Case Study on Bioeconomy Campus, Central Finland

Journal:	*Biofuels, Bioproducts & Biorefining*
Manuscript ID	BIOFPR-16-0070.R1
Wiley - Manuscript type:	On the Map
Date Submitted by the Author:	14-Oct-2016

Complete List of Authors:	Ylimartimo, Anneli; JAMK University of Applied Sciences, School of Technology/ Institute of Bioeconomy

Keywords:	BERST project, case study, cluster, innovation ecosystem, Bioeconomy Campus, rural area, Central Finland

Case Study on Bioeconomy Campus, Central Finland

Anneli Ylimartimo

JAMK University of Applied Sciences, School of Technology/ Institute of Bioeconomy,
Tuumalantie 17, FI-43130 Tarvaala, Finland; gsm +358 40 574 9376, anneli.ylimartimo@jamk.fi

Abstract

This article studies the development path, the assets and the challenges of an initiative for bioeconomy innovation ecosystem located in sparsely populated rural area. The case studied is Bioeconomy Campus in northern Central Finland. Central Finland was one of the European bioregions whose bioeconomy was analyzed from the clustering point of view by the FP7 project of BERST - BioEconomy Regional Strategy Toolkit (2013-2015). In this article, the role of the Bioeconomy Campus in the Finnish RDI system is described and the development path of the campus is studied in the context of the BERST results from Central Finland. The cluster analyses in BERST were based on information about Bioeconomy clusters located mostly in central European densely populated areas with big industries. The potential of the Bioeconomy Campus to further develop and to promote smart growth in the surrounding rural environment is discussed by comparing the findings of this case study with the BERST results and with some results presented in literature on clusters and innovation ecosystems. The main aim of the comparison is to get indication about the relevance and usefulness of that type of down-scaling for further exploitation of BERST results.

Keywords:
BERST project, case study, cluster, innovation ecosystem, Bioeconomy Campus, rural Central Finland

1. INTRODUCTION

Central Finland characterized by forests and watercourses was one of the European bioregions analyzed from the clustering point of view in the FP7 project of BERST – BioEconomy Regional Strategy Toolkit - during 2013-2015 (http://www.berst.eu). BERST aimed to understand and to estimate the potentials and challenges of regional bioeconomies. The project developed regional bioeconomy profiles and smart strategies for bioregions, taking the performances of Good Practice bioeconomy clusters as exemplars for their future. The BERST project and its results on bioeconomy clusters are described more thoroughly in another article of this special issue.

The results achieved in BERST (see e.g. BERST publications [1-5] and other articles in this special issue) provide good background and reference material for analyzing an initiative of bioeconomy innovation ecosystem established in Central Finland. The case studied in this article is the Bioeconomy Campus located in rural environment in Tarvaala, in the outskirts of the municipality of Saarijärvi (small rural town with 10 000 inhabitants), in the sparsely populated northern part of Central Finland. The Bioeconomy Campus is a joint initiative by JAMK University of Applied Sciences (JAMK), Vocational Education Institute of Northern Central Finland (POKE), municipality of Saarijärvi, the SSYP Kehitys Oy Ltd Business Development, the SSYP kiinteistöt Oy Ltd Facilities (SSYP), and the Regional Council of Central Finland. The aim of the initiative is to integrate bioeconomy-related education, research, development, innovation, entrepreneurship and commercialization. The core actors are tied to each other by formal linkages or untraded

interdependencies. The Bioeconomy Campus may be characterized as a nascent regional bioeconomy innovation ecosystem that has also elements of initiative for clustering.

'What is a Cluster?' Porter [6] asked and answered that **clusters** are 'geographic concentrations of interconnected companies and institutions in a particular field' (p.78). The linked entities include, for example, suppliers of components, machinery, and services, and providers of specialized infrastructure. Clusters often extend downstream to channels and customers and laterally to manufacturers of complementary products and to companies in related industries. [6] Clusters may also include governmental and other institutions that provide specialized training, education, information, research, and technical support. Smart Guide to Cluster Policy by European Commission [7] emphasizes that:

'Clusters cannot be understood as fitting into the narrow sectoral view…, but should be considered as regional ecosystems of related industries and competences featuring a broad array of inter-industry interdependencies. They are defined as groups of firms, related economic actors, and institutions that are located near each other and have reached a sufficient scale to develop specialized expertise, services, resources, suppliers and skills' (p.11).

In this article, **a bioeconomy cluster** is perceived as a geographical concentration of interconnected actors such as R&D institutes, bioeconomy enterprises and policy makers aiming to develop the bioeconomy. Given the broad coverage of sectors within the bioeconomy, the bioeconomy clusters might be rather heterogeneous in their specific focus.

Cluster initiative refers to an initiative or political effort to create, maintain, or upgrade an economic stronghold. Lindqvist et al. [8] defined cluster initiative as follows: 'Cluster initiatives are organized efforts to increase the growth and competitiveness of clusters within a region, involving cluster firms, government and/or the research community' (p.1). The same authors also emphasized that innovation should be at the heart of clusters. [8] For a more in-depth discussion of similarities and differences between the networks, clusters, and cluster initiatives, see e.g. the European Competitiveness Report 2012 [9].

