Public Deliverable – D 3.1

Good Practices in selected bioeconomy sector clusters; a comparative analysis

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Contents

1. Introduction

The overall aim of WP3 of the BERST project is to explain the bioeconomy development path of regional Case Studies and selected Good Practices to serve as a practical guide and source of inspiration for other regions who wish to develop their bioeconomy potential.

Under this analysis:

- **Case studies** 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.

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This report (Deliverable 3.1) provides an overview of **Good Practice clusters and regions** performed within the BERST project in collaboration with the research[1] and regional partners[2]. The aims of the report are:

- to present a catalogue of Good Practices regarding their development in terms of bioeconomy.
- to share experiences and lessons learnt as well as to inspire European regions to support cluster formation and promote developments in the bioeconomy sectors.

The methodology for evaluating the development pathways of the under study clusters was the same across the Good Practices and Case Studies (Deliverable 3.2 *A representative set of case studies*) in order to maintain consistency in the analysis and allow comparisons to be made. In both cases, statistical data, literature and interviews with key actors were used.

Bioeconomy clusters have been categorised 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 and feed;
- construction;
- chemicals and polymers;
- pulp and paper;
- textile and clothing;
- energy;
- R&D services.

This report is structured in four main chapters. Chapter 2 provides an overview of the Good Practices and the regions that they are located. Chapter 3 describes the methodological approach. Chapter 4 translates the key findings from the analysis using two main dimensions of the analysis conducted in BERST i.e. key assets and time horizon and discusses their transferability to other regions. Finally, Chapter 5 provides concluding remarks, lessons learnt and recommendations.

[1] http://www.berst.eu/ResearchPartners.aspx
[2] http://www.berst.eu/RegionalPartners.aspx

2. Overview of Good Practice Regions and Clusters

This Chapter presents an overview of the Good Practice regions and clusters studied in the BERST project and described their main characteristics, regional specificities and relevant bioeconomy sectors they are involved in.

In this report, Good Practices are examples of successful bioeconomy clusters identified from literature, internet, contacts, other ongoing initiatives (e.g. Climate KIC, etc.). They are in the mature or close to mature production stage and have long term experience in their field, successful establishment and cluster organisation as well as strong presence of entrepreneurs and/ or large industrial actors with respective programs and joint initiatives. They are also presented in Table 2.

The bioeconomy is based on different sectors. In BERST, we distinguish eight sectors on which bioclusters can be based (Table 1).

Table 1: Bioeconomy sectors recognised by BERST

	Bioeconomy sector	Activities included
1	Primary biomass sectors	Arable, livestock, horticulture, fishery, aquaculture, forestry/wood
2	Food	Food and Feed processing
3	Construction	Natural fibre, based building materials, timber
4	Chemical and polymers	Chemicals and polymers, enzymes, biorefinery
5	Pulp and paper	Paper, fibres
6	Textile and clothing	Clothes, wearing, shoes
7	Energy	Solid energy, gaseous energy, liquid energy, co-digesting
8	R&D services in biomass	R&D services in biomass

Source: BERST Discussion Paper 3: Subsectors in Bioeconomy in BERST (2014).

2.1 Bioeconomy Sectors and Good Practices

This section introduces the Good Practices and identifies the respective bioeconomy sectors. Section 2.2 provides more detail on the Good Practices.

Table 2 presents the bioeconomy sectors that were involved in each Good Practice region and highlighted in green are the sectors where the respective clusters are considered by the interviewed stakeholders and the consortium and Good Practices.

R&D services is a key sector in most cases. In most cases, it is highly driven by the industrial demand and accompanied by substantial and consistent budgets for research and innovation at national and regional level.

Table 2 Bioeconomy sectors involved in each Good Practice region[3]

Bioeconomy sectors	Central Finland (FI)	Lower Bavaria (DE)	Biobased Delta (NL)	Westland (NL)	North Rhine Westfalia (DE)	Manchester (UK)	Ghent (BE)	Toulouse (FR)
Primary biomass	✓	✓	✓	✓				
Food and feed		✓		✓				
Construction			✓					✓
Chemicals and polymers		✓	✓		✓	✓	✓	✓
Pulp and paper	✓							
Textiles and clothing							✓	
Energy	✓	✓	✓				✓	
R&D services	✓	✓			✓	✓	✓	✓

***in green the bioeconomy sectors that are Good Practices within the study regions

Good Practices for the primary biomass sector have been identified in Central Finland (FI), lower Bavaria (Straubing, DE), Biobased Delta (NL) and Westland (NL). Central Finland is also considered as Good Practice for two more bioeconomy sectors, i.e. pulp & paper and energy.

North Rhine Westphalia (CLIB2021, DE) and Toulouse (Toulouse White Biotechnology, FR) are considered Good Practices for chemicals and polymers.

Ghent (GBEV, BE) is considered Good Practice for energy.

Manchester (Ciobio3, UK) is considered a Good Practice for R&D services.

No specific Good Practices have been recognised among the studies clusters and regions for the construction and textiles & clothing sectors, but they are present in Biobased Delta and Ghent (GBEV) so many of the issues affecting their performance will have similarities to the other sectors that are already Good Practices in the respective regions.

[3] Four of the regions (Central Finland, lower Bavaria, Westland and Biobased Delta) that are partners in BERST are considered as Good Practices for certain sectors.

The analysis in this report 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.

2.2. Good Practice regions

Good Practice regions in Belgium, Finland, France, Germany, Netherlands and United Kingdom have been analysed in order to:

- Understand how the various key assets interacted and performed during the development stages.
- Draw a number of general and specific lessons for the development of the 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.

The Good Practice clusters are briefly described below to provide the context of their nature and the characteristics of the region they operate.

Belgium: Ghent Bioenergy Valley[4]

Ghent Bio-Energy Valley was founded at the initiative of Wim Soetaert in July 2005 as a Public Private Partnership between Ghent University, the City of Ghent, the Port of Ghent, the Development Agency East-Flanders and a number of industrial companies related to the Ghent region, active in the fields of generation, distribution, storage and use of bio-energy.

The driving force for the establishment of GBEV was mainly of a political nature. By joining forces, companies were hoping to obtain an as large as possible production quota for biofuels from the Belgian government. In addition, the partnership was intended to tackle common problems related to production, feedstock or infrastructure. Finally, GBEV also provided a platform to inform the general public on these new products and technologies in a concerted way.

In 2013, the cluster acknowledged that despite the fact that it was initiated with bioenergy activities, a new range of activities were subsequently introduced; the name was changed to “Ghent Bio-Economy Valley” to reflect this.

Germany: North Rhine Westphalia- CLIB2021

CLIB2021 was founded with the aim to initiate research and development projects in the field of industrial biotechnology. The cluster has 80 members, encompassing: large industrial partners (such as Evonik, Henkel, LANXESS, Bayer, and BASF Personal Care); small and medium-sized enterprises (SMEs), which account for 40 per cent of their membership, and bring diversity of technologies and products to the cluster; and universities. Its operation and future development is structured across four key principles:

[4] http://www.gbev.org/en/who-is-gbev/history

Closing gaps between science and technology: The cluster brings together academic and industrial members who are active in research, development, production and commercialization – all crucial elements of the industrial value chain.

Addressing emerging markets: Novel, innovative materials, cost-efficient production processes and simplified downstream workflows, as well as feedstock which is leading the market both economically and ecologically are crucial elements. The cluster addresses these market demands and helps its members to manage the process of innovation.

Providing win-win solutions for all stakeholders: Academia provides technologies tailor-made to real industrial needs and takes care of the rising generation of scientists and engineers. SMEs provide an extensive range of services, and products. In collaboration with big industries, SMEs find academic institutes and research companies within the cluster to partner with and fill the product pipeline. All stakeholders need infrastructure, investors and production sites as well as business support and legal advice. Through its members, CLIB provides all these competencies to develop business based on science and technology.

Drive excellence in science and technology: The cluster has a well-structured communication platform for professionals in the research and industrial field which facilitates knowledge transfer, communication, networking and dissemination activities.

Germany: Lower Bavaria- Straubing

The region of Straubing in Lower Bavaria, Germany, is relatively rural with the proportion of people employed in agriculture and forestry significantly higher than the national average. As well as being agriculture and forestry-rich, the region has direct inland waterway access via a major port on the Danube to Eastern as well as to Western Europe. The port is specialized in biomass handling and freight. The Eastern Danube countries hold large biomass potential which makes the region an ideal source for biomass or intermediate imports.

A priority economic sector for Bavaria is life-sciences and the Straubing-based cluster “Renewable Raw Materials” was initiated in 2009 as a politically-led top-down initiative rather than industry-led. The cluster comprises four sub-sectors, namely primary biomass; energy; chemicals; R&D services in biomass. The state of development is heterogeneous. Primary biomass is at mature stage and is analysed in this report as Good Practice. Energy is at drive to maturity stage. R&D services and chemicals & polymers are both at initial stage. The other sectors are analysed in the individual Case Study report which is part of D3.2: A representative set of case studies.

Despite the fact that the majority of the circa 100 members are from the private sector, engagement of the private sector is considered to be relatively weak. This is due to the origin of the cluster being top-down and politically-led.

Finland – Central Finland

The area of Central Finland (Keski Suomi) has a population of 270,000 inhabitants and covers nearly 20,000 km^2. The region is characterized by 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.

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.

France – Mid Pyrenees- Toulouse White Biotechnology

Toulouse White Biotechnology (TWB) is a pre-industrial demonstrator that supports the development of innovative biological tools (enzymes, microorganisms, microbial consortia), thus opening new avenues for the production of chemical molecules, biopolymers, biomaterials and biofuels based on the use of renewable carbon. Most of the participating companies are SMEs. There are three key aims:

To promote white biotechnology: White, or industrial, biotechnology is the application of biotransformation and fermentation for manufacturing chemicals, materials, energy on an industrial scale through use of biomass as a renewable raw material. The challenge lies in developing an innovative bio-economy that makes use of renewable carbon without competing with food requirements.

To be a catalyst for scientific innovation: TWB promotes scientific and technological innovation by funding pre-competitive projects carried out in the very early stages of development that are potential sources of intellectual property. By adopting a project-based approach to research, TWB encourages collaboration between research teams that are specialists in their field of expertise, thus increasing the capacity for scientific innovation.

To strengthen links between research and industry: The TWB consortium, which comprises in particular 23 industrial partners and nine public institutions, is organized in such a way as to simplify contractual agreements, to encourage exchange between research and industry. Technology transfer is therefore speedier. Meetings between academic researchers and industrial partners are organized regularly to make joint projects more accessible

The cluster is in the transition from drive to maturity to mature stage and has as focus technology development and provision of innovative technology services alongside with science and building skills in the field of biotechnology. The biotechnology sector is part of Chemicals & Polymers within the categorisation used by the BERST project.

Netherlands- Zeeland and West-Brabant - Biobased Delta

The Biobased Delta cluster in south-west Netherlands began to operate in 2012, formed by the merger of two clusters in Zeeland and Brabant regions. In 2014, the Biobased Delta changed from a collaboration to a

formal foundation with a Board. Recently, there has been increased collaboration with neighbouring region Zuid-Holland.

Zeeland and West-Brabant have strong, mature agricultural sectors that provide major contributions to local and national economy. Since this activity in the primary biomass sector is part of the EC definition for bioeconomy activities, the bioeconomy of the Biobased Delta region could be considered to be in a mature stage as well. However, this would not do justice to the actual mission of the Biobased Delta biocluster organisation, which is to specifically enhance new economic activities in the non-food and non-feed sectors. These sectors (see more detail in the Case Study included in D3.2 ***) are at the initial stage. Though these sectors are relatively small, they have good growth potential, driven by factors such as rising oil prices, climate change, and the political drive to reduce dependency on energy imports. The Biobased Delta organisation aims to exploit the potential within regional players and to further strengthen the mature primary biomass sector. Primary biomass is at mature stage and is analysed in this report as Good Practice.

