

# **Towards Islands of Sustainability**

Energy Self Supply for the Tourism Island of Spiekeroog in 2030

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# **MESPOM**

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## **Abstract**

The main sustainability goal of many small islands in the North Sea is to become self supplied in renewable energy in 20-30 years. The majority of the islands are trying to repeat Samsø's success – to make a transition towards energy sustainable system by new energy production from local renewable sources such as wind, solar and biomass. However, for other islands like Spiekeroog island, a tourist destination, this transition pathway cannot be applied due to many local policy restrictions, physical limitations and residents' sensitivities.

The current research is aiming to generate a roadmap towards energy self-sufficiency in another way – by large reductions of electricity consumption. The core of the research uses the backcasting approach to generate future visions and scenarios in order to explore possible and desirable sustainable futures and identify necessary steps to achieve the one most preferred by the majority of local stakeholders. To frame the roadmap, the barriers, drivers and current Spiekeroog conditions for transition are analysed and possible actions are suggested. Finally, the roadmap and recommendations on how to facilitate the transition are presented.





## **Executive Summary**

### **1.1 Background**

Small size and isolated context of areas like small islands make sustainability problems more visible and immediate for the local governments and communities. In this regard they have more opportunities to look for different local solutions and, thus, can be islands of sustainability – frontrunners of good examples of sustainable practice for the rest of the world.

Cradle to cradle islands (C2CI) project provides the involved islands with innovative ideas in fields of energy and transportation, water and materials how to solve their problems in a more environmentally friendly way with benefits for communities and local economies. One of the main final goals for C2CI is to reach 100% energy supply with current solar income (using only local renewable sources) in the next 30 years. However, how to achieve this goal is the question mark and topical issue for the majority of C2C as well as non C2C islands.

Some islands in the North Sea like Samsø made a transition to energy sustainable system by new energy production from local renewable sources (wind, solar and biomass) based on local cooperation and investments from citizens, local households, companies and municipalities. However, for other islands like the German East Frisian island of Spiekeroog, this transition pathway cannot be applied, since it has much more tourists and local policy restrictions, physical limitations and residents' sensitivities for implementation of more renewable energy generating solutions.

On Spiekeroog, there are limited possibilities and opportunities to produce more electricity based on local renewable sources. Nature and old buildings are under Government protection. There are many old and historical buildings, which are energy inefficient. The islanders are very sensitive to any changes since it can badly affect tourism development which is the main and only one economical activity on the island. Residents' interest in significant environmental improvements is low: local people are quite wealthy and tourists can be only one considerable motivation to change and reduce energy consumption for them.

Therefore, the current research raised tried to explore the very interesting and topical question for many tourism islands like Spiekeroog: how to make transition towards energy self-sufficiency in a different way – consume less but without considerable limitations for tourism development. In the current research the author assumed that 50% of the current electricity demand can be covered by local energy production in the future, whereas another 50% can be potentially reduced by halving the current electricity demand by 2030. It should be noticed that this way of transition is also quite consistent with C2C approach by highlighting that all sustainability is based on local solutions and by stimulating and supporting cooperation, networks and communicational activities within the local context.

### **1.2 Methodology**

The data for the analysis is collected via combination of different research methods: literature review, study visit and on field semistructured and unstructured interviews with different stakeholders, creativity and backcasting workshop with students in TU Delft and expert and stakeholder consultations mainly during C2CI project Partner's meeting and the Conference in Shetland islands.

In order to explore and generate transition pathway towards sustainable energy system on Spiekeroog, elements of many theoretical, analytical and designing approaches and techniques were used. The core of the research was the backcasting approach encompassing generation of future visions and scenarios to explore possible and desirable sustainable futures and identification of necessary steps to achieve the one, most preferable by the majority of local stakeholders.

### 1.3 Outcomes

Based on the analysis of the current and future trends and the creativity backcasting workshop with students from Delft University, four scenarios were constructed:

- ‘smart’ (going for intelligent technological improvements aiming to increase energy efficiency and effectiveness),
- ‘responsible’ (focusing on significant behavioural changes due to side demand management measures – more responsible and environmentally concerned tourists and residents, their interaction and cooperation),
- ‘active’ (new types of active pensioners and workers as main tourists, they prefer stay longer and combine work and pleasure; more community based and shared services on the island),
- ‘slow’ (oriented on less but more exclusive tourists year-round with the same outcome for local population; residents have more time to diversify their economical activities and be more self sufficient in many regards).

The majority of Spiekeroog local stakeholders believe that it is realistic and more preferable to see in the future a combination of ‘smart’ and ‘responsible’ scenarios with the same visitors’ structure, but more environmentally concerned and educated as well as new eco-tourists guests who stay longer but not in their own houses.

The main current barriers for the transition and emerging trends which have to be broken down are: increasing popularity of luxury tourism services; residents’ passive position and low motivation in environmental performance improvements; own notion of ‘sustainability’ – “the same as it ever was”; and their perception that renewable and sustainable energy solutions are not attractive for tourists.

The main favourable conditions which should be built up: stimulate healthy competitive market conditions for ‘green’ innovations in the tourism sector; diffuse innovative sustainable ideas and knowledge; support and motivate the islanders to replace all old and not efficient appliances and equipment; and renovate buildings into eco-buildings. It was revealed that tourists are the only one considerable motivation for islanders to change their behaviour.

The roadmap has three main phases:

- Predevelopment and take-off (2010-2014), when the necessary conditions are created and the transition starts, the main changes are not very visible (in people's minds). The main actions that could lead to learning processes among residents and tourists are: demonstration and pilot projects to raise awareness, and provide information and diffuse knowledge through new networks.
- Acceleration phase (2015-2025) when the main visible changes happen: technological, structural, organisational, cultural and behavioural. New technological (EE equipment, appliances & lightning, renovated buildings and smart systems) and other solutions are becoming part of everyday life and common practice for the islanders and tourists. The actions should stimulate healthy competitions in tourism businesses for 'green' innovations by different benchmarking and awards schemes.
- Stabilization phase (2026-2030) when new dominant regime is establishing.

## 1.4 Recommendations

- Future vision – creation and spreading out the desirable future vision – green and low energy demanding island.
- Demonstration and pilot projects: 1) renovations to eternal holiday house; 2) renovation of old historical building; 3) two renovated buildings equipped with smart metering and optimized into smart house and micro grid; 4) pilot project for introducing local eco-certification scheme.
- Introduction of local eco-certification scheme: 1) step by step improvements through introducing new innovations by annually revised criteria and monitoring and control, 2) raising awareness and educating residents and tourists, 3) green feedbacks and different tourist-islanders interactions through smart metering, benchmarking schemes and other awards – to create competitive conditions for tourism businesses; 4) involve tour operator and tourism business association – to ensure adequate green marketing.
- New networks (businesses with eco-certificates, households and businesses connected to the island smart grid and local energy company) as well as existing network (tourism business association and local council) will facilitate diffusion of knowledge and information.
- More information for public from the local government about current policies and national government and EU programs – providing different kind of support for innovative and EE projects.



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## **Abbreviations**

C2C – Cradle-to-cradle

C2CI – Cradle-to-cradle islands

CHP – Combined heat and power

DRIFT – Dutch Research Institute for Transitions

EE – Energy efficiency

EU – European Union

PV – Photovoltaic energy

R&D – Research and development

STSc – Sociotechnical scenarios

TM – Transition management



# 1 Introduction

## 1.1 Background

After the Rio Conference the world widely recognised that modern society, especially in the developed world, have to move towards a more sustainable path to meet “the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987). At the global level sustainability can be reached by a bottom-up approach starting locally and regionally from ‘islands of sustainability’, acting as ‘cells of innovation’ and initiating a transition process where the whole unsustainable system moves towards a sustainable one.

According to Wallner et al. (1996) and Deschenes & Chertow (2004), the region can be assumed sustainable or resilient if:

- anthropogenic material flows do not exceed local assimilation capacities;
- it is mainly characterised by inner material cycles and low throughput of matter;
- internal communication is dominant, but balanced with external one;
- self-sufficiency of basic needs is relatively high
- its communities are living in a sustainable way.

In this regard any area functionally can be considered as an ‘island of sustainability’ or sustainable regional system (Wallner et al., 1996). Nevertheless, actual insulated contexts (small islands, mountains and other remote regions) all over the world bring sustainability challenges as well as unique innovative opportunities much more urgently and rapidly to the foreground of the local policy and management agenda (Deschenes & Chertow, 2004).

Indeed, islands as well as other isolated areas are facing many common critical sustainability problems. The main two factors which make small islands especially vulnerable in this regard are issues of small size and isolation (Kerr, 2005). Small islands usually depend on imported fossil fuel, have limited fresh water reserves and have to export their waste since they do not have enough space to operate landfills (Stuart, 2006; Lenzen, 2008). Isolation factors bring also problems of high cost of transportation, energy production and manufacturing (Stuart, 2006). Beside this, small islands are frequently very fragile from environmental point of view and especially challenged by climate change issues including different natural disasters. In addition, small islands often rely on monopoly and/or external service oriented based economies, for instance tourism or oil imports etc. (Stuart, 2006; Deschenes & Chertow, 2004).

On the other hand, the small size of the islands makes it easier to coordinate tourism and other developments, and to innovate and adapt to changing external conditions (Scheyvens & Momsen, 2008). Many islands have diverse and sufficient renewable energy potential such as wind, tidal, wave, biomass, and solar which can significantly contribute to sustainable development (Stuart, 2006).

In many aspects, small islands are considered as microcosms – ideal places for studying different phenomena, since all inputs and outputs can be measured and feedback loops between the pressure and its impact are very tight (Kerr, 2005). Therefore, islands, due to their small scale, can be viewed as excellent laboratories for sustainability by experimenting with new technologies and testing new solutions. Being catalysts for sustainable innovations, small islands have very big potential to become ‘islands of sustainability’.



Figure 1-1 Cradle to Cradle Islands' participants

C2CI project is a part of the Interreg IVB North Sea Region Programme: partnership of 10 islands (in blue) and 12 other design and educational organizations (in red) from six North Sea countries with Lead Partner – Provincie Fryslân (NL). 1 January 2009 – 1 July 2012

Source: C2CI, 2010

Cradle to Cradle Islands (C2CI) project is initiated to contribute in achieving sustainability of small islands around the North Sea by encouraging and developing different innovative sustainable and cradle to cradle solutions in three clusters: water, energy and mobility and materials (C2CI, 2010). Cradle to cradle (C2C) approach is a new way of thinking which ideally is aiming to achieve a world without wastes. Practically, C2C is mainly focusing on product design but can be applied to many aspects of sustainable development.

The project has initiated many different activities, focusing on designing sustainable innovations and entrepreneurship. Some examples are: decentralised water system based on separation of household water in several streams and capturing water from air; electrical mobility (electrical scooters); eternal holiday houses (energy producing, constructed with local materials; transportable and biodegradable); 'blue energy' technique and etc (C2CI, 2010; (Van Meerendonk, 2010).

The involved islands (figure 1-1) hope that the project will bring new opportunities to resolve their problems and to start transition towards more self-sufficiency in future. Some of the islands have already very strong and ambitious targets to be self-supported in energy and water from the mainland in near future; whereas some others islands do not have any particular future vision or policy goals (WSC, 2007; M. Palm, S. Dahllöf, J. Schoustra, K. Edlefsen, personal communication, April 28, 2010).

A path towards sustainability is very slow and challenging process. It needs significant and radical structural changes of all elements of the existing system, which are dynamic, complex, and interactive, since a wide range of different stakeholders is involved. The transition can be influenced by many unpredictable factors and have some level of uncertainties, but it is still possible to guide it to the desirable future and avoid unwanted development (Elzen & Wiczorek, 2005).

One of the most promising approaches to understand and address such complex issue like system innovation transition towards sustainability is participatory backcasting. This normative, goal and policy oriented approach is aiming to develop desirable future visions and scenarios to further explore by looking backwards what measures are required to achieve them (Robinson, 1982; Strupeit & Peck, 2008; Quist, 2007). Backcasting experiment can be considered as the first steps in a long process of structural system change when existing culture, structure and institutions are broken down and new system is built up (Sondeijker, 2009).

## 1.2 Research problem and research questions

### 1.2.1 Problem statement

The small islands around the North Sea, belonging to the territories of such developed and advanced European countries such as the United Kingdom, the Netherlands, Denmark, Germany, Norway and Sweden, are sharing many of typical island sustainability problems. Almost all of them are characterised by depopulation and rely on external resources in terms of income, water, energy and materials. Frequently, there are not enough local resources to sustain their needs. It is especially serious problem during few summer months – a peak touristic season when a lot of people are attracted by beautiful nature (Brandt & Wollesen, 2009).

Many of these islands are typical tourist destinations whereas tourism is the main source of income for local populations. Taking into account that untouched nature of the North Sea islands is very valuable for tourism in this region, sustainable innovations are considered as real opportunities to achieve sustainability goals (Krozer & Christensen-Redzepovic, 2006).

As stated above, many islands in the North Sea region have visions to become more sustainable and self-supported in future. Dutch West Frisian islands signed the Ambition Manifesto to become energy and water supply self supported in 2020 (WSC, 2007). One of the main final goals for C2CI is to reach 100% energy supply with current solar income (using only local renewable sources) in the next 30 years. Therefore, German island Spiekeroog also would like to be energy independent from the mainland in 2030.

The ongoing C2CI project, strengthening sustainable innovations and entrepreneurship from the micro-level perspective as well as partnership and exchange of experiences, will apparently bring additional opportunities for the involved islands and for the whole region in general. Currently the islands, having in mind new sustainable innovative solutions which could be potentially implemented in future, are looking for appropriate roadmaps or strategic actions plans in order to reach their quite ambition policy goals.

The participating islands are very diverse and have their specific problems and opportunities and, thus, their own possible and desirable pathways to sustainability. The results of stakeholders' session on Texel Island showed that the island is not ready to significantly reduce energy consumption and make any limitations for tourism development. The only possible way to become energy self-supported is to locally produce more energy by different innovative technological options (H. Brezet, personal communication, April 6, 2010).

However, for some areas there are not many real possibilities to increase energy production. At the same time the current energy consumption is growing and the use of electrical appliances are becoming more and more intensive over the years. Therefore, significant changes are required not only from the production side but also from the consumption pattern. Improvements of energy efficiency and technological options alone will not give the necessary effect. Technological innovative solutions have to be combined with considerable social changes in lifestyle and culture, reducing resource-intensive modes of consumption.

In international and regional practice there are very good examples like Danish island Samsø which made the transition to energy sustainable island by new energy production from local renewable sources. Samsø is totally self-sufficient in electricity, and 70% self-supported in heating, produced by different renewable sources – wind, solar and biomass (Hermansen, 2010). However, Samsø has relatively few tourists and therefore cannot be copied by Spiekeroog (and similar islands like Spiekeroog). Meanwhile, the field how to reach self-sufficiency by making a giant step towards energy sustainable consumption by residents and tourists through their interaction and implementation of different sustainable innovative solutions is under explored.

### **1.2.2 Overall purpose**

This thesis intends, by means of backcasting approach, to explore how to make transition of North Sea islands with high touristic profile towards energy self-sufficiency by 2030 through mainly reduction of electricity consumption.

The research was conducted on German island Spiekeroog – one of the four Wadden Sea islands/group of islands involved in the C2CI project. This region is considered as a nature oriented mass tourist destination and at the same time is very fragile from an environment point of view – significant areas of these islands are under protection status (figure 4.3).

Spiekeroog was chosen as a case-study for two main reasons: suitability for research (typical and the same time extreme instance), practical considerations (very small size – feasible to study within the time frame, potential interest in the current research by the island) (Denscombe, 2007).

### 1.2.3 Research questions

The main research question is the following:

*Which insights – particularly in terms of a roadmap – can be gained for future sustainable energy systems, using the backcasting approach as a tool and Spiekeroog C2C Island as a case study?*

Possible sub-questions guiding the working process of the research can be following:

- What are the current sustainability problems (barriers) related to energy systems on the island?
- Which macro and arena trends will shape the future energy system on Spiekeroog?
- How desirable and possible futures on Spiekeroog could look like?
- Which conditions are currently existing and which one should be created in the island to facilitate the transition towards sustainable system?
- How the roadmap to 2030 could look like?
- Which actions should be recommended in order to reach the desirable future?

### 1.3 Research approach

The paper structure and the research approach are presented in the figure 1-2.

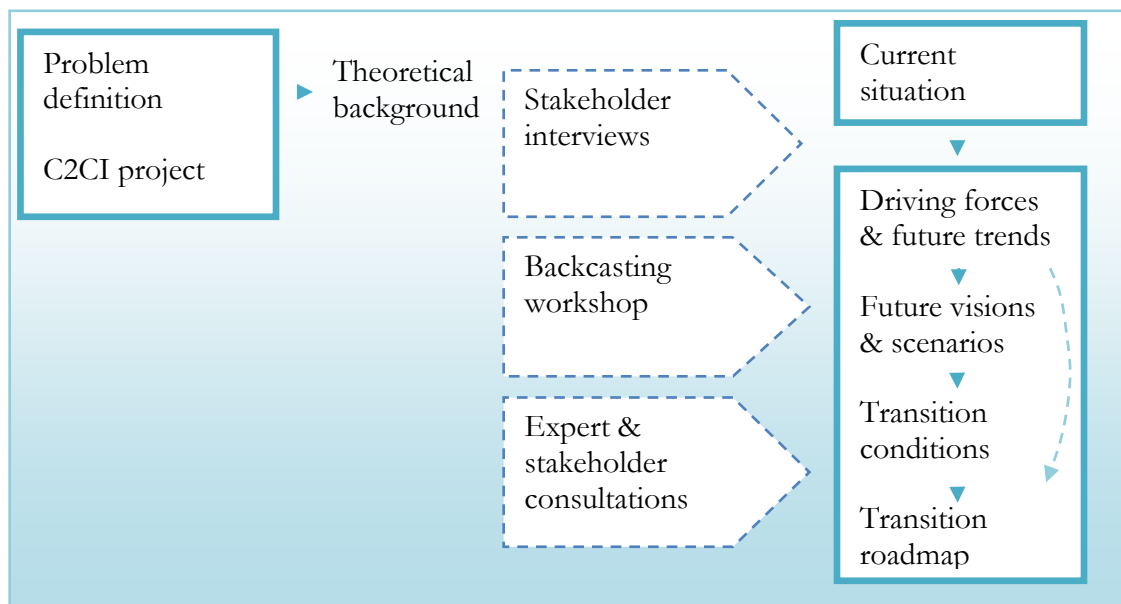


Figure 1-2 Research approach

## 1.4 Research methods

### 1.4.1 Literature review

The investigation started with review of scientific literature and documents in order to define theoretical background for the research. C2C approach, different backcasting approaches, scenario techniques, innovation and system transition theories were studied.

Literature review also provided with initial insights for strategic problem orientation: current conditions of studied region as well as main driving forces and future trends of development affecting focal issue at macro level; general information on Spiekeroog island and its sustainability problems. Based on studying energy model developed by Aalborg University (2010) and other relevant documents the Spiekeroog energy system and main stakeholders related to the studied system were defined (figure 1-1). Three main functions of the energy system are presented in the figure: energy sources and energy generation; energy supply; and energy consumption or services. The focus of the current research is on the consumption part, thus, the following main stakeholders were selected:

- Residents (households)
- Local business (tourist accommodation sector, cafes and restaurants, tourism business organisation and other tourist services)
- Policy and decision-making (local government – municipality, local council, environmental committee)
- Education and raising awareness (boarding school, environmental centre)
- Supportive research (C2CI partners)
- Non resident entrepreneurs<sup>1</sup>

Finally, analysis of different documents and literature sources helped to define specific strategies and actions for future scenarios elaborated based on the workshop results.

