



25 CASES FOR BIOECONOMY INNOVATION

AROUND THE BALTIC SEA REGION



 **Interreg**
Baltic Sea Region



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DEVELOPMENT
FUND

RDI2CluB



25 Cases for Bioeconomy Innovation Around the Baltic Sea Region

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www.rdi2club.eu

Editor: Irīna Kulitāne

Proof-reading: “Junique” Justin Nnorom

Layout: Laima Grāve

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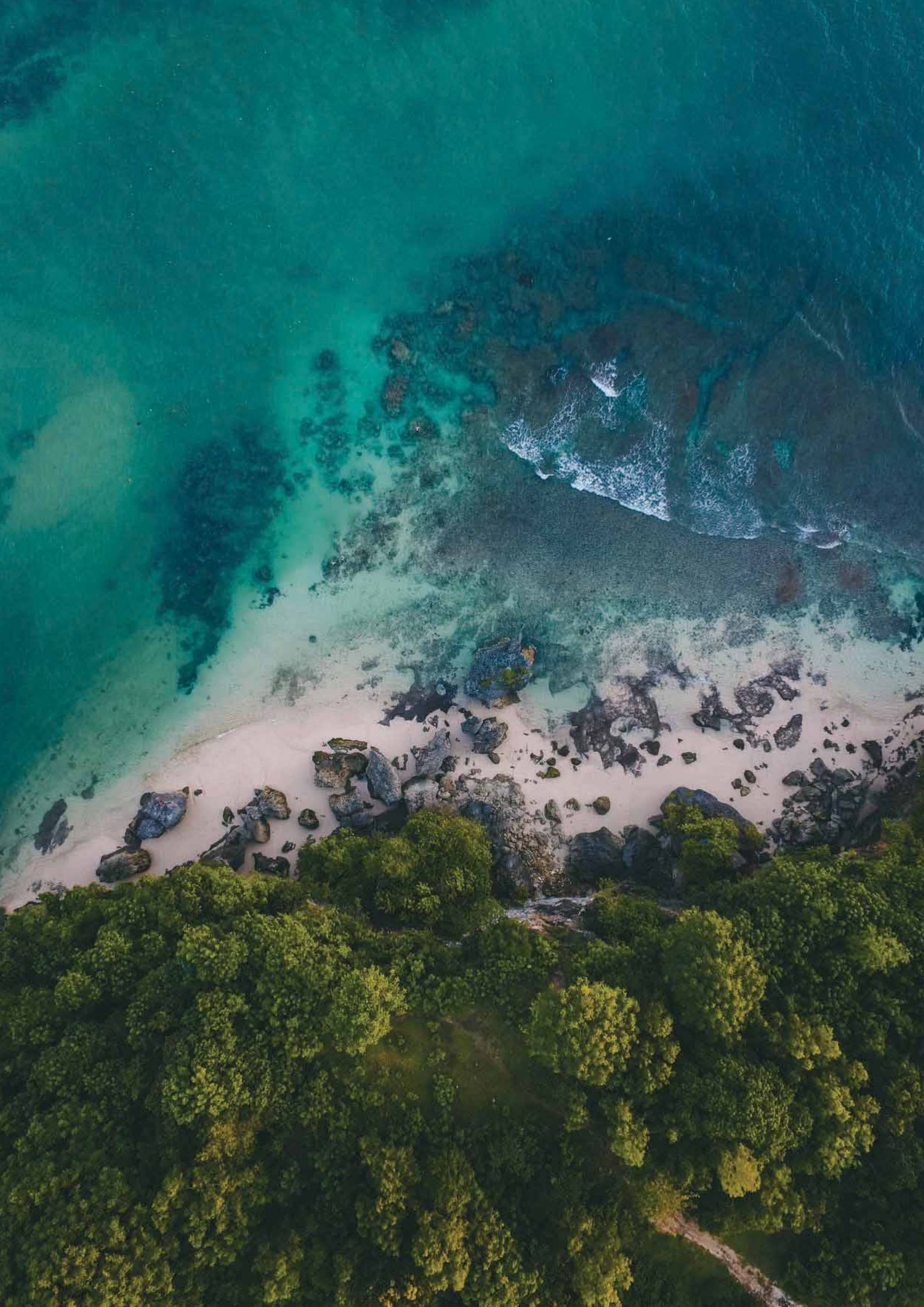


