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Nordic Centre for Spatial Development

Green Growth and Innovation in Nordic Regions: Case Studies

Lise Smed Olsen, Christian Fredricsson and Liisa Perjo

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Stockholm, Sweden, 2012

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Preface

This working paper is published as part of the project Regional Strategies for Green Growth and Innovation commissioned by the Nordic Working Group for Third-Generation Regional Policy. The intention of the “third-generation regional policy” is to use the potential of each region in the best possible way and to integrate all Nordic regions and local communities into the global economy. The working group is composed of representatives from the national ministries responsible for regional policy. It was established by the Nordic Committee of Senior Officials for Regional Policy. One of the working group’s priorities is to explore the potential of green growth for regional development, for which purpose this project was initiated in July 2011. Its main objective is to provide policymakers with a useful reference on regional challenges and opportunities to achieve green growth and innovation.

This working paper builds on the first working paper “Scoping Green Growth and Innovation in Nordic Regions” (Olsen and Weber, ed., 2012), produced within the framework of the project, which consisted of a literature review and a quantitative mapping exercise of green growth in Nordic regions. This working paper will elaborate on concrete initiatives to support green growth and innovation through two regional case studies. These illustrate the utilisation

of green-growth potential in an urban environment and a sparsely populated rural region, and describe the characteristics of economic sectors relevant to green growth and innovation. The first study involves the urban region of Skåne in Sweden and the regional and local initiatives to support the cleantech sector; the second involves the rural region of South Savo in Finland and the regional and local initiatives to develop bioenergy in the forestry sector.

A final working paper synthesising the work of the project will follow this paper. It will also include policy implications identified within the framework of the project in preparation for post-2013 regional development strategies.

The authors would like to thank the representatives of the Nordic Working Group for Third-Generation Regional Policy who have commented and provided valuable input on draft versions of this working paper. Furthermore, we thank Maria Lindqvist and Lisa Hörnström for their comments and advice during the working process.

Ole Damsgaard
Director

Stockholm, November 2012

Introduction

This working paper builds on the paper “Scoping Green Growth and Innovation in Nordic Regions” (Olsen and Weber, ed., 2012), which was produced as part of the project. This second publication further develops the initial work which involved: scoping the concept of green growth, eco-innovation and related concepts; exploring the international, Nordic and national policy framework; and carrying out a quantitative study to map the current situation concerning green growth and innovation at regional level in the Nordic countries as far as possible. One of the main conclusions of this study was that there is a distinct urban-rural dichotomy in the regional preconditions for green growth and innovation.

In rural and remote areas, the focus has been on the potential for green growth alongside the predominant challenge of job and population loss. It was shown that policy and investment-driven interventions at the interface of the energy, agricultural and forestry sectors can provide a number of opportunities. With these opportunities, however, comes the need for proactive regional governance, which is essential for understanding the local potentials of wind, bioenergy or any other renewable resources. The natural potential identified by indicators such as wind velocity or bioenergy is useful to a certain degree, but the indicators do not consider necessary local considerations that will have an impact on the potential in reality. In contrast to rural areas, urban centres will continue to provide the bulk of the research and innovation capital that drives technological development of various domestic energy and environmental interventions. Urban areas, however, are also where the bulk of economic production and resource consumption

takes place. That being so, one of the main issues in reforming urban economies for green growth centres on identifying the potential to mitigate excessive material and resource consumption.

This working paper explores the urban-rural dichotomy in, respectively, an urban and rural region, Skåne in Sweden and South Savo in Finland. The case studies take as a point of departure the strategies of the regions for economic development and innovation in the two sectors under study, cleantech in Skåne and bioenergy in South Savo. It then goes on to study the activities that are carried out in connection with publicly funded initiatives in the industries. The main purpose of the regional level studies is to understand the processes by which the specific green innovation activities are being supported, and the interplay between public policy at different levels, regional and local authorities, higher education institutions, and firms. In addition, firm-level case studies are carried out in order to get a better understanding of the impact of public policies in practice. Concrete innovation processes are studied, supported by one or more public policy programmes or projects. The firm-level case studies follow the development in innovation processes step by step in order to identify challenges under way and the importance of public policy. Conclusions on the case studies introduce the main drivers and the regional policy framework for developing the cleantech and the bioenergy sectors respectively. The policy implications from the case studies will be further discussed in the synthesis of the two parts of the project, which will be published as a final report to include discussion of policy implications as well.

I. Case study: Cleantech in the Skåne Region, Sweden

Lise Smed Olsen and Christian Fredricsson

Introduction

This case study seeks to provide a deeper understanding of regional and firm-level processes towards green growth and innovation with a focus on cleantech/environmental technologies in the region of Skåne (Region Skåne), Sweden. During the last decade, Region Skåne has supported the development of the cleantech sector through the cluster organisation Sustainable Business Hub (SBH) which provides support to strengthen the competitiveness and export of cleantech firms. With a point of departure in the comprehensive ERDF co-funded project, the Swedish Model for Clean Growth, carried out between 2007 and 2010 and led by SBH, a number of qualitative face-to-face in depth interviews have been carried out with actors involved in the project, including civil servants from the regional and local level, representatives from the cluster organisation, and cleantech firms. The case study on cleantech in Skåne provides an example of green growth and innovation in an urban region.

The case study is structured as follows. First, the socio-economic characteristics of the region are introduced, including a brief introduction to the cleantech sector in the region, and to the issue of human resources and the relevance of higher education for cleantech firms. Second, an overview is given of the most relevant current strategies and policy measures designed to support green growth and innovation

by Region Skåne and Malmö City. The third section looks at the regional-level approach to supporting the cleantech sector, which is focused on cluster development and export. A deeper analysis of some of the activities of the Swedish Model for Clean Growth and the results and relative importance of the project for SBH and the firms involved is provided, including a discussion on the role of SBH and the institutions and policy initiatives which are significant for its activities. Fourth, the focus of the case study turns to two firm-level studies: one explores the process of developing new environmental technology and the start-up process of a firm that sells energy-saving drying cabinets, and the other study focuses on firm-level activities for export of environmental technologies, more specifically the export collaboration initiated between three SBH members in the water and wastewater treatment industry, to the Ukrainian market. The processes of developing a new product and the starting-up of a firm as well as initiation of export collaboration are explored with the purpose of identifying the institutions and policy initiatives which are significant in the respective situations. Finally, drawing on both the regional and firm-level perspectives, the conclusion introduces the main drivers and the regional policy framework for developing the cleantech sector.

The Region of Skåne

The region of Skåne is situated in the southernmost part of Sweden and covers an area of some 11 035 km². Skåne is surrounded by sea on three sides, and to the west of the region, across the narrow strait of Öresund (the Sound), is the capital of Denmark, Copenhagen (see Figure 1). The number of inhabitants in Skåne is 1 243 329 million, which accounts for approximately 13% of the Swedish population. The population increased from

1 123 786 in 2000 to 1 243 329 in 2010 and according to the latest forecast is projected to reach 1 350 000 in 2020 (Region Skåne, 2010).

During the period 2000-09 the population increase was relatively equally distributed to all municipalities of the region (Region Skåne, 2011). In total, there are 33 municipalities in Skåne, and 90% of the population live in urban communities. The largest

cities are located in the western part of the region: Malmö with over 294,000 inhabitants, Helsingborg with 128,000 and Lund with 110,000. Besides the main cities there are over 250 urban areas of different sizes, which are mainly concentrated in the western coastal areas of the region. According to the latest OECD Territorial Review there is an overall trend that the south-western part of the region has higher growth than the rest of the region. Owing to this development there is a further trend that the region is becoming a more hierarchical polycentric region with Malmö and Lund as the dominant core. Furthermore, this means that the western areas have higher accessibility to jobs, educational opportunities, services and so forth (Region Skåne, 2011).

The region of Skåne performs relatively well with regard to the standard socio-economic measure of

GDP per capita (2009) both in a Nordic and in a Swedish context. In Sweden, the region performed on the same level as the two other metropolitan regions (Stockholm and Västra Götaland), and considerably better in terms of nominal GDP growth than the rest of the country during the period between 1995 and 2006. The gross regional product (GRP) is relatively stable, accounting for 12% of the Swedish total (Region Skåne, 2011).

The regional employment proportion (2009) among 20-64-year-olds is 73%, which is below the national average of 75%. From a geographical perspective the bulk of the people employed live in the western parts of the region, including the cities of Malmö (28%), Lund (12.1%) and Helsingborg (11.8%). In the eastern part of the region, the city of Kristianstad has the largest number of employees at 6.3% (Region Skåne, 2011).

Figure 1. Map of the Skåne Region



Historically, the economic structure of Skåne has been based on natural resources like agriculture products and limestone quarry, and from the nineteenth century onwards textile industry and engineering, especially in the coastal cities of Malmö, Landskrona and Helsingborg. Lund is a traditional academic centre because of Lund University, which is one of Scandinavia's largest institutions for education and research with about 35 000 students and 6000 employees. Industrial production and engineering suffered dramatic economic restructuring from the 1960s to the 1990s. The service sector started to grow during the 1970s. New sectors such as IT and medical technology started to develop gradually in

the 1980s. In 2000 the economic and social settings of Skåne changed profoundly when the road and rail bridge to Denmark opened. Skåne is a long way from the Swedish capital city of Stockholm (approximately 600 km) but the distance to the Danish capital Copenhagen over the Sound is only a few kilometres. Because of an earlier bottleneck, however, the connections in both passenger and goods transportation between these cities were limited. Together the Skåne and Copenhagen metropolitan region form the cross-border region Öresund with 3.6 million inhabitants (Dahlström et al., 2010).

After a strong agricultural and industrial history,

Skåne is at present characterised by a private and public service sector economy. Large and medium-sized companies provide the major source of private employment, often in transnational companies. Small firms particularly operate in farming, business-to-business services and trade contexts. The public sector is a large employer, not least within the higher education and health sectors. Twelve per cent of the region's employees are working in research & development and education. In line with the general pattern in Western economies, there is a decline in employment in primary and secondary industries and a growth in the service sector. The number of business start-ups per 1 000 inhabitants is higher in Skåne than the national average, but clearly lower than in the County of Stockholm (Dahlström et al., 2010; Region Skåne, 2011).

It is important to note the large intraregional differences within the Skåne region.

At the sub-regional level the economies as well as the settlement patterns are quite different. All of the sub-regions have experienced decline in manufacturing industries, except the south-eastern part of the region. The south-western part, which includes Malmö and Lund, stands out as the most expansive area and, as Figure 2 shows, the business services sector as well as the research and development industry is strong. The north-western part of the region is characterised by a mix of sectors, but has a similar structure to the south-eastern part. The south-eastern part of the regions has a relatively small labour market, and a relatively large proportion of people working in the construction, agricultural, fishery and forestry sectors. The north-eastern area has the highest number of people employed in the manufacturing industry and a quite low number of employees in the business services (Region Skåne, 2009).

Figure 2. Industry sectors in Skåne (2007)

Industry sector	North-Western Skåne	North-Eastern Skåne	South-Western Skåne	South-Eastern Skåne	Skåne
Sector unknown	1.1%	1.2%	1.2%	2.0%	1.2%
Agriculture, forestry, hunting, fishing	2.2%	3.5%	1.0%	5.9%	2.0%
Mineral extraction, manufacturing	18.3%	21.1%	12.5%	13.5%	15.4%
Energy and water supply, waste management	0.9%	0.8%	1.0%	0.5%	0.9%
Construction	7.4%	7.5%	6.2%	9.3%	6.9%
Wholesale, retail, transport, warehousing	21.8%	16.5%	20.1%	18.0%	19.9%
Credit institutions, real estate management, business services	11.8%	8.8%	16.5%	8.6%	13.7%
Research and development, education, health services, social services	25.6%	30.5%	29.1%	30.6%	28.5%
Personal and cultural services	6.8%	5.6%	7.2%	7.1%	6.8%
Civil authorities, defence, international organisations	4.1%	4.5%	5.0%	4.5%	4.7%
Total as %	100%	100%	100%	100%	100%
Overall total	135 336	81 670	284 120	34 459	535 585

Source: Skåne's Innovation Capacity – A situation analysis (2009)

Geographically, the case study is mainly centred on the south-western part of Skåne where Malmö and Lund are located, and where most cleantech firms are based.

The cleantech sector in the region of Skåne

The cleantech concept originates from the United States and has increasingly been used in the Nordic countries to describe the environmental technology sector. Swentec, the Swedish Environmental Technology

Council in place from 2008 to 2010, used cleantech as a direct translation for environmental technologies. In this working paper, we approach cleantech as a concept synonymous with environmental technologies, which is defined as “all technologies whose use is less environmentally harmful than relevant alternatives”. Swentec defined a number of areas within which cleantech firms operate. They comprise 11 environmental technology sectors (Malmö Cleantech City, 2012; Swentec, 2009). In 2007, the energy sector was the cleantech category that had most companies at the national level. According to a

review carried out by Sustainable Business Hub, there were 311 potential cleantech firms in Skåne in 2008, i.e. potential members of the SBH organisation. The division of firms in the cleantech sector in the region of

Skåne is shown below. The total number of cleantech firms is 311, but in cases where firms were found to be active in more than one cleantech sector they have been included in each relevant category in the study by SBH.

Table 1. Cleantech firms in Skåne, 2008

Cleantech sector	Number of firms
Waste and disposal	55
Construction and urban development	84
Energy	90
Air	21
Remediation	5
Technical consultants	50
Transport	11
Material	3
Water and wastewater	59
System, measure and regulation technology	25
Others	34

Source: *Sustainable Business Hub, 2008*

Within the largest category of cleantech firms, energy, the two largest groups comprised 35 firms within bioenergy and 30 firms working with energy efficiency. In wind energy and solar energy eight and four firms were active respectively (Sustainable Business Hub, 2008). It is clear that in relation to Figure 2, which provides an overview of industry sectors in Skåne, the 11 environmental technology sectors or areas do not belong to one industry sector alone. Thus, whereas some firms naturally belong to the category of energy and water supply and waste management, others will be categorised under manufacturing, construction or business services.

According to interviewees, especially concerning water and wastewater management and sustainable urban development, many of the Swedish competences can be found in Skåne. The water and wastewater industry has been developed over a longer period of time and has several strong players such as the family-owned Malmberg Water (part of a firm-level case study), which was established in 1866. The area of sustainable urban development has grown in the region during the last two decades, especially as part of the strategy which Malmö City developed in the 1990s as a response to the on-going economic restructuring process. The strategy was to create new residential areas with a focus on strengthening the environmental profile in areas such as the Western Harbour, a former shipyard area, which has developed into a centre for education, business and housing. Malmö City today has several demonstration projects and generally a strong

focus on sustainable urban development, which in turn makes Skåne an attractive base for firms in the industry (Edelstam; Pelin; Kristjansson, interviews).

Human resources and the role of higher education institutions

According to the interviewees, cleantech firms in Skåne recruit from the entire country and to some extent also internationally; however, the importance of having relevant higher education programmes in the region is stressed. Further, a study by Lindell et al. (2010) about the future needs of human resources in Skåne clarifies that the majority of students of higher education in the region come from Skåne and most of them are also subsequently employed in the region. A large group of higher education graduates that supply the private sector labour force are engineers in energy and electro-technology and construction. Higher education institutions that are especially relevant in this regard are the Faculty of Engineering and the International Institute for Industrial Environmental Economics (IIIEE) at Lund University. Malmö University also has education programmes that are of relevance for cleantech firms, e.g. which are concerned with sustainable urban planning. Kristianstad University with its Master's programme in sustainable water management is of relevance. Finally, the Swedish University of Agricultural Sciences, which has a division based in Alnarp, has relevant programmes in the fields of biotechnology and biochemistry.

Several interviewees stated that firms in the

biogas industry are especially experiencing problems in recruiting the number of engineers they need. One respondent stated that this is mainly an issue for the smaller firms that recruit newly educated engineers, who need approximately two years' further training before they work at "full capacity"; after these two years the graduates are often offered a job at one of the big companies which is able to offer them a better salary.

Some interviewees stated that the appropriate engineering programmes are in place, but the main issue is that not enough young people choose this type of education. It was suggested that a main challenge here is to encourage young people to become engineers and create prestige around technical education programmes.

Meanwhile, it was also noted that not only were technical competences important in the cleantech sector. There is a lack of competences in parts of the cleantech industry that deal with increasingly important issues, such as the linkages between IT and environmental technologies. In connection with this, it is also argued that a greater knowledge of the cleantech sector is needed by business school graduates for their better understanding of the specific organisational, export and market conditions of the sector. Another respondent argued that the cleantech firms need to be more aware of the benefits of hiring graduates who are not engineers but have gained other relevant higher education. For example, the environmental sciences programme at Malmö University, which is not technical but gives the students a broad knowledge of environmental management, is mentioned as a potentially useful resource for cleantech firms (Pelin, Edlestam, Kristjansson, Simonsen, interviews).

Regional development and innovation policy

Region Skåne is the regional authority responsible for healthcare services, the development of business, communications, and culture in the region, and cooperation with other regions in and outside Sweden. The political authority of Region Skåne is the Regional Council, which is directly elected by the inhabitants of Skåne. This section introduces the main strategies of Region Skåne, as well as the local-level strategies of Malmö City. The Regional Development Programme is an important strategy document supported and realised through a number of sector-oriented development strategies and action plans. The sectoral activities connected with green-growth activities are mainly the environmental programme, the climate programme, the business development programme, and the recently launched innovation strategy, which are introduced in the following (Region Skåne, 2009).

The Regional Development Programme for Skåne

2009-2016 is the main strategic document outlining the strategy for regional development in the region. The overall objective and vision of the programme is that Skåne will be a dynamic region and a sustainable society. One important goal which explicitly shows the region's high ambitions in terms of sustainable development is the aim of being fossil fuel-free by 2020.

