Case Study (BERST region): Central Finland

8/15/2015

Project acronym: BERST
Project full title: "BioEconomy Regional Strategy Toolkit"
Grant agreement no: 613671
1. Introduction

The BERST project explains the bioeconomy development path of a) BERST regions and b) selected Good Practices. Aim is to provide a practical guide and source of inspiration for other regions that wish to develop their bioeconomy potential. Under this analysis:

- **BERST regions** are structured narratives for development pathways of clusters in different bioeconomy sectors in the regions of partners in the BERST project;
- **Good Practices** are examples of regions that contain one or more successful bioeconomy clusters at the mature production stage.

Especially, Good Practices have been analysed in order to:

- understand how the various key assets interacted and performed during the development stages;
- draw a number of lessons for the development of bioeconomy clusters within their respective regions; and
- provide recommendations to other regions and clusters for each key asset and each bioeconomy sector on which issues they have to take into account in order to establish, develop and successfully operate similar clusters.
1.1 Bioeconomy clusters
The bioeconomy can be described in terms of an economy that ‘encompasses the production of renewable biological resources and their conversion into food, feed, bio-based products and bioenergy. In BERST, a bioeconomy cluster is perceived as a geographical concentration of actors in vertical and horizontal relationships aiming to develop the bioeconomy. Bioeconomy clusters have been categorised to allow comparison and better understand synergies and interactions of the various elements involved in the formation of bioregions. BERST recognises eight bioeconomy sectors, namely:
- primary biomass;
- food and feed;
- construction;
- chemicals and polymers;
- pulp and paper;
- textile and clothing;
- energy;
- R&D biotechnology.

Given the broad coverage of sectors within the bioeconomy, bioeconomy clusters might be rather heterogeneous in their specific focus. The development and marketing of bioeconomy products does not differ from other products: the challenge is to introduce competitive bioeconomy products that can be sold in profitable quantities on the basis of its price, quality, and service combination preferred by buyers over that offered by competing products. This implies that in the analysis of the development of the bioeconomy clusters the same three factors play a role as in the case of clusters aiming at the introduction and marketing of televisions or cars: input-output linkages among firms, social capital and institutional thickness.

1.2 Key assets and development paths of bioeconomy clusters
The input-output linkages among firms, social capital and institutional thickness in the cluster are all embodied by actors with varying properties. In the analysis of the development path of a bioeconomy cluster, we assume that the actors of the region, in which the cluster is located, apply a strategy to develop the bioeconomy by transforming biomass into competitive bioeconomy products. Such a transformation process takes time. Hence, our analysis is guided by two starting points:

1. a focus on five key assets of a bioeconomy cluster, as outlined in our conceptual model for the analysis of the strategy of a bioeconomy cluster (Fig. 1). These are:
   a. entrepreneurs: the presence of an entrepreneurial culture with active, innovative, flexible and risk taking entrepreneurs plays a pivotal role in driving clusters towards successful development;
b. **policymakers**: political leaders who are willing to support the development of the bioeconomy by providing governance, institutional structures and financial support;

c. **knowledge institutes**: organizations that provide the technical knowhow and innovation for the development of bioeconomy products;

d. **availability of biomass resources**: a continuous supply of biomass resources of constant quality is critical for the development of bioeconomy products;

e. **competitive bioeconomy products**: commercially viable products, such as chemicals, medicines, food, bioplastics, transport fuels, electricity and heat.

2. a long run time horizon of a bioeconomy cluster, with 3 phases (Fig. 2):

   a. **initial stage and take off**: the bioeconomy is introduced in the regional planning agenda and the policy, socio-economic and R&D landscape for its establishment and operation is created;

   b. **drive to maturity**: the first competitive bioeconomy products are sold at the market. The cluster grows with the setup of new companies, cluster infrastructure (with incubator, training centre etc.) has been established, and the cluster is able to attract both private and public funding

   c. **age of mature production**: the cluster is able to produce competitive bioeconomy products at an extensive scale.

The exact duration of each of these phases differs from cluster to cluster; according to estimates of PwC (2011) the duration of the initial stage and take off is about 5 years, that of the drive to maturity 5-10 years, and that of the age of mature production 10-20 years.

![Conceptual model for the analysis of the strategy of a bioeconomy cluster](image)

**Figure 1** Conceptual model for the analysis of the strategy of a bioeconomy cluster
1.3 Bioeconomy clusters in BERST project

The bioeconomy clusters that are analysed in BERST are distinguished in ‘Good Practices’, i.e. bioeconomy clusters within the age of mature production, and ‘BERST regions’, i.e. bioeconomy clusters in the regions of partners in the BERST project (Table 1).