PREFACE



Why should we think about, highlight the role and impact of bioeconomy and take action to promote its development? Because bioeconomy is of great socio-economic significance and plays its role in every single country – it covers all sectors and systems that rely on limited biological resources, such as plants, animals, derived biomass, organic waste, their functions and principles. It includes and interlinks land and water ecosystems and services they provide, and all primary production and industrial sectors that use biological resources to produce or process food, feed, bio-based products, energy and services. At the same time, bioeconomy has an impact on the life of every individual, whether a person is aware of it or not – the ways in which and how biological resources are used and treated have an impact on the quality of food, air, nature, the living environment and many other aspects of life, important for present and future generations.

This brochure contains inspirational stories about how private and public sector players in five European countries have sought and found, and continue to develop knowledge-based, smart and efficient solutions aimed at promoting bioeconomy development – to sustain biodiversity and ecosystem services, increase competitiveness of businesses, and unlock the unexplored potential of well-known and appearing resources. In most cases, this positive change grounds on one of the most effective tools – collaboration, which has no borders or limits, and which opens horizons for the most novel knowledge and approaches, available inside and outside a regional ecosystem, and creates preconditions for innovation, necessary for the more effective and sustainable development of bioeconomy.



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INTRODUCTION



Bioeconomy has been on the agenda of the European Union since 2012. Since that time, new challenges have appeared on the EU's and World's agenda, leading to the need for adopting new international agreements: the 2030 Agenda for Sustainable Development, Sustainable Development Goals, as well as the Paris Agreement. In light of the adopted agreements, Europe's bioeconomy strategy was updated, placing sustainability and circularity at its heart and focusing on the modernisation of primary production systems, the renewal of industries, the protection of the environment and the enhancement of biodiversity. The strategy offers a complementary and integrative framework that cuts across multiple sectors and policies, interlinks them, facilitates synergies and helps deliver various policy objectives with greater coherence.

Someone would ask – what is the role of my region, village and company in the implementation of Europe's Bioeconomy strategy? The answer is – very direct! The updated strategy considers and proposes action to scale up and deploy bioeconomy **LOCALLY**, by carrying and introducing research and innovation achievements, unlocking the potential of resources and increasing company competitiveness, thus **LOCALLY** creating growth and job opportunities.

Bioeconomy is also one of 13 priority areas of the Action Plan, developed for implementation in the first macro-regional strategy in Europe – EU Strategy for the Baltic Sea Region (EUSBSR). Although the bioeconomy in the plan is more closely linked to contributing to improvements and tackling challenges in the fields of agriculture, forestry and fisheries, its thematic focus and effects also cover and overlap with priority areas such as education, energy and innovation. Considering the performance of the project “Rural RDI Milieus in Transition Towards Smart Bioeconomy Clusters and Innovation Ecosystems” (RDI2CluB), funded by the Interreg Baltic Sea Region Programme 2014-2020, it has been approved as EUSBSR Flagship, serving as a pilot example within the Bioeconomy Policy Area.

The Nordic Council of Ministers acts as a coordinator for the Bioeconomy Priority Area. It provides an access point and support function for stakeholders that wish to pursue bioeconomy cooperation activities supporting overall objectives of the EUSBSR.