Critical mass, location (with local partners, markets and talent base), active collaboration linkages, and related industries enabling cross-overs are known to be important for successful clustering development. [6-8] These preconditions are generally fulfilled in densely populated urban areas. Rosenfeld [10] lists the following factors contributing to the growth of clusters: innovation, imitation and competition, entrepreneurial energy, networking and networks, connections and intermediaries, specialized work force, industry leaders, talents, and tacit knowledge. Further, it has been shown that in the presence of strong clusters, new business formation and start-up employment are higher, new firms are more likely to succeed and grow, the employment is growing, growth opportunities in other industries are enhanced, and new establishments of existing firms are formed. [11, 12]

However, Beaudry and Breschi [13] have shown that clustering in itself is not conducive to firm's innovation performance (indicated by patent counts). While other innovative companies in a firm's own industry in a cluster positively affect the firm's innovation activities, the presence of non-innovative companies may have even an opposite effect. They concluded that positive effects of clustering on the likelihood of innovating 'arise only from the co-location within an existing population of innovative companies' (p. 340). [13] Further, it has been found that clustering is more beneficial to younger firms and to the firms having higher knowledge stocks with higher absorptive capacity. [14] Furthermore, there is even evidence that firms are more likely to fail as a cluster gets very large. [15] However, the reasons behind these phenomena are complex, the positive relationship between clustering and innovation cannot be generalized, and differences in performance between different clusters are not easy to understand. [14-16]

European Commission's Smart Guide to Cluster Policy [7] notes that clusters and cluster initiatives are important parts of **innovation ecosystems,** and outlines the difference between clusters and innovation ecosystems as follows:

'Innovation eco-systems are similar to clusters, but do not have the same focus on specific sets of related industries. They tend to encompass all activities in a given location that are connected to innovation. In practice, this perspective can easily lead to a focus on research-driven innovation and the linkages between academia and business. It lacks the specificity of a distinct cluster, and often tends to have more of a supply-driven rather than a market-driven perspective' (p.16).

Jackson [17] describes innovation ecosystem as a combination of two distinct economies, the research economy, which is driven by fundamental research, and the commercial economy, which is driven by the marketplace. According to Jackson's [17] model (p.4-5), when a small amount of profits are sacrificed to finance the research, the result is feed-back loop called virtuous cycle presented in Fig.1. Further, when the innovation induced increase in profits exceeds the R&D investment, the innovation ecosystem is growing. [17]

Fig. 1. Virtuous cycle in a thriving innovation ecosystem, where R&D investments are replenished through increased profits in the commercial economy. [17] The figure has been modified from Figure 1. in Jackson [17] (p.5).

Durst and Poutanen [18] reviewed research on innovation ecosystems and found that innovation ecosystems have been described in multiple ways, suggesting that an innovation ecosystem is a hybrid of different networks or systems or collaborative arrangements. Durst and Poutanen [18] state:

'The collaborative arrangements,… might be based on local concentration of industrial specifications, such as Porter's (1998) clusters, but the ecosystem model has expanded the idea of local clustering... Additionally, the idea of open innovation expands the scope of potential participants of the innovation process from internal actors of the R&D function to the numerous possible co-creators and co-innovators outside an organization. In this sense, ecosystem thinking comes close to what is called an open innovation.' (p.29)

However, the use of ecosystem analogy to describe innovation ecosystems that are influenced by complex economic, social and political factors has also been criticized. [18]

For an ecosystem to be innovative, a continuous cross-pollination of ideas, questions, knowledge and technology between research, development, and application is necessary (e.g. Estrin [19]). Similarly, in an ideal cluster, the different actors collaborate perfectly. However, in reality, many kinds of barriers prevent the interaction and create gaps, which in turn prevent innovation processes [8]. Lindqvist et al. [8] presented 'The Gap Model – the seven innovation gaps' (p.38) that describes five innovation gaps within a cluster and two external gaps, one between the cluster and other clusters and another between the cluster and global markets (Fig. 2).

Fig. 2. The Gap Model by Lindqvist et al. [8] depicting the seven innovation gaps. The figure has been modified from Figure 4.2 in Lindqvist et al. [8] (p.38).

According to Lindqvist et al. [8], a key role for cluster organization is to bridge the internal gaps. Besides bridging the internal gaps, the cluster initiatives also work for bridging the external gaps. Cluster organizations can overcome the innovation gaps e.g. by helping to bring different types of actors together. [8]

The interaction between different actors is also influenced by cultural factors related to communication, willingness to share and receive information and to build trust relationships. According to Jackson [17], 'a healthy ecosystem also provides a mechanism for building relationships and other intangibles between the actors and entities.'(p.9).

BERST results [1-3] from regional bioeconomy clusters and from Good Practice Bioeconomy clusters, show that role of entrepreneurs, policymakers, and knowledge institutions and their interaction in a cluster are key assets involved in clusters. 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.[1-3] Other success factors are organizations that provide technical know-how and innovation for the development of bio-products, and political leaders who are willing in long-term to support the development of the bioeconomy, providing governance, institutional structures and financial support. [1-3]

Durst and Poutanen [18] suggest that factors for the successful implementation of innovation ecosystems can be found in the areas of resources, governance, strategy and leadership, organizational culture, human resources management, people, partners, technology and clustering.' (p.35).

Jackson [17] examines the gap between academia and commercial marketplace in an innovation ecosystem. For example, in academia, there is concentration of government investment in fundamental research, while industry investment is concentrated in commercial marketplace in direct product development. In between, there is a gap in resources for technology demonstration and development (TD&D). Jackson [17] continues:

'This gap… is colloquially known as the *Valley of Death*. The actors engaged in moving innovations from discovery through commercialization are academia, small businesses, the investor community, and commercial industry. For these actors, it is within this *valley* that many potential innovations die for lack of the resources to develop them to a stage where industry or the investor community can recognize their commercial potential and assess the risk associated with bringing them to market.' (p.6)

For more in-depth discussion and literature review on the concept, characteristics, and functioning of innovation ecosystem, see e.g. Durst and Poutanen [18] and Jackson [17].