Skåne Regional Council adopted the Climate Committee's Strategic Programme for Climate Work in Skåne 2009-2020 at the beginning of November 2009. The programme is based on certain fundamental principles designed to act as a guide for the climate work and give a vision of a climate-neutral approach adopted by Region Skåne by 2020 as well as to identify strategic areas: transportation, biogas, use of energy, agriculture and forestry, land use planning and climate change adaptation (Region Skåne, 2012). In line with the climate strategy the County Administrative Board of Skåne, Region Skåne, and the Association of Local Authorities work together on the regional initiative "Climate Collaboration". The aim is to further coordinate the work on climate issues in the region between regional public bodies and local actors such as municipalities (Klimatsamverkan, 2012).

Another example of the commitment of Skåne to the area of green development is that the County Administrative Board of Skåne has been appointed by the government as one of three *green pilot counties* to initiate a project on green development, whereby the County Administrative Board is to support and inspire other counties through its initiatives in the energy and environmental areas. The project runs between 2010 and 2013, and is supported by a number of national authorities (Swedish Energy Agency, 2012).

The Business Development Programme 2009-2016 comprises the main regional policy framework for innovation and business development in the region and guides the utilisation of EU Structural Funds. Region Skåne has been able to utilise the EU Structural Funds since 2007, and it is part of the NUTS 2 region Southern Sweden together with the region of Blekinge. The Operational Programme of Skåne-Blekinge 2007-2013 is strongly focused on innovation and renewal. Approximately 46% of the total budget (141 m. EUR) is allocated to priority 1, Innovation and Renewal, and the overall goal is to create more business activity, and increase business expertise and knowledge-based innovation (Skåne-Blekinge, 2007).

Region Skåne is one of the few regional authorities in Sweden that has developed a regional innovation strategy, the International Innovation Strategy for Skåne 2012-2020. The strategy is partly a response to the Europe 2020 strategy in which the European Commission has outlined future development directions towards the "Innovative Union". The Innovation

Strategy also forms a strategic basis for the national innovation strategy which the Swedish government intends to adopt during 2012. The innovation strategy introduces the vision that Skåne will be Europe's most innovative region in 2020. The strategy outlines six overarching strategies to strengthen the innovation system: (1) develop a systematic leadership, (2) broaden the sense of what innovation is – include more people, (3) streamline the support structure for innovation, (4) develop new innovative areas and creative environments, (5) develop international cooperation, and (6) strengthen innovation capacity in the region's existing industry and public sector activities. An international action plan will be developed to support the implementation of the strategy and the realisation of the vision. It will form part of the national innovation strategy and make regular contributions to the government's research and innovation proposals. National stakeholders such as VINNOVA and the Swedish Agency for Economic and Regional Growth and the government will be included in discussions to develop the action plan (FIRS and SIS, 2011, a).

One sub-strategy for Skåne's innovation strategy has been developed entitled "From cluster initiatives to open innovation arenas in Skåne". According to the strategy, the clusters developed in Region Skåne will develop into open innovation arenas which will attract national and international resources from outside the region to a greater extent. This requires clearer international positioning and profiling, and increased participation in international platforms. Two specific areas are prioritised as global innovative arenas with great potential for international collaboration, where the aim is to develop platforms around which several clusters can collaborate: "personal health" and "smart, sustainable regions/cities". In the region of Skåne there are currently seven cluster initiatives which are working to strengthen the competitiveness of firms in the region; one of them is the Sustainable Business Hub (FIRS and SIS, 2011, b).

Since 2011 Region Skåne has been working on a project to enhance the open innovation arena within the area of smart and sustainable cities. The aim of the project titled "Intelligent, Smart Processes, Innovations and Test Beds" is to establish a cross-sectoral consortium, which facilitates the innovation process in smart energy solutions and new collaboration forms in the field of sustainable and attractive cities. The project is co-financed by VINNOVA within the programme titled "Challenge-Driven Innovation", the objective of which is to strengthen the Swedish innovation capacity (VINNOVA, 2012).

Malmö City public policy initiatives

Malmö City, where many of the cleantech firms are located, has its own initiatives to support the cleantech sector, which are related to the four environmental targets the City has set for the period 2009-20. The objectives for 2020 are: (1) Malmö will be the "climate-smartest" city in Sweden (more renewable energy, changing transport and travel habits, etc.), (2) the city will lead sustainable urban development, (3) it will ensure sustainable use of natural resources, and (4) it should be easy to do the right thing (public procurement of Malmö City will be characterised by high environmental requirements, etc.).

Within the framework of the local initiative titled "Malmö Cleantech City" there are three projects which help the cleantech firms to access marketing assistance, new meeting-places and business opportunities. The first project, "Malmö Cleantech Cluster", involves marketing initiatives to collectively promote the firms based in the city. This also includes efforts to promote the gathering of cleantech firms in four specific areas of Malmö where there is high activity in the cleantech sector. The second project, "Malmö Cleantech Centre", is a physical meeting-place for cleantech firms and a demonstration location to attract visitors who come to Malmö to learn more about firms' environmental technologies. The final project is called "Malmö Cleantech Test Bed" and involves "matchmaking" activities to set up meetings between cleantech suppliers and potential clients involving both firms and municipalities (Malmö Cleantech City, 2012).

Malmö City has developed collaboration with the City of Copenhagen on a number of policy issues within the framework of *green growth*. Their joint efforts were initiated by the current mayors of Malmö and Copenhagen who realised they had similar political priorities, especially concerning their high ambitions regarding environmental issues. Examples of how the two cities cooperate range from large development projects, such as the development of a wind farm, to cooperation on how to integrate learning for sustainable development in the education system.

In addition to Copenhagen across the Sound, Malmö City has established cooperation with Hong Kong. This was initiated when the Mayor of Malmö and the head of the environmental management department of Malmö City were invited to the meeting of the C40 Cities Climate Leadership Group in Hong Kong. The representatives of Malmö City and Hong Kong discovered that they

could learn from each other. Hong Kong has problems with air pollution and waste management, areas in which Malmö-based firms have strong competences. In turn, Malmö has much to learn from Hong Kong's public transport system and innovation system management. In the summer of 2011 the discussions between the parties led to a cooperation agreement, which the Ministry of the Environment of Hong Kong came to Malmö to sign.

With regard to the issue of human resources and young people's lack of interest in engineering programmes, an approach to the problem could be initiated through the exchange of experiences with

Hong Kong. Malmö City, in cooperation with Hong Kong, is considering adopting a similar approach to the Inno Carnival, which is an annual event, held in Hong Kong whereby students have the opportunity to exhibit their cleantech innovations. It is being considered whether a similar event might help to generate interest and "prestige" in relation to engineering programmes.

Further, the cooperation with Hong Kong may provide business opportunities for cleantech firms based in Skåne, and the Director of Sustainable Business Hub visited representatives in Hong Kong in the autumn of 2011 in order to discuss opportunities (Pelin, interview).

Regional level study: cluster development

A decade ago the development of environmental technologies was not the highest political priority, either nationally or in Region Skåne. Owing, however, to initiatives of individuals in the environmental strategy division of the regional development department of Region Skåne who established dialogue with the business development department, a first initiative to establish a network of "environmentally friendly" firms was established in the form of Sustainable Business Hub (SBH) in 2001. The environmental strategy division saw opportunities to enhance the environmental profiles of businesses in the region, subsequent to the realisation that the regional politicians at this time were more concerned with business development than with environmental concerns (Pelin, interview). The initiative to establish SBH thus originally came from the environmental strategy division at Region Skåne, who with the business development department on board were allocated project funds from the Regional Council to initiate the organisation.

The idea of establishing a network organisation was also supported by a number of firms in the region, Malmö City, and other public actors, who were co-founders of the non-profit association Sustainable Business Hub. At the same time, Sustainable Business Hub Scandinavia Ltd. was established. It was owned by the members of the association, and financially supported by Region Skåne. This organisational set-up in a sense entails two organisations, as one is a non-profit network organisation and the other a limited company. In practice, however, reference to SBH comprises both organisations, i.e. the initiatives studied in the following are managed by the company but for the benefit of the members of the non-profit organisation.

In 2005, SBH had several employees and

approximately 80 members, but not many activities were taking place within the framework of the organisation, and it did not have a clear strategy. At this time, the political interest in developing a "green" profile for the region was increasing and funds were allocated to carry out analyses to identify its strengths and weaknesses in the environmental area. The environmental strategy division of the regional development department and the business development department at Region Skåne carried out the analyses in cooperation with a consultant. Three overall sectors were identified as potential green-growth areas: agriculture and food; transport; and cleantech. After further consideration, however, the potential to support measures in agriculture, e.g. organic farming, was reduced because the influential local farmers' association had a relatively conservative view on land use. Green transport in the form of biogas production was also identified as a strength of Skåne, but it was assumed that a region such as Västra Götaland with its stronghold in the automotive industry would always be stronger in this field than Skåne. Eventually, it was decided to focus on the area of cleantech, where Skåne was especially strong compared with the rest of the country.

Three key areas of strength were identified in the cleantech sector: energy efficiency, water, and sustainable urban development. Consequently, a strategy for the cleantech sector was developed, and in 2006 the two departments delivered a proposal to the Regional Council. The politicians supported the proposal, and in 2006 it was decided to increase the annual amount allocated for environmentally-driven business development in the region.

For the first five years SBH was running, it received 700.000 SEK annually from Region Skåne.

With the stronger strategic focus of the Region in 2006 on the development of the cleantech sector, the annual amount allocated to SBH was more than quadrupled, thereby guaranteeing the organisation more funding. At this stage organisational changes were also implemented at SBH, a new Director was recruited, and the organisation reviewed its members. It was decided only to allow actual cleantech firms to be members, and this meant almost half of the firms at the time could no longer be members, as they were mainly wished to provide services to cleantech firms, e.g. web agencies that wanted to produce their websites. In the years that followed, a number of cleantech firms decided to become members of SBH (Kristjanson; Edlestam; Simonsen; Pelin, interviews). As described on the organisation's website:

“The purpose of Sustainable Business Hub is to strengthen the competitiveness and export of the region's cleantech firms and thereby generate growth in the cleantech sector in Southern Sweden. Sustainable Business Hub will also be an efficient actor in supporting, stimulating and creating cooperation between actors who can contribute to this.” (Sustainable Business Hub, 2012, our translation)

Today SBH has approximately 120 paying members, and 12 employees. The non-profit organisation has a board of directors of 11 members, including a representative from Malmö City and a representative from the International Institute for Industrial Environmental Economics at Lund University. The limited company has a board of seven directors, including a representative from Region Skåne and a representative from Malmö City. The latter board

meets more frequently and is in charge of the strategic development of SBH.

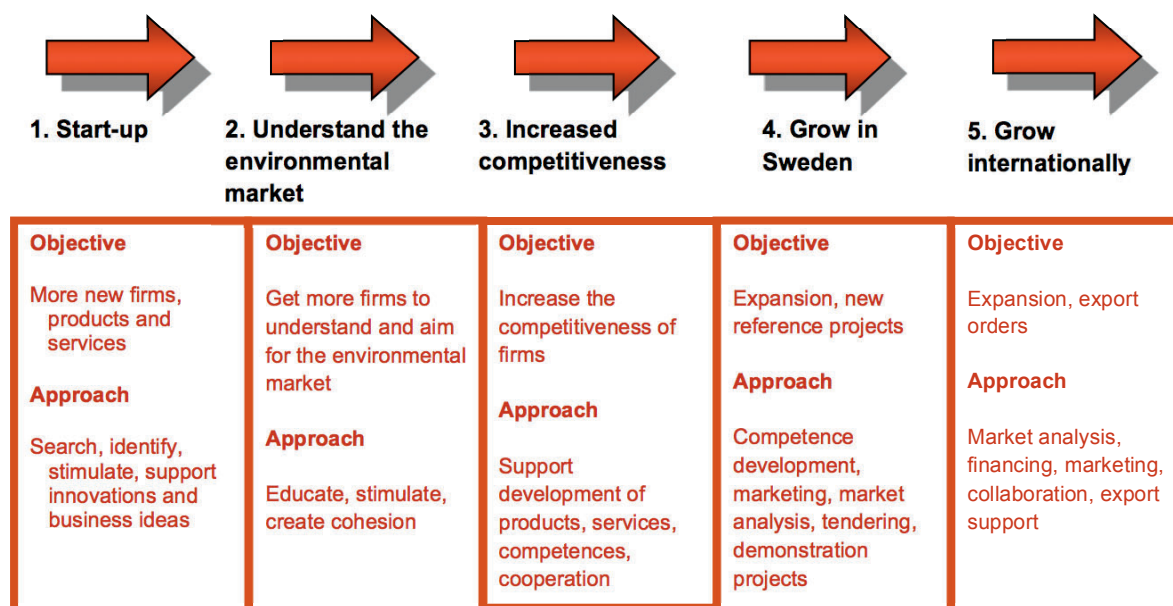
Swedish Model for Clean Growth

Much of the organisational development at SBH has happened with the help of the ERDF co-financed project “Swedish Model for Clean Growth” which was run during from 2007 to 2010. This project was one of the first ERDF projects to be implemented in Skåne. The project owner was Region Skåne, and it was managed by SBH. Its purpose was to develop an environmentally-targeted innovation system which would strengthen the competitiveness of cleantech firms.

“The project will create opportunities for actors in research, the business community, and politics/public authorities in collaboration to generate, exchange, and utilise new technology and new knowledge in order to create sustainable growth through new products, services and processes within the area of environmental technologies.” (Sustainable Business Hub, 2007, p.5, our translation)

It was intended that the project would create a holistic approach for developing cleantech firms in a regional perspective, especially focusing on small and medium-sized firms. For this purpose a so-called five-stage model was developed, which illustrates the general development stages of firms and which type of business development support is needed at each stage. The five stages are illustrated in Figure 3, which provides a simplified picture of how firms tend to move from the left to the right side of the model (Edlestam, interview).

Figure 3. The Five-stage Model for cleantech firms



Source: Sustainable Business Hub (2007, p.5, our translation) (developed by Mikael Edelstam, Miljöstrategi AB)

In each stage of the model an objective was set for the Swedish Model for Clean Growth, and in identifying the approach which was needed to reach each objective it was explored whether the support opportunities were already available in the existing innovation system and how the project activities would complement the existing system. Five sub-projects were established within the framework of the Swedish Model for Clean Growth, of which two were categorised as functional projects and three were content projects.

The first functional project dealt with support for start-up firms in the field of energy and the environment, and it was managed by Teknopol, which is an organisation providing business start-up and innovation advisory services for a number of incubators based in Skåne as well as in the Blekinge region. For this sub-project three business advisers with special competences in the field of environmental technologies were employed by Teknopol to form a virtual incubator for cleantech firms in southern Sweden.

The second functional project was run by SBH and was focused on strengthening the competitiveness of environmental firms. This involved supporting initiatives and structures for business development, and export development. Within this project SBH also carried out market analyses and gathered an index of all firms in the region which dealt with environmental technologies; they aimed to support the development of networking between firms and to facilitate firms' use of research in their product development. Finally, public procurement was another issue which was dealt with within the framework of this functional project.

Overall, this involved working with public authorities at the regional and local level to encourage them to take into consideration environmental requirements in public procurement, and thereby support public investments in environmental technologies.

The content projects dealt with the three cleantech sub-sectors towards which the project was especially targeted: energy, sustainable construction, and green chemistry. Under each content project a number of activities were initiated and led by different actors in the region (Sustainable Business Hub, 2007). It is beyond the scope of this project to describe all activities of the project Swedish Model for Clean Growth in detail. On the basis of the interviews with the project manager and other stakeholders involved, however, it is possible to identify some aspects that worked well and others that were less successful.

For the activities of the Swedish Model for Clean Growth targeted at the public sector the test-bed approach was developed. The idea behind the test-bed approach is that municipalities can support firms by testing new products for them before they are brought to the market. At SBH the main purpose was to give the member firms of the organisation the opportunity to have municipal test installations. In order to clarify the situation and interest of the member firms of SBH a questionnaire was sent to them asking about new products and obstacles to their sale. Subsequently SBH set up meetings with heads of business development departments and purchasers at a number of municipalities in Skåne. In connection with this, SBH had a dialogue with the municipalities

about test purchasing of cleantech products, and to consider this as a part of the local business support system. Sustainable Business Hub carried out two so-called test beds, where purchasers from municipalities met representatives from construction and cleantech firms during the project period, and since then the test-bed concept has been widely used in Skåne, and in areas other than cleantech (Hallworth; Simonsen; Olsson; Kristjanson, interviews).

According to the project leader of the Swedish Model for Clean Growth, it provided a useful opportunity for SBH to test a number of different approaches. Although the test-bed approach was considered successful, another project, “Hands-on Environmental and Industrial Demonstration Initiative” (HEIDI), was less so. The purpose of this project was to promote the growth of cleantech firms by offering them a physical space at Malmö University for product development and product demonstration in cooperation with researchers. In a longer-term perspective it was intended that cleantech firms would be able to rent space in the demonstration centre, which could also be used for bringing visitors who came to the region to learn about its cleantech activities. HEIDI was run for one year as part of the Swedish Model for Clean Growth, after which it was intended to be run by Malmö University. It was found, however, that Malmö University alone did not have sufficiently broad disciplines for what was needed in order to run the research and demonstration centre. For this purpose it was argued that it would have been useful to include the relevant technical departments at Lund University. This initiative to develop cooperation between cleantech firms and higher education institutions, which was not continued after the project period, has so far been the only one of its kind within the framework of SBH. The board of directors is currently discussing whether more coordination with higher education institutions in the region is needed, and how it can be approached (Simonsen, interview).

Through the export initiatives in the Swedish Model for Clean Growth SBH gained several cooperation partners who are still important to the organisation today. During the project period cooperation was initiated with an organisation similar to SBH. Ecoex is based in the region of Västra Götaland, and offers support to firms that wish to export environmental solutions. One way in which the two organisations collaborate is by drawing on each other’s specific market knowledge. Ecoex has a better knowledge of the French market and SBH knows the area around the Baltic Sea, especially Poland, better, and the firms based in the two regions that wish to start exporting can benefit from this. Another organisation with which SBH initiated cooperation during the project period is the Swedish

Export Council, which has been a significant partner in connection with sales missions, e.g. to Poland and London (Simonsen; Kristjanson, interviews).

