Report on the

INTERNATIONAL CONFERENCE ON BIOECONOMY BUSINESS DEVELOPMENT & INNOVATION

Alnarp, Sweden 2019/06/18

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Project acronym	BioBIGG
Work Package	WP4 – Material flows and innovation potentials of agro-industrial value-chains
Deliverable	D4.3 – Knowledge transfer, result dissemination and establishing cross-border thematic clusters
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1. Introduction

The BioBIGG project has the aim to point out attractive business opportunities for SMEs concerning the production of innovative food, non-food products and bioenergy production, based on regionally available resources and innovation potentials. By cross-border knowledge transfer, advisory activities and innovation activities for the preparation of piloting and investments the project will initiate the development of new biomass-based products and pave the way for the growth of the bioeconomy in the South Baltic Area.

The project group organised the *International conference on bioeconomy business development & innovation* on 18 June 2019 in Alnarp, Sweden as a part of the BioBIGG project activities. The goal of the conference was to create a meeting point for researchers, innovative companies and other stakeholders with a focus on major value chains: sugar, straw, wood, industrial and household food wastes. During the conference, possibilities were created to talk to experts on e.g. crop production, agricultural residue recovery, protein extraction, bioenergy and sustainability assessment. The focus was also to inspire the participants and to exemplify how products for the bioeconomy can be developed.

2. Conference program

The conference included presentation of case studies and showcases of innovative production processes as well as pre-feasibility studies carried out within and outside of the BioBIGG project (section 3). The case study presentations were rounded up with an outlook on the further challenges in the transition to a green bioeconomy. After that, cross-border thematic clusters were formed within which essential questions and issues were discussed in the workshop part of the conference (section 4). For a detailed conference program please see appendix A.

3. Presentation sessions

3.1. **REST-till-BÄST – From organic residues to soil improver**

Ann-Mari Fransson, SLU, Sweden

Using agricultural residues from seed production as a solid fuel for biochar production is already a commercial reality in a small town in Skåne, south Sweden. Ann-Mari Fransson from the Swedish University of Agricultural Sciences (SLU) in Alnarp presented the changes that were made in Skånefrö, the seed company, and several new opportunities the biochar production has opened up for. Process energy is used for district heating while the biochar is developed as soil improver for urban applications such as city tree plantations, green roofs or innovative storm-water constructions. The bio-oil produced in the process can be used for e.g. heating purposes or as a fuel. Biochar is produced by pyrolyzing organic material in an oxygen-free environment. The biochar production units are situated at Skånefrö´s Hammenhög seed plant. The residues from the seed cleansing are first pelletized and then pyrolysed to produce biochar. It is estimated that the main pyrolysis unit will produce 6,500 tons biochar per year with an energy output of 1500 kW. Biochar treatment of biomass can help to mitigate climate change where 1 ton of biochar corresponds to 1.7 tons CO_2 mitigation. The biochar has mechanical stability with a half-life of biochar around 150-5000 years.

Ann-Mari Fransson also presented the ongoing project “Rest till Bäst” financed by Sweden’s Innovation Agency. The project´s aim is to develop solutions to manage organic residues from society based on experimental tests to adjust the temperatures in the pyrolyzing process which takes place in a second, experimental pyrolysis unit. The goal is to create an attractive product with a minimized climate and environmental impact by creating a carbon sink. Ann-Mari Fransson also presented results from the project BiodiverCity where four different tree species were planted in 2014, each with and without the addition of biochar. From measurement conducted in 2018 it was concluded that the biochar increased productivity of some tree species, while others were not affected. Biochar can therefore be seen as a catalyst to improve growth and biomass production in certain tree species.

3.2. Wetland biomass for district heating – the Agrotherm GmbH

Anke Nordt, Greifswald Mire Centre, Germany

Paludiculture, or cultivation of rewetted peatlands, was one of the adjusted farming solutions presented by Anke Nordt from the German Mire Centre. The idea originated from the need to decrease the substantial greenhouse gas emissions originating from drained peat soils and suggests potential crop alternatives that result in similar revenues for the involved farmers compared to their original cropping systems.