The brochure aims to showcase what diverse bioeconomy stakeholders in 5 European countries have done and how they have achieved on a local scale, thus contributing to the achievement of greater – national, EU and UN – sustainability and bioeconomy goals. Cases, presented in this brochure, were selected using criteria elaborated and applied by the Nordic Council of Ministers and its partners for the creation of the catalogue “Nordic Bioeconomy. 25 cases for sustainable change” in 2017. The criteria are: **SUSTAINABLE USE OF NATURAL RESOURCES, TECHNOLOGICAL INNOVATION, ENVIRONMENTAL BENEFITS, SOCIETAL BENEFITS, BUSINESS MODEL INNOVATION**

“Owners” of cases were asked to provide a detailed case description and justify its relevance to the parameters set for each criteria, though the authors of the brochure would like to emphasise that the criteria are non-exhaustive and not all criteria can be applied to each case. Three criteria were chosen as most relevant for each case. However, the approach taken does provide an excellent starting point to select diverse cases demonstrating a variety of activities involving the development of products and services in different bioeconomy sectors, presenting innovation and research initiatives and actions striving to develop and strengthen bioeconomy innovation ecosystems.

In the textboxes you will find the five criteria and related assessment parameters used to evaluate applications:

SUSTAINABLE USE OF RESOURCES



- Does the case address the issue of resource availability and security in a local context?
- Does the approach chosen minimize or optimize the use of natural resources?
- To what extent and how does the case demonstrate the optimized use of biomass?
- How does the case contribute to the circular economy?

SOCIETAL BENEFITS



- Has the case promoted the creation of new jobs in the local community?
- How does the case engage with the local community and diverse groups of local stakeholders?
- Is there any potential for creating a positive impact on public health and wellbeing?

ENVIRONMENTAL BENEFITS



- Does the case have an impact on the reduction of CO2 emissions across the value chain?
- What are potential benefits of the case regarding the environment: air and water quality, biodiversity, natural resource resilience, etc.

BUSINESS MODEL INNOVATION



- To what extent does the business model involve innovation? Why should their value propositions be considered innovative?
- Does the business model involve new cost structures or revenue streams?
- Has the case opened access to new markets?

TECHNOLOGICAL INNOVATION



- Does the case include the development or implementation of new technology?
- How does the case adapt existing technologies to new applications?

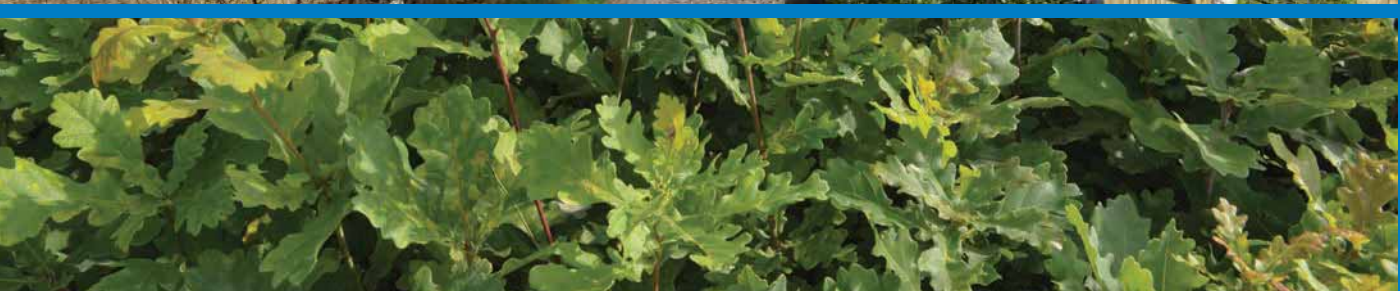
25 cases are structured in four sub-groups – chosen as actions having the greatest impact on the successful development of the bioeconomy. These groups are:

**Sustain
biodiversity and ecosystem services**

**Increase
business competitiveness**

**Unlock
potential**

**Collaborate
for positive change**



Sustain biodiversity and ecosystem services

The challenge and task of the bioeconomy is to balance the objectives and needs of economic development with the concern of sustaining biodiversity and maintaining quality in all terrestrial and water ecosystems, where life inter-plays with the physical environment. Securing ecosystem services, i.e. the structures and functioning of ecosystems, is a precondition for a sustainable bioeconomy.