This article first describes Central Finland as growth milieu to the nascent bioeconomy innovation ecosystem. Then the development path and the present role of the Bioeconomy Campus are examined. Finally, the challenges, assets, and the potential of the Bioeconomy Campus to promote innovations and smart growth in the surrounding rural environment are discussed by comparing the findings with some results presented in literature on clusters and innovation ecosystems and with BERST results on bioclusters. The BERST results were based on information collected either from BERST regions at NUTS3 or NUTS2 level or from Good Practice Bioeconomy clusters that were located in central European densely populated areas with big industries. The main aim of this article is to apply the BERST results to understand and to estimate the potentials and challenges of small bioeconomy innovation ecosystem located in sparsely populated rural area, in order to get indication of the relevance and usefulness of that type of down-scaling for further exploitation of BERST results.

2. CENTRAL FINLAND AS GROWTH MILIEU TO BIOECONOMY CAMPUS

The following description of the bioeconomy in Central Finland is based on the BERST results, especially on the case study results from the analyses of bioclusters in Central Finland and on the regional bioeconomy profile for Central Finland. [1-5]

The area of Central Finland covers nearly 20,000 km2 and has a population of 270,000 inhabitants. The most important biomass resources are forests, in total almost 14,000 km2. Central Finland 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. The most important hotspot of the paper and pulp sector with developed industrial symbiosis is located in Äänekoski, where a big next-generation bioproduct mill (with investment cost of approximately EUR 1.2 billion) of Metsä Fibre (http://biotuotetehdas.fi/in-english) is presently being built. The hotspot is located within the distance of only around 30 km from the Bioeconomy Campus.

Central Finland is a front-runner in forest based bioenergy. Local renewables contribute nearly 70% of the region's own energy production and more than 40% of total use of energy. On contrary to paper and pulp sector, the bioenergy sector is characterized by small enterprises. Biomass for energy is usual business activity in the region. All town centres and industries in Central Finland have biomass fuelled CHP or heating plants. People are employed in fuel supply and power and heating plants, and also in sectors which are connected to bioenergy, such as machinery manufacture. Further, Central Finland also has well developed and extensive bioenergy R&D - including education and training activities. The Bioeconomy Campus in Tarvaala is an important part of the whole.

The bioeconomy cluster in Central Finland began in 1992 with the primary focus being development of forest biomass value chains. During the drive to maturity stages 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. The integration between the supply and the demand sectors was a key feature of the drive to maturity stage. At present, competitive bioeconomy products are being sold in the market. The products include primary forest based wood fuel and raw material for the pulp and paper industry, briquettes and pellets, sawmill products, cellulose and pulp for different kind of paper products, conventional paper products and new innovative paper products, plywood products, polymers (CMC), chemicals and enzymes from wood.

Among the enabling factors for biocluster development in Central Finland have been active actors including several R&D institutes, forest industry together with energy production, various forest organizations, and SMEs. They were expert organizations mostly with complementary competences and could as such work rather well together in comprehensive development of bioeconomy. Another enabling factor has been high availability and supply of forest biomass in the region. Even agricultural biomass is available but handling and logistics are not yet well developed. Further, support from the regional government as well as from regional development companies and local authorities has been strong and consistent. The key drivers for policy formation were related to economic development and forestry, later also to environmental issues. There has also been strong motivation to create and sustain jobs in rural areas and local industries and SMEs.

Public funds have been available through the operation of the biocluster with the main focus being research and demonstration leading to competitive products and thus development opportunities. In addition to these, several EU co- funding sources coming from ERDF, ESF, and EAFRD 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. Private funds were low to moderate during the initial stage but during the drive to maturity they increased substantially.

Among barriers for development of biocluster in Central Finland is the firm structure especially in bioenergy sector. 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. Further, new investments in road infrastructure are required to support future development of the clusters activities - even though the recent biorefinery investment in Äänekoski has already contributed to the availability of public funds for maintenance of roads. Furthermore, diversity of bio-based market sectors increases the complexity for technological transfers. Diversity also makes scaling up of new conversion pathways and commercialization of new bio-base products more complex.

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. Also the complexity of data required alongside with the large datasets required causes delays in providing evidence and informing policy formation. Finally, reinforcement of trans-regional and international perspective would expand business development prospects.

3. DEVELOPMENT PATH AND PRESENT ROLE OF BIOECONOMY CAMPUS

The base for the present Bioeconomy Campus was the College of Agriculture and Forestry of Central Finland – later on, Natural Resources and Environment – and its estates in Tarvaala. The college has 150-year history in education and the estates are owned by POKE.

Along with the restructuring of the education system in Finland, JAMK established in 1999 the Institute of Natural Resources in the same campus area. [20] The tasks of the new institute were tertiary education, applied R&D and regional development. From the very beginning, the role of JAMK's institute was focused to applied research and development rather than to education. [20] The institute soon developed strong applied RDI expertise in its three strategic specialization fields: bioenergy, new rural businesses, and environmental management of rural areas. Later on, the name of the Institute of Natural resources was replaced with the *Institute of Bioeconomy*.

During the first years, the role of the new institute was not always understood by cooperators who would have preferred to see JAMK's institute as network member merely in the education and training role. Later, this was changed along with the rapid growth of the institute's R&D project portfolio and networks. The growth was supported by the availability of EU funds especially for rural SME development in northern Central Finland. Networking further widened the role of the institute e.g. to the strategy work for rural development of the region. In the field of bioenergy, especially the membership of Benet network was important to the development of the institute. The institute started its operations at regional level and later, extended its activities to national and transnational levels.