While living peatlands accumulate biomass and have a positive carbon balance, drained wetlands are subject to mineralization processes that slowly decrease the peat layer, releasing large amounts of greenhouse gas emissions. For example, grassland and cropland on peatland release around 29 and 37 tons of CO_2-equivalents per hectare and year, respectively. While covering only 3% of the global land area, peatlands contain >500 Gton of carbon, which is roughly twice the carbon stocks of the global forest biomass. Drained wetlands are currently used for e.g. cattle grazing, potato cultivation and forest production. Rewetting would solve most problems with peatlands, though current production schemes on drained peatlands would have to be changed to maintain the production function.

New production schemes may include wet meadows and paludicultural crops. Wet meadows may produce biomass for solid fuel production, biogas feedstock, bedding material and animal feed. Yields range between 2-12 tons DM/ha and year at 1-2 cuts per year using adapted grassland harvest technology. However, rewetting is seldomly implemented in agriculture due to missing subsidies for the farmers that have lower income on rewetted compared to drained peatland. The Greifswalder Mire Centre suggests payments for ecosystem services as new funding instruments to tackle this problem.

An example of successful implementation of rewetting, the biomass heating plant in Malchin, Germany, uses 1200 tons of wet meadow hay harvested from 300 ha and supplying 4 GWh of district heat at the cost of 5 €-ct/kWh which is competitive to the natural gas price. The plant operates economically without receiving any funding for the greenhouse gas emission reduction. A major challenge in establishing the heating plant was to gather the relevant stakeholders including a power production company, heat consumers, local authorities, site owners and investors, and to come to an agreement. It took one right person at the right time and place to coordinate all stakeholders, but also to evaluate the legal situation (CAP, nature conservation law).

3.3. Utilizing the potato starch feedstock fully – protein, fiber and fruit juice

Kalle Johansson, Lyckeby Starch, Sweden

Kalle Johansson from Lyckeby Starch, a south Swedish starch producer, presented how the potato starch feedstock can be fully utilized, with focus on protein, fibre and fruit juice. The potato consists of 74% water, 20% starch, 3% ash, 1% fibre and 2% protein. Kalle Johansson underlined the importance of continuous development as they have done in the history of their company. Resource-efficiency and valorisation of side streams need to go hand in hand in order to justify the investments in a process addition or change. In the 1950s there was an environmental pressure which lead to the development of new technology at Swedish Starch Producers Association (SSF) and Lyckeby to utilize process water as fertilizer. This was developed further in the 1960s where more concentrated potato juice was used for fertilization. In the 1980s refined potato fibre process was developed to meet market needs. A process for extraction of potato protein for feed was developed in to 2000s. In 2010s the focus was on an evaporator to produce fruit juice concentrate and a pilot process for food protein. Kalle Johansson also showed some on-going developments, including refining extracted products, reducing media/energy consumption and potatoes for better utilization of side streams. The side streams generate 7 million Euros per year for Lyckeby Starch today. Examples of driving forces and difficulties at Lyckeby Starch that Kalle Johansson mentioned was market need for the product, cost for disposal, legislations and company profile (sustainability). For being a relatively small company, it has proofed to be challenging to maintain and develop the technical knowledge and to cover the relatively large investment cost needed. Furthermore, the rate of processed material is high which would require considerable storage facilities should Lyckeby Starch aim at producing fibres from all the potatoes they are handling.

3.4. The future of biomaterials and possibilities for a regional production of polymers

Åke Rosén, Gaia BioMaterials, Sweden

Large-scale production of bioplastic polymers is a reality already, with innovative material properties as demonstrated by Åke Rosén from Gaia Biomaterials, Sweden. However, the feedstock is currently imported from Asia, but could just as well be produced in Sweden instead if the full potential for crop production was utilized as Åke argued. However, the right choice of feedstock may also bring additional benefits as the improved visual material properties and reduced climate impact. GAIA has an ongoing project together with Skånemöllan to replace fossil plastics by using a renewable feedstock from the cereal chain. The biomaterial that was developed by GAIA is called Biodolomer and example of products of this material available on the market is bags, trays and disposable cutlery. Biodolomer is certified according to EN13432 standard for composting.