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<sup>1</sup> Was added after more detailed study of the current situation



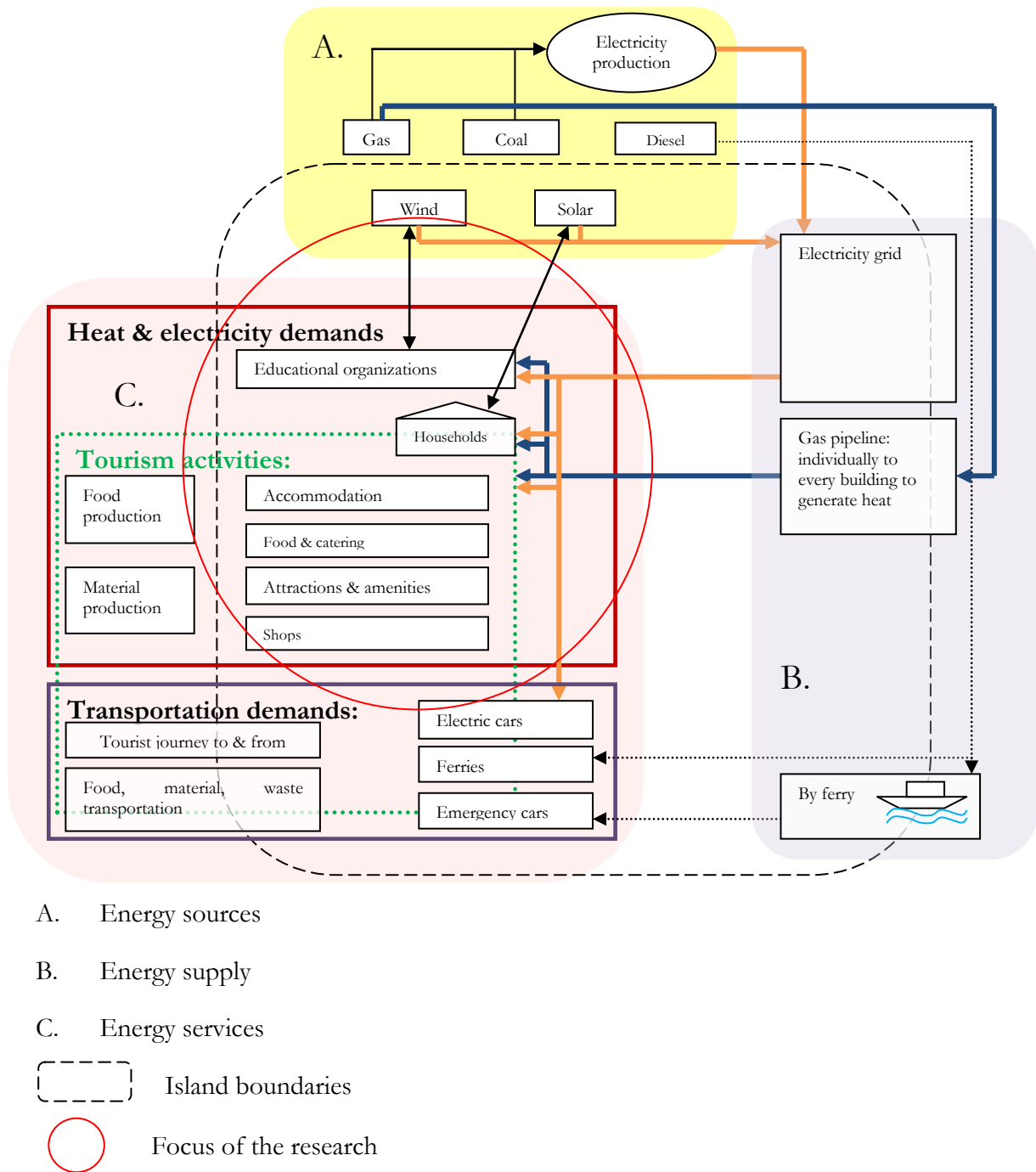


Figure 1-3 Spiekeroog current energy system

### 1.4.2 Interviews, expert consultations and backcasting workshop

The main data collection methods for studying Spiekeroog local conditions, stakeholders, their interactions and generating future visions were stakeholders' interviews and backcasting workshop.

### *Interviews*

According to Quist (2007), stakeholders are very important sources of context-specific knowledge for generation of common future vision as well as for follow-up activities, learning and facilitation of social acceptance for system transition changes. Therefore, interviews with Spiekeroog stakeholders were necessary in order to get necessary specific and detailed information on current state of the studied systems and to understand perceptions of different stakeholder groups on future self-sufficiency in energy, future development and possible relevant environmental improvements.

Series of semi structured and unstructured interviews with Spiekeroog residents and tourists were held during the short visit of Spiekeroog 8-10 of April 2010. The checklist of the questions and list of interviewed people are in the attachments 1 and 2. The specific names are not mentioned in the current research due to cultural sensitivity of German islanders.

### *Creativity and backcasting workshop*

Creativity and backcasting workshop with assistance of Han Brezet, professor from TU Delft, was carried out 12 of April, 2010. This workshop intended to (1) create different desirable pictures for Spiekeroog in 2030; (2) develop strategies and concrete creative solutions how to reduce electricity consumption in 50% by 2030<sup>2</sup>; (3) define the timeframe for the path towards future visions. The program of the workshop with description of the assignments is in the attachment 3.

### *Expert and stakeholder consultations*

The future visions generated during backcasting workshop were elaborated into scenario skeletons with concrete strategies and proposals. Then, they were fleshed out based on analysis of theoretical literature, expert consultations and discussion with stakeholders from different C2C islands (but mainly Spiekeroog).

Participation in C2CI project Partner's meeting and the Conference in Shetland islands 26 – 29 of April, 2010 brought the opportunity to get more insights and knowledge about visions on future development and different innovations developed and implemented in the other C2C islands, their problems and experience of dealing with them etc.; to discuss first results on backcasting experiment with Spiekeroog stakeholders and other islands and get feedbacks in order to identify possible transition barriers and opportunity for construction of the roadmap.

## **1.4.3 Data analysis**

Data analysis is framed by backcasting approach methodology and transition theories (Chapter 2), which involves variety of methods: system and problem analysis; future vision generation and scenario building; backcasting analysis, design and visualisation methods.

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<sup>2</sup> The explanations why the goal was chosen to decrease electricity consumption by 50 % are given in the sub-chapter 5.1 Workshop.

## 1.5 Scope and limitations

Geographical boundaries of this research are limited by Spiekeroog island as a case study. The studied system is defined and presented in figure 1-1, which shows that in a life cycle prospective the boundaries of the system can be expanded far beyond the geographical boundaries of the island. Nevertheless, the focal issue for the current research is energy (but mainly electricity) consumption on Spiekeroog.

It was unfortunate that the time for the current research and particularly for the workshop concurred with the beginning of high tourist season in the studied island – Easter holidays. Even though the municipality of Spiekeroog and local stakeholders were quite positive about carrying out the backcasting workshop on the island, the time of year was not convenient at all for the local society totally dependent on tourism. They are ready to participate but only during winter free of tourist season.

Therefore, the backcasting workshop with stakeholders from the island was substituted by its simulation with students and researches from TU Delft, where students played different roles based on specific information about the island obtained by the author from interviews with Spiekeroog residents and tourists.

Initially the workshop with stakeholders from the island was intended to be the main source of data the analysis. Therefore simulation of the workshop brought some disadvantages, but also some advantages to the research. The main disadvantage and limitation was the lack of context specific stakeholder groups' opinions, which was not possible to get through interviews and other research methods due to several reasons. First of all, workshops could create a favourable atmosphere to bring different opinions and local knowledge to brainstorm together, open up minds for creativities and generation not only probable and possible, but desirable future visions. Secondly, the important part of stakeholder interaction, argumentations and exchanging of opinions was missing as well as generation of common and shared future vision for further spreading out, mobilising other stakeholders and facilitating learning process. Last but not least, the workshop could be carried out via translators, whereas interviews were limited by language barriers – very few people on the island can speak and understand English (not as much as it was planned). Therefore, not all important stakeholders' representatives were interviewed or were interviewed partially. The time was also important constraint.

The advantage of the workshop simulation with students that it brought more generic sense to the research – can be applicable to other areas with similar problems. Moreover, the workshop with students had a lot of values in regards that it brought many interesting and innovative ideas. Real stakeholders would have probably more practical ways of thinking blocking the creativity.

Moreover, the results of the workshop and the emerging scenario's have been discussed with and commented informally by C2C Islands' representatives at the C2C Islands' meeting on the Shetlands.

Due to the limitations outlined above, the research was complimented by more additional literature reviews that took more time that was initially planned. The investigation of current and future global, European, regional and national trends aimed not to deeply study all possible driving forces, but only to identify the main directions to go in order to define possible future scenario framework and shape possible future development.

The aim of the current research is to explore the possible and desirable futures, but not how to actually reach them. Therefore, the presented scenarios are qualitative and it was assumed that they will lead to the desirable goal in sustainable ways. However, their sustainability assessments were out of the scope of this research. The scenarios were constructed based on my understanding and interpretation of the problems from the literature review and interviews, my common sense, knowledge and my analysis. It would bring much more value to the current research if I could get the feedback from different stakeholder groups. However due to lack of time, I would recommend exploring it in a further research.

Due to time and scope limitations the research was not aiming to discuss advantages, disadvantages and possibility to implement the particular actions (necessary changes) suggested in the roadmap. Meanwhile, they should be considered more as recommendations and directions to think.

## 2 Theoretical background

“With transition scenarios the future is not that hard to imagine” (Sondeijker, 2009)

This chapter provides the theoretical background for the research: explains the key principles of C2C, describes the nature of transitions by defining sustainable innovation and innovation system, different approaches for study future and transition scenarios and the applicability of discussed theories for the current research.

### 2.1 Cradle to cradle

#### 2.1.1 C2C principles

Cradle to cradle is a new holistic or cyclic approach of human society development inspired by nature because only nature can be considered truly good and sustainable. It is mainly focusing on completely different model of product design in order achieve “zero waste, zero emissions and zero ecological footprint”. “Being less bad” is not enough, the goal is to be “100 percent good” for the environment (McDonough & Braungart, 2002).

C2C approach uses nature system as a model for designing and functioning of human society. The vision for every technological and techno-biological system in the world at all levels (building, factory, island or planet) is to be as wasteful and useful as a cherry tree – to grow in a good way by using the sun’s energy creating new niches, health, nutrients, diversity, intelligence for current and future generations of inhabitants.

“...the tree’s growth sets in motion a number of positive effects. It provides food for animals, insects, and microorganisms. It enriches the ecosystem, sequestering carbon, producing oxygen, cleaning air and water, and creating and stabilizing soil. Among its roots and branches and on its leaves, it harbours a diverse array of flora and fauna, all of which depend on it and on one another for the functions and flows that support life. And when the tree dies, it returns to the soil, releasing, as it decomposes, minerals that will fuel healthy new growth in the same place” (McDonough & Braungart, 2002).

C2C design approach enhance sustainability concept which ideally is based on balance between social, economical and environmental aspects but in practice it is often rely only on economical consideration with ecological or environmental benefits. C2C tool is based not on triple bottom line, but triple top line approach – which means very high standards maximum value in all three pillars: ecology, economy and equity.

C2C approach has three fundamental principles:

- Waste equals food
- The Use of Solar Energy
- Respect diversity

## Waste equals food

The C2C design is based on elimination of concept of waste as waste, but considering waste as nutrients by closing all material loops either in the technical sphere or biosphere (figure 2-1). Therefore, in C2C materials should not be downcycling, but truly recycled or even upcycling as in natural systems.

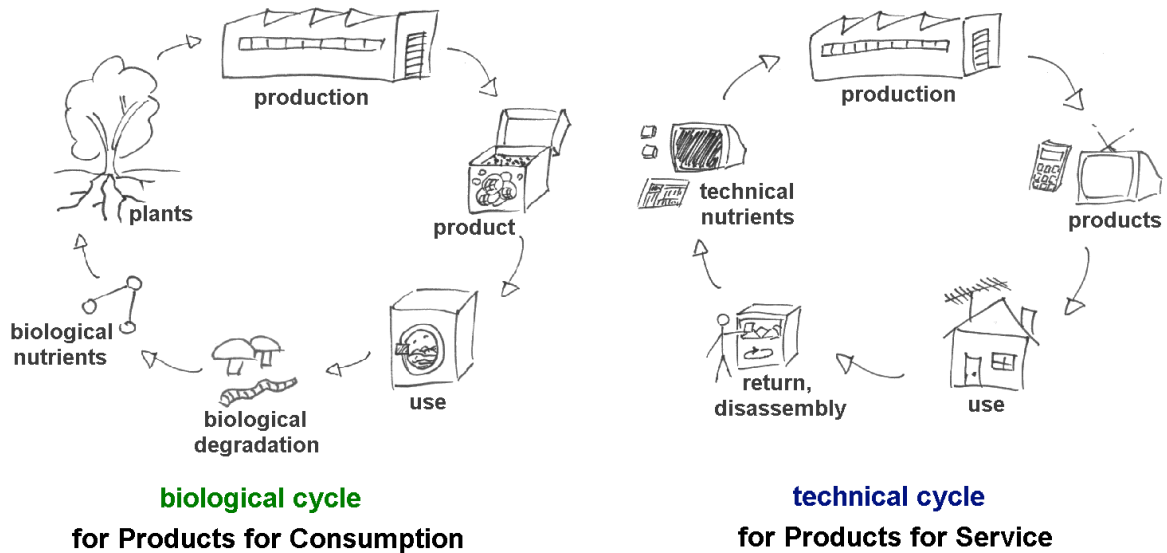


Figure 2-1 Vision behind Cradle to Cradle design

Source: EPEA, 2010

## The Use of Solar Energy

The goal of C2C is to create systems driven by solar energy and other derivatives of solar energy sources like wind, hydro and biomass.

## Respect diversity

This fundamental is based on the fact that natural system as well as any other system is more resilient, health and flourish when it is diverse and complex. Monoculture and monopoly means weakness of the system. Respect diversity means support variety of all elements of the system – biodiversity, cultural, economical, social etc. (McDonough & Braungart, 2002).

### 2.1.2 C2C island

The final goals of the Cradle to Cradle Islands project for the involved islands is to generate up to 100% energy supply during next 30 years using solar income including overall material flow (Braungart, 2009). Therefore, the main objectives to reach the goal are to develop innovative sustainable solutions in the area of energy, water and materials, where possible in a C2C way. The current research is focusing only on energy flow.

The model of C2C is not only limited by product design, but also can be applicable as fundamentals for sustainable development. C2C can be used as a tool to guide the social and

economical development in a right direction with environmental goals – to create an inspiring vision for future human development rather than depressing “be less bad”.

In this regard some C2C ideas enhance an ecological concept of resilience, “the the capacity of a system to absorb disturbance and reorganise while undergoing change, so as to retain essentially the same function, structure, identity and feedbacks”. The main principles of resilience concept in respect of development are diversity (of livelihoods, land use, enterprise and energy system); self-reliance and self-sufficiency (based on local food and decentralized energy production) and tightness of feedbacks (Hopkins, 2009).

McDonough and Braungart highlight that “**all sustainability is local**”: “material and energy flows...local customs, needs, and tastes, from the level of molecule to the level of the region itself” (2002). Based on principles described above cradle-to-cradle island as well as any other regional unit can be defined by the main following criteria (Braungart, 2009; McDonough & Braungart, 2002):

#### **Energy and climate:**

- Stimulate and beautifully integrate renewable energy into buildings, nature and landscape so they produce more energy and clean air than they consume
- Homes should be opened to natural energy flows – bioclimatic architecture orientation principles; use daily light, passive and intelligent solutions (smart appliances, houses, grid)

**Biological nutrients:** restore biological nutrients from organic materials and ensure their return to soil to increase productivity of the system

**Water and nutrients:** nutrient flow management solutions – integrate recycling of water and biological nutrients in buildings and landscaping

**Biodiversity:** support biodiversity and avoid introduction of invasive non-native species

#### **Economy:**

- Increase and diversify profitable local enterprises businesses
- Enhance distributed economies concept: production and use of local products, materials and food
- Support local solutions bringing convenience (savings) to business and homeowners

#### **Social (equity):**

- Diversity of social groups, social and cultural activities (it brings people more pleasure and delight)
- Respect local needs, history, customs and culture

- Stimulate and support cooperation, networks and communicational activities (mutual relationships enhance viability of the system, use and exchange of materials, energy and knowledge).

## 2.2 Sustainable innovations and system innovation

Transition towards sustainable and especially C2C system means giant improvements in environmental efficiency which requires significant and radical structural changes of all elements of the system (figure 2-2). Therefore, here we can talk about *system innovation* i.e. long-term transitions from one socio-technical system to another based on innovative changes in technology, culture and society, practices, institutions, networks and infrastructure (Hofman, Elzen, & Geels, 2004; Loorbach, 2007).

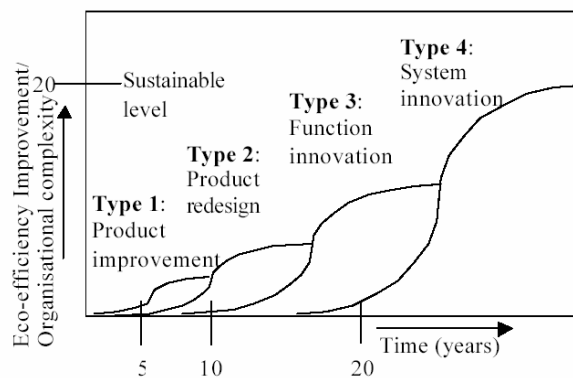


Figure 2-2 Eco-efficiency curves

Source: Brezet, Bijma, Ebreinfeld, & Silvester, 2001

*Sustainable innovations* or eco-innovations in this research are based on definition of Krozer & Christensen-Redzepovic – “innovations that enable to generate income and decrease risk for the environment” (2006). Innovations towards sustainable system can be viewed at different levels: technological, social and institutional. According to Schumpeter’s concept, innovations mean “doing things differently”: new ideas, methods, practice, behaviour, products, services etc (Hellström, 2007).

## 2.3 Transition theory

### 2.3.1 Transition system

To develop a transition roadmap it is crucial to comprehend the nature of innovation transition systems. Basically it is *dynamic, multi-factor, multi-phase, multi-level* and *multi-actor*.

Transition system is defined as a complex adaptive system, which characterized by co-evolution, emergence and self-organization. Such system is dynamic, where *internal* and *external factors* create climate for structural changes. When conditions are changing, transition system is adapting and going to higher order of organization and complexity (Rotmans, 2005).



By nature, transition system is multi-level, multi-phase, multi-aspect and multi-actor system. It is presented by non-linear four phase S-curve process (figure 2-3): the pre-development; the take-off phase (when structural changes start), the acceleration (visible structural changes) and the stabilization; and has three levels: micro – *niches* (where innovations are created and tested – ‘incubation rooms’), meso – *regime* (where structural changes occur) and macro – *landscape* (external environment) (Rotman, 2005; Loorbach, 2007).

Niches acts as locations for learning about technology, user preferences, policy etc. as well as for creation social *networks* to support innovations. Regimes are represented by interactions of several social groups: public authorities, research network, producer network, suppliers, financial network, user and societal groups. Their activities, orientation and coordination are guided by normative and formal rules of the dominant regime. The landscape is beyond the direct influence but they “form gradients for actions” (Hofman et al., 2004). Therefore, transition system is mainly determined by internal interaction i.e. regime, niches and their co-evolution (Rotman, 2005; Loorbach, 2007).