The most important results of the ERDF co-funded project Swedish Model for Clean Growth is, according to the project leader, that an approach to organising sales missions has been developed which involves a focus on “sustainable solutions” that could bring together firms from different industries to provide solutions abroad. Further, cooperation in a number of sub-clusters has been initiated within SBH in the areas of: water and wastewater treatment, biogas, energy systems, and sustainable urban development (Simonsen, interview). Similarly, the final evaluation of the project concluded that the networks within SBH were established as part of the project, whereas the original objective of 50 firms initiating exports as part of the project was not met. The activities of the project were focused on disseminating knowledge about international markets, rather than actively supporting a group of firms to become exporting firms. According to the evaluation, however, although not to the extent originally anticipated, processes for export were begun in the project (Ramböll Management, 2010).

The role of Sustainable Business Hub and public policy

SBH is one of six cluster initiatives developed by Region Skåne, and in connection with the recently developed innovation strategy, an evaluation of them was carried out. The results of a questionnaire sent to members of SBH found that overall SBH has contributed to increasing knowledge of the industry, new networks and increased cooperation between the members. Approximately 30 per cent of the firms have developed new products and services and have strengthened their competitiveness, 10 per cent have hired new employees, and 20 per cent have experienced increased sales at least to some extent thanks to SBH membership. Although 73 per cent state that SBH membership is very useful to them, several respondents state that SBH should improve its skills in business development, e.g. through business-driven projects which stimulate cooperation (Oxford Research, 2011, p.64).

According to the deputy director of the business development department at Region Skåne, the early work with SBH steered how some of the other cluster initiatives were developed in the region. With the introduction of the innovation strategy and the sub-strategy for developing open innovation arenas out of the cluster initiatives, more chances to participate in international platforms for cleantech cooperation may be developed. One interviewee stated that a weakness of SBH is that it has not focused on internationalisation

in the sense of participating in international cluster networks, which would increase visibility of SBH and provide opportunities for exchange of experiences.

The role of SBH in relation to higher education institutions in Skåne is currently being discussed by the board of directors. As yet, there is no formalised cooperation or coordination with higher education institutions. There are several education programmes which are relevant for cleantech firms, but there is no coordination between the institutions, and no coordination with the cleantech sector. Ways in which SBH could play a role include providing an arena for bringing together representatives of education programmes and representatives of cleantech firms in order to discuss the development of the industry and the needs of education in terms of the new candidates emerging from the universities in the region. In addition to the question of dialogue between industry and universities about higher education, the question of potential R&D cooperation between researchers and cleantech firms is also discussed by the board. It is argued by some respondents that the higher education institutions themselves would have to “own” this question and be in charge of coordination between researchers and the cleantech industry, whereas others suggest that SBH could play an important role as a mediator between research and industry.

The European Regional Development Fund (ERDF), Region Skåne and membership fees are the most important funding sources for the management of SBH. SBH also depends on regional, national and EU funding for its project-based activities.

The Swedish Agency for Economic and Regional Growth has been the most significant national funding body for SBH activities, providing funding from the Cluster Programme and the Programme for Environmental-driven Markets, for example. Some funding has also been allocated by the Swedish Energy Agency for internationalisation projects, and recently by VINNOVA, the Swedish Governmental Agency for Innovation Systems. Moreover, funding has been granted by the national programme titled “Delegation for Sustainable Cities” managed by the Swedish National Board of Housing, Building and Planning (2012), which

is intended for export projects of new construction or reconstruction in urban districts or residential areas.

The Swedish Model for Clean Growth is an example of an ERDF co-financed project which, as mentioned above, has been seen as important for the development of SBH. The interviews suggest that to some extent the national programmes and EU Structural Funds supplement each other: e.g. during the project period funding for export support was provided by the Swedish Agency for Economic and Regional Growth and strengthened the export initiatives within the model. The funding of the three national agencies, i.e. the Swedish Agency for Economic and Regional Growth, the Swedish Energy Agency and VINNOVA, is characterised by being based on calls for proposals. This entails that the framework of project activities is to a large extent decided at the national level. This is unlike the EU Structural Funds which are more flexible, and can more easily be adapted to the specific regional context and to changes which may be taking place during the course of a given project.

The Baltic Sea Region Programme and to a higher extent Interreg funds are also important to SBH. These projects are particularly beneficial with regard to establishing collaboration with other regions, and have a particular focus on the Baltic Sea region. Although there are some Interreg-funded activities with partners on the other side of the Sound, several respondents have stated that Öresund collaboration on cleantech development has not been applied to its full potential. The management of SBH and Copenhagen Cleantech Cluster have met to discuss opportunities for collaboration which may be initiated at a later stage, e.g. in terms of receiving visitors from abroad and organising sales missions together. Actual cooperation has however not yet been established. In this context, it is worth noting that Copenhagen Cleantech Cluster is a national initiative, whereas SBH is regional. The issue of utilising and developing the potential opportunities of the Öresund region in the cleantech sector as regards green growth generally is more developed at municipal level than at regional level, as Malmö City and the City of Copenhagen have developed a common green-growth strategy.

Firm-level case studies: entrepreneurship and export collaboration

Two different firm-level case studies were carried out to illustrate different stages of the development process of cleantech firms. With reference to Figure 3, the five-stage model for cleantech firms, one study explores the product development and start-up process of a firm that sells an energy-saving drying cabinet, the first stage of the model, whereas the other study, which concerns three firms' collaboration to export water and

wastewater solutions to Ukraine, involves the fifth stage of the model, international growth. The firms studied in the two cases have all been involved to some extent in the ERDF co-financed project Swedish Model for Clean Growth, but it becomes clear that they have utilised a wider range of public funding and support system opportunities.

Developing environmental technology in Skåne

This section explores the start-up process of a company called Knycer AB in an interview with the CEO of the firm, Monica Hallworth. The stages and various actors involved in the process of developing the product and starting up the firm are introduced first, followed by a discussion on the process in terms of innovation and the relative importance of public policy.

Hallworth and her business partner started up Knycer AB in 2006 with the idea of developing a drying cabinet which does not use heat and therefore consumes less energy than other drying cabinets which are commonly used in Sweden. Hallworth worked for a number of years until 2006 as a salesperson, selling Swedish drying cabinets in France. It was during this time she had the idea to develop drying cabinets which would be more energy-efficient than the type of cabinets which were on the market.

In 2006, she moved with her family to Skåne, and started exploring opportunities to implement her business idea. Hallworth contacted the business incubator Minc, based near Malmö University, to seek advice. Minc is a business incubator with space for 25 knowledge-intensive firms with high growth potential. When a business is accepted at Minc it is offered coaching and expert guidance, capital funding contacts, and strategic training. The incubator programme runs for two years, and it is tailored to the needs and situation of the individual entrepreneur (Minc, 2012). With the support of the business advisers at Minc and in cooperation with her business partner, who lives in France, Hallworth wrote a business plan. Subsequently, Knycer AB was established as a limited company with an investment of 50 000 SEK by both Hallworth and her business partner. The latter is today mainly a financial partner, and Hallworth is in charge of the day-to-day management of the firm.

Knycer was based at Minc. The next step was

to apply for a loan from Almi Företagspartner, which is a national organisation with regional offices that promote the development of innovative small and medium-sized businesses, e.g. by providing loans for the commercialisation of innovative ideas (Almi, 2012). Knycer was granted a loan of 170 000 SEK by Almi.

As she did not herself have the technical knowledge required, the advisers at Minc put Hallworth in touch with an appropriate firm, which was contracted to manage product development which amongst others required a specific software development. A first prototype of the drying cabinet, that unlike other drying cabinets does not generate heat and therefore uses less energy, was presented in 2007 at an exhibition in Skåne. The same year Knycer was granted 300 000 SEK by the programme VINN NU ("win now") run by VINNOVA in cooperation with the Swedish Energy Agency and the Swedish Agency for Economic and Regional Growth. The programme is targeted at start-up firms whose operation is based on development results. The programme receives applications once per year, when up to 24 firms can be granted financing (VINNOVA, 2012, b).

Through Minc, contact was established with a patent agency which was contracted to write a patent application. The firm was granted a patent in 2009. Minc business advisers also facilitated contact with the business angel network, Connect Skåne, through which Knycer has found capital investment. Ten business angels have invested in the firm.

It was because of Knycer's base at Minc that Hallworth first learned about Sustainable Business Hub at a breakfast meeting. Knycer became a member of SBH and Hallworth is today a member of the board of directors of the non-profit organisation. The administration of SBH is based in the same building as Minc. During 2008, when the Swedish Model for

Clean Growth was on-going, Hallworth initiated a dialogue with the management at SBH about the potential role of local authorities as test-purchasers of green innovations. Knycer had reached a stage by then where the drying cabinet needed to be tested in a real environment. This was well in line with the framework of the project, and Hallworth became employed on a short contract to develop the test-bed approach, as described above, in cooperation with SBH.

By the beginning of 2009, a first version of the drying cabinet was ready to be tested, and Knycer sold their product to Malmö City after a meeting where the purchasers agreed to provide a test bed for two cabinets at a local kindergarten.

Initially, the kindergarten experienced problems with the cabinets, which were not functioning as well as intended. Hallworth spent time trying to understand the deficiencies of the product and to meet the needs of the kindergarten by communicating with the staff. During the first trial period, the cabinets were sent back to the firm which had developed them. After adjustment they started functioning as intended.

In 2010, the product was launched commercially, and after the first test purchase by Malmö City, it started selling in other municipalities in Skåne, and then across the country. The main clients are municipalities, and most of the cabinets are used in kindergartens. In 2010 Knycer moved from Minc to its own facility in Skåne.

In 2011, a board of directors with backgrounds in finance, industry and technology was constituted. The same year, the firm was allocated a so-called growth loan by the Swedish Energy Agency for the purpose of linking its sales and service networks. Finally, Knycer's drying cabinet, along with the products of nine other local firms, became part of the exhibition at Malmö Cleantech Centre.

Implications – innovation and policy

The production of a drying cabinet that does not run on heat and is more energy-efficient than other products on the market may be considered a product innovation. This is evident with regard to the OECD definition of product innovation, which is characterised by significant improvements in technical specifications and incorporated software. The innovation may be seen more as incremental than radical innovation as it builds on an existing product and improves it by developing an environmental technology whose use is less harmful than relevant alternatives.

Hallworth's idea to develop a more environmentally-friendly drying cabinet was based on her own knowledge of the market but technical knowledge in terms of developing the technology and software of the cabinet needed to be found elsewhere.

Furthermore, in the costly process of developing a new product and starting up a business, business advisory services, e.g. with regard to gaining loans and grants for the product development, played a significant part. Finally, when the product was first developed it was important to have the opportunity to test its practical application in the environment where it was intended to be used. Several actors were involved in the process.

According to Hallworth, without the business incubator Minc her business idea would probably have been much harder to realise. Her base at the incubator when the product was first developed and tested was essential to the process. Specialists were available to give advice and help, providing helpful contacts for the development and financing of the product and patent application. Moreover, the location at Minc entailed daily contact with other entrepreneurs and the cluster organisation SBH of which Knycer became a member. Finally, Minc was essential in terms of the staff's knowledge on relevant loan and grant opportunities and assisting with applications.

As the drying cabinet reached the stage where it was ready to be tested, SBH played a significant facilitating role. Hallworth became involved in developing the test-bed approach and the potential role of local authorities as test purchasers of green innovations. This approach involved a series of meetings between SBH and local authorities and was developed within the framework of the ERDF co-financed project Swedish Model for Clean Growth. It was through a test-bed meeting with purchasers at Malmö City that the two first cabinets were sold for testing at a local kindergarten.

The opportunity to test the practical use of prototype cabinets in the environment in which they were to be used was essential in the initial development of the drying cabinet. According to Hallworth, the general support of Malmö City for the idea of installing test beds for cleantech products is highly significant for the development of firms, especially start-ups, with innovative ideas. Knycer's drying cabinet is also exhibited at Malmö Cleantech Centre. Visitors who come to Malmö to hear about activities in the cleantech area are introduced to the product, along with other innovations from cleantech firms in the region.

In terms of public funding sources, a loan from Almi was helpful in the start-up phase of the firm and the initial product development. The programme VINN NU ("win now") run by VINNOVA in cooperation with the Swedish Energy Agency and the Swedish Agency for Economic and Regional Growth, which provided a grant for Knycer, was significant both in terms of the funding and in the promotion of the business idea and the opportunities to use this in the marketing of the firm. Furthermore, the Swedish Energy Agency has recently provided a loan for the firm. Indirectly, through

the Swedish Model for Clean Growth the ERDF funds have also played a facilitating role in the development of Knycer.

Although the national programmes and funding opportunities have been helpful to the development of the firm, Hallworth also stresses that she has concerns regarding her financial security. It has been necessary for her and her business partner to invest their own money in the business, and during the first five years while the product was being developed Hallworth did not have an income. Her husband supported her initiative, however, and the family has been able to live on one income. In turn, the years without an income have had an impact because no savings for retirement during these years have been possible, and she has not

had health insurance, as she would have had if she had been employed. The financial risk is a significant aspect to consider in connection with starting up a business. In this case an appropriate business support infrastructure in the form of the Minc incubator and the support of a personal network made it possible to see the process through. Attracting capital for product development has been a difficult and time-consuming task, and product development has been put on hold several times. Hallworth argues that more could be done to stimulate early investments from business angels and potential partners interested in investing in firms. Today, she receives a monthly salary, and the firm is increasing its sales.

Exporting Swedish environmental technology

This section studies collaboration on exports to the Ukrainian market between three firms in the water and wastewater industry. Interviews were carried out with representatives from two firms, both based in Skåne: Malmberg Water and Läckeby Water. At the time the case study was carried out it was not possible to establish contact with the CEO of the third firm, Nordic Water, based in the region of Västra Götaland. The firm-level case study is thus based on interviews with the two Skåne-based firms. First, the development of the Swedish water and waste industry is presented to explain the context in which the firms are operating. Second, the firms involved in the export initiative Swedish Water Experience (SWE) are presented, followed by a description of the process of initiating and developing the national and regional initiative SWE. Finally, the study discusses how these firms are coping with the challenges and opportunities of exporting Swedish environmental technology, highlighting implications related to innovation and policy.

The water and wastewater industry in Sweden and Skåne

One of the key sub-sectors of the cleantech sector is the water and wastewater treatment industry. The industry has been highlighted by the former Swedish Environmental Technology Council (Swentec) as one of the sectors with strong potential to be a world leader in environmental technology. Furthermore, the industry is more developed than other environmental technology sectors (Swentec, 2007). The industry has a strong tradition in Sweden and in the region of Skåne. Thanks to the early construction of Swedish water supply and sanitation systems, Swedish firms have a

competitive advantage in relation to other countries.

At the beginning of the 1970s many industries received government grants for environmental conversion measures largely designed to improve the water treatment process. In addition, the Swedish government invested approximately 11 billion SEK in municipal water treatment plants between 1971 and 1979. A consequence of these investments, combined with environmental regulations, was that Swedish industrial companies started to manage their own water disposal process (Swedish Environmental Protection Agency, 2010). Another important benefit was that cooperation between firms, municipalities and research environments was established early. Consequently, the Swedish water industry developed important test and demonstration sites for new concepts and innovations. This treatment technology is no longer unique, however, and innovation in the industry is most often in the form of incremental innovations in the sense that existing technologies are improved or adapted to specific conditions (Arnold et al., 2008; Möllerström, Johansson, interviews). In this context, the Swedish water industry is today a mature industry with few new so-called radical innovations (Myllyoja et al., 2008).

The subsector has developed a comprehensive approach regarding integrated water and wastewater solutions, whereby they manage the entire process from start-up to the end-customer product. This includes production of components, management of the development process, operation and services (Swentec, 2007; Möllerström, Johansson, interviews). Thereby, the subsector has developed strong know-how and experience in modern purification technologies and management. Today the industry provides a large variety of solutions for water and wastewater services and

products. In Sweden, the water and wastewater firms mainly consist of small- and medium-sized firms and a number of them are situated in Skåne, as well as in the Stockholm-Mälardalen region and Västra Götaland.

The industry is the third largest within the cleantech sector in Skåne, involving approximately 60 firms (Sustainable Business Hub, 2008). The water and wastewater firms based in the region of Skåne hold a strong position both on the domestic market and internationally.

The Swedish Water Experience

The collaborative export initiative Swedish Water Experience (SWE), which is the focus of the firm-level study, so far comprises three firms, as well as a number of regional and national partners. The main purpose of the SWE initiative is to establish a national and regional initiative for exporting water solutions. SWE was initiated within the framework of SBH at the beginning of 2011. The firms Malmberg Water and Läckeby Water are based in Skåne, and Nordic Water is situated in the region of Västra Götaland. These three firms are among the largest and strongest in the water industry both in a regional and in a national context. As shown in Box 1, Läckeby Water is the largest firm with about 200 employees, Malmberg Water has 144 employees, and Nordic Water has approximately 80 employees.

The firms operate in the regional, national and international markets, providing environmental technology products and services in the field of water and wastewater and other related products, such as biogas production and upgrading. Historically, all have developed their products in close cooperation with municipalities and industry. and have been exporting products and services to countries such as Germany, Poland, Lithuania, the United Kingdom, and China since the 1960s and 1970s.

The SWE firms based in Skåne consider

themselves to have good connections with higher education institutions in the region, both with regard to finding new employees and to gaining new knowledge for the development of their products. Because the firms offer a wide range of water solutions they employ both generalists and specialists in the areas of water treatment, energy, drilling, service and environmental management. Civil engineers with skills in project management, sales, construction and processing are especially attractive to the firms.