3.5. Circular economy principles applied to a potato value chain – a Polish symbiosis

R. Bochniak, A. Gołąbek, R. Andrzejczyk, P. Dąbrowski, D. Mikielewicz, J. Wajs, University of Gdańsk, Poland

As a Polish example, Dariusz Mikielewicz presented Podole Wielkie, a crop and cattle farm, and the Farm Frites Poland, a potato factory. The two companies form an intriguing symbiosis, where the respective entities use each other´s product and residual streams to close material, energy and nutrient loops.

Farm Frites was established in 1994 and employs 224 persons having a turnover of around 70 M€. The factory uses around 220,000 tons of potatoes grown on 7000 ha. The major product is French fries (107,000 t/yr; 92%) and minor products of potato flakes (6,700 t/yr; 6%) and potato pancakes (2,800 t/yr; 2%). Major by-products from production include soil (2,100 t/yr), stones (800 t/yr), mud, crumbs (650 t/yr), peelings (20,000 t/yr), starch (2,200 t/yr), wet cuttings (8,000 T/yr) and dry cuttings (2,900 t/yr).

The potato flakes are produced from the by-product wet cuttings, a stream that will be further reduced by a future second installation for potato flakes. Much of the organic material is used as biogas feedstock in the nearby biogas plant maintained by the Nadmorskie Elektrownie Wiatrowe Darżyno (SeasideWind Power Plant Darżyno). This plant produces 2,600 MWh of electricity from the biogas in the 1.2 MW co-generation unit. The residual starch is received by the Podole Wielkie Farm, producing ethanol. The only waste that is collected by an external company for recycling is frying oil, waste paper and foil.

The factory further recovers heat from the frying oven, and the heat is used to pre-heat fresh air. Heat is also recovered from the blanching machine, subsequently used for pre-heating fresh water entering the process.

The Podole Wielkie Farm was established in 1993 and employs 25 persons. On 600 ha, the farm produces potatoes, cereals and rapeseed as well as cattle and with 1.5 million litres per year is the largest producer of potato spirit (ethanol) in Poland. The second line of ethanol production is based on reject potatoes, rye, barley and wheat, producing at 30 litres/hour. From the rapeseed, rapeseed oil is produced in small-scale (1000 bottle/year). From the distillation process, stones, sewage and decoction are produced as by-products. Since 1994, straw is used to fire the process boiler. Agricultural residues such as rancid straw are preferably used as fertilizer. Similarly, the decoction is used as fertilizer or animal feed. Even the residues from rapeseed oil production are used as animal feed. Plans include the construction of an own biogas plant, that will enable steam generation from the engine driving the generator, covering 60% of the steam requirements. New ideas for future straw and potato-based products for the bioeconomy include filament of 3D-printing, concrete supplements, chemicals, food antioxidants, glues, adhesives, MDF and chipboard substitutes and bio-sorbents. Pre-feasibility studies investigating cellulose acetate from straw and by-products of the alcohol secondary fermentation as well as biodegradable plastic from starch are currently carried out in cooperation with the BioBIGG consortium. Conclusions from symbiosis development are that ecology should go hand in hand with economics. Due to the vast market potentials for bioplastics, production of bioplastics from the residual streams of local enterprises seems feasible and promising.

3.6. **Intermediate crops as sustainable feedstock for protein extraction**

Thomas Prade and William Newson, Swedish University of Agricultural Sciences

As a reaction to the strong trend towards more plant protein-based diets, new feedstocks are investigated for the extraction of food-grade protein concentrate for direct consumption or as food additive. Thomas Prade and William Newson from the Swedish University of Agricultural Sciences (SLU) presented a prefeasibility study on the use of intermediate crops grown as catch and cover crops as feedstock for this purpose. Within an ongoing innovation project, the Plant Protein Factory, the proposed extraction process will be tested in the soon to be opened pilot plant at SLU.

The Plant Protein Factory project aims at overcoming a number of challenges that include unprofitable production systems for biogas, EU2020 restrictions on biofuel production, the currently ongoing vegan/protein shift, the need for functional proteins in the food industry, the avoidance of new allergens and the related need for new feedstock crops, the waste of food from field to fork and the reduction of the reliance on imported soybean. The project aims to present new plant-based feedstock for future plant protein factories, to investigate new business models and revenue streams, to become an anchor for future SLU research, and to present solutions to the EU2020 restrictions on transportation biofuels.