The updated focus of the Biobased Delta is clearly stated in the business plan released in 2013, titled “Agro meets chemistry”. The main economic activity which Biobased Delta aims to increase is the refinement and conversion of biomass (either locally sourced or imported) to chemicals. These include fuels, bulk, platform and specialty chemicals, and polymers. Biobased Delta is a leading European cluster in its field, in large part due to presence of strong chemical industry and primary sectors. Nonetheless, sustainable biobased chemistry activities are still in their infancy compared to the traditional oil based chemistry. Unlike oil extraction, refining and conversion, the agro and chemistry sectors historically have little common ground to build new activities on. Establishing these new relationships in the chain from biobased feedstock to biobased end product producers is therefore one of the tasks of the Biobased Delta organisation. Another is to stimulate and facilitate R&D efforts that are required along the chain.

The Biobased Delta also targets other bioeconomy sectors, including bioenergy and construction. Compared to the chemicals sector discussed in the previous paragraph, these are much lower value applications. It is, however, important to note that economic feasibility of biomass refinery depends on using all isolatable fractions in the highest value applications possible – this is no different from traditional oil refinery. All potential outlets are important: health and human nutrition products have highest value whilst feed and energy provide outlets for products that cannot be used elsewhere. The concept is ‘total biorefinery’. It is rare that a single product alone can enable costly refining processes to be economically feasible. Thus, many successful innovations involve large agro-companies with existing expertise and the ability to expand their existing food and feed portfolios with chemicals and materials derived from major side streams. An example is the large R&D effort made by Cosun and its partners to find ways to valorise the one million tonnes of pulp that remains annually after production of beet sugar, approximately half of which is in the Biobased Delta region. It is likely that products derived from sugar beet pulp will eventually find their way to all potential bioeconomy end product sectors defined in the BERST project. In the process, the primary biomass sector, the biorefinery sector and the R&D services sector will benefit as well.

Netherlands- Westland

The cluster was initiated by the Municipality of Westland in 2013. The main driver was the presence of a large area (approximately 3.000 ha) of greenhouses in the area with vegetables, flowers and plants and the concept to gain value from residues such as stems, leaves and class 3 products. The Westland area is very well known for its horticulture. Its location on the coast leads to a favourable climate conditions year-round, including relatively high light density which is beneficial for horticulture. In addition, the region lies between a few big Dutch cities and has good water, road and airplane connections for transport. The Westland is a prosperous and innovative area, due to the fast-growing developments in the field of agribusiness. In the greenhouse cluster there is an extensive cooperation between supplying companies, production, trade and knowledge institutes. The total turnover in the region is approximately 2 billion euros per year.

United Kingdom- Manchester- CoeBio3[5]

CoE Bio3 is a research based organisation funded by industrial actors with focus on the industrial development of northwest England. So far they have funded mostly doctoral level research on pharmaceuticals but there is a recent re-focus to advanced chemical applications including bioenergy and biomass. Albeit these activities are relatively new and advanced, they already form an important part of the activities among certain partners of CoBio3.

3. Methodology

The methodology for analysing the development path of the BE cluster was the same across the Good Practices and Case Studies in order to maintain consistency in the analysis and allow for comparisons. Two research dimensions have been used to analyse the development of the bioeconomy sectors within the bioclusters in the study regions, as follows:

1. Clusters' key assets and their interaction
2. Time horizon and stages of development

3.1 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 (ref). Figure 1 provides an illustration of a biocluster.

[5] http://www.coebio3.org/

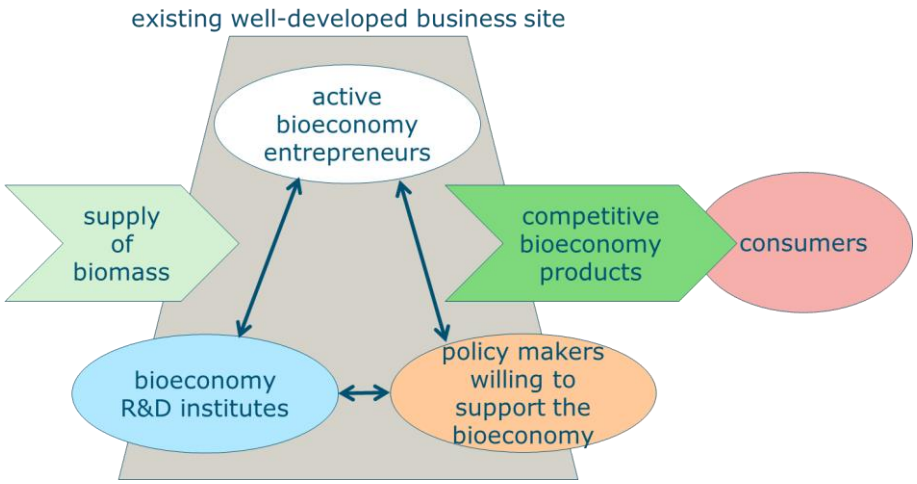

Figure 1 Organisational structure of a biocluster

Each key asset is described below:

a. Actors: 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.

b. 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.

c. Competitive bioeconomy products: commercially viable products such as fine chemicals, medicines, food, chemicals, bioplastics, transport fuels, electricity and heat.

d. Funding: consistent funding both from public and private sources, new funding resources and attractive funding mechanisms for the entrepreneurs and investors.

e. 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.

3.2 Time horizon and stages of development

Biocluster development passes through three main stages, typically taking 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. The stages of development are illustrated in Figure 2.

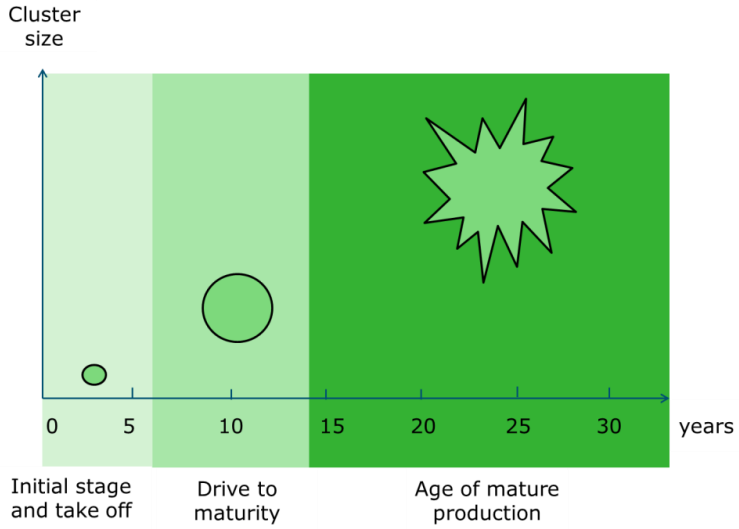

Figure 2 The development path of a biocluster

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 BERST project, we distinguish three phases[6]:

- 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)[7] the duration of the initial stage and take off is about 5 years, that of the drive to maturity 5-10 years and

[6] Inspired by Rostow's stages of growth.

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.

[7] PriceWaterhouseCoopers (2011), Regional Biotechnology: Establishing a methodology and performance indicators for assessing bioclusters and bioregions relevant to the KBBE area; Brussels; via website: http://ec.europa.eu/research/bioeconomy/pdf/regional-biotech-report.pdf

4. Key Findings, Transferability to Other Regions and Lessons for bioeconomy sectors

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 time horizon.

The work presented here provides comparative analysis of the key assets, their 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 for other clusters with similar characteristics in terms of sectors and assets.

This report uses traffic light colour coding to reflect the relative strength and importance of each key asset in the progress and performance of the cluster. The traffic light colour coding provides a qualitative interpretation of responses by thirty interviewees from the clusters and region as well as the regional partners from the BERST project. The code is as follows:

Low	Moderate	High

The Chapter is structured in three parts:

1. the first presents the key findings for each key asset and development stage which can serve as recommendations for other clusters or regions
2. the second evaluates the transferability of the recommendations per key asset and development stage to other regions
3. the third presents lessons drawn from the analysis of the Good Practices for each bioeconomy sector.

4.1 Key findings which can form recommendations per key asset and development stages

Table 3 presents the ranking of key assets (green- high, amber- moderate, red- low) in the Good Practices per development stage.

Table 3: Key Assets Rated with High (green), Moderate (amber) and Low (red) Importance by Development Stage

Bioeconomy sectors	Central Finland (FI)			Straubing (DE)			Biobased Delta (NL)			Westland (NL)			North Rhine Westphalia (DE)			Manchester (UK)			Ghent (BE)			Toulouse (FR)		
Stage	Initial	Drive to maturity	Mature production	Initial	Drive to maturity	Mature production	Initial	Drive to maturity	Mature production	Initial	Drive to maturity	Mature production	Initial	Drive to maturity	Mature production	Initial	Drive to maturity	Mature production	Initial	Drive to maturity	Mature production	Initial	Drive to maturity	Mature production
Cluster Organisation																								
Actors																								
Entrepreneurs																								
Large industrial actors																								
Policy makers																								
Knowledge institutes																								
Biomass supply																								
Bioeconomy product																								
Policies and measures																								
Funding																								

Figure 3 illustrates the improvement in the performance of key assets from the initial stage to drive to maturity stage. An example is the role of funding. At the initial stage, approximately 30% of Good Practices rated funders to have low performance (see the red section of the column *Funders (IS)*) and only 10% of Good Practices rated funders to have high performance (green section of the column *Funders(IS)*) By the drive to maturity stage, there were no Good Practices which considered funders to have low importance and the proportion that rated funders to have high performance had increased from 10% to 40% .

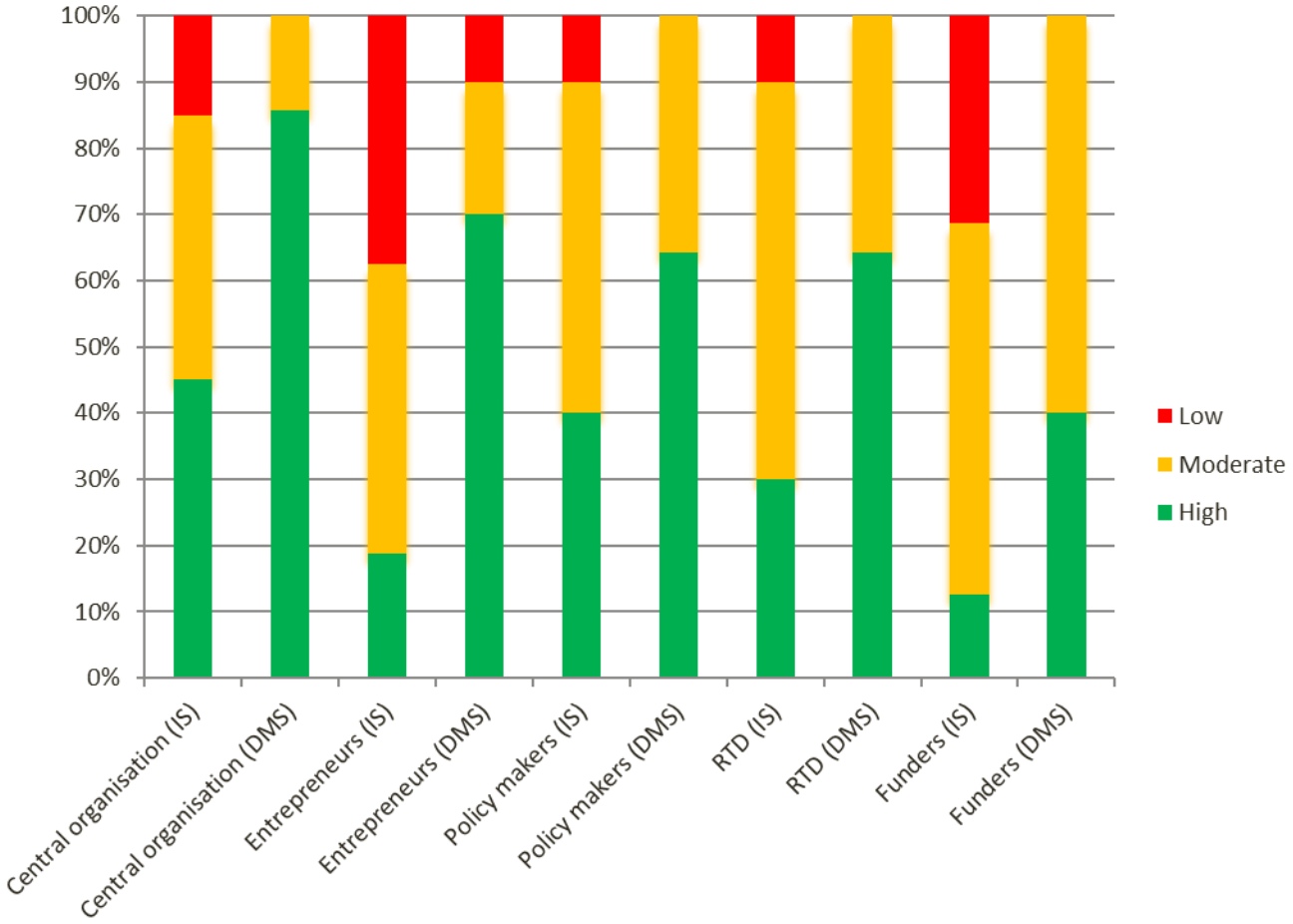

Figure 3 Performance of Key Assets at Initial Stage and Drive to Maturity Stage for all Good Practices

The conclusion that could be drawn is that clusters may be initiated with relatively low levels of funding, but if funding is not found then a cluster will not progress beyond the initial stage – in other words, *funding* is a critical success factor. A similarly profound change is shown for the key asset *entrepreneurs*. At the initial stage, less than 20% of Good Practices rated entrepreneurs as a high performing asset but, by the drive to maturity stage, this had increased to 70%.

