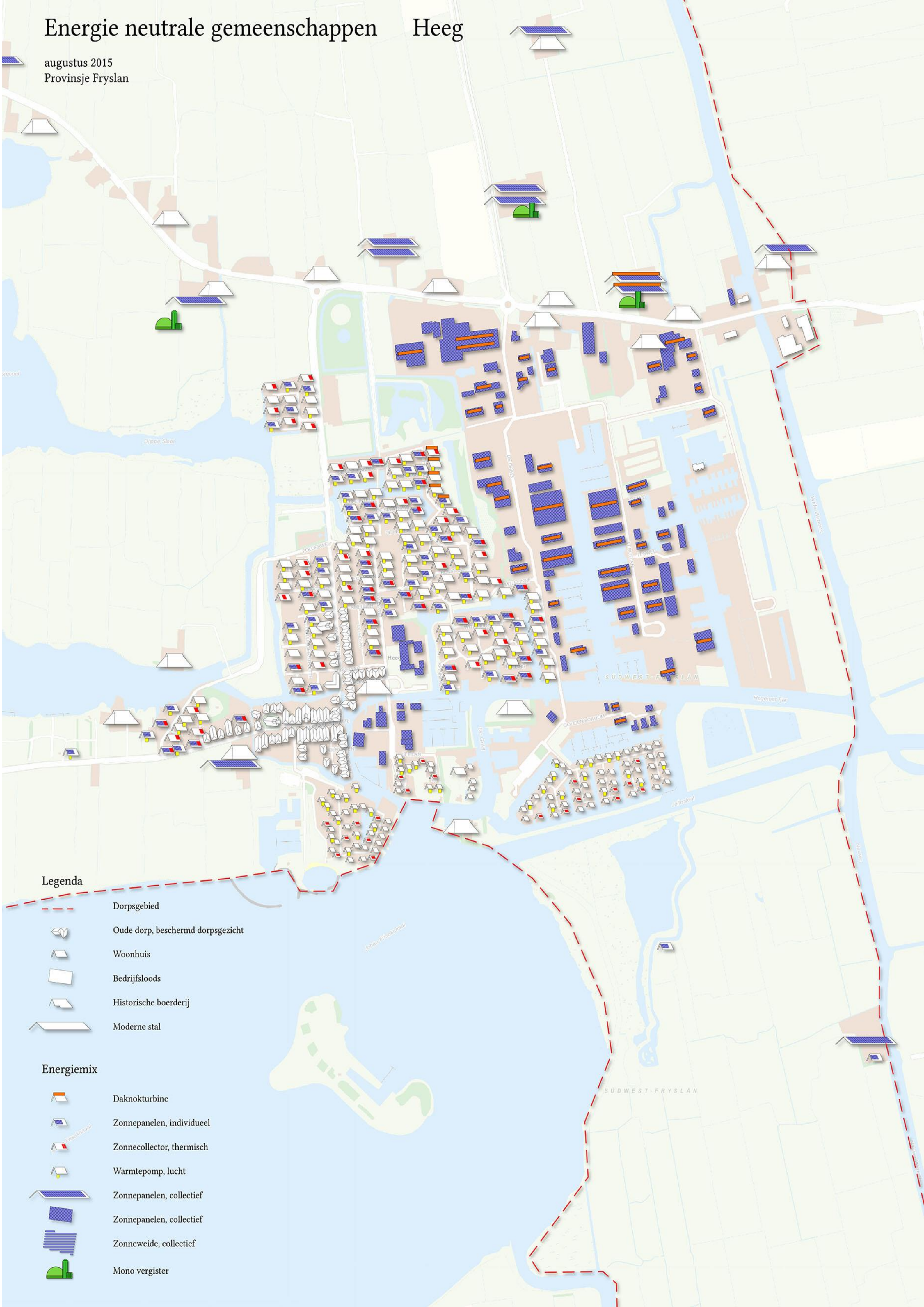
As a result of the addition of this technology too much heat was produced. Therefore it was decided to lower the amount of renewable energy technologies producing heat. A first step was to lower the number of mono-digester producing gas. It turned out that this technology would not even be necessary within the current mix. However, the participant absolutely wanted to install mono-digesters, especially as they might also play a role in the manure problem for the farmers. Therefore a minimum number of four mono-digesters were set which would instead of green gas produce electricity. Then, still too much heat was produced and as a result it was decided to first lower the amount of HCS systems to 100 pieces as these are relatively expensive technology in terms of purchase. Also the amount of air water heatpumps and solar collectors was lowered to respectively 400 and 300.

It is expected that within the future also a lot of home owners will install solar PV panels on their houses, Although these renewable energy technologies have not been included in the final mix the participants are not against this development (the same holds for solar boilers). Instead the installation of these renewable energy technologies was considered as a bonus. As in principle all the electricity needed is produced on the large roof surfaces. The installation of solar PV on private houses might be interchanged with the amount of solar PV surface to be installed on the large roofs of the industry. Based on the visualizations the participants agreed that the renewable energy technologies which are installed on the roofs, such as solar PV panels and solar collectors, should not be placed within the historical parts of the town. It was decided that the houses in this part of the village should install less visually prominent renewable energy technologies such as pellet- and woodstoves or air water heat pumps and HCS systems.

Finally the participants were asked whether they also had the ambition to store the energy produced on the local level. The participants mentioned that this would indeed be desirable and that the upcoming new batteries of Tesla might offer a solution to this. However, no concrete ideas on whether this energy storage should be organized on the individual or the collective level were present.

9.4 Main differences with workshop 1

The final energy mix is very similar to the mixes created within the first workshop. Also these initial mixes have very similar characteristics. The most notable differences concern the high increase of roof ridge turbines within the final model. This difference is effected by the fact that the participants absolutely wanted to use the potential of wind energy within the area. As they could not agree on the installation of a windturbine, the roofridge turbines were chosen as an alternative. A windturbine was kept and placed as an option far north from the village. Another notable difference is the absence of solar PV panels within the village and the related increase of solar PV surface on the large roof surfaces of the industry. However, this is not to say that the participants are against the installation of solar PV panels upon the houses within the village. The surface of solar PV panels that will be installed upon the houses within the village are perceived as a bonus and can be interchanged with the needed surface upon the large roof surfaces of the industrial area. An exception should however be made for the historical part of the village for which it was decided that, after seeing the visualizations, no visually prominent renewable energy technologies should be installed.


Energie neutrale gemeenschappen Heeg
augustus 2015
Provinsje Fryslan
Legenda
Dorpsgebied
Oude dorp, beschermd dorpsgezicht
Woonhuis
Bedrijfsloods
Historische boerderij
Moderne stal
Energiemix
Daknokturbine
Zonnepanelen, individueel
Zonnecollector, thermisch
Warmtepomp, lucht
Zonnepanelen, collectief
Zonnepanelen, collectief
Zonneweide, collectief
Mono vergister

10 Clay - Baard

Baard is a small village in the heart of the municipality Litenseradeel, around 200 people live in the village in about 85 houses. Once, before 1440, Baard took in an important place as main town with its own jurisdiction and as administrative center in the grietenij (term for old Frisian administratine division) Baarderadeel. This position was strongly influenced by its strategic position along the waters of the ‘important’ Bolswardertrekvaart, which give the village good access to other areas. In 1830 Baard also received road access along the road from Franeker to the hinterland of Jorwert and surroundings. For many centuries Baard was ruled by the noble family Dekema which had their ‘stins’ a type of fortification situated over here. The only memory of their presence at current is the Dekemawei. The only mobile bridge along the long Bolswardertrekvaart is situated at the village edge. On both sides of the main street compactly built, relatively simple, mostly plastered rentiers houses can be found, which are not really aligned. Within the center of the village an open field can be found which is used for the traditional ‘kaats’ sports in Baard. The neighborhood behind the church which consists of a mix between older and post-war houses forms a closed front on the north-side of the village towards the canal and harbor situated there. Further on the road towards Jorwert mixed buildings have been developed in the course of time (Karstkarel 2005).

Baard enjoys a rich associational life, generally speaking the people of Baard are not afraid to roll up their sleeves (Westhof 2015). The village is located within the Clayterp landscape. A description of the landscape typology of the area surrounding Baard can be found in table 5.

Table 5 Landscape typology Baard and surroundings

Main Landscape	Clayterps Landscape (Kleiterpenlandschap)
Description	Former tidal areas where terps are raised for a safe place to live
Soil and geology	heavy calcareous marine clay soils (knipklei), former gullies present
Size and scale	Medium to large-scale open landscape, bounded horizon (within approximately 3-5 km)
Structures	Higher terps within open landscape
Villages	scattered terp villages; small villages
Farmyards	at edges of terp villages or spread horizontally, sometimes on terp
Roads	tortuous, random pattern; church paths
Water	presence waterways, channels and strong meandering former gullies
Parcelling	locally radial parceling near terps, ancient irregular block parceling
Vegetation	pointwise at terpvillages and farmyards, sparsely along roads
Particularities	church towers with gable roof, (house) mounds, church paths, dairy factories, Slachtedike, system of canals and towpaths

Within Baard the local initiative ‘Grieneko’ is working towards sustainability goals. This LEI was established on the 19^{th} of April 2015 as a result of local roundtable discussions in which it was specified that a collective sustainable approach for (the development of) Baard and surroundings was desired. It was decided to come to a collective approach for a sustainable energy policy, in which less gas, less electricity and more comfort are the main goals. On the basis of an inventory it was also decided that these goals should be tackled through a collective approach. As a result a local energy cooperation was founded through which the deliverance of energy through the NLD became possible.

The main goals of the LEI are:

- Encouraging and realizing energy savings;
- Encouraging and realizing solutions for renewable energy production;
- Advising members / customers on energy consumption;
- Running or participating in a company focused on the buying and selling of renewable energy;
- Encouraging and realizing social/societal goals;
- Using profit, which is not required for operation for renewable energy and social projects in line with the objectives of the cooperative.

The name 'Grieneko' which is the merging of Green and Eco was inspired by the Frisian cow. The LEI operates in the 'Greidhoeke' which is an area characterized by the many dairy livestock farms. Grieneko, which can also be read in Frisian as Green Cow refers to the cow which is a very efficient digester of biomass with milk, meat and biogass as a result.. This kind of efficiency inspires the LEI to work in a similar manner with energy and the local landscape (Grieneko 2015).