The civil engineering programme at the department of road and water construction at Lund University supplies both firms with new competences and knowledge, e.g. the department has an area of specialisation in water resource management. The firms have some collaborative projects with this department, which involves master students carrying out projects in cooperation with or for the firms. Other essential educational programmes are the environmental science programme at Lund University and the civil engineering programme at Chalmers University of Technology situated in Gothenburg. Läckeby Water is based at the Ideon science park close to Lund University and has continuous contact with researchers at Lund University, mainly from the department of road and water constructions. New employees are mainly recruited from the higher education institutions in the region, such as Lund University and Malmö University, but civil engineers from Chalmers Technological University and the Royal Institute of Technology (KTH) in Stockholm are often recruited.

According to the interviewees of the two companies, they have no problem recruiting skilled people, possibly because they are relatively large and well-known compared with most other firms in the sector. As stated by the firm representatives there is a significant element of goodwill associated with environmental technology firms, which helps to attract new employees.

Box 1: Firms in the Swedish Water Experience (SWE)

Malmberg Water AB is a cleantech company within the field of biogas, geo energy, water treatment and drilling. The fifth-generation family business has a long history and was founded in 1866 in Yngsjö, close to Åhus and Kristianstad, where the head office is still situated. The firm now has offices in Kaunas (Lithuania), Sofia (Bulgaria), and Merseburg (Germany). Today, the company has 144 employees and has an annual turnover of 400 million SEK.

Läckeby Water Group AB is an independent, privately-owned Swedish group, which offers contracting, products and servicing for water treatment and biogas production. The firm is established on three continents, but its main office is situated in the city of Lund. In total, the company has 200 employees and an annual turnover of 700 million SEK.

Nordic Water AB provides equipment and systems for water and wastewater treatment to process industries and public utilities. The Nordic Water story begins in 1961 with the foundation of the Axel Johnson Institute. It was a privately-owned institute doing research within, among other areas, water and wastewater treatment. Soon patented products were developed, which are still being brought to the market by Nordic Water. Today, the head office is in VästraFrölunda (Gothenburg) on the Swedish west coast. The firm has offices and service units in Stockholm, Mariestad, Klippan and Fjärås (Kungsbacka). It has around 80 employees and an annual turnover of 400 million SEK.

The first discussion on developing SWE was initiated between SBH, the firms and VARIM (Swedish Association of Suppliers of Effluent and Water Treatment Equipment) at the beginning of 2011. Several firms within VARIM were involved in the first phase, but Malmberg Water, Läckeby Water and Nordic Water had the overall responsibility for driving the process forward.

Sustainable Business Hub is in charge of administrative tasks and financial support, as well as more coordinative functions to support the contacts with national authorities and arrange exhibitions abroad. At national level the Swedish Trade Council assists SWE with contacts with Ukrainian authorities and other issues concerning the export process. The Swedish Trade Council administrates the national initiative SymbioCity, founded by the Swedish government and Swedish industry. SymbioCity is the national marketing concept developed to promote the Swedish experience in sustainable urban development and in exporting products and knowledge worldwide. The Swedish Agency for Economic and Regional Growth supports SWE financially.

During the creation of SWE all involved actors discussed the potential markets for environmental technology services and products. They decided to focus on the Ukraine market, largely because the country has an extensive demand for environmental technology solutions, especially in the area of water infrastructure systems. Furthermore, the water and wastewater infrastructure in Ukraine is underdeveloped and the market has great potential in both a short- and a long-term perspective. Another important reason is the relative geographical closeness to the Ukrainian market, in comparison with other potential environmental technology markets, such as China, India, Brazil and South Africa. SWE firms have also already established

relations with neighbouring countries, such as Poland and the Baltic countries which facilitate market entry into Ukraine. Furthermore, Ukraine has similar climate conditions to Sweden, which is an important factor in the delivery of water and wastewater solutions. Seen in a historical perspective the cold climate in Sweden makes the operation of the biological treatment process more difficult, which in turn has stimulated the industry to be at the forefront in the treatment process, especially in handling the process of reducing nitrogen in wastewater (Myllyoja et al., 2008; Möllerström, interview).

The first step towards the Ukrainian market was made in November 2011 when SWE, Sustainable Business Hub, and the Swedish Trade Council participated in the International Water exhibition "AQUI Ukraine 2011". The aim was to establish contacts with Ukrainian municipalities, cities, and ministries. During the exhibition the firms involved established contact with customers in Ukraine and received a request to develop the water infrastructure facilities in three Ukrainian cities (Zhytomyr, Horvlika, and Dymotrov), which all had at least 100 000 inhabitants. The CEO of Malmberg believes that this is an important step for them as an actor in the cooperative initiative SWE. The potential value of the contract is around three billion SEK.

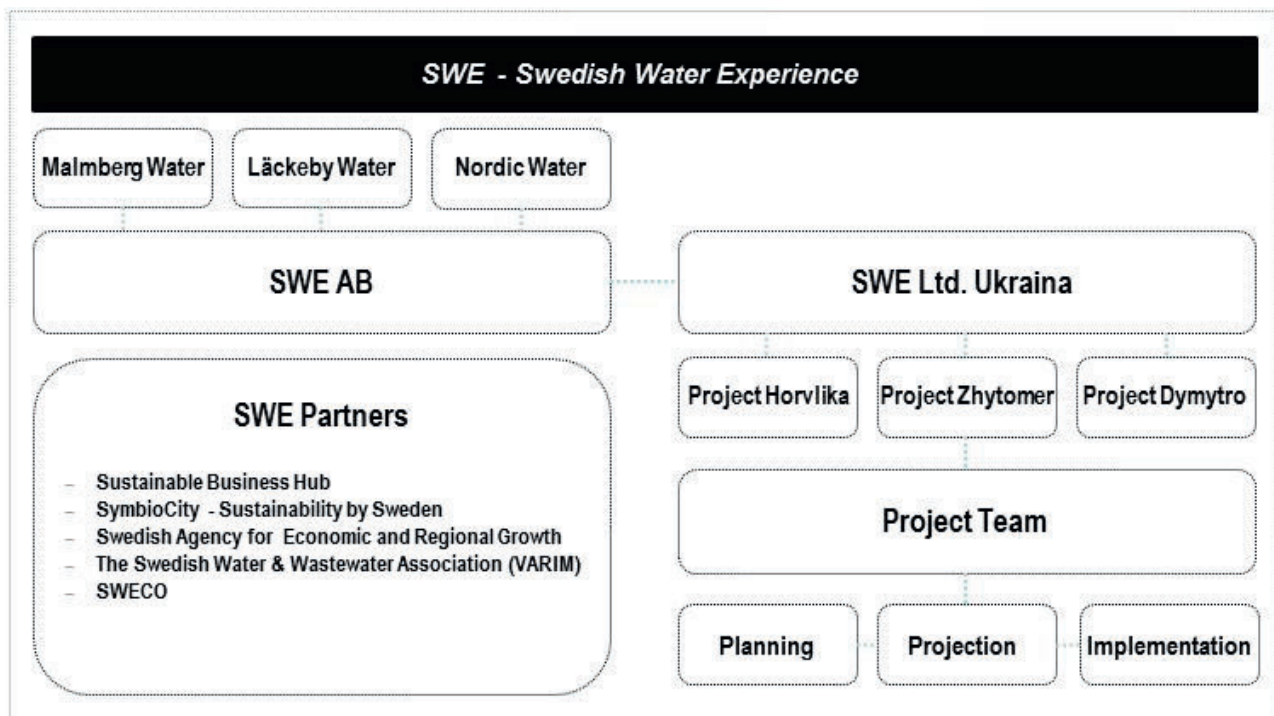
SWE developed a memorandum of understanding with the Ministry of Regional Development, Construction and Municipal Economy to deliver wastewater treatment solutions, which was signed in March 2012. One objective is that Ukrainian wastewater management over a five-year period will meet EU standards. Work has now been initiated in the cities of Zhytomyr, Horvlika, and Dymotrov.

In order to combine services and be able to act as one firm, the limited company SWE AB has been established. Each of the SWE firms owns one-third of

SWE AB and the board consist of two representatives from each firm. Current plans involve establishing a joint firm based in Ukraine, which will be owned 100% by SWE AB. The chairmanship of the board will rotate between the firms. All projects implemented in Ukraine will be owned by the Ukraine-based firm. As regards

the project management in Ukraine, a common project team has been appointed to realise the projects and the staff will be employed by SWE Ltd. Ukraina, Malmberg Water, Läckeby Water and Nordic Water. The projects will be run as a so-called “open book project”.

Figure 4. Organisational structure of SWE



According to the CEO of Malmberg Water, there have been initiatives to establish export collaboration since the 1980s but SWE is the first collaborative initiative with a comprehensive strategic plan, in that several qualified companies join forces to create a consortium. All firms in SWE are relatively small in comparison with the large international companies and firm constellations in other industrial sectors, which is one of the main reasons for creating a consortium. The firms are too big for the Swedish market and too small to export individually to Ukraine, which all three of the firms have tried unsuccessfully to do.

“To gain more strength and to create a more coherent structure, we must cooperate to export to international markets. We are normally competitors, but when we do business in Ukraine, we work together.” (Möllerström, interview)

Another added value of creating SWE is that the firms do not need to operate as single businesses towards customers and public authorities. In this sense they can coordinate their marketing activities and facilitate discussions with governmental bodies and other actors. As the firms of SWE are keen to stress, however, it

is important to understand that the model should not be seen as a static process towards exporting Swedish environmental technology. By this they mean that it is essential to develop all stages in the process and that it is central not to lose the focus on developing the Swedish environmental technology markets and products:

“Swedish environmental technology starts in Sweden. If we don’t prioritise investments in Sweden we have nothing to export.” (Hjelm, interview)

According to the interviewees there have been fewer public policy investments in late years, and some concerns were raised that there are not enough demonstration sites and test-bed facilities to test and develop new innovative water solutions. The industry is to a large extent dependent on public investments in infrastructure.

The product SWE intends to deliver to the Ukrainian market is an integrated concept on water and wastewater solutions. The firms stress that they have unique competences and products, and that all involved firms basically offer comparable products and services. In this way, SWE take care of everything from start-

up to final product, including the operation of water facilities.

All the firms have been working on idea this for a long period of time and they have a strong history of developing water solutions. In this sense the firms have built know-how and experience by operating both on the Swedish market and on international markets.

Implications of initiating export to a new market – innovation and policy

The SWE initiative illustrates how the Swedish water industry is at the forefront of environmental technology water solutions. The water and wastewater solutions have been developed over a long period of time, which has consequently created strong know-how in the water industry in Skåne and in Sweden generally. According to the interviewees, the early investments in the Swedish water infrastructure system have been important in allowing the SWE firms to test various types of water solutions and develop innovative products and services. The establishment of SWE does not involve a radical product innovation or new development of clean technologies. This is illustrated by the creation of SWE, whose firms are planning to use existing environmental technologies but to combine them in a consortium in order to introduce them to the Ukrainian market. In this sense SWE may be described as an organisational innovation, with a number of cleantech firms joining forces to move into the Ukrainian market. Normally, the firms are competitors on both the Swedish and the international markets, but because of the small size of the firms they cannot export efficiently on their own. SWE may also be seen as a marketing innovation which combines the firms' knowledge and the well-known reputation of the Swedish water industry into one integrated concept. The well-known experience and the existing values of water technologies are used for developing a concept innovation.

From a policy perspective it is important to acknowledge that regional actors, such as Sustainable Business Hub, hold an important position in the start-up phase of the initiative. This includes administrative tasks and financial support, as well as more coordinative functions to support contacts with national authorities and arrange exhibitions abroad. In relation to market entry in Ukraine, however, it is important to stress the importance of national actors in terms of securing good contacts with foreign authorities and financial support.

All firms agree that there are difficulties in establishing this kind of export collaboration and a number of challenges have to be overcome before a full-scale project can be realised. First of all it has to

be emphasised that most water treatment markets are managed by municipalities or state authorities. Consequently, the relationship with the public sector can be seen as an obstacle to entry to the Ukrainian market and it is important to develop relations with Swedish authorities. In addition Swedish national authorities can be helpful in relation to difficulties that arise in understanding differences in national legislative frameworks, which can also be seen as a barrier to market entry (Mylloja et al., 2008; Malmberg Water, 2012).

Another key issue in relation to the national level support is that the SWE firms stress that some kind of public financial support is needed in order to realise the project in Ukraine. There is often an enormous need for investment in water infrastructure around the globe, but not many financial possibilities in the public sector to realise such projects. Thus, some form of financial support is needed to cover the costs. For example, according to a respondent, the Ukrainian public authorities will only be able to cover around 70% of the costs of the project. The current financial support system is well developed by the export credit opportunities afforded by EKN (Export Credit Guarantee Ordinance), but not fully suitable for projects such as SWE. Thus, the firms are currently also negotiating with the Swedish International Development Agency (SIDA), in order to secure development assistance and funding for the water projects in Ukraine. Another opportunity for financial support might be the Nordic Environment Finance Corporation (NEFCO), which provides financial support and capital investments for a wide range of environmental projects in Central and Eastern Europe, including Ukraine. The firms have managed the issue of being competitors in other markets than the Ukrainian by establishing a Swedish-based limited company. When (if) the memorandum of understanding with the Ukrainian authorities has been signed, the firms intend to establish a Ukraine-based company owned equally. Plans have been made for management of projects and for profits to be shared between the partners.

The current national priorities for export of environmental technologies are, according to SWE firms, first of all a focus on markets such as China, India, Brazil and South Africa; arguably public support is mainly suited to larger international firms. There are now good indications, however, that SWE will realise the necessary financial agreements with Swedish and Ukrainian authorities, after which their plans for export can continue.

Conclusions and Policy Framework

Main drivers for development of the cleantech sector

The development of the cleantech sector initiated by Region Skåne during the 2000s stemmed from the collaboration in 2001 between the environmental strategy division at the regional development department and the business development department at Region Skåne on establishing the network organisation Sustainable Business Hub (SBH).

In 2005, the potential of the cleantech sector was further clarified when it was found that too little had happened after the establishment of the membership organisation Sustainable Business Hub (SBH) and a clear strategy for the area needed to be developed. The environmental strategy division at the regional development department and the business development department at Region Skåne in cooperation with an environmental consultant carried out analyses in order to identify the main strengths of the region in the environmental area. Three overall sectors were identified as potential green-growth areas: agriculture and food; transport; and cleantech. It was decided to focus on the area of cleantech, where Skåne was found to have a competitive advantage compared with the rest of the country. It was in 2006 that cleantech became a strategic focus area of the region. In addition to energy and sustainable urban construction, the water and wastewater industry was identified as a main strength, which probably has its roots in the traditional industrial profile of the region. More than 300 firms have been identified by SBH (2008) as cleantech firms in the region and one-third are members of SBH.

In 2006, when focus on the cleantech sector increased, the political environment also became more focused on the opportunities afforded by environmentally driven business development, and the Regional Council raised the annual amount of basic funding to SBH significantly. This development was crucial for the development of the cleantech sector. It entailed a strategy shift to increase the focus on the sector, and the increased funding meant that it was possible for SBH to improve its organisation and activities. The continuing financial support of the Regional Council remains significant for the operation of SBH.

Malmö City has also been an important driving force behind the development of the cleantech sector, especially with its strong profile of sustainable urban construction. The city's focus on sustainable urban construction was initiated by local policymakers to cope

with the economic restructuring process of the region from the 1960s to the 1990s when industrial production and engineering were in decline, especially in Malmö. The political focus of Malmö City on developing a profile of sustainable urban construction was initiated during the 1990s.

National-level policy

Four main national authorities have been influential in the development of the cleantech sector through the cluster organisation SBH: the Swedish Agency for Regional and Economic Growth, VINNOVA, the Swedish Energy Agency and the Export Council.

SBH as well as individual firms has received funding from the Swedish Agency for Regional and Economic Growth, the Swedish Energy Agency and VINNOVA. These funding opportunities are based on calls for proposals. This means that the framework of project activities is to a large extent decided at the national level. Some case study respondents argued that the programmes initiated by these three main national authorities generally contain "too little money for too many projects" and that the authorities might benefit from coordinating their activities, which overlap to some extent.

The Export Council has been the most significant actor with regard to the firms being able to establish contact with the relevant authorities to initiate export abroad and generally the Export Council's knowledge of export markets. Collaboration has been initiated between the Export Council and the Skåne-based organisation SBH, strengthening the export initiatives.

It has been argued that in addition to the initiatives to support export missions and market entry of cleantech firms, there is a need for more cleantech demonstration projects on the domestic market combined with export initiatives. National funding for demonstration projects has been reduced significantly during recent years.

Regional-level policy

At the regional strategic level, the current Regional Development Programme for the period 2009-16 has set the overall objective for the region to be fossil fuel-free by the year 2020. Closely linked to this programme is the Strategic Programme for Climate Work in Skåne

2009-2020, and in the case of cleantech the newly developed International Innovation Strategy for Skåne 2012-2020 is especially relevant. As part of the strategy it is planned that SBH and other cluster initiatives in the region should develop into open innovation arenas, so the clusters can collaborate around two platforms: “personal health” and “smart, sustainable regions/cities”. The latter platform, which is especially relevant to cleantech firms, is currently being developed, supported by funding from VINNOVA’s programme for “Challenge-Driven Innovation”. An application in cooperation with several partners is currently being prepared for this programme in order to ensure a more long-term initiative in the area of smart and sustainable regions and cities.

The EU Structural Funds are highly significant in the development of cleantech and of the membership organisation SBH. It is argued that a main benefit of the Structural Funds is the flexibility of projects, which can be adapted to the specific regional context and to changes which may occur during the course of a given project (unlike the less flexible national programmes).

Local-level policy

Malmö City has its own environmental goals for 2020 which amongst others sustainable urban development and public procurement. Moreover, the initiative Malmö Cleantech City has different activities to support cleantech firms based in the municipality. Malmö Cleantech City is described by respondents as an initiative supporting the growth of firms locally, whereas SBH offers support for export.