<table>
<thead>
<tr>
<th>Table 1 Studied bioeconomy clusters in BERST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Good Practices</strong></td>
</tr>
<tr>
<td>Ghent (Belgium)</td>
</tr>
<tr>
<td>North Rhine Westfalia (Germany)</td>
</tr>
<tr>
<td>Toulouse (France)</td>
</tr>
<tr>
<td>Manchester (UK)</td>
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</table>

The bioeconomy clusters in the BERST regions are in varying stages of development, and some of them can also be regarded as Good Practices (Central Finland, lower Bavaria, Biobase Westland and Biobased Delta). Statistical data, literature and interviews with key actors have been used to collect information on the functioning of each bioeconomy cluster. The analyses of the bioeconomy clusters of the Good Practices have provided a number of key findings on the interaction of actors in the cluster. Subsequently, in the analysis of the BERST regions it has been explored to which extent the key findings of the Good Practices also apply for these bioeconomy clusters and which barriers they face in developing the bioeconomy cluster. The analysis in BERST focuses primarily on the Good Practice mature bioeconomy sectors within the study countries, but as the clusters encompass more than one sector, the performance and interactions of key assets is expected to influence them as well.
2. Central Finland (Finland)
Authors: Hannu Koponen (RCCF), Laura Vertainen and Anneli Yimartimo (JAMK); Calliope Panoutsou (Imperial)

Place and date: Jyväskylä and London, May 2015

2.1 Executive summary
Central Finland is very well established in forest based pulp and paper and bioenergy. The three bioeconomy sectors of primary biomass, pulp & paper and energy are considered Good Practices from which other clusters or regions can draw lessons and get recommendations on how to establish, develop and successfully operate similar cluster activities.

The main strengths and opportunities reported were as follows:

- Forest biomass resources are abundant and managed sustainably;
- There are abundant users of biomass resource in the region;
- Road and rail based transportation are good but there is scope to improve with additional investment;
- The sector is well established and human resource is excellent, with substantial numbers of people educated, trained and experienced in the various aspects of bioenergy;
- There are good opportunities to exploit technical, managerial and other know-how from Central Finland in world-wide markets.

Key recommendations for the successful operation of the cluster in the current-drive to maturity stage- as well as the transition to the maturity were drawn from the interviews and categorised as follows.

**Organisation**

- Ensure the role of the cluster coordinator is sustained and reinforced to coordinate the formation of efficient sector policies and bio-economy strategies.
- Support the development of a well-functioning structure of the cluster initiative, by appointing a good cluster manager, developing clear membership arrangements and setting up an appropriate governance structure.
- Enrich services provided to cluster participants, such as training, promotion of sustainability and resource efficiency principles and metrics, networking and cooperation; information dissemination.

**Actors**

- R&D providers have played a central role in the cluster to date. It is recommended that educational programmes are developed further to enhance exchange of creative ideas, increase collaboration with industry, and help further innovation.
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- Perform gap analysis on skills from an industrial perspective and work together to integrate courses and human resources to the particular sectors of interest.

**Biomass supply**

- Improvement of road and rail infrastructure.
- Improve the resource efficient exploitation of wood industry raw material side streams and the integration of wastes in the value chains.

**Competitive biobased products**

- Successful transition from forest and energy products to innovative and competitive biobased products as well as their integration to the market involves engagement of local companies of all sizes, both large and small, and formation of targeted regional targets, accompanied with the appropriate advice for funding.

**Funding**

- Develop a central coordinated structure for investigating funding opportunities from mixed sources; informing/ updating entrepreneurs and R&D actors and providing support for the application procedures.

**Policies and measures**

- Refine strategic priorities and narrow to a set of limited, targeted areas for actions, which should reflect the capabilities of the cluster and strengthen adoption of innovation rates in the bioeconomy sectors.
- Evaluate the efficacy of policies and measures in place (and those used historically) and adjust and tailor taking into account the needs and assets of businesses involved in the cluster, national and international market trends and prospects for future business development.
- Facilitate discussion about the regional cluster’s position in European and global markets, identify opportunities for expertise and technology to be exported and develop outreach strategies.

**2.2 Introduction**

The work presented here provides a structured narrative for the development of the biocluster in central Finland, which may serve as a practical guidance and source of inspiration for other regions that are willing to develop their bioeconomy potential. It is based on analysis of statistical data, literature and interviews with key actors involved in the development of bioeconomy and the biocluster in the region.

The report is structured in three main chapters. Chapter 2 provides an overview of the socio-economic and environmental situation in the region. Chapter 3 translates the findings from literature review, stakeholder interviews and consultations with regional partners in a narrative that follows the two main dimensions of the analysis.
conducted in BERST; i.e. key assets and long time horizon. Finally, chapter 4 provides
concluding remarks, lessons learnt, opportunities, barriers and recommendations.

The biocluster in central Finland has been further categorised to sectors in order to
allow comparison and better understand synergies and interactions of the various
elements involved in the formation of bioregions. The BERST project recognises eight
bioeconomy sectors, agreed with regional partners and interviewees, namely:
primary biomass; food; construction; chemicals and polymers; pulp and paper;
textile and clothing; energy; R&D services.

Two research dimensions have been used to analyse the development of the
bioeconomy sectors within the bioclusters in the study regions, as follows:

- Clusters’ key assets and their interaction
- Time horizon and stages of development

**Clusters’ key assets and their interaction.**

Clusters can be considered forms of network structures. A cluster is characterised by
multiple, networked groups or teams who seek to accomplish organizational
objectives. Team-based organizations offer much by way of flexibility while projects
can be approached on a planned or ad hoc basis.