Central organisation is also seen to be a critical success factor. At the initial stage, only 45% of Good Practices rated this asset as high performance but by the drive to maturity stage, 85% of Good Practices rated it high, and none rated it low performance.

Detailed recommendations for other clusters and regions per each key asset and development stage are provided below and further summarised in Table 4. These recommendations have to be applied by the individuals or authorities who wish to form a cluster and initiate similar activities in the regional bioeconomy.

4.1.1 Cluster organisation

- Cluster organisation has been considered by the interviewed stakeholders a useful means of developing the cluster and ensuring its smooth operation through the various stages. Most responders suggested that during the first steps of the initial stage the importance of a centralised cluster organisation ranks moderate but it is critical to create the cluster "culture".

- It is, however, important to establish an efficient cluster structure before entering the drive to maturity stage and strengthen the involvement of cluster management in regional business processes via the development of new, more effective operative tools (e.g. data bases, funding instruments, open innovation processes etc.).

- As the cluster moves to the mature production stage it is essential to ensure the consistent and continuous evolution of its management body to follow developments and meet the requirements of entrepreneurs, suppliers, technology providers, politicians, financiers, etc.

4.1.2 Actors

- The three stakeholder categories forming the group of actors which influence the development of a cluster are considered of equal importance across the three development stages with knowledge institutes ranking slightly higher at the initial stage, and entrepreneurs during the drive to maturity and the mature stages.

- In detail, the presence of entrepreneurs and entrepreneurial culture has been ranked higher among the other key assets in all the cluster development stages. In most cases, it was considered of major importance to have strong interest and active participation of such actors from the set up to the maturity stages. At this point it should be stressed that large industrial actors are considered of ultimate importance for the biotechnology/ chemicals & polymers and the energy sectors as they are the driving forces behind highly innovative products and components (CLIB2021, TWB, GBEV, etc.).

- During the initial stage, it was considered very important to follow an "open & participatory" approach that will allow efficient communication, discussions, transfer of knowledge and formation of synergetic actions.

- During the drive to maturity stage a key message from interviewees was to upgrade the competences of the cluster actors, adapting provision of vocational education and training to the economic trends and productive system requirements.

- As the cluster moves to the mature stage, it should develop and maintain a broad network with other institutions from the relevant field as well as with other clusters, both within the country as well as cross-boundary, as this will provide access to latest information as well as a platform for dissemination and promotion of cluster members' activities.

4.1.3 Biomass supply

- Biomass supply has also been given high scoring in most cases alongside with the good infrastructure and logistics, i.e. the cases of Straubing, Biobased Delta, Westland and Central Finland.

- During the initial stage, interviewees from most of the clusters have suggested that locating the cluster close to raw material is a key success factor both for the security of supply but also for the awareness of professionals and the public on issues related to handling, transporting and using the raw material.

- At the drive to maturity stage, the scale and nature of supply & logistics becomes more complex as the cluster businesses develop their activities and scale-up. It is therefore important that local industry and regional authorities have strong collaborations and become aware of new possible prospects that may arise from the biobased economy and the synergies that may develop among its various market sectors.

- During the mature production stage scales and number of businesses expand so the actors involved should exploit the secondary biomass resources, focus on industrial symbiosis and foster the cascading use of biomass and the circular economy.

4.1.4 Competitive bioeconomy products

- The role of competitive bioeconomy products was considered important for the drive to maturity and mature stages while it was ranked quite low for the initial stage.

- As biobased sectors require complex interactions across supply and demand sectors (chemicals, fuels, energy etc.) during the initial stage the cluster activities should focus on successful cross-over among sectors.

- During the drive to maturity stage, start-up financing from the industry creates better prospects for product development and market uptake.

- To ensure smooth transition to and operation of the mature stage, it is important to steer the development of new products according to the principles of specialization, resource availability and market demand and in this respect improve learning mechanisms from other regional clusters with a similar economic or geographical profile.

4.1.5 Policies and measures

- Although strong political support alongside stable and consistent policies and measures have been regarded helpful for establishing and operating a cluster, the importance of their role has been ranked lower to that of securing funding from either public or private sources.

Table 4: Recommendations per key asset and development stage for the development of bioclusters

Key asset	Initial	Drive to maturity	Mature production
Cluster organisation	Establish an effective governance structure.	Strengthen the involvement of cluster management in regional business processes	Ensure consistent and continuous evolution of the cluster management body to follow developments and meet the requirements of actors involved
Actors	Follow an "open & participatory" approach with efficient communication.	Upgrade the competences of the cluster actors, and improve vocational education and training.	Develop a broad network with other institutions from the relevant field as well as with other clusters, both within the country as well as cross-boundary.
Biomass Supply	Locate the cluster close to regions with high concentration of raw material.	Develop strong collaborations to cope with the complex scale and nature of supply & logistics.	Emphasize the importance of secondary biomass and foster the cascading use of biomass and the circular economy
Competitive bioeconomy product	Focus activities on successful cross over among sectors.	Sustain start up financing from the industry.	Steer the development of new products according to the principles of smart specialization, resource availability and market demand.
Policy	Develop policy and focus of the cluster with the active participation of the industry	Ensure political commitment to facilitate building of industrial production units and commercialisation of new products	Develop and maintain long-term regional bioeconomy policy with emphasis on smart specialization potentials
Funding	Ensure long-term (co-) funding from public bodies	Set up mechanisms to attract venture capital to the region	Ensure business commitment, both from SMEs as well as from big companies

- During the initial stage of the cluster, strategy and vision should be carefully discussed and analysed with the participation of the local industrial actors and/ or entrepreneurs who are likely to join and integrate their activities.
- At the drive to maturity stage, the cluster should ensure political commitment, consistent targets for bioeconomy as this is expected to facilitate building of industrial production units and commercialisation of new products
- During the mature production stage, a long-term regional bioeconomy policy with emphasis on smart specialization potentials should be established and be consistent throughout the lifetime of the cluster.

4.1.6 Funding

- During the initial stage, most interviewees highlighted that security of long-term funding from public bodies was important to set up the cluster and start operation.

- As the cluster moves to the drive to maturity stage, support mechanisms and infrastructures should be established in order to attract venture capital to the region and assist entrepreneurs start up their businesses.

- During the mature production stage, the cluster should focus on maintaining its successful businesses and bioeconomy products as well as expanding towards other innovative pathways and routes. To achieve this the cluster management should ensure business commitment in terms of co-financing, both from SMEs as well as from big companies.

4.2 Transferability of findings in Good Practice cluster and regions

This section provides a overview with regard to evaluating the recommendations per key asset and development stage to other regions. The objective is to help regional and local authorities in designing strategies to develop a competitive bioeconomy.

Transferability[8] in this analysis is defined as the process in which knowledge about technologies, policies, administrative arrangements, institutions and ideas in one political and administrative or geographic setting (past and present) is used in the development of technologies, policy, administrative arrangements, institutions and ideas in another setting and geographical area.

[8] PriceWaterhouseCoopers (2011), Regional Biotechnology: Establishing a methodology and performance indicators for assessing bioclusters and bioregions relevant to the KBBE area; Brussels; via website: http://ec.europa.eu/research/bioeconomy/pdf/regional-biotech-report.pdf

Table 5: Degree of transferability of key issues in Good Practices and clusters for the various key assets and development stages

Key asset	Stage	Issue(s)	Degree of transferability
Cluster Organisation	Initial	Establish an effective governance structure; consistency and continuous evolution of the cluster management	**Moderate** and reliant to the prevailing situations in each region sand the commitment, persistence and aspiration of individuals
	Drive to maturity	Strengthen the involvement of cluster management in regional business processes via the development of new, more effective operative tools	**High** as there are plenty examples and good software/ tools available to improve transfer of knowledge and communication with local businesses. The only challenge is to ensure there are job position in the cluster management body to take this on board.
	Mature production	Consistency and continuous evolution of the cluster management body to follow developments and meet the requirements of entrepreneurs, suppliers, technology providers, politicians, financiers, etc.	**Moderate to high** as it requires a cluster organisation body with consistent operation and continuous presence in the region.
Actors	Initial	"Open & participatory" approach within the innovation communication channels	**High** as openness and discussions can be facilitated by the cluster organisation or leading individuals. Still, at some occasions where there are small companies and competition is rather high the issue of openness can become a challenge.
	Drive to maturity	Upgrade the competences of the work force	**Moderate to high** through the improvement of education programmes and dedicated workshops. The challenge at local level may be securing funds to perform the programmes and ensuring that adequate experts exist in their regional academic and research institutions. R&D funding from EU can provide strong assistance in such cases.
	Mature production	Develop a broad network with other institutions from the relevant field as well as with other clusters, both within the country as well as cross-boundary.	**Moderate to high** for the same reasons as above. EU funds for networking & knowledge transfers can be extremely beneficial
Biomass supply	Initial	Location close to raw material	**Moderate** and location related
	Drive to maturity	Complex scale and nature of supply & logistics	**High** transferability and knowledge for efficient logistics can be transferred and tailored
	Mature production	Importance of secondary biomass and cascading use	**High** transferability as both principles (waste use and recycling) and cascading are applicable (to different extent) to all raw materials

Table 5: (continued) **Degree of transferability of key issues in Good Practices and clusters for the various key assets**

Key asset	Stage	Issue(s)	Degree of transferability
Competitive bioeconomy product	Initial	Successful cross over among sectors	**Low to moderate** as cross overs depend highly on nature or disciplines involved and maturity of the markets within a region
	Drive to maturity	Start up financing from the industry	**Low to moderate** as industrial presence is not always certain- some clusters rely on the strong entrepreneurial culture of SMEs instead.
	Mature production	Steer the development of new products according to the principles of smart specialization, resource availability and market demand	**High** since there are a lot of efforts from the European Commission and the regions across Europe to design and implement smart specialisation strategies[9]
Policies and measures	Initial	Align strategy with industrial/ entrepreneurial demand and requirements	**High** since this is one of the first steps in the communication of policy makers and producers/ end using industries/ SMEs in order to agree on the focus of the cluster, establish it and introduce bioeconomy policies and measures
	Drive to maturity	Ensure political commitment	**Low to moderate** as policy makers at all governance levels are subject to change after certain periods of time so the new ones need to be informed and the process requires continuous attention, adaptation and communication of consistent messages.
	Mature production	Develop and maintain long-term regional bioeconomy policy with emphasis on smart specialization potentials	**Moderate** as long term policies are quite hard to implement and maintain and require strong commitment from governments, regional authorities and administrative bodies.
Funding	Initial	Long-term (co-)funding from public bodies	**Low to moderate** as public co- funding is subject to change and revisions after certain periods of time so the new ones need to be informed and the process requires continuous attention, adaptation and communication of consistent messages.
	Drive to maturity	Attract venture capital to the region	**Low to moderate** as it is strongly reliant to the economic situation and competitiveness of individual countries and regions, investment environment and competition with other regions
	Mature production	Ensure business commitment, both from SMEs as well as from big companies	**Moderate** as long term commitment requires economic and political stability, trust from investors and funding bodies as well as good success stories with high replication potential.