Bioeconomy can contribute to the preservation and restoration of these ecosystems, thus favouring society with a multitude of benefits, starting from food, clean water and protection from nature caused disasters to the availability of nature and cultural heritage and the creation of a sense of belonging to a place.

Sustainable use of natural resources for the production and provision of goods and services is essential for sustaining biodiversity and securing ecosystem services.

The cases presented in this section demonstrate local actions undertaken by Latvian, Norwegian and Polish stakeholders in various fields of bioeconomy. We invite you to read seven stories about the experiences in practices in the establishment and maintenance of agroforestry farming systems, the purification and re-use of industrial wastewater, and the use of technologies for monitoring air pollution.

The Hias wastewater treatment plant – the next generation of wastewater treatment



Hias Inter Municipality Company and Hias How20 Ltd

www.hias.no

TECHNOLOGY INNOVATION



Nutrient recovery is still in its infancy in the water management sector. The struvite recovery plant at the Hias water resource recovery facility will be the first demonstration case in Norway with a significantly higher P-recovery output than comparable installs. The biogas plant is a novel down-scale project of offshore technology.

ENVIRONMENTAL BENEFITS



According to a Life Cycle Assessment, performed by the research institute Østfoldforskning, the Hias Process will reduce the daily CO₂ emission by 88% and 95%, compared with two major treatment processes, activated sludge and MBBR, respectively. Switching to biogas as a vehicle fuel can reduce greenhouse gas emissions in the transport sector between 60% and 80% compared to fossil-based fuels like gasoline and diesel. The Hias Process eliminates the need for metal-based chemicals for phosphorus removal, accounting for 1800 tonnes fewer chemicals annually delivered and used at Hias WRRF. Also, both struvite and phosphorus in biosolids will be plant available and will reduce the need for mineral fertilizers in professional gardening and agriculture. Biosolids are also an excellent raw material to produce peat-free soil, together with struvite and other recycled resources.

BUSINESS MODEL INNOVATION



Recycling valuable resources from wastewater will establish a new and circular value chain with a valuation of secondary products. A significant reduction in OPEX is foreseen with the Hias Process installed. In addition, there is possibility for new revenue streams from fertilizers and enriched peat-free soil products. Partners are planning to enter the market for professional gardening, and possibly offer enriched peat-free soil products to the consumer market via established retailers. Stakeholders from four continents are highly interested in the Hias Process.

Through a series of innovative projects, a traditional wastewater plant – the Hias water resource recovery facility (Hias WRRF) – was transformed into a ground-breaking resource recovery facility and, by 2021, will be the most resource effective, environmentally friendly wastewater treatment plant in the world. The complete facility, consisting of four separate plants, will include a patented process for biological wastewater treatment, called the Hias Process.

The project was initiated in 2010 and tests on a large-scale prototype have been ongoing since 2016. The Hias Process effectively removes organic substances, phosphorus and nitrogen, without the use of metal-based chemicals, from wastewater. The outcome of such an approach is significantly reduced OPEX, a reduced CO₂ footprint, and nutrients readily available for recovery and processing into fertilizers, as well as the thermal hydrolysis of sludge by using Cambi THP sludge treatment technology, developed in the 90s.

The Cambi sludge treatment plant and the biogas upgrade plant, which converts raw biogas into pure compressed methane, is in production. The wastewater treatment plant and the nutrient recovery plant, where 50 % of incoming phosphorus and some nitrogen will be recovered as mineral struvite, classified as a phosphate mineral fertilizer, are under construction. The complete plant will be finished by 2021.