At first, the institute's cooperation in practice with POKE was mainly based on sharing education facilities. Over the years, the cooperation has widened and intensified through common R&D projects with cooperation in field experiments and pilots and through joint projects for developing the Bioeconomy Campus area.

At present, the Bioeconomy Campus may be characterized as a nascent regional bioeconomy innovation ecosystem (Fig.3). It also has elements of technology park or initiative for clustering to create an economic stronghold – all those in a smaller scale than the respective entities in densely

populated urban areas. The interconnected actors in the core of the Bioeconomy Campus are Institute of Bioeconomy (BTI) of JAMK, the Natural Resources and Environment unit of POKE, municipality of Saarijärvi, and both the business development company and the facilities company of SSYP. These core organizations are located or being presented in the same campus area, they have a mutual agreement and a common brand of "Biotalouskampus" (Bioeconomy Campus). Their key-persons form a Managing Board that meets at regular intervals. Other involved actors are Regional Council of Central Finland, Chamber of Commerce of Central Finland, associated enterprises (the focus is on SMEs and micro-enterprises), municipal business development companies, and cooperating research institutes such as VTT Technical Research Center of Finland, LUKE Natural Resources Institute Finland, SYKE Finnish Environment Institute, etc.

Fig. 3. Position of the Bioeconomy Campus (Biotalouskampus) in Finnish RDI system. Modified and translated from Figure 5. in Paananen, M. [21] (p.17).

The campus has strong applied RDI competence, as well as tertiary and secondary education, e.g. in bioenergy, forestry, water protection, and dairy and beef cattle husbandry. Infrastructure in campus provides a pilot environment from laboratory to field experiments and testing of new methods and technology. New entrepreneurs are supported with laboratories, business incubator, start-up funding, business consulting and innovation services. Offices for SMEs will also be built in the campus area. At present, the campus employs mainly the staff of JAMK/BTI and POKE (altogether staff of around 100 persons) and has around 500 students. The campus also subcontracts increasing amount of maintenance, construction, training, and other services of local and regional/national companies.

Especially multidisciplinary and applied RDI cooperation projects (mainly coordinated by JAMK/BTI involving different stakeholders and students) have allowed cross-fertilization and interconnections among the following sectors: bioenergy, forestry, logistics, pulp & paper, agriculture, food & feed, water management, ICT, applied chemistry, ecosystem services, etc.

The new biorefinery of Metsä Fibre (http://biotuotetehdas.fi/in-english) presently being constructed within the distance of only around 30 km from the Bioeconomy Campus has already speeded up investments and RDI activities also in the Bioeconomy Campus area. For instance, there is presently a new bioterminal under construction in the campus area, new RDI projects on supply chains and storage of forest energy biomass are going on, and a "KasvuOpen" [GrowthOpen] business development process focusing to biomass value chains and byproducts of biorefinery is being carried out in cooperation with innovative SMEs. On the whole, the Bioeconomy Campus area will form an innovation and demonstration platform/pilot environment for development of smart bioeconomy businesses in rural environment.

4. DISCUSSION

Eliasson and Westlund [22] who studied entrepreneurship in urban and rural areas, summed up that differences between cities and countryside in their most fundamental form can be described in terms of variations in density of and accessibility to resources. The cities have more modern infra- and industrial structure, better supply of physical, financial and human capital and the connected services, and consequently, higher shares of growing industry. Concerning the access and acquisition of human, financial and social capital, it can be argued that rural entrepreneurs have lower access than their urban counterparts. However, it can also be argued that rural firms can overcome these disadvantages by, e.g., appropriate business networks. [22] According to Eliasson and Westlund [22], countryside's industrial structure has a smaller share of growing industries, and as countryside's startups follow the existing industrial structure, the 'modernity gap' between densely built up areas and countryside remains.

Rosenfeld [10] focused on cluster-based actions appropriate to less advantaged regions such as the peripheral or less populated region that has been dependent on resource-based industries but which must, with rising productivity and out-migration of youth reducing employment, find new growth opportunities. That description of less advantaged region fits northern Central Finland and the environment of Bioeconomy Campus. According to Rosenfeld [10], among barriers facing clusters in those kind of regions are also deficits in physical infrastructure and in technology institutional structures, lack of access to capital, lack of skills and opportunities to acquire them, and regional insularity such as limited access to new information, ideas, and markets from greater distances.

On the other hand, it can be argued that in the knowledge society of today the gap between urban and rural areas is no longer relevant. Like Westlund and Kobayashi [23] state, all places and regions are under a strong influence from cities, and thus there is rather a continuum between more and less urbanized places. Even the Bioeconomy Campus, located in the outskirts of the small rural town of Saarijärvi and only 30 km from the industrial hotspot in the larger town of Äänekoski, might be best placed along that continuum. Further, new possibilities offered by ICT today may help also rural enterprises and start-ups to follow the latest innovations and to build networks. However, ICT alone cannot fully compensate the lower access of human, social and financial capacity for rural enterprises, as acquisition of know-how, informal learning, and building trust require the face-to-face contacts. [10]

According to the BERST results from bioeconomy performance in whole Central Finland (NUTS3 level as compared to NUTS0 Finland in 2013), primary sector, bioenergy, and construction were dominating in the number of enterprises, whereas biotechnology sector was practically missing in Central Finland. Significance of paper and pulp sector was shown in employment structure, the sector was among the biggest employers. Excluding the paper and pulp sector, most of the enterprises in the region are very small, especially in forest fuel production and bioenergy. Separate figures for sub-regions like Saarijärvi were not included in BERST analysis, but we can suppose that the situation in rural Saarijärvi is comparable with that of Central Finland on the whole – if not even less favorable for growing industries. Thus, the 'modernity gap' mentioned by Eliasson and Westlund [22] can be recognized also in the rural environment of Bioeconomy Campus. Moreover, the small rural enterprises have limited resources for building up appropriate business networks.