Figure 7 Logo LEI Baard

10.1 Workshop 1

10.1.1 Description

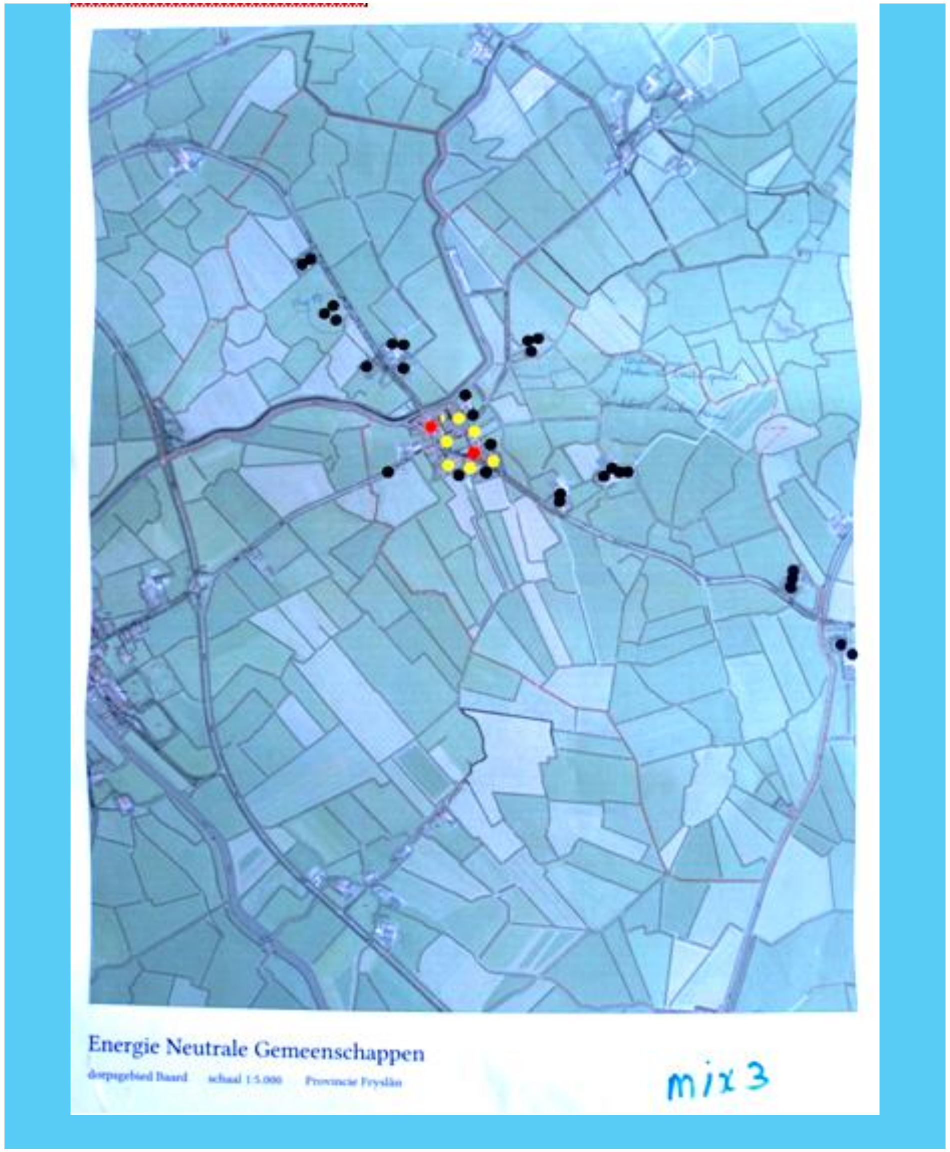
The first workshop with Baard was held at Tuesday evening the 9th of June 2015. The workshop was organized as a standalone event of the LEIs and was organized in the townhouse ‘The Murdhoun’ in Húns, due to the occupation of the townhouse in Baard itself. Húns is a small village approximately 3km away from Baard which is in the meantime also included in the LEI called Grieneko . More than 20 people had indicated to join the workshop beforehand, of which eventually 12 actually participated. After the introductory presentation the participants were divided into 3 groups. Following these 3 groups completed exercise 1 and 2 as explained within the methods section. The workshop started around 20.00 hours and was finalized at around 22.30 hours. The findings from the workshop will be presented and discussed below

10.1.2 Results

10.1.2.1 *Exercise 1 - create your own mix*

			Mix 1	Mix 2	Mix 3
Besparing					
	Warmtepomp WKO	per huis	10	3	5
	Warmtepomp Lucht	per huis	1	17	22
	pellet CV kachel	per huis	2	17	10
	hout kachel	per huis	10	25	25
	led-verlichting	per huis	85	50	85
(vb. van label C naar A++)	isolatie/triple glas	per huis	85	5	60
Zonne-energie Particulier	zonnecollector Thermisch	per huis (10m2)	10	20	
	zonneboiler	per huis (3.2m2)	10	20	20
Productie	zonnecellen PV	per huis (14m2)	65		
Zon PV Collectief op dak	zonnecellen PV	per **ha.**	0,5	0,5	0,4
Zon PV Collectief in veld	zonnecellen PV	per **ha.**		1	
Windturbines	huis en tuin turbines	per huis			
	daknokturbine	per stuk	4	3	
	doarpsmûne/dorpsmolen	per stuk			
	grote turbine	per stuk			
Biomassa	vergister elek	per stuk			
mono-vergisting	vergister gas	per stuk	1		
verbranding excl. warmtenet	hout/snippers	per stuk			
Verkeer en vervoer	elektrische auto's	per stuk	60	20	75
	groen gas	per stuk	90	10	75

10.1.2.2 ***Exercise 2 - positioning the mix in the local scale***



Customization

During the workshop the need rose for the customization of the (black) stickers representing solar PV panels amongst. This need rose as all the groups intended to implement solar panels on the large barn roofs in the outer area. Due to the small size of the village of Baard around 0,5 ha of solar panels can provide the electricity demand in the created mixes. In the initial scaling this would mean that 1 large black round sticker would need to be placed in the outer area. However this would not represent the actual situation as the implementation of 0.5 ha of solar PV panels would mean that almost all barn roofs would be covered by PV panels. And thus actually should be labeled with a black sticker. Therefore the large black sticker indicating 5000m^2 of solar panels was subdivided into small black stickers. Which each represented 140m^2 of solar PV panels in the original scaling. As such 1 large black sticker comprised (5000/140) 35 small black stickers. This causes the large amount of small black stickers in the outer area of Baard on maps 1,2 and 3.

10.2 Preliminary findings

10.2.1.1 *Mix 1*

Mix 1	
In the Baard of 2050 there will be:	
10	houses with a HCS thermal storage system
1	house with an air water heat pump
2	houses with a pelletstove
10	houses with a woodstove
85	houses fitted with LED-lighting
85	houses with improved Isolation (e.g. Label C to A++)
10	houses with 10m2 of solar collector (heatpipes) each
10	houses with a solar boiler
65	houses with 14m2 of solar PV panels each
0,5	ha. of solar PV panels on large roof surfaces.
4	units of 8 meter roof ridge turbine
1	mono-digester producing Gas
60	electric cars
90	green Gas cars

The spatial implications of the energy mix as created by group 1 are summed up in the figure on the right. Within the desired future as described by group 1 solar PV panels are installed on almost all available roof surface, both within and outside the village on large barn roof surfaces. Additionally roof ridge turbines will be installed on the ridge of a barn as many of those turbines can be installed there simultaneously. The group will take advantage of the availability of pruning's and wood residues at the terrain called the 'Dwinge'. By making their own pellets from this residue wood the group has found a useful way to solve the disposal problem existing at the site. Furthermore the group assigns a role to the production of energy from the manure present at the surrounding livestock farms through the implementation of a mono-digester. This mono-digester is placed specifically at the border of the own local scale in order to allow the surrounding farmers to join in the mono-digester. The group want to produce more electricity than needed on a yearly base with the intention to use the surplus to produce hydrogen in the form of energy storage. This hydrogen may then be used as an admixture within diesel in agricultural equipment.

10.2.1.2 *Mix 2*

Mix 2	
In the Baard of 2050 there will be:	
3	houses with a HCS thermal storage system
17	house with an air water heat pump
17	houses with a pelletstove
25	houses with a woodstove
50	houses fitted with LED-lighting
5	houses with improved Isolation (e.g. Label C to A++)
20	houses with 10m2 of solar collector (heatpipes) each
20	houses with a solar boiler
0,5	ha. of solar PV panels on large roof surfaces.
1	ha of solar PV panels in contiguous field setup
3	units of 8 meter roof ridge turbine
20	Electric cars
10	Green Gas cars

The spatial implications of the energy mix as created by group 2 are summed up in the figure on the left. Within the desired future as described by group 1 solar PV panels are installed on half of the available roof surface. These solar panels are placed especially on large roof surfaces, such as barns, in which monumental building are spared. At the houses which have solar panels installed, a combination is made with heat pumps for the provision of heat. Besides solar PV panels on roofs there is also a solar field established adjacent to the east of the village. This specific site is especially chosen as it provided the opportunity to embed the solar field in the landscape with the use of shrubbery. The electricity produced through the solar PV panels is also stored locally (undetermined), which gives rise to the opportunity to the disconnection of the gas grid and thereby sparing the fixed charges related to this connection. Furthermore roof ridge turbines are installed on a barn which are specifically chosen above wind turbines. For the transportation in and out of the village all cars are driven by electricity.

10.2.1.3 *Mix 3*

The spatial implications of the energy mix as created by group 1 are summed up in the figure on the right. Within the desired future as described by group 3 the production of heat takes place at the houses, with the use of different renewable energy technologies. An important preliminary step to this was to make sure that energy does not 'fly out' of one's house. In general there is much to be gained through realizing energy savings which should therefore be the first step. Therefore almost all houses have first been provided with improved insulation and LED-lighting. Solar PV panels have not been installed within the village. Instead the production of electricity through PV panels is implemented collectively on large roof surfaces in the outer area.

Mix 3	
In the Baard of 2050 there will be:	
5	houses with a HCS thermal storage system
22	house with an air water heat pump
10	houses with a pelletstove
25	houses with a woodstove
85	houses fitted with LED-lighting
60	houses with improved Isolation (e.g. Label C to A++)
20	houses with a solar boiler
0,4	ha. of solar PV panels on large roof surfaces.
75	Electric cars
75	Green Gas cars

10.2.2 General reflection

The three described desired futures all have their own distinct spatial implications on the local scale. Throughout the three created energy mixes it becomes clear that within the outer area of Baard an important role is given to the collective production of electricity with solar PV panels on large barn roofs. The related spatial implications of this multifunctional use of space mainly concentrate on visual aspects. This is because the installation of solar panels on barns basically implies the addition of one extra layer upon already existing roof surface. Visually however, this development will most likely lead to a change in colour as well as texture of the roof surface of barns, which are currently, most often covered with non-shining corrugated sheets. It is especially the texture of the barn roofs which will change through the covering of the roof with smooth (and shiny) solar PV panels, as the colour of solar panels can be varied.

Besides the production of electricity through the installation of solar PV panels, two groups have also envisioned a place for roof ridge turbines on the large (long) roofs of barns in the outer area. Again this multifunctional use of space will only impose visual changes of the ridge of the barn roof through the addition of a turbine along the ridge.