Research of technologies for the development of sustainable, low-investment agroforestry growing systems

 The Latvian State Forest Research Institute “Silava” and The Research Institute of Agronomy of Latvia University of Life Sciences and Technologies

www.silava.lv

The case presents research aimed at developing an agroforestry system, where various forest based and agricultural plants are combined on one large scale plot – a multifunctional plantation. The plants used are: trees – Hybrid aspen (*Populus tremula* L. x *P.tremuloides* Michx.), Lime, Poplar, Wild cherry and perennial agricultural plants – Galega (*Galega orientalis* Lam.), Reed canary grass (*Phalaris arundinacea* L.), Festulolium (x *Festulolium pabulare*), and Lupin. Trees as agriculture crop were planted as an agroforestry system together with perennial crops as intercrop.

Plantings were fertilized by applying fermentation residue (30 tDM ha⁻¹), wastewater sludge (10 tDM ha⁻¹), and wood ash (6 tDM ha⁻¹). All kinds of fertilizers significantly increased the seed yield of Festulolium by 30%, but fodder Galega only showed a positive response to wood ash fertilization, resulting in +15 % of seed yield. Results of the study showed that herbaceous plants can successfully be cultivated along with fast-growing trees. It was concluded that the selection of a productive clone has the most significant impact on tree plantation productivity. Fertilizer application and the type of intercrop are also significant.

SUSTAINABLE USE OF RESOURCES



The developed agroforestry system can be applied and managed as one of the best circular economy approaches. Products (wood and plants) can be used to produce energy and animal feed or source for bio refinery. Trees can be used to produce chips to be used as firewood, wood pellets, sauna boards and boards for packaging pallets. Perennial crops can be used to produce seed and as biomass to produce biogas or fodder rich in nutrients. Catchments in woody biomass compensate for the decomposition of soil organic. Residuals and by-products, such as wood ash, digestate and wastewater sludge, obtained at the very end of the production process, can be used as fertilizers, thus ensuring closed circle production, where there is no need for additional waste management measures and a decreased amount of deposited waste.

TECHNOLOGY INNOVATION



The technology used for planting trees – in alleys, 800 trees per hectare with a 2,5 x 5 meter line spacing between rows for the cultivation of perennial agriculture crops – is innovative in the Baltic region. This enables weed management and grass harvesting to be done by machines and helps avoid costly and time-consuming handwork. Technology can be applied by SMEs willing to diversify products in a situation of limited availability of land.

ENVIRONMENTAL BENEFITS



During the establishment of the system, greenhouse gas emissions are the same as for arable land, starting from the second year of planting as in meadows and from the fifth year as in forested pastures. Ten years after the creation of an agroforestry system, the field could be carbon neutral. The application of herbicides only in the first year after field establishment reduces the negative impact of farming on the natural ecosystem. Plantation provides feed for wild birds and animals, thus helping to maintain biodiversity.

Research for the development of new bathwater cleaning technology for the Świętokrzyskie Health Resorts



Busko-Zdrój Health Resort S.A.

www.ubz.pl www.sanatoria.org

SUSTAINABLE USE OF RESOURCES



Services, provided by the resorts, are based on non-renewable resources - underground mineral waters, taken from specially drilled intakes. The quantity of mineral water used for curative bathing is diminishing, and, at the same time, large volumes of wastewater are being created. The development and implementation of new technology on cleansing bathwater might be a solution to these problems, thus having a positive contribution to the reuse of wastewater.

TECHNOLOGY INNOVATION



The research aims to develop new technology for cleansing curative bathwater, currently treated as industrial wastewater, to a level enabling its reuse for diverse purposes: curative water reuse for health treatment procedures in own spas, as curative water to be sold to other resorts, for use in the graduation tower (to be developed) and for the production of bath salts. The application of other ingredients, to be obtained after the water cleansing process, for domestic purposes, e.g. fertilization or keeping roads in proper condition during the winter period, will be tested as well. The foreseen result of the research will be an innovative, complex system of cleansing and regaining mineral water.