The actors in a cluster are thus a key asset. Several groups play a key role, as follows:

- Entrepreneurs. The presence of entrepreneurial culture plays a pivotal role in
driving clusters towards successful development. Clusters usually leverage on the
presence and active participation of various individuals with an entrepreneurial
spirit who are flexible, risk-takers and willing to try new ideas. The level of
entrepreneurial culture can therefore be seen as a critical success factor whereas
low levels of entrepreneurship would be a cause for concern (PWC, 2011).
- Policymakers. Political leaders who are willing to support the development of the
bioeconomy, providing governance, institutional structures and financial support.
- Knowledge institutes. Organisations that provide technical know-how and
innovation for the development of bio-products.

Other assets involved in clusters are:

- Biomass supply: Consistent provision of biomass resources is critical. The analysis
of case studies and best practices in BERST project includes both indigenous raw
material streams and imports (if applicable) and elaborates on the advantages
and disadvantages of each option to the cluster development pathway.
- Competitive bioeconomy products: commercially viable products such as fine
chemicals, medicines, food, chemicals, bioplastics, transport fuels, electricity and
heat.
Funding: consistent funding both from public and private sources, new funding resources and attractive funding mechanisms for the entrepreneurs and investors.

Policies and measures: legislative and policy framework conditions affecting the introduction of products made from biomass including measures relating to legislation, policies, standards, labels, certification and public procurement.

Time horizon and stages of development

Biocluster development passes through three main stages, typically taking 10-15 years to reach maturity. The challenges at the initiation of the biocluster differ from that during a mature stage. Hence it makes sense to distinguish the phases in the development path of the biocluster. This dimension forms the basis for the second starting point in the analysis within BERST.

It takes considerable time from the launch of a bioeconomy cluster to the time by which a mature cluster is in place. In the analysis of the development path in BESRT project, we distinguish three phases:

- **Initial stage and take off (IS):** Introducing the bioeconomy in the regional planning agenda and creating the policy, socio-economic and R&D landscape for its establishment and operation.

- **Drive to maturity (DMS):** The first competitive bioeconomy products are sold at the market. The cluster grows with the setup of new companies, cluster infrastructure (incubator, training centre etc.) has been established, and the cluster is able to attract both private and public funding.

- **Age of mature production (MS):** The cluster is able to produce competitive bioeconomy products at an extensive scale.

The duration of each of these stages differs from region to region; according to estimates of PwC (2011)\(^2\) the duration of the initial stage and take off is about 5 years, that of the drive to maturity 5-10 years and that of the age of mature production 10-20 years. Within each stage, we analyse the interaction of the key assets, as given in our conceptual model. It is notable that clusters studies were considered to be either in initial stage or in the drive to maturity stage. No clusters were considered to be fully mature although, in some regions, elements of clusters had reached mature state of development.

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1 Inspired by Rostow’s stages of growth.
2.3 Environmental and socio-economic indicators of the region and clusters

The region

The area of Central Finland\(^3\) (Keski Suomi) has a population of 270,000 inhabitants and covers nearly 20,000 km\(^2\). The most important biomass resources are forests, in total almost 1.4 million hectares (14,000 km\(^2\)).

![Figure 2.1 Map of central Finland](image)

The region is characterized by the strong presence of the paper and pulp sector, which is based on equally strong primary supply and has also a very well developed bioenergy sector. Also, the region has the most developed and extensive bioenergy R&D - including education and training activities - in Finland.

In 2012, renewable energy was 7,4 TWh or 42% of total energy consumption. Biomass accounted for 68% of local heat and electricity production.\(^4\)

The region represents 6% of the total land area of the country and has 5% of the population. Population characteristics are similar to national averages (see Table 2.1).

The energy sector represents just 0.4% of the Gross Domestic Product (GDP) and the expenditure in R&D is also quite low in the region (0.6 %) compared to the country average which is equal to the EU respective figure.

\(^3\) [http://en.wikipedia.org/wiki/Central_Finland](http://en.wikipedia.org/wiki/Central_Finland)

\(^4\) Source: BIOCLUS outputs - The BIOCLUS project (12/2009-11/2012) was focused on the sustainable use of biomass resources and aims at boosting the regional competitiveness and growth in five European cluster regions: Central Finland, Navarre (Spain), Western Macedonia (Greece), Slovakia and Wielkopolska (Poland). The project was funded by the EU seventh framework programme for research and technological development. The project was coordinated by JAMK University of Applied Sciences.
Table 2.1 Basic facts about population in Central Finland, 2003-2013 (Eurostat, 2013)

<table>
<thead>
<tr>
<th></th>
<th>Central Finland</th>
<th>SUOMI / FINLAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population size, 2003 (1000 inh.)</td>
<td>267</td>
<td>5206</td>
</tr>
<tr>
<td>Population size, 2013 (1000 inh.)</td>
<td>275</td>
<td>5427</td>
</tr>
<tr>
<td>Population growth, 2003-2013 (% p.a.)</td>
<td>0.31%</td>
<td>0.42%</td>
</tr>
<tr>
<td>Size of the region, 2013 (1000 km²)</td>
<td>19.949</td>
<td>338.431</td>
</tr>
<tr>
<td>Population density, 2013 (inh/km²)</td>
<td>13.8</td>
<td>16.0</td>
</tr>
<tr>
<td>Composition of the population, 2013:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Population &lt;15 years (% of total population)</td>
<td>16.5%</td>
<td>16.4%</td>
</tr>
<tr>
<td>- Population 15-65 years (% of total population)</td>
<td>64.1%</td>
<td>64.8%</td>
</tr>
<tr>
<td>- Population &gt;65 years (% of total population)</td>
<td>19.4%</td>
<td>18.8%</td>
</tr>
</tbody>
</table>