The project has already passed the Vinnova UDI Step 1 (2017-2018) and is currently in the second step that includes the construction of a pilot plant in Alnarp (2019-2021). The third step will then lead to a full-scale production facility and is planned for the years 2022-2023. Besides SLU Holding, SLU and Vinnova, the project currently has 13 partners within different sectors.

Intermediate crops (ICs) stand out as a resource that is currently only utilized to reduce nutrient leakage, for erosion and weed control, as support for pollinating insects and to increase soil organic carbon pools. However, when these functions are fulfilled, the biomass remains in the field and e.g. may contribute to nutrient leakage during mineralization. Better nutrient recovery could be accomplished by harvesting the aboveground biomass (leaving the stubble and root biomass to contribute to soil organic carbon) and using the biomass as feedstock. In the present pre-feasibility

study coordinated within the BioBIGG project, the researchers from SLU investigated the use of ICs as feedstock for production of leaf protein concentrates for human consumption.
With a current production of catch crops on 80,000 hectares in Sweden and a potential of 194,000 ha with yields ranging between 1.2-4.1 t DM/ha a total potential of approx. 400,000 t DM could be made available.
A general process for plant protein includes the steps of washing the feedstock plant material, crushing it and pressing it into the green juice and a fibre-rich residue that can be used as feed for ruminants. Application of heat will precipitate the green protein fraction, e.g. applicable as feed even for monogastric animals such as pugs, while the following acid treatment will precipitate the white protein fraction aimed for human consumption. The remaining residue, the brown juice, can be used as fertiliser.
The pre-feasibility study investigated four ICs including hemp, oilseed radish, buckwheat and phacelia, intercropped with legumes and as pure stands. Costs for cultivation, harvest, transport, storage and processing ranged from 85-178 €/ton DM with the feedstock cost representing 68-86% of the production costs. Revenues from white and green protein fraction sales were estimated to be 369-709 €/t DM with the white fraction representing an estimated 71%. More details of the pre-feasibility study will be published soon.

3.7. Hemp oil production

Gun Hagström, Swedish University of Agricultural Sciences (SLU)
During the lunch break, Gun Hagström demonstrated the small-scale pressing of oil from industrial hemp seeds and engaged in discussions with the conference attendees. The demonstration included a tasting opportunity, and discussion on the potential use of the press cake as animal feed or for further processing of e.g. of high-value compounds or plant protein.

3.8. Unlocking the potentials of a circular bioeconomy in Regions

Tyge Kjær, University of Roskilde, Denmark
This presentation rounded up the program by reminding the auditorium of the dimensions of the challenge in the transition to a bio-based economy and the still increasing energy and resource demand. On the other hand, the potentials for increased biomass production and supply are large and present a vast variety of opportunities for research and companies to not only solve the environmental problems of today but to create a more sustainable bioeconomy in the near future.
The two reasons for the green transition that we are currently seeing and supporting were given in the finiteness of the fossil resource that the world is using in an increasing rate and the problem that the release of the carbon is causing the world climate to change. The transition to a bioeconomy can thereby be seen as the green shortcut using the photosynthesis of plants to build biomass but avoiding the 10 million years of fossilising the biomass to energy carriers, but instead using the fresh biomass carbon directly in the economy. The total mass of over 13 billion tons of CO_2 released annually from fossil sources gives the dimensions of the transition needed to go over to a fully renewable carbon bioeconomy.
This transition needs to utilise biomass from different sectors including agriculture, forestry and marine production by applying different methods of production and conversion with examples such as pyrolysis and fermentation.
A growing bioeconomy mainly aims at the use of biomass outside the production of food and feed, which can and should be deeply integrated with food production none the least. It is important to apply cascading principles, i.e. prioritizing highly value ingredients before extracting or producing bulk products. Furthermore, energy recovery should be the final step, but technology choices should allow for plant nutrient and carbon recycling to the primary production sectors. This way, the