[9] http://s3platform.jrc.ec.europa.eu/s3-platform-registered-regions

4.3. Lessons Learned

This section presents general and specific lessons drawn from Good Practice clusters per key asset and development stage for the BERST bioeconomy sectors. These lessons can facilitate the development of bioeconomy potential in the under study sectors in European regions.

General lessons are identified as overarching principles that experience has shown must be followed to give success to the development of bioeconomy clusters.

4.3.1 General lessons across all bioeconomy sectors

Cluster organisation

- Focus on developing "triple helix" among knowledge institutes, entrepreneurs and policy makers (*Initial stage*)

Actors

- Networking is of great importance; focus on bringing together different target groups having the same targets/ visions. *(Initial, drive to maturity, maturity stages)*

Biomass Supply

- Both primary and secondary biomass have several usage paths already. For long term supply carefully evaluate synergies, industrial symbiosis and competition. *(Initial, drive to maturity, maturity stages)*

Competitive bioeconomy product

- The development of competitive biobased products should meet the requirements of industrial actors and be supported by them. *(Drive to maturity, maturity stages)*

Policies

- Policies with a long term orientation on bioeconomy are more likely to be successful. *(Initial, drive to maturity, maturity stages)*

Funding

- Business development should not rely only on public funds. *(Initial, drive to maturity, maturity stages)*

Within each of the general lessons, specific learning points are described – these provide a deeper "dive" into the actual instruments and activities that have been used to help create success. Lessons are further analysed by key asset and development stage and by individual bioeconomy sector.

4.3.2 Specific learning points for developing potential of Primary Biomass sector

Cluster organisation

- Establish an effective governance structure including a board or committee from the very beginning (*Initial stage*)
- Provide tailored services for networking between different sectors (*Drive to maturity, maturity stages*)

Actors

- Develop an "open & participatory" approach within the innovation communication channels. (*Initial stage*)

- Communicate and discuss findings, success and failures frequently. *(Initial, drive to maturity, maturity stages)*
- Inform and promote the "collaborative spirit" to biomass producers in order to establish trust between production and demand site. (*Initial stage*)

Biomass supply

- Emphasize the importance of secondary biomass, thus waste material, both in the sphere of R&D (development of technologies for usage) and industry. (*Drive to maturity, maturity stages*)

Competitive biobased product

- Facilitate open innovation processes between the different sectors; strengthen biorefinery concept and application. (*Drive to maturity, maturity stages*)

Funding

- Subsidies for initial investments can be critical for start-ups. *(Initial, drive to maturity stages)*

4.3.3 Specific learning points for developing potential of Food & Feed sector

Cluster organisation

- Central location of the cluster and the cooperatives provides excessive exposure and public awareness of the primary sector's stakeholders about the cluster' existence and activity. *(drive to maturity stage)*

Actors

- Strong cooperatives with high entrepreneurial culture in the region strengthen the cluster establishment and operation. *(Initial, drive to maturity stages)*

Biomass supply

- The scale and nature of supply & logistics is complex; it is therefore very important that local industry and regional authorities have strong collaborations. (*Drive to maturity, maturity stages*)

Policy

- The future strategy and perspectives of the cluster should be carefully considered with the participation of the industry. *(Initial, drive to maturity, maturity stages)*

Funding

- Subsidies for initial investments can be critical for start-ups. *(Initial, drive to maturity stages)*

Table 6: General Lessons and Specific Learning Points by Key Asset, Development Stage and Bioeconomy Sector (blue highlight indicates most important learning points by sector)

General Lessons & Specific Learning Points	Key asset	Stage[10]	Primary biomass	Food	Construction	Chemicals & polymers	Pulp & paper	Textiles & clothing	Energy	R& D
Focus on developing "triple helix" among knowledge institutes, entrepreneurs and policy makers	Cluster organisation	IS	✓	✓	✓	✓	✓	✓	✓	✓
Establish an effective governance structure including a board or committee from the very beginning		IS	✓			✓			✓	
Develop a strong cluster organisation body with staff combining skills from industry and academia		IS			✓	✓	✓	✓	✓	
Develop a «Cluster culture».		IS	✓			✓			✓	✓
Ensure the connection of value chain elements, especially regarding flow of information for project development and the like;		DMS	✓			✓			✓	✓
Central location of the cluster and the cooperatives provides excessive exposure and public awareness of the primary sector's stakeholders about the cluster' existence and activity.		DMS	✓	✓	✓	✓		✓	✓	
Provide tailored services for networking between different sectors		DMS	✓	✓		✓				
Strengthen the involvement of cluster management in regional business processes via the development of new, more effective operative tools (e.g. data bases, funding instruments, open innovation processes etc.)		DMS	✓	✓		✓				

[10] Initial stage: IS; Drive to maturity stage: DMS; Maturity stage: MS

General Lessons & Specific Learning Points	Key asset	Stage	Primary biomass	Food	Construction	Chemicals & polymers	Pulp & paper	Textiles & clothing	Energy	R& D
Networking is of great importance; focus on bringing together different target groups having the same targets/ visions.	Actors	IS DMS MS	✓	✓	✓	✓	✓	✓		✓
Develop an "open & participatory" approach within the innovation communication channels. Communicate and discuss findings, success and failures frequently.		IS DMS MS	✓	✓	✓			✓		✓
Attempt to reach an as concentrated as possible regional focus; beyond-regional scattering and spread lead to difficulties in stakeholder management		IS				✓			✓	✓
Long tradition & strong history in the field improves the relationship and understanding among stakeholders		IS		✓	✓	✓	✓	✓	✓	✓
Research organisations which have strong expertise and international leadership can support the establishment and operation of the cluster		IS DMS		✓		✓			✓	✓
Strong cooperatives with high entrepreneurial culture in the region strengthen the cluster establishment and operation.		DMS	✓	✓				✓		
Upgrade the competences of the work force, adapting the supply of vocational education and training to the economic trends and productive system needs.		DMS			✓	✓			✓	✓
Develop a broad network with other institutions from the relevant field as well as with other clusters, both within the country as well as cross-boundary, as this will provide access to latest information as well as a platform for dissemination and promotion of cluster members' activities		DMS			✓	✓			✓	✓

General Lessons & Specific Learning Points	Key asset	Stage	Primary biomass	Food	Construction	Chemicals & polymers	Pulp & paper	Textiles & clothing	Energy	R& D
Both primary and secondary biomass have several usage paths already. For long term supply carefully evaluate synergies, industrial symbiosis and competition	Biomass supply	IS DMS MS	✓	✓	✓	✓	✓	✓	✓	✓
The scale and nature of supply & logistics is complex; it is therefore very important that local industry and regional authorities have strong collaborations		DMS MS		✓	✓	✓				
Location close to raw material is a key success factor		IS	✓							
Inform and promote the "collaborative spirit" to biomass producers in order to establish trust between production and demand site.		IS	✓	✓					✓	
In order to use primary and secondary biomass as feedstock for bioeconomy applications, consistent stakeholder dialogues and coordination needs to be facilitated;		DMS	✓			✓			✓	✓
Emphasize the importance of secondary biomass, thus waste material, both in the sphere of R&D (development of technologies for usage) and industry		DMS MS	✓		✓	✓	✓		✓	
Improve cooperation and communication between farmers and forestry as providers of primary feedstock and entrepreneurs responsible for industrial applications in order to avoid deadlocks, feedstock shortages and overpriced feedstock		DMS MS	✓	✓						
Foster the cascading use of biomass and the circular economy in order to make full use of biomass potential		DMS MS			✓	✓	✓		✓	

General Lessons & Specific Learning Points	Key asset	Stage	Primary biomass	Food	Construction	Chemicals & polymers	Pulp & paper	Textiles & clothing	Energy	R& D
The development of competitive biobased products should meet the requirements of industrial actors and be supported by them	Competitive Biobased products	DMS MS	✓	✓	✓	✓	✓	✓	✓	✓
Start up financing from the industry creates better prospects for product development and market uptake		DMS MS		✓	✓	✓		✓	✓	✓
Cluster management should be more engaged in and informed about product development of its cluster partners in order to monitor project processes, recognize potential cross-overs and facilitate cooperation		IS	✓			✓			✓	✓
Steer the development of new products according to the principles of smart specialization, resource availability and market demand and in this respect improve learning mechanisms from other regional clusters with a similar economic or geographical profile		DMS MS			✓	✓	✓		✓	
Facilitate open innovation processes between the different sectors; strengthen biorefinery concept and application		DMS MS	✓						✓	

General Lessons & Specific Learning Points	Key asset	Stage	Primary biomass	Food	Construction	Chemicals & polymers	Pulp & paper	Textiles & clothing	Energy	R& D
Policies with a long term orientation on bioeconomy are more likely to be successful	Policy	IS DMS MS	✓	✓	✓	✓	✓	✓	✓	✓
The future strategy and perspectives of the cluster should be carefully considered with the participation of the industry		IS DMS MS		✓	✓	✓	✓	✓	✓	
Bind the cluster development to a state or federal cluster programme that also provides solid and long-term funding (e.g. Clusters of Excellence Initiative or the like)		IS	✓	✓		✓			✓	
Ensure political commitment also for the drive to maturity phase that could involve building of industrial production sites and the like which need public acceptance and political will and support		DMS			✓	✓	✓	✓	✓	

General Lessons & Specific Learning Points	Key asset	Stage	Primary biomass	Food	Construction	Chemicals & polymers	Pulp & paper	Textiles & clothing	Energy	R& D
Business development should not rely only on public funds	Funding	IS DMS MS	✓	✓	✓	✓	✓	✓	✓	✓
Subsidies for initial investments can be critical for start ups		IS	✓	✓	✓	✓	✓	✓	✓	
Ask for cluster participation/membership fee, as it will heighten the value of the membership to companies; Ensure long-term (co-)funding from public bodies (e.g. ministry)		IS DMS MS	✓			✓			✓	✓
Ensure business commitment, both from SMEs as well as from big companies (only partially given)		DMS MS	✓						✓	
Set up mechanisms to attract venture capital to the region		DMS MS		✓	✓	✓	✓	✓	✓	

4.3.4 Specific learning points for developing potential of Construction sector

Cluster organisation

- Develop a strong cluster organisation body with staff combining skills from industry and academia. *(Initial stage)*

Actors

- Upgrade the competences of the work force, adapting the supply of vocational education and training to the economic trends and productive system needs. *(Initial, drive to maturity stages)*

Biomass supply

- Foster the cascading use of biomass and the circular economy in order to make full use of biomass potential. (*Drive to maturity, maturity stages*)

Competitive biobased product

- Start up financing from the industry creates better prospects for product development and market uptake. (*Drive to maturity, maturity stages*)

Policy

- The future strategy and perspectives of the cluster should be carefully considered with the participation of the industry. *(Initial, drive to maturity, maturity stages)*

Funding

- Subsidies for initial investments can be critical for start-ups *(Initial, drive to maturity stages)*

4.3.5 Specific learning points for developing potential of Chemicals & Polymers sector

Cluster organisation

- Develop a strong cluster organisation body with staff combining skills from industry and academia. *(Initial stage)*

Actors

- Develop a broad network with other institutions from the relevant field as well as with other clusters, both within the country as well as cross-boundary, as this will provide access to latest information as well as a platform for dissemination and promotion of cluster members' activities. (*Drive to maturity stage*)

Biomass supply

- Foster the cascading use of biomass and the circular economy in order to make full use of biomass potential. (*Drive to maturity, maturity stages*)