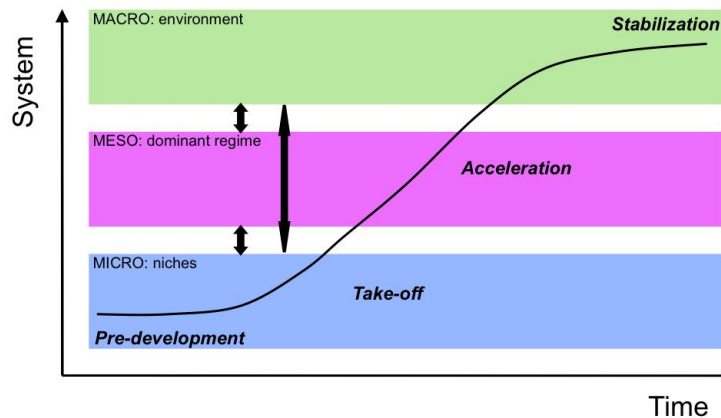


Figure 2-3 Transition system

Source: based on Sondejker, 2009

### 2.3.2 Transition management and policy

The literature review shows that there is no one single vision and recognised methodological approach to analyse transition from niche towards system change. However, there is a common pattern of thinking in the studied theories. The new way of governance is needed, based not on regular top-down and bottom-up paradigms but on *network management* and *high order learning processes* instruments.

The most well-known and, probably, developed one is *transition management* (TM) based on transition arena (industrial network) approach, where co-evolution between social system and the innovation sub-network structure cause development of *arenas of arenas*, which, in turn, result in transitions (from level of niche to level of regime and further).

TM approach is based on the assumption that transition processes can be influenced. It is a scientific governance and operational policy approach to cause long term societal change (Rotman, 2005). According to transition management theory developed by Jan Rotman and Derk Loorbach (DRIFT, ERASMUS University), innovations are taking place at the level of societal system. Transition is seen as a society change resulting in economical, environmental, technological, institutional and cultural developments. Therefore, it is aiming to break down

present societal system and encourage societal innovations towards a sustainable society. It is based on understanding of complexity of transition system, its dynamics, the process of transition, new mode of governance and social theories (Loorbach, 2007).

Transition management is based on *network approach*. The main instrument is a *transition arena* – “legitimate experimental space permitted by regular policy in which the actors involved use social learning processes to acquire new knowledge and understanding that leads to a new perspective on a transition issue” (societal network of innovation). Transitions are results of co-evolution between social system and the innovation sub-network structure by developing arenas of arenas. During the implementation of transition path it is important to keep going the process by participatory decision-making (Loorbach, 2007).

Transition management has cyclic character and encompasses four main generic blocks within three-level steering framework: strategic (envisioning), tactical (negotiating) and operational (executing). Four blocks are listed below:

- 1) Strategic: *transition arena* (setting up transitional objective – integrated system analysis, actor and network analysis, establishing transition arena)
- 2) Tactical: *transition agenda* (development of vision of sustainable future, setting up interim objectives and defining the necessary transition pathway)

Operational: implementation

- 3) *Transition experiments*
- 4) *Monitoring & evaluation.*

Transition experiment is created from transition vision and established in a societal context (district or neighbourhood). It is aiming to stimulate co-evolutionary process within and between subsystems in order to learn and facilitate transition. An experiment can be presented by already existing innovations, which are running in parallel without integrated management. To organize the experiment all relevant actors should develop and design the shared vision and the action plan. The focus should be on social aspects: quality of life, living environment and etc. Learning experience from experiment can contribute to everyday policy changes. The idea is to encourage all types of cooperation and networking – social learning (“*learning by doing and doing by learning*”) (Rotman, 2005; Loorbach, 2007).

Barriers for transitions encompass regulatory, production, customer preferences, infrastructural, financial, technological etc. To overcome them transition management utilizes variety of governance instruments, which are mainly based on discussed above TM principles: *network management* (transition arenas, strategic niche management, new networks and coalitions), *monitoring and learning instruments* (evaluating different types of learning processes), *experimental and policy labs* and *interactive policy-making* (financial or organizational stimulation initiatives) (Loorbach, 2002). Regular (top-down and bottom-up) policies are also used in regards to innovations: by performance environmental standards and by encouraging R&D subsidies etc. (Elzen & Wieczorek, 2005).

### 2.3.3 Transition routes

Hofman et al. (2004) considered two types of transition routes: *technical substitution* route and broad *transformation*. In the substitution route one technology is substituted by another one with very little change of user behaviour. Transformation route requires much deep changes – in user behaviour, cultural, policy, infrastructure etc. The long-term pattern of broad transformation is that first current regime opens up for niches until they become a dominant regime. The short-term mechanisms of the transformation can be different: *sailing ship effect* (existing regime defends itself by technical improvements); *niche-accumulation*; *hybridisation* (merging of two technical options to create new one); *'learning by using'* (small groups of users are changing their behaviour developing new practice) (Hofman et al., 2004).

### 2.3.4 Functions of innovation system

For the current research it is important to keep in mind that in order to faster innovations and transformation of the system it is necessary to create favourable conditions and stimulate certain types of activities.

Management of innovation process is determined by activities which encourage and fasten innovations, i.e. functions of innovation system. These functions are resulting in technological change. Insights of technical changes based on interaction between incumbent technology (regime) and innovation system (niche). This interaction defines special favourable conditions for niche to become part of current regime. There are many different activities which occur in innovation system, but not all of them are equally influence on technological change (Geels, Hekkert, & Jacobsson, 2008; Hekkert, Suurs, Negro, Kuhlmann, & Smits, 2007; Hekkert & Negro, 2009; Negro, Hekkert, & Smits, 2008).

Hekkert et al. (2007) identified the main functions of innovation system as following: *entrepreneurial activities*; *knowledge development and diffusion through networks*; *guidance of the search, market formation, resource mobilization and creation of legitimacy and counteract resistance to change*.

Entrepreneurship is playing important role in the innovation process; it creates opportunities to transform new knowledge, networks and markets through business activities into wide practical application of innovations. Experiments are necessary to overcome uncertainties and get more knowledge about societal system – response of consumers, suppliers, government and other relevant actors and contribute to societal learning. Learning is key mechanism of innovation process: learning by searching and learning by doing. To make favourable conditions it is necessary to create compatible economical conditions – protected space for innovations – niches, as well as mobilise financial and human resources (Hekkert et al., 2007; Suurs, 2009; Suurs & Hekkert, 2009).

## 2.4 Future scenario approaches

Transition theory provides the insights of the functioning of the transition system, its main functions and management which is necessary for understanding how to stimulate and make transition happened. However, it does not give enough information how to explore long-term future and driving forces influencing the future in order to develop the future (transition) pathways. Scenario approach is aiming to address this issue – it is providing with opportunities to handle future uncertainties. Generally there are three types of scenario methods, reflecting the main ways of thinking about the future: *predictive* (probable – what will happen?); *explorative* (possible – what can happen) and *normative* (preferable or desirable –

how can a specific target be reached?) (Börjeson, Höjer, Karl-Henrik Dreborg, Ekvall, & Finnveden, 2006).

### 2.4.1 Scenario building

Future scenarios are not fixed end states, but the description of different pathways for future development: who does what, with whom, when, where and why (Lindgren, 2003). Scenarios should explore range of possible alternatives. There are many different scenario building techniques. The main methodological steps in scenario building are following:

- Identify focal issue
- Analysis of aspects and processes (trends) which directly and indirectly influence the focal issue (figure 2-4)
- Rank aspects and processes by importance and uncertainty
- Select scenario logic (skeleton)
- Flesh out and write scenarios
- Derive implication for indicial decisions (Hofman et al., 2004; Lindgren, 2003)

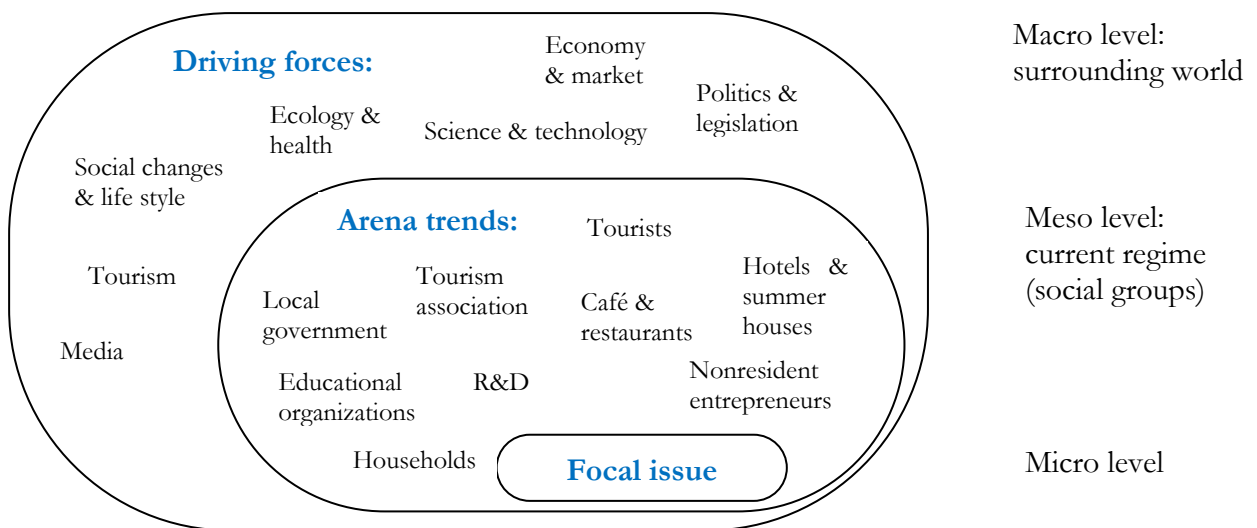


Figure 2-4 Framework for driving forces affecting the focal issue

### 2.4.2 Backcasting approach

The scenarios can be distinguished based on vantage point, from where scenario is developed: *forecasting* or *backcasting* scenarios. In forecasting scenarios the present is as a starting point, whereas in backcasting scenarios it is a future desirable target (Van Notten, Rotmans, Vanasselt, & Rothman, 2003). Sondejker (2009) referred to three generation of scenarios. The first generation scenarios (1950 – 1960) mainly focused on quantitative technological and economic forecasting. Second generation – on strategic planning scenarios

appeared in 1970s as a respond to ‘oil crisis’. These two types are conventional forecasting scenarios.

Many scholars stated that not all scenario methods are entirely applicable to explore system of innovations; therefore many different transition scenario approaches has emerged since that time trying to address complexity and dynamic of transition system towards sustainability such as backcasting-experiments of Quist and Vergragt, WP4 (under ToolSust project) of Carlsson-Kanyama, Dreborg et al., Sociotechnical scenarios (STSc), TRANSCE of Sondejker etc. (A. Carlsson-Kanyama, K.H. Dreborg, H.C. Moll, & Padovan, 2008; Annika Carlsson-Kanyama, Karl-Henrik Dreborg, Rebecka Engström, & Greger Henriksson, 2003; Hofman et al., 2004; Quist, 2007; Sondejker, 2009). It is so called third generation or *transition scenarios*, which are based or closed to backcasting approach, which are of great interest for the purpose of the current research.

Backcasting approach is chosen as theoretical framework for the research due to the following reasons pointed out by Dreborg (1996): 1) focus problem is complex; 2) major change is needed; 3) dominant trends are part of the problem; 4) the problem is a matter of externalities; 5) time horizon is long enough (Dreborg, 1996).

“Backcasting is a process whereby the construction of a future vision or normative scenario is followed by looking back in time and creating a strategy or action plan for proceeding from the present towards that desired future (Vergragt & Quist, 2004). It is normative, goal and policy oriented process which currently is considered as very prospective tool in sustainable strategic planning (Robinson, 1982, 2003; Robert et al., 2002; Robert, 2000). It is well-known approach in the Netherlands, Belgium, Sweden and Canada (Quist, 2007).

Initially, *backwards-looking* analysis was applied by Lovins to energy study in the 1970s as an alternative for traditional forecasting (as cited in Anderson, 2001; Quist, 2003). In the beginning of the 1990s, when the concept of “sustainable development” was highly recognized, the *backcasting approach* has started to be used to explore solutions for sustainable future (Quist & Vergragt, 2006).

Participatory principle is one the key principle of sustainable development. Therefore, backcasting for exploring system innovation towards sustainability requires participatory approach, where data for backcasting analysis is mainly collected through a participatory interactive process between individuals, stakeholders and experts (Quist, 2007; Partidario & Vergragt, 2002).

Carlsson-Kanyama (2008) distinguishes two types of backcasting studies: think-tank model, which is carried out by research team and are not directly related to decision-making, but have more inspiration purpose of orienting society towards sustainable future options; and participative model, which involve local stakeholders and problem-owner in visionary and problem solving activities and is more policy-making and actions connected. The format of latter approach can be based on workshops – structured brainstorming with clustering of ideas by stakeholders (Carlsson-Kanyama et al., 2003, 2008).

In practice there are many different variations of participatory backcasting in terms of methods and tools, ways of stakeholder involvement and number of steps (Quist, 2007; Quist & Vergragt, 2003; Robinson, 2003; Carlsson-Kanyama et al 2003; Vergragt & Brown, 2007; Sondejker, 2009; Wilson et al., Strupeit & Peck, 2008)

In the current research participatory backcasting was chosen to carry out the research and collect necessary data for backcasting analysis based on the workshop and interviews with stakeholders on the island and experts. Due to limitations discussed in the scope and limitation section it was also complimented by desktop research.

The main steps of participatory backcasting are briefly summarised in the table 0-1 (Attachment 5).

Generation of common *future vision* is the central part in a participatory backcasting experiment. It should provide the answer to the question: “where to go” (Quist, 2007). Desirable future is generated by solving problems of current systems identified in the previous step (Quist, 2006). One of the main methodological tools for this step of participatory backcasting is stakeholder creativity workshop, which is aiming to generate ideas of desirable vision of sustainable future (Carlsson-Kanyama et al., 2008).

*Backcasting analysis* aims to answer the question “what to do” – what economical, technological, behavioral, structural, institutional, organizational or regulatory changes are needed to achieve the generated future vision. The pathway is to be described by setting milestones (overcoming problems, taking opportunities, achieving some indicators etc.) from present situation to desirable future. To address these questions short-term and long-term actions should be developed (Quist, 2007; Quist, & Vergragt, 2006; Carlsson-Kanyama, 2008).

According to Vergragt & Quist (2003), backcasting analysis stage is the least elaborated and described in the literature. In the current research it was done by identifying attractive solutions (ideas, options) that would help significantly increase eco-efficiency and necessary changes which would help to achieve the desired future.

### 2.4.3 TRANSCE

TRANSCE (or TRANSition SCEnario) is the approach developed by S. Sondejker, professor and researcher from Dutch Research Institute for Transitions (DRIFT) at the Erasmus University Rotterdam. She aimed to develop new approach of a transition scenario towards sustainability in order to incorporate system transition theories into backcasting scenario approach. Majority of scenarios are trend based, whereas all determinants of structural change should be studied co-evolutionary to overcome the main challenges of transition scenarios – complexity and uncertainly (Sondejker, 2009). This methodological framework has similar steps, methods and tools to backcasting experiment of Quist as well as some TM ideas, which will be useful and complimentary to discuss for the aim of this research – some elements can be applied for the analysis.

TRANSCE has six steps listed and described in the table 0-1 (Attachment 5). It has three-dimension transition framework: culture (norms and values), structure (institutional, physical, legal and economical aspects) and practice (routines, habits and procedures) (Sondejker, 2009). The structural changes in images of a desirable future should be identified and analysed in accordance with multi-level nature of transition system: landscape – ongoing trends and developments; regime – personal implication (traditions and habits) and niche – every day existence.

According to this approach, the roadmap of necessary structural changes (backcasting analysis phase) has to be developed based on the *drivers and barriers analysis*. The practices of the current system which are barriers for transition should be broken down, whereas current components in favour of desirable future should be built up during the transition pathway. To get more dynamic impression about transition system it is necessary to study trends and developments (drivers for structural changes) and their interaction. They can vary from events at the micro level to trends at the macro level. They should be listed and categorised: weak signals, uncertain and certain development with defining which encourage and which faster structural change (Sondeijker, 2009). This approach can be applied in the research in order to analyse the drivers for generation of the roadmap.

#### **2.4.4 Sociotechnical scenario**

The Sociotechnical scenario (STSc) is another new transition scenario method which is aiming to get insights how to build transition paths; therefore it is reasonable to also briefly describe it in this research. The heart of the approach is a co-evolution of technology and society. It argues that in all existing scenario approaches are determined by external factors, whereas regime and niche factors are also important and should be taken into consideration. In this regard the approach is similar to TRANSCE approach. The main variables relevant to the focus issue should be analysed from multi-level perspective (macro-, meso- and micro-levels) (Hofman et al., 2004).

The STSc approach is still under development, however, analysis of drivers for scenarios from multi-level perspective can be utilised where it is possible in the current research.

### **2.5 Analytical framework**

Based on the theories discussed above the analytical framework for the construction of the roadmap can be presented by the following figure (figure 2-5). The most probable and likable (by the main stakeholders) future scenario (transition scenario) should be defined and described in terms of possible necessary changes (institutional, organizational, cultural, behavioural, technological and etc.). Macro trends (level of environment) are mainly shaping the future scenarios but not playing active role as drivers for structural changes. Meso trends (dominant regime) are to be defined by interactions of different social groups (or stakeholders) on the island. Their activities are creating dominant regime as well as main conditions (drivers) for transition. Analysis current state of transition system is based on innovation functions defined by Hekkert et al. (2007). The main findings of the current state together with analysis of drivers and barriers for structural changes based on TRANSCE approach will frame the transition pathway.

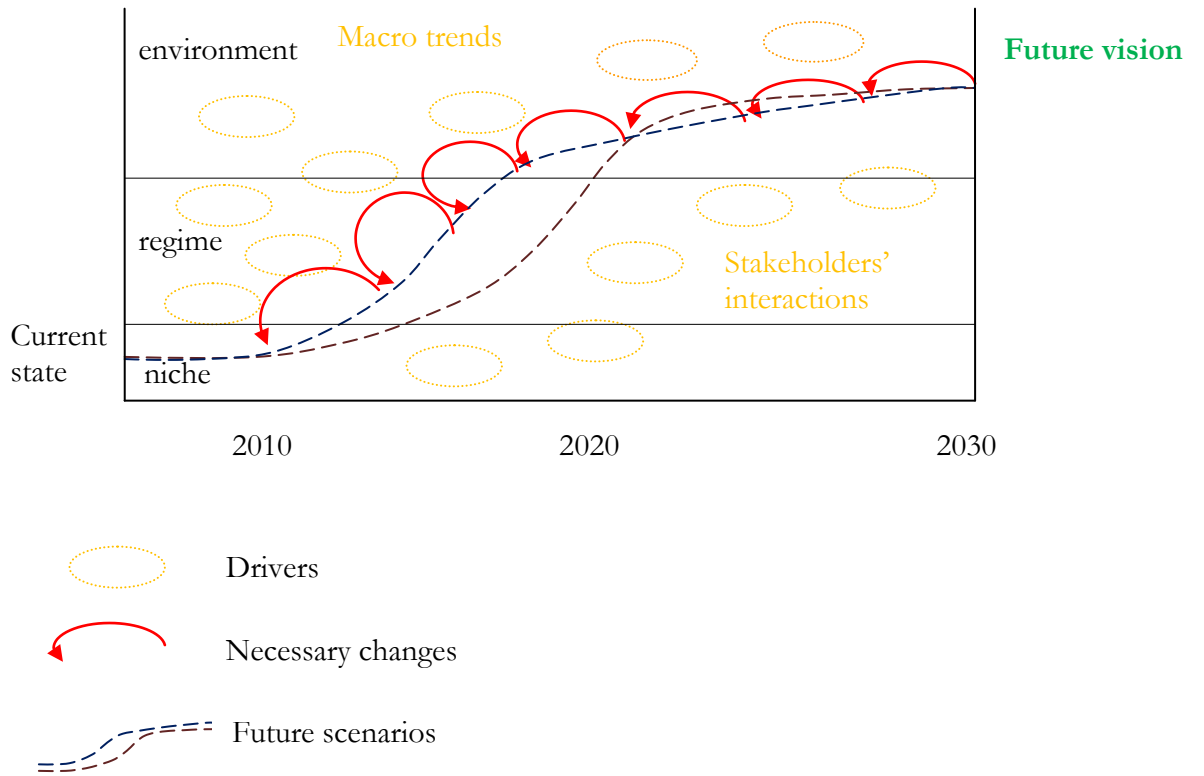


Figure 2-5 Analytical framework: essential elements for the roadmap construction



### 3 Current and future trends – macro level

In order to look into future and define desirable and possible future scenarios it is important to have a picture of current and future trends and driving forces that may have impact on future development of studied system. In case of demand side energy system in Spiekeroog it can be trends from different areas: science and technology, tourism, environment and health, social changes and lifestyle, economy and market, policy and legislation, structures and organisations. Long-term developments of Spiekeroog rely to some extent on macro trends in the surrounding world at different levels: global, European, regional (Wadden Sea) and national (Germany).