SOCIAL BENEFITS

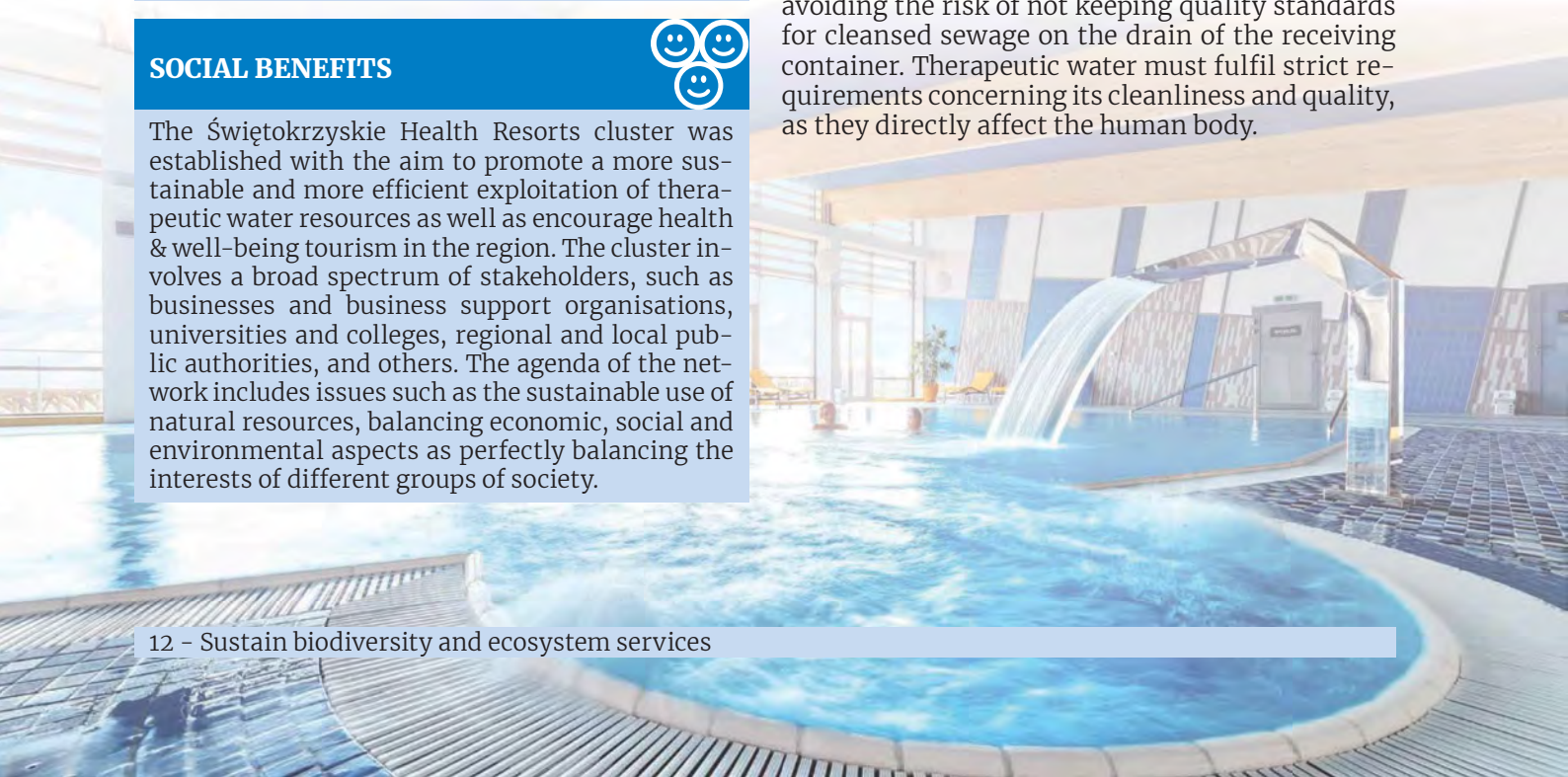


The Świętokrzyskie Health Resorts cluster was established with the aim to promote a more sustainable and more efficient exploitation of therapeutic water resources as well as encourage health & well-being tourism in the region. The cluster involves a broad spectrum of stakeholders, such as businesses and business support organisations, universities and colleges, regional and local public authorities, and others. The agenda of the network includes issues such as the sustainable use of natural resources, balancing economic, social and environmental aspects as perfectly balancing the interests of different groups of society.

The Świętokrzyskie Health Resorts is a group of numerous spas & wellness centres located in two municipalities of the Świętokrzyskie Voivodeship, rich with natural sources of curative mineral waters. The resorts offer therapeutic procedures involving the use of sulphide water, iodide and bromine water, as well brine therapies for the treatment of disorders of circulatory, motor and vegetative systems, female diseases, heavy metal poisoning, malfunctions of peripheral and central nervous systems, as well as rheumatic, orthopaedic and post-traumatic ailments, among others. Thousands of people from Poland and abroad undergo therapy in these resorts annually.

As the number of visitors increases, the amount of used curative mineral water is also increasing. It is causing a challenge as mineral water resources are limited. Moreover, the health resorts create huge amounts of used bathwater (on average 200.000 m³ per year per resort), giving rise to the need of more effective and economic wastewater management.

The identified needs and challenges have encouraged research that would enable the cleaning and re-use of mineral water, thus satisfying the demand for mineral water based health services and ensuring that this important natural resource is used in a sustainable and responsible way. The great challenge to be solved by research is the cleansing of bathwater, at the same time avoiding the risk of not keeping quality standards for cleansed sewage on the drain of the receiving container. Therapeutic water must fulfil strict requirements concerning its cleanliness and quality, as they directly affect the human body.



Novel solutions for sustainable and effective seedling management



Latvian State Forests JSC

www.lvm.lv