Competitive biobased product

- Steer the development of new products according to the principles of smart specialization, resource availability and market demand and in this respect improve learning mechanisms from other regional clusters with a similar economic or geographical profile. (*Drive to maturity, maturity stages*)

Policy

- The future strategy and perspectives of the cluster should be carefully considered with the participation of the industry. *(Initial, drive to maturity, maturity stages)*

Funding

- Subsidies for initial investments can be critical for start-ups *(Initial, drive to maturity stages)*

4.3.6 Specific learning points for developing potential of Pulp & paper sector

Cluster organisation

- Develop a strong cluster organisation body with staff combining skills from industry and academia. *(Initial stage)*

Actors

- Long tradition & strong history in the field improves the relationship and understanding among stakeholders. *(Initial stage)*

Biomass supply

- Foster the cascading use of biomass and the circular economy in order to make full use of biomass potential. (*Drive to maturity, maturity stages*)

Competitive biobased product

- Steer the development of new products according to the principles of smart specialization, resource availability and market demand and in this respect improve learning mechanisms from other regional clusters with a similar economic or geographical profile. (*Drive to maturity, maturity stages*)

Policy

- The future strategy and perspectives of the cluster should be carefully considered with the participation of the industry. *(Initial, drive to maturity, maturity stages)*

Funding

- Set up mechanisms to attract venture capital to the region. (*Drive to maturity, maturity stages*)

4.3.7 Specific learning points for developing potential of Textiles and clothing sector

Cluster organisation

- Develop a strong cluster organisation body with staff combining skills from industry and academia. *(Initial stage)*

Actors

- Develop an “open & participatory” approach within the innovation communication channels. Communicate and discuss findings, success and failures frequently. *(Initial, drive to maturity, maturity stages)*

Biomass supply

- Foster the cascading use of biomass and the circular economy in order to make full use of biomass potential. (*Drive to maturity, maturity stages*)

Competitive biobased product

- Start up financing from the industry creates better prospects for product development and market uptake. (*Drive to maturity, maturity stages*)

Policy

- The future strategy and perspectives of the cluster should be carefully considered with the participation of the industry. *(Initial, drive to maturity, maturity stages)*

Funding

- Set up mechanisms to attract venture capital to the region. (*Drive to maturity, maturity stages*)

4.3.8 Specific learning points for developing potential of Energy sector

Cluster organisation

- Establish an effective governance structure including a board or committee from the very beginning. (*Initial stage*)

Actors

- Develop a broad network with other institutions from the relevant field as well as with other clusters, both within the country as well as cross-boundary, as this will provide access to latest information as well as a platform for dissemination and promotion of cluster members' activities. (*Drive to maturity stage*)

Biomass supply

- Inform and promote the "collaborative spirit" to biomass producers in order to establish trust between production and demand site. (*Initial stage*)

Competitive biobased product

- Facilitate open innovation processes between the different sectors; strengthen biorefinery concept and application. (*Drive to maturity, maturity stages*)

Policy

- Ensure political commitment also for the drive to maturity phase that could involve building of industrial production sites and the like which need public acceptance and political will and support. (*Drive to maturity stage*)

Funding

- Ensure business commitment, both from SMEs as well as from big companies. (*Drive to maturity, maturity stages*)

4.3.9 Specific learning points for developing potential of R&D services sector

Cluster organisation

- Develop a «Cluster culture». *(Initial stage)*

Actors

- Develop an "open & participatory" approach within the innovation communication channels. Communicate and discuss findings, success and failures frequently. *(Initial, drive to maturity, maturity stages)*

Biomass supply

- In order to use primary and secondary biomass as feedstock for bioeconomy applications, consistent stakeholder dialogues and coordination needs to be facilitated. *(Drive to maturity stage)*

Competitive biobased product

- Cluster management should be more engaged in and informed about product development of its cluster partners in order to monitor project processes, recognize potential cross-overs and facilitate cooperation. *(Initial stage)*

Funding

- Ask for cluster participation/membership fee, as it will heighten the value of the membership to companies. *(Initial stage)*
- Ensure long-term (co-)funding from public bodies (e.g. ministry). *(Initial, drive to maturity, maturity stages)*

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http://www.errin.eu/content/bioeconomy

ANNEX I Good Practice regions

A1 Toulouse White Biotechnology Cluster

With kind contribution from: Dr Pierre Monsan

The region and the cluster

The region

Toulouse is the capital city of Midi-Pyrénées region, south west France (NUTS2: FR6). The city lies on the banks of the River Garonne, 150 kilometres from the Mediterranean, 230 km from the Atlantic and 680 km from Paris. With 1,250,251 inhabitants at the January 2011 census[11],[3] Toulouse metropolitan area is the fourth largest in France[12].

Toulouse is the centre of the European aerospace industry, with the headquarters of Airbus, the Galileo positioning system, the SPOT satellite system, the Airbus Group (former EADS), ATR and the Aerospace Valley.

The city also hosts the European headquarters of Intel and CNES's Toulouse Space Centre (CST), the largest space centre in Europe[13]. Thales Alenia Space and Astrium Satellites (Airbus Group's satellite system subsidiary) also have a significant presence in Toulouse. Its world renowned university is one of the oldest in Europe (founded in 1229) and, with 103,000 students, is the fourth-largest university in France[14].

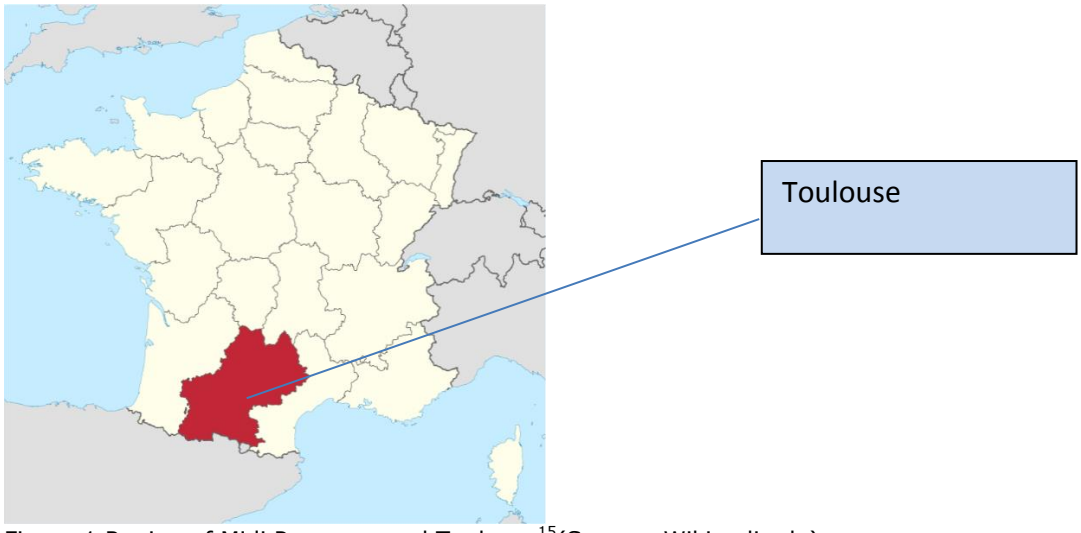

Figure 1 Region of Midi Pyrenees and Toulouse[15](Source: Wikipedia.de)

[11]Sérieshistoriques des résultats du recensement - Aireurbaine 2010 de Toulouse (004)". INSEE.
[12] INSEE. "Les 30 premières airesurbainesen 2010" (in French).
[13]CNES. "Ademe.fr" (PDF) (in French). Retrieved 30 May 2007
[14]http://cache.media.enseignementsup-recherche.gouv.fr/file/Atlas_2012-2013/24/0/Midi-Pyrenees_316240.pdf
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Midi Pyrenees region has identified six focus economic activities around which the capabilities, target markets and strategic development priorities of the region are shaped, namely: manufacturing & industry; motor vehicles and other transport equipment; food; human health; nanotechnology; biotechnology. The cluster examined in this report falls within biotechnology.

The cluster

Toulouse White Biotechnology (TWB) is a pre-industrial demonstrator that supports the development of innovative biological tools (enzymes, microorganisms, microbial consortia), thus opening new avenues for the production of chemical molecules, biopolymers, biomaterials and biofuels based on the use of renewable carbon. The cluster was initiated in mid 1980s, where the Bioresource centre was funded with the support of the pharmaceutical industry. Most participating companies are small and medium size enterprises (SMEs). The cluster is in the transition from drive to maturity to mature stage. It focuses on technology development, provision of innovative technology services, and building scientific capability in biotechnology.

Performance of key assets during the development pathway of the cluster

Toulouse White Biotechnology is a Good Practice in biotechnology which is part of the chemicals & polymers sector in BERST. This section analyses performance of key assets performed during cluster development stages as well as barriers and enabling factors which have framed progress. Traffic light colour coding is used to illustrate strength and performance of key assets and show how this has impacted in the progress of the cluster's activities. Traffic light colour coding reflects discussions with stakeholders from the clusters and the region as well as the regional partners from the BERST project. Table 1 presents the performance of the key assets within the two bioeconomy sectors which are present in the cluster during the initial stage (IS), drive to maturity stage (DMS) and mature stage (MS).

Table 1 Performance of key assets by bioeconomy sector during development stages

Key asset	Chemicals & Polymers		
	IS	DMS	MS
Cluster Organisation			
Actor			
Entrepreneurs			
Policy makers			
Knowledge institutes			
Biomass supply			
Competitive bioeconomy product			
Funding			
Policies and measures			

Low **Moderate** **High**

Biocluster organization

Initially there was no central management for the cluster but there were already four scientific parks where an entrepreneur could set up a company.

Table 2 Cluster performance by organisation-related key assets

Issue	Chemicals & Polymers		
	IS	DMS	MS
Central organisation that coordinates, manages, and facilitates the biocluster			
Role of key actors			
• *Entrepreneurs*			
• *Policy*			
• *RTD*			
Funding			

Following there was a network which interfaced between the academic world and the companies. The knowledge and scientific support came through the University of Toulouse which has a strong presence in the biotechnology field at international level and also the critical mass in terms of human resources, research infrastructures and funding.

Barriers

- Lack of central management at the initial stage prohibited efficient communication and transfer of knowledge

Enabling factors

- Strong commitment from the leading individuals facilitated the organisation of the cluster.

Actors

The University of Toulouse has a key role as the main knowledge providing institute. Other key actors included CNRS, INRA and several biotechnology companies. Biocluster entrepreneurs were located at the four science parks within the region so they are geographically close which has facilitated cooperation.

Table 3 Cluster performance by actor-related key assets

Issue	Chemicals & Polymers		
	IS	DMS	MS
Entrepreneurs activity			
Interaction of entrepreneurs with RTD			
Geopolitical position of the region			

From the early stage, there has been strong political commitment at both local and national levels, including provision of incentives to establish scientific parks to host start-up companies.

Barriers

- Highly innovative products or components require long and consistent efforts for training, education and knowledge transfer to entrepreneurs prior to commercialisation.

Enabling factors

- Excellency in research from the main knowledge provider, University of Toulouse;
- Increased awareness and consistent interactions among policy, industry and research actors.

Supply of biomass

The biocluster is based on carbohydrates and lipids. There are limited options of local supply for these materials so they are usually imported either from other regions in France or from abroad.

Table 4 Cluster performance by biomass supply-related key assets

Issue	Chemicals & Polymers		
	IS	DMS	MS
Biomass availability			
Indigenous supply			
Biomass trade			

Most biomass is supplied to south France from other French regions where there are starch processing plants, rapeseed oil factories etc that have by-products which can be diverted to the production of carbohydrate and lipids.

Barriers

- Lack of indigenous resources
- Sourcing lignocellulosic biomass is a big challenge
- Ensuring constant supply of raw materials with consistent quality is a challenge when producing bulk products from seasonal feedstocks.

Enabling factors

- Well-developed road infrastructure
- Using residual or by-products from agricultural industries increases the potential for adding value both to the farmers and the traditional markets.