Through the relatively large size of barns and their predominant saddle-type roofs, in combination with their individual and dispersed placement within the open landscape, barns can be considered to be iconic elements within the agricultural landscape surrounding Baard. The implementation of solar panels and roof ridge turbines on the barn roofs will become an important part of these iconic elements in the desired futures and thereby visible elements within the landscape.

Besides the 'energy production' function of the barn roof, there seems to be another energy production function attributed to the agricultural plot. Within the group discussion of the desired futures, all participants were positive about the implementation of mono-digesters at livestock farms. As these mono-digesters might potentially form a solution to the manure problem whilst simultaneously producing renewable energy. Such a mono-digester will generally demand around 200m^2 of space on the agricultural plot in proximity of the barn.

Following, within the built-up area of the village the three desired futures comprise different spatial implications. Whereas within the outer area a main role for the collective production of electricity was reserved on the roof surface of barns. Within the village a main role is reserved for the individual production of heat. All the available renewable energy technologies for the production of heat are applied in the village within the described futures, albeit in varying degrees. An exception should however be made for the use of heatpipes within mix 3. As mix 3 is also against the implementation of solar PV panels on houses within the village, the choice not to implement heatpipes might also be related to a perception within group 3 not to install relatively large (in excess of 10 m^2) renewable energy technologies on roofs within the village. Concerning the additional installation of solar PV panels within the village there seems to be a difference in perspective in whether (mix 1) or not (mix 3) to install solar PV panels on the roofs of houses within the village. Where mix 2 describes a combination between these two by giving preference to the installation of solar PV panels on the large roof surfaces also within the village whereby monumental buildings are excluded (mix 2).
Throughout the three futures it has become apparent that there is no place for a wind turbine in and around Baard (eventhough there already is an old (2-bladed) Lagerweij turbine present). The participants in the workshop argued that the scale of a wind turbine is too large for a small community such as Baard. Especially as it turned out that there is enough roof surface available at the surrounding barns to accommodate the electricity demand. It seems also therefore that in all the three described futures, the available roof surface of barns in the outer area are used for the collective production of electricity.

10.3 Visualizations Baard

Farm Baard

Farm with mono-digester and solar PV panels

Street Baard

Street Baard solar PV panels and roof ridge turbine


'Kaats' sport accommodation Baard


'Kaats' sport accommodation Baard solar PV panels and heatpipes


New housing Baard


New housing Baard solar PV panels, air water heatpump, heatpipes and roof ridge turbine


Entrance Baard


Entrance Baard solar PV panels and heatpipes


Historical farm building


Historical farm building solar PV panels

Street Baard

Street Baard solar PV panels and heatpipes

View from sports field

View from sports field solar PV panels and heatpipes

Haadstrjitte

Haadstrjitte solar PV panels, air water heat pumps, heatpipes and roof ridge turbines

Potential solar PV field

Solar PV field ‘covered’ with shrubbery


Aerial photograph Baard


Aerial photograph Baard solar PV on all houses and heatpipes


Aerial photograph Baard solar PV field and mono-digesters


Aerial photograph Baard solar PV on houses, small solar field and mono-digesters at livestock farms

Sight on Baard

Sight on Baard solar PV only on barn roofs and mono-digesters

Sight on Baard solar PV on all large roof surfaces

Sight on Baard village wind turbine

10.4 Workshop 2

10.4.1 Description

The second workshop with Baard was held Thursday evening the 2nd of Juli 2015. The workshop was organized at the same location: townhouse 'The Murdhoun' in Húns, 10 people joined in this second workshop. First, a short word of welcome was provided and following the intent and structure of the workshop was explained. After this short introduction the word was given to the designer Erik Overdiep, who had prepared a short presentation of 10 minutes on the local scale of Baard and its main spatial qualities. This presentation merged into the presentation of the visualizations of the initially desired futures as created in the first workshop, which also took around 10 minutes. Following, the participants were asked to gather around the central table displaying a blank map of the local scale. At the same time the 'create your own mix model' was projected on the big screen. In order to familiarize with the results of the first workshop and for any 'new' participants the maps created in the first workshop were also displayed on the table. For each of the mixes one representative was asked to shortly explain their considerations. Following the discussion was opened by asking the participants their reaction to the visualizations as well as to fill in the model starting from those renewable energy technologies on which all could agree. The workshop started around 19.30 and was finalized at around 22.30 hours. The findings from the workshop will be presented and discussed below.

10.4.2 The final energy mix Baard

			Final Mix
Besparing			**Baard**
	warmtepomp WKO	per huis	**0**
	warmtepomp Lucht	per huis	**25**
	pellet CV kachel	per huis	**25**
	hout kachel	per huis	**0**
	led-verlichting	per huis	**0**
(vb. label C naar A++)	isolatie/triple glas	per huis	**40**
Zonne-energie particulier	Zonnecoll. Therm.	per huis (10m2)	**25**
	zonneboiler	per huis (3.2m2)	**0**
Productie	zonnecellen PV	per huis (14m2)	**40**
Zon PV collectief op dak	zonnecellen PV	per **ha.**	**0,300**
Zon PV collectief in veld	zonnecellen PV	per 3 **ha.**	**0,000**
Windturbines	huis turbines	per stuk	**0**
	daknokturbine	per huis	**16**
	dorpsmolen	per stuk	**0**

	grote turbine	per stuk	**0**
Biomassa	vergister elek	per stuk	**1**
mono-vergisting	vergister gas	per stuk	**2**
verbranding excl. warmtenet	hout/snippers	per stuk	**0**
Verkeer en vervoer	elektrische auto's	per stuk	**150**
	groen gas auto´s	per stuk	**0**

10.4.3 Placement of the mix within the local scale

- Solar PV ($14m^2$) panels on 10 houses
- Solar collector ($12m^2$) or solar boiler ($3{,}2m^2$) on 10 houses
- Air-water heatpump, HCS system, Wood- Pelletstove at 10 houses
- Home windturbines on 10 houses
- Village wind turbine or large (3MW)
- Mono-digester electric or gas a piece
- Solar PV panels in field set-up per 0.5 ha

10.4.4 Preliminary findings

The spatial implications of the final energy mix as created by the participant in the workshop of Baard are summed up in the figure below.

Final Mix	
In the Baard of 2050 there will be:	
0	houses with a HCS thermal storage system
25	houses with an air water heat pump
25	houses with a pelletstove
0	houses with a woodstove
0	houses fitted with LED-lighting
40	houses with improved Insulation (e.g. Label C to A++)
25	houses with 10m2 of solar collector (heatpipes) each
0	houses with a solar boiler
40	houses with 14m2 of solar PV panels each
0,300	ha. of solar PV panels on large roof surfaces.
0,000	ha. of solar PV panels in contiguous field setup
0	houses fitted with a home wind turbine
16	units of 8 meter roof ridge turbine
0	Village wind turbine (≤1MW)
0	Large wind turbines (3MW)
1	Mono-digester producing Electricity
2	Mono-digester Gas
0	Biomass (wood/chips) burning
150	Electric cars
0	Green Gas cars

10.4.5 Creation of the final mix

In the second workshop with Baard one final energy mix has been created and placed within the local scale. In the debate leading to the creation of this mix the following elements were present. Starting from the renewable energy technologies on which all can agree upon, first pellet stoves were mentioned as suitable technology for application within Baard. However not all participants agreed and a discussion started on the sustainability of use and production of pellets. Main objections raised were the system of first storing but then again emitting CO2 in pellets and the origin of the biomass within the pellets. As no clear agreement could be reached is was opted to move on to another technology first. The next technology to be discussed is the installation solar PV panels on the large roof surfaces. One participant argues that the installation of solar PV panels on all the large roofs available is the best solution as it is a relative easy and clear choice of which the investment can also relatively well be substantiated. Instead of starting to fill in the model starting from these large roof surfaces the participants suggest to start with the installation of solar PV panels upon the houses within the village.

From a practical point of view participant argues that not every home owner in the village will be willing to install solar panels on his house. Subsequently, not all houses upon which home owners are willing to install solar panels are suitable for the installation of solar panels. From a recent stocktaking that was conducted by the LEI at the households within the village. 18 out of 72 respondents indicated to already have installed solar panels. Another 32 households were willing to install solar panels in the short term. Most likely this is the percentage of houses that will have installed solar panels within the near future. As such there are still a number of barn roofs needed for the installation of solar PV panels in order to produce enough electricity. All the available roof surface of the large barns within the local scale can be used as the possible over production of electricity might again be consumed through the installation of for example air-water heatpumps at the individual houses within the village.

One of the participants disagrees with the former point made that around 40 houses will install solar PV panels. She argues that when people would get acquainted with the opportunity to collectively install solar PV panels on large roof surfaces, while maintaining the financial benefits. Everybody would much rather install solar PV panels collectively on large roof surfaces. All participants agree that the installation on large roof surfaces would be more preferable, however some perceive it as more or less inevitable that homeowners will install solar PV panels. Then the question was asked whether the participants found it important to protect specific places from the installation of solar PV panels. One answered that he has also installed solar PV panels upon his house. However he had specifically chosen to install these panels on the back of his barn as he did not want these panels to be installed in sight. Even though he would not see these panels himself if they would have been installed on the side of his house which would be a more favourable place in terms of electricity production. Thereby the participant was implying that people themselves will most often install such panels on the visually most suitable roof surfaces, or in other words out of sight. It was decided that electricity from solar PV panels should play an important part within the electricity production of Baard therefore it was decided that half of the houses within Baard would install (14m2) of solar PV panels and that all of the available 3200m2 large roof surface of barns would also be used for the installation of solar PV panels.

Hereby all the yearly demanded electricity was produced renewable on the local scale. As a next step the participants wanted to discuss the renewable energy technologies for the production of heat. The first technology to be discussed were the air water heatpumps, these renewable energy technologies were perceived to be more popular than HCS systems as they are much cheaper in purchase. It was specified that around 30% of the households within Baard would install such a air water heatpump and that another 30% of the households would install a pelletstove. Relating to the idea to produce the needed pellets locally, which arose within the first workshop, it was asked whether the participants also wanted to plant their own piece of woodland. Many participants thought this was a good idea and a specific location has been indicated on which such a woodland for the production of the own pellets could be planted.

The following technology to be discussed were mono-digester as they could play a role in filling in the extra electricity demand resulting from the installation of the air-water heatpumps, as well as the production of green gas. It was decided that in total three mono-digesters could be installed within the local scale of Baard of which one should produce electricity and two green gas. Then only transportation was still dependent upon fossil fuels, the participants all agreed that all cars would in the future be driven by green electricity. And through this addition all the energy consumed on a yearly base within the local scale of Baard was also produced with renewable energy technologies within the local scale.