SBH has an international focus and Malmö Cleantech City a local focus, and the City of Malmö would seem to have established more international cooperation in the area of cleantech compared with Region Skåne. Malmö City has initiated cooperation with its cross-border neighbour the City of Copenhagen, based on an agreement between the two mayors, and the departments of the two municipalities have started finding ways to collaborate within the framework of “green growth”. This has been emphasised as the most developed example of Öresund cooperation involving the cleantech sector. Nothing similar has been developed at the regional level.

II. Case study: Bioenergy in the Region of South Savo, Finland

Liisa Perjo

Introduction

This case study aims at studying processes on regional and firm level towards the development of bioenergy in South Savo. The case study provides an example of processes aimed at green growth in a peripheral rural region where the potential is strongly based on available natural resources from forest and also on a good logistical position. The focus is mainly on the development of small and medium-sized companies dealing in bioenergy and especially forest energy. The expansion of production of biocoal from wood is a strategy that can count on the availability of biomasses and a good logistic position because of a deep-water harbour and a new biolistics centre that will be built next to it. In order to increase the use of potential forest resources in bioenergy, a bioenergy cluster initiative concentrating solely on forest energy was established in 2011.

This report first introduces the socio-economic characteristics of the region and the bioenergy sector

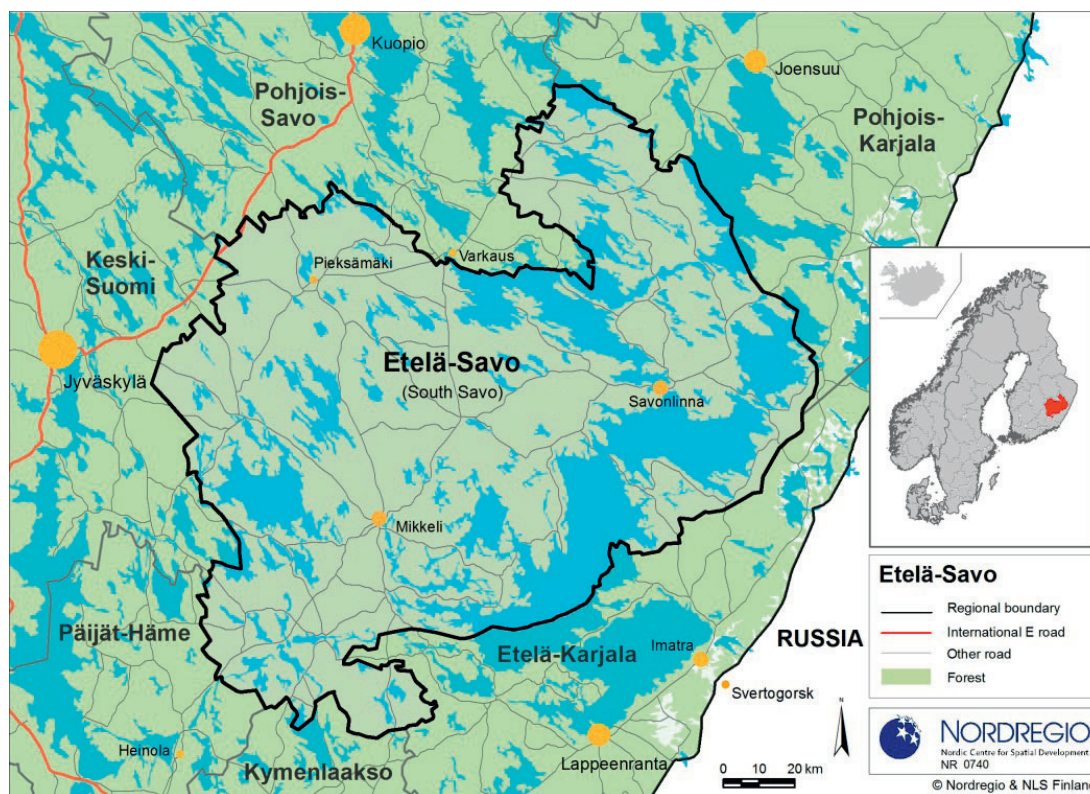
in South Savo. Following interviews with relevant stakeholders in South Savo, human resources issues and the role of higher education institutes in bioenergy development in South Savo are discussed. In the second part of the study, relevant current policies and strategies related to bioenergy development on different administrative levels are described. The third part focuses on a regional level case study where process towards the development of a forest energy cluster is studied and the background of bioenergy development in South Savo discussed. A firm-level perspective on bioenergy development is given in the fourth part and a case study is presented. The case study explores the process of adapting a component product to bioenergy logistics and describes the challenges and the most important support measures related to it. Finally, drawing on both the regional and firm-level perspectives, the conclusion introduces the main drivers and the regional policy framework for developing the bioenergy sector.

The Region of South Savo

The region of South Savo (Finnish: Etelä-Savo, Swedish: Södra Savolax) is situated in Eastern Finland and consists of 17 municipalities. The overall size of the region is 18 767 km² and it has 153 738 inhabitants. The region has only 11.1 inhabitants per land square kilometre and the average number of inhabitants per

land square kilometre in Finland is 17.7. Mikkeli is the biggest town in the region with 48 676 inhabitants, and it is also the regional administrative centre of South Savo (Regional Council of South Savo and Centre for Economic Development, Transport and the Environment, South Savo, 2012).

Figure 5. Map of South Savo



The region of South Savo has for years suffered from negative population change and the average age of the population in the region has been increasing. The region now has the highest average age of the Finnish population. The GDP of the region is lower than the national average and in 2009 the GDP in South Savo was 24 500 € per inhabitant (whereas the national average was 32 500 € per inhabitant).

Also, the level of education of inhabitants in South Savo is below the national average. The number of inhabitants with tertiary education is low and the number of inhabitants with secondary education is slightly higher than the Finnish average. Mikkeli has a University of Applied Sciences and the University of Eastern Finland and Aalto University have campuses that provide tertiary education in South Savo. Educational programmes are provided in e.g. business administration, tourism, nursing and engineering. Lappeenranta University of Technology is also present in the region through its research activities e.g. in the field of bioenergy.

The employment rate in the South Savo region is about 65% and the proportion of the workforce employed in primary production (8.8%) is higher than the Finnish average of 3.7%. The sectors employing the highest share of the workforce in South Savo are health care and social services (19.8%), industry (13.7%), wholesale and retail trade (10.4%) and agriculture, forestry and fishery (8.8%). The average salaries in South Savo are lower than the national average.

Taking into consideration the total number of people employed in the region, the percentage of entrepreneurs is the highest in Finland. Most of the firms are small or medium-sized and 95% of the companies in the region employ fewer than 10 people. In 2010 there were in total 10 524 firms with branches in South Savo. Compared with the Finnish average, the number of enterprises in agriculture, forestry and fishery is unusually large as 20% of the enterprises are within the fields of agriculture, forestry and fishery. Fifteen per cent of the enterprises are in the commercial sector, 8% in logistics and 7% in industry.

The role of primary production in South Savo is central. More than 50% of the primary production products are not processed in the region but exported to other regions. Forest industry is important and more than 50% of the primary production products exported from the region consist of raw wood and wood products (Regional Council of South Savo and Centre for Economic Development, Transport and the Environment, South Savo, 2012). Agriculture, metal industry, tourism, food industry, construction, commerce and healthcare and social service sectors are important sources of livelihood and employment (Regional Council of South Savo and Centre for Economic Development, Transport and the Environment, South Savo, 2012; Centre for Economic Development, Transport and the Environment, South Savo, 2011).

Forestry and bioenergy in the region of South Savo

Approximately 88% of the land area in South Savo is forest land, accounting for 6% of all Finnish forest land. In South Savo, the amount of forest land is the highest in Finland and the forests grow exceptionally fast. In 2009 the forest sector in South Savo employed approximately 4 000 people. Some 1 700 of them worked in the forest industry in forest management, timber harvesting or other tasks, 2 440 worked in sawn timber, wood products, furniture or paper product manufacturing, and wood product manufacturing was the largest employer with 1 790 employees. Forestry is significant for the regional economy and the forest sector makes up 10% of the regional GDP in South Savo. Seventy-seven per cent of the South Savo forests are privately owned, usually by families, and forest owners have become economically less dependent on their forests. A growing number of the forest owners live outside the region or in urban areas and may value recreational or landscape values more than economic profit. The role of the Forest Management Association is important in activating small forest owners to sell wood for e.g. bioenergy.

Traditionally South Savo has acted as a raw material provider in the Finnish forest economy. The amount of wood processed in the region has been small and approximately three-quarters have been processed outside the region as it lacks a paper industry and big sawmills. In south-east Finland the role of paper and pulp has been significant whereas in Eastern Finland (South Savo, North Savo and Northern Karelia) the role of the forest economy has been more important. In South Savo the plywood industry has also been a significant actor. Increasing the use of natural resources and wood processing in South Savo is seen as a way to promote the welfare of the region and the bioenergy sector is seen as one possibility to further utilise the raw material resources. The raw material could be processed in the region to a higher extent if, for example, wood-based biocoal pellets were produced. Given the available forest resources, bioenergy in South Savo usually means forest energy and wood fuels. Therefore, in this study we consider bioenergy as energy derived from forest resources (Finnish Forestry Centre, 2011; Miktech, 2012a). In Finland, the national energy policy is outlined in the National Climate and Energy Strategy of 2008, whose target was

to increase the amount of renewable energy to 38% by developing support schemes. The strategy is currently being updated and a new long-term strategy with revised goals is expected by the end of 2012. On a national level, the aim has been to double the use of wood chips in energy production by 2020. As long ago as 1990, Finland introduced a carbon dioxide tax that has contributed to the development of renewable energy in the country. National energy policy in Finland has promoted renewable energy through supporting investments and research projects in the field and introducing support schemes in the form of a system of feed-in tariffs, for example, that has been significant in terms of bioenergy development. An electricity producer whose power plant is approved in the system can receive a subsidy (feed-in tariff) for a maximum of twelve years and the subsidies vary on the basis of a three-month electricity market price or the market price of emission allowances. The Ministry of Employment and the Economy has recently been preparing a change in the law to promote the use of wood fuels. According to the new law, in addition to changes in the prices of emission allowances, changes in the taxation of peat will be taken into consideration in order to maintain the competitiveness of woodchips in energy production (Hiltunen, 2004; Ministry of Employment and the Economy, 2012a; Ministry of Employment and the Economy, 2012b).

The percentage of renewable energy in Eastern Finland in general is twice the Finnish average and in 2008 40% of the energy consumed in Eastern Finland was wood energy. The wood fuels used consist mainly of wood chips, wood residue from industry, sawdust and bark. In South Savo, the use of wood chips in bioenergy is particularly well-developed and approximately 40% of the wood energy produced in the region in 2010 came from wood chips. The forest resources in the region would allow the use of wood chips to be quadrupled, however. The greatest potential for the future lies in using forest biomasses to produce new kinds of biofuels (such as processed wood pellets and wood-based biocoal) that can be for example used in traditional coal-powered plants. It is also believed that biocoal could one day be exported to global markets (Finnish Forestry Centre, 2011; Miktech 2012a; Miktech 2012b).

The largest companies in the bioenergy sector are the energy and district heating providers

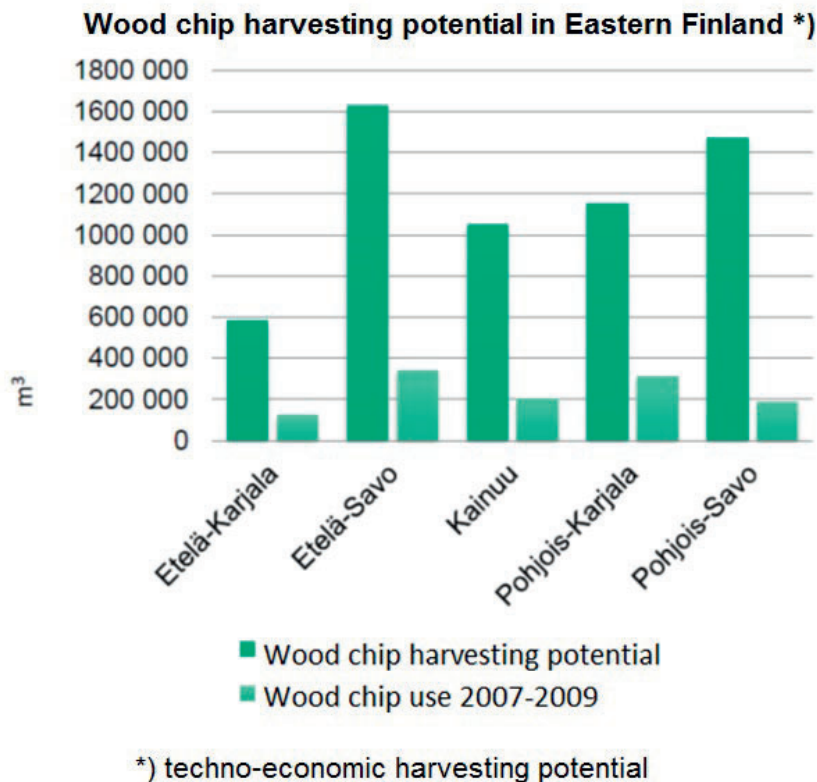
Etelä-Savon Energia and Suur-Savon Sähkö. The companies are forerunners in the use of wood fuels and thanks to them the bioenergy production chain and enterprises needed to support the production chain have been established. Etelä-Savon Energia is owned by the City of Mikkeli and 57% of Suur-Savon Sähkö is owned by municipalities in the region and the rest by communities, congregations and private owners. The energy foundation Suur-Savon Energiasäätiö (founded in 1990 by Suur-Savon Sähkö and its owner municipalities) is also an important actor in the region. The foundation is owned by the municipalities and its board of directors consists of their representatives. It has allocated funding to almost all bioenergy-related projects in South Savo from the dividend income it receives from being the largest shareholder in the energy company Suur-Savon Sähkö. Legally the foundation is considered to be a private actor and funding received is private funding (Etelä-Savon Energia, 2012; Suur-Savon Sähkö, 2012; Municipality of Rantasalmi, 2012; interviews).

The energy and district-heating provider Etelä-Savon Energia produces almost all of the energy it sells at its Pursiala power plant with wood chips as the main fuel and its energy production is self-sufficient. Sixty per cent of the fuels used by the company are wood-based and it exports approximately 20% of the energy produced to other regions. It also uses peat and sells wind energy and hydropower. Of the energy and district heating produced at the power plants owned by Suur-Savon Sähkö, 77% is produced from wood fuels and 11% from peat. Both Etelä-Savon Energia and Suur-Savon Sähkö are members of the new Biosaimaa cluster that was established in South Savo in 2011 (Etelä-Savon Energia, 2012; Suur-Savon Sähkö, 2012; Miktech, 2012a).

In 2008, a total of 78 SMEs in the bioenergy sector were active in South Savo and employed a total

of 242 people. Most of the bioenergy companies at present are very small micro firms and very few of them have notable international business activities. Most of them are only active in the region of South Savo. Technology firms active in bioenergy in the region are also small or medium-sized, focusing on different parts of the wood-chip production chain. The production chain of forest energy consists of activities in relation to harvesting, transport, biomass storage and processing, biofuel refinement, energy production and use of by-products. As noted earlier, the use of wood chips could be quadrupled, something which could create a further 600 new jobs in the bioenergy sector in the region (Miktech, 2012a; Finnish Forestry Centre, 2011). The strengths of the bioenergy sector in the region are related to availability of raw material resources, existing competences in the forest energy production chain and the good logistic position of the region as well as strong regional commitment and the availability of research resources and networks. The region of South Savo, however, has not been able to profile itself as a bioenergy region clearly enough even though it both produces and consumes a high amount of bioenergy. The weaknesses of the forest energy sector in the region at the moment are related to the small number of technology firms, which are also very small in size, the low amount of raw material processed in the region and the few international activities. The national markets for wood chips have also been very dependent on subsidy schemes, which is a challenge for long-term bioenergy development in South Savo. Nationally, it is challenging that the development of the sector is so intertwined with mercurial support schemes. In order to increase profitability and decrease dependence on subsidy schemes, the whole production chain from harvesting to logistics and processing needs to be developed. In biocoal pellet production, which will especially be developed in South Savo, the material flows are vast and therefore it is of crucial importance to develop the logistics and the first stages of the production chain (Miktech, 2012a).

Figure 6. Wood-chip harvesting potential in Eastern Finland



Source: Miktech, 2012a

Human resources and the role of higher education institutions

According to the interviewees, the background to bioenergy activities in South Savo is based on available natural resources rather than on specific competences of human resources. South Savo does not have its own university, but universities and research institutes based outside the region have established units in the region (e.g. Lappeenranta University of Technology, Eastern Finland University, Aalto University School of Business and Ruralia Institute). There are no Master's degrees related to forest energy in the region but Mikkeli University of Applied Sciences trains engineers for more practical research and development positions. Furthermore, the secondary education institute South Savo Vocational College, for example, trains machine drivers for the forest industry. It was stated in the interviews, however, that in general the availability of relevant education in the region is poor.

There have so far been no real difficulties in attracting the necessary competent labour force in the bioenergy sector as the bioenergy firms in the region are relatively small and even the bigger power plants do

not require a large number of employees. As the plan is to significantly increase the use of wood energy in the region, however, it may be a challenge to obtain the necessary workforce for harvesting and logistics even though relevant secondary education is available. The targets of increasing the use of forest energy and developing the bioenergy sector are set high and more labour will be needed, especially at the beginning of the bioenergy production chain (Kuva; Muinonen; Ollikainen; Pulliainen, interviews).

As there is no university providing forest-related Master's education in the region, there have been some challenges in relation to attracting a competent highly educated labour force. In its education and research strategy (2008), the Regional Council of South Savo emphasises the important role of education and research institutes for regional development and it sees the lack of an own university as partly hindering the region from developing into a high competence area.