Table 2.2 Environmental and socio-economic indicators of Central Finland, 2013

<table>
<thead>
<tr>
<th></th>
<th>Keski-Suomi</th>
<th>SUOMI / FINLAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total employment in all sectors</td>
<td>109569</td>
<td>2354422</td>
</tr>
<tr>
<td>Employment in the agricultural sector as % of total employment</td>
<td>3.6%</td>
<td>2.9%</td>
</tr>
<tr>
<td>Employment in the industry sector as % of total employment</td>
<td>18.4%</td>
<td>15.6%</td>
</tr>
<tr>
<td>Employment in the services sector as % of total employment</td>
<td>77.9%</td>
<td>81.5%</td>
</tr>
<tr>
<td>GDP (min euro)</td>
<td>7878</td>
<td>188744</td>
</tr>
<tr>
<td>GDP/capita (PPS, index EU27 = 100)</td>
<td>105</td>
<td>116</td>
</tr>
<tr>
<td>GDP in the chemical sector as % of regional GDP</td>
<td>0.5%</td>
<td>0.5%</td>
</tr>
<tr>
<td>GDP in the energy sector as % of regional GDP</td>
<td>0.4%</td>
<td>0.5%</td>
</tr>
<tr>
<td>R&amp;D expenditure as % GDP (EU=1)</td>
<td>0.6305</td>
<td>1.00</td>
</tr>
<tr>
<td>Number of competitive bioeconomy products brought to the market in the last three years, 20xx-20xx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% population with (only) lower secondary education level (ISCED 1-2)</td>
<td>14.2</td>
<td>14.2</td>
</tr>
<tr>
<td>% population with (only) upper secondary education level (ISCED 3-4)</td>
<td>47.3</td>
<td>45.3</td>
</tr>
<tr>
<td>% population with (only) tertiary education level (ISCED 5-6)</td>
<td>38.5</td>
<td>40.5</td>
</tr>
</tbody>
</table>

The region has identified three focus economic activities around which the capabilities, target markets and strategic development priorities are shaped, bioeconomy, digital economy and knowledge based economy. The cluster examined in this report falls into the first and the third ones.

Table 2.3 Focus economic activities for central Finland (source: S3Platform)

<table>
<thead>
<tr>
<th>Economic activity</th>
<th>Capabilities</th>
<th>Target Markets</th>
<th>EU Priorities</th>
</tr>
</thead>
</table>
The bioenergy cluster in central Finland

Central Finland has a long tradition in forest fuelled bioenergy value chains and the bioenergy cluster is among the most important and well known ones in Finland and in Europe. The main enterprises in the region are forest industry, production of machinery and equipment, information technology, pulp and paper and bioenergy.

Table 2.4 Employment and firms dynamics in the under study bioeconomy sectors in central Finland, 2004-2013

<table>
<thead>
<tr>
<th></th>
<th>Employment (employees)</th>
<th>Firms</th>
<th>Micro-firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture national</td>
<td>69,992</td>
<td>68,461</td>
<td>56,889</td>
</tr>
<tr>
<td>Agriculture regional</td>
<td>3,859</td>
<td>3,978</td>
<td>2,771</td>
</tr>
<tr>
<td>% of national</td>
<td>6</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Energy national</td>
<td>9,838</td>
<td>10,887</td>
<td>951</td>
</tr>
<tr>
<td>Energy regional</td>
<td>435</td>
<td>417</td>
<td>57</td>
</tr>
<tr>
<td>% of national</td>
<td>4</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Pulp &amp; paper national</td>
<td>35,631</td>
<td>20,534</td>
<td>290</td>
</tr>
<tr>
<td>Pulp &amp; paper regional</td>
<td>3,404</td>
<td>1,858</td>
<td>16</td>
</tr>
<tr>
<td>% of national</td>
<td>10</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>R&amp;D national</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R&amp;D regional</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of national</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total national</td>
<td>2,245,780</td>
<td>2,354,422</td>
<td>349,356</td>
</tr>
<tr>
<td>Total regional</td>
<td>104,705</td>
<td>109,569</td>
<td>15,458</td>
</tr>
</tbody>
</table>

Pulp and paper has the highest share in the regional employment in the under study bioeconomy sectors (9% in 2013) with agriculture and energy following with 6% and 4% respectively.

2.4 Analysis of the development path of the biocluster

This chapter translates the findings from literature review, stakeholder interviews and consultations with regional partners in a narrative that follows the two main dimensions of the analysis conducted in BERST; i.e. key assets and long time horizon. The work presented here provides a comparative analysis of the key assets, their

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performance and rationale as well as their evolution and interactions across the development stages of the cluster. The outputs from this analysis facilitate the development of recommendations i) for the clusters’ successful transition to the next stage and ii) for other clusters with similar characteristics in terms of sectors and assets.

