Benchmarking Report: Triple-helix Co-operation in Biobased Delta

RDI2CluB consortium benchmarking visit to Biobased Delta bioeconomy cluster in the Netherlands, April 18.-20.2018

This report provides an overview of the Biobased Delta bioeconomy triple helix co-operation including cluster development. The report provides an overview of the identified good practices, lessons learned and potential action areas for the RDI2CluB consortium members. The report serves as an input document for RDI2CluB partnership in the development of the Joint Action Plans for developing bioeconomy.

Report has been compiled by Kristaps Ročāns, Vidzeme Planning Region, based on feedback from all partners and participants of the Biobased Delta benchmarking visit.

2018

Content

Disclaimer: *The information presented in this report in relation to Biobased Delta and its actors may include inconsistencies and misunderstandings because of the collective data collection method, and potential mistaken conceptions due to language and culture differences. If looking for information on Biobased Delta , it is recommended to fact-check from other sources.*

Foreword

The benchmarking visit to Biobased Delta was an inspiring way to start our work on developing the regional bioeconomy innovation ecosystems as well as the transnational co-operation between the RDI2CluB regions. As a European best practice bioeconomy cluster, Biobased Delta demonstrates the value of a strong triple helix co-operation and strategic inter-regional and international networking. United by a shared development vision, business sector, research and development institutes and public administration manage to lead a transition to a biobased economy and support the development of new competitive biobased products and materials.

We had an impressive participation to the benchmarking visit. A total of 34 participants representing our partners from Central Finland, Hedmark (Norway), Świętokrzyskie Voivodeship (Poland), Vidzeme Planning Region (Latvia) and Estonia as well as external experts from Latvian High Added Value and Healthy Food Cluster, Ministry of Agriculture of Latvia, the city of Äänekoski in Finland and Norwegian University of Science and Technology took part in the visit. Our team's mission was to gain insights to the development of the bioeconomy innovation ecosystem in the regions and identify needed action areas for the Joint Action Plan for the development of the bioeconomy innovation ecosystem.

Our hosts engaged in an open dialogue with us on the success factors and obstacles encountered as well as provided plenty of good practices to study. Leads for future co-operation were explored during the multiple networking opportunities in the course of site visits, evening program and the Natural Fiberstastic event. All in all, a very fruitful visit that has helped us to identify focus areas and critical questions in relation to the innovation management and building the identity and vision of bioeconomy development in the rural regions of Baltic Sea.

The example of Biobased Delta has also awoken us to acknowledge our specialties and the differences between our regions and the industrial agglomerations. In the Baltic Sea Region, we have our own approach to bioeconomy stemming from the surrounding vast nature as well as values of environmental protection, clean food, well-being and the vitality of rural areas. By finding our identity and strengths, unique competitive advantage and the added-value bioeconomy products and services can be discovered.

My gratitude goes to our fantastic hosts, especially Mr. Willem Sederel, for the full and exciting programme with a balanced mix of networking, discussions, information exchange and long waited sunshine. Among all the insights gained, this was a good lesson for us on designing the benchmarking approach to coming visits as well. Furthermore, I would also like to thank our colleagues from Vidzeme Planning Region, Santa Niedola and Kristaps Ročāns, for coordinating the preparations and for summarizing all the signals and inputs for us.

Finally, my appreciation to the whole team of 34 experts for your active engagement in the programme and the participation in data collection and analysis. Now it is time to apply the inspiration to the Joint Action Plans for bioeconomy development.

Anna Aalto, RDI2CluB Project Coordinator

Biobased Delta Bioeconomy Cluster Development

Biobased Delta Bioeconomy Cluster Description

Biobased Delta is a geographically concentrated and internationally linked metacluster - a network of several clusters (including the sugar cluster and biobased clusters organized around specific applications, technologies and feedstocks), innovation hubs/technology parks, R&D and pilot facilities. Biobased Delta is located the Antwerp - Rotterdam - Rhine - Ruhr Area, which is the world's biggest chemical cluster area. Biobased Delta cluster is based in the three provinces in Netherlands: Zeeland, West-Brabant and South Holland, and has strong cross-border cooperation links with Belgium and Germany.

Biobased Delta focuses on green chemistry in order to facilitate the transition to the biobased economy. The cooperation between knowledge institutions, government bodies, regional development agencies and the industry (SME and multinationals) is crucial in this respect. Valorisation of sugar, large-scale biorefinery and bio-aromatics are important unifying themes. In addition to an agenda for green chemistry, the Biobased Delta works using an application-oriented, regional agenda in which local partnerships play a key role. More than fifty SMEs are involved in this process. They are collaborating with knowledge institutions, regional development agencies, development companies and the Chamber of Commerce in the areas of, for example, packaging, fibres, algae, paint and coatings, infra and horticulture.