For the development of the region, it is important to attract employers who will pay higher salaries in order

to attract a more qualified labour force. The number of high technology firms in South Savo is small and the salaries are also considerably lower than the Finnish average. Even small high-competence concentrations paying slightly higher salaries could contribute to making the region more attractive to highly educated people. They could also cause a snowball effect, attracting more and more high-competence employees and employers to South Savo. Bioenergy development is seen as one opportunity to establish more high technology companies in the region (Regional Council of South Savo, 2008; Regional Council of South Savo 2010b; Kuva; Muinonen; Ollikainen; Pulliainen; Ranta, interviews).

According to a representative from the Ministry of Employment and the Economy, the biggest challenge to developing a bioenergy cluster in South Savo is the lack of research activities. Firms are more likely to move to regions such as Jyväskylä with high-level research infrastructures. The greatest potential of the sector in South Savo could lie, however, in activating SMEs in different parts of the value chain where they can apply their own innovations without extensive support from research institutions (Kutinlahti, interview).

At the moment, the Savo Unit of the Lappeenranta University of Technology (LUT Savo) is the most important higher education institute contributing to bioenergy development. It coordinates R&D projects and cooperates particularly with SMEs in various bioenergy projects but has no Bachelor or Master students. Master and PhD students from the Lappeenranta University of Technology do however

occasionally participate in projects and include them in their theses. In terms of R&D projects, the LUT Savo Unit cooperates with firms. R&D projects have mostly focused on the beginning of the bioenergy production chain (e.g. harvesting, processing and logistics). It is argued that SMEs need assistance with bioenergy development, especially during pilot phases when the functionality of their technology in the bioenergy sector is tested (Ranta, interview).

Originally the Lappeenranta University of Technology Unit was set up in Mikkeli because the Mikkeli University of Applied Sciences wanted to cooperate with a university to deepen its research activities. Four professorships were established in Mikkeli in 2003 by the Lappeenranta University of Technology and bioenergy was one of them. Seventy per cent of the funding of the professorships is from EU structural funds and 30% is funded by local enterprises and the city of Mikkeli. The bioenergy professorship that is held by Tapio Ranta is of special significance. It receives approximately 30% of its funding from the municipally-owned energy foundation Suur-Savon energiasäätiö. Approximately two out of five workdays of the bioenergy professor consist of dissemination activities at the main campus in Lappeenranta but the professorship system and the help of EU Structural Funds has made it possible for Ranta to concentrate more on research activities. The professorship project will end at the end of 2014. The professorships depend on university policy and at the moment the Lappeenranta University of Technology is not in favour of continuing to promote this type of professorship (Ranta; Pulliainen, interviews).

Regional development and innovation policy

Bioenergy from forests is an overarching theme that is included in all relevant strategies on the regional level. It is seen as an important opportunity for the region to utilise its forest resources in a sustainable way and generate growth and well-being via innovation and business activities. In addition to more general regional development strategies, innovation, research, education and bioenergy strategies influence the development of the bioenergy sector in South Savo.

Regional-level strategies are drawn up by the Regional Council of South Savo and the most exhaustive regional development document, the "Regional Development Strategy of South Savo", is currently being updated. Renewal of the municipal structure, strengthening the competence supply and innovations and promoting the competitiveness and energy efficiency of the enterprises in the region are some of the most central goals in the current long-

term strategy. There are goals related to increasing exports and the number of jobs in the technology and forestry sectors. There are also targets related to energy efficiency and increased use of wood-chip energy which is directly linked to bioenergy development (Regional Council of South Savo, 2009).

The Regional Development Programme of South Savo for 2011 to 2014 has positive net-migration and stronger regional economy as its main objectives. It states that in order to strengthen regional economy, it is important to handle its structural change. Technology and wood industries are emphasised, and well-functioning education and research activities are also in focus. The programme puts a lot of weight on supporting enterprises and their growth, development and networking. Furthermore, developing secondary and tertiary education, institutionalising research and innovation structures and increasing networking in

Russia are identified as central targets. As forestry is one of the biggest sectors in the region, it is essential to handle on-going structural changes and keep the sector vital. As the region has mostly engaged in forestry and wood product manufacturing, the negative development in the paper and pulp manufacturing industry in Finland has not had a great impact on South Savo. It has, however, caused a slight decrease in the demand for wood from the region. The programme notes that production of wood fuels (such as wood chips and biocoal pellets) promises to become more and more important as a source of income in the region.

Included in the Regional Development Programme for 2011 to 2014 is an *environment report*. In relation to bioenergy, the aim is to increase energy self-sufficiency by increasing bioenergy-related R&D activities and pilot projects. The programme also links bioenergy with more general climate targets. Overall, the programme emphasises bioenergy as one of the most central factors contributing to the region's chances of reaching its targets of climate and energy efficiency, innovation and successful business activities. As regards forests and forestry, it is stated that the aim is to have well-functioning, successful and eco-efficient businesses within the sector and to increase the stage of wood processing in the industry in order to move away from producing only raw materials. The programme sets targets to increase the use of renewable energy by 20% and increase energy efficiency by 20% (Regional Council of South Savo, 2010a).

In addition to their inclusion in regional development documents of a more general nature, bioenergy research and innovation are addressed in some of the more specific regional-level programmes and strategies, such as the South Savo innovation strategy for 2010 to 2015 on technology and service innovations. Globalisation and changes related to sustainable development, new technologies and an ageing population are seen as the main challenges that the region has to respond to by e.g. heightening specialisation and competences. Bioenergy is highlighted as one of the most important growth sectors in the region. New business and material possibilities in forestry are seen as one way to link South Savo actors with other Eastern Finnish actors such as higher education institutes and core enterprises. The strategy recognises that there is a demand for bioenergy innovations in Russia particularly, but is prepared to commercialise ideas for the global markets as well. In relation to technology innovation, the target of the innovation strategy is that by 2015 five significant innovations related to bioenergy, material technology or some other biomass industry will have been engendered in the region. By 2015, there should also be up to three pilot or demonstrator plants developing bioenergy.

Bioenergy and material technology should create 50 million euros of new business activities every year, as well as at least a hundred new jobs (Regional Council of South Savo, 2010b).

Furthermore, the education and research strategy of South Savo for 2009 to 2015 aims at diversifying the education supply in the region and at institutionalising the existing education and research units as essential parts of the regional research structure contributing to regional development. The Regional Council considers that the existing research activities in the region are not sufficient to transform the region into a high competence area attracting employers paying competitive salaries and employees with high qualifications. The strategy emphasises the importance of developing high-level RD&I activities in the region and bioenergy is again highlighted as an important opportunity (Regional Council of South Savo, 2008).

There are two specific programmes for bioenergy development in the region: the bioenergy business development plan for South Savo and the Eastern Finland bioenergy programme on an inter-regional level. The first was drawn up by the mainly municipally owned technology and innovation centre Miktech Ltd in 2011 after bioenergy was chosen as one of the spearheads of innovation in Mikkeli. The plan identifies the main actors (firms, research institutes, associations and public authorities) and potentials of the bioenergy sector in South Savo. It also sets targets and priorities for development work and describes the activities of a new bioenergy cluster, Biosaimaa, that was set up in 2011. According to the vision of the business development plan, by 2020 South Savo will be the most important producer of processed forest energy products and a nationally recognised forest energy technology developer and user. In addition to identifying the strengths and weaknesses of the South Savo bioenergy sector, the plan also analyses the competing sectors in central Finland and North Karelia, taking a look at the education in those regions as well as the R&D activities and actors, business activities and firms and clusters and associations and other important factors (Miktech, 2012a).

The Eastern Finland Bioenergy Programme 2020 was drawn up in collaboration between all regions in Eastern Finland (South Savo, North Savo, Kainuu, South Karelia and North Karelia). It aims at realising national and regional climate and energy targets and profiles Eastern Finland as a bioenergy pioneer that has both the necessary raw material from forests and a high level of competence in bioenergy and machine building. The bioenergy programme emphasises the positive consequences that the development of bioenergy can have on the regional economy and employment. The focus is on forest energy with different targets related to

e.g. the use of wood pellets but solar energy and biogas are also discussed (Regional Council of North Karelia, 2011).

At the moment, the Regional Council of South Savo is also engaged in setting up a Savo climate programme in cooperation with the Regional Council of North Savo and the Centre for Economic Development, Transport and the Environment in Savo. The programme will be published in 2013 and it aims at bringing the national climate targets to regional level. Energy production is one of the aspects that will be taken into consideration in the programme alongside e.g. natural resources, eco-efficiency and lifestyle (Ministry of Environment, 2012).

The Operational Programme for the European Regional Development Fund for Eastern Finland wants the region to become "a globally competitive environment for knowledge, business and living and its proximity to Russia will be a strength". Within the bioenergy sector, the ERDF programme particularly funds projects aiming at setting up bigger energy facilities, projects related to extensive technology ventures and preparation of comprehensive action plans. Bioenergy is largely funded through Axis 2: Promotion of innovation and networking and strengthening of knowledge structures (Ministry of Employment and the Economy, 2008).

Bioenergy in municipal strategies

Bioenergy became a strategic spearhead in the City

of Mikkeli in 2011. It had been included in different strategies previously, but in 2011 it was chosen as one of the most central development areas. The general strategy of Mikkeli from 2009 (City of Mikkeli, 2009) promotes the city of Mikkeli as the strong centre of the South Savo region where enterprises, education institutes, and research institutes work tightly together with the municipality to reach common goals.

The business activities in the city are described in more detail in the Vitality and Competitiveness Strategy of Mikkeli (2011). It guides the development of the business life and environment in the city. The strategy identifies the "spearheads of know-how" in the region and bioenergy was chosen as one of Mikkeli's competitive skills alongside services, environmental safety, electronic archiving and tourism. The activities related to the identified spearheads of knowledge are outlined in specific development programmes such as the Bioenergy Business Development Plan. (City of Mikkeli, 2011; Kauranen, interview).

Furthermore, several municipalities in Mikkeli region are at the moment in the process of putting together a shared vitality and competitiveness programme. The municipalities will provide funding within different priority areas that are decided in the programme. Bioenergy is expected to be an important priority area as it is not only of importance for the more central and partly more urbanised City of Mikkeli but also for smaller and more rural and forested municipalities (Kauranen, interview).

Regional-level study: Cluster development

According to the interviewees, the origin of the bioenergy or forest energy sector development in South Savo lies clearly in the vast natural resources of the forests in the region. Forestry has traditionally been one of the most important economic activities but, as noted earlier, only a small amount of wood has been processed in the region and South Savo has largely been seen as a raw material producer in the Finnish industry. Bioenergy activities are seen as a way to move away from the traditional role and increase the amount of processed wood and thereby increase economic profits.

Apart from the available raw materials and the traditional role of forests and forestry in the region, the two energy companies, Etelä-Savon Energia and Suur-Savon Sähkö, have also played a significant part in the birth of the bioenergy sector in South Savo. They started to use wood fuels in the 1990s. Their activities have contributed to the birth of several other companies that are needed to keep up the bioenergy production

of the two bigger companies. In the 1990s the energy foundation Suur-Savon energiasäätiö was established; it provides funding for bioenergy projects, inter alia (Kauranen; Kuva; Muinonen; Ollikainen; Pulliainen; Ranta, interviews; Etelä-Savon Energia, 2012).

Regional councils in their current form were established in the 1990s and from its early days the Regional Council of South Savo emphasised the potential of the vast forest resources of the region. As a clearly defined theme, bioenergy and wood fuels became included in regional strategies from the late 1990s onwards. In the 1990s an energy agency promoting the use of bioenergy was set up in South Savo by the Regional Councils of Eastern Finland as a cooperation project with ERDF funding. The agency provided guidance to municipalities and larger companies who were interested in bioenergy and, according to interviewees, the inter-regional cooperation agency succeeded very well, many municipalities and power

plants starting to use bioenergy in the 1990s and 2000s. In the early 2000s there were also projects on bioenergy research and development. They were however not well coordinated and they were simpler and less knowledge-intensive than later projects. The earlier projects were mostly concentrating on mapping the potential of forest energy and finding out where suitable energy wood could be found (Kauranen; Kuva; Muinonen; Ollikainen; Pulliainen, interviews).

In 2002, the Regional Council applied for a position in the national Centre of Expertise Programme and, in 2003, the technology and innovation centre Miktech started to function as the Mikkeli Centre of Expertise. The Centre of Expertise Programme is a fixed-term special programme coordinated by the Ministry of Employment and the Economy in compliance with the Act on Regional Development. It is based on national cross-regional clusters operating on a bottom-up principle whereby regional actors initiated cooperation with other regions and sent proposals for clusters to the Ministry of Employment and Economy which then chose the most suitable cluster initiatives based on their potential (Centre of Expertise Programme, 2010; Kutinlahti; Kuva; Muinonen; Ollikainen, interviews).

The programme is meant to function as a tool for combining high-level research with technological, design and business competences. It offers operational models and networks as well as services for enterprises, universities, universities of applied sciences and research institutions. It is important to note that the programme is not a funding instrument but a political instrument promoting networking of various actors with a special focus on SMEs. Its mission is to combine the know-how of enterprises and the research sector in order to create new innovations that can be turned into profitable businesses. Overall, the programme has succeeded in promoting cross-regional cooperation and integrating resources and it has been especially profitable for smaller regions and cities. According to Kutinlahti from the Ministry of Employment and the Economy, smaller actors have been able to benefit from cooperating with stronger actors but the importance of the programme for bigger cities has been decreasing since the 1990s. The significance of the Centres of Expertise has been relatively small for bigger cities and stronger regions that have other resources and measures to support innovation as well as possibilities to participate in international networks. In some cases the development of a bigger city with strong resources in a cluster may even have been slowed down by its participation in the cluster activities with regions with fewer resources (Centre of Expertise Programme, 2010; Kutinlahti, interview; Ministry of Employment and the Economy, 2012c).

Even though the membership of the Centres of

Expertise Programme was important in terms of the innovation activities in the region, there was at first no focus on bioenergy and Miktech as the Mikkeli Centre of Expertise worked with material and composite technology and intelligent wood structures. The Mikkeli Centre of Expertise has been participating in the Forest Industry Future cluster, whose mission is to combine the know-how of companies and research institutes to create product, material, service and production innovations which in turn produce profitable business. Other regions participating in the cluster are North Karelia, Kokkola sub-region, south-east Finland and Oulu and Jyväskylä sub-regions. According to the interviewees, however, the cluster has not been very successful, especially when it comes to cross-regional cooperation. The projects within the cluster have mostly been regional and local and development has been slow. The challenges of the cluster can be seen as partly dependent on the conservative nature of the forest sector (Forest Industry Future, 2012; Centre of Expertise Programme, 2010; Kutinlahti, interview).

A bigger leap towards more systematically developed bioenergy in South Savo was taken in early 2011 when the City of Mikkeli chose bioenergy as one of five strategic areas to specialise in. In line with the new municipal strategy the bioenergy sector in South Savo was to be developed more systematically and a specific development plan for bioenergy was to be drawn up. At the same time, on the basis of the evaluations conducted in 2010, the Forest Industry Future cluster in the Centre of Expertise Programme was reorganised and the cluster decided to start a new biocomposite and bioenergy competence area. Miktech as the Mikkeli Centre of Expertise became a member of the new competence area and the focus of its activities in the Forest Industry Future cluster shifted from wood structures to bioenergy. As Miktech's role is to implement the goals of the City of Mikkeli in relation to technology and innovation in practice, it started to develop the bioenergy business development plan initiated by the city. Fifty-one per cent of Miktech is owned by the City of Mikkeli, which provides Miktech with annual funding of approximately 150 000 €. It has 17 employees and an annual turnover of 2.5 million euros (Muinonen, interview).

When the focus of the Centre of Expertise Programme was shifted to bioenergy, there were already many companies in the bioenergy sector in the region and the number of projects and firms participating in Centre of Expertise activities increased notably. Several companies that had been involved in Miktech's activities in the Centre of Expertise Programmes or other projects were interested in participating in bioenergy activities. The Mikkeli Centre of Expertise within the Forest Industry Future cluster receives 50% of its

funding from the Finnish Ministry of Employment and the Economy, 32% from the City of Mikkeli and the Mikkeli sub-region municipalities, 6% from the Regional Council of South Savo (from national-level regional development funds) and 12% from the energy foundation Suur-Savon energiasäätiö. The specific projects of the cluster members relating to bioenergy development are largely funded by EU Structural Funds and TEKES - the Finnish Funding Agency for Technology and Innovation (Kuva; Muinonen; Ollikainen, interviews).

Establishing the Biosaimaa cluster organisation

In 2011, Miktech started to build up a forest energy cluster known as Biosaimaa, an instrument for implementing all bioenergy-related actions and the Centre of Expertise Programme in bioenergy in South Savo. The mission of the cluster organisation is to increase the use of South Savo forest resources in a way that is profitable and economically, ecologically and socially sustainable by all actors in the value chain. The aim is to increase the business activities of the bioenergy firms, increase the use of forest biomass and its processing in the region and brand the region as an expert in forest energy. In general, the cluster and the activities undertaken within its framework are closely related to the main challenges and weaknesses of the bioenergy sector identified by Miktech, such as the low amount of raw material processed in the region, the few international activities and the need to make the production chain more efficient from harvesting to logistics and processing in order to decrease dependence on national subsidy schemes. The cluster is also seen as a good way to communicate and brand the bioenergy sector in South Savo more visibly. The interviews suggest that the Centre of Expertise Programme is unknown to many firms even though it has been active in the region for ten years. The Biosaimaa cluster is a tool to make the Centre of Expertise activities more visible (Muinonen, interview).