Forests are the pride of the Vidzeme region. They cover more than half of the region's area. One of the biggest maintainers of the forests in Latvia and the region is the JSC "Latvian State Forests" (Latvijas valsts meži). The nursery "Podiņi", the daughter company of JSC "Latvian State Forests", has been developing innovation for sustainable and effective forest management since 2001.

The latest innovation is the robotic treatment of spruce seedlings with environmentally friendly wax Ekovax, which is currently being carried out on one of the two facilities available in the world. The technology enables the protection of forest spruce against damage, especially – against a great pine-weevil. The method effectively protects spruce plants without the use of pesticides harmful to the environment and humans. The protective effect lasts for at least two seasons, which is a long period, compared to the effects of chemicals that last a couple of months.

Another novel solution that has been created is the innovative plant type – seedlings with an improved root system. Namely, in greenhouses and outdoor landfills, special-purpose plant cassettes with small-sized cells are used to grow frame rails, which are later displayed on the field. The technology allows seedlings to reach the size necessary for planting, in two seasons instead of four seasons, while yielding higher quality seedlings.

SUSTAINABLE USE OF RESOURCES



The nursery also continuously takes care of the genetic potential of plants, seeds for growing plants are collected in special orchards of selected spruce, birch and black alder seedlings, thus enabling future forest stands to be more rapid and up to 20% more productive.

TECHNOLOGY INNOVATION



The robotic treatment of seedlings with environmentally friendly wax is currently only being carried out in two facilities in the world.

ENVIRONMENTAL BENEFITS



The applied technology effectively protects plants without the use of pesticides harmful to the environment.



Raising awareness of society in terms of low emission pollutants



Regional Science and Technology Centre

www.rcnt.pl

TECHNOLOGY INNOVATION



The use of drone technology to measure air quality is a new solution for the region that enables the collection of more extensive results, than with stationary metering devices, and also the storage and analysis of data, thereby allowing the situation to be assessed and changes to be made in order to take responsible decisions on necessary improvements.