The parties involved also create a link with the creative industry because it is preferable for biobased products to look different to 'ordinary' products. In this context, Biobased Delta plays a facilitating and stimulating role, and not just at regional level. Cooperation is also taking place with partners from other Dutch regions and at national level on accelerating the biobased economy.[1]

The Biobased Delta cluster aims to replace fossil carbon with green, renewable carbon and to develop new products based on biomass that can replace most of the oil-based products that dominate the regional chemical industry. Cluster ensures a cooperation model to increase the added value of the biomass, and to develop solutions for biomass conversion and innovative bio-based products (building blocks for other industries – connecting chemistry to food and construction sectors) in the Netherlands and globally.

Biobased Delta cluster is built on the competitive areas of the region – agriculture and chemical industry. It is based around several local and regional sources of biomass and imported biomass. Main local sources are sugar beets, potato, various sources of pulp, and utilization of road grass and waste. The biomass is regionally available due to the presence of the World's most efficient and large-scale sugar beet production industry. Feedstock (i.e. agricultural waste streams, wood-based biomass) are regionally sourced or imported via the (deep) seaports of Rotterdam, Antwerp, Moerdijk, Terneuzen, Vlissingen and Ghent. Hence, the biomass supply is sustainable.

Biobased Delta has a strong triple helix network of companies, R&D institutions, public sector organizations and an array of infrastructures. Role of the cluster is in connecting ecosystems and infrastructures, networking among members, including companies of different sizes and maturity and

[1] Biobased Delta homepage - Discover the Biobased Delta : https://biobaseddelta.nl/en/what-is-the-biobased-delta/

promotion. The infrastructure is spread all over the Biobased Delta macro region in 17 locations. It includes a variety of ecosystems: seaports, industry-parks, pilot service plants, application, innovation and knowledge centres, education centres, campuses like: Green chemistry campus, Bio Innovation centre.

Important actor in the cluster - a supplier of biomass – is Royal Cousun, an agro-industrial cooperative of 9,000 Dutch sugar beet growers' majority of which are based in the region, owners of Cosun Research & Development and Cosun New Business & Innovation. The Innovation Centre of Cosun came into service in 2017 and accommodates around 100 employees. They are working on the development of new food industry products, chemicals and energy products. The R&D laboratories are equipped for chemical as well as biological analysis. Furthermore, there is a pilot-plant built in the innovation centre to facilitate the scale-up of the biorefinery technologies. The success of the Royal Cosun is connected to the long history of cooperation, smart specialization with clear focus, crossbreeding of two main industries - agriculture and chemical industry as well as developing triple-helix partnerships.

The focus themes and product areas developed within the cluster are:

- Green chemical products;
- Aromatics;
- Bio based packaging;
- Bio based construction materials;
- Agro-food products – potato, sugar beets & wheat;
- Bio-fuels: alcohols to jet-oil to jet-syngas to jet;
- Horticulture products; and
- Large-scale bio-refinery of lignocellulosic biomass (2nd generation carbohydrates and lignin).

Successful examples of currently available products – commercial bio products - include:

- The expanded polystyrene alternative Biofoam;
- Biodiesel production from animal waste stream fats by Electrawinds;
- Ethanol production from DDGS (cereal waste stream) and corn by Cargill and Abengoa;
- Large scale biogas production by Suikerunie;
- The exchange of CO2 and biogas between companies;
- The production of algae for fish farming;
- Flax products for construction, composites etc., produced by Van der Bilt;
- Natural detergents from EcoPoint;
- Starch based bioplastics from Rodenburg;
- Natural colorants from Rubia Tincorum by Rubia Natural Colorants;
- Plant pots based on potato industry waste streams produced by Planty Pot (linked with Rodenburg);
- Construction material based on mineralized horticultural residues like tomato plant stems by Nova-Lignum;
- Bionafta from Neste Oil on the cracker of SABIC (certified PE);
- Biobased polyurethane from Nestaan;
- Work on chicory and sugar beet leaves usage and derivatives of wood biomass, e.g. are carried out; and
- Organic waste, residues of sugar beet and grass processing valorisation.

Cluster Organization and Management

Legal form of the Biobased Delta cluster is foundation - a triple helix public-private partnership. The origins of the plan to develop Biobased Delta started in 2007. First collaboration activities in the Biobased Delta started in 2010. Biobased Delta was formed from a merger between regional clusters in Zeeland and West-Brabant in 2012. South Holland joined in 2014. The partnership that was initiated by regional development agency took form of a foundation at the end of 2013.

Three focus areas of the Biobased Delta where defined in 2012 – 2015:

1. Sustainable process industry;
2. Novel crops and feedstock; and
3. Green building blocks.

In the initial phase key steps and support instruments were:

- National subsidy program “Pieken in de Delta”, which allowed foundation to explore the regional potential of biobased economy and fund the first pilot projects;
- Development of a joint triple helix agenda on Biobased Economy, called “agro meets chemistry”;
- Commitment of regional governments for developing the cluster organization, clusters and projects; and
- Establishment of the foundation Biobased Delta and the branding of Biobased Delta .