The Biosaimaa cluster activities are run with funding received for the Centre of Expertise activities but it also received additional funding of 25 000 € from the City of Mikkeli to commence its activities and benefits from an annual grant of 40 000 € from the energy foundation Suur-Savon energiasäätiö. In the future, membership fees will be charged. Within the cluster, the aim is to find new synergies and innovations via competition, interaction and specialisation across business sector boundaries. The member companies of the cluster cooperate in working groups on different themes related to the strategic priorities of the cluster. The concrete activities within the priority areas include

e.g. developing R&D projects and searching for funding and partners, systematic development of SMEs, arranging workshops, promoting the establishment of new bioprocessing facilities, promoting the establishment of a new bioenergy logistics centre in Ristiina, developing a communications plan and making the cluster more visible in the media as well as increasing the utilisation of theses from the education institutes of the region and thereby intensifying the cooperation between firms and higher education institutes (Miktech, 2012a; Muinonen, interview).

At the moment, the cluster organisation has 12 member companies including the two main energy companies in the region as well as several small and medium-sized firms working with different parts of the bioenergy production chain. The firms participating in the Biosaimaa cluster are from various economic sectors. Some of them are clearly bioenergy companies but many are looking to bioenergy to expand their activities and get new support for their business from the bioenergy sector. The firms might have their main activities in other sectors but are interested in the possibilities of applying their innovations or technology to bioenergy production. In 2011 a new firm on heat treatment of wood was established and it is expected that several new biocoal firms will be set up in the region. The research and education members of the cluster include LUT Savo, Aalto University School of Small Businesses, South Savo Vocational College, Ruralia Institute, Mikkeli University of Applied Sciences, Forest Centre South Savo, Forest Owner Association, Savo Forest Management Association and MIT Agrifood Research Mikkeli. According to the interviewees, so far LUT Savo is the institute that has been most actively involved in bioenergy development work in practice.

The steering group of the cluster consists of some of the firm and research institute cluster members but also has representatives from the City of Mikkeli, the Regional Council and the Centre for Economic Development, Transport and the Environment. The interviews suggest that the municipality, the Regional Council and the centre participate mostly in bioenergy development as funding providers and monitor how the money is used.

It is seen as important to have a shared policy between different regional actors when it comes to negotiating with different ministries on national level and to assure the ministries of a shared regional state of will. Biosaimaa functions as a focal point in the middle of all the bioenergy activities and now that the Regional Council is drafting its new development strategy it makes sure that the strategy is in line with the targets of the bioenergy business development plan and the cluster (Miktech 2012a; Kauranen; Kuva; Muinonen; Ollikainen; Pulliainen; Ranta, interviews).

By summer 2012, most of the actual projects within the Biosaimaa cluster organisation were still in their early stages. Compared with the bioenergy-related projects of ten years ago, the projects now are more knowledge-intensive, advanced and require higher competences, and special focus is on projects related to bioenergy logistics. The most significant results of the Centre of Expertise activities in bioenergy are the bioenergy business development plan and the Biosaimaa cluster. The more concrete projects related to the Biosaimaa initiative include the setting up of a biolistics centre in 2013 and an associated biocoal plant fully operative from 2015. A pilot project on heat treatment will take place in the premises of the energy company Etelä-Savon Sähkö in autumn 2012. In August 2012, the two Biosaimaa member energy companies Etelä-Savon Energia and Suur-Savon Sähkö also made decisions to increase their use of wood fuels. Etelä-Savon Energia will open a new power plant with 100% wood fuels and reduce its use of peat by half and Suur-Savon Sähkö will build a new bio-heating plant utilising local wood chips and wood residue (Kauranen; Kuva; Muinonen; Ollikainen; Pulliainen; Ranta, interviews; Etelä-Savon Energia, 2012; Suur-Savon Sähkö, 2012).

Public policy implications and bioenergy development in South Savo post-2013

As regards the R&D projects in bioenergy, the EU Structural Funds (allocated by the Regional Council, the Centre for Economic Development, Transport and the Environment and TEKES) and funding from the energy foundation Suur-Savon energiasäätiö have been pivotal. Almost all of the bioenergy-related projects have received money from Structural Funds and the energy foundation, which both have clear regional connections. The bioenergy professorship and several R&D projects that have been considered very important for bioenergy development have been funded by ERDF and the energy foundation. Under Axis 2 (promotion of innovation and networking and strengthening of knowledge structures) of the Eastern Finland ERDF programme, approximately 1.2 million euros is allocated to bioenergy research and development. The energy foundation Suur-Savon energiasäätiö allocates approximately 1 million euros annually to bioenergy research and development projects and investments. It was highlighted in the interviews that without Structural Funds and funding from the energy foundation, the bioenergy sector in South Savo would not have developed to the extent it has. Regional development funds from the national level have further importance for networking and general development of the bioenergy sector.

Several actors in the region are concerned about

the expected decrease in both national-level regional development funds and concern about what kind of funding the region will receive after 2013. As a small region with limited resources it is difficult for South Savo to compete for funding from larger EU and national programmes and it needs considerable support from both the EU Structural Funds and the national regional development funds. Miktech and LUT Savo have been researching and applying to other EU projects and programmes but without success. In addition, it is also possible that projects with direct national and EU funding would not have clear regional effects and implications as their funding terms may not require regional effects. This could slow down the bioenergy development in the region. Tapio Ranta further notes that the opportunity for LUT Savo to be located in Mikkeli is very dependent on Structural Funds. It has been strategically valuable for Lappeenranta University of Technology to keep the unit in South Savo where it can more easily be run with the support of Structural Funds while at the same time not competing with other units of the university in Lappeenranta for the funding available in that region (Kauranen; Kuva; Muinonen; Ollikainen; Pulliainen; Ranta, interviews).

For SMEs in bioenergy, the funding and policy initiatives from TEKES (the Finnish Funding Agency for Technology and Innovation) are pivotal. SMEs in the region contact the Centre for Economic Development, Transport and the Environment in South Savo to get in touch with TEKES and three technology experts represent TEKES at the Centre, providing advisory services to technology companies applying for money. As technology firms in South Savo are usually small, however, it is often challenging for them to come up with the 50% of the funding which is required in order to qualify for help from TEKES. The interviews suggest that TEKES funding has been relatively low in the region whereas the number of patents has been relatively high in comparison (Kauranen; Laitinen; Muinonen; Pulliainen; Ranta, interviews).

The expected change in Finnish innovation policy after 2013 is an important factor influencing the bioenergy development in South Savo and also one of the background factors behind the decision to establish a bioenergy cluster in South Savo to implement the Centre of Expertise Programme and promote bioenergy. The Centre of Expertise Programme will end at the end of 2013 and will not be continued. A representative from the Ministry of Employment and the Economy stated that the Centre of Expertise Programme will be replaced by an “innovative cities programme” and a “competence and innovation networks programme”. Both of the programmes are still under construction but the aim is to build stronger innovation centres in bigger cities and decrease the number of innovation

centres and clusters across the country (Kutinlahti; Muinonen, interviews).

Current innovation measures and activities of the Centre of Expertise Programme have been beneficial to smaller regions but their importance for stronger regions has arguably been decreasing since the 1990s. In the new innovative cities programme, the aim is to build stronger and more influential entities based on a bottom-up principle whereby regions can come up with cluster suggestions or proposals after which the most internationally competitive Finnish regions will be included in the programme. The programme aims at supporting “smart specialisation” and promotes collecting the RD&I resources to the nationally most significant themes and projects instead of having several smaller clusters. It is of special importance for the programme that the chosen activities are based on market demand or demand based on big societal challenges.

Smaller regions will not be able to participate in the new innovative cities programme directly but, within a new network implemented with Structural Funds, they can participate in specific activities within the programme and cooperate with the bigger cities. Structural Funds will be used to promote networking between the innovation centres in the innovation cities programme and other regions in order to spread knowledge and develop innovation activities, *inter alia*. The definition of innovation will be broad in the network and the aim is to be flexible and leave space for new ideas. By September 2012 there was still no public document available describing the more detailed goals of the initiative (Kutinlahti, interview; Ministry of Employment and the Economy, 2012c).

The regional actors in South Savo consider the Biosaimaa cluster organisation as an effective way to strengthen the bioenergy sector and create a shared determination to improve the chance of South Savo’s forest energy sector getting a position in the innovation system after 2013. The cluster helps to promote South Savo as a bioenergy region and to make the forest energy activities more visible. The interviewees expect that if the region is able to display a functioning bioenergy development programme, a cluster and some likely concrete results, it is more likely to be taken on board and given some kind of role in some of the new larger innovation centres post-2013 (Kauranen; Muinonen, interviews).

Miktech and the Biosaimaa cluster organisation are also preparing for the end of the Centres of Expertise Programme by starting cooperation with other Centres of Expertise in Savonlinna and Varkaus (both within 100 kilometres of Mikkeli). The idea is that the bioenergy activities in Mikkeli, Savonlinna and Varkaus could complement each other and form a stronger entity to apply for a place in a future bio-economy innovation concentration that according to the interviewees is expected to be located in a larger city such as Jyväskylä or Joensuu. The clusters in Mikkeli, Savonlinna and Varkaus are small on their own but cooperation in building a functioning entity is expected to help them to get a position in the new post-2013 innovation system. The actual content of the cooperation between the centres is still unclear and negotiations were still on-going between the cities of Mikkeli, Savonlinna and Varkaus in summer 2012 (Muinonen, interview).

Firm-level case study: Applying composite technology to bioenergy

A firm-level case study was carried out in order to illustrate the implications of different policy initiatives at the firm level. Like several other companies in the bioenergy sector in South Savo, the Fibrocom firm did not take its point of departure in the bioenergy sector, but is now striving to use its product in the bioenergy field. The firm has been involved in ERDF-funded projects in cooperation with higher education institutes and participated in the activities of Miktech and the Centres of Expertise Programme for a longer period of time. In this case study we aim at following the development of Fibrocom towards a product that can be utilised in the bioenergy sector nationally and internationally, and look into the background factors

facilitating and hindering Fibrocom’s involvement in bioenergy development.

Fibrocom was founded in 1993 by its CEO, Mauri Laitinen. Fibrocom has 11 employees and an annual turnover of approximately 2 million euros. Mauri Laitinen has a degree in material technology from the Tampere University of Technology and has worked in composite technology. He founded Fibrocom to work on the channel composite technology which he had developed while working at his previous firm. All of Laitinen’s and Fibrocom’s business activities are based on the channel composite developed by Laitinen in the late 1980s and early 1990s. Channel composite is a new kind of composite that can be used in e.g. containers

and trains. It has a seamless structure and better weather and corrosion resistance than the traditional plywood structure. The composite is light but resistant and from the 1990s onwards Fibrocom has been applying the composite in various transport vehicle projects. It has for example provided protective covers for use in Pendoline Sm3 trains in Finland. Fibrocom has also been participating in various composite projects with funding from TEKES and it has been a partner in an international project funded by the European Commission.

As regards its activities in the material technology sector, the Mikkeli University of Applied Sciences has been a significant cooperation partner of Fibrocom and Fibrocom has commissioned the institute and its students to do smaller studies and research projects. In relation to bioenergy, the role of the LUT Savo Unit is more central. In the region there is no education directly related to Fibrocom's activities. According to Laitinen, it can become a challenge in the future to find employees with right competences to develop and market Fibrocom's products. In addition to engineers, Fibrocom is expected to need employees with an understanding of business and marketing combined with an understanding of the sector and Fibrocom's technology.

Fibrocom has been working towards increased internationalisation. It has been a supplier of big international companies but internationalisation has mostly taken place at Fibrocom's own initiative without further assistance from policy initiatives or public funding. Fibrocom has been actively looking for cooperation possibilities in Finland in relation to internationalisation but few have been found. It has not been able to find suitable exporting and internationalisation instruments either. It is difficult for a small firm to establish cooperation with big companies and function as their supplier.

In the early 2000s, Fibrocom took part in activities related to the material technology focus area of the Centre of expertise Programme in Mikkeli. When the focus shifted from composites to bioenergy, it was natural for Fibrocom to become part of the Biosaimaa cluster as the firm wishes to apply its composite technology to bioenergy. The firm has become part of a group of companies working with harvesting and wood-chip drying, inter alia. Fibrocom sees the cluster and the firm group as a possibility to find synergies and build bigger bioenergy entities (from harvesting to processing) that could be exported. Biosaimaa could constitute suitable support for the internationalisation activities that Fibrocom has lacked so far. For Fibrocom, the most important outcome of the Biosaimaa cluster would be concrete projects with other firms. By summer 2012, the firm group that Fibrocom belongs to within

the cluster had had a few meetings but no concrete activities had yet taken place (Laitinen, interview).

Towards channel composite containers for forest energy

Fibrocom's channel composite product was not initially designed with bioenergy in mind but it is possible to utilise the technology in different ways in bioenergy. Fibrocom's first contact with the bioenergy sector came in the early 2000s when the company tested the channel composite on wind-power stations. It participated in three projects related to wind power. With assistance from different business and innovation support organisations and in cooperation with higher education institutions, among others, the possibilities of applying Fibrocom's technology to build wing constructions for wind-power mills were studied. Even though it was found that the composite technology would be suitable, no cooperation partners could be found in Finland and Fibrocom was not able to apply its channel composite technology to wind-power mills in practice.

In 2003, Fibrocom was contacted by VTT Technical Research Centre of Finland with whom the bioenergy company VAPO was studying possibilities to reduce the weight of peat and wood-chip transport vehicles. VTT had known about the channel composite technology developed by Fibrocom and was aware of its potential application to railroad transports. In 2003, calculations were conducted showing that the weight of peat and wood-chip transport vehicles could be significantly reduced by the use of channel composite containers. In 2004, the first prototypes for bioenergy transports were built and in 2005 the technology was tested. From 2005 onwards, channel composite containers were manufactured for customers. The development work by Fibrocom was conducted at its own cost but the firm received funding of approximately 20-30 000 € from the Ministry of Employment and the Economy for a small development project related to pouring of the wood chip or peat from the vehicles.

As bioenergy shifted more and more into the focus of national and regional policy and new biofuel and biodiesel power plants were expected to increase the demand for wood and wood chip, Fibrocom decided to develop its bioenergy container solution. The earlier solution was only applicable to lorry transportation as the containers were built in. The built-in container solution was too inflexible for long-distance transport if the material had to be moved from lorries to trains and ships. In order to maximise the capacity and the imposed load, development of a new transferrable container was initiated. The aim was to build lightweight containers that could be used like any traditional containers and transported easily by rail and sea. The new solution is

a significant advance in transporting forest energy. It has high potential as transport expenses of bioenergy products make up 20 to 50% of the total product price and logistics is the only part of the production chain where expenses could still be notably decreased.

During the autumn of 2009, Fibrocom started to contact firms in the forest industry to find out if there was any interest in such a solution. Several influential companies were interested because the new container could be economically profitable for them. In early 2010, Fibrocom contacted TEKES, which financed a pre-study. Fibrocom used LUT Savo as an external consultant to do the required calculations. It was found that the new logistical solution could reduce transport expenses by 10%, a notable reduction.

After the pre-project phase the aim was to demonstrate and test the new container solution and to do research on its competitiveness and the logistic chain, inter alia. The aim was to plan, construct, test and study containers but when Fibrocom applied for funding from TEKES, it was informed that TEKES would not be able to fund the manufacturing of the test containers as its funding terms did not cover manufacture. This was a major complication since it was not possible to study the containers without producing the containers first. Later Fibrocom applied for money from the energy foundation Suur-Savon energiasäätiö but was only granted one-third of the required sum. With a loan from TEKES and funding from the foundation, however, work could start.

The development project also includes a research element for which LUT Savo is responsible. It is funded by TEKES and ERDF and by the several companies who are included in the firm consortium and participate in it by e.g. testing the product (including VR, UPM, Stora Enso, Fortum, and several smaller energy and logistics companies). The container project is on-going until 2013. By summer 2012, three containers had been built and tested and LUT Savo had made comparisons with traditional container technology. Laitinen averred, however, that the long decision-making process of

TEKES and the lack of funding from the foundation had affected the schedule and the scope of the development (Laitinen, interview).

Implications – innovation and policy

As stated earlier, Fibrocom's product was not originally developed for use in the bioenergy sector but as bioenergy became a regional and national focus area the company started to consider the product's application to the sector. At first the firm tried to apply the composite technology to wind-power mills but the lack of cooperation partners meant the project was put on ice. Later on Fibrocom was contacted by the national technical research centre VTT and started the development process towards producing lightweight channel composite containers for use in the bioenergy production chain to reduce logistic costs. The application of its product in a new sector can be seen as an incremental product innovation, as it involves adjusting an existing product for use in a different sector as part of a product different from that originally intended.

Whereas regional and national policies and legislation have provided new business opportunities for Fibrocom as the need for bioenergy logistic solutions has increased, the availability of funding has been a significant challenge for the development of the firm and the success of its projects. It was further emphasised by Laitinen that there is no one-stop shop to coordinate all the available funding. Especially since Fibrocom is not explicitly a bioenergy company and has traditionally worked with material technology and composites, it is difficult for it to get access to information on funding opportunities in the bioenergy sector. Furthermore, more long-term funding will be needed since product development usually takes longer than expected. Long-term projects eat up the resources of small companies and if the development activities do not instantly create profitable business the economic losses can be crippling for small enterprises.

Conclusions and Policy Framework

Main drivers for development of the bioenergy sector

The region of South Savo has vast forest resources and forestry has traditionally been an important sector in the region. Within the forest sector, the region has mainly been producing raw material to be processed elsewhere. The background of the bioenergy sector in South Savo

is strongly linked with the biomass-producing potential of the forests and the role that forestry has in the region. The logistical position of the region is also seen as its strength in relation to bioenergy and it is one of the reasons why the region has seen potential in producing

wood fuels.

Even though the drivers behind the focus on the bioenergy sector have been linked with available natural resources rather than existing competences, the two municipally owned energy companies Etelä-Savon Energia and Suur-Savon Sähkö have been important in terms of systematically coordinated bioenergy development. A carbon dioxide tax system favouring the use of wood, wind energy and waste fuel was established on a national level in Finland in 1990 and in the 1990s the energy companies also started to favour wood fuels in their power plants. A bioenergy production chain from forests to power plants was established following earlier activities in the field, and several companies were established to support the chain. Without the two forerunner companies' use of wood fuels, it would not have been possible to build a network of enterprises active in different parts of the production chain. At the same time, the trend of national policy to promote renewable energy had a role in facilitating the companies' use of wood fuels. Furthermore, the energy foundation Suur-Savon energiasäätiö has been a significant actor, providing funding to almost all bioenergy development projects in South Savo.