production system will be characterised by multiple circularity options that substantially reduce the fraction of linear streams by way of reuse, recycling or recovery of side-streams.
For both agriculture and forestry, such circular concepts have been proposed and are currently implemented. As an example, the Nova Institute in Germany has predicted the share of biomass in the chemical industry to increase from 10 to 20% in the years 2010-2050, while still growing in production with almost 300% in the same interval.
The green bioeconomy transition is expected to hold great opportunities and solutions in all kinds of areas including sports, mechanics, building and decorating, consumer goods, automotive and transport textiles and flexible packaging. However, the largest market share for renewable materials is the market for rigid packing with a renewable version of PET.
For both the agricultural sector and the forestry sector, policy support has either been implemented or is highly prioritised to be implemented until 2020.

4. Workshop sessions

In the afternoon, company representatives and researchers gathered for a workshop where barriers and drivers for the development of innovative bio-based products were discussed in thematic sessions. These sessions included the four main value chains that are in the focus of the BioBIGG project and that cover the most substantial feedstock potentials for product development – straw, forestry industry residues, industrial and household food wastes and residues from the sugar industry.

4.1. **Straw residues**

The group discussion was divided into three subsections; (A) Clarification about the utilization of straw in Sweden, Denmark and Spain. (B) Identifying differences between Sweden, Denmark and Spain concerning the straw market. (C) Discussions about the effects of the drought in 2018 on the different straw-markets.

A) Clarification about the utilization of straw in Sweden, Denmark and Spain

In Sweden straw is primarily used for energy, bedding and feed purposes. In Denmark straw is primarily used for energy purposes and to a much larger extent compared to Sweden. A marginal amount is used for biogas, bedding and feed. In Jutland high-quality straw is exported to Holland, Germany etc. In Spain straw is primarily used for bedding and feed purposes.

B) Identifying differences between Sweden, Denmark and Spain in relation to the straw market

The Swedish straw market has not yet been fully developed and is primarily based around trades between straw suppliers and buyers within short distances. In periods of supply shortage, Swedish woody biomass is used as bedding material instead of straw. The Danish straw market is developed within the energy sector, where it is utilized by centralized and de-centralised energy plants. The supplier market can be divided into two subcategories: the contractual market (straw supply based on contracts of 2, 3, 5 years for energy purposes) and the spot market (no contractual agreements prior to sale). The market for straw to biogas is under development, especially in Jutland.

C) Discussions about the effects of the drought in 2018 on the different straw markets

In Sweden the drought created a supply shortage for bioresources for feed purposes. The straw prices on the spot market increased. Straw was imported from Denmark. There were also examples of straw imported from France. Logistical difficulties were encountered in importing straw from France by international cargo ships. This was primarily related to fire restrictions, as the straw bales needed to be covered in plastic. However, it was possible to transport the straw bales by road, and through tunnels, with fewer restrictions. This solution was utilized by some buyers. In some cases, straw initially harvested for use as bedding material was used for feed instead. In Denmark the straw prices on the spot market also increased as a consequence of the drought. Supply shortages on the energy market occurred, as the straw was partly utilized for feed purposes instead. Straw bales were exported to Sweden and Norway at high prices. The high prices, and lack of feed material for cattle and pigs, decreased the amount of straw left on the fields. This also indicated that the security of supply was not only dependent on weather conditions, but also on price fluctuations. The effects of the drought on the straw market in Spain, was not elaborated upon in the group discussion. In general, there was an agreement in the group, that supply shortage and lack of secure supply needed to be minimized in order to increase the long-term usage of straw for multiple purposes.

4.2. Residues from forestry and forestry industry residues

During the workshop, the group discussed what is needed to help the innovation of sustainable products for the bioeconomy in relation to forest industry. The group concluded that the main driver or barrier for innovations is economy. It is the economy that defines all the frameworks in which the entire bioeconomy moves. For example, in Denmark, wood prices are falling, so Denmark slows down its forest economy, reducing tree felling. It ceases to be profitable. Besides, it focuses on fast-growing trees to stimulate forest economy to grow.