This chapter will give a brief review and analysis of current and future trends in outer for Spiekeroog environment. It has been done based on literature and media scanning and the discussions during the workshop, where the trends were underlining different stories about future Spiekeroog. Figure 3-1 reflects this brief analysis. The trends which have the most relevance and impact on focus issue are marked by red colour.

#### 3.1 Global

According to forecasts, the global population will be around 8 billion people that along with economical growth and increased living standards will be resulted in significant growth in energy demand – around 35 % higher than now. Electricity demand will be especially intense. To address this problem different technology will play growing role and energy efficiency of all appliances and equipments will increase especially in developed world mainly by means of governmental regulations (ExxonMobile, 2009).

Fossil fuel will remain the main energy source while renewable (wind, solar and biofuel) will play increasing role (ExxonMobile, 2009). At the same time the prices for fossil fuel might be higher than today due to overall growing scarcity of natural resources including energy resource shortage. Climate change will be very top priority issue since CO<sub>2</sub> emissions expected to be 60 % higher in twenty years (IEA, 2004).

Global population is aging, especially critically in Western part of the world. Moreover this process will be even fastening in coming years. According to Calder (2006), by 2050 the average age of the world will increase in 10 years and will reach 37 years, whereas around 2 billion people will be older than 60 years. Expected that there will be much more active and working pensioners than today.

Urbanisation is another important global trend of the current and future. During coming decades it will more and more affect developing rural areas changing their life style, family structure and consumption pattern. Due to globalisation and rising income and living standards consumerism is spreading around the world (Calder, 2006).

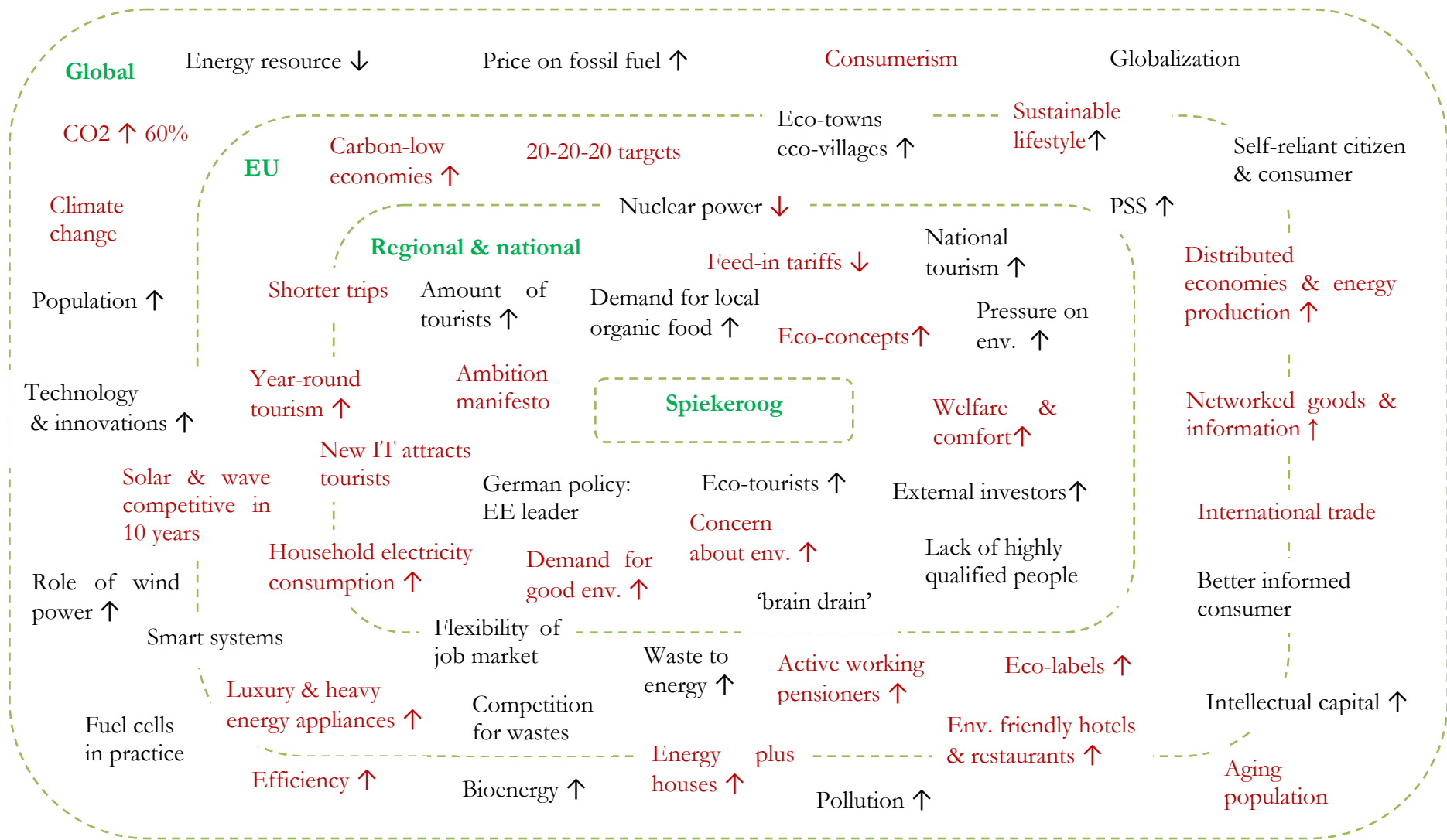


Figure 3-1 Macro trends shaping the future of Spiekeroog

## 3.2 European Union

Within the European Union energy demand and CO<sub>2</sub> emissions are increasing much slowly than at global level. European Commission recently has set a series of targets – the 20-20-20 objectives for 2020, which means 20 % reduction of greenhouse gas emissions (compare to 1990 level), 20% decrease of energy consumption by improving of energy efficiency and 20% share of renewables of EU energy consumption (EC, 2010). This policy will definitely affect policies of European countries for next decade, even though some countries like Sweden already have more ambitious goals – 49 % share of renewable energy (IEA, 2010).

During next twenty years renewable, especially wind will be the fastest growing energy source. Biomass and waste will be used quite moderately, whereas solar will still take not very significant share in energy mix (NTUA, 2003). However, many scholars believe in huge solar potential in future. According to Jacobson & Deluccini (2009), solar and wave power will become competitive already in 10 years (Jacobson & Delucchi, 2009). In 2030 around half of all electricity produced in EU will be from carbon free energy sources (EC, 2003).

Household energy demand is growing. Even though population growth is limited in EU, the number of households is increasing (40 millions more during the period 2000 – 2030) due to change of age structure, lifestyle, smaller household size (EC, 2003; Kovacheva et al., 2006).

Even though household appliances are more and more energy efficient every year, they becoming technically more advanced and complicated and have more different and extra functions. Therefore, in general they are more energy consuming like, for example, plasma TV compare to LCD. Moreover, people tend to become wealthier, have high living standards and use a lot of various electric appliances which make life easier and more comfortable. For example, the electricity consumption of households in the Netherlands doubled between 1990 and 2005 (Jansen, 2009).

In coming years huge attention will be paid to new different energy efficiency and innovative technology reducing energy use not only by optimising systems but also influencing on consumer behaviour – smart energy concept, including smart grids, smart buildings, smart vehicles and empowering consumers. Moreover, in the future an expanding number of households and businesses will generate electricity – ‘energy plus’ houses concept (Arndt, 2009). As to future transport system, it is expected that fuel cells will come into practice and play an important role (van den Bosch, 2004).

There are a lot of emerging trends related to more sustainable life style and market models, which will be apparently much stronger and spread out more around the world in future. Just few of them are eco-town and eco-villages concepts, eco-design, C2C, distributed economies (and energy), etc. (IIIIEE, 2009). Sustainable tourism as well as more environmentally friendly hotels and restaurants will be probably more popular and common.

What is also important to notice, consumer (and tourist) will become better informed and organised in his choice. He will be more critical and demanding for better solutions with best correlation between price and quality. The information about environment and environmentally friendly options will be also very important for future consumer (Hofmann, Rollwagen, & Schneider, 2007; NetForum, 2000).

Untouched nature and quality of tourist destinations will play increasing role for European citizens. People will demand good environment: air, water and healthy organic food. Tourists will be more active and will be able to have holidays more often and year-round and will

demand for new, diverse, interesting and environmentally oriented activities (NetForum, 2000).

### 3.3 Regional and national

The North Sea region in general and the Wadden Sea in particular will be apparently used even more actively in future in many regards: like transportation roots, place for off-shore wind power, material and resource extraction, tourism and so on. It will be resulted in more pressure on the environment (Nehls & Witte, 2009; NetForum, 2000). Tourism is growing sector in the world, however in the region it will be just slightly growing or stay at the same level (NetForum, 2000).

Tourists of Wadden Sea region will be generally more concerned about the environment and will demand and accept more sustainable solutions. Inter-regional Wadden Sea Cooperation among Denmark, the Netherlands and Germany in protection of the Wadden Sea will be gradually raising public awareness.

Some Wadden Sea islands already have very strong and ambitious targets to be self sufficient in energy and water of the main land. For example, five Dutch West Frisian Islands (Texel, Vlieland, Terschelling, Ameland and Schiermonnikoog) signed the Ambition Manifesto to become energy and water supply self supported in 2020 (WSC, 2007).

According to research carried out for Wadden Sea forum, the region has to introduce new technology in area of information and attract new target groups to adapt to year-round tourism (2000). Another tourism related trend is that trips from inland cities to Wadden Sea islands are becoming shorter – more weekend visits (WWF, 1991)

As to energy consumption, there is very alarming trend on Wadden Sea islands, that to increase the occupation rate holiday houses are becoming more luxury. Klein Vaarwater on Ameland is building holiday houses equipped with different kind of luxury equipment such as indoor swimming pools, solariums, whirlpools and saunas. These types of houses are consuming 5 times more than conventional bungalows and 4 times more than average Dutch household. Moreover, the occupation rate of such luxury bungalows, which are very popular and should be booked long time in advance, is extremely high – around 95-98 % compare to 40-60 % of conventional ones (Jansen, 2009; J. Schoustra, personal communication, April 28, 2010).

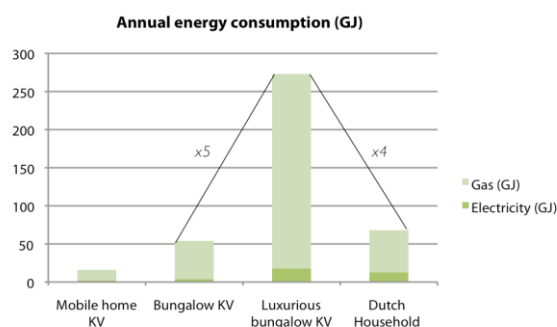


Figure 3-2 Annual energy consumption by different summer houses on Ameland Source: Jansen, 2009

The economy of the region is limited to very few activities such as tourism, agriculture and fishery. Job diversity is continuing to decrease in the region – agriculture and fishery is being replaced by more profitable tourism activities. Most part of works is seasonal here and level of unemployment in winter is quite high – around 15-20%. There are not a lot of opportunities for young generation: low level of physical (transport) and social (cultural, educational facilities) infrastructure, lack of highly qualified employee and demand for such employee compare to other areas (WWF, 1991). Moreover, due to tourism, the price for renting and purchasing accommodation is high that makes difficult for young people to afford staying here and force to move to other areas. Therefore, the region is characterised by “brain drain” – young people are leaving region for their further education and careers and only few come back (NetForum, 2000).

German government has very ambitious national targets to reduce greenhouse gas emissions (40 % by 2020 compare to 1990 levels) (IEA, 2010). Beside this, Germany took a decision to progressively close nuclear power by 2025. In order to achieve it the focus of the national energy policy is on development of domestic fuels and renewable as well as become world leader in energy efficiency (IEA, 2002; Energy Daily, 2007). At the same time financial support for renewable energy – feed-in tariffs may be reduced in the course of 2010 (Lang & Mutschler, 2010).

As to tourism sector, it is becoming greener in Germany. According to WWF survey, 43 % of interviewed people prefer to choose close destination for vacation to reduce CO2 emissions (Sefrin, n.d.). There are many different examples of carbon-neutral holidays and climate-neutral hotels. Moreover, there is a competition for “Environmentally Friendly Hotels and Restaurants”. National railway company Deutsche Bahn promotes national assets by encouraging visiting 18 German protected areas destinations (DB, 2010).

## **4 Spiekeroog: current situation**

### **4.1 General info**

Spiekeroog is the second smallest German Eastern Frisian islands with the area of 18.73 km<sup>2</sup>. It is located between Langeoog to west and Wangerooge to east. Administratively the island belongs to the municipality of the District of Wittmund, Federal State of Lower Saxony. There is only one village on the island which is also called Spiekeroog. The population of the island is very small – in summer around 820 inhabitants; in winter – 780 inhabitants (Spiekeroog municipality, 2009).

### **4.2 Brief history**

The origins of the name ‘Spiekeroog’ is quite controversial – most of the people believe that it is a translation of ‘storage island’. It was first mentioned in 1398 as island of ‘Spiekeroch’. In 1600 the village Spiekeroog was founded. Currently it is considered as the oldest village of East Frisian Islands. People were living by farming, fishing and production of shell limestone. The following years other activities like whaling and shipping became more important to Spiekeroog.

For thousands of years people have lived and worked here in harmony with nature. The active development and human influence on the nature has started during last two centuries. At the beginning of the 19th century tourism started to develop in the German North Sea islands. The first coastal resort was founded in 1797 on the island of Norderney. Tourism on Spiekeroog has started since 1820.

The first weekly ferry connection with the mainland – Neuharlingersiel was established since 1972, daily – since 1842. To improve the comfort of tourists a 1.7 km long horse-driven railway was established 1885 between the village and the western beach. It was extended in 1892 to the newly-built harbour in the southwest of the island. Later on in 1949 it was replaced by diesel train. Nowadays the horse-driven railway is functioning a few times a year for tourists.

In 1925 the first power station based on crude oil engines was built. In 1964 Spiekeroog became connected to the national electricity grid. In 1968 – gas pipe was constructed from mainland to Spiekeroog (Spiekeroog, 2010).

### **4.3 Geography and environment**

Spiekeroog is one the islands located in the Wadden Sea. It has humid oceanic temperate climate with mild summer and moderate winter. The mean temperature of January and July it is around 2° C and 16.5° C respectively (Norderney) (as cited Jansen, 2009, p.65). In later autumn-winter time there a lot of storms.

Wadden Sea region is a unique sandy-muddy tidal ecosystem with very high biological productivity and natural dynamics. It is the largest wetland area in Europe, the largest mudflats in the world and, therefore, highly protected nationally and internationally. Protected areas are covered more than 76 % of the total area (figures 4-1, 4-2, 4-3) (CWSS, 2009a).



Figure 4-1 Dunes



Figure 4-2 Mudflats

Due to strong wind and currents the Wadden Sea islands, formed by sand dunes, are constantly shifting and changing their topographical shape eastward – western sides are eroded whereas eastern ones are deposited.

The region is protected by national legislations of the Netherlands, Germany and Denmark. It is also under protection of Ramsar Convention and Habitat Directive (Natura 2000). Since June 2009 Dutch – German Wadden Sea part is included in UNESCO World Heritage list (CWSS, 2009b). Many types of human activities (including construction of wind turbines) are prohibited in the protected areas; outside the Nature Conservation Area they are only allowed if there is no negative impact on the environment (Nehls & Witte, 2009).

In 1986 the major territory of Spiekeroog (around 90%) became part of the National Park of Lower Saxony “Niedersächsisches Wattenmeer”. Some of these areas on Spiekeroog located to the south of the village historically available for some activities such as horse grazing. However, more than 75 % of the territory of Spiekeroog is very strictly protected (figure 4-3, in red colour).

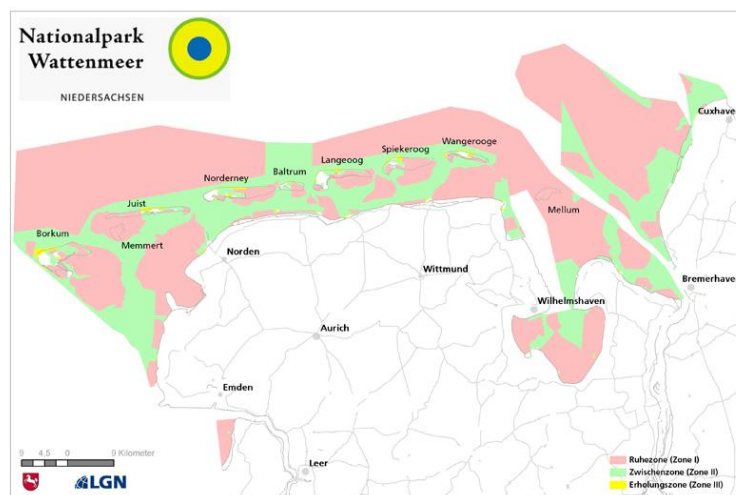


Figure 4-3 National Park “Niedersächsisches Wattenmeer”

Source: Nationalpark-wattenmeer, 2010

## 4.4 Socio-economical situation

Nowadays the main economic activities are related to tourism with a share of approximately 95 – 98 %. The level of unemployment on the island is very low – around 2 % (B. Schade, personal communication April 9, 2010). However, due to seasonal character of tourism activities there are a lot of seasonal workers coming from different places from the mainland.

Spiekeroog as well as other islands in the North Sea is suffered by emigration of young people caused by limited job and educational opportunities on the island. The dominate age groups are people of 25 – 54 years old (around 50% of the population) and older than 55 years (30 % of Spiekeroog constant population) (figure 4-4) (Spiekeroog Municipality, 2009).

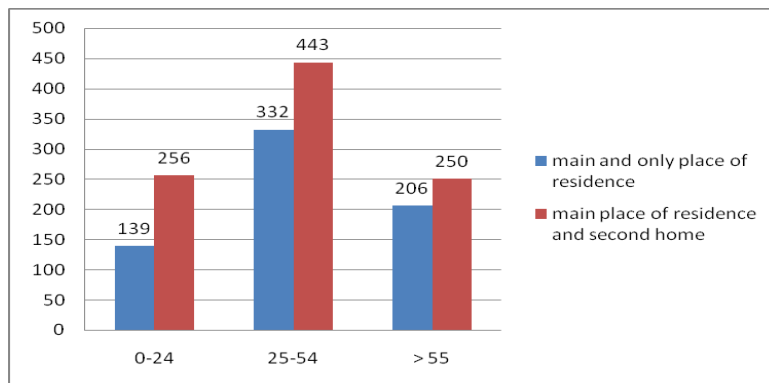


Figure 4-4 Inhabitants of Spiekeroog by age group Source of data: Municipality of Spiekeroog, 2009

### 4.4.1 Tourism

Like other Wadden Sea islands Spiekeroog is a mass tourist destination. Annually the island hosts around 90.000 overnight guests with 600.000 overnight stays and around 85.000 one day visitors. The tourism index, which means overnight stays per 100 inhabitants, is 74.022 (Municipality of Spiekeroog, 2009). During last years amount of overnight tourists is slightly increasing, whereas daily visitors – almost the same or decreasing (figure 4-5). The average stay on the island is 6.7 nights/ guest (figure 4-6), which is longer period in compare to other East Frisian Islands (Municipality of Spiekeroog, 2009; B. Schade, personal communication April 28, 2010).