Table 3.1 Cluster performance in the under study key assets

<table>
<thead>
<tr>
<th>Key asset</th>
<th>Primary biomass sectors</th>
<th>Energy</th>
<th>R&amp;D services in biomass</th>
<th>Pulp and paper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IS</td>
<td>DMS</td>
<td>IS</td>
<td>DMS</td>
</tr>
<tr>
<td>Cluster Organisation&lt;sup&gt;6&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actors&lt;sup&gt;7&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entrepreneurs</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Policy makers</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Knowledge institutes</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Biomass supply&lt;sup&gt;8&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competitive bioeconomy product&lt;sup&gt;9&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funding&lt;sup&gt;10&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Policies and measures&lt;sup&gt;11&lt;/sup&gt;</td>
<td></td>
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</tbody>
</table>

Table 3.1 presents the performance of the various bioeconomy sectors which are present in the cluster across the key assets, during the initial (IS) and the drive to maturity stage (DMS), based on the results from the questionnaire survey. Details on how the individual key assets performed across the two development stages are provided in the following sections alongside with barriers and enabling factors which have framed their progress. The traffic-light colour coding has been introduced to reflect the strength and performance of each key asset during the development stages and how this has impacted in the progress of the cluster’s activities. The ranking of the traffic light coding reflects the discussions with stakeholders from the clusters and the region as well as the regional partners from the BERST project.

<sup>6</sup> An organizational structure with many groups or teams to accomplish organizational objectives.
<sup>7</sup> The key types of actors involved in the cluster formation and operation.
<sup>8</sup> The consistent provision of biomass resources at given prices throughout the operational periods.
<sup>9</sup> The commercial/cost competitive products such as fine chemicals/medicines, food, chemicals/bioplastics, transport fuels, electricity and heat.
<sup>10</sup> Consistent funding both from public and private sources, new funding resources and attractive funding mechanisms for the entrepreneurs and investors.
<sup>11</sup> Measures related to legislation, policies, standards, labels, certification and public procurement.
The bioenergy cluster in Central Finland began to operate in 1992 and is now in the drive to maturity stage, based on the results from the analysis the stakeholder responses. At the present time, competitive bioeconomy products are being sold in the market, the cluster infrastructure (incubator, training centre etc.) is well established, and the cluster is growing with the setup of new companies, attracting both private and public funding.

The sections below provide an analysis for the performance of the cluster across the under study key assets during the two development stages, as it has been assessed from literature and the individual responses from interviewed stakeholders.

**Biocluster organization**

The cluster began in 1992 with the primary focus being development of forest biomass value chains. The value chain for energy developed alongside that for pulp and paper. In the pulp and paper sector, the aim was to increase efficiency of production and improve the quality of end products. In the energy sector, the focus was to create markets for biomass and increase overall market share. Thus, the IS was characterised by development of supply and logistics, including manufacturers of equipment and producers of densified biomass (pellet, briquette).

Support from the regional government has been strong and consistent from the early 1990s. Bioenergy has had strategic, political support. The cluster has benefited from continuous technical guidance from regional R&D providers (VTT, University of Jyväskylä and JAMK), all of which are internationally well-known in this field.

During the decade of 2000, there were in total three triple-helix bioenergy clusters in Central Finland:

- Benet bioenergy network, managed by Jyväskylä Science Park (private-public ownership about 50%/50%) until 2006 and later managed by private company Benet Ltd.
- Centres of Excellence (e.g. heat entrepreneurship), funded by the Ministry of Employment and Economy.
- Bioenergiasta elinvoimaa (Dynamic Bioenergy) financed by the regional council of Central Finland together with regional development companies.

<table>
<thead>
<tr>
<th>Table 3.2 Cluster performance in biomass organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issue</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Central organisation that coordinates, manages, and facilitates the biocluster</td>
</tr>
<tr>
<td>Role of key actors</td>
</tr>
<tr>
<td>- Policy</td>
</tr>
<tr>
<td>- RTD</td>
</tr>
</tbody>
</table>
Case Study (BERST region): Central Finland

Table 3.2 illustrates that, during the initial stage (IS), central organisation between the various sectors comprising the cluster was moderate but this improved to high / very high during the drive to maturity stage (DMS). Integration between the supply and the demand sectors was a key feature of the DMS. The role of key actors and their interactions was strong from the initial stage and became even more pronounced at the drive to maturity stage, helping to ensure success within the sector.

**Barriers**

Forest fuel production enterprises in the cluster are relatively small scale and – while this has advantages such as competition and local employment - it also brings challenges. Networking and interaction among these enterprises is complex and can be slow-moving. Also, reaching the participants, for example with training initiatives, is difficult. The rate of creation of start-ups by entrepreneurs is relatively slow.

**Enabling factors**

Central organisation of the cluster provided focus and steer the developments.

Good cross sector collaboration among primary and end use sectors.

**Actors**

Various actors have been participating in the bioenergy cluster including the R&D institutes VTT, JAMK, University of Jyväskylä, Jyväskylä Innovation (via the centre of excellence program) as well as the regional council of Central Finland. The role of Jyvaskyla Innovation was to coordinate, VTT and University of Jyväskylä were responsible for research and demonstration and University of Jyväskylä together with JAMK were responsible for education and training issues. Later, JAMK’s role was widened to cover also research, demonstration and innovation.