At the time of Benchmarking visit the membership base of the Biobased Delta was more than 150 companies – SMEs, medium sized companies and large Multinationals operating in agricultural, horticultural, chemical and polymers, construction, biofuels and bioenergy sectors. SMEs represent 75 members. The cluster is open for new memberships - new member companies join via other SMEs.

Funding and management structure of the cluster

Biobased Delta foundation budget is around 1 million EUR per year. Majority of funding for the cluster comes from three provinces accounting for 70 per cent of the funding. Fifteen per cent of funding comes from industry (large member companies pay 20 000 EUR per year, SMEs are not obliged to pay, but are involved in projects) as well as 15 per cent of funding is attracting via various EU project funding, such as the H2020 BIOPEN project.

Biobased Delta is managed by the board and supervised by an advisory board. The board consists of six people, primarily industry-based professionals, i.e. CEOs with strong personal networks who provide a lot of in-kind investment managing the cluster, and it also includes administrators from the provincial governments and knowledge institutions from regions involved.

Supervisory board is formed by 14 people. The Supervisory Board checks whether the goals of the foundation are being achieved and monitors the joint Biobased programme. The Supervisory Board members also play an inspirational role for the board and act as ambassadors on behalf of the Foundation. The members of the Supervisory Board include administrators from the provincial

governments, the business community and knowledge institutions from the regions involved. Supervising board meets four times a year.

The cluster operates around the developed business plan and agenda. Business is in the lead in formulation of the agenda. Regional governments and their regional development agencies act as the facilitators and are strongly involved in the execution of the Biobased Delta program and projects, but do not determine agenda - companies together with R&D institutes are the main actors who determine the agenda. Developing and setting a joint agenda has been the starting point of the cluster and is the key factor of success. Currently Biobased Delta operates within the framework of Multiannual Business Plan 2018. – 2020. [2]

For the period 2018-2020, this multiannual plan focuses on four main lines:

1. Continuation of the development of sustainable circular and biobased programs – Redefinery, Sugar Delta and Biorizon, focusing on consortium formation and acquisition.
2. Extending the national and international network to accelerate knowledge, R&D and business development and accelerate new business initiatives (MNO, SME, start-ups and scale-ups).
3. Increase the added value of the operating lines supporting the (I) regional circular and biobased SME ecosystem and (II) the regional operating lines in cooperation with regional economic development agencies and (III) superregional coordination and linking between top locations and application centres
4. Reorientation & repositioning is planned on the following subjects:

    - Strategy: mission, objectives, connection with government policy regarding public funding, added value and earnings model (Attract business partners with financial and / or in-kind contributions)
    - Structure: organisation and governance
    - Flagship projects: acquisition, consortia, scalable business cases (connect MNOs, SMEs, startups and scale-ups)
    - Operating lines: intensification and optimization, focused on supporting circular and biobased MNOs, SMEs, startups and scale-ups.[3]

There are areas where member companies compete, and there are areas where they can successfully collaborate. When developing joint agendas, Biobased Delta tries to avoid direct competition within the cluster. They try to avoid putting together companies who are directly competing for the same piece of value chain. Local government is strongly involved in supporting innovation by making cities "Living labs". Green Deals are one of the main field where municipalities and government can help to businesses and innovation centres. Board tries to facilitate a specific project where companies can work together in a project.

[2] Business plan Biobased Delta Foundation 2018-2020, accessible: https://biobaseddelta.nl/wp-content/uploads/2018/08/business_plan_biobased_delta_public_en_0.pdf

[3] Biobased Delta homepage -multiannual business plan: https://biobaseddelta.nl/en/multiannual-businnes-plan/

From idea to commercial innovation

For selecting the development projects, Biobased Delta has criteria for selecting business ideas for further development based on the commercialization potential. This criterion is focusing on commercialization potential and has eight (8) categories. The business case is analysed on the categories of business plan, feedstock, technology, market, supply chain, operator, location, policy with 10 critical questions to consider for de-risking all aspects for large bankable projects.

As major key part of the joint agenda, Biobased Delta currently implements three large scale flagship projects. Flagships are primarily run and focused towards the large companies (while SMEs are included). These projects promote a future vision for economic transition. Flagships are:

- Sugar Delta - valorisation of sugar, large-scale biorefinery and bio aromatics
- Redefinery - large-scale biorefinery
- Biorizon

"Be focused! we don't' go broad, we go deep – 3 flagships only!"

W. Sederel, Biobased Delta

Cluster management organization model is light and very flexible with Board playing a major role as facilitators utilizing and leveraging their personal networks and contacts. Role of the board as facilitator is focused on connecting stakeholders, ecosystems, networking and cluster promotion, development of new projects.