Entrepreneurs and entrepreneurial culture play key role also in bioeconomy clusters.[1-4] Many rural entrepreneurs and innovators in the region do have promising new ideas for bioeconomy products and services and they are willing to develop bioeconomy businesses. The problem is that they have no instruments, no resources, nor necessary networks to further develop and test their business ideas. Thus, the Bioeconomy Campus with its networks, infrastructure and testing environments has an important role as innovation broker and as facilitator for building appropriate business networks with rural firms. According to the operation model of the Bioeconomy Campus, the new business idea will be introduced to the experts, evaluated, refined, and developed further in cooperation of the enterprises and other relevant actors. [21] The aim is to generate new bioeconomy businesses and to promote the development and growth of enterprises.

Among key assets of a bioeconomy cluster are biomass supply, competitive bioeconomy products, and funding. [1-3] Consistent provision of biomass resources is critical. Commercially viable products such as fine chemicals, medicines, food, chemicals, bioplastics, transport fuels, electricity and heat are success factors. Consistent funding both from public and private sources, new funding resources and attractive funding mechanisms for the entrepreneurs and investors are also necessary. [1-3]

Forest biomass is abundant in the region. Also agricultural biomass is available, but its handling and logistics need development. The Bioeconomy Campus is modernizing rural bioeconomy businesses

in the primary sector. As example of that are the projects and pilots on digitalizing different biomass production chains, carried out in cooperation with JAMK's Institute of Information Technology and ICT enterprises. That will create new opportunities for rural services and will increase the profitability of rural businesses. Further, the new biorefinery/bioproduct mill of Metsä Fibre in Äänekoski offers new possibilities for exploitation of the side streams of pulp and paper industry for developing competitive bioeconomy products. Metsä Fibre has invited local enterprises to participate in the process. However, the participation requires skills, resources, and testing platforms that are not available for local enterprises. Here again, the Bioeconomy Campus with its testing and piloting environments, experts and networks, will help the SMEs. These kind of actions are ideal for diminishing the modernity gap of rural industries in the region, and are in accordance with the idea by Rosenfeld [10]: 'The technology infrastructure is the mortar for building cluster-based economies'. (p.10)

The Bioeconomy Campus with its TD&D facilities and resources, for one, can help startups to span the "valley of death" described in Jackson's [17] model of innovation ecosystem. According to Jackson[17], a substantial increase in the TD&D resources available in the valley of death may move more innovations into the commercial sphere. However, Jackson [17] notes that it doesn't guarantee a thriving innovation ecosystem as a result, because to maintain the virtuous cycle of a thriving innovation ecosystem, even higher growth in net profit is needed at the same time. This is a challenge for innovation ecosystem – especially for a nascent one like the Bioeconomy Campus - that 'lacks the specificity of a distinct cluster, and often tends to have more of a supply-driven rather than a market-driven perspective' [7] (p.16).

Jackson [17], notes that from the venture capital point of view, there is a high probability most enterprises launched in the innovation ecosystem will fail. Therefore the ecosystem should handle failures in a way that encourages terminating losing investments early enough and efficiently recovering and recycling any resources including human capital that are released upon the failure of individual enterprises. Jackson [17] also remarks that '… even failed enterprises bring valuable lessons and experience into the culture of the ecosystem' (p.11). The future will show how the Bioeconomy Campus will succeed to handle the possible failures of enterprises and investment losses.

According to Jackson[17], there is no set of recipe for enhancing the odds that emerging technology innovations will successfully bridge the valley of death, but gives some practical examples that could help the venture to span the valley - for instance, training champions to shepherd ventures toward commercial success, and building a rapid prototyping infrastructure to low the entry costs for start-ups to engage in innovation. Further, finding ways 'to translate knowledge of discoveries developed in the research community into a context that is relevant to the industry investors reduce the perceived risk for the investor… to invest in the technology at an earlier stage' (p.11). Jackson also suggest regular brainstorming dialogs between researchers and members of the investor communities about nascent technology and its potential capabilities. In these respects, the asset of the Bioeconomy Campus is the already existing good network as well as the culture of active communication with various stakeholders, and a broker role between research and commercial communities.

As to the actions to support clustering in less favored regions, Rosenfeld [10] states that there is no single recipe to follow that will meet the needs of all different kind of clusters, but there is a menu of actions from which to choose: (1) understand and benchmark regional economies, (2) engage different actors, (3) organize and deliver services by cluster, teams, external connections, (4) build a specialized work force, (5) stimulate innovation and entrepreneurship by supporting and investing in innovations, start-ups, cluster-based incubators and technology hubs, and networks, (6) allocate and attract resources and investments, and (7) promote marketing and branding a region (p. 14-15). (For detailed descriptions and examples of the suggested actions, see Rosenfeld [10] p. 15-31.) Regarding most of the actions listed by Rosenfeld [10], the Bioeconomy Campus has well got under way.