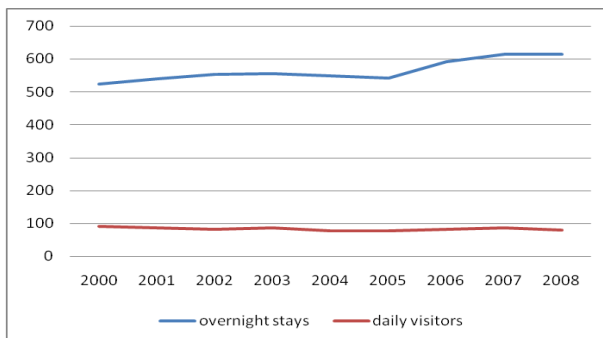


Figure 4-5 Amount of tourists during (in thousands)

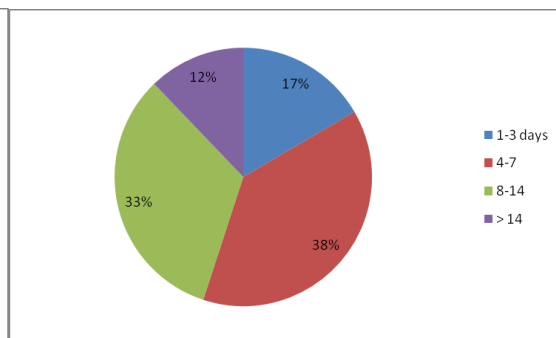


Figure 4-6 Duration of tourist visits (%)

Source of data: Nordseebad Spiekeroog, 2010

Source of data: Nordseebad Spiekeroog, 2010



Tourist season is quite long on Spiekeroog: usually it is from March till October and Christmas holidays. Around 95 % of all visitors are coming by car or train from Germany, other from other mainly German speaking countries like Switzerland and Austria (Hotel “Spiekeroog”, personal communication, April 8, 2010).

Typical visitors are families with children, seniors, people with respiratory diseases (asthma, etc.), groups (sports, religions). What is special about Spiekeroog tourists is that there is already generations of tourists who are regularly coming back. According to the survey of Nordseebad Spiekeroog (2010), around 40 % of all interviewed people are coming to Spiekeroog every year. Apparently this figure is even higher – around 70 % are coming here regularly (Hotel “Spiekeroog”, personal communication, April 8, 2010).

#### 4.4.1.1 Accommodation structure

Spiekeroog has limited capacity of beds for guests – 3587, including all types of accommodation: hotels, pensions, private rooms, apartments, summer houses and sanatoriums. Accommodation structure is presented in the figure 4-7. Holiday houses and apartments are quite typical accommodation for all Wadden Sea islands, including Spiekeroog (around 84 % of all beds). The houses are mainly owned by local residents, some hotels and summer houses – by private owners from other parts of Germany. According Jansen (2009), the popularity of holiday houses among tourists is increasing. On Spiekeroog holiday houses are mainly presented by conventional houses turned into holiday houses.

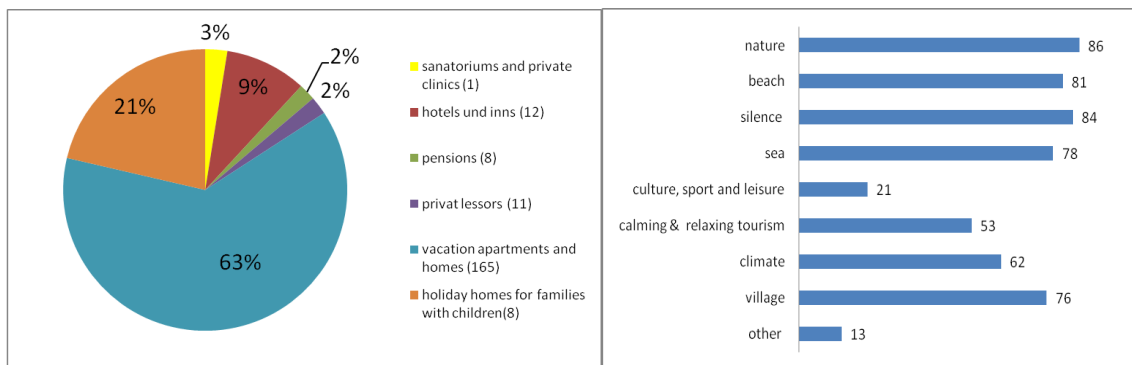


Figure 4-7 Accommodation structure (%)

Figure 4-8 The main tourist attractions (%)

Source of data: Nordseebad Spiekeroog, 2010

Source of data: Nordseebad Spiekeroog, 2010

#### 4.4.1.2 Attractions and amenities

The main attraction for tourists is nature itself (for 86 % of tourists), beach (81 %) and sea (78%), historic townscape with traditional old houses and Churches (76 %), silence and calmness and good environment (84 %) (Nordseebad Spiekeroog, 2010). Visitors really like that there is no cars, just few bicycles, very safe (no crime – people even do not lock their doors) and they can be very close to the nature (Tourists, personal communication, April 8-9, 2010).

Since one of the main target tourist groups of Spiekeroog is aged and recovering people there are health facilities and different spas, therapy centre with massages and fitness and salt water swimming pool, which is old and inefficient – functioning since 1973. Beside this there are

some museums, an environmental centre, the art house, some sport and cultural events such as the International Jazz festival, sailing and horse riding school (Crasemann, n.d.).

Untouched nature and absence of human impacts are among main motives why people like to visit this place (NetForum, 2000). The main activities of tourists here are often very simple: spending time on the beach, (sun) bathing, walking, eating, sleeping and reading (Tourists, personal communication, April 8-9, 2010). Some people are taking walking-tours through the protected mud flats, watching bird and seals colonies, horse riding and visiting exhibitions.

#### 4.4.2 Waste and water management

Spiekeroog is currently self-sufficient in drinking water, which is pumped from underground water bubble. OOWV (Internetseiten des Oldenburgisch-Ostfriesischen Wasserverbandes), water supply and sewage operator of the East Frisian, is currently looking for solutions how to sustain it for future (U. Suetering, personal communication, April 27, 2010). The island has the sewage system with waste water treatment, which periodically during heavy rains has problems and being overloaded.

As to wastes, Spiekeroog especially during high tourist season produces a lot of waste. Like everywhere in Germany it has to be separated and collected and recycled. On Spiekeroog there are no facilities to deal with wastes, so everything including organic wastes is transported to the mainland by everyday ferry (figure 4-12).

#### 4.4.3 Energy system

Energy system of Spiekeroog almost totally relies on the mainland. It is connected to the national electricity and gas grids. Electricity demand of the island is 7400<sup>3</sup> MWh/ year. Around 8 % (653 MWh/ year) is locally produced by the wind turbine at the Hermann Lietz-Schule (installed power 225 kW) and 22MWh/ year by a few PV installations (figures 4-9, 4-10). The heat demand (15 210 MWh/ year) is covered individually trough household gas boilers (Aalborg University, 2010; Spiekeroog Municipality, 2009).



*Figures 4-9, 4-10 Current local electricity generation on Spiekeroog*

Spiekeroog has daily ferry connection to the harbour of Neuharlingersiel. The journey takes

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<sup>3</sup>The data for 2008

around 50 minutes (8 km). On the island with exception of fire and rescue vehicles cars are not allowed. There are 24 electric cars for luggage transportation from harbour of Spiekeroog to the village (the distance around 800 meters) and for post delivery (Aalborg University, 2010). Bicycles on Spiekeroog is mainly privilege of inhabitants, since it is not possible to rent a bike on the island and expensive to transport to the island (21 €) (G. Aper, personal communication, April 9, 2010).



Figure 4-11 Electric cars on Spiekeroog



Figure 4-12 Daily ferry to Spiekeroog

## 5 Spiekeroog: main actors and their interactions

As discussed in the theoretical section (Chapter 2), dominant regime is created and maintained by several social groups interacting with each other. Their activities reflect normative and formal rules of the current regime (system). Therefore, to understand and identify the current and future trends on Spiekeroog it is essential to look at Spiekeroog main stakeholder groups, their activities and perception on future development<sup>4</sup>. The main stakeholder groups related to energy (consumption) system on the island are showed below (figure 5-1). Since almost all people on the island involved to some extend into tourism activities (as well as into political work) it is not easy to distinguish precisely stakeholder groups and their opinions<sup>5</sup>.

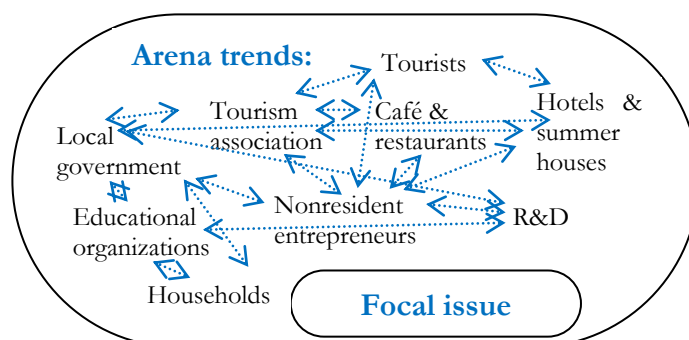


Figure 5-1 Arena trends: main social actors and their interactions

### 5.1 Residents

There are approximately 400 households and 370 houses on Spiekeroog. Houses have a lot of potential for energy savings. The majority of the houses are old and, thus, very energy inefficient – bad insulated and expensive to heat. Around 40 buildings are very old and protected by the National and local law as a world heritage (figures 5-2, 5-3). It means that outside appearance of these houses can be changed without special approval of the local government which it is quite difficult to get. Moreover, there are special rules for the construction and reconstruction of the houses in the village – the colours, size and shape of windows, roof etc.

However, the interest of islanders how to make houses more energy efficient is not very high. When the Municipality organized the exhibition to provide necessary knowledge, the idea was very supported by residents, however, unfortunately only few people actually visited it.

<sup>4</sup> This sub-section is written mainly based on insights gotten from interviews and talks with people from Spiekeroog, April 8-9, 2010. Some information is based on scanning of different media sources: (Kazim, 2006; Stelljes, 2010; Wetzel, 2009)

<sup>5</sup> Almost all interviewed residents belong to different stakeholder group at the same time



Figure 5-2, 5-3 Traditional houses, Spiekeroog village

The majority of people on the island support the idea to be energy self-supported in the use of renewable energy. Dependency on the mainland and ferries make their life much more expensive. Moreover, it is natural for islanders to have the willingness to be self-supported from the mainland as it was before. Some people believe that somehow it will happen in future – and they have to change. However, since they live on tourism and tourists like Spiekeroog as it is and coming here because nothing is changing, resident do not want to reach this goal at any costs but only without any visual damage “Spiekeroog should remain as it is”.

Nevertheless, people are changing their perceptions and improving their houses but it takes time like everything on Spiekeroog. If something needs to be changed, it goes slowly and cautiously. As to energy, reduction of energy bills is good but not ultimate motivation for people. Most of the islanders are quite wealthy. Even though tourism is the main source of revenue, people close their shops and businesses for a few hours for a lunch break. Island motto is ‘slowing down, relaxing’.

According to Fernández (2009), national and regional context where environmental issues playing important role positively influences on islanders’ everyday life. It creates favourable atmosphere for environmental innovations because knowledge and technology are more available as well as more sustainable lifestyle are slowly becoming part of everyday life.

## 5.2 Local business

Local businesses are totally dependent on tourism activities – different accommodations (figures 5-4, 5-5), cafes and restaurants (figures 5-6, 5-7), shops, attraction and amenities etc. **Tourism is the main driver for them to look for new solutions in order to improve their environmental performance** and keep their tourists.

Hotels have started to change their old gas heat into modern and energy efficient ones – to install micro combined heat and power (CHP), which produce electricity as well as heat. There are already a few such boilers on the island.



Figure 5-4, 5-5 \*\*\* & \*\*\*\* Hotels, Spiekeroog

All products and materials are coming from the mainland. They have to be transported every day from by ferries as well as all wastes (in summer time restaurants and hotels produce a lot of organic waste in summer – around 100 tones/ a year). Due to transportation costs all products in shops, catering and accommodation is around 20-30 % more expensive than in the mainland. In Spiekeroog nobody is fishing and growing vegetables in their gardens because is not profitable and people are too busy with tourism.



Figure 5-6, 5-7 Cafes & restaurants

The tourism development on the island is regulated by the amount of beds available in the island due to limitations on the living area (area outside the village is protected zone) and amount of available water on the island.

### 5.3 Tourism business association

Tourism business organization “Nordseebad Spiekeroog GmbH” is the daughter company of the Municipality, which is responsible for service of the health resort, public tourism facilities, ferry traffic and control the payment of tourist taxes. This organisation can play very important role in an environmental innovation process since it is assembling Spiekeroog tourism businesses and, thus, highly influential actor in a tourism development and it has capacities to study, introduce and monitor environmental innovations related to tourists, for knowledge development and their diffusion through local tourist business network.

Currently Nordseebad Spiekeroog GmbH is interested in renovation of old indoor swimming pool (figure 5-8) in order to make it more eco (energy)-efficient as much as possible in C2C way.



Figure 5-8 Indoor swimming pool



Figure 5-9 Municipality building

## 5.4 Educational organisations

Educational organisations are represented by the boarding school (figure 5-10) and environmental centre (figure 5-11). The private boarding school (the Hermann Lietz-Schule GmbH) is second biggest employer after Nordseebad Spiekeroog GmbH – the only one organization which is not involved in tourism activity on the island with about 40 employee and 120 students per year. The school is a kind of innovative spirit of Spiekeroog, 15 years ago it initiated installation of a wind turbine on the island (figure 4-9). Currently the boarding school is planning to replace the old wind turbine with the bigger turbine, which will cover approximately 50 % of Spiekeroog electricity needs.



Figure 5-10 Hermann Lietz-Schule



Figure 5-11 Environmental centre

A few years ago (2006) the boarding school also initiated the foundation of the environmental center with permanent exhibition about the nature of the island. The school is located 30 min walk from the village and functioning independently from the village. In the beginning they felt opposition from old inhabitants of the village, but now people are quite happy and positive about what the school is doing.

The school also is a source of young generation on the island, which is important for social sustainability of the island. As it was stated above, young people are leaving Spiekeroog and only few have opportunities and possibilities to come back.

Moreover, besides generation of innovative ideas and support of creativity, participation and interest of tourists, the boarding school is also diffusing them through students into outside world as well as into Spiekeroog society. In regards of energy we can see a good example – a son of one of few owners of solar panels on the island – is a student of the boarding school.

## 5.5 Tourists

Usually people on vacation show different pattern of consumption than at home since people do not want to limit themselves during holidays (as cited Jansen, 2009 p. 76). On Spiekeroog, it seems that visitors who are coming here already quite special in this regard. People are ready to pay a bit more for good environment and clean air. They are coming because of the nature and they care about the environment. Environmental concern is growing among tourists. However, some residents believe that Spiekeroog needs more “right tourists”. Only half of current tourists coming to the island are enough environmentally aware and care for the environment.

As already outlined above, the majority of tourists are regularly 1-2 times a year visiting the island. They like that everything remain the same – nature, village with old traditional houses and people – everybody knows each other. But at the same time, according to the interviewed tourists, they do not mind to see minor changes which are making the island more sustainable and self-sufficient like solar panels on roofs from not visible sides especially not in the center – “we do not look at roofs”. However, for majority of current tourists there is no matter whether Spiekeroog self-sufficient in energy or not.

## 5.6 Local government

Local Government is presented by municipality and the elected mayor (figure 5-9). Moreover, Spiekeroog has local council and environmental committee. It is 11 people in total, representatives of the different businesses and local community of the island. Many of them are member of several committees on the island. They meet every two weeks to discuss the problems and future of the island. The Municipality organizes and leads this process and facilitates interaction among different actors. All policy regulations and measures in order to be realized have to be approved by the members of the local council.

The local government is willing to stimulate more activities for sustainable development on the island. In order to monitor the results and facilitate communication with stakeholders it is trying to elaborate sustainable standards in the next topics: energy, water, material, waste, nature, culture, socials, food, (environmental) education and traffic. Therefore it is building up cooperation with the University of Oldenburg to develop software for sustainability reporting for Spiekeroog, which can be a very useful instrument for supporting decision-making process.

As to energy issue, the Municipality would like to find good solutions related to the renewable energy, which will not affect tourism and not destroy attractiveness for tourists, since it can bring additional benefits for tourism and, thus, economical development of Spiekeroog.



However, many different renewable energy options have been already discussed and some people from the local council do not see any real possibility to become energy self-supported in future since nothing can be changed in the environment of the island (95 % of the territory is a protected area).

## 5.7 Non resident entrepreneurs

More than 10 years ago a non resident entrepreneur from the mainland fell in love with Spiekeroog and by investing several million euro in various projects brought a small 'revolution' on the island. He has had his own vision how to improve it – bring more services and wisely modernize the island. However, it was completely different from the vision of the majority of islanders.

The investor started with a house with apartments and a four-star apart-hotel, which caused a lot of critics that the building was not consistent with architectural style of the old village – too high and balconies are too big. Then the entrepreneur bought and demolished several old buildings and constructed new holiday houses and apartments in the style of island architecture. He also spent millions to renovate the house in the old centre of the village and opened pottery, boutique and bookstore there. Even critics agreed that it was wonderfully made (Kazim, 2006).

Many islanders were complaining that rich people are accumulating the property of the island – that they do not want social market economy on Spiekeroog. The council was discussing the question to prohibit buying land and houses to non-residents of Spiekeroog. However, who else could buy the houses, rebuild and renovate then in such beautiful way? With pottery and bookstore you cannot make money – but it brings benefits for tourism development (Kazim, 2006).



*Figure 5-12, 5-13 Art house*

Currently this entrepreneur owns the major amount of tourist beds on the island, few restaurants and shops. He believes that today consumers have different needs – he wants to bring 'fresh air' – new activities and attractions to change tourists' behaviour – new visitors who not only lying on the beach but also act creatively and attend cultural events. Therefore, in 2007 he opened the art house – 2500 square meters of exhibition space and large equipped studios for workshops (figures 5-12, 5-13). There are 220 courses for all age groups in twelve areas of art (sculpture, painting, jewellery design, photography etc.) with experienced artists

and teachers from universities and academies. There are also three scholarships annually for young artists (Wetzel, 2009).

Even though artist house became a new tourist attraction, the project has been very controversial among the islanders. With new opportunities it brings new challenges. Local people are wondering why to change something if it was well till now for a long time; the visitors want it the way like it is. So far Spiekeroog was considered as a paradise for eco-tourists – ‘green’ island with its own charm and reasonable prices. Since he has opened the expensive apartments and holiday houses (150-250 euro per night) and the art house, new visitors are attracted to visit the island. Local people are afraid that it will change tourism market on Spiekeroog – will cause further increase of prices and change visitor structure: instead of elders and families with children – young and wealthy tourists – an exclusive island for rich people (second Sylt<sup>6</sup>). Some islanders see that charm of the island already disappear (Stelljes, 2010).

There is another question why the Municipality and tourist business association were not happy with the entrepreneur’s activities. He operates three small boats which are three times faster and can run at low tide and competing by this with regular ferries which can drive only during high tide. Moreover only taking ferry ensures that tourists actually pay the tax which is quite big revenue (Kazim, 2006).

Meanwhile things are calming down – it seems that the island has accepted him. More and more people are supporting his activities, since they are strengthening the economic and stimulate tourism development not like house owners who only have second home on the island. Some people believe that he made local businesses wake up and stimulated them to think about future, possible changes and improvements.