In order to ensure that all preferred renewable energy technologies had been included in this final model it was decided to run through the model again. One of the participants mentioned that he would really like to install some roof ridge turbines upon his barn roof. Together with another participant they had approximately 150 meters of roof ridge at their disposal upon which 16 roof ridge turbines could be installed. The other participants could abide to this choice and therefore it was decided that upon these large roof ridges 16 roof ridge turbines of 8 meters would be installed. As a result too much electricity was produced which meant that the surface of solar PV panels could be lowered.

It is mentioned that within the current mix not all houses within the village have installed renewable energy technologies for the production of heat approximately 50 out of the 85 houses have renewable energy technologies installed whereas the remainder of the green gas is provided by mono-digesters. Solar collectors are mentioned as a desirable technology to be installed within Baard. One of the participants mentions that it would be desirable that all individual houses within the village would produce their own heat demand. Additionally he mentions that this heat is than stored in buffer tanks within the house, which can also heat the water with electricity when there would be to less heat produced by the technology. This electricity is subsequently also produced renewably.

This statement causes a discussion on the specific order in which different energy types (electricity and heat) are produced locally. On the basis of the above the participants mention that it would be desirable to first locally produce the heat demand with renewable energy technologies. First, because when looking at the household expenses, natural gas consumption for heating takes up the largest part (2/3) of the energy bill. And second because the additional and remaining amount of electricity needed is not very difficult to be produced.

The participants were brought to the attention that so far, insulation had not been filled in within the model. All participants felt that insulation is an indispensible part of realizing an energy neutral community. However, a remark was made that the insulation of houses can only go until a certain height, as when reaching a specific standard (e.g. energy label A) it will become cheaper to invest in renewable production than to add extra insulation measurers. A total number of 50 houses was set of which the insulation standard would be improved in the coming years. Additionally, it was decided that around a quarter (25) of the households would install solar collector systems.

Through the installation of these renewable energy technologies more energy was produced locally than consumed on a yearly base. The participant in the workshop felt that having a little over production was not a problem as in this way possible fall outs of specific renewable energy technologies can be intercepted. Additionally, it was mentioned that this over-production could also be used in those areas within the province, such as for example a city as Leeuwarden, where they will have real problems in producing the needed amount of energy on the own local level.

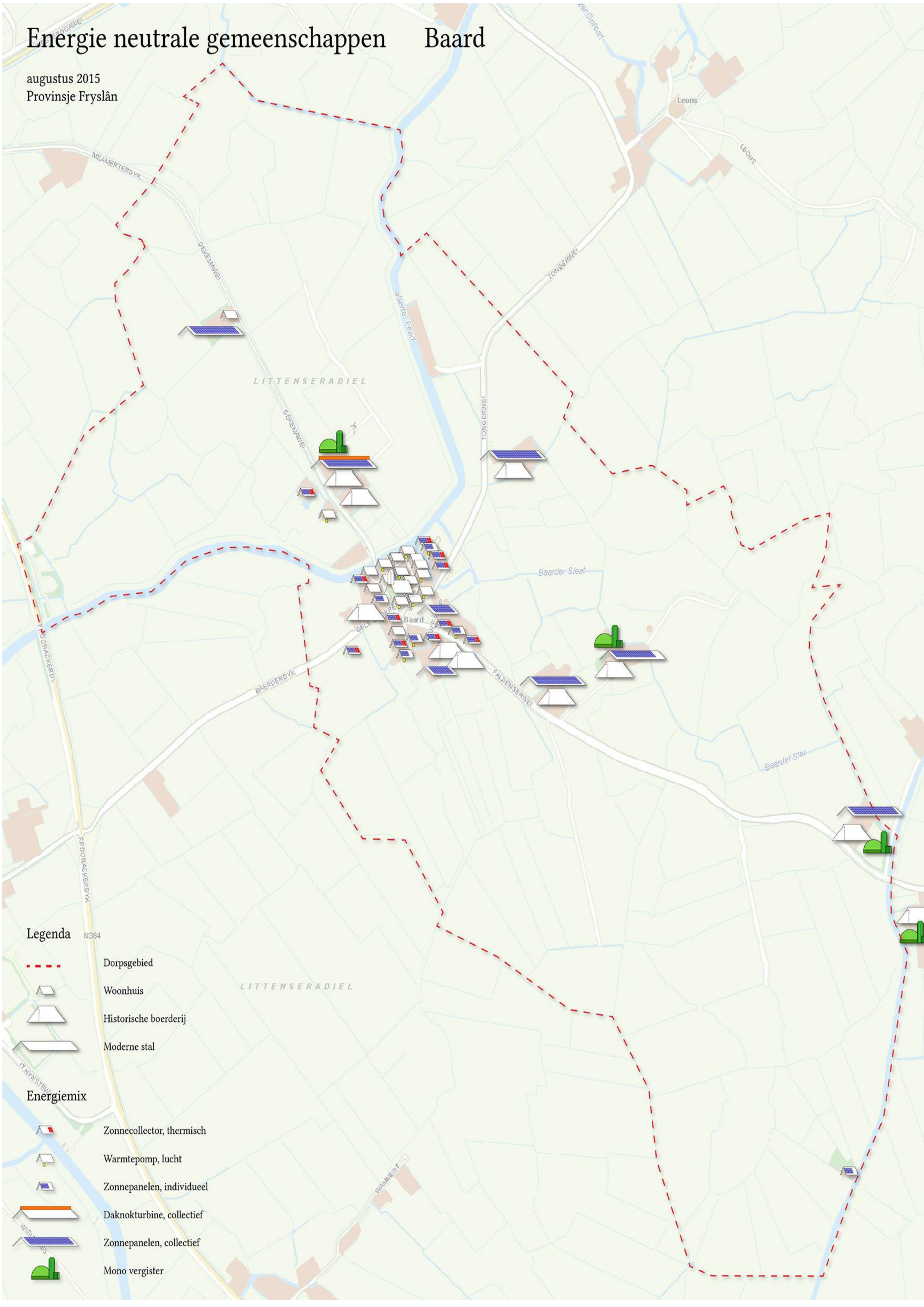
10.5 Main differences with workshop 1

The final energy mix is very similar to the mixes created within the first workshop. The main difference within the final energy mix and the mixes created in the first workshop concern the installation of solar PV panels upon the houses within the village. In the first workshop two out of three mixes mentioned rather not to install solar PV panels within the village. However, in the final mix they have been included upon half of the houses. On the basis of the discussion with the second workshop it can be concluded that the decision to install solar PV panels within the village has resulted from practical experience i.e. inhabitants will install solar panels upon their houses anyways. This is not to say that the general opinion stating that it would be preferable to install solar panels upon large roof surfaces has changed among the participants. This also seems to be reflected in the absence of a solar field within the final mix, which was initially chosen by one of the groups.

Other differences compared to the initial energy mixes is the increase of roof ridge turbines as well as the number of mono-digesters. As within the discussion after the first workshop none of the participants were explicitly against the installation of these renewable energy technologies, these changes cannot be related to difference/change in perspective compared to the first workshop.

Energie neutrale gemeenschappen Baard

augustus 2015
Provinsje Fryslân



11 Conclusions

The previous chapters described the planning strategy referred to as the localized approach together with the results of applied testing in the context of three LEIs. The localized approach focuses on identifying and learning from spatial implications of diverse local courses of actions with the purpose to promote energy transition actions based on the acquired understanding of their spatial implications.

In short, the localized approach consist of a series of two workshops that

- allow the constructions of diverse courses of action on the local scale with the help of the energy mix model
- substantiate alternative courses of action with their respective spatial implications and the help of the map exercise and visualizations
- facilitate a debate on the possibility and desirability of the discussed courses of action
- construct a shared course of action for realizing the energy goal based on this debate

The localized approach has proven to be a viable planning strategy the Province of Fryslân could adopt in order to

a) surpass the ambiguities concerning the spatial implications of the energy transition
b) coordinate and integrate current and future LEIs towards the energy transition

The research objective stated that outlining and testing this planning strategy should make a contribution to:

- exploration of spatial implications when integrating renewable energy technologies (RETs) in local landscapes and the conceptualization of local energy transition perspectives by enabling local communities to visualize the relevant spatial implications
- enabling policy makers to evaluate whether the spatial implications of the energy transition, facilitated on a local scale, would contribute to the energy transition on a regional scale against the strategic horizon of 2050 consistently, harmoniously and in an integral way
- advancing LEIs' development and growth through supporting the development of comprehensive energy visions wherein the visual and land-use effects of these renewable energy technologies can be easily appreciated by local communities
- indicating first elements of a strategy the provincial authority could adopt to address the possible spatial implications that follow the progresses of LEIs in time and environment

In this concluding section, the gathered results will be explained in terms of their potential contribution to a planning strategy the Province of Fryslân could adopt based on the points listed above. In the following paragraph, the identified local energy transition perspective and the related spatial implications of a Frisian energy transition on a local scale will be explained. In the second paragraph, the local course of action and its suitability for becoming part of an energy transition strategy on a regional scale is explained. The third paragraph describes the actions that have been enabled on both the local and regional scale as a result of the localized approach. Finally, the fourth paragraph relates the developed localized approach for the renewable energy transition to the spatial planning theories that have been adopted for framing and interpreting the respective results.

11.1 Local energy transition perspective and its spatial implications for Fryslân

As was explained in the chapter research design, the construction of local energy transition perspectives together with the three selected villages enabled the exploration of local energy transition perspectives that local communities commonly share. Based on the results of the workshops, one commonly shared local energy transition perspectives has been identified. This perspective is:

- the multifunctional use of space

The multifunctional use of space

The multifunctional use of the space relates to a strong preference for installing renewable energy technologies in the local urban area. It is also in this urban area – that constitute communities' main living environment – that the bulk of supplied energy is consumed. This urban area consists of the aggregation of all building plots and their building objects present on the local scale.

This implies that the installation of renewable energy technologies required to become an energy neutral community should first happen in available space of the existing urban area, before considering changing other current land uses. As such, it makes a clear distinction between the urban area and the non-urban rural area. It is the latter that should be protected from the installation of required renewable energy technologies. In the urban area, renewable energy technologies will be installed in, on or adjacent to the buildings, all on their own building plot. Examples are the installation of solar PV panels on roofs, an air-water heat-pump adjacent to or on a building or a mono-digester on the agricultural plot. This multifunctional installation of renewable energy technologies on building plots does not cause any land-use changes on a local scale.

Results from the workshops indicate that urban areas offer enough space for the multifunctional production of renewable energy needed to cover the majority of energy demand pertaining to heat, electricity and transportation. As such, this will give an answer to the following question:

What are the spatial implications of renewable energy technologies that would be required on a local scale to facilitate the Frisian energy transition ambition for 2050?