Especially, as to understanding and benchmarking regional [bio]economies (1), the BERST results [1-4] can notably help clustering and further development of the Bioeconomy Campus.

In BERST analyzes [1-3], knowledge institutes were identified among key assets involved in bioeconomy clusters. The Bioeconomy Campus includes two knowledge institutes, and has close contacts to other knowledge institutes and RDI organizations. The main campus of JAMK is located in Jyväskylä (60 km south from Saarijärvi) and has staff of 700 and around 8 500 students (e.g. in the fields of technology, ICT and transport, business administration, social services and health care), 20 laboratories, a Generator – a market place for innovation and entrepreneurship, etc. Several fields of JAMK have linkages to bioeconomy, which enables integration of different expertise for creating new innovations for development of bio-products. The close RDI cooperation with VTT Technical Research Center of Finland as well as with LUKE Natural Resources Institute Finland and SYKE Finnish Environment Institute strengthen the RDI competence, technical know-how and resources at the Bioeconomy Campus. The cooperation of JAMK with University of Jyväskylä (with 15 000 students) and Jykes Ltd (Jyväskylä regional development company) offer strong scientific knowledge-base to generate new ideas and bioeconomy businesses. Further, the political and financial support from regional and local authorities has been strong and consistent for the development of the Bioeconomy Campus already from the early development stages.

Other assets involved in bioeconomy clusters are 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. [1-3] Political climate in the region is favorable for the development of the Bioeconomy Campus. There is a strong political will to develop bioeconomy in the region and to support bioeconomy businesses and the development of high-value bio-products. The Bioeconomy Campus is seen as a suitable tool for these aspirations. The present Strategy of Central Finland including the Plan for the Province until 2040, identifies three focus economic activities around which the capabilities, target markets and strategic development priorities are shaped: bioeconomy, digital economy and knowledge based economy. The strategy, for its part, has facilitated the allocation of public funds for bioeconomy RDI projects carried out at the Bioeconomy Campus as well as at the other RDI organizations acting in Central Finland such as VTT, University of Jyväskylä, and LUKE.

BERST results [1-4] indicate that development of bioeconomy cluster passes through three main stages, typically taking 10-15 years to reach maturity. First, in 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 are created. Second, during the drive to maturity, the first competitive bioeconomy products are sold at the market, the cluster grows with the setup of new companies, the cluster infrastructure (incubator, training center etc.) has been established, and the cluster is able to attract both private and public funding. Third, in the age of mature production, the cluster is able to produce competitive bioeconomy products at an extensive scale.

The Bioeconomy Campus in its present organized form is still in initial state, but it is rapidly approaching the drive to maturity stage. The Campus area is being continuously developed and the plans are actively implemented step by step. BERST analyses resulted in recommendations for the development of bioclusters in Central Finland. Considering the present stage of the Bioeconomy Campus, the recommendations seem quite relevant also for the future development of the campus. The Bioeconomy Campus will obviously benefit from the knowledge produced for NUTS3 Central Finland in BERST analyses. Based on the present case, we may conclude that the BERST results at NUTS3 level may also be down-scaled for sub-regions.

Acknowledgements: The author is grateful to Dr. Hannu Koponen for useful comments and to two anonymous reviewers for their valuable inputs.

REFERENCES

1. BERST. *Catalogue of bioeconomy clusters in Good Practices and BERST regions.* (15.8.2015). In: *Catalogue of Good Practices and Case studies.* Available from http://berst.databank.nl/report/catalogue%20of%20bioclusters%20in%20gp%20and%20berst%20regions.pdf [Accessed 23 February 2016].

2. BERST. *Good Practice: Central Finland (Paper & Pulp, Bioenergy)* (15.8.2015). In: *Catalogue of Good Practices and Case studies.* Available from http://berst.databank.nl/report/gp%20central%20finland%20(primary%20biomass,%20paper%20and%20pulp,%20bioenergy).pdf [Accessed 23 February 2016].

3. BERST. *Lessons learned from Good practice bioclusters.* (15.8.2015). In: *Catalogue of Good Practices and Case studies.* Available from http://berst.databank.nl/report/lessons%20learned%20from%20good%20practice%20bioclusters.pdf [Accessed 23 February 2016].

4. BERST. *Towards a bioeconomy cluster in Keski-Suomi: Current performance and future potential of regional bioeconomy*. In: *Regional Bioeconomy Profiles reports (dynamic reports)* (2015). Available from http://berst.databank.nl/report/keski_suomiprofile.pdf [Accessed 23 February 2016].

5. Vertainen, L., Ylimartimo, A. Comparison of Regional Bioeconomy Profiles for Primary Biomass Sectors between Central Finland and Good Practice Region Straubing (DE). In: Benet Ltd. (ed.) *Bioenergy 2015. Book of Proceeding for International Bioenergy Exhibition and Conference 2.-4.9.2015, Jyväskylä, Finland*; p. 42-47 (2015).

6. Porter, M.E. Clusters and the new economics of competition. *Harvard Business Review* **76** (6): 77-90. (1998)

7. European Commission. Smart Guide to Cluster Policy. *Guidebook Series – How to support SME Policy from Structural Funds* **11**:1-58 (2016). Available also from: DOI:10.2873/48105.

8. Lindqvist, G., Ketels, C., Sölvell, Ö. *The Cluster Initiative Greenbook 2.0.* Ivory Tower Publishers, Stockholm (2013). Available from: http://www.clusterobservatory.eu [Accessed 6th June 2016]

9. European Commission. *European Competitiveness Report 2012. Reaping the benefits of globalization.* European Union, Brussels (2012). DOI: 10.2769/68300 [Accessed 31 August 2016].