Competitive bioeconomy products

The following bioeconomy products have been developed within the cluster to date:

- Diabetics- monocronalant bodies for therapeutic use;
- cosmetic products;
- polysaccharides and oligo saccharides;
- diagnostic kits for medical products;
- recombinant protein production for the pharmaceutical industry;

Toulouse also has strong presence of major seed production companies (Syngenta, Pioneer) and the cluster has developed strong links with plant biotechnology.

Table 5 Cluster performance in competitive bioeconomy products

Issue	Chemicals & Polymers		
	IS	DMS	MS
Innovation of bioeconomy products			
Cross over/ Transfer between sectors			
Degree of innovation			

Barriers

- Volatility of raw material prices
- High energy costs
- Complexity over meeting product specifications due to variable and volatile physical properties of the bio- based products

Enabling factors

- Increasing consumer demand for products that can be recycled or composted strengthens the role of biotechnology and bio-based products

Financing

The cluster has good access to public RTD funds. The main source of funding continues to be national funds aimed at competitiveness clusters in medicine and agriculture. These funds have a relatively long ten year duration although there is more frequent (three years) monitoring of progress and outputs. During the drive to maturity stage, the cluster has gained substantial additional funds directly from industrial actors.

Table 6 Cluster performance by financing-related key assets

Issue	Chemicals & Polymers		
	IS	DMS	MS
Public funds			
Accessibility of funds / Procedures			
Private funds			

Barriers

- Private funds were difficult to secure during the initial stage as the cross sector transfers, respective methods and products were not yet developed

Enabling factors

- Increased access to public funding for research, development and demonstration activities provided opportunities for entrepreneurs and for increased innovation in end products.

Policies and measures

Key policy mechanisms which facilitated start-up and successful development were grants for competitiveness cluster creation (which were available ten years ago) and the Investment For the Future Programme. The latter has funds of Euro 35 billion over the period 2010 to 2019.

Table 7 Cluster performance by policy-related key assets

Issue	Chemicals & Polymers		
	IS	DMS	MS
Presence of policy instruments			
Effectiveness of policy instruments			
Consistency of policy			
Monitoring procedures			

Barriers

- Communicating the importance of clusters and innovation to policy makers remains a challenge, especially when it is initiated by the academic sector.

Enabling actors

- Interest in initiative from public authorities
- Possibility for funding of research and infrastructure through national and regional funding

Difficulties, opportunities and lessons learnt

Difficulties and opportunities during the initial and drive to maturity stages

The most important difficulty has been the efficient communication of benefits and strong impact of the cluster during the initial stage to the policy makers in order to attract their interest, persuade them to include cluster formation both in policy and support financing measures at the regional level.

The major opportunity has been consistent- long term interest from the industrial actors which coincided with good research – industry collaboration and project funding.

Lessons learnt

In this section a set of specific learning points have been collected based on the interviews with stakeholders in the Good Practice clusters / regions. The learning points are linked to the key assets, the development stages and the respective bioeconomy sectors.

Table 8 provides specific learning points learnt from the development of the biocluster in Toulouse per key asset, development stage and bioeconomy sector.

Table 8 Specific learning points from Toulouse White Biotechnology cluster

Specific lessons per key asset	Stage related to	Specific lessons	Bioeconomy sector
Organisation	Initial Drive to maturity	Develop a strong cluster organisation body with staff combining skills from industry and academia	Chemicals & Polymers Construction
	Initial	Develop a «Cluster culture».	R&D services
Actors	Drive to maturity	Develop a broad network with other institutions from the relevant field as well as with other clusters, both within the country as well as cross-boundary, as this will provide access to latest information as well as a platform for dissemination and promotion of cluster members' activities.	Chemicals & Polymers
	Initial Drive to maturity;	Upgrade the competences of the work force, adapting the supply of vocational education and training to the economic trends and productive system needs	Construction
	Initial Drive to maturity; Mature production	Develop an "open & participatory" approach within the innovation communication channels. Communicate and discuss findings, success and failures frequently.	R&D services
Biomass Supply	Drive to maturity; Mature production	Foster the cascading use of biomass and the circular economy in order to make full use of biomass potential	Chemicals & Polymers Construction
	Drive to maturity	In order to use primary and secondary biomass as feedstock for bioeconomy applications, consistent stakeholder dialogues and coordination needs to be facilitated.	R&D services
Products	Initial Drive to maturity; Mature production	Steer the development of new products according to the principles of smart specialization, resource availability and market demand and in this respect improve learning mechanisms from other regional clusters with a similar economic or geographical profile	Chemicals & Polymers
	Drive to maturity; Mature production	Start up financing from the industry creates better prospects for product development and market uptake.	Construction
	Initial	Cluster management should be more engaged in and informed about product development of its cluster partners in order to monitor project processes, recognize potential cross-overs and facilitate cooperation.	R&D services
Funding	Initial Drive to maturity; Mature production	The future strategy and perspectives of the cluster should be carefully considered with the participation of the industry.	Chemicals & Polymers
	Initial Drive to maturity;	Subsidies for initial investments can be critical for start-ups	Construction
	Initial	Ask for cluster participation/membership fee, as it will heighten the value of the membership to companies.	R&D services
	Initial Drive to maturity; Mature production	Ensure long-term (co-)funding from public bodies (e.g. ministry).	R&D services
Policies	Initial	Subsidies for initial investments can be critical for	Chemicals &

	Drive to maturity	start-ups	Polymers
	Initial Drive to maturity; Mature production	The future strategy and perspectives of the cluster should be carefully considered with the participation of the industry	Construction

References

http://www.toulouse-white-biotechnology.com/

BIOTECHNOLOGIES EN MIDI-PYRENEES. www.midipyrenees-expansion.fr

A2 Ghent Bioeconomy Valley

With kind contribution from Prof. Wim Soetaert

The region and the cluster

The region

East Flanders is a province of Flanders, one of the three regions of Belgium. It borders Zeelandic Flanders (the Netherlands) and the Belgian provinces of Antwerp, Flemish Brabant (both in Flanders), Hainaut (Wallonia) and West Flanders (Flanders). It has an area of 2,991 km² which is divided into six administrative districts containing 65 municipalities. The provincial population is 1,408,484 and the capital is Ghent.

Figure 1 Map of East Flanders[16]

The region of East Flanders has a good geopolitical location and the location and infrastructure (industrial zone and Port of Ghent) and the awareness and commitment of the local authorities have all been strong assets for the development and successful operation of the cluster.

The cluster

Ghent Bioeconomy Valley (GBEV) has operated since 2005 and is in stage of mature production. Both the initial and the drive to maturity stages lasted on average three years, which is short compared to other clusters analysed in this work. There are currently several companies which produce biofuels and bioenergy at large scale but they still maintain all the functions from the initial stage such networking, incubators etc.

The cluster was founded through the initiative of Prof Wim Soetaert as a Public Private Partnership between Ghent University, the City of Ghent, the Port of Ghent,

[16] http://en.wikipedia.org/wiki/East_Flanders#/media/File:Provincie_Oost-Vlaanderen_in_Belgium.svg

the Development Agency East-Flanders and a number of industrial companies related to the Ghent region, active in the fields of generation, distribution, storage and use of bio-energy.

The driving force for the establishment of GBEV was mainly of a political nature. By joining forces, companies were hoping to maximise their production quota for biofuels from the Belgian government. In addition, the partnership was intended to help them to tackle common problems related to production, feedstock and infrastructure. Finally, GBEV also provided a platform to inform the general public about new products and technologies.

GBEV finally succeeded in acquiring 80% of the Flemish quota for biofuels in October 2006, representing an investment of €120m in the port of Ghent. Production at Bioro and Alco Bio Fuel started in the spring of 2008.

In 2008, GBEV obtained a legal identity becoming a non-profit organization, supporting all biobased activities, including bioenergy. GBEV activities include collaborative programmes, joint initiatives and synergy creation between the partners in the fields of Research & Development, structural measures and policy, logistics and communication towards the general public.

Performance of key assets during the development pathway of the cluster

Ghent Bioeconomy Valley is a Good Practice for the energy (bioenergy, biofuels) sector.

Table 1 Cluster performance in the under study key assets

Key asset	Energy		
	IS	DMS	MS
Cluster Organisation			
Actors			
Entrepreneurs			
Large industrial actors			
Policy makers			
Knowledge institutes			
Biomass supply			
Competitive bioeconomy product			
Funding			
Policies and measures			

Low | Moderate | High

Table 1 presents the performance of the various bioeconomy sectors which are present in the cluster across the key assets, during the initial (IS), the drive to maturity stage (DMS) and the mature stage (MS), 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. Traffic light colour coding illustrates the strength and performance of each key asset during development stages and how this has impacted in the progress of the cluster's activities. The ranking of the traffic light coding reflects the replies given by the interviewed stakeholders from the cluster.

Biocluster organization

The cluster organisation was strong from the beginning, with the leadership being experienced both in academic and industrial research.

Table 2 Cluster performance in biocluster organisation

Issue	Energy		
	IS	DMS	MS
Central organisation that coordinates, manages, and facilitates the biocluster			
Role of key actors			
• *Entrepreneurs*			
• *Big industrial actors*			
• *Policy*			
• *RTD*			
Funding			

Table 2 indicates how central organisation and key actors performed an important role as the cluster moved through the development stages. It is evident that GBEV had highly efficient central organisation with the active participation of big industrial actors, policy and knowledge providers. The only category that the cluster ranks low in all development stages is entrepreneurs who - mainly due to the nature and scale of production - have not been active in the cluster.

Barriers

- Lack of secure funding for cluster management prohibits the full time employment of personnel in developing the cluster's activities, as they also have to secure funding from other sources.

Enabling factors

- Strong commitment of individuals that lead the cluster organisation, typically without being directly employed by GBEV.

- Consistent participation of large industrial actors and good cross sector collaboration on projects among primary and end use sectors.
- Good cooperation between the cluster management and frequent information exchange between knowledge institutes and business support/cluster management.
- Strong and consistent political commitment towards the development of all aspects of the cluster.

Actors

The cluster is a joint initiative of Ghent University, the City of Ghent, the Port of Ghent, the Development Agency East-Flanders and a number of industrial companies related to the Ghent region that are active in the fields of generation, distribution, storage and use of biobased products and bio-energy. As noted above, entrepreneurs have not participated in the cluster.

Table 3 Cluster performance in actors involved

Issue	Energy		
	IS	DMS	MS
Entrepreneurs activity			
Interaction of entrepreneurs with RTD			
Geopolitical position of the region			

The geopolitical position of the region is favourable. The region has good infrastructure and industrial networks as well as a major port which is a key asset for both the provision of imported raw materials and export of products.

Entrepreneurs

The cluster members are mostly big and small companies, mainly due to the fact that its core activities were built around large production facilities. So far the cluster has not been very effective in stimulating entrepreneurs or start-up companies. However, this is likely to come in the future, once the pilot plant is at mature stage.

Policy makers

Regional and local politicians have mainly a representative role but individuals are also members of the supervisory board, so they influence financing, representative, and strategic activities and are thus major actors.

R&D institutes

The focal R&D institute is the University of Ghent but the cluster also collaborates with several universities and research institutes across Europe.

Barriers

- Lacking active participation by entrepreneurs in cluster activities due to strong focus on big industrial actors for energy and fuels
- Slow development of start-up companies as the activities are developed within large industries.

Enabling factors

- Strong collaboration with industry, R&D and regional partners in several EU funded projects
- Ghent is a very attractive region for establishment of new companies as one of the large ports of northern Europe

Biomass supply

Since the cluster is established within close proximity to the Port of Ghent biomass supply options are various including both indigenous and imports making use of the strong infrastructures.

Table 4 Cluster performance in biomass supply

Issue	Energy		
	IS	DMS	MS
Biomass availability			
Indigenous supply			
Biomass trade			

Barriers

- Both primary and secondary biomass types already have several end uses which creates raw material competition for potential new bioeconomy applications and high prices.

Enabling factors

- Port of Ghent facilitates the flow of biomass imports while the well-developed road and rail infrastructures facilitate the provision of locally produced raw materials.