The cluster network model is in a transition - changing of joining agenda from "Agro meets chemistry" to "Agro meets chemistry and markets.

Biobased Delta Innovation Services to the Companies within the Cluster

Services for the companies

SMEs are in the centre of short-term commercialization projects thus, the SMEs require quicker and more flexible innovation services that can service a wider range of business ideas with commercialization potential. SMEs receive support in R&D (especially via Green chemistry campus), piloting, testing, development of the business idea and on commercialization.

Prominent R&D and piloting services suppliers in the cluster network include:

- Technical University of Delft (Biotechnology, Bio-catalysis, Bio-energy &fuels, Process Intensification, Biotech & Society Group);
- Centre of Expertise Biobased Economy Breda (Biobased Economy, plant ingredients, energy & water, green building & construction, aquatic biomass) Education – Research - Knowledge Centre.
- Scientific Council of Biobased Delta ;
- Imares Research Institute is part of Wageningen University in the field of maritime ecosystems;

- Green Chemistry Campus in Bergen op Zoom;
- BE-Basic (Delft) - an international public-private partnership;
- BioBase Training Centre - an education, network and exhibition centre promoting the development of a sustainable biobased economy;
- Laboratory, pilot and demo facilities: Bio Processing Facility (BPF) in Delft;
- Natural Fibres Application Centre (NAC) in Raamsdonkveer: open access facility with capabilities for pulp & paper plus bio-composites;
- Rusthoeve: experimental farm with Bio Innovation Garden. Small scale Biorefinery equipment focused at direct processing and plant ingredients for high value applications; and
- Some of the large companies are offering support to SMEs by sharing their production facilities with smaller companies to let them test new promising ideas.
- Living labs
- Interreg and H2020 well utilized

The BBD Foundation organizes the 'Biobased Business Development Day' - a networking event for companies to find collaboration partners and funding (approx. 150 attendees every year). Other events are organized regionally, e.g. inspiration sessions and workshops, networking events focusing on green chemical building blocks and theme sessions on specific themes, e.g. natural fibres.

Biobased Delta organizes networking events for local and regional companies to:

- bring people together;
- train them how to speak the same language;
- animate the cooperation;
- show potential and current members win-win situations and best practices;
- explain value chains processes and build partnerships on the way; and
- form the structure, manage it, initiate strategies and programs, form new projects, look for funding opportunities, lobby, enlarge the cluster

Spontaneous cooperation between cluster members occur (informal in such clusters like e.g. natural fibre cluster, coating cluster, natural colorants cluster, building cluster, infrastructure cluster, pyrolysis cluster), facilitated by meetings, networking and working in concrete projects (Sugar Delta, Redefinery, Biorizon).

National Strategies and Internationalization of the Bioeconomy Cluster

In Netherlands, there are several national strategies and programs in place that directly or indirectly facilitate the Biobased Delta cluster and innovation hub development and internationalization, providing favourable framework conditions for the cluster and innovation hub ecosystem. These include:

- The Investment Agenda for the cabinet formation 2017 "Towards a Sustainable Netherlands", a sustainable approach consists of three components: approach to energy, circular economy and climate change.
- "The Netherlands Circular in 2050" was published on behalf of different ministries, which states that the Netherlands will be 100% circular in 2050 and 50% in 2030.
- In January 2017, government and business and government organizations, including the BBD Foundation, signed the ‘Raw Materials Agreement’, implementing the Dutch sustainability program.

- Dutch circular agenda for the building and civil works.
- National subsidy program “Pieken in de Delta”

Cluster Internationalization is among key focus areas of the cluster. Biobased Delta has implemented several collaborative projects with international partners, such as:

- Chemical Regions for Resource Efficiency (R4R) FP7 CSA call;
- BERST project (2013-2015) aiming at toolkit and network for enhancing regional bioeconomies (FP7);
- Biobase NW Europe (Interreg 4b) Sharing best practices and stimulating SME Connecting CO2 (NL-VL), Interreg;
- CO2 and CH4 as carriers for a regional economy, Interreg, continuation of Connecting CO2;
- Biobase Europe Pilotplant and Training centre (2009-2018), Interreg
- The H2020 project "Biopen" has created an open innovation platform. The platform provides for scientific literature search possibilities and the available project funding opportunities along with a matchmaking and collaboration services. These are open access services for researchers, SMEs, start-ups, large companies and others working with the biobased feedstocks.

These projects have boosted competitiveness and business opportunities for regional SMEs by e.g. identifying and promoting successful innovation systems, mechanisms, processes and incentives (e.g. in chemical industry). The Biobased Delta network has identified good practices across European regions to accelerate innovation, e.g. in resource and energy technologies, enhancing regional bioeconomies. Biobased Delta has also accelerated innovation and promoted European eco-innovative technologies on global scope and encouraged international cooperation by connecting with relevant clusters outside Europe to ensure the development of a wide resource efficiency community.