10. Rosenfeld, S.A. *Creating Smart Systems. A guide to cluster strategies in less favoured regions. European Union-Regional Innovation Strategies*. (2002) Available from: https://www.researchgate.net/publication/237285965 [Accessed 6th June, 2016]

11. Delgado, M., Porter, M.E., Stern, S. Clusters and entrepreneurship. *Discussion paper CES* **10-31**: 1-31 (2010). Available from: http://www.ssrn.com/abstract=1689084 [Accessed 31 August 2016].

12. Delgado, M., Porter, M.E., Stern, S. Clusters, convergence, and economic performance. *NBER Working Paper* **18250**: 1-52 (2012). Available from: http://www.nber.org/papers/w18250 [Accessed 31 August 2016].

13. Beaudry, C., Breschi, S. Are firms in clusters really more innovative? *Economics of Innovation and New Technology* **12**(4): 325-342 (2003); Available also from: DOI: 10.1080/10438590290020197.

14. McCann, B.T., Folta, T.B. Performance differentials within geographic clusters. *Journal of Business Venturing* **26**: 104-123 (2011).

15. Folta, T.B., Cooper, A.C., Baik, Y-s. Geographic cluster size and firm performance. *Journal of Business Venturing* **21**: 217-242 (2006).

16. Akpinar, M., Mermercioglu, M. Benchmarking competitiveness and innovation performances in two information technology clusters from Finland and Turkey. *Finnish Business Review* (16.12. 2014). Available from http://urn.fi/urn:nbn:fi:jamk-issn-2341-9938-3 [Accessed 23 February, 2016].

17. Jackson, Deborah J. *What is an innovation ecosystem.* National Science Foundation, Arlington, VA (2011). Available from: http://www.urenio.org/2011/05/20/ [Accessed 31 August, 2016]

18. Durst, S., Poutanen, P. Success factors of innovation ecosystems: A literature review. In: Smeds, R., Irrman, O. (eds.) *CO-CREATE 2013: The Boundary-Crossing Conference on Co-Design in Innovation. Aalto University Publication Series SCIENCE + TECHNOLOGY* **15**: 27-38 (2013).

19. Estrin, J. *Closing the innovation gap: Reigniting the spark of creativity in a global economy.* McGrew Hill, New York. (2009)

20. Panhelainen, M. (ed.). Kokeilua, kehitystyötä, tuloksia. Jyväskylän ammattikorkeakoulun alkuvaiheen tarina. [Experimenting, development work, results. Report on early phases of JAMK University of Applied Sciences]. *Jyväskylän ammattikorkeakoulun julkaisuja [Publications of JAMK University of Applied Sciences]* **81**: 1-425 (2007).

21. Paananen, M. *Biotalouskampus innovaatiojärjestelmä. Ehdotus kehittämishankkeeksi. [Bioeconomy Campus innovation system. Proposal for a development project.]* Working paper in Finnish (2016).

22. Eliasson, K., Westlund, H. Attributes influencing self-employment propensity in urban and rural Sweden. *Ann Reg Sci.* **50**(479) (2013); DOI: 10.1007/s00168-012-0501-9. [Accessed 23 February, 2016].

23. Westlund, H., & Kobayashi, K. *Social Capital and Rural Development in the Knowledge Society.* Cheltenham: Edward Elgar Publishing (2013).

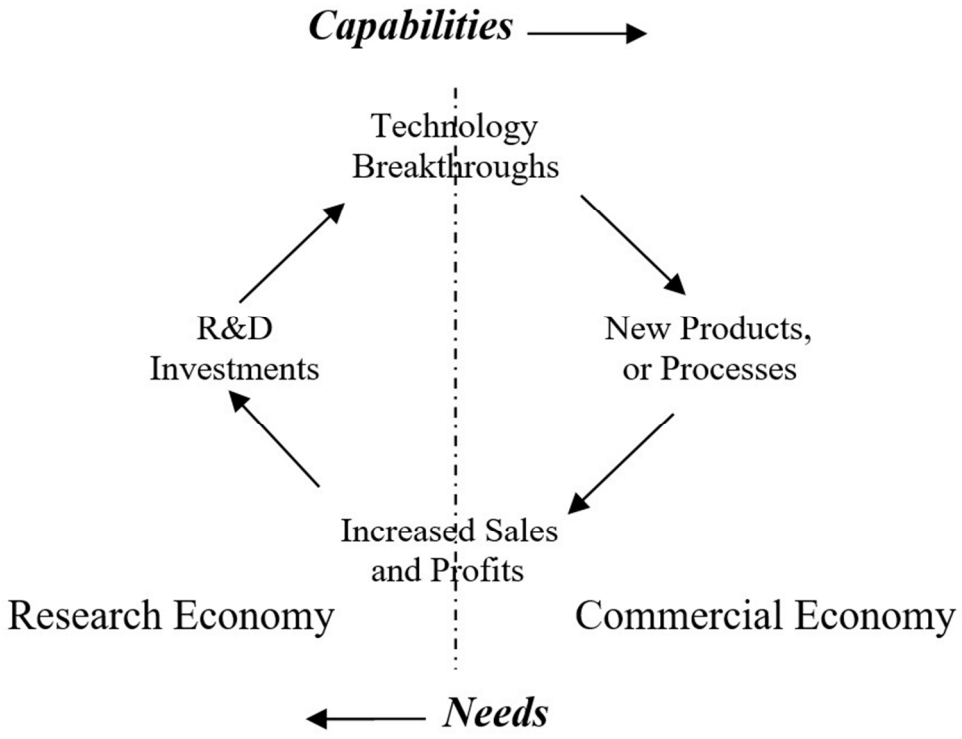


Fig. 1. Virtuous cycle in a thriving innovation ecosystem, where R&D investments are replenished through increased profits in the commercial economy. 17 The figure has been modified from Figure 1. in Jackson 17 (p.5).