National-level policy

The interviews suggest that the policy initiatives and funding of the Ministry of Employment and the Economy and TEKES are the most important national-level initiatives supporting the bioenergy development in South Savo. The national-level regional development fund has been of significance for the region and the bioenergy sector. Funding by TEKES is especially important for SME development even though the enterprises have to come up with half of the project funding independently.

The Centre of Expertise Programme coordinated by the Ministry of Employment and the Economy has been significant for the development of SMEs and innovation in the region of South Savo. According to evaluations, the programme has made it possible for small peripheral regions to cooperate with stronger regions and has proved to be profitable in smaller regions with relatively low resources. It has not been equally beneficial for stronger regions. Consequently, the Ministry of Employment and the Economy decided to end the programme after 2013 and start a new programme on innovative cities with fewer but stronger innovation centres.

According to the interviews, it may be challenging for a region of South Savo's type to find its place in the post-2013 innovation system with fewer clusters of

stronger member cities. It will be possible for smaller regions to cooperate with the clusters of the innovative cities programme but they cannot become actual cluster members. In September 2012, it was still unclear how the South Savo bioenergy sector will in practice be able to participate in the activities of the new clusters and how the bioenergy development in South Savo and the new Biosaimaa cluster will be influenced by the changes in the national innovation policy.

It is also unclear to regional actors what kind of funding they will receive on the national level in the future. A decrease is expected in national regional development funds and it is unclear how it will influence development and activities.

In relation to bioenergy production in general, the importance of different national support schemes is significant. At the same time, the dependence on support schemes of the bioenergy sector in Finland in general is also seen as problematic. In terms of the case study, it is essential to make sure that the support schemes can support the production of energy from Finnish forests. The low prices of emission rights have made it more profitable for bigger cities to use coal instead of bioenergy and therefore it is expected that a functioning support model will be needed to steer firms away from using coal towards using biocoal. Furthermore, the case study suggests that jointly owned forests or collective forests should be more actively promoted on the national level in order to facilitate the building of larger coherent forest areas and make sure that wood is available. Low availability of wood caused by split forest ownership can be a significant challenge, especially to smaller municipalities strongly dependent on forest industry, and it may even have strong effects on regional economy.

In relation to SMEs, the changing national support schemes and fluctuating taxation are factors posing challenges to firms. When long-term investments in e.g. harvesting machines are made, entrepreneurs may feel insecure about whether the support systems in relation to energy or forestry will change in the short term. Changing tax levels create further insecurity that can prevent entrepreneurs from making investments in bioenergy-related businesses. On the firm level, the availability of suitable long-term funding is also a significant challenge. Extensive development projects require significant amounts of time and resources and small firms would need long-term support in order to be able to engage in innovative development processes.

Regional-level policy

In South Savo, the local and regional actors have been able to integrate bioenergy in relevant policies and strategies in an integrated way. In the interviews, it was

noted that as South Savo is a small region, the number of people working with regional development is relatively low, which has contributed to the creation of a common determination when it comes to developing bioenergy. In strategies, bioenergy and especially development of wood-fuel production is seen as a way to move away from the traditional role of the region as a raw material producer and increase the profits of the forest industry. In the long-term and medium-term regional development strategies of South Savo, there is a focus on institutionalising research and innovation structures and on the forest sector and its on-going changes (including forest energy). Furthermore, as the City of Mikkeli chose bioenergy as one of its strategic focuses in 2011 and the focus of the Mikkeli Centre of Expertise was shifted to bioenergy, a new specific bioenergy business plan for South Savo was drawn up.

Wood-fuel production should have the potential to become an increasingly important source of income in the region. It is apparent from the strategies that bioenergy can contribute to a heightened competence profile and an increased number of high-competence jobs. Increasing bioenergy production is therefore expected to attract better-qualified employees to the region. Thereby bioenergy may be able to contribute to changing the negative demographic development that the peripheral region of South Savo has been experiencing.

In addition to including bioenergy as an overarching theme in regional strategies, the region has been actively initiating cooperation with other Eastern Finnish regions in order to avoid competition and to facilitate synergies. The actual implementation of the new Eastern Finland Bioenergy Programme was still in its early stages in summer 2012 but it is seen as a way for the Eastern Finnish regions to specialise and cooperate in the field of forest energy.

On the regional level, the Regional Council of South Savo and the Centre for Economic Development, Transport and the Environment allocate funding to bioenergy development from national sources and from the EU Structural Funds. The latter are of crucial importance for the development of the bioenergy sector in South Savo. The funding terms of the Structural Funds are better suited to a small region with low resources than are the terms of national or direct EU funding. Furthermore as a small region, it is very challenging for South Savo to compete with stronger regions for national funding or for a position in EU programmes and makes funding from the Structural Funds essential. The EU Structural Funds are also important for maintaining the research infrastructure of the Lappeenranta University of Technology in Savo. The availability of EU Structural Funds in South Savo has also been one of the reasons for the Lappeenranta

University of Technology's decision to have a research unit in Savo.

In relation to the EU Structural Funds and the South Savo research infrastructure, the bioenergy professorship funded by Structural Funds has been significant. Firms in the region have been able to get the necessary support for their development work from the research unit of LUT Savo and the bioenergy professorship. For example, the case study firm Fibrocom has been cooperating with LUT Savo and the bioenergy professor in developing its composite container for forest energy use. LUT Savo had an important role in the early stages of the project as the unit was commissioned by Fibrocom to do a pre-study on the profitability of the solution. As it was discovered that the new solution would be profitable and capable of considerably reducing logistic costs, LUT Savo applied to TEKES for funding for a research project related to the container solution. LUT Savo has also been presenting the project at bioenergy fairs in Finland and Sweden, making it more visible, which might be a challenging task for a small company to do on its own. The example of Fibrocom's development project is an illustrative one showing how the support of the research institute has been important for the development of the firm and its product. SMEs often need support from the research unit in the phase when they are testing their product's applicability to the bioenergy sector and this is a demand that LUT Savo has been able to respond to. LUT Savo has also been supporting bigger companies who have considered its support to be highly useful; for example, when new procedures for securing the availability of fuels for power plants are to be studied and devised.

The interviews suggest that the expected decrease in the national-level regional development funds in combination with the changing Finnish innovation policy could present a significant challenge to the future development of the forest energy sector in South Savo. Actors in South Savo's bioenergy sector will have to apply for more funding from national and direct EU sources, very challenging for a small region like South Savo. Furthermore the regional effects of the projects which obtain national and EU funding can be expected to be less clear and less significant as the funding terms do not require the projects to have clear regional implications.

Local-level policy

On the municipal level, bioenergy was chosen as one of the critical success factors of the City of Mikkeli in 2011. The role of the municipality is important in funding bioenergy development by providing basic funding to the innovation and technology centre Miktech and

funding its activities within the Forest Industry Future cluster in the Centres of Expertise Programme.

In summer 2012, the municipality was also working on a common competitiveness and vitality programme with other municipalities in the Mikkeli sub-region. Bioenergy was expected to be one of the themes of the programme, which will be used to allocate funding to bioenergy development in a coordinated way between the neighbouring municipalities.

Unique to South Savo's bioenergy sector is the role of the energy foundation Suur-Savon energiasäätiö. The interviews suggest that without the foundation the small peripheral region of South Savo would not have been able to develop its bioenergy sector as extensively as it has. The foundation has also had an important role in bringing together the various bioenergy actors and functioning as a forum for discussion between actors.

References

- Almi (2012) Available from: <http://www.almi.se/ALMI-in-English/>
- Arnold, M. Koivunen, K. Mroueh, U-M.Paulsrud, B. Rusten, B. (2008) NOWATECH – Innovative Nordic Water Technologies – Technology Review, Research Report, No, VTT-R-04158-08.
- Centre for Economic Development, Transport and the Environment, South Savo (2011) Etelä-Savon materiaalitase. Centre for Economic Development, Transport and the Environment, South Savo, Mikkeli.
- Centre of expertise Programme (2010) Osaamiskeskusohjelman tarkistaminen ja suuntaviivat vuosille 2011-2013. The Ministry of Employment and the Economy, Helsinki.
- City of Mikkeli (2009) Mikkelin kaupungin strategia. City of Mikkeli, Mikkeli.
- City of Mikkeli (2011) Vitality and competitiveness strategy. City of Mikkeli, Mikkeli.
- City of Mikkeli (2012) Mikkeli-tieto. Available from: http://www.mikkeli.fi/fi/sisalto/03_mikkeli_tieto/01_perustiedot/
- Dahlström, M., Hedin, S., Olsen, L.S. (2010) Knowledge dynamics in moving media in Skåne – cross-sectoral innovations in game development and film tourism, Nordregio report 2010:1, Nordregio, Stockholm.
- Etelä-Savon Energia (2012) ESE vähentää turpeen käytön puoleen. Newsletter. Available from: http://www.esefi.fi/ESE_vahentaa_turpeen_kayton_puoleen.
- Finnish Forestry Centre (2011) Etelä-Savon metsäohjelma 2012-2015. Helsinki, Finland.
- FIRS (Skåne Research and Innovation Council) & SIS (Sounding Board for Innovation in Skåne) (2011a) Skåne – Europe's most innovative region in 2020. An International Innovation Strategy for Skåne 2012-2020, Region Skåne, Malmö, Sweden.
- FIRS (Skåne Research and Innovation Council) & SIS (Sounding Board for Innovation in Skåne) (2011b) Sub-Strategy: From cluster initiatives to the development of open innovation arenas in Skåne, Region Skåne, Malmö, Sweden.
- Forest Industry Future (2012) Available from: <http://www.oske.net/fifcluster/>
- Hiltunen, M. (2004) Economic environmental policy instruments in Finland. Finnish Environmental Institute, Helsinki, Finland.
- Klimatsamverkan(2012) Available from: <http://www.klimatsamverkanskane.se/OmKlimatsamverkan/tabid/404/Default.aspx>
- Lindell, J., Bjerkesjö, P., Hallencreutz, D., Lundequist, K. (2010) Skånes kompetensförsörjning – vilka är morgondagens utmaningar? Näringsliv Skåne, Region Skåne, Malmö.
- Malmö Cleantech City (2012) Available from: <http://www.malmocleantechcity.se/cleantech/company.aspx>
- Mikkeli University of Applied Sciences (2012) Available from: http://www.mamk.fi/tutkimus_ja_kehitys/materiaalit_ja_ymparisto/kaynnissa_olevat_hankkeet
- Miktech (2012b) Available from: <http://www.miktech.fi/>
- Minc (2012) Available from: http://minc.se/about_incubator.aspx?lang=en
- Miktech (2012a) Bioenergialiiketoiminnan kehittämissuunnitelma 2012 [[The Bioenergy Business Development Plan]. Mikkeli, Finland.
- Miktech (2012b) Kilpailu biomassasta kovenee puun uusien käyttömuotojen myötä.
- Ministry of Employment and the Economy (2008) Itä-Suomen EAKR-toimenpideohjelma 2007-2013. Ministry of Employment and the Economy, Helsinki.
- Ministry of Employment and the Economy (2012a) Available from: <http://www.tem.fi/index.phtml?s=2481>
- Ministry of Employment and the Economy (2012b) Hallituksen esitys Eduskunnalle laiksi uusiutuville energialähteillä tuotetun sähkön tuotantotuesta annetun lain muuttamisesta. Ministry of Employment and the Economy, Helsinki.
- Ministry of Employment and the Economy (2012c) INKA – Innovatiiviset kaupungit ohjelma 2014-2020. Työryhmän esitys uudeksi innovaatiopolitiiseksi ohjelmaksi. Ministry of Employment and the Economy, Helsinki.
- Ministry of the Environment (2012) Savon ilmasto-ohjelma esite. Ministry of the Environment, Helsinki.
- Municipality of Rantasalmi (2012) Suur-Savon Energiasäätiön valtuuskunnan kokoonpano.
- Myllyoja, J. Wessberg, N. Koivunen, K. Könnölä, T (2008) NOWATECH market report – Nordic Water Technology Approach for ETV system, Research Report VTT. Research Report NOWATECH, VTT Technical Research Centre of Finland, VTT.
- Näringsliv Skåne (2009) Skåne's Innovation Capacity – A Situation Analysis, Region Skåne, Malmö, Sweden.
- Olsen, L.S., Weber, R. (Eds.) (2012) Scoping Green Growth and Innovation in Nordic Regions, Nordregio Working Paper 2012:11. Nordregio, Stockholm.

- Oxford Research (2011) Utvärderingsmodell för skånska klusterinitiativ. En utvärdering av sex skånska klusterinitiativ 2011. Oxford Research.
- Ramböll Management (2010) Ökad konkurrenskraft för miljöteknikföretagen. Sluttuppföljning.
- Regional Council of North Karelia (2011) Itä-Suomi Uusiutu – Itä-Suomen bioenergiaohjelma 2020. Regional Council of North Karelia, Joensuu.
- Regional Council of South Savo (2008) Etelä-Savon koulutuksen ja tutkimuksen strategiset linjaukset 2009-2015. Regional Council of South Savo, Mikkeli.
- Regional Council of South Savo (2009) Uusiutuva Etelä-Savo – Maakuntastrategia. Regional Council of South Savo, Mikkeli.
- Regional Council of South Savo (2010a) Etelä-Savon maakuntaohjelma 2011-2014. Regional Council of South Savo, Mikkeli.
- Regional Council of South Savo (2010b) Etelä-Savon innovaatiostrategia 2010-2015. Regional Council of South Savo, Mikkeli.
- Region Skåne (2009) Regionalt utvecklingsprogram för Skåne 2009–2016. Region Skåne, Malmö.
- Region Skåne (2010) Detta är Skåne: Regionala trender, Konkurrensfördelar, Outnyttjad potential. Region Skåne, Malmö.
- Region Skåne (2011) Territorial Review Skåne, Part 1. Region Skåne, Malmö.
- Region Skåne (2012) Available from: <http://www.skane.se/sv/Skanes-utveckling/Miljo-och-klimat1/Climate/>
- Regional Council of South Savo and the Centre for Economic Development, Transport and the Environment South Savo (2012) Available from: www.esavoennakoi.fi
- Skåne-Blekinge (2007) Regional Strukturfondsprogram för regional konkurrenskraft och sysselsättning i Skåne-Blekinge 2007-2013. Operativt program.
- Sustainable Business Hub (2007) Svensk Modell för Ren Tillväxt – Virtuellt storprojekt/funktionsprojekt för ökad konkurrenskraft, internal document, project description.
- Sustainable Business Hub (2008) Skånska miljöteknikföretag, 12 sep. 2008, internal document, PowerPoint presentation.
- Sustainable Business Hub (2012) Available from: <http://www.sbsub.se/index.php?cat=redaktionellt>
- Swedish Energy Agency (2012) Available from: <http://energimyndigheten.se/sv/>
- Swedish Environmental Protection Agency, Waste Treatment in Sweden (2010) Available from: <http://www.naturvardsverket.se/Documents/publikationer/978-91-620-8416-5.pdf>
- Swedish National Board of Housing, Building and Planning, 2012 Available from: <http://www.hallbarastader.gov.se/Bazment/hallbarastader/sv/delegationen.aspx>
- Swentec (2007) Swentec: Svensk vattenrening för industri världsledande, Tidningen för Miljöproffs, Miljö & utveckling, Vattenrening, 2007-05-10.
- Swentec (2009) Rapport till regeringen maj 2009, Vägen mot en effektiv struktur för svensk miljöteknik. Swentec, Stockholm.
- TEKES (2012) Available from: <http://www.tekes.fi/en/community/SMEs/1151/SMEs/2525>
- VINNOVA (2012a) Available from: <http://www.vinnova.se/sv/Om-VINNOVA/Insatsomraden/Utmaningsdriven-innovation/Utmaningsdriven-innovation/>
- VINNOVA (2012b) Available from: http://www.vinnova.se/vinn_nu

Case study interviews

Skåne

Edelstam, Mikael, CEO, Miljöstrategi AB, and Co-founder/Business Developer, Cleantech Scandinavia, 2012-01-12.

Hallworth, Monica, CEO, Knycer AB, 2012-01-13.

Hjelm, Peter, CEO, Läckby Water AB, 2012-01-11.

Johansson, Per, Business Area Manager, Malmberg Water AB, 2012-01-11.

Kristjansson, Gudmundur, Deputy Director, Business Development Department, Region Skåne, 2011-12-14.

Möllerström, Johan, Managing Director - Malmberg Water AB and Chairman of VARIM, 2012-01-11.

Olsson, Heidi, Communications Officer, Sustainable Business Hub, 2011-12-15.

Pelin, Katarina, Managing Director, Environment Department, Malmö City, 2011-12-15.

Simonsen, Per, Deputy Director and Project Manager, Sustainable Business Hub, 2011-12-15.

Thulin, Peter, Marketing Director, Läckby Water AB, 2012-01-11.

South Savo

Kauranen, Aki, Development Manager, City of Mikkeli, 2012-08-14.

Kutinlahti, Pirjo, coordinator of the Centres of Expertise Programme, the Ministry of Employment and the Economy, 2012-09-21.

Kuva, Jyrki, Manager, Regional Programming, the Regional Council of South Savo, 2012-08-15.

Laitinen, Mauri, CEO, Fibrocom, 2012-08-15.

Muoinen, Mika, Cluster coordinator, Miktech (and the Biosaimaa cluster), 2012-08-14.

Ollikainen, Jukka, Manager, Regional Development, the Regional Council of South Savo, 2012-08-15.

Pulliainen, Juha, Director, Centre for Economic Development, Employment and the Environment, 2012-08-15.

Ranta, Tapio, Professor, Lappeenranta University of Technology, Savo Unit, 2012-08-14.



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