The forest industry has a long history and it is a well-known industry. On the other hand, it did not change a lot over the centuries. We still perceive wood as a building material, and the residues generated during its processing is utilized as a source of energy that can be converted into pellets or wood chips and then combusted. However, wooden residues can bring much more value. Several investigations show that forest growth can be significantly increased through various measures. But the available knowledge must be more widely applied. Partly this is the industry's own responsibility, but it also requires change in regulations. A prerequisite is that biodiversity is conserved in planning and execution of various forestry measures.

The forest industry needs innovations to make its production more sustainable. On the other hand, implementation of innovative products and services can imply a high (investment) risk, which is why entrepreneurs prefer implementing verified solutions. The woody biomass industry offers many possibilities and waste from its processing has different valuable elements that can be used in various industries such as chemical, biological, food or agricultural industry.

4.3. Residues from the food industry and individual food waste

In the discussion present were 9 persons from different countries such as Denmark (2), Germany, Slovakia, Sweden, Slovakia and Poland (3).
An important topic was the differentiation between industrial and individual food waste. There are appropriate laws in power that define the required response from both considered sides. The industry usually complies with the established laws; however there may be minor misbehaviours of individual actors. Nonetheless there are no established problems. A concern was raised in the discussion regarding the execution of the laws by individuals in case of household waste. In countries such as Denmark, Sweden and Germany good practices are already in place for some time and there are fewer cases of misconduct whereas in countries such as Poland or Slovakia, although people are officially supporting the waste segregation there are still many cases where people do not adopt food waste rules domestically. Hence continuous raising of public awareness is required which eventually should end up with penalties for those who not observe the rules.

Companies' ambitions concerning waste management are very pragmatic. Companies do not like to trespass the established laws so in general they comply with the law. However when some of the waste streams from their production lines could be sold to other companies they would be likely willing to do so. Otherwise the process of waste management is carried out by the company.
In general, there are no differences between treatment of waste between the SME and large enterprises. In some cases there may be different procedures applied, for example in the production of regional products (e.g. local cheese, beverages, alcohols, etc.).
Regarding possible products, materials or services, the discussion group agreed that materials can be regarded as leftovers without an alternative use. These include residues from animal processing plants (blood, trims, bones, feathers, fish skin, etc.), residues from biomass processing (e.g. brewers spent grain, mushroom substrate) or elements and compounds from the waste (e.g. nitrogen, potassium, carbon, proteins etc.). Amongst potential service mentioned were recycling companies, and environmental services.
Considering the market opportunities and demand, the group unanimously agreed that the opportunities are endless whereas demand for bioeconomy products is currently developing with different technologies emerging to the market.
Regarding specific processes, the conversion of carbon dioxide into useful products was stressed as the primary one as well as polymerization of simple compounds.

4.4. Sugar industry residues

The group discussed barriers and drivers for innovation in the bioeconomy, market opportunities or demands and possibilities for new products. One of the first points discussed was the deregulation of the European sugar market in 2017. Before that, a sugar quota existed, and the market was regulated. Now European sugar companies must compete on the international market, which has led to a significant price drop on the European market and the struggle of not only the sugar companies, but also for farmers, because of the decreased price per ton of sugar beets.

The discussion then continued about the impact of policies and market regulations on innovations in the sugar industry and how they can inherit a driving or blocking function. A high economic value was seen as an essential factor for establishing an innovation and guiding it to the market, provided there is a market for the innovation. The innovation itself must have a manageable risk and can be adapted in a reasonable timeframe. Furthermore, we talked about the lobby in the sugar industry, which can also act as a driver as well as a barrier. The ambitions of companies either to use residues themselves or to sell the residues as feedstock are from the discussion group´s point of view mainly economically motivated; the decision whether to process them or to sell them boils down to the most profitable solution. The group did not identify differences between SMEs and large companies, because the sugar value chain resolves only around big companies and there are no SMEs found in the value chain.