Biobased Delta is member in:

- Bio-based Industries Consortium (BIC) and 3BI intercluster - a strategic European partnership that builds on the complementary strengths of four regional innovation clusters (including Biobased Delta); and
- European Strategic Cluster Partnerships (ESCP-4i).

Biobased Delta and its member companies are very active on the international markets such as Flemish, German and Canadian markets.

Biobased Innovation Hubs in the Biobased Delta Area

Biobased Delta as a metacluster acts as a network of several sub-clusters and innovation hubs/technology parks. Clear distinction between the Biobased Delta cluster and the larger innovation hub around the cluster does not exist. Cluster is embodied in the larger innovation ecosystem in the region while at the same time facilitating the cooperation between the elements of the ecosystem, thus serving as a facilitator of the hub development, creating a complex and intertwined network structure.

The larger innovation hub in the Zeeland, West-Brabant and South Holland area includes not only a cluster type organization – Biobased Delta foundation, but also regional development agencies, facilities, campuses, infrastructures and related activities and services, projects, centres of expertise, biobased education and research programs as well as digital work spaces.

Top Locations Form the Core of the Hub

Among the most important top locations with facilities and infrastructure to accelerate these developments, are:

- The Green Chemistry Campus (hosting the Biorizon technology cluster focussing on bio aromatics, and application centres for natural fibres, colorants and biopolymers). Green Chemistry campus was initiated in 2011. Ambition is to help proven innovations to go for further development of the products (commercialisation time 3-5 years). Currently it is an office, meeting and co-working space, but a demo facility is being built along with support services for companies. Campus is located at the area of SABIC chemical company.
- Nieuw Prinsenland (application and development green commodities);
- Port of Moerdijk (pyrolysis application and realize resource efficiency through energy circles);
- Amerstreek region (fiber applications from agro-streams aiming at various markets such as construction, packaging, horticulture, etc.). Chain concepts like ‘circular horticulture’ and ‘closing the mineral chain (phosphates recovery) are also covered by consortia.
- In Zeeland - Impuls (regional economic development agency) has established the 'Biobased Economy and Food' cluster. Many projects with algae and weeds for food consumption, aqua, chemistry and energy are developed and facilitated in this cluster. In addition, the ‘Delta Smart Resources’ initiative has been launched in the region to achieve resource efficiency in the process industry, for example by sharing residual heat.
- Zeeland has a number of focus points for biobased activities: Biopark Terneuzen, the Zeeuws-Vlaamse Kanaalzone with the Biobase Europe Training Center in Terneuzen, Bevelanden, several pilot locations for both algae and weeds and the Rusthoeve with the Biobased Innovations Garden. Impuls also has a circular and biobased vouchers scheme to stimulate innovative SMEs to develop new circular and/or biobased products, services, processes or concepts.
- Delft is an important location within the province of Zuid-Holland because of the Bioprocess Pilot Facility, the Biotech Campus and the incubator Yes! Delft. Also, the port of Rotterdam is of great economic importance, due to the import of biomass and the presence of large-scale chemical industry. Test- and pilot facilities for biobased and circular processes are available in PlantOne, SuGu and BlueCity010. In Zuid-Holland, work is being done on green chemistry, industrial biotechnology (focus Delft) and high-value plant ingredients.

Other relevant projects and centres of R&D include:

- BioBase4SME advises start-ups and SMEs from Northern Europe on how to market their biobased innovations. Support with the continued development of biobased research into a commercial innovation. Offers training, innovation boot camps, workshops and innovation coupons worth a maximum of € 100,000.
- CoE BBE: Biobased Network: Collaboration of application centres throughout the entire chain within the biobased economy. An application centre is a development workshop which a company can contact an idea, concept, or issue in order to develop biobased products. Smart pilots: Shared pilot facilities provides expertise, research and demonstration facilities. Continuously improving policy for the use of these facilities, so that solutions can be implemented in practice faster.
- Centre of Expertise in Biobased Economy is formed in collaboration of Universities of Applied Sciences (Avans, HZ UAS). National network of centres of expertise (UAS) and centres of innovative craftsmanship (vocational level); Aeres, Avans, Inholland, HZ, support innovation in Netherlands and work with business to modernize higher professional education (Human capital agenda).

Biobased educational innovation, applied Biobased research and business support:

- Biobased education; MOOC Biobased economy introduction, minors and specialization (biorefinery)
- Living lab – Biobased Brazil (Looking for European living lab)
- Biobased research: 6 research groups: Biobased marine specialties, biobased products, Biobased society (art/design), biopolymers, energy;
- Business support: Biobased purchase, green deals, colour application centre, incubator, knowledge vouchers, biopolymer application centre

Bioprocess Pilot Facility in Delft

The Bioprocess Pilot Facility in Delft offers an infrastructure for testing and developing new innovative biobased production processes. This facility is connected to the overall bioeconomy cluster and it was established in 2012. In this facility, CSM, Royal DSM and Delft University of Technology are participating in a joint venture for bio-process research. Any interested companies can apply to make contract with the BPF as longs as their aim fits with the services what the BPF offers. BPF works as an intermediate organization where companies can test any new ideas before creating their own facilities (from laboratory scale to industrial scale). Biological raw materials can be processed and tested in the facility. For example, steps-by-step processes for converting agricultural side-streams into biofuels or other value-added products can be piloted.