The energy transition on the local scale will mainly cause visual changes to the existing individual building plots. Examples of these visual changes can be found in the visualizations created for the three villages (e.g. pages 98-104).

Electricity

On a local scale in Fryslân, renewable electricity is produced through a combination of individual and collective production. Renewable energy technologies that will be installed for the production of renewable electricity are solar PV panels, mono-digesters and roof-ridge turbines. Typically half of all the existing houses on a local scale will have around 14 m^2 of solar PV panels installed. Additionally, there might be a few houses (possibly unable to install solar PV panels) with a roof-ridge turbine.

The remainder of local electricity demand is produced by means of collective installation of solar PV panels on large roof surfaces of barns, public buildings and warehouses present on the local scale, and the installation of mono-digesters on livestock farms. Typically, all of the available large roof surfaces on the local scale will have solar PV panels installed. Also, all livestock farms will have a mono-digester installed. In addition, on a number of large roofs the installation of roof ridge turbines is to be expected.

The visual spatial changes on a local scale related to the renewable production of electricity are mainly concerned with the installation of renewable energy technologies on existing roof surfaces and the installation of mono-digesters on the agricultural building plot.

Heat
On a local scale in Fryslân, the renewable production of heat will mainly take place on the individual building scale. All houses will have renewable energy technologies installed for the renewable production of heat. However, a distinction should be made between (passive) insulation and renewable energy technologies producing heat. Insulation will be an important element on the local scale and generally around half of all available houses will have significantly improved their insulation. The insulation of buildings will not have any spatial implication on a local scale.

The renewable energy technologies that will be installed for the production of renewable heat are solar collectors, air water heat pumps, HCS systems, pellet-woodstoves and woodstoves. Based on their preference, it seems that air water heat pumps will be installed on site at around 35 % of the individual houses. Additionally, 25% of the individual houses will have around 10 m^2 of solar collectors installed. The remaining renewable energy technologies will be installed at around equal shares at the remaining 40 % of the individual buildings on site.

Visual spatial changes on the local scale related to renewable production of heat are mainly concerned with the installation of renewable energy technologies on or adjacent to the existing buildings and on the roofs of these buildings.

Indicator for land-use change
Through the multifunctional use of space perspective, the energy transition on a local scale will mainly cause visual changes in the local landscape. However, when there is not enough room to accommodate the required amount of desired renewable energy technologies in the urban area, renewable energy technologies will have to be installed in the surrounding fields, leading to change in current land use. This research has shown that installing renewable energy technologies in the surrounding area will only occur for production of electricity.

Only on local scales where both the installation of solar PV panels on large roofs and roofs of individual houses as well as the installation of mono-digesters at all livestock farms lack the production capacity for the yearly electricity demand, the function of current land uses will have to change for the production of electricity. In that case, it seems that the most likely spatial implication is the installation of solar PV panels on the field. Typical areas for the installation of solar PV panels on the local scale seem to be undeveloped plots owned by the municipality, where local communities envision no developments in the near future. Another option is farmland close to the village border.

Based on the empirical work in this research no final conclusions can be drawn on the frequency and the extend of these particular spatial implications in Fryslân, as this merely depends on specific characteristics of the local scale.

Differences between regions
The three case studies in this research were all positioned on one of the three main soil types in Fryslân: sand, peat and clay. Over time, three different landscapes have developed on these soil types. Underlying thought for this selection was that communities in different landscapes might have different energy transition perspectives.

Although the three energy neutral futures envisioned by the LEIs differ from one another regarding both the specific choices made and the related quantities of the available renewable energy technologies, specific differences related to the geographical placement of the initiative on one of the three main soil types in Fryslân have not been found.

11.2 Conclusion on the local course of action

The local course of action documented through the examined LEIs seems to indicate an interesting and feasible direction for provincial planning authorities and policy makers regarding the realization of the Frisian energy transition. All three selected local communities were able to transform into an energy neutral community based on well-informed choices for renewable energy technologies, and on the acquired understanding of their spatial implications through their visualization.

Based on the workshops, it can be concluded that at least a quarter of the energy demand for mobility is also produced renewable on the local scale. This is because a minimum of half of the current fossil fuel cars are replaced by electric vehicles. Based on the energy demand per sector of Fryslân (see figure 5), the local course of action can provide 75% of the renewable energy demand for Fryslân. As such, the local course of action provides an interesting direction on a strategic level that can seriously contribute to the realization of the Frisian energy transition. At the same time, the possible contribution of the local course of action to the Frisian energy transition requires that the Province of Fryslân should also focus on finding other means for producing the remaining 25% of renewable energy.
Renewable production of the remaining energy demand for mobility is of particular interest for policy makers. The use of green gas for mobility requires special attention as it can no longer be derived from farms through the local course of action. This is because all the available green gas at farms is needed and employed for the renewable production of the local electricity demand with the use of mono-digesters. This means that the Province of Fryslân should also focus on finding additional renewable energy sources for mobility in Fryslân.

The multifunctional use of space perspective identified through the local course of action is consistent with current spatial policy of the Province of Fryslân. Therefore, the local course of action could without difficulties become an important fundament of the provincial strategy towards the realization of the Frisian energy transition. In the local course of action, the majority of the renewable energy technologies will be installed in the urban area on the local scale. This is of strategic importance as the Province of Fryslân is limited in its abilities to steer the development of LEIs in Fryslân within the urban area. In the urban areas, the municipalities are the main authorities for spatial planning. This means that the local course of action requires a sound alignment on spatial planning principles for the Frisian energy transition between the provincial and municipal planning authorities.
If for any reason the Province of Fryslân would want to actively steer the development of LEIs, it should provide alternative locations in Fryslân where the opportunity is offered to citizens to participate in renewable energy production.

11.3 The localized approach and the undertaking of actions on the local and regional planning scale.

In this research, the localized approach has been developed and tested as a planning strategy that the Province of Fryslân could adopt in the future in such a way to surpass the ambiguities concerning the spatial implications of the energy transition that are hindering the undertaking of concrete energy transition actions (Späth & Rohracher 2014; Sijmons & van Dorst 2012; Stremke & van de Dobbelsteen 2012). On both spatial scales, the developed localized approach has led to the removal of uncertainties concerning the spatial implications of specific courses of action and enabled the undertaking of action. The specific contribution of the strategic spatial plan differs on both the local and regional scale. At the same time both spatial scales also faced differing impediments to the undertaking of action.

11.3.1 Regional effects

On the regional scale, the strategic exploration of existing local energy transition perspectives has provided guidance for the decision- making and the undertaking of actions for the realization of the provincial ambition of 2050. Whereas the current rapid expansion of the local energy initiative was initially monitored by the Province of Fryslân as one of the many developments within the Fryslân, that perhaps could take part in the realization of the provincial energy transition ambition. The identification of the spatial implications that could follow the progress of these local initiatives has led to a much more active stimulation of LEIs in Fryslân in order to reach the provincial goal for an energy transition in 2050. The new coalition agreement of the Province of Fryslân mentions explicitly that all Frisians will be given the opportunity to make their village an energy neutral community (Provinsje Fryslân 2015a).

Based on the results and reactions upon the strategy created within this research, the Province of Fryslân has decided to adopt the method as its new standard for the support of LEIs within the province. A team of provincial employees is currently working to include two complementary steps to the localized approach. These additional steps are: the inclusion of spatial design and the calculation of business cases.

11.3.2 Local effects

The localized approach has provided guidance for the undertaking of actions towards the realization of the local ambition of becoming an energy neutral community. The specific organization of the workshops focused at identifying the spatial implications of diverse (desired) courses of action, have enabled the establishment of mutual learning within local energy initiatives. As a result, uncertainties concerning the number of different renewable energy technologies needed to achieve set goals and the differences in spatial implications when opting for specific renewable energy technologies could be removed. In all cases, both the removal of these uncertainties as well as the creation of local courses of action initiated on the basis of a consensus building process materialized into well-supported actions strategies that will help fulfil local energy transition ambition in the years to come.

Examples of this are the grant application and granting by the village of Heeg for the installation of a roof ridge turbine on one of the buildings in the harbour, the recent start-up session for the collective installation of a solar field on one of the large roof surfaces in Heeg, or the follow-up meetings with the owners of large roof surfaces that are now being organized in all villages with the owners of large roof surfaces within the villages.

11.4 Insights for theory

The localized approach developed in this research focused on identifying and learning from the spatial implications of diverse local courses of actions with the purpose to promote the undertaking of energy transition actions. On both the local and regional scale, the learning established through the approach enabled decision-making and (short term) actions towards the realization of the ambition to become free from fossil fuels by the year 2050. As such, the realization of the Frisian energy transition has come a step closer to realization. This research thereby demonstrates that elements of the strategic spatial planning approach, in combination with design-oriented approaches to local spatial transformations and with the practice of visualization of these transformations, can help the planning of complex challenges such as the energy transition at multiple spatial planning scales.

Through the specific adoption of the development of LEIs in Fryslân as a valuable strategy for the development towards the Frisian energy transition, a new form of exploring diverse courses of action through the strategic spatial plan could be applied. In the strategic spatial planning process this information is normally drawn from plans “which have predefined courses of action for them and explored the implications” (Faludi 2000 p.304). This research however, adopted ideas that have been created by the local communities involved, through direct interaction between the affected citizens, describing the courses of action as well as their spatial implications. As a result, mutual learning between the stakeholders, but also open dialogue, collaboration and consensus-building is initiated in an earlier stage of the strategic spatial planning process.

This working method could make the traditional strategic spatial planning process more democratic and transparent, both of which are desired qualities within strategic spatial planning processes (Carsjens 2009, Albrechts 2004). Within the traditional strategic spatial planning process, a democratic and transparent process, through which mutual learning is established, is initiated upon the plans that are traditionally created from an outside expert position. This might lead to a lack of feeling for local particularities or desires. The empirical work in this research shows that these plans can also very well be established by, and on the basis of, the input of affected citizens. This finding is supportive to the conclusion of Boonstra (2015), who argues that planning approaches in times of active citizenship should accept everybody who initiates a spatial initiative as a spatial planner.

Expert knowledge is still essential in this new style of strategic spatial plan making. However, its role in the creation of strategic spatial plans changes from the creation of a set of plans that have explored the implications of diverse courses of actions beforehand, into utilizing expert knowledge for the creation of a podium that will enable the affected citizens to create these plans themselves, by allowing the substantiation of the courses of action as desired by the affected citizens. In order to allow this, such a podium should make the information, needed to make the relevant decisions, available in a simple, understandable, integrated and interactive manner. As a result, the process of the exploration of divers courses of action and the creation of initial strategies are more or less integrated in which learning, open dialogue, collaboration and consensus building can already take place.