Furthermore, the potential for new products was discussed. The use of sugar beet leaves and tops as a biomass resource for the fermentation in a biogas plant was seen as an important opportunity. However, we also identified key barriers to that innovation, which have to be overcome first. The main problem lies in the harvesting process. At the moment, there is no machinery produced that harvests the beets as wells as the leaves and tops, so one must drive with either two machines to harvest both or drive more than once over the field. Both practices are considered not to have a positive effect on the soil, especially in wet or muddy conditions. Farmers plough the leaves and tops back into the soil and use them as fertilizer at the moment and their argumentation is that if they are removed, they have to fertilize the soil a lot more. The discussion indicated that this is not the case. Especially in winter months, the fertilizing value of beet leaves and tops is quite low and the farmers would be provided plant nutrients from the fermentation residues (digestate) instead. Also, the plant availability of nutrients from digestate is higher compared to the biomass. Logistics were agreed to be the most significant hurdle in the value chain for tops. Beet leaves and tops cannot be transported for long distances, because they consist of at least 85% water and thus need to be processed near the fields. Despite these barriers, beet tops were considered to have a substantial potential as feedstock for protein extraction or biogas production. At last, the group discussed how interest in developing this process could be increased. For that reason, dedicated pre-feasibility studies were selected, show-casing successful companies with economically feasible processes that generate a certain turnover were seen as an effective tool to attract industrial interest.

5. Conclusions and outlook

5.1. Conclusions from the conference and workshop

During the day many ideas were exchanged and developed. The informative atmosphere was appreciated by many participants and the discussions in plenary and breaks were a start to bridge the gap between the researcher´s and the industry´s view on how to promote more and faster product development and residue valorisation in the bioeconomy.

Typical for all value chains was that high potential economic profits for innovative products are in sharp contrast with the high investment risk, indicating the need for extended public investment funding or support schemes. Another barrier was identified in the industry demand for homogeneous feedstocks at consistent quality, while residual feedstocks are often varying in quality and volume during the year, boiling it down to issues in storage and logistics. It is therefore difficult for local producers to compete in markets where defined raw materials and intermediate products are traded. Enabling market access for existing residual side-streams and by-products would require the creation of logistics companies accessing local and regional side-streams. These companies would also need to develop intermediate processing steps to assure consistent quality and feedstock volume, especially for many agricultural by-products. This gives the companies access to an added product value. These are requisites to accessing to the European and international markets. Companies with ambitions to develop products in their biorefinery need to continuously work with product development to adapt to rapidly changing market requirements.

The role of enthusiasts in the successful development of new value chains was highlighted by many company representatives. It is these key persons with enough time and energy to coordinate the many actors in a suggested value chain that made the successful implementation of many innovative production processes possible. It may be of interest to research and innovation funders to consider the establishment of special funding possibilities for such key persons, although identifying suitable persons may prove a challenge.

In several applications within the bioeconomy in Europe, the feedstock is currently imported from Asia or somewhere else abroad but could just as well be produced in Europe instead if the full potential for crop production was utilized. One advice given during the presentation on how to build a solid foundation for a company that uses biobased feedstock was to acknowledge the importance of continuous development and to always apply a “biorefinery thinking”.

5.2. **Further development of the cross-border thematic clusters**

The thematic clusters formed in this workshop will continue to play an important role in the future work within the BioBIGG project. For example, the members of the thematic clusters will be invited to the workshop on “Legal and regulatory frameworks related to the bioeconomy in the SBA” which will be held in Germany in November 2019. The workshop is arranged as a part of activity 6.4 in the BioBIGG project.

5.3. **Outlook**

The BioBIGG project will continue with selecting exciting case studies and preparing pre-feasibility studies for the most promising innovative value chains. This work will then continue with the preparation of roadmaps and innovation programs of selected case studies.