A key challenge for the bio-economy is to bring newly developed molecules and techniques from the lab to the market. The main bottleneck in the innovation chain is the step from technology development to deployment. This step must be performed first in a pilot plant and later in a demonstration plant where a production process can be tested and optimized in an industrial production setting. Bioprocess Pilot Facility provides this opportunity.

Bioprocess Pilot Facility takes part in the Pilots4U project that unites the bioeconomy pilot and demo facilities in Europe creating a network of bioeconomy open access pilot and multipurpose demo facilities. Pilots4U groups all European open access bioeconomy pilot and multipurpose demo facilities under one easily accessible network. Pilots4U also wants to assess the current and future needs of the European bioeconomy and looks to invest in equipment modules that are seen essential to catalyse innovation.

Identified Good Practices & Development Lessons Learned

Success Factors of Biobased Delta Bioeconomy Cluster Development

Common agenda, to which all the bioeconomy cluster stakeholders are committed, is a key enabling factor to start and develop the successful cooperation within the cluster. Biobased Delta is a business-oriented cluster. Entrepreneurs are in the lead of the cluster and the definition of the agenda, and accordingly provide part of the funding for the cluster organization and flagship projects. Cluster is focused - clear selections of few key action areas are defined. There are only few flagship projects.

Even though the role of the businesses is very high, cluster operates in a triple helix model. Academic sector involvement and public sector funding and support ("oil for the wheels") is very significant - regional development agencies are strongly involved in the execution of the Biobased Delta program and projects. Advisory board of the cluster strongly represents the triple helix model. Political support for the cluster is ensured.

Knowledge of the markets is essential. The starting point of the successful cluster development relies on the products and areas that already have established markets; finding the competitive advantages, focusing the resources available and having a strong industrial and research base. **Availability of local biomass** is a huge asset (e.g. sugar beets in the Biobased Delta area), but it is not defining necessity to develop cluster initiative only around one or few available sources of biomass. Biobased Delta heavily relies on the local biomass, but at the same time is working on adding value to the biomass that is sourced from other regions and countries. Establishing a sustainable biomass source is important.

Biobased Delta cluster is not developed around one single organization, company, funding program, source of biomass, industry or academic sector, market or product – it is built around the whole **biobased value chain** in three provinces. **Cross- sectoral cooperation** (agro meets chemistry and markets) is imperative to a successful development of such **value chain focused cluster.**

Biobased Delta have successfully worked on:

- combining chemical industry with agriculture;
- combining construction with agriculture;
- ability to reconcile intensive agriculture with environmental protection; and
- 100% usage of cultivated plants.

Cluster is based in an area that has exceptionally strong, highly concentrated industrial and R&D support infrastructure base (17 top locations and array of state-of-the-art facilities) and a strong critical mass of large companies and SMEs. Cluster is geographically focused, yet not bound by the administrative borders. Three provinces are jointly involved in the development and funding of the cluster. While being geographically focused, cluster has very **active international agenda.** Interactions between big companies and SMEs are facilitated within the cluster. Cluster avoids direct competition among members by joining together parties from the different parts of the value chain.

While the cluster is focused and business oriented, the governance and management model are kept flexible. Team of the cluster facilitators play a major role in developing the cluster. The core team is small, yet consists of dedicated professionals with strong market and technologies knowledge and

executive level background, wide networks and rich personal contacts. They are open minded, targeted, passionate, easy-going, and excellent storytellers with an outside-the-box thinking.

Development of the Biobased Delta cluster started in 2007 and required many regular, intensive direct meetings between core stakeholders in the beginning to commit them to the cluster development. Development of the bioeconomy cluster is a **long-term** strategic mission takes a lot of time and requires a lot of patience.

Identified Good Practices that can be transferred to RDI2CluB Consortium

Biobased Delta is an excellent example of a strong bioeconomy cluster and innovation ecosystem and provides many learning opportunities and good practice examples. However, direct transfer of the model to the regions forming the RDI2CluB consortium is not possible due to different framework conditions and historical context of industry development. Still, many elements can be used and adjusted in the scope of local conditions.