What is for future plans? Sponsoring the project of zero-emission hydrogen ferries to Spiekeroog for 100 persons, speed 15 knots, hybrid system 150 Kw fuel cell and diesel motor in case of emergency<sup>7</sup>. It is planning that the ferry would be ready by 2012 (Kazim, 2006).

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<sup>6</sup> Sylt – North Frisian island, one of the most popular tourist luxury destinations for rich tourists with its own golf fields and small airport

<sup>7</sup> The city of Hamburg has developed the The ZemShip – the world’s first project in a fuel cell-driven passenger ship. <http://www.proton-motor.de/zem-ship-zero-emission-ship.html>

## **6 Future visions and scenarios**

### **6.1 Criteria for generation of future vision**

Study of current energy system and local conditions on Spiekeroog (Chapters 4, 5) revealed that there are quite limited possibilities and opportunities to produce more electricity based on local renewable sources. The main ideas of discussed possibilities are presented below:

- second wind turbine is very difficult – “even one wind turbine is already too much” – it is anaesthetic and destroys the view of the untouched and unique nature of the island
- no PV in the village centre (potentially it is calculated that photovoltaic production potential is 178 kW (Aalborg University, 2010))
- geothermal heat not possible due to fresh water bubble which has to be protected in order to ensure water supply to the island
- organic material for biogas – only considerable amount during summer time
- ‘blue’ (osmotic) energy is in research (but seems not enough fresh water on the island)
- heat power of the ocean (Gulf Stream) – maybe?
- tidal power – maybe? but probably not effective and efficient (not very high tides; very active geomorphologic processes would probably cause technical difficulties)
- plans for hydrogen boat in 2012.

The main problems related to the current energy system are:

- Major part of energy exported from the mainland (coal and natural gas outside the region).
- Old historical and inefficient buildings (very expensive and technically difficult to make them more efficient)

Residents’ sensitivity:

- Nature and old village are main economical resources (valuable for tourists) and it is protected by the Government
- Own notion of “sustainability” – don not change anything

- Low interest of islanders in significant environmental improvements: people are quite rich here – no need to change – tourists are coming anyway
- Tourists can be only one motivation to change and reduce energy consumption

Since new generation of electricity on the island is very difficult, the backcasting workshop was mainly aiming to generate new and creative ideas and future visions how to reduce electricity consumption in 50% by 2030. This goal was set up based on the following assumption:

- Replacement of the old wind turbine with the bigger one will cover approximately 50 % of Spiekeroog current electricity needs
- In this case with halving electricity demand – Spiekeroog can become self-supported in electricity in future.

## 6.2 Workshop

The creativity and backcasting workshop took place in 12 of April, 2010 in the Sustainability Department at the University of Delft.

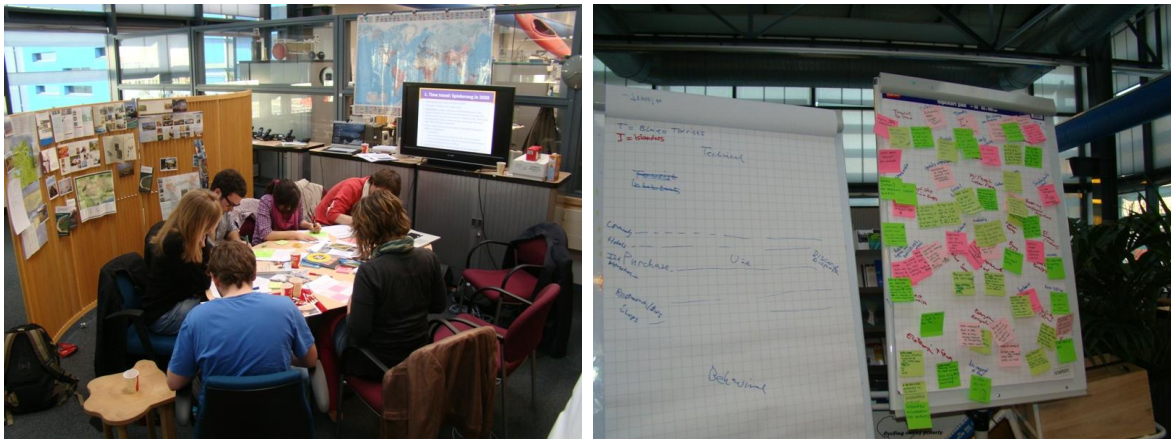


Figure 6-1, 6-2 Simulation of the backcasting workshop for Spiekeroog with students in TU Delft

The workshop was very productive and resulted in many different and creative ideas (figures 6-1, 6-2). All these ideas were clustered and elaborated into four proto-scenarios based on Goals – Strategies – Proposals analysis, where goals are general purposes; strategies are actions to reach the goals and proposals are particular innovative options (Quist, 2000a).

Four main goals were identified:

- ‘High-tech’ island: reduce electricity demand of households through technological innovations
- ‘behavioural shift’: reduce electricity use through influencing residents’ and tourists’ behaviour

- ‘sharing services’: reduce energy demand through addition of services (product to service switch)
- ‘slow’ island (traditional & with less tourists): reduce electricity demand by decreasing amount of overnight visitors during high season.

### 6.3 Scenarios framework

Later on, I have tried many ways how better organize these proto-scenarios in order to incorporate the different current and future trends and driving forces identified from literature review, interviews and the workshop (Chapters 4, 5.4). The list of the main trends shaping the future and affecting the focal issue is in the attachment 4. Finally I ended up with scenario cross<sup>8</sup> – two-dimension scenarios framework reflecting interaction between two main uncertainties: the way of energy reduction and types of tourist (figure 6-3). The two dimensions do not exist separately from each other but are complementary.

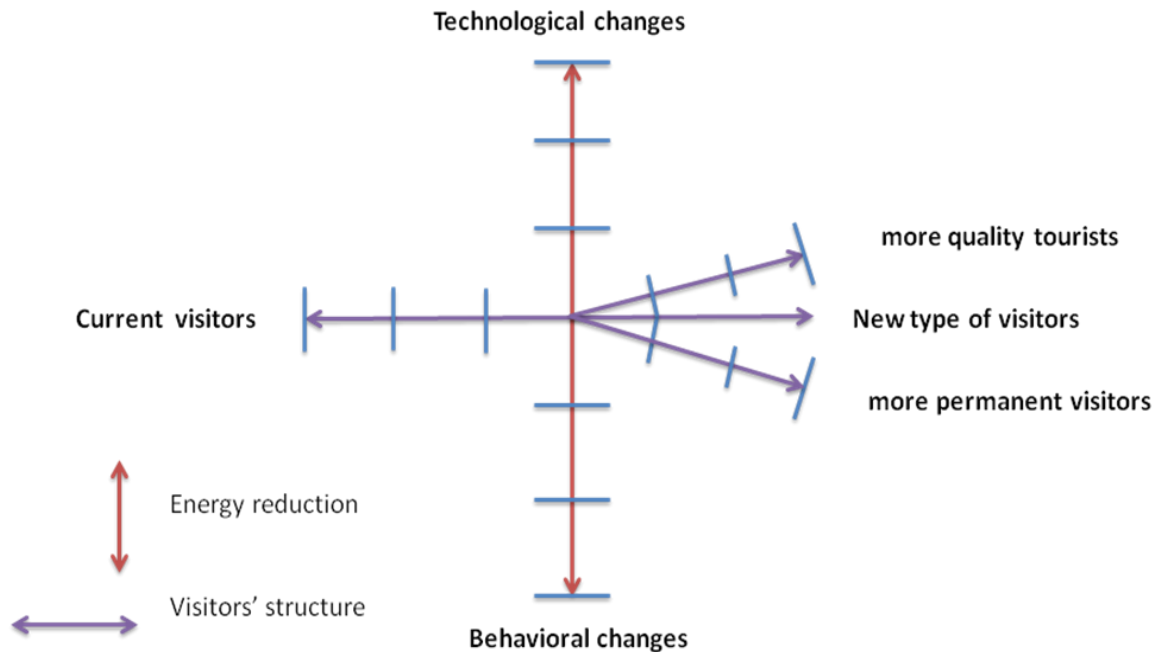


Figure 6-3 Scenarios framework

Vertical dimension represents how to reduce electricity consumption: only with technological options and only by behavioural changes. Horizontal dimension reflects types of tourists: current tourists who are coming to Spiekeroog now and new types of visitors which might come in future if necessary conditions will be created: more permanent tourists and more quality (exclusive) tourists. Based on this framework four different scenarios were constructed: ‘smart’, ‘responsible’, ‘active’ and ‘slow’ (Figure 6-4).

It is obvious that the “real” future will not be any of these scenarios, but will probably have some elements of all of them. The goal is to explore different plausible futures and assess them in order to generate the most realistic and desirable roadmap towards more sustainable energy system on Spiekeroog.

<sup>8</sup> The selected approach of scenario building is briefly described in the Chapter 2.

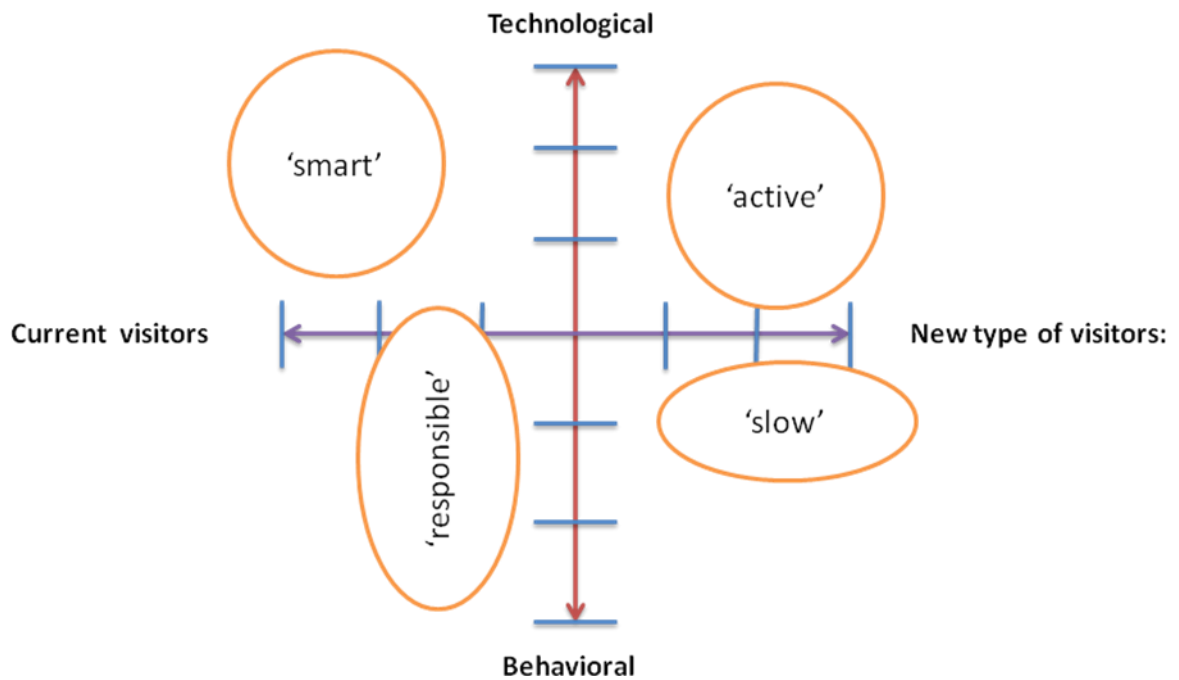


Figure 6-4 Future scenarios

## 6.4 Description of future scenarios

### 6.4.1 'Smart'

From the first tourist glance 'smart' Spiekeroog looks exactly the same as it was twenty years ago: the same type of tourists – families with children and seniors demanding silence and feeling of security, the same relaxed and nature-based tourist activities. But from inside you can see invisible for tourists' eyes changes. All buildings including very old ones are renovated – energy efficient affordable and sustainable by:

- better insulating (walls, glazing, floor etc.)
- implementing energy and water technological solutions to increase the efficiency and decrease demand
- implementing renewable and/or efficient non-renewable where it is possible

All residents' houses, hotels, restaurants, holiday houses and apartments and tourist amenities (swimming pools, spas, saunas) have low-energy equipment and appliances: fridges, washing machines, ovens and stoves etc., modern efficient CHP or boilers as well as efficient lighting system (LEDs, sensors and alternative lighting).

To protect the view of the old traditional village of Spiekeroog that is so much likable by visitors, local people found out renewable solutions which do not arrest no one's attention: solar (or solar paint) from not visible to tourist' eye sides, micro-wind turbines integrated in the style of old houses etc.

Kitchens are equipped with a special sinks for organic wastes which go to small biogas digesters for several households. Therefore, there is no need to transport all organic and food waste to the mainland, whereas demand for amount of natural gas piped from the mainland can be significantly reduced.

The energy systems of all houses are optimized at house and island levels in an island smart grid. All houses have metering and energy-management tools, which allow optimizing energy performance of houses during the day and avoid unnecessary energy use of major appliances, heating and lightening, manage peak loads among different consumers and exchange extra electricity with neighbouring households.

Residents are pleased that these measures helped to significantly reduce living costs – gas and electricity bills with improved comfort, social status and satisfaction that it provided a lot of environmental benefits for the island. Tourists in general are aware about such renovations. They are proud and happy of having their vacations here.

The main proposals are:

- (1) energy efficient equipment, appliances & lightning
- (2) renovation of existing buildings
- (3) energy system optimisation (smart houses and grid)

#### **6.4.2 ‘Responsible’**

Today tourists of Spiekeroog are much more environmentally educated than visitors twenty years ago and more conscious about the environment of the island, the Wadden Sea region and our earth and sustainability issues in general. The main tourists remain the same as before but became 20 year older – already grown up children with their own children. They are visiting Spiekeroog every year and gradually learning from the island as well as the island’s residents are learning from them.

‘Responsible’ Spiekeroog is already a new touristic brand – very ‘green’ island which attracts only ‘right’ tourists. Unsustainable behaviour is socially undesirable here. Everybody understands how special is their island (tourists feel they belong to the island and, thus, also responsible for it) and they are willing to change their habits and reduce their energy consumption especially if it is fun and interesting. They are coming here because of nature and they respect the fact that there are no extra luxury electrical appliances on their apartments, hotel rooms, holiday houses etc. as well as luxury amenities such as whirlpools, saunas and solariums.

Visitors like that there are always a lot of interesting, new and fun activities for everybody, aiming to raise awareness, educate and motivate people to have more sustainable life style.

One day visits are not so popular here anymore. It is regulated by ferry ticket price which is quite expensive and therefore discouraging to come only for one day.

The main proposals are:

- (1) motivating energy savings

- (2) education and raising awareness
- (3) prohibition of luxury equipment
- (4) climate-friendly holidays

### **6.4.3 'Slow'**

'Slow' Spiekeroog is not mass tourist destination anymore. It has around 30 % less tourists during high season than today but with the same level of income for local people. These tourists are more exclusive and willing to pay more for valuable experience.

Residents have less work related to tourists and, thus, more time to diversify their activities – to come back to more traditional life-style that their forefathers had before. They are more sustainable and self-sufficient in food. They are having small-scale organic farms, composting organic waste and using it and animal manure as fertilizers for gardening and growing vegetables in their gardens. Beside this there are a lot of other local small-scale businesses: fishing and different handcrafting.

In this scenario tourists are coming here year-round. Tourists are involved in everyday islanders' activities – "learn by leaving": how to fish in a traditional way, cook traditional recipes, work with animals, do organic farming, make traditional handicrafts etc. What are routines for residents are adventures activities for visitors. Tourists also benefit by getting new tourist package – healthy local organic and seasonal food available in hotels and shop as well as 'slow' traditional food with stories about food in restaurants.

The main proposals are:

- (1) Less, year-round tourists
- (2) Local diversified small-scale businesses

### **6.4.4 'Active'**

'Active' Spiekeroog has a lot of 'new' tourists who stay much longer time on the island especially during nice and hot summer time. They are wealthy active pensioners with different interests who love the nature, cultural activities and atmosphere of the island and prefer to combine work and pleasure. Due to flexibility of future job market people can afford to work on a distance and at the same time to spend more time on the beach with their grandchildren, friends or meet new people.

Half a day tourists are working in a community office centre located at the end of the village. The centre has a wireless internet connection and equipped with necessary office equipment. The building is generally constructed in traditional village style and colours, but modified and modernized in accordance with bioclimatic architecture principles. Moreover, the roof surface is integrated with solar panels in order to provide the office centre with own electricity as well as to supply the surplus to the grid.

Beside its main working functions, the community office centre is a core of social life of the tourists and residents of the island – people have possibility to cook and eat together and



socializing. In evenings the centre becomes a place of different social collective activities – listening music, reading books, discussing different topics, playing games etc. Finally, the centre attracts tourists of different age in educational purposes as a good example of sustainable solutions.

In general the majority of tourists know each other. Therefore, beside common kitchen in the office centre for their convenience there are other different community-based services such as washing centre, the place where they can share or hire different kinds of sport or household equipment.

Tourists are living here quite long period of time, therefore they are attending many cultural and sport activities: sport and dance classes – there are a human powered energy generating gym; cultural courses, health-based courses: yoga, stress management, ‘mindfulness’ in nature.

The main proposals are:

- (1) electricity producing office centre
- (2) community-based services
- (3) human powered energy generating gym.

## 7 Designing a roadmap: Spiekeroog towards 2030

Scenarios, their evaluation and analysis of actors' roles and existing conditions as driving forces and barriers for transition were used as the main inputs for the construction of the roadmap.

### 7.1 Evaluation of the scenarios

The main criteria for the evaluation of the future scenarios are desirability, attractiveness and ease of implementation by stakeholders.

Since the most important criteria are based on stakeholder feedbacks, the scenarios were discussed with Spiekeroog Municipality, which represented the opinion of the local government as well as the majority of local community and local businesses. First of all, they believe that reduction of electricity consumption on Spiekeroog by 50% in 20 years is too ambitious.

The results of the discussions are presented in the figure (7-1) – it is combination 'smart' and 'responsible' scenarios. According to their opinion, it is not the question which scenario they like most, but rather which scenario is most realistic. The main Spiekeroog stakeholders would like to keep current type of visitors. They do not think that it is possible and good for the island to attract other types of tourists. It would be beneficial to see current but more environmentally concerned and educated visitors and new eco-tourists, as well as guests who stay longer time but as tourists not in their own houses.

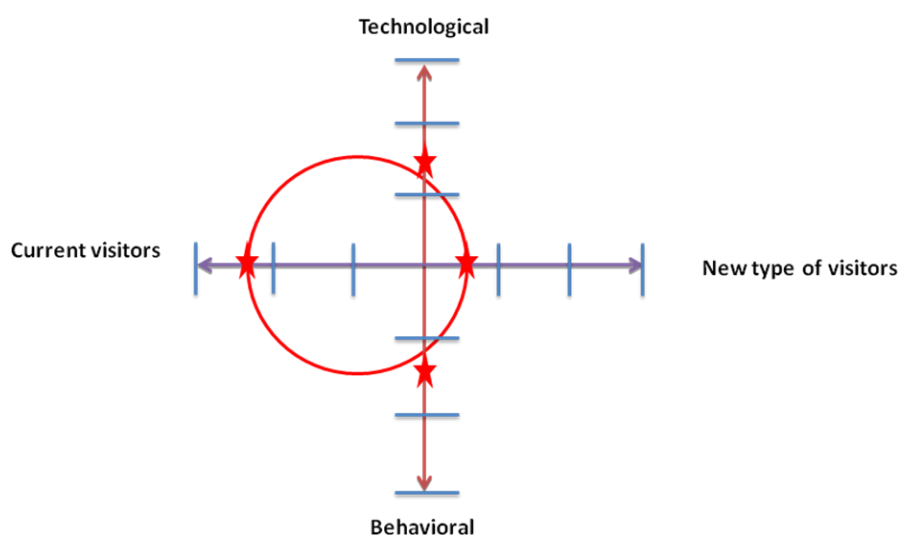


Figure 7-1 Desirable and realistic future vision of Spiekeroog in 2030

To reduce amount of tourists and change significantly tourist structure is not realistic and desirable by the islanders. The inhabitants are not willing to reduce the number of beds for the guests. It is already quite expensive to have holidays on Spiekeroog, therefore it is not possible to make tourists pay more and involve them in any kind of activities ('slow' scenario), since there is no other economic activities. Other activities like organic farming or fishing etc. are limited by scale – difficult to make something small scale and profitable and, thus, risky

whereas requires a lot of hard work. Moreover, generally the islanders do not want to spent more time with tourists, they are friendly but want to be at some distance from their guests.