Other actors include the forest industry together with energy production (VAPO, UPM, JE, etc.), the Finnish forest center (Metsäkeskus), the forest owners’ association and several wood chipping SMEs.

They were all expert organizations mostly with complementary competences and could as such work rather well together in comprehensive development of the bioenergy sector.
Table 3.3 highlights the fact that entrepreneurs have been involved and interacted at a high level from the outset of the operation of the cluster. Good interactions and successful collaboration among the actors was important in facilitating progress and development across the various bioeconomy subsectors.

There were also many public owned companies in energy supply - traditionally Finland has a good coverage of district heating and often that is managed by public company.

Most of the biocluster entrepreneurs were located in variable places within the country.

The cooperation of cluster activities among the entrepreneurs has been focused in beneficial “industrial symbiosis” and that is the primary reason why most of them exhibited strong willingness to develop the bioeconomy and pool resources towards new product development.

- Timber industry could convert by-product that used to be waste in energy or develop some other product (e.g. chipboards).
- Pulp and paper industry also used by-products (black liquor and wood harvesting leftovers, branches, tree tops).
- Forest owners could use harvesting wood for energy instead of leaving them in the forest and utilize wood ash as a forest fertilizer.

Policy makers

The main policymakers participating in the cluster were the regional council of central Finland as well as the regional development companies which aimed to develop the whole region and thus bring this aspect to the overall development of the sector. Local authorities have also played an important role. For example, the cities of Jyväskylä and Saarijärvi have been pro-active and pioneering in the use of bioenergy.

The northern part of Central Finland is sparsely populated and therefore individual companies benefitted from high co-funding rates from the EC.

R&D institutes
VTT, University of Jyväskylä and JAMK University of Applied Sciences had a strong role in bringing research knowledge to regional decision makers. These institutions have all collaborated with industry actors (ranging from SME’s to large companies) in R&D projects. VTT as a national organization also utilized their knowledge from all their offices. All the institutes are located in Jyväskylä, the central city of the region with the exception of the R&D centre in Tarvaala which has currently a strong role in the regional bioenergy (and bioeconomy) R&D.

**Barriers**

- The closure of Jyvaskyla Innovation was considered by the interviewed stakeholders a potentially strong hindering factor for the central coordination of the cluster activities.
- Centralised location of R&D slightly prevents funding spread in other regional/local research institutes.

**Enabling factors**

Availability of well-educated manpower and good infrastructure are also considered as key assets. The region of Central Finland is an attractive location for developing forest-based bioenergy business with important factors such as:

- manufacturers for equipment have long tradition in the field;
- the market for bioenergy has been established for many years;
- research organisations have strong expertise and international leadership;
- synergies (though also competition) with the pulp and paper industry.

**Biomass supply**

The biocluster is based primarily on forest biomass comprising of field and wood industry residues. Agricultural biomass is also available but handling and logistics are not yet well developed. Peat is also available.

<table>
<thead>
<tr>
<th>Table 3.4 Cluster performance in biomass supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issue</td>
</tr>
<tr>
<td>Primary sectors</td>
</tr>
<tr>
<td>IS DMS</td>
</tr>
<tr>
<td><strong>Biomass availability</strong></td>
</tr>
<tr>
<td><strong>Indigenous supply</strong></td>
</tr>
<tr>
<td><strong>Biomass trade</strong></td>
</tr>
</tbody>
</table>

Availability and supply have always been very high in the region which is highly forested while the element of biomass trade was low during the initial stage but became very important both for energy and the pulp and paper sectors as their capacities increased with a respective increase in competition.

**Barriers**
Although the region has agricultural biomass, handling and logistics for this resource are not yet well developed. There has been consideration for using biomass to produce biogas but take-up is impeded by high costs. It is considered that new investment in road infrastructure is required to support future development of the clusters activities.

**Enabling factors**

Forest biomass is relatively abundant and can be easily transported in the region where roads are located.

**Competitive bioeconomy products**

The first products during the initial stage where based on traditional pathways and processes of exploiting wood for energy and for pulp and paper respectively. Consequently, innovation and cross-over interactions between sectors were at low level. This changed substantially during the drive to maturity stages and all the sectors evolved to integrate innovative elements in their work processes to facilitate cross-overs and interactions. This benefited significantly the efficiency of deployment of bioeconomy.

**Table 3.5 Cluster performance in competitive bioeconomy products**

<table>
<thead>
<tr>
<th>Issue</th>
<th>Primary sectors</th>
<th>biomass</th>
<th>Energy</th>
<th>R&amp;D services in biomass</th>
<th>Pulp and paper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IS</td>
<td>DMS</td>
<td>IS</td>
<td>DMS</td>
<td>IS</td>
</tr>
<tr>
<td><strong>Innovation of bioeconomy products</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cross over/ Transfer between sectors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Degree of innovation</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Since the cluster began to operate in 1992, there has been a sequence of products with the necessary technological evolution to meet the increased and changing demand patterns from society and industry. These include:

- Primary forest based wood fuel and raw material for the pulp and paper industry, briquettes and pellets
- Sawmill products (masts for marine sailing ships).
- Sawmill products: timber for construction
- Cellulose and pulp for different kind of paper products
- Conventional paper products (e.g. soft papers, printing papers, packaging materials, etc.) and new innovative paper products (sensitive label materials, sticker laminates)
- Polymers (CMC), chemicals
- Enzymes from wood
- Plywood products
Barriers

Diversity of bio-based market sectors increases the complexity for technological transfers. Diversity also makes scaling up of new conversion pathways and commercialisation of new bio-base products more complex.