Competitive bioeconomy products

The key bioeconomy products are bioenergy and biodiesel (totalling 500,000 tonnes per year). Most of the activities of the cluster have focused on developing these products and cross over between sectors have been low during the initial stage and limited in the drive to maturity one. The interactions with the chemicals & polymers and textiles have started only at the mature production stage and innovation became high at that point.

Table 5 Cluster performance in competitive bioeconomy products

Issue	Energy		
	IS	DMS	MS
Innovation of bioeconomy products			
Cross over/ Transfer between sectors			
Degree of innovation			

Barriers

- Variability of bio-based market sectors increases the complexity for cross over technological transfers, scaling up of new conversion pathways.
- Commercialisation of new bio-based products is a slow process which requires secure policy and financing conditions to minimise the investment risk

Enabling factors

- Consistent and continuous transfer of knowledge and strong collaboration between R&D and big industrial actors within the biofuels and energy sectors
- Significant cross-overs and synergies in the product development under the guidance or leadership of GBEV.

Funding

Throughout its operation, GBEV benefited from both public and private funds. At the initial stage there was no public funding; companies paid a modest fee which supported the start-up of the cluster. The initial stage was based heavily on efforts and strong personal commitment from Prof Soetart and his immediate collaborators.

At a later stage, GBEV applied successfully for competitive, project-based research funds, and during recent years turnover has been approximately €1m per year.

Table 6 Cluster performance in funding

Issue	Energy		
	IS	DMS	MS
Public funds			
Accessibility of funds / Procedures			
Private funds			

Barriers

- Lack of consistent public funds financing for the long term operation of the cluster management.

Enabling factors

- EU funding for large demonstration facilities in project contexts.

- Proximity of the cluster to large industrial facilities with interest in biofuels facilitated joint activities and respective funding.

Policies and measures

The most helpful policy drive for GBEV has been the EU target for liquid biofuels and the implementation of the Renewable Energy Directive. As a consequence, two biodiesel companies have been established and grown. Moreover, this success attracted attention and support from government and public funds.

Table 7 Cluster performance in policies and measures

Issue	Energy		
	IS	DMS	MS
Presence of policy instruments			
Effectiveness of policy instruments			
Consistency of policy			
Monitoring procedures			

Barriers

- Adoption of EU legislation at local and regional levels required long term and consistent efforts form the cluster management.

Enabling factors

- Strong political drive from EU has been successfully adopted by the regional government.

Difficulties, Opportunities and Lessons Learned

Difficulties and opportunities during the initial and drive to maturity stages

The most important difficulty has been to raise awareness among the stakeholders in industry and policy and convince them to join efforts and intensify activities. This was mostly due to lack of technical knowledge, access to information, lack of trust in academic research outputs and credibility.

The major opportunity was to take advantage of the favourable legislation for biofuels at EU level, combine existing capacities and enable the development of large scale biodiesel plants.

Lessons learned

In this section a set of specific learning points have been collected based on the interviews with stakeholders in the Good Practice clusters / regions. The learning

points are linked to the key assets, the development stages and the respective bioeconomy sectors.

Table 8 provides specific learning points learnt from the development of the biocluster in Ghent per key asset, development stage and bioeconomy sector.

Table 8 Specific learning points from the Ghent Bioeconomy Valley cluster

Specific lessons per key asset	Stage related to	Specific lessons
Organisation	Initial	Establish an effective governance structure including a board or committee from the very beginning
Actors	Drive to maturity	Develop a broad network with other institutions from the relevant field as well as with other clusters, both within the country as well as cross-boundary, as this will provide access to latest information as well as a platform for dissemination and promotion of cluster members' activities.
Biomass Supply	Initial	Inform and promote the "collaborative spirit" to biomass producers in order to establish trust between production and demand site.
Products	Drive to maturity	Facilitate open innovation processes between the different sectors; strengthen biorefinery concept and application.
	Maturity	
Funding	Drive to maturity	Ensure political commitment also for the drive to maturity phase that could involve building of industrial production sites and the like which need public acceptance and political will and support.
Policies	Drive to maturity	Ensure business commitment, both from SMEs as well as from big companies.
	Maturity	

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http://www.gbev.org/en
http://www.easyfairs.com/fileadmin/groups/6/INDUSTRIE%20MILIEU_BE_2010/learnShops/woensdag/LSP_Hal1_Woe_Ghent_BioEnergyValley.pdf

A3 North Rhine Westfalia (CLIB2021)

With kind contribution from: Dr Manfred Kircher

The region and the cluster

The region

North Rhine Westfalia was formed in 1946 and is the fourth largest region in Germany by area. In the 1950s and 1960s, Westphalia was known as Land von Kohle und Stahl or the land of coal and steel. In the post-WWII recovery, the Ruhr was one of the most important industrial regions in Europe, and contributed to the German "Wirtschaftswunder". From the late 1960s, these industries contracted. On the other hand, production sectors, particularly mechanical engineering and metal and iron working industry, experienced substantial growth.

GDP in 2007 was 529.4b euro (21.8% of national GDP) making it the most important economic region in Germany, as well as globally significant[17]. From Germany's top 100 corporations, 37 are based in North Rhine-Westphalia. On a per capita base, however, North Rhine-Westphalia remains one of the weaker among the Western German states[18]. As of June 2014, the unemployment rate is 8.2%, second highest among all western German states[19].

Figure 1 Region of North Rhine Westfalia [20](Source: Wikipedia.de)

North Rhine-Westphalia attracts companies from both Germany and abroad. In 2009, the state had the most foreign direct investments anywhere in Germany[21]. Around 13,100 foreign companies from the most important investment countries control their German or

[17] Ministerium für Wirtschaft, Mittelstand und Energie des Landes Nordrhein-Westfalen: Konjunkturindikatoren NRW

[18] Arbeitskreis Volkswirtschaftliche Gesamtrechnungen der Länder: Volkswirtschaftliche Gesamtrechnungen der Länder[

[19] Statistik der Bundesagentur für Arbeit". statistik.arbeitsagentur.de.

[20] hhttp://en.wikipedia.org/wiki/North_Rhine-Westphalia

[21] The Online Editor. "FDI". New European Economy.

European operations from bases in North Rhine-Westphalia. In 2014, North Rhine-Westphalia was ranked as the European Region of the Future[22] in the 2014/15 list by FDi Magazine[23].

The cluster

CLIB2021 was founded with the aim to initiate research and development projects in the field of industrial biotechnology. The cluster has 80 members, encompassing: large industrial partners (such as Evonik, Henkel, LANXESS, Bayer, and BASF Personal Care); small and medium-sized enterprises (SMEs), which account for 40 per cent of their membership, and bring diversity of technologies and products to the cluster; and universities. Its operation and future development is structured across four key principles:

Closing gaps between science and technology: The cluster brings together academic and industrial members who are active in research, development, production and commercialization – all crucial elements of the industrial value chain.

Addressing emerging markets: Novel, innovative materials, cost-efficient production processes and simplified downstream workflows, as well as feedstock which is leading the market both economically and ecologically are crucial elements. The cluster addresses these market demands and helps its members to manage the process of innovation.

Providing win-win solutions for all stakeholders: Academia provides technologies tailor-made to real industrial needs and takes care of the rising generation of scientists and engineers. SMEs provide an extensive range of services, and products. In collaboration with big industries, SMEs find academic institutes and research companies within the cluster to partner with and fill the product pipeline. All stakeholders need infrastructure, investors and production sites as well as business support and legal advice. Through its members, CLIB provides all these competencies to develop business based on science and technology.

Drive excellence in science and technology: The cluster has a well-structured communication platform for professionals in the research and industrial field which facilitates knowledge transfer, communication, networking and dissemination activities.

Performance of key assets during the development pathway of the cluster

Clib2021 is a Good Practice in the chemicals & polymers sector in BERST.

[22] "London and Nordrhein-Westfalen, Germany best investment locations in Europe". FinFacts Ireland.
[23] "European Cities and Regions of the Future 2014/15". fDiIntelligence.com. London. 17 February 2014.

Table 1 Cluster performance in the under study key assets

Key asset	Chemicals & Polymers		
	IS	DMS	MS
Cluster Organisation			
Actor			
Entrepreneurs			
Policy makers			
Knowledge institutes			
Biomass supply			
Competitive bioeconomy product			
Funding			
Policies and measures			

Low **Moderate** **High**

Table 1 presents the performance of the various bioeconomy sectors which are present in the cluster across the key assets, during the initial (IS), the drive to maturity stage (DMS) and the mature stage (MS), based on the results from the questionnaire survey. Details on how the individual key assets performed across the development stages are provided in the following sections alongside with barriers and enabling factors which have framed their progress. Traffic light colour coding is used to illustrate 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 traffic light colour coding reflects discussions with stakeholders from the clusters and the region as well as the regional partners from the BERST project.

Biocluster organization

Initially there was no central management but after a short time there was a central organisation with a board and an advisory board. This was very beneficial for the cluster's development, networking and communication activities, particularly with the growing number of members (initially 32; currently circa 100).

Table 2 Cluster performance in biocluster organisation

Issue	Chemicals & Polymers		
	IS	DMS	MS
Central organisation that coordinates, manages, and facilitates the biocluster			
Role of key actors			
• *Entrepreneurs*			
• *Policy*			
• *RTD*			
Funding			

Since 2013, the cluster management is paid by member fees which were introduced at that year.

Barriers

- Lack of central management at the initial stage prohibited efficient communication and transfer of knowledge

Enabling factors

- Central organisation was developed shortly after the establishment of the cluster.

Actors

The focus of the cluster is the development of products for the chemical industry and the member comprise a mix of large scale industries, entrepreneurs and knowledge institutes.

The region of North Rhine Westfalia is favourable for the operation and development of the cluster as it is highly industrialised and the location of many chemical industrial firms.

Despite the fact that there are no policy makers on the board of the cluster, the organisational team and members are well connected at national and EU level as well as having strong cross border and cross regional relationships with decision makers at local level.

Table 3 Cluster performance in actors involved

Issue	Chemicals & Polymers		
	IS	DMS	MS
Entrepreneurs activity			
Interaction of entrepreneurs with RTD			
Geopolitical position of the region			

Knowledge providers have strong interactions with the cluster entrepreneurs and large industries and are mostly located within Germany with some from other countries including Poland and USA.

Barriers

- Initial interaction with entrepreneurs was time consuming and required effort to communicate benefits of biobased innovations.

Enabling factors

- Knowledge providers with strong capability provided a successful start to the cluster through research projects;
- Increased awareness and consistent interactions among policy, industry and research actors.

Supply of biomass

The cluster sources raw materials both from indigenous local sources (strong agriculture and forestry and well developed food industries) but also from imports (e.g. palm oil from Malaysia).

Table 4 Cluster performance in biomass supply

Issue	Chemicals & Polymers		
	IS	DMS	MS
Biomass availability			
Indigenous supply			
Biomass trade			

Scale of operation is large so industries source lignocellulosic biomass and the organic fractions of municipal and industrial waste.

Barriers

- Sourcing lignocellulosic biomass is a big challenge.
- Ensuring constant supply of raw materials with consistent quality is a challenge when producing bulk products from seasonal feedstocks.

Enabling factors

- Well-developed road infrastructure.
- Using residual or by-products from agricultural industries increases the potential for adding value for farmers and traditional markets.

Competitive bioeconomy products

The following competitive bioeconomy products have been developed within the cluster so far:

- cosmetics;
- bio-polymers;
- bio-adhesives;
- nutrition/ feed additives.

These have been a result of successful cross over and transfers between the respective sectors.

Table 5 Cluster performance in competitive bioeconomy products

Issue	Chemicals & Polymers		
	IS	DMS	MS
Innovation of bioeconomy products			
Cross over/ Transfer between sectors			
Degree of innovation			

Barriers

- Volatility of raw material prices
- Complexity over meeting product specifications due to variable and volatile physical properties of bio-based products.

Enabling factors

- Efficient cross over and transfer among the entrepreneurs and the regional chemical industries.