‘The energy mix model’ in this research is an example of such a podium for the affected citizens that enables the participants to explore the spatial implications of diverse courses of action in an interactive manner. The organization of workshops would seem to be an appropriate setting for these explorations. Within these workshops the participants should be given the opportunity to explore diverse courses of action and thereby to determine their own preferred spatial strategy. The role of the expert within the workshop is to provide information in an attempt to open up possibilities and to enable the participants to make substantiated choices by moving along with the ideas that arise.

In addition to providing a podium, the creation of spatial strategies could also strongly benefit from design-oriented approaches through the intermediate visualization of the proposed courses of action. Especially when a key role in the spatial development challenge is situated in the induced changes within the physical landscape. In these type of challenges the use of visualizations is a valuable step that should become an integral part of the strategy making process. Visualizing initial strategies works very well in initiating a discussion and thereby provides the opportunity for an important and additional check on whether the created strategies would still be preferred or whether on the basis of this new insight, the initial strategies would have to be adjusted.

Based on this research, it seems that the creation of a podium for the affected citizens is particularly suitable for the strategic spatial planning of demarcated spatial planning challenges on a local scale. Logically, when a spatial planning challenge would become too broad (both in terms of spatial extend and spatial planning subjects) the provision of a podium for the affected citizens will become ineffective or impossible. Also on larger spatial scales, the lack of local context might impede the creation of constructive strategies. The exact point for when a spatial planning challenge will become too broad both in terms of spatial extend and planning subject remains undetermined. In these situations, one could rely on the traditional style of strategic spatial planning in which experts explore the implications of diverse courses of actions resulting in a collaborative process to create shared spatial strategies.

12 Discussion

12.1 The local energy transition perspective and the spatial implications for the Province of Fryslân

The identified local energy transition perspective and its related spatial implications for Fryslân have provided several insights that are of strategic relevance for the Province of Fryslân in establishing the energy transition. However, the local energy transition perspective and its related spatial implications as specified through the localized approach should not be taken for granted and generalized, bearing in mind there are elements that have not been fully explored through the created localized approach. An example is a choice experiment concerning the willingness of local communities to pay for the selected set of renewable energy technologies. Such an exploration might lead to different results within local energy transition perspectives.

Additionally, the exploration of local energy transition perspectives has only been performed amongst three LEIs in Fryslân. These LEIs can be regarded as front runners within the Province of Fryslân, and as such it might be possible that other LEIs have different local energy transition perspectives. Further experiments amongst other LEIs in Fryslân is required.

12.2 Scaling up the localized approach

The localized approach could also be employed to aid the creation of strategies towards the energy transition on spatial planning scales larger than the local planning scale adopted in this research.

Moving to larger spatial planning scales may give rise to several difficulties. First, there is the potential that arises on larger spatial scales "to increase energy assimilation and optimize energy flows" (Stremke 2010 p.99). Within the current energy mix model, the potential to optimize energy flows and increase energy assimilation is not taken into account. Applying the localized approach on larger spatial scales, these potentials will have to be considered. Second, when operating on larger spatial scales, new renewable energy technologies need to be incorporated within the energy mix model. Examples of such renewable energy technologies are large (>7.5MW) wind turbines, waste burners or tidal power plants. Third, when operating on larger spatial scales (e.g. national scale) it will be impossible to open the localized approach to all the affected citizens. If the localized approach is used on larger spatial planning scales, new manners for the inclusion of the affected citizens should be established.

Operating on larger spatial scales will also mean proceeding to a higher level of abstraction. This might impede the creation of spatial strategies due to a reduction in tangibility of the consequences of decisions, or the likelihood of shifting the burden of specific necessary and/or desired developments onto a third (external) party.

Based on the above, the researcher argues that the localized approach can be scaled to aid the creation of strategies towards the energy transition on larger spatial planning scales with the help a certain modifications. Still, the local scale seems to be the most appropriate spatial planning level for the localized approach. Especially because on a local level consequences of specific strategies remain tangible and close to the mind and heart of the included participants, possibly leading to more locally embedded strategies.

12.3 Critical reflection- enhancing strategic insights

Within the localized approach, the analysis of the renewable energy potential (Van den Dobbelsteen et al. 2007) on a local scale has received a relatively minor role. Relevant information provided through the localized approach is limited to exploration of the available amount of roofs and roof surface and the yearly available amount of woody biomass on the local scale.

Although energy potential mapping is typically performed on a regional scale (Van den Dobbelsteen et al. 2007), a more detailed exploration of the energy potential on a local scale might improve the quality of the local courses of action. An example can be found in the village of Baard. During the workshop in Baard, the idea arose to use the residual wood available at one of the local companies to create wood pellets for the inhabitants of Baard. As the energy potential of this residual wood had not been explored prior to the workshop, this solution could not be incorporated quantitatively in the local course of action.

Apart from exploring the energy potential on the local scale, the exploration of energy potentials on the regional scale might also result in additional renewable energy production possibilities on the local scale. Due to the focus in this research on the local scale, these regional potentials have remained underexposed. However, given the possibility that exploration of energy potential on a regional scale might result in new and highly desired renewable energy production possibilities on the local scale, the exploration of regional energy potentials could benefit the current method.

12.4 Crystallizing spatial implications

The localized approach touches upon specific spatial implications of the installation of renewable energy technologies on individual buildings merely in general. The method allows for specifying the quantity of different types of renewable energy technologies on local buildings. However, specific allocation of these renewable energy technologies amongst individual buildings remains unclear. As a result, it is e.g. not clear whether the renewable energy technologies will be installed in order to achieve energy neutral buildings or whether they will be dispersed over all houses in which the remainder of energy demand is acquired through collective renewable production. Because empirical findings show that individual production of renewable energy will become an important element within the energy neutral communities, an extra focus (e.g. discussion) on the specific choices made for individual houses and the corresponding spatial implications could benefit the current method. Here, a type of custom work for individual buildings on a local scale could help concretize the strategies created on a local scale into specific measures on an individual building scale. The creation of a similar energy mix model directed at and based upon individual houses could help in structuring and engaging a debate on the measures taken on an individual house scale.

12.5 What to do with larger towns

The results from this research indicate that the majority of local scales within Fryslân are able to become energy neutral on their own local scale. This is because most of the 419 local scales are comparable to those addressed in this research. Typically, these local scales are characterized by a small village surrounded by a relative large (and empty) outer area consisting mainly of agricultural plots and rural/nature areas in which several livestock farms and houses are dispersed.

Nevertheless, for the larger towns and cities within Fryslân, especially those housing some sort of industry e.g. Leeuwarden or Drachten, it might be very difficult to become energy neutral on their own local scale, taking into account that these local scales might have a much higher relative energy demand. Additionally, it might also be questionable whether becoming energy neutral on a local scale is to be desired in these situations.

Further research on the spatial implications of a localized approach for these high-energy demanding local entities could help in finding solutions for the renewable production of the energy consumed.

12.6 Ethical controversies

Ethical controversies exist concerning the method adopted in this research. A first controversy concerns the local course of action for high-energy demanding localities such as e.g. Leeuwarden. It is debatable whether high-energy demanding local scales should also become energy neutral on their own local scale. Such localities typically serve a sustaining function for other local scales, mainly in the form of employment both direct and indirect, or by providing other services like hospitals or shopping centers, that benefit other local scales. At this point it makes sense to divide a share of the needed renewable energy amongst the local scales that are also sustained by the high-energy demanding local scale. As such, a division of renewable energy production provides an opportunity to minimize spatial implications. The current research method did not address such a possible division, but further discussion is strongly required, as this would mean that especially the low-energy demanding localities will need to install more renewable energy technologies than needed for their own local energy consumption. This may also require a definition for local scales that are high-energy demanding, as well as rules on the share of the needed renewable energy that can/should be divided amongst other local scales, based on their sustaining function.

Other ethical controversies caused by the research method applied concerns the central role given to the local stakeholders in shaping their own energy neutral future. Creating spatial strategies based on desires of local stakeholders, being daily users and spectators of the area under planning, might be a valid argument within the challenge for the energy transition focused on the inevitable changes within the physical landscape and its surrounding socio-political arena (Sijmons & van Dorst 2012 p. 46), it might be questioned whether these local stakeholders are able to make the right choices based on information provided on different renewable energy technologies and visualizations of their spatial implications. The focus in the corresponding debate will revolve around whether strategies based on desires are also the right strategies for approaching the energy transition. An example of such a debate could focus on what to do when a specific spatial strategy based on exploration of the regional/local energy potential is not desired by the local participants. What strategy then works best for approaching the energy transition? It would be sensible for the Province of Fryslân to prepare for these type of questions.

Also, the status given to strategies could cause ethical controversies, especially when certain strategies are seen as 'carved in stone'. On policy level, for example, difficulties might arise when the desired spatial strategies cannot be executed if they are conflicting with municipal or provincial spatial policy. As a result, the method might result in a futile exercise when the freedom of thought within the method is not reflected/offered by spatial policy. The main ethical question focuses on whether local stakeholders should be allowed to create spatial strategies free from restrictions of current spatial policy. When the method would be applied more generally on other local scales, both establishing freedom of thought within this method as well as the status of the plans created through the method should be clearly discussed and decided upon clearly beforehand. Here, it would be best to let spatial strategies enable the specification of collectively approved, short term actions in order the realize (long-term) sustainability ambitions.

12.7 The local course of action

In the local course of action, the total number of kWh's consumed on a yearly base on a local scale is also produced renewably. The storage of energy on the local scale is not taken into account, but is needed because our energy consumption and production patterns are not aligned. During the workshop, many participants expressed the desire to also locally store the renewable energy produced locally, in order to not to be dependent upon the energy grid. The possibilities for energy storage on the local scale, the related spatial implications as well as its implications for the energy grid should be further looked into.