317x237mm (72 x 72 DPI)

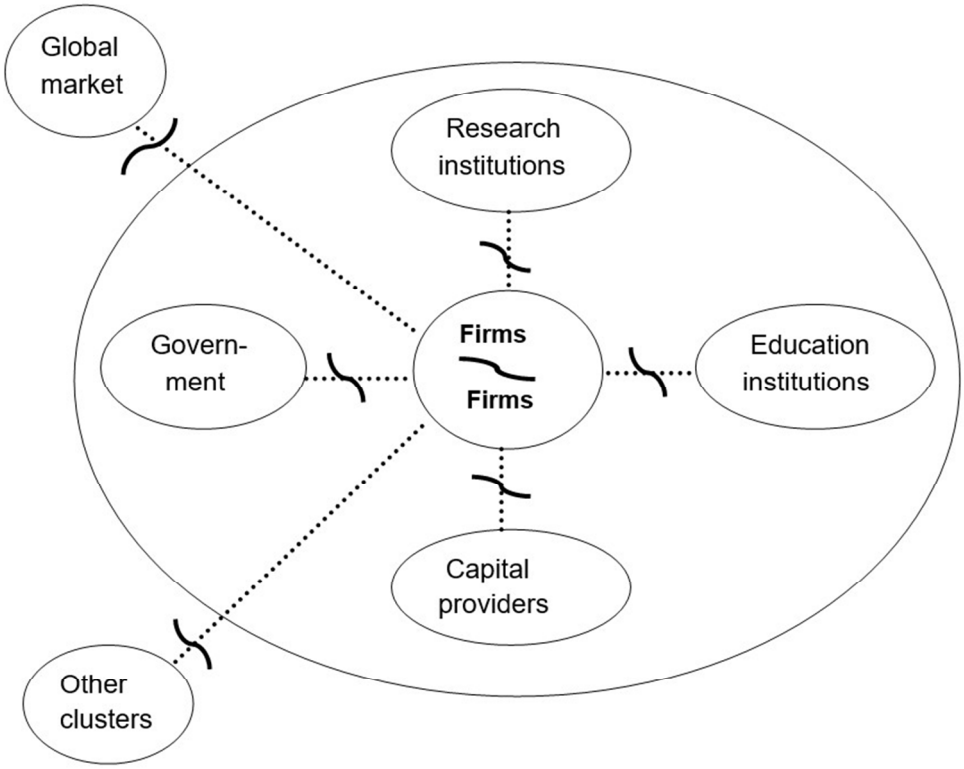
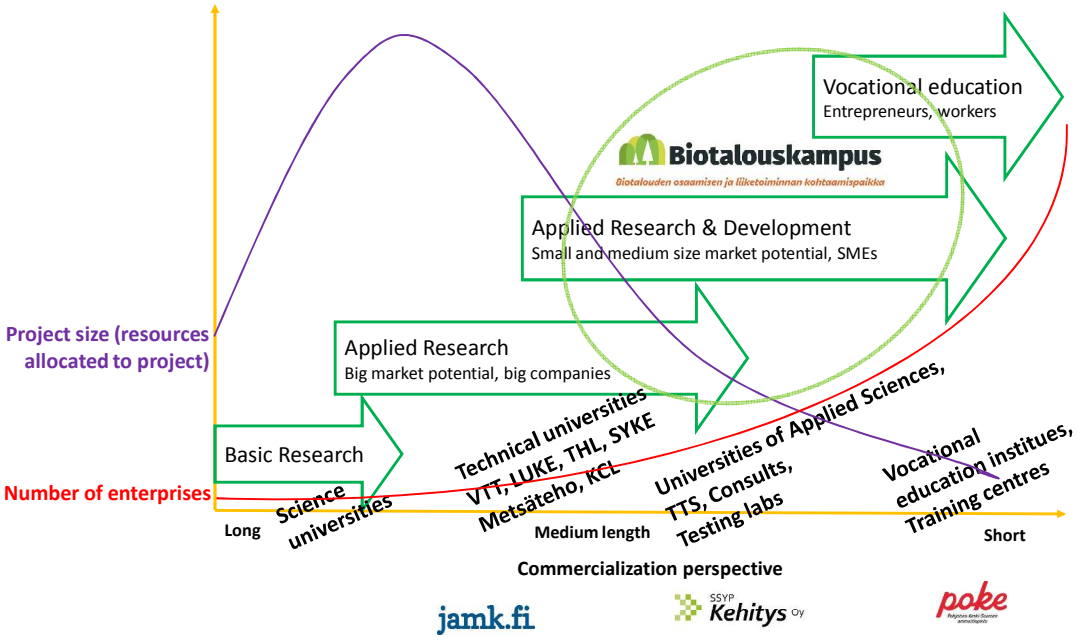


Fig. 2. The Gap Model by Lindqvist et al. 8 depicting the seven innovation gaps. The figure has been modified from Figure 4.2 in Lindqvist et al. 8 (p.38).

314x245mm (72 x 72 DPI)

Bioeconomy Campus (Biotalouskampus) in Finnish RDI system



Bioeconomy Campus (Biotalouskampus) in Finnish RDI system