Financing

The cluster has had good access to public funds for RTD. The initial stage relied on research projects, with total budget of Euro60m. From the drive to maturity stage, the cluster gained additionally from substantial funds contributed by industrial actors who share the same vision for the sector in Germany and at international level.

Table 6 Cluster performance in financing

Issue	Chemicals & Polymers		
	IS	DMS	MS
Public funds			
Accessibility of funds / Procedures			
Private funds			

Barriers

- The availability of private funds was difficult to secure during the initial stage as the cross sector transfers, respective methods and products were not yet developed.

Enabling factors

- Increased access to public funding for research, development and demonstration activities provided opportunities for entrepreneurs and for increased innovation in end products.
- Successful R&D programmes strengthened the cluster's position in terms of technological excellence and brought funding from private sources/ industrial actors as well.
- Efficient process of financing start- up companies.

Policies and measures

The key policy mechanisms which have facilitated the start-up and successful development are mainly EU and national policy targets for the chemical industry as well as the respective EU and German bioeconomy strategies.

Table 7 Cluster performance in policy

Issue	Chemicals & Polymers		
	IS	DMS	MS
Presence of policy instruments			
Effectiveness of policy instruments			
Consistency of policy			
Monitoring procedures			

Barriers

- Variability of demand sectors increases the complexity of setting targets and developing cross sector policies.

Enabling actors

- Interest in initiative from public authorities.
- Possibility for funding of research and infrastructure through national and regional funding.

Difficulties, Opportunities and Lessons Learned

The most important difficulty has been the absence of local industrial actors. Most of the industrial companies are not in the region or even the country or even Europe- but are mostly international.

The major opportunity has been consistent- long term granting investment from government

Lessons learned

In this section a set of specific learning points have been collected based on the interviews with stakeholders in the Good Practice clusters / regions. The learning points are linked to the key assets, the development stages and the respective bioeconomy sectors.

Table 8 provides specific learning points learnt from the development of the biocluster in North Rhine Westphalia per key asset, development stage and bioeconomy sector.

Table 8 Specific learning points from Clib2021

Organisation	Initial Drive to maturity	Develop a strong cluster organisation body with staff combining skills from industry and academia	Chemicals & Polymers
	Initial	Develop a «Cluster culture».	R&D services
Actors	Drive to maturity	Develop a broad network with other institutions from the relevant field as well as with other clusters, both within the country as well as cross-boundary, as this will provide access to latest information as well as a platform for dissemination and promotion of cluster members' activities.	Chemicals & Polymers
	Initial Drive to maturity; Mature production	Develop an "open & participatory" approach within the innovation communication channels. Communicate and discuss findings, success and failures	R&D services

		frequently.	
Biomass Supply	Drive to maturity; Mature production	Foster the cascading use of biomass and the circular economy in order to make full use of biomass potential	Chemicals & Polymers
	Drive to maturity	In order to use primary and secondary biomass as feedstock for bioeconomy applications, consistent stakeholder dialogues and coordination needs to be facilitated.	R&D services
Products	Initial Drive to maturity; Mature production	Steer the development of new products according to the principles of smart specialization, resource availability and market demand and in this respect improve learning mechanisms from other regional clusters with a similar economic or geographical profile	Chemicals & Polymers
	Initial	Cluster management should be more engaged in and informed about product development of its cluster partners in order to monitor project processes, recognize potential cross-overs and facilitate cooperation.	R&D services
Funding	Initial Drive to maturity; Mature production	The future strategy and perspectives of the cluster should be carefully considered with the participation of the industry.	Chemicals & Polymers
	Initial	Ask for cluster participation/membership fee, as it will heighten the value of the membership to companies.	R&D services
Policies	Initial Drive to maturity	Subsidies for initial investments can be critical for start-ups	Chemicals & Polymers

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http://www.clib2021.de/en

http://www.germanbiotech.com/de/db/detail.php?c=6084551k$Snrm6KUYXujAQ

A4 Greater Manchester (CoE Bio3)

With kind contribution from Dr Mark Corbett

The region and the cluster

The region

Manchester is a city in England, with population (2013) of 514,417 as of 2013[24]. Manchester is in the south-central part of North West England, which is the UK's second most populous region, with population 2.5m[25]. It is fringed by the Cheshire Plain to the south, the Pennines to the north and east and an arc of towns with which it forms a continuous conurbation.

Figure 1 Region of Greater Manchester

Today Manchester is ranked as a beta world city by the Globalization and World Cities Research Network and is consequently the highest ranked British city except for London[26]. Its metropolitan economy is the third largest in the United Kingdom with an estimated PPP GDP of US$92 billion as of 2014[27].

The cluster

CoE Bio3 is a research based organisation funded by industrial actors with focus on the industrial development of northwest England. So far they have funded mostly doctoral level research on pharmaceuticals but there is a recent re-focus to advanced chemical applications inclusing bioenergy and biomass. Albeit these activities are relatively new and advanced, they already form an important part of the activities among certain partners of CoBio3.

Performance of key assets during the development pathway of the cluster

CoE Bio3 is a Good Practice in the R&D services sector in BERST.

[24] UK population estimates". Office for National Statistics. 26 June 2014.
[25] 2011 Census – Built-up areas". ONS.
[26] The World According to GaWC 2012". Globalization and World Cities Research Network.
[27] Istrate, Emilia; Nadeau, Carey Anne (November 2012). "Global MetroMonitor". Washington, DC: The Brookings Institution.

An analysis of the performance of key assets across cluster development stages is provided in the following sections alongside with barriers and enabling factors which have framed their progress. Traffic light colour coding is used to illustrate 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. Traffic light colour coding reflects the discussions with stakeholders from the clusters and the region as well as the regional partners from the BERST project.

Table 1 presents the performance of the various bioeconomy sectors which are present in the cluster across the key assets, during the initial (IS), the drive to maturity stage (DMS) and the mature stage (MS), based on the results from the questionnaire survey.

Table 1 Cluster performance in the under study key assets

Key asset	R&D services		
	IS	DMS	MS
Cluster Organisation			
Actor			
Entrepreneurs			
Policy makers			
Knowledge institutes			
Biomass supply			
Competitive bioeconomy product			
Funding			
Policies and measures			

Low **Moderate** **High**

Biocluster organization

Table 2 shows how CoE Bio3 has strong centralised cluster organisation with dedicated jobs and roles. This structure facilitates transfer of knowledge, communication and facilitates strong networking activities. The cluster was focused from the outset on industrial research and was successful in simplifying intellectual property rights and administrative procedures with the result hat industry was able to access and to fund the cluster's activities.

Table 2 Cluster performance in biocluster organisation

Issue	R&D services		
	IS	DMS	MS
Central organisation that coordinates, manages, and facilitates the biocluster			
Role of key actors			
• *Entrepreneurs*			
• *Policy*			
• *RTD*			
Funding			

Since 2013, cluster management is paid by member fees.

Barriers

- As the cluster is initiated by R&D providers strong efforts were required to communicate the results that are mature and close to commercialisation and persuade for the added value of the innovative components.

Enabling factors

- Central organisation was developed shortly after the establishment of the cluster.

Actors

The strong support from the North West Development Agency (a regional government entity) was critical at the initial stage of development. More recently, the cluster engages with stakeholders via research projects, Climate KIC, etc.

The dialogue with the policy makers in the region has been in the forefront of the cluster's activities as it is very important to help maintain both the profile and secure support.

Table 3 Cluster performance in actors involved

Issue	R&D services		
	IS	DMS	MS
Entrepreneurs activity			
Interaction of entrepreneurs with RTD			
Geopolitical position of the region			

Barriers

- Initial interaction with entrepreneurs was time consuming and required effort to communicate benefits of biobased innovations.

Enabling factors

- Strong knowledge providers provided a successful start to the cluster through research projects;
- Increased awareness and consistent interactions among policy, industry and research actors.

Supply of biomass

The cluster is not directly linked with large biomass supply, since its focus is R&D. However, and as their members plan to move towards biorefinery research the issue of biomass supply is expected to gain more interest.

Table 4 Cluster performance in biomass supply

Issue	R&D services		
	IS	DMS	MS
Biomass availability			
Indigenous supply			
Biomass trade			

Barriers

- Sourcing lignocellulosic biomass for future research in biorefineries is expected to be a big challenge

Enabling factors

- Well-developed road infrastructure
- Using residual or by-products from agricultural industries increases the potential for adding value both to the farmers and the traditional markets.

Competitive bioeconomy products

The following competitive bioeconomy products have been developed within the cluster so far:

- Components for the pharmaceutical industry,
- biocatalytic toolkits for diagnostics,
- fine chemical manufacturing, etc.

All of them have been results of successful cross over and transfers between the respective sectors.

Table 5 Cluster performance in competitive bioeconomy products

Issue	R&D services		
	IS	DMS	MS
Innovation of bioeconomy products			
Cross over/ Transfer between sectors			
Degree of innovation			

Barriers

- Volatility of raw material prices
- Complexity over meeting product specifications due to variable and volatile physical properties of the bio- based products

Enabling factors

- Efficient cross over and transfer among the entrepreneurs and the regional chemical industries.

Financing

CoE Bio3 is a virtual centre which obtains funding from industrial contract research assignments and large European research and demonstration projects.

Table 2.6 Cluster performance in financing

Issue	R&D services		
	IS	DMS	MS
Public funds			
Accessibility of funds / Procedures			
Private funds			

Barriers

- The availability of private funds is rather difficult to secure during the initial stage as the cross sector transfers, respective methods and products are not yet developed.

Enabling factors

- Increased access to public funding for research, development and demonstration activities provided opportunities for entrepreneurs and for increased innovation in end products.
- Very successful R&D programmes strengthened the position of the cluster in terms of technological excellence and brought funding from private sources/ industrial actors as well.

Policies and measures

The cluster, being driven mostly by the research and innovation policies, has benefited through the years by targets set for bioeconomy and biobased products at different governance levels, including EU, national but also regional ones that focus at fostering industrial innovation.

Table 7 Cluster performance in policy

Issue	R&D sevices		
	IS	DMS	MS
Presence of policy instruments			
Effectiveness of policy instruments			
Consistency of policy			
Monitoring procedures			

Barriers

- Variability of demand sectors increases the complexity of setting targets for research across sector budgets.

Enabling actors

- Interest in initiative from industrial actors.
- Possibility for funding of research and infrastructure through national and regional funding.

Difficulties, opportunities and lessons learned

Difficulties and opportunities during the initial and drive to maturity stages

An initial difficulty was access to UK funds to enable large industrial collaboration. Such opportunities were more readily available through European programmes with industrial research focus. UK funding for developing technology from the laboratory to industrial scale has only recently become available.

The major opportunity was the diversity of funding sources (public, private, EU, national, regional, etc.) which allows flexibility, facilitates efficient intellectual property rights, efficient IT and operational access to all partners involved.

Another critical opportunity for the development of the cluster was the presence of the Centre of Excellence with academic participants who were focused, visionary and able to work with industry.

Lessons learned

Specific learning points from the development of the bio-cluster in Manchester

In this section a set of specific learning points are described, based on the interviews with stakeholders in the Good Practice clusters/ regions. The learning points are linked to the key assets, the development stages and the respective bioeconomy sectors.

Table 8 analyses a set of specific lessons learnt from the development of the biocluster in Manchester by key asset, development stage and bioeconomy sector.

Table 8 Specific lessons learnt in Manchester

Specific lessons per key asset	Stage related to	Specific lessons	Bioeconomy sector
	Initial	Develop a «Cluster culture».	R&D services
Actors	Initial Drive to maturity; Mature production	Develop an "open & participatory" approach within the innovation communication channels. Communicate and discuss findings, success and failures frequently.	R&D services
Biomass Supply	Drive to maturity	In order to use primary and secondary biomass as feedstock for bioeconomy applications, consistent stakeholder dialogues and coordination needs to be facilitated.	R&D services
Products	Initial	Cluster management should be more engaged in and informed about product development of its cluster partners in order to monitor project processes, recognize potential cross-overs and facilitate cooperation.	R&D services
Funding	Initial	Ask for cluster participation/membership fee, as it will heighten the value of the membership to companies.	R&D services

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