Enabling factors

There has been successful cross-over between paper and pulp, forestry and energy based sectors through the years. This has included technical, managerial and other know-how. The sectors have been efficient in transfer of knowledge and this has contributed to high rates of adoption of innovation. High public awareness and requirements for heat have enhanced the market uptake of bioenergy and solid biofuels in the domestic, commercial and industrial sectors.

Funding

Public funds have been available through the operation of the cluster with the main focus being research and demonstration leading to competitive products and thus development opportunities. Funding was used to support concrete actions, the administration was comprehensive and the rules and procedures for investment support were clear and easy to access.

<table>
<thead>
<tr>
<th>Table 3.6 Cluster performance in funding</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Issue</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Public funds</td>
</tr>
<tr>
<td>Accessibility of funds / Procedures</td>
</tr>
<tr>
<td>Private funds</td>
</tr>
</tbody>
</table>

In addition to these several EU co-funding sources coming from ERDF, ESF, and EATGGF enabled investments and project development with substantial participation (and funding) from the entrepreneurs and the private sector.

This also enabled the start-up for new heat-entrepreneurs, a business branch where the entrepreneur sells the equipment together with the maintenance and production of energy to the customer (ESCo-model).

Private funds were low to moderate during the initial stage but during the drive to maturity they increased substantially. Public funds were important at the initial stage but they grew in importance, and procedures related to public funding became more developed, in the drive to maturity stage.
Barriers

Coordination of efficient uptake of funds from public and private sources along with the monitoring procedures during the actual project implementation.

Enabling factors

Availability of both public and private funds with simplified rules and procedures.

Policies and measures

The key drivers for policy formation were related to economic development and forestry while environmental issues have been increasingly important. There has also been strong motivation to create and sustain jobs in rural areas and local industries including SMEs.

Table 3.7 Cluster performance in policies and measures

<table>
<thead>
<tr>
<th>Issue</th>
<th>Primary biomass sectors</th>
<th>Energy</th>
<th>R&amp;D services in biomass</th>
<th>Pulp and paper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IS</td>
<td>DMS</td>
<td>IS</td>
<td>DMS</td>
</tr>
<tr>
<td>Presence of policy instruments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effectiveness of policy instruments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consistency of policy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring procedures</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

The following measures have been reported by the interviewed stakeholders:

- KEMERA\(^{12}\) (= subsidies for energy wood harvesting and further processing.)
- Investment subsidies for heating plants that use bioenergy
- Subsidies for start-up companies

Barriers

- The fragmented nature of the various bio-based economy sectors prohibits the fast design and uptake of cross sector targets and the subsequent sectorial policy alignment.
- The complexity of data required alongside with the large datasets required causes delays in providing evidence and informing policy formation.
- Reinforcement of trans- regional and international perspective would expand business development prospects.

Enabling factors

- Effective policy linking primary (forest based) production with sustainable energy.
- Consistency and stability of policy aims and targets.

- Continuous update and monitoring of policy based on consultations with the industry.

2.5 Concluding remarks and lessons for other regions

Concluding remarks

Since the bioenergy cluster began to operate in 1992, it has been consistently supported by a set of robust R&D providers with long term expertise and outstanding performance in their field. Until 2013, organisational and operational aspects were closely tied to Jyväskylä Innovation. Other sub-regions have had similar structures. For instance, JAMK established the Bioenergy Center in its Institute of Natural Resources - nowadays the Institute of Bioeconomy (BTI) - located in Tarvaala, Saarijärvi (in northern Central Finland). BTI is part of the Tarvaala Bioeconomy Campus with active cooperation networks. The region has been actively supporting these establishments and there are plans, strong motivation and many activities are ongoing to develop the Tarvaala Bioeconomy Campus as a cluster.

Central Finland is a front-runner in forest based bioenergy and interviewed stakeholders suggested that this has been largely due to the successful and efficient operation of the cluster. Local renewables contribute 68% of the region’s own energy production and 42% of total use of energy.

Biomass for energy is business as usual activity in the region, employing 400 people in fuel supply and power and heating plants. All town centres and industries in Central Finland have biomass fuelled CHP or heating plants. Also, many people are employed in sectors which are connected to bioenergy, such as machinery manufacture.

Difficulties and opportunities during this stage

Uncertainty regarding political decision making has been identified as a concern. Public funding of various types including subsidies has been essential for the progress of the cluster, and political support remains important. One positive factor is that the economic and environmental value of decentralised energy production is now widely recognised – this was not always the case.

The main opportunities reported are:

- Forest biomass resources are abundant and managed sustainably;
- There are abundant regional users of biomass resource;
- Road and rail based transportation are good and there is scope for further improvement with additional investment;
The sector is well established and there are good human resources, with substantial numbers of people who are educated, trained and experienced in the various aspects of bioenergy.