The inhabitants are not dreaming about stimulating the year-round tourism. Since in winter time they like to be on their own, have holiday themselves or renovate their houses and do other preparations for tourist season. It would be also beneficial for the island to reduce day visitors since they usually do not spent money on the island – they bring food with you but leave their wastes on the island.

In order to reduce energy (electricity) consumption the island would like to go for both technological and behavioural changes. However, it is very difficult to convince and motivate inhabitants to change anything. As stated before, it seems that all changes can be initiated and influenced (1) only by wish of tourists – literally, when residents recognize that tourists want to stay in the house with solar panel on the roof, they will think about changes; (2) and/ or by high costs for energy (electricity and gas) expense. Nevertheless, it will not be the main motivation for the islanders because most of them are quite wealthy, and like generally people on islands, are “a little bit” stubborn - “the same as it ever was”.

The most likable elements of scenarios:

- Keep current tourists
- Invisible and gradual technological and behavioural interventions

The least likable elements

- Reduce and change tourist structure
- Other economical activities and involvement tourist in these activities
- Too much interaction between tourists and residents (sceptical about games)

## 7.2 Conditions for the transition

The existing conditions for system transition on Spiekeroog were studied against the main functions of innovation system defined by Hekkert et al. (2007) (table 7-1).

Table 7-1 Functions of innovation system, Spiekeroog

Functions of innovation system	Spiekeroog conditions
Entrepreneurial activities	Entrepreneurial activities are very important for innovation system. They have very big potential to realise new knowledge, networks and markets into concrete actions to take advantage of new business opportunities. On Spiekeroog it seems that among local businesses not many new activities like diversification of existing businesses are emerging. However, the new entrants (non resident entrepreneurs) have been playing quite important role in the market and recent (tourism) development. All these activities are not directly related to the focal issue, but some possible options regarding renewable has been explored. Moreover, the activities of the non-resident entrepreneur caused quite deep resonance in the society and especially local businesses, which may lead to create healthy competitive conditions for local entrepreneurial activities. These conditions should

	<p>be stimulated more by different benchmarking, competitions and awards schemes.</p> <p>Apart from this, analysis of the current and future trends identified that in future the region will apparently attract more new investors. Therefore, the islanders have to be more forward looking, innovative and 'green' in order to be competitive and secure from different kind of outside intervention to keep their businesses profitable.</p>
Knowledge development	<p>There is no R&amp;D is going directly on the island. However, Spiekeroog through the Municipality and apparently non resident entrepreneurs has been interacting with different research institutes and other islands, developing different sustainable innovative solutions especially through C2CI project. In this regard it would be interesting to watch Ameland' demonstration project with renovations to eternal holiday house in order to learn from the experience, adapt to local conditions and apply on Spiekeroog (as a show case first).</p>
Diffusion through networks	<p>Members of the Local council are represented by different businesses and local community. It ensures diffusion of knowledge among other islanders. However it seems that there are much more potentials for residents – tourists – residents interactions. In this regard the tourism business association can play much more important role as provider and exchanger of information (more green feedbacks and information for tourists).</p>
Guidance of the search	<p>There is no (ambition) vision supported by the majority of the island to reduce energy consumption and there are no established targets in this regard. Currently there are motivating regional and national targets. Regional – the Ambition Manifesto signed by Dutch Frisian islands – to become self-sufficient in 2020 in energy and water – but focusing mainly on finding ways to produce locally renewable energy. National targets: increasing of energy efficiency and renewable energy. There is also C2CI project goal for the involved islands – to generate up to 100% energy supply in next 30 years using the current solar income.</p> <p>It is necessary to set up targets on the level of Municipality and local businesses (hotels, summer houses, restaurants and different tourist facilities) to reduce energy and provide more information on possible cost-beneficial measures.</p>
Market formation	<p>Germany policy context can provide a lot of opportunities for niche market formation. This function should be studied more in regards of particular innovations and technologies.</p>
Resource mobilization	<p>Apparently, resources (both financial and human) can be found for the implementation of interesting solutions but strong motivation is needed for stakeholders to realise their importance, environmental, social and financial benefits for now and for future.</p>
Creation of legitimacy and counteract resistance to change	<p>It would be probably very difficult to bring any significant changes since residents through the local council will lobby any policy decisions affecting their businesses. Therefore all changes should be progressive – starting with learning step, understanding and accepting the information.</p>

Based on the analysis of the existing conditions and drivers for structural changes (tables 7-1, 0-1), it can be summarised that the following main emerging trends have to be broken down in the dominant regime in order to facilitate the transition: increasing popularity of luxury tourism services (with heavy energy consuming appliances and equipment), residents' passive position in environmental performance improvements and their perception that renewable and sustainable energy solutions are not attractive for tourists.

The main conditions which are favourable for the transition (and should be build up) towards low energy demanding Spiekroog can be defined as following: creation and spreading out the desirable future vision; stimulation healthy competitive market conditions for environmental improvements and innovations in accommodation and catering sector; motivating consumer to buy new and usually more expensive EE appliances and equipments, enhancing the interest in renovation of buildings to eco-buildings; necessary knowledge, information and learning ('learning by doing' and 'doing by learning') from variety of sources, capacity building and networks, new habits and practice, organisational and financial support; tourism business stimulation by tourists' feedbacks; 'green' marketing for more eco-tourists.

## 7.3 Roadmap

### 7.3.1 Future outlook

By 2030 Spiekeroog's practices, rules and people life style have dramatically changed versus 2010. Meanwhile, the island mainly look the same as many years ago: the same people, tourists, relaxing and charming atmosphere of the good and untouched environment and old village. All buildings including very old ones are renovated inside and, where it was possible, outside in order to be resource efficient, energy passive or energy plus houses. All households and businesses (hotels, restaurants, holiday houses, apartments and tourist amenities) have low-energy equipment, appliances and lightening system. The energy systems of all houses are optimized at house and island levels in an island smart grid. But technological changes were not alone, but accompanied with changes of people (both islanders and tourists) behaviour, culture and practice. The new networks have been created – the islanders who are interested in improving energy and other environmental performance of their businesses.

Good practice in hotels, restaurants and households became a routine, whereas monitoring and controlling metering and energy-management tools – a habit. Tourists respect the rules on the island and aware about efforts which the islanders are taking. Beside the fact that they feel good living in the climate friendly accommodation, they also like to see positive changes based on their feedbacks. Today tourists of Spiekeroog are much more environmentally educated than visitors twenty years ago and more conscious about the environment. Due to successful marketing campaign the islands attracts only 'right' tourists. Unsustainable behaviour is socially undesirable here. Everybody understands how special is their island (tourists feel they belong to the island and, thus, also responsible for it) and they are willing to change their habits and reduce their energy consumption especially if it is fun and interesting.

### 7.3.2 The changes underlying the pathway

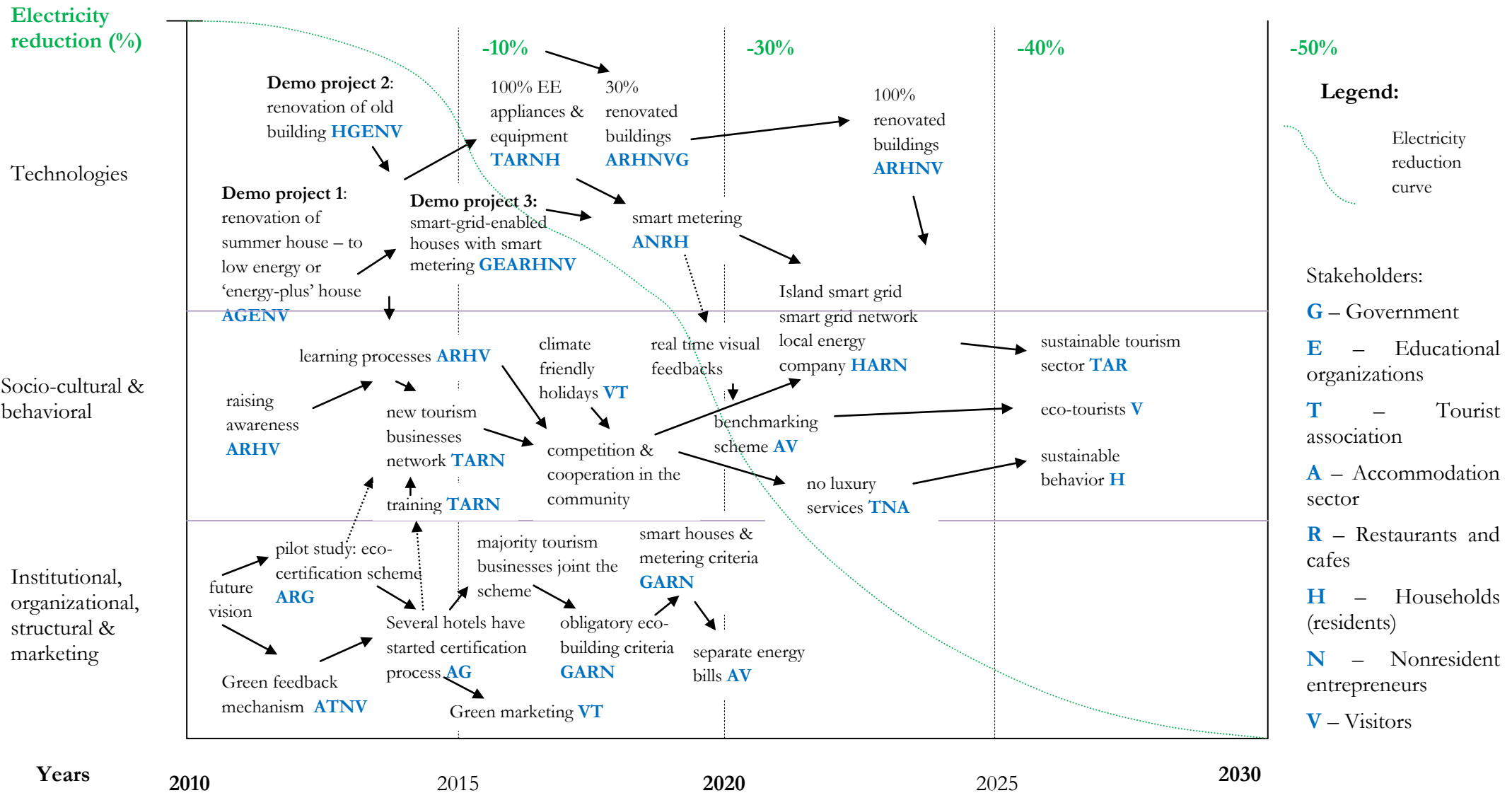
The main necessary changes as well as role of different stakeholder groups to realize the future outlook are presented in the table below (table 7-2) and in the roadmap (figure 7-2). According to transition theory they are described in three phase: predevelopment and take-off (2010-2014) when the necessary conditions are created in order to transition start, acceleration phase (2015-2025) when the main visible changes happen and stabilization phase (2026-2030) when new dominant regime is establishing.

*Table 7-2 Changes underlying the transition pathway*

Sphere	Predevelopment & take-off: 2010-2014	Acceleration: 2015-2025	Stabilization: 2026-2030...
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<p>Structural, organisational, institutional &amp; marketing</p>	<p>The <b>future vision</b> is established: Spiekeroog – green and <b>low energy demanding island</b></p> <p>The <b>pilot study of the new local eco-certification</b> (or eco-labelling) scheme for the tourism businesses on the island</p> <p><b>Energy audit of the tourism businesses</b> to study the potential for cost-beneficial improvements</p> <p><b>Tourist survey</b> – to understand green demand in order to motivate the tourist businesses to make sustainable improvements</p> <p>The Municipality has introduced Spiekeroog <b>voluntary eco-certification scheme</b> – several hotels have started certification process. Role Municipality – green commission</p> <p><b>‘Shame and name’ list:</b> five best energy performing tourist businesses and 5 worst are listed on the municipality building and published in local media (once per month) as well as all improvements and positive effects to encourage islanders and raise awareness and interest among tourists</p> <p><b>System of awards</b> for the best environmental (energy) tourism businesses</p>	<p><b>The majority of tourism businesses</b> (hotels, summer houses, apartments, restaurants and other tourist facilities) <b>joint the scheme and got green certificates</b></p> <p>The certified tourism businesses have specific <b>future visions and annually updated targets</b> as well as <b>environmental policies</b>, motivating for continues improvements</p> <p>The <b>certification criteria</b> are revised regularly and benchmarking level is constantly increasing</p> <p><b>Regular</b> (once a two years) <b>auditing</b> (external and internal auditors)</p> <p><b>Eco-building</b> (passive or energy plus) criteria are obligatory for the eco-certification</p> <p><b>Smart metering and real time visual feedbacks</b> – are among the criteria</p> <p><b>Separate energy bills</b> for tourists are implemented in the accommodation sector.</p> <p>The local <b>energy company</b>, which was established to operate the <b>island’ smart grid</b>, includes almost all households and businesses</p> <p>Mechanism of <b>green feedbacks</b> and regular <b>reporting</b> are functioning in order to monitor and improve</p> <p>Involve tour operators and good advertisement in order to ensure <b>green marketing</b> of the island: attract more right tourists and enhance energy competition among tourism businesses</p>	<p>The main regulations are related with regular revising of the criteria and auditing to maintain improvements, which are slight and not so visible now.</p>
<p>Technologies</p>	<p>Three demonstration projects introduced within this period: (1) <b>renovated holiday house</b> and (2) <b>renovated historical building</b> in the centre of the old village; (3) two these buildings equipped with <b>smart metering</b> and optimized into</p>	<p><b>New technologies and sustainable innovations were spread out on the island.</b> The majority of households and businesses (hotels, summer houses, restaurants, health facilities) <b>replaced their equipment, appliances &amp;</b></p>	<p>The major technological changes in islanders’ houses and island infrastructure happened. The minor continues improvements and</p>

	<b>smart house</b> and <b>micro grid</b>	lightning into energy efficient (low energy consuming) ones, <b>renovated the buildings</b> and <b>introduced smart systems</b> .	changes are going on.
Socio-cultural & behavioural aspects	<p>The demonstration projects caused the lively interest from residents and tourists. Empowered and stimulated by regulatory, institutional changes and <b>trainings</b> it <b>raised awareness</b> and led to <b>learning processes</b>, formation of new <b>networks</b> of knowledge and <b>slow diffusion of knowledge and information</b>.</p> <p>Financial benefits and <b>tourist interest</b> (through feedback system) motivating people to take actions.</p>	<p><b>New practice and expertise</b> is <b>diffusing through networks</b> and becoming <b>common practice, routine and habits</b>. Step by step <b>people accepting</b> new technologies.</p> <p>Even more sceptical people have to innovate since nobody wants to lose profit, clients and good image. <b>Market conditions stimulate competitions</b> as well as <b>cooperation</b> among members of the community (<b>smart grid network</b>).</p> <p><b>Tourists</b> are provided with quite a lot of <b>information</b> why and how to reduce energy consumption during their staying and they do not want to use more energy than guests who had stayed before them. Moreover they pay less for the accommodations – since they pay separate bill for energy use.</p> <p>There are <b>no extra luxury electrical appliances</b> on holiday apartments and houses, hotel rooms etc. as well as luxury amenities such as whirlpools, saunas and solariums on the whole islands.</p> <p><b>Real time visual feedbacks</b> - regular meter-reading is fun and informative for both islanders and tourists.</p> <p><b>System of awards in hotels:</b> discounts and other benefits for sustainable (tourists) behaviour</p>	Sustainable tourists and islanders' behaviour and practice. Equilibrium with nature.





## **8 Conclusions and recommendations**

This Chapter will summarize the main outcomes of the thesis research including possible and desirable future visions and scenarios, current conditions and necessary changes for the future transition; state the recommended actions to facilitate the transition and suggest some implications for future research.

### **8.1 Conclusions**

Small size and isolated context of areas like small islands make sustainability problems more visible and immediate for the local governments and communities. In this regard they have more opportunities to look for different local solutions and, thus, can be islands of sustainability – frontrunners of good examples of sustainable practice for the rest of the world.

Cradle to cradle islands project provides the involved islands with innovative ideas in fields of energy and transportation, water and materials how to solve their problems in a more environmentally friendly way with benefits for communities and local economies. One of the main final goals for C2CI is to reach 100% energy supply with current solar income (using only local renewable sources) in the next 30 years. However, how to achieve this goal is the question mark and topical issue for the majority of C2C as well as non C2C islands.

Some islands in the North Sea like Samsø made a transition to energy sustainable system by new energy production from local renewable sources (wind, solar and biomass) based on local cooperation and investments from citizens, local households, companies and municipality. However, for other islands like German East Frisian island Spiekeroog this transition pathway cannot be applied, since it has much more tourists and local policy restrictions, physical limitations and residents' sensitivities for implementation of more renewable energy generating solutions.

Therefore, the current research raised and tried to explore more the very interesting and topical question for many tourism islands like Spiekeroog: how to make transition towards energy self-sufficiency in a different way – consume less but without considerable limitations for tourism development. In the current research the author assumed that 50% of current electricity demand can be covered by local energy production in future whereas another 50% can be potentially reduced by halving the current electricity demand by 2030. It should be noticed that this way of transition is also quite consistent with C2C approach by highlighting that all sustainability is based on local solutions and by stimulating and supporting cooperation, networks and communicational activities within the local context.

In order to explore and generate transition pathway towards sustainable energy system on Spiekeroog elements of many theoretical, analytical and designing approaches and techniques were used. The core of the research was backcasting approach encompassing generation of future visions and scenarios to explore possible and desirable sustainable futures and identification of necessary steps to achieve the one, most preferable by the majority of local stakeholders.

Based on the analysis of current and future trends and the creativity backcasting workshop with students from Delft University four scenarios were constructed:

- ‘smart’ (going for intelligent technological improvements aiming to increase energy efficiency and effectiveness),
- ‘responsible’ (focusing on significant behavioural changes due to side demand management measures – more responsible and more environmentally concerned tourists and residents, their interaction and cooperation),
- ‘active’ (based on the assumption that tourist structure and people values may significantly change in future – new types of active pensioners and workers as main tourists, they will prefer stay longer and combine work and pleasure; more community based and shared services on the island),
- ‘slow’ (oriented on less but more exclusive tourists year-round who are willing to pay more for valuable and forgotten experience; residents have more time to diversify their economical activities and be more self sufficient in many regards – kind of ‘distributed economy’).

The main insights in terms of a roadmap towards sustainable future system on Spiekeroog are considered as followings:

- The majority of Spiekeroog local stakeholders believe that it is realistic and more preferable to see in future **combination of ‘smart’ and ‘responsible’ scenarios** (invisible and gradual technological and behavioural interventions) with the **same visitors’ structure, but more environmentally concerned and educated** as well as new eco-tourists guests who stay longer time but as tourists not in their own houses.
- **The main current barriers** for the transition and emerging trends which have to be broken down are: increasing popularity of luxury tourism services; residents’ passive position and low motivation in environmental performance improvements; own notion of ‘sustainability’ – the same as it ever was; and their perception that renewable and sustainable energy solutions are not attractive for tourists.
- **The main favourable conditions** which should be build up:
  - stimulation healthy competitive market conditions for ‘green’ innovations in accommodation, catering and other tourism sectors;
  - organisational, informative, educational and financial support and motivation for people (residents, tourists and newcomers) to replace all old and not EE appliances and equipments, renovate buildings to eco-buildings and change behaviour into sustainable one;
  - diffusion of innovative sustainable ideas and knowledge should be enhanced.
- It would be difficult to bring any significant changes since residents through the local council will lobby any policy decisions affecting their businesses: all changes should be progressive – starting with learning step, understanding and accepting the information.