6. Appendices

6.1. Appendix A - Conference program

Program

8.30 – 9.00	Registration and coffee
9.00 – 9.30	Welcome and presentation of the program **Bengt Malmberg**, moderator, Research Institutes of Sweden (RISE) **Lena Ekelund Axelsson**, vice dean of the LTV faculty at Swedish University of Agricultural Sciences (SLU)
09.30 – 12.00	Presentation session *REST-till-BÄST – From organic residues to soil improver* **Ann-Mari Fransson**, Swedish University of Agricultural Sciences *Wetland biomass for district heating – the Agrotherm GmbH* **Anke Nordt**, Greifswalder Moorzentrum, Germany *Utilizing the potato starch feedstock fully – protein, fiber and fruit juice* **Kalle Johansson**, Lyckeby Starch, Sweden *The future of biomaterials and possibilities for a regional production of polymers* **Åke Rosén**, Gaia BioMaterials, Sweden *Circular economy principles applied to a potato value chain – a Polish symbiosis* **D. Mikielewicz**, R. Bochniak, A. Gołąbek, R. Andrzejczyk, P. Dąbrowski, J. Wajs, University of Gdańsk, Poland *Intermediate crops as sustainable feedstock for protein extraction* **Thomas Prade and William Newson**, Swedish University of Agricultural Sciences
12.00 – 13.00	Lunch break – Exhibition about innovative uses of industrial hemp *Hemp oil production*, **Gun Hagström**, Swedish University of Agricultural Sciences (SLU)
13.00 – 13.30	*Unlocking the potentials of a circular bioeconomy in Regions* **Tyge Kjær**, University of Roskilde, Denmark
13.30 – 15.00	Workshop around thematic tables – What is needed to help innovation of sustainable products for the bioeconomy?
15.00 – 15.45	Presentation of workshop results and discussion
15.45 – 16.00	Concluding remarks

6.2. **Appendix B - List of participants**

#	Name	Affiliation
1	Qasim Ali	Czech University of Life Sciences
2	Elin Anander	Swedish University of Agricultural Sciences
3	Carlos Ayneto	AGROINDUSTRIAL PASCUAL SANZ, S.L., Spain
4	Filip Bengtsson	Odd Season AB, Sweden
5	Ingemar Bjurenvall	cReal Food AB, Sweden
6	Roksana Bochniak	Gdansk University of Technology, Poland
7	Raj Chongtham	Swedish University of Agricultural Sciences
8	Beate Cuypers	University of Greifswald, Germany
9	Pawel Dabrowski	Gdansk University of Technology, Poland
10	Nawa Raj Dhamala	Swedish University of Agricultural Sciences
11	Annie Drottberger	Swedish University of Agricultural Sciences
12	Andreas Dyreborg Martin	Roskilde University, Denmark
13	Lena Ekelund Axelson	Swedish University of Agricultural Sciences
14	Jeanette Flodqvist	Skånemejerier, Sweden
15	Ann-Mari Fransson	Swedish University of Agricultural Sciences
16	Aleksandra Golabek	Gdansk University of Technology, Poland
17	Helmi Hunin	
18	Kjell Ivarsson	LRF, Sweden
19	Eva Johansson	Swedish University of Agricultural Sciences
20	Kalle Johansson	Lyckeby Starch AB, Sweden
21	Christer Johnsson	Skåne-möllan AB, Sweden
22	Selvaraju Kanagarajan	Swedish University of Agricultural Sciences
23	Tyge Kjær	Roskilde University, Denmark
24	Eva Komanická	
25	Emma Kreuger	Lund University, Sweden
26	Johanna Lund	RISE, Sweden
27	Bengt Malmberg	RISE, Sweden
28	Dariusz Mikielewicz	Gdansk University of Technology, Poland
29	Max Mittenzwei	University of Greifswald, Germany
30	Faraz Muneer	Swedish University of Agricultural Sciences
31	Saraladevi Muthusamy	
32	William Newson	Swedish University of Agricultural Sciences

#	Name	Affiliation
33	Mark Nielsen	Roskilde University, Denmark
34	Anke Nordt	Greifswalder Moorzentrum, Germany
35	Anna-Lovisa Nynäs	Swedish University of Agricultural Sciences
36	Rasmus Nør Hansen	Roskilde University, Denmark
37	Julia Pernet	Lyxxa
38	Silvana Postolache	AGROINDUSTRIAL PASCUAL SANZ, S.L., Spain
39	Thomas Prade	Swedish University of Agricultural Sciences
40	Åke Rosén	Gaia Biomaterials, Sweden
41	Roya Sardari	Lund university, Division of Biotechnology, Sweden
42	Magnus Skøt	Roskilde University, Denmark
43	Paulien Strandberg	WSP group, Sweden
44	Sven-Erik Svensson	Swedish University of Agricultural Sciences
45	Gunnar Thelin	Ekobalans Fenix AB
46	Madeleine Uggla	Swedish University of Agricultural Sciences
47	Ecevit Yilmaz	YLS Consulting AB, Sweden