Key challenges in RDI2CluB rural regions compared to the Biobased Delta area are:

- Distances (lack of tightly geographically concentrated critical mass of industry and support infrastructure);
- Lack of large infrastructures, lack of big industry players – “cluster locomotives”;
- Lack of awareness on market demand and understanding of bio-based/ bio-economy;
- Culture of academy driven rather than business driven innovation; and
- Lack of clear understanding of existing strong points in bio-economy. Abundance of bio resources has hindered the necessity for deep specializations and focus on added value.
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Since there is lack of comparable critical mass of industry, lack of major industrial drivers and considerably smaller concentration and availability of infrastructures in the RDI2CluB consortium regions, the development of bioeconomy clusters and ecosystems must utilize other strong points and look for opportunities how to build critical mass utilizing cross-border potential.

The strong areas in the RDI2CluB regions are:

- Strong and sustainable availability of high quality bio-based resources - high quality of feedstock, shared resources in Baltic Sea macro-region;
- Similar ecosystems across the partner regions;
- Transition to bio-based economy from fossil based is easier – the prerequisites are there, the oil based industrial base is less developed, while bio based is strong;
- Presence of nature and wildlife in natural condition;
- Shared resources – forests;
- Less intensive agriculture than in the Netherlands. Organic and natural food of high quality; and
- Combination of environmental protection with the industry development.

Key Elements for Transfer of Practices

Understanding the market

Knowledge of market is critical. It is necessary for RDI2CluB regions to also study the markets' interest in more details to better understand the commercialization potential of different bioeconomy products and services. At present, the market understanding is not sufficient. Based on the market research decisions need to be made on which bioeconomy areas to focus the RDI efforts. Understanding the market demand and potential should be a key consideration in this decision-making process of bioeconomy innovation ecosystem and cluster development.

Identification and mapping of available resources, strong areas and key actors

It is essential that we can jointly agree within the consortium on key definitions – what is understood as a bioeconomy cluster, hub etc. Joint understanding will help us to identify collaboration areas and common interest.

Furthermore, we need to assess available resources, but not stay too focused only our own resources (available feedstock, infrastructure). Instead, we should find areas where resources can be combined with other regions, or where we can jointly utilize sources of biomass from several regions. **Find and define possible cross-sectoral borderlines in our regions** (e.g. agro meets chemistry as in Biobased Delta). **Choose bioeconomy niches, go deep in the niches.**

As an example, Biobased Delta has identified 17 top locations in the Biobased Delta (including several application centres) aiming to speed up innovations. Collaboration between top locations is enhanced and promoted in the Biobased Delta Business Plan. The top locations include Application, Innovation & Knowledge Centres as well as Industry-parks and Pilot-Service plants.

For mapping and presenting our innovation ecosystem in RDI2CluB, we should as well look at how to introduce our 'top locations'. The map-based picture with different icons for different actors is an effective tool for presenting the regional bioeconomy innovation ecosystem in practice. Complemented with other tools, this kind of picture could also help us to map our bioeconomy innovation ecosystem.

In the first steps of developing the joint operational model for innovation management, we should have joint concepts for describing the innovation ecosystem and mapping the actors and 'hotspots' of bioeconomy innovation. Joint concepts with a common definition would make the regional descriptions of the innovation systems more comparable and thus facilitate identification of joint transnational actions and collaboration potential. Following the example of Biobased Delta, one way to classify the 'hotspots' of bioeconomy innovation in a region could be the following grouping:

- **Research groups** focusing on Technical Readiness Level 1-3
- **Centres of expertise, application centres or innovation hubs**, where applied research is carried out in collaboration with companies, focusing on Technical Readiness Level 4-6
- **Testbeds, demonstration and pilot facilities** focusing on Technical Readiness Level 6-8

These concepts could be complemented by identification of **clusters** as well as relevant **industrial parks and ecosystems.** The mapping might also feature some key figures depicting the biomass supply potential.

Building & strengthening the network of committed stakeholders able to form and develop a bioeconomy cluster

The situation is very different among the RDI2CluB regions - some regions already have established strong clusters in the bioeconomy sectors, others have not. Some clusters are larger and experienced, while others are small or are in transformation process. Therefore, strategies and actions for each region can be different. Some might focus on the establishment phase of the bioeconomy cluster, others on transforming or strengthening existing cluster, while others exclusively on connecting existing strong clusters to wider innovation ecosystems.

Main consensus is to **stay focused on existing smart specialization areas.** Do not try to establish new clusters, if no existing base or core of companies or infrastructure is in place – focus on current RIS3 and adjust existing bioeconomy profiles. Developing bioeconomy cluster means upgrading or establishing a cluster governance model. This could involve:

- Development of managerial structures, such as the supervisory board;
- Connecting networks together in an ecosystem and creating a network of networks;
- Developing financing structures and structures for voluntary involvement of industry experts;
- Identifying relevant value-chains and cross-sectoral potential; and
- Strengthening the bottom-up processes in cluster development and strengthening industry leadership
- Cluster development is a bottom-up process that required support but cannot be managed from "top-down" perspective.