The roadmap can be divided into three main phases: predevelopment and take-off (2010-2014) when the necessary conditions are created and the transition starts, acceleration phase (2015-2025) when the main visible changes happen and stabilization phase (2026-2030) when new dominant regime is establishing.

The main changes during **predevelopment and take-off phase** are not very visible: changes are mainly happening in people' minds. The action (i.e. various demonstration and pilot projects) should raise awareness, provide information and diffuse knowledge, cause learning processes among residents and tourists ('learning by doing' and 'doing by learning'), capacity building and network creation, tourism business stimulation by tourists' feedbacks and 'green' marketing for more eco-tourists.

During **acceleration phase** the major visible transformations are going on: technological, structural, organisational, cultural and behavioural – sustainable innovative technological (EE equipment, appliances & lightning, renovated buildings and smart systems) and other solutions are becoming part of everyday life and common practice for the islanders and tourists. The actions should stimulate healthy competitions in tourism businesses for 'green' innovations by different benchmarking and awards schemes.

## 8.2 Recommendations to facilitate the transition

The following actions briefly outlined above are believed to facilitate the transition towards sustainable energy system on Spiekeroog:

- **Future vision** – creation and spreading out the desirable future vision (i.e. green and low energy demanding island). I would recommend carrying out real backcasting session with main stakeholder groups from the island – in order to create, discuss and spread out the common vision, to generate implementation plan with specific short and long term actions.
- Demonstration and pilot projects:
  - It would be interesting to watch **Ameland's demonstration project with renovations to eternal holiday house** in order to learn from its experience, adapt to local conditions and apply on Spiekeroog (as a show case first).
  - **Renovation of old historical building** – can be interesting not only in regards of Spiekeroog scale, but in regards of many places in Europe, where there are many similar problems with old historical not EE buildings. There is a lack of experience everywhere how increase efficiency while saving historical value. It could be beneficial for the island to be frontrunner in this question – to replicate the experience not only within the island, but outside of the region. It is probably possible to get some EU funding for such project.
  - Two renovated buildings equipped with smart metering and optimized into smart house and micro grid (real time visual feedbacks can be very motivating tool for electricity savings especially if amount of saved megawatts is immediately translated into monetary and CO2 pollution equivalent).

- Pilot project for introducing local eco-certification scheme aiming to identify appropriate criteria for the eco-certification, understand tourist perception and demand (since only tourists can be considerable motivation to change and reduce energy consumption) reveal realistic and profitable opportunities for the businesses.
- The information and knowledge about different sustainable solutions should be easily available and demonstrative for people – all cost and benefits should be described in detailed and understandable way.
- As the main institutional change to stimulate behavioural changes and healthy competitive conditions among the tourism businesses in order to make it greener – **introduction of local eco-certification scheme**, which provide a lot of opportunities for step by step improvements: introducing new innovations by annually revised criteria, monitoring and control, raising awareness, educating residents and tourists, green feedbacks and different tourist-islanders interactions trough smart metering, benchmarking schemes and other awards; to involve tour operator and tourism business association to ensure adequate green marketing.
- New networks will facilitate diffusion of knowledge and information (i.e. businesses with eco-certificates, households and businesses connected to the island smart grid, local energy company). Moreover, there are much more potentials for residents – tourists – residents interactions by using existing networks. In this regard the tourism business association can play much more important role as provider and exchanger of information (more green feedbacks and information for tourists).
- Germany policy context can provide a lot of opportunities for niche market formation. This function should be studied more in regards of particular innovations and technologies. More information for public from the local government about current policies and national government and EU programs – providing different kind of support for innovative and EE projects.

### 8.3 Recommendations for C2CI project and implications for future research

For Spiekeroog:

- I would recommend, first of all, to study in detail current (energy) conditions. The research revealed that even though the community is very small, there is no available and collected information in one place about current energy system state, efficiency etc. Energy audit with calculations of potential savings (and especially in monetary terms) and regular monitoring system for all households and business buildings and facilities are necessary and can significantly facilitate communication with stakeholders and further improvements.

For C2CI in general the following recommendations can be interesting:

- Based on my observations, only few C2CI are currently developing future strategic plans, whereas the majority has no particular pathway to go and, thus, no applicable

tool to manage the transition in desirable direction. In order to move towards sustainable future it is important to try to brainstorm and envision desirable future all together with the main stakeholder groups presenting different interests. In this regard it is essential to think not only in practical dimension (for now), but more in desirable perspective (for future). Based on my experience it is not so easy. Therefore, it is very important to have creativity and backcasting sessions – brainstorming workshops with stakeholders to open up people minds for new solutions and creative ideas. Participatory approach in backcasting is necessary for more successful results.

- In regards of the most applicable approaches for the construction of the transition roadmap, discussed in the Chapter 2, I would say that all Transition Management based approaches, even though essential for comprehending and understanding the dynamic and functioning of the transition (innovation) system, are quite confusing and far from practical implications especially for non specialists in this area. Therefore, for decision making can be difficult to apply. In my opinion, backcasting participatory experiments by Quist and Vergragt as well as WP4 (under ToolSust project) of Carlsson-Kanyama, Dreborg seem easier to use in practice. They provide more clear directions how to carry out workshops and analyse them. Meanwhile, I found out that some elements of other relevant approaches can be also useful.
- C2CI project creates opportunities to generate ideas, however the islands should do a lot of work to adopt them into local conditions – deliver them in the most understandable and acceptable way to local communities and businesses (for the islanders it is important to feel that the ideas did not come from outside but was generated inside during talks and discussions).
- From scientific and practical perspective it would be interesting to carry out similar studies for other islands with different conditions (regulatory, economical, social, geographical etc.) actors involved to compare and make different variations of roadmaps. It could help to guide future sustainable development for the areas sharing similar problems.
- It would be also interesting to apply the research approach to study other fields like water, food, materials and transport in C2C islands. These kinds of bottom-up researches could really help to guide sustainable R&D for the needs of local communities.
- I would also recommend researching deeper different possibilities and opportunities of energy reduction through resident-tourist cooperation and interactions and elaborating more possible sustainable solutions and evaluating their practical implementation.

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Maria Palm, Municipality of Tjörn. Informal interview. Shetland islands, 28 April 2010

Sten-Ove Dahllöf, Municipality of Tjörn. Informal interview. Shetland islands, 28 April 2010

Birgit Schade, Municipality of Spiekeroog. Informal interviews. Spiekeroog, 9 April, 2010 and Shetland islands, 28 April 2010

Gerald Aper, Boarding school 'Hermann Lietz-Schule'. Informal interviews. 9 April, 2010 and Shetland islands, 28 April 2010

## **Appendix 1. Checklist for interviews with Spiekeroog stakeholders**

### **I. Current energy system, its functions and elements:**

#### Municipality

Who is doing the research for the island in regards to energy? (Outside institutes or there is some organisation on the island?)

Who is responsible for developing energy related policy actions and decision making?

Who is responsible (owner) for generation of renewable energy on the island (wind, solar)?

Is somebody growing/ producing any food in their backyards? Any local farmers? Are there any physical possibilities to locally produce some types of food?

Which (luxury) amenities and tourist services do you have on the island?

Energy consumption, seasonal differences (monthly), figures?

Which trends do you see for tourism development?

What are the current activities in energy related issues - energy savings, energy sustainable behaviour, technological changes?

Which measure to promote year-round tourism?

#### To tourism related stakeholders:

Where the tourists mainly are coming from? How? Do you monitor the information about the tourists? Feedbacks?

Are there any figures how much energy does average tourist consumes?

Competitions, any other stimulation, awards for environmentally friendly hotels, restaurants?

Which (luxury) amenities do you have on the island (spa-centre, what else)?

Which trends do you see for tourism development in Spiekeroog?

#### To hotels, restaurants:

Where is the food for your hotel/ restaurants come from? How? How often? Any local partnership?

Have you ever experienced any problems with energy/gas supply? How much do you pay for the electricity and gas per month? What is the difference in low/high tourist seasons?

#### To tourists:

Why do you like to come to Spiekeroog for your vacations? How often? Where are you coming from? By which transport means? What are main attractions and amenities for you on the island?

Is the pattern of your energy consumption the same during your vacations (here) as at home? Why yes, why not?

What do you think if energy costs would not be included in the accommodation costs? Will it motivate to reduce the energy consumption of tourists?

Would it be better for you if you knew that you stay at energy self-sufficient hotel, house? Or it does not matter for you?

## **II. Stakeholders' perception on current problems with energy system:**

How do you see the main problems (if there are) with present and future energy production and consumption on the island? What are the main causes?

Do you see any transportation/ mobility problems within the island and to the mainland? In future?

How do you see the current emerging and dominant trends and developments with respect to energy production and consumption in Spiekeroog (tourism, politic, socio-demographic and economical factors)?

What is your opinion about possibility of use of renewable locally produced energy (wind, biomass, solar, tides, etc.)?

Any possible solutions to improve current energy and mobility systems on Spiekeroog? What do you think can be barriers for their implementation?

## **III. Position<sup>9</sup> of different Spiekeroog stakeholders with regard to future energy sustainable development:**

How do you look at Spiekeroog energy self-sufficient in use of renewable energy in future? (i.e, positive, negative, do you see the importance for you? Independent in what and in which extend? when?)

How would you like to see future development (including energy system) on the island? How the energy sustainable Spiekeroog could look like in future?

Are you interested in participation in any activities or short-term projects aiming to decrease energy dependency from the main land – becoming energy sustainable island (increasing energy efficiency, generation of local renewable energy etc.)? if so, how? How important it is for you?

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<sup>9</sup> Based on (van den Bosch, 2004)

## **Appendix 2. Interviewed stakeholders**

### **Tourists:**

1. Tourist A (young women with old mother)
2. Tourist B (couple with a child)
3. Tourist C (young couple)
4. Tourist D (old women)

### **Hotels and summer houses:**

5. Hotel “Spiekeroog”
6. Hotel “Inselfriede”

### **Restaurants and cafe**

7. Restaurant

### **Local business**

8. Pharmacy
9. Tourist business association
10. Art house

### **Households**

11. Resident A
12. Resident B

### **Local government**

13. Municipality
14. Local council
15. Environmental committee

### **Educational organisations**

16. Boarding school

## Appendix 3. Backcasting workshop program and description of the assignments

Table 0-1 Creativity and backcasting workshop program<sup>10</sup>: energy self-supported Spiekeroog by 2030

Time	Content
17.00 – 17.15	Reasons & purposes of the workshop
17.15 - 17.45	Introduction to the problem: Samsø experience & Spiekeroog current situation
17.55 – 18.00	Figures: how to achieve sustainable energy system in 2030
18.00 – 18.45	Time travel: Spiekeroog in 2030
18.45 – 19.15	Break for pizza
19.15 – 19.45	Identifying necessary changes to realize this future visions: In two groups: tourists and residents
19.45 – 20.15	Defining short term steps for the implementation of the proposals
20.15 – 20.45	Priority and policy recommendations
20.45 – 21.00	Plenary discussion of the results

### Assignment 1. Time travel: Spiekeroog in 2030

How sustainable Spiekeroog could look like? Use your creativity and imagination!

Instructions: imagine that you visited Spiekeroog in the future, 20 years from now and lived there for one day. You were as old as you are now and you needed to eat, drink and rest like you do today. What are your memories from that day? What did island look like?

Future vision ideas may encompass substantial changes in different categories: technologies; social and cultural aspects (people life style, norms and values); structure (institutional, legal, infrastructural and economical aspects) and practice (daily routines and habits).

30 minutes to think and discuss your ideas.

Output: the best ideas will be used as the directions for future visions

### Assignment 2. Identification of necessary changes

In two groups: tourists and residents

Brainstorm and discuss:

- what kind of technological, cultural/ behavioural and institutional changes would be necessary for realising these future visions?

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<sup>10</sup> Based on (Carlsson-Kanyama et al., 2003; Carlsson-Kanyama et al., 2003; Quist, 2000b, 2000c; Quist, Pacchi, & van der Wel, 2000; Quist et al., 2001)

- how to make it more sustainable and attractive?
- identifying barriers and conditions for its implementation.

Output from each group:

- a list of the best ideas of technological, cultural, behavioural and institutional changes necessary for realisation of future visions
- a list of barriers and conditions for their realisation

Guiding questions:

- Which technologies and technological changes are necessary?
- What cultural and behavioural changes are necessary?
- What institutional changes are necessary?
- What are conditions and barriers?
- How can we reduce barriers?
- How to make future visions more attractive for residents and tourists?
- What policies and policy changes are necessary? What should do the government?
- Who would support it? And who would oppose it?

**Assignment 3.**

**Part1. Defining short term oriented steps for implementation of the proposals**

What can be done now in concrete short term oriented activities and who should do that or is willing to do?

Output:

- concrete short term oriented steps towards implementation of specific visions and proposals
- a list with concrete ideas and experiments and suggestions for stakeholder cooperation (e.g. around proposals or practical experiments)
- specific policy recommendations and specific ways of barrier reduction

Guiding questions:

- What concrete short term oriented steps and activities towards implementation of proposals and supporting ideas could be done?

- Who should do this step (stakeholder co-operation)?
- How could this step be organised and funded?
- What policy recommendations could help this step or activity?
- Which technologies are necessary? Behavioural changes? Which products and services?
- What does the solution mean for different types of household organisation?
- Which actors are necessary for introduction or implementation?
- Who will oppose it?
- How effective is the solution?
- How could it be introduced?

## **Part 2 Developing policy recommendations**

What should be done first and who should take the lead and how could it be funded?\_

### Output:

- a hierarchy in the concrete proposals
- 'top priorities' in future plans and actions and the role the stakeholders are willing to play
- policy recommendations

Guiding questions:

- Which steps, concrete activities, proposals will contribute most significantly to a more sustainable function fulfilment?
- Which steps, activities, proposals, etc. are most feasible?
- Which steps, activities, proposals, should get most priority?
- How can these be funded? Who should take the lead? And which actor groups are necessary?
- What could be done in terms of communicating the results and others?



## Appendix 4. List of current and future trends

Table 0-1 List of current and future trends

Conditions & current and future trends	certain	uncertain	weak signals	hamper	accelerate
<b>Macro: environment</b>					
Prices for fossil fuel ↑		*			*
CO <sub>2</sub> emissions ↑	*				*
Energy demand ↑	*			*	
Aging population	*				
EU target 20-20-20: Germany 40% CO <sub>2</sub> ↓; Ambition Manifesto	*				*
Solar and tidal power competitive in 10 years	*				*
Biofuel and bioeconomies ↑		*			*
Wind power ↑	*				*
Number of households ↑	*			*	
Appliances more energy consuming	*			*	
More sustainable innovations and EE technologies	*				*
Eco-concepts ↑		*			*
Sustainable tourism ↑		*			*
Better information for consumer/ tourist, eco-labels		*			*
Sustainable lifestyle		*			*
'Energy plus' houses		*			*
Distributed economies & energy generation ↑					
Year-round tourism ↑	*				
More diverse tourism activities	*				*
PSS ↑		*			*
North Sea region: more economical activities incl. tourism	*			*	
Inter-regional cooperation for protection of the region ↑	*				*
More weekend visits	*			*	

Luxury accommodation more popular ↑		*		*	
Germany – world leader in EE		*			*
<b>Meso: regime</b>					
Interest in EE buildings and appliances by residents – theoretically high, but in practice low	*			**	*
Vision in future energy self-sufficiency		*			**
Well-being of residents and tourists ↑	*			*	*
Any changes and improvements are very slow	*			*	
Amount of tourists – at the same level	*			*	*
Tourist structure is changing (new tourists, new activities)		*			
Increasing luxury and service		*		**	
Improving and slowly renovating their houses and more efficiency appliances	*				**
Environmental concern among tourists ↑	*				**
New vision of island development (more innovation but more luxury services)		*		**	*
The same as it ever was		*		**	*
Tourists are coming back every year	*				*
Conditions to compete ↑		*			**

## Appendix 5. Main steps of participatory backcasting of Quist and TRANSCE

Table 0-1 Main steps of participatory backcasting of Quist and TRANSCE

Backcasting experiment (J. Quist)	TRANSCE approach (S. Sondejijker)
<p><b>Step 1. Strategic problem orientation</b></p> <p>System boundaries</p> <p>Policy goals and normative assumptions</p> <p>Current state of the system</p> <p>Description of socio-technological systems</p> <p>Factors and driving forces which influence on sustainability in future; development and main trends related to studied socio-technological systems</p> <p>Sustainability and resilience problems (from current and future prospective) and their causes</p> <p>Identification and analysis of main stakeholders and actors, and their perception.</p> <p>Criteria for generation of future vision</p>	<p><b>Step 1: Barriers for structural change</b></p> <p>Defining current and future-oriented persistent problems/ barriers:</p> <ul style="list-style-type: none"> <li>• Culture</li> <li>• Structure</li> <li>• Practice</li> </ul>
<p><b>Step 2. Future vision generation</b></p> <p>Normative, knowledge and process demands for future generation</p> <ul style="list-style-type: none"> <li>• Stretch of future sustainable system:</li> <li>• Fulfilment of needs</li> <li>• Technologies</li> <li>• Social and cultural aspects (people life style)</li> <li>• Structure</li> <li>• Institutions</li> </ul>	<p><b>Step 2. Defining transition change and images of a desirable future sustainable system</b></p> <p>Scope of the system: a clear direction and focus</p> <p>Conditions of future system</p> <p>Qualitative description of state of sustainable future system</p> <p>Should reflect different levels of systems:</p> <ul style="list-style-type: none"> <li>• landscape (ongoing trends and developments)</li> <li>• regime (personal implication – traditions and habits)</li> <li>• niche (every day existence)</li> </ul>
<p><b>Step 3. Backcasting analysis</b></p> <p>Necessary changes needed to achieve the generated future vision:</p> <p>Technologies</p> <p>Socio-cultural/ behavioural aspects</p> <p>Structural and organisational (institutional, physical, regulatory and economical aspects)</p> <p>Identification of milestones for changes</p>	<p><b>Step 3. Necessary structural changes</b></p> <p>Necessary structural changes (in terms of processes of build-up or break-down):</p> <ul style="list-style-type: none"> <li>• Culture</li> <li>• Structure</li> <li>• Practice</li> </ul>
<p><b>Step 4. Elaboration, design, analysis and follow-up agenda</b></p> <p>Analysis of generated future pathway in order to make it feasible and viable from economical, environmental and social (consumer acceptance) in long term prospective</p> <p>Drivers of change, barriers, conditions and external</p>	<p><b>Step 4. Drivers for structural changes</b></p> <p>Trends and developments and their interaction</p> <p>Categorisation of drivers for structural changes: weak signals, uncertain and certain development; accelerate, hamper</p> <p>Construction of various pathways</p>

<p>variables for reaching the future vision</p> <p>Development follow-up</p> <ul style="list-style-type: none"> <li>• Short-term actions</li> <li>• Long-term actions</li> <li>• Policy recommendations</li> <li>• Implementation plan</li> </ul> <p>Role and degree of involvement of different stakeholder group</p>	<p><b>Step 5. Anticipative strategies of group of actors</b></p> <p>Defining strategic moves (specific actions, group of actors and time) that describe how different groups of stakeholders:</p> <ul style="list-style-type: none"> <li>• anticipate the uncertain and emerging drivers</li> <li>• in order to stimulate and support the pathway</li> <li>• and reach the desirable and sustainable state</li> </ul>
<p><b>Step 5. Embed results and agenda &amp; stimulate follow-up</b></p>	<p><b>Step 6. Framing the transition</b></p> <p>Final step is co-evolution of the patterns in one pathway</p>

Source: (Quist, 2007; Sondejkeer, 2009)