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Figure 3: Energy usage Fryslân 2012 + prognoses. Provinsje Fryslân (2010). Duorsume enerzjy yn Frylsân: energy use and production of renewable energy. By KNN advice Groningen

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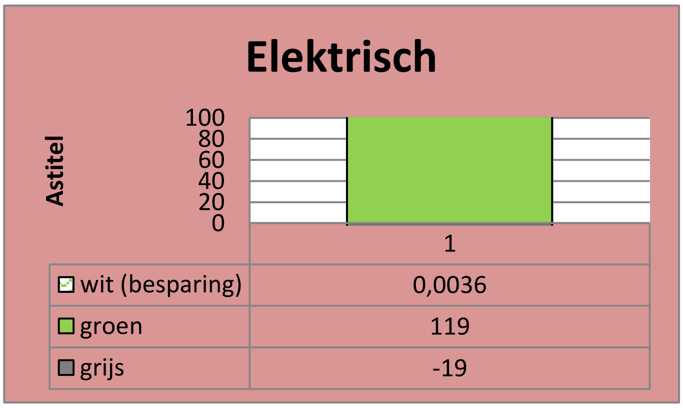
Annex 1

Stel je eigen mix samen varieer de gele waarden…			opbrengsten	besparing	extra vraag	Kostprijs energie	Investering	Investering
Besparing		aantal	kWh per jaar	kWh per jaar	kWh	per jaar	per stuk	Totaal
huis	Warmtepomp WKO	1		17.000	4.300	€ 1.700	€ 18.000	€ 18.000
gebouwen	Warmtepomp Lucht	1		17.000	4.300	€ 1.632	€ 5.000	€ 5.000
	pellet CV kachel	1		17.000		€ 1.139	€ 3.000	€ 3.000
	hout kachel	1		13.000		€ 468	€ 2.500	€ 2.500
	led-verlichting	1		350		€ 50	€ 50	€ 50
(van label C naar A++)	isolatie/triple glas	400		4.000.000		€ 4.000.000	€ 10.000	€ 4.000.000
								€ 0
Zonne-energie Particulier	zonnecollector Thermisch	1		13.000		€ 299	€ 10.000	€ 10.000
	zonneboiler	1		1.000		€ 33	€ 1.200	€ 1.200
	zonnecellen PV	1	2.800	0		€ 392	€ 4.000	€ 4.000
								€ 0
Zonne-energie Collectief	zonnecellen PV	1	2.000.000	0		€ 220.000		€ 0
								€ 0
Windturbines	huis en tuin turbines	1	500	0		€ 165	€ 5.000	€ 5.000
	daknokturbine	[illegible]	2.500	0		€ 350	€ 8.500	€ 8.500
	doarpsmûne/dorpsmolen	[illegible]	2.000.000	0		€ 180.000	€ 500.000	€ 500.000
	grote turbine	1	6.900.000	0		€ 483.000	€ 2.000.000	€ 2.000.000
								€ 0
Biomassa	vergister elek	1	312.000	0		€ 37.752	€ 480.000	€ 480.000
mono-vergisting	vergister gas	1	364.000	0		€ 49.504	€ 480.000	€ 480.000
exclusief kosten warmtenet	verbranding hout/snippers	1	2.000.000	0		€ 102.000	€ 8.000	€ 8.000
								€ 0
Verkeer en vervoer	elektrische auto's	100	0	700.000	350.000		€ 0	€ 0
	groen gas	100	700.000	0			€ 0	€ 0
			14.281.800	4.778.350	358.600	€ 5.078.484		€ 7.525.250

1

2

Gas		in kWh/t	%	Elektra in kWh	%	verkeer en v	%
vraag 2050		21.927.251		9.332.624		12600000	
max verbruik		21.927.251		9.691.224			
verbruik (huidig)		17.849.251		9.690.874		11.900.000	
besparing		4.078.000		350		700.000	
grijs		15.485.251	71	-1.876.926	-19	11.200.000	89
groen		2.364.000	11	11.567.800	119	700.000	6
wit (besparing)		4.078.000	19	350	0,0036	700.000	6



3

The working method of the model will be explained on the basis of the filled in example model on the previous page. For all of the available technologies a quantity (aantal) of 1 has been filled in within the model with an exception for the electric and green gas car for which a quantity of 100 has been filled in. The model consist of three elements which are: the fill in model (1), the renewable share calculation (2) and the stacked bar graphically representing the renewable share (3). All three elements are directly connected with each other with simple calculation formulas. All number in the model represent kWh. The exact working of the model will now be explained through an example for the renewable share within the yearly electricity demand (Elektra in kWh in the red column in element 2)):

To the right the relevant section of element 2 has been copied, from here the rows: **Vraag 2050** (energy demand in 2050), **max verbruik (**maximum energy usage), **verbruik huidig** (current energy use), **besparing** (energy savings), **grijs** (grey), **groen** (green) **and wit/besparing** (energy savings can be identified).

		Elektra in kWh	%
vraag 2050		9.332.624	
max verbruik		9.691.224	
verbruik (huidig)		9.690.874	
besparing		350	
grijs		-1.876.926	-19
groen		11.567.800	119
wit (besparing)		350	0,0036

Row **Vraag 2050:** indicates the future energy (in this case electricity) demand of the local scale. Which is similar to the current energy demand due to the linear energy demand scenario.

Row **max verbruik:** indicates the maximum energy usage in 2050 which is based upon row **Vraag 2050** plus any extra energy demand resulting from the installation of technologies which demand extra electricity such as for example air water heat pump (Warmtepomp lucht) and HCS system (Warmtepomp WKO). This extra energy demand is indicated in the row **extra vraag** in element 1 on the previous page. The row **max verbruik** enables the eventual calculation of the produced renewable share of energy, the share of energy savings realized and the share of fossil energy .

Row **verbruik (huidig):** indicates the actual energy demand which is based upon the energy demand resulting from the **max verbruik** minus the row **besparing** which indicates the energy savings realized through for example the installation of LED lamps in the case of electricity.

Row **grijs:** indicates the remaining fossil energy demand resulting from the **verbruik (huidig)** minus the row **groen which** indicates the quantity of energy renewably produced.

The row **wit (besparing)** indicates the same as the column **besparing** and is essentially an extra check. The quantity of energy saved is here calculated by the row **max verbruik** minus the row **verbruik (huidig).**

<u>Now all these elements will be put to action using the filled in example model on the previous page thereby showing how the model works:</u>

The electricity demand in 2050 (**Vraag 2050)** is similar to the current electricity usage which is 9.332.624 kWh's of electricity. Looking at the column **extra vraag** in element 1 (with the blue ovals) we can see that only the air water heat pump (Warmtepomp lucht), HCS system (Warmtepomp WKO) and the electric cars cause an extra electricity demand, in this case (4300+4300+350.000=358.600kWh). This means that the maximum energy usage (**max verbruik)** will be (**Vraag 2050+ extra vraag)** 9.332.624 kWh+358.600= 9.691.224 kWh.

Within the row energy savings (**besparing**) in element 1, there is only one technology which realizes energy savings for electricity which are the replacement of regular bulbs with LED light (indicated with the purple oval) (all the other technologies realize energy savings for the yearly heat and transportation energy demand). The energy saving realized in this example model is 350 kWh's of electricity. As a result of this electricity saving the actual energy demand in 2050 is (**max verbruik-besparing**) 9.691.224-350=9.690.874kWh's of electricity.

Than the quantity of renewably produced electricity (**row groen)** should be calculated and can be found in the column renewable production (**opbrengsten**) in element 2(indicated with the red ovals). The amount of renewable produced electricity is 11.567.800 kWh (2800+2.000.000+500+2500+2.000.000+6.900.000+312.000+350.000). the reason why the 350.000 from the row **extra vraag** is included is because as mentioned within the scenario's electric cars will in half of the occasion be charged at other places than the local scale. The electric charging network for cars only charges renewable electricity thereby also forming part of the renewable share within the total electricity demand.

As all these number are known the calculation can now be completed. For the electricity the remaining share of fossil fuel demand is **huidig verbruik** minus **groen** (9.690.874-11.567.800) = - 1.876.926. In here a negative number means that for the production of electricity no fossil fuel have to be used. In percentages relates to minus 19% (**grijs/max verbruik* 100%**) - 1.876.926/9.691.224*100.

The share of the renwable production of electricity is (**groen/max verbruik* 100%**) 11.567.800 /9.691.224*100= 119%.

The share of energy savings realized is **(besparing/max verbruik* 100%**) 350/9.691.224*100=0.0036%

The stacked bar is based upon the percentages for white (energy savings) green (renewable production) and grey (fossil energy) calculated in element 2. These calculation rules also yield for the calculation of the renewable share in the yearly heat and transportation energy demand and are automated within the excel model.

Annex 2

'REIS NAAR EEN ENERGIENEUTRAAL HARKEMA'

Door Haryt Dijkman vanuit Doarpswurk en Provinsje Fryslân

provinsje fryslân
provincie fryslân

doarpswurk
sociale innovatie

IN DEZE PRESENTATIE

- *Energie vraag Harkema*
- *Energie scenario 2050*
- *Technieken tot aan 2050*
- *Korte impressie verschillende technieken*
- *Verschillen tussen de technieken*
- *Uitleg oefening 1 energiemix model*
- *Uitleg oefening 2 kaart oefening*

ENERGIE VRAAG HARKEMA

-GAS
-ELEKTRA
-VERKEER EN VERVOER

Harkema	Gas in m³	Elektra in kWh	Verkeer en Vervoer in liters brandstof
Totaal	5.408.342	5.408.342	1.253.577 l.
Alles naar kWh	factor 8.61	blijft	factor 9.25
Totaal	16.977.654 kWh/t	5.408.342 kWh/e	11.595.591 kWh/vv

Bron: Energie in Beeld en Klimaatmonitor

ENERGIE VRAAG HARKEMA 2050

- *Trend Fryslân: energie besparing gelijk aan extra verbruik*
- *Deze trend houden we ook aan vanavond!*
- *Dus……*

- 1.971.853M³ Gas
- 5.408.342 kWh
- 1.253.577 l. brandstof

DUURZAME ENERGIE TECHNIEKEN EN HUN RUIMTELIJKE IMPACT

Tot 2050 energie uit :

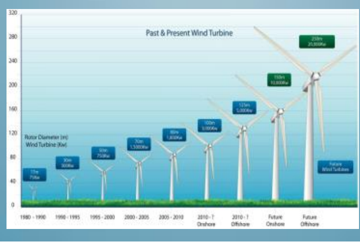
- *Wind*
- *Zon*
- *Biomassa*
- *Bodem*

(bron: PBL en ECN)

WIND

Verschillende vormen:

- *Op eigen huis*
- *Doarpsmûne ≤ 1MW*
- *Grote turbine 3- 5- 7.5 MW*



WIND OP EIGEN HUIS

WIND OP EIGEN HUIS


DOARPSMÛNE ≤ 1MW


GROTE WINDTURBINE


ZON
Verschillende vormen:
• Zon PV → opwekken elektriciteit
• Zonnecollector → opwekken warmtevraag huis
• Zonneboiler → voor warm water douche etc.