**Lessons learned**

*General lessons from the development of the bio-cluster in central Finland*

In this section a set of general lessons have been collected based on the interviews with stakeholders in the Good Practice clusters/regions. The lessons are linked to the under study key assets (cluster organisation, actors, biomass supply, competitive biobased products, funding and policies/ measures) and are further evaluated with the support of the regional agency as opportunities and/or barriers for the future development of the cluster in central Finland to foster the development of concise recommendations.

The analysis presented in Table 4.1 is further integrated into the last section of this chapter dealing with recommendations for the region.

**Table 4.1** Specific lessons learnt in central Finland per asset and development stage

<table>
<thead>
<tr>
<th>Specific lessons per key asset</th>
<th>Specific lessons</th>
<th>Bioeconomy sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organisation</td>
<td>Good cross sector collaboration among primary and end use sectors.</td>
<td>Primary biomass</td>
</tr>
<tr>
<td></td>
<td>Integration between the supply and the demand sectors was a key feature of the DMS.</td>
<td>Primary biomass</td>
</tr>
<tr>
<td></td>
<td>Location with proximity to primary sources (forest)</td>
<td>Primary biomass</td>
</tr>
<tr>
<td>Actors</td>
<td>Long tradition &amp; strong history in the field</td>
<td>Primary biomass</td>
</tr>
<tr>
<td></td>
<td>Research organisations have strong expertise and international leadership</td>
<td>Energy R &amp; D services</td>
</tr>
<tr>
<td>Supply</td>
<td>Forest biomass is available and can be easily transported in the region.</td>
<td>Primary biomass</td>
</tr>
<tr>
<td>Products</td>
<td>Successful cross over between paper &amp; pulp, forestry and energy based sectors through the years.</td>
<td>Primary biomass Energy</td>
</tr>
<tr>
<td></td>
<td>Efficient transfer of knowledge and high rates of adoption of innovation</td>
<td>Primary biomass</td>
</tr>
<tr>
<td></td>
<td>High public awareness and requirements</td>
<td>Energy</td>
</tr>
<tr>
<td>Funding</td>
<td>Funding from mixed sources offers better options for innovation and secures financing in the longer term</td>
<td>Primary biomass</td>
</tr>
<tr>
<td></td>
<td>Clear rules and simplified procedures</td>
<td>Energy</td>
</tr>
<tr>
<td>Policies</td>
<td>Consistency and stability of policy aims and targets.</td>
<td>Primary biomass</td>
</tr>
<tr>
<td></td>
<td>Continuous update and monitoring</td>
<td>Energy</td>
</tr>
</tbody>
</table>

**Recommendations**

13 The bioeconomy sectors defined in BERST
Based on the conclusions and the general and specific lessons presented in the tables above, recommendations are provided for the transition to the next development stage (maturity) for each of the key assets examined in the previous sections.

The key recommendations for organisation include the following:

- Ensure that the role of the cluster coordinator (which was performed until 2013 by Jyvaskyla Innovation) is sustained and reinforced to keep momentum of the cluster, coordinate the formation of efficient sectorial policies and bioeconomy strategies.
- Support the development of a well-functioning structure of the cluster initiative which among others implies appointing a good cluster manager, developing clear membership arrangements and setting up an appropriate governance structure.
- Enrich service orientation towards the companies in the cluster. This could include, for example, training courses; understanding and promotion of sustainability and resource efficiency principles and metrics; networking events such as conferences; coaching with regard to inter-cluster cooperation; informing cluster members about changes in regulations; informing cluster members about calls for proposals for subsidies and grants etc.

The key recommendations for actors include the following:

- R&D providers: Design and reinforce educational programmes to raise interest among students; enhance the active exchange of creative ideas, increase collaboration between industry and policy in innovative aspects.
- Joint action for entrepreneurs and R&D actors: Perform gap analysis on skills from an industrial perspective and work together to integrate courses and human resources to the particular sectors of interest.

The key recommendations for biomass supply include the following:

- Place effort and funds towards reinforcing the road and rail infrastructure for supply.
- Improve the resource efficient exploitation of wood industry raw material side streams and the integration of wastes in the value chains.

The key recommendations for competitive biobased products include the following:

- The successful transition from forest and energy products to innovative and competitive biobased products as well as their integration to the market involves engagement of local companies of all sizes, both large and small, and formation (in a way that captures the interest of the companies) of targeted regional targets, accompanied with the appropriate advice for funding.

The key recommendations for funding include the following:
• Develop a central coordinated structure for investigating funding opportunities from mixed sources; informing/ updating entrepreneurs and R&D actors and providing support for the application procedures.

The key recommendations for policy and measures include the following:

• Refine the smart specialisation strategy priorities (see Table 2.3) and narrow to a set of limited, targeted areas for actions, which should reflect the capabilities of the cluster and strengthen adoption of innovation rates in the bioeconomy sectors.

• Evaluate the efficacy of policies and measures in place (and those used historically) and adjust and tailor taking into account the needs and assets of businesses involved in the cluster, national and international market trends and prospects for future business development.

• Facilitate discussion about the regional cluster’s position in European (and global) market, identify opportunities for expertise and technology to be exported and develop outreach strategies

2.6 References/ Links

http://www.keskisuomi.fi/edunvalvonta JA_yhteistyO/kansainvaliset_yhteydet/kv - hankkeet/berst