Development of bio-economy cluster must happen with a focus on a value chain that can be started around one topic or area of bioeconomy. Creating a bioeconomy cluster that does not have a clear value chain focus and industrial leadership is not advisable. Having a clear industrial leadership, flexible structure, political support and strong team of core facilitators with strong networks in the value chain are among several key success factors. This creates a problem for regions where large companies do not function. There is also some difficulty in the fact that scientists are sometimes distrustful of business, which makes cooperation difficult.

Effective network of networks is a key to ensure international, multi-disciplinary collaboration between large companies, SMEs, start-ups, educational institutes, researchers, universities etc. It is important to build a ‘win-win’ situation between all interested parties and develop a joint long-term strategic agenda and commit key stakeholders to it.

Bioeconomy as an area or sector is very broad. Clusters active in the bioeconomy sectors can be specialized in niches and/or value-chain clusters. There is an opportunity to developed "Sub" clusters in every niche focus area, acting as a part of larger bioeconomy cluster. For example, the bioeconomy cluster can be seen as a metacluster under which there are groupings (or clusters) of SMEs and companies working together on specific niche or value-chain development. The size of the cluster is less important than its cash flow.

In the RDI2CluB regions, the academic corner in the Helix is needed as a driver in a stronger form than in Biobased Delta, due to the lack of big companies in the regions. However, the academy needs to strengthen their response to industry-driven R&D needs.

Open innovation and innovation collaboration between companies

According to the Biobased Delta example, open innovation can effectively be used to promote social innovations and the development of business models, while technical and scientific innovations remain closed to ensure competitive advantage to the companies involved. Therefore, for collaboration in technological innovation, a process of closed innovation with clear contracts on rights of usage are needed.

Biobased Delta example shows that innovation collaboration involving several companies usually works best across a value chain. In other words, innovation cooperation together with direct competitors is not generally advocated, but companies with complementing products or that form a supply chain have a greater potential for mutually beneficial collaboration. Related to circular economy models and valorisation of waste streams, there is a potential to connect companies from very different fields to create competitive advantage through collaboration. Biobased Delta also presented their operational model for sharing intellectual property (IP that can also be transferred).

Communication, awareness building and ensuring public sector support for the bioeconomy cluster development

It is necessary to work with the mind-sets of key stakeholders – to initiate them, to let them think about Biobased materials and products. Building a fluent dialogue between sectors and between industry and academy takes time and effort, but can be a start of discovering competitive advantages.

To build a political advocacy for the bioeconomy cluster, involving the local authorities to support businesses that are working with bio-based innovations and solutions is advised (living labs, demo and piloting places). The contribution of government is one of the main aspects to ensure society involvement and a financial support in the biobased innovation hubs and clusters. It is necessary to convince the local authorities about investments that give target deliverables in a 10 or 20-year far future. Showing the case studies and best practices across borders can enhance the support and interest from key stakeholders.

A take-away message for RDI2CluB is that there is a necessity to boost communication and branding of our clusters and ecosystems. Joint communication activities and strategic storytelling – raising awareness - can be a joint set of actions carried out by several partners in RDI2Club Consortium.

Active participation in national and international processes

Active participation in national and international processes is crucial for addressing obstacles (lack of scaling, lack of adequate funding, lack of mechanisms to protect pioneers from product failures), learning how to eliminate these obstacles (Europe has taken over the Green Deal approach of the Netherlands) and learning how to speed up other/future entrepreneurs. It also allows to keep updated on possible shifts in key interests of policy makers towards CO2 / Energy neutral or Industry 4.0. BBD may also make sure that biobased is adequately stressed in regional, national and international agendas.

Potential Action Areas for RDI2CluB

The RDI2CluB regions were asked to report their main take-away lessons and to share them via regional communication channels. The main message that the regional partners have shared was the importance of strong triple helix dialogue and cooperation. This seems to be a necessary action area when developing the bioeconomy innovation ecosystem. We have also taken away several insights on branding, storytelling, cluster structures and financing.

As a summary, we have listed the potential action areas for Joint Action Plans that were identified during the reflections in reporting and the closing workshop held for participants. These include:

- Market research, analysis and understanding;
- Mapping of the existing resources, infrastructures, actors, potential linkages and cross-sector, cross-border collaboration areas, competitive advantages, feedstock and its utilization opportunities;
- Defining joint agendas;
- Improving existing bioeconomy strategies and framework conditions in the regions;
- Initiation of bioeconomy clusters in RIS3 niches;
- Improving the structure, management, services, open innovation and collaboration within the existing clusters, broadening or narrowing the cluster value chains;
- Connecting clusters, cluster internationalization, integrating clusters in wider innovation hubs;
- Facilitating cross-cluster projects and activities;
- Developing support structures/ incentives for bioeconomy product and services innovation; and
- Awareness building and ensuring stakeholder support for the bioeconomy cluster strategic long-term development.