ZON-PV


ZON PV


ZONNEBOILER


ZONNECOLLECTOR


ZONNECOLLECTOR DAGLICHT

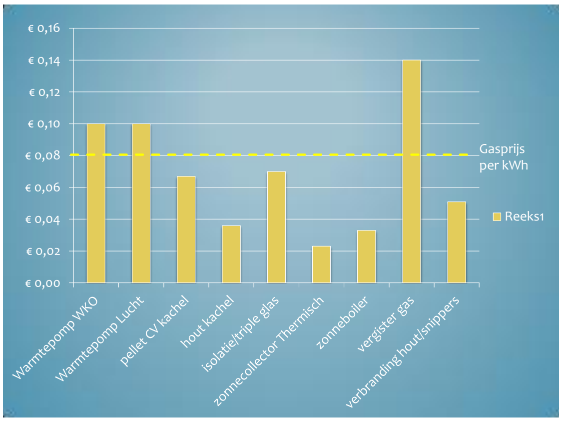

WATER WATER WARMTEPOMP
WKO- SYSTEEM
Verticaal gesloten bronsysteem


LUCHT WATER
WARMTEPOMP


HOUT OF PELLET KACHEL
WOODPELLETS


BIOMASSA


VERSCHILLEN TUSSEN DE TECHNIEKEN
• Productiecapaciteit (p/j)
• Ruimtebeslag voor energievraag
• Kostprijs per kWh


€ 0,16
€ 0,14
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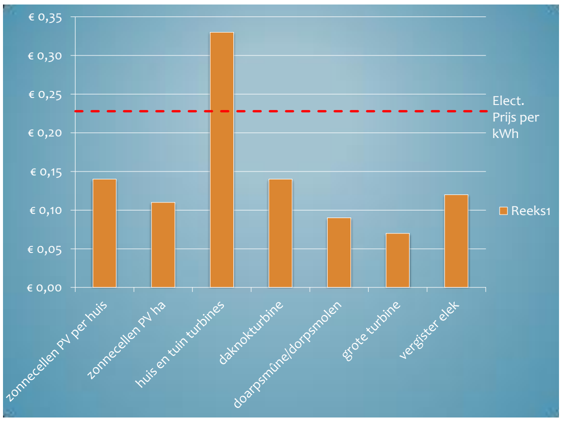
€ 0,02
€ 0,00
Gasprijs per kWh
Reeks1
Warmtepomp WKO
Warmtepomp Lucht
pellet CV kachel
hout kachel
isolatie/triple glas
zonnecollector Thermisch
zonneboiler
vergister gas
verbranding hout/snippers


€ 0,35
€ 0,30
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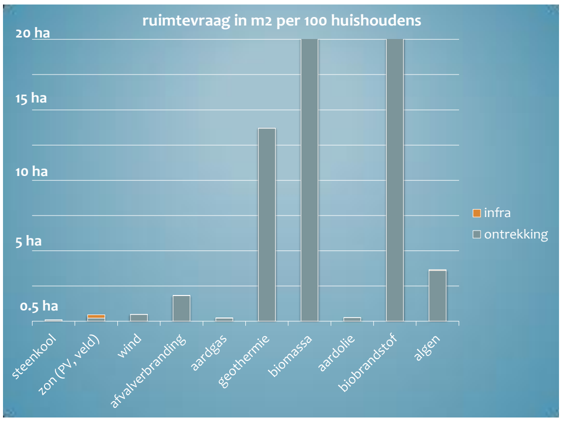
€ 0,15
€ 0,10
€ 0,05
€ 0,00
Elect. Prijs per kWh
Reeks1
zonnecellen PV per huis
zonnecellen PV ha
huis en tuin turbines
daknokturbine
doarpsmûne/dorpsmolen
grote turbine
vergister elek


infra
Grootte van de technologie
ontrekking
Totale benodigde ruimte



Duurzame Techniek	Aantal huishoudens	Ruimtevraag
1 ha zon PV	570	Schuin dak (45°) 1 ha. Plat dak of veld 3 ha.
Doarpsmûne (MW)	570	60 m2 direct
Windturbine (3MW)	1970	88m2 direct
Monovergister elektrisch	90	200 m2
Monovergister gas	21	200 m2
Houtsnipper ketel	120	150 m2

HET ENERGIEMIX MODEL

- *Stel in 30-45 min je gewenste energiemix samen*
- *Plaats deze mix in Harkema*
- *Korte presentatie gemaakte mixen en plaatsing in Harkema*

Annex 3

Oproep tot aanmelding

Energie Neutrale Gemeenschappen

Raerd, 18 februari 2015

Energieneutrale dorpen & buurten

Afgelopen jaren werkten we samen met dorpen en buurten aan diverse energieprojecten. Wat begon met gezamenlijke inkoop van zonnepanelen is het bij sommige initiatiefgroepen doorontwikkeld tot bijvoorbeeld een lokaal energiebedrijf. Een aantal dorpen en buurten spreken zelfs de ambitie uit om helemaal *zelfvoorzienend* te worden. Een ambitie die niet binnen een jaar gerealiseerd is maar waarin we dit jaar wel stevige stappen kunnen zetten.

We blijven alle dorpen & buurten bijstaan met raad en daad maar besteden in 2015 bijzondere aandacht aan deze kleine groep koplopers. Samen met deze kleine groep dorpen werken we aan inspirerende voorbeelden in onze eigen provincie.

Ons aanbod

Zijn jullie dé pioniers van Fryslân op het gebeid van duurzame energie?. Dit is ons aanbod voor 2015:

- ✓ Een inspirerende excursie naar een (bijna) zelfvoorzienend dorp (bijvoorbeeld in Duitsland)
- ✓ Onderzoek naar mogelijkheden in de directe omgeving (Per dorp / buurt)
- ✓ Procesondersteuning van professionals
- ✓ Inzet van deskundigen met specifieke kennis van techniek en/of methoden
- ✓ Ontwikkelen van een business cases
- ✓ Kennisuitwisseling met andere pioniers uit Fryslân (community of practice)

Aanmelden

Meldt uw dorp aan op onze website van Doarpswurk door hier te klikken. Let op! Er zijn maar een beperkt aantal plekken beschikbaar daarom gelden er enkele selectiecriteria:

1. Een stevig kader met een heldere visie van de initiatiefgroep
2. Reeds succesvolle projecten afgerond / lopend
3. Veel draagvlak in dorp of buurt
4. Voldoende bestuurlijk draagvlak/ passend bij het beleid van de gemeente

Voldoet uw dorp aan de bovengenoemde criteria ? Geef u dan op.
We organiseren op woensdag 25 maart van 19:30 tot 21:00 uur een informatiebijeenkomst voor de dorpen en buurten die zich hebben opgegeven Locatie Kantoor Doarpswurk, Buorren 28, 9012 DH Raerd.

Voor meer informatie stuurt u een email met daarin uw contactgegevens en uw vragen naar: energiewerkplaats@netwerkduurzamedorpen.nl We nemen dan contact met u op.

Ús Koöperaasje — alliander — Friese milieu federatie — netwerk duurzame dorpen, ontmoeten, delen & inspireren — doarpswurk, sociale innovatie — koninklijke nederlandsche heidemaatschappij

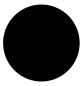
Annex 4

Name LEI
Amelander Energie Coöperatie
Bakhuizen Mirns Rijs Energiebesparing Initiatief (BEI) "
De Bildtse Energie Coöperatie U.A.
Camminghaburen Duurzame Wijk
Boksum Energie
Coöperatie EnergieKûbaard u.a.
cooperatieve vereniging Doniawerstal (voorheen; Duurzaam Idskenhuizen en Omstreken (DIENO)
Duurzaam Akkrum Nes
Duurzaam Aldlan ambitie e coop
Cooperatie Duurzaam Heeg
Doarpskoöperaasje Krigel Nijbeets
Duurzaamheidsplatform Heerenveen
Duurzame energiewerkgroep Spannum Edens
Ecodorp Gaasterland
Energie Cooperatie Achter de Hoven
Energie Coöperatie Ængwirden
Enerzjy Koöperaasje Aldeboarn
Energie cooperatie Dongeradeel
Enerzjy koöperaasje easterwierrum u.a
Energie cooperatie Gaasterland
Energie Coöperatie Kûbaard
Energiecoöperatie “Mei-inoar Grien” U.A.Ferweradiel"
Energie cooperatie Duurzaam Woudsend
Energie Cooperatie Pingjum
Energie cooperatie Schiermonnikoog
Energie cooperatie De Eendracht-Ooststellingwerf
Energiecooperatie Sneek Scharnegoutum e.o.
Enerzjy Koöperaasje Garyp
Energie cooperatie Vlieland
Enerzjy Kooperaasje Om (de)Noorderpolder U.A.
Energie cooperatie Wommels in oprichting
Energie Coöperatie Westeinde U.A.
Enerzjy Koöperaasje Westergeast
Feriening kollektyf wynmûnebesit Wommels Iens
Energiecooperatie Trynergie
Groene Flach Sneek: orienteren zich op energie. Focus: wijktuin
Griene Enerzjy Koöperaasje Easterein U.A. (GEKE)
Lokaal energie Cooperatie Opsterland
Initiatiefgroep De lege Geaen
"LEF Feanwalden Leefbaar met Energie Feanwâlden "
Marsumer Energie Kooperaasje
Oosterbierum
Oosternijkerk

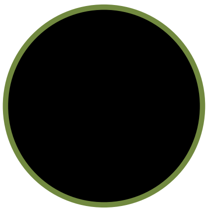
Parregaaster Energie Maatschappij
Sinnich mei Sinne
"Stichting Bewonersbedrijf Heechterp Schieringen Leeuwarden"
Stichting milieuwerkgroep Bolsward
Stichting Windenergie Kubaard
Stichting Lokaal Ideaal Makkinga
Stichting Dorpsmolen Pingjum
Stifting Doarpsmûne Reduzum
Stifting Doarpsmûne Reahûs
Stichting Dorpsmolen Ternaard/ Energie cooperatie Ternaard (ENCOTER)
Stichting Miljeu en Aktiviteiten Stipe Tsjom
Stichting Wynturbine de Twa doarpen
Terhenrster Energiecooperatie De Poask U.A
Transition Town Joure
Vereniging dorpsmolens Wyns, Bertlehiem en Tergreft
Werkgroep Energie Koöperaasje Aldeboarn (EKA)
Werkgroep Duurzaam Grou
Werkgroep Energieneutraal Finkum
werkgroep St. Energievoorziening Dearsum
werkgroep Duurzaam Gytsjerk
Werkgroep Duurzaam Koudum
Werkgroep duurzame energie Aldtsjerk
Werkgroep MijnGaasterland
werkgroepOverTjonger
werkgroep Makkum Aantrekkelijk Duurzaam
Wirdum (wens collectief PV project) Zuiderzon

Annex 5

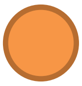
Legenda Stickers



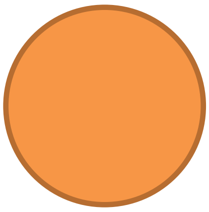
Solar PV (14m^2) panels on 10 houses



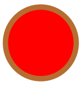
Solar PV panels in field set-up per 0.5 ha



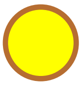
Home wind turbines on 10 houses



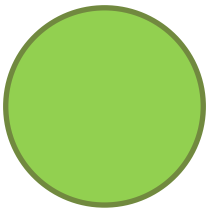
Village wind turbine or large (3MW) turbine a piece



Solar collector (12m^2) or solar boiler (3,2m^2) on 10 houses



Air-water heat pump, HCS system, Wood-pellet stove at 10 houses



Mono-digester electric or gas a piece