ENVIRONMENTAL BENEFITS



The case focuses on the improvement of air quality by reducing dangerous chemicals, like PM₁₀, PM_{2.5} and PM₁, mostly consisting of organic pollutants, and SO₂, both stemming from the use of technologically obsolete local heating systems. The improvement of air quality is significant from the perspective of the environment, health and well-being.

SOCIETAL BENEFITS



Educating local inhabitants about low emission, air pollution and ways of preventing them. Focusing on air quality improvement is crucial for society from the perspective of health and well-being. Clean air is one of the factors having an impact on community rating when choosing a specific place for life and work.

The Regional Science and Technology Centre (RS&TC), in cooperation with the Świętokrzyskie Voivodeship, is doing a pilot project aiming to measure the air pollution caused by emissions in two SPA municipalities located in the Świętokrzyskie Voivodeship. A drone is used for collecting air samples. Thanks to this innovative approach, it is possible to collect many air samples from different locations and create detailed pollution maps. Data obtained and analysed shows that during the heating period (October – March) air quality is lowered, and though the situation is acceptable there is definitely a need for improvement, particularly when acknowledging international agreements aimed at pursuing actions contributing towards Climate Change.

In order to encourage positive change, RS&TC has organised awareness raising meetings with citizens and local authorities, where individuals are provided information and knowledge on the origin of low emission, its fatal effects and the possibilities of reducing it at a local level. During the meetings, the results of air quality measurements are presented, thus raising awareness on the role of households in reducing emissions.

Air pollution measuring and mapping will be continued for more than five years. Throughout this period, the results obtained will be analysed and appropriate actions aiming at reducing air pollution will be planned and implemented. In parallel with the measures described, it is planned to continue raising social awareness on the role of individuals and households in reducing environmental pollution with special focus being placed on educating children and young people.



The Ydalir Neighbourhood – a zero emission neighbourhood



Elverum Vekst Ltd

www.elverumvekst.no

Ydalir is a new neighbourhood in the town of Elverum in Innlandet (Hedmark) with high energy and emission ambitions. It aims to become a ZEN - Zero Emission Neighbourhood. The selected neighbourhood area is an old gravel pit, around 133 hectares (330 acres) in size, located in the town, which makes Ydalir attractive for living and easy for residents to adapt to a more sustainable lifestyle. A new school and kindergarten have already been established in the middle of the planned neighbourhood. The neighbourhood is planned as a combination of detached houses and blocks of flats, built around the school and kindergarten. By 2035, approximately 800 buildings will have been developed in Ydalir. Elverum Vekst, a company owned by the Elverum municipality, is responsible for the development of the neighbourhood as well as being the largest landowner in Ydalir.

Ydalir is one of nine pilot projects of the Research Centre on Zero Emission Neighbourhoods in Smart Cities (FME-ZEN) led by research organisations SINTEF and NTNU. Both the Elverum Municipality and Elverum Vekst are members of the research centre. The fact that the Elverum Municipality and site companies are members of FME-ZEN ensures that while building houses, the most novel, environmentally friendly solutions, advised by high-competence research organisations SINTEF and NTNU, will be used, therefore helping Elverum to become Norway's most forward-looking neighbourhood. A masterplan was developed for Ydalir, defining ambitions, principles and requirements binding to any developer. Five different local and regional developers have already signed contracts and include requirements for energy, material use, mobility and spatial planning. The start of construction work is foreseen in 2020.

SUSTAINABLE USE OF RESOURCES



Ydalir will be built by minimising emissions of harmful greenhouse gases during the construction phase and operation. Emissions, which cannot be avoided, will be compensated by the production of cleaner energy, for example by solar cells. Materials with low greenhouse gas emissions will be used for building constructions. District heating and photovoltaics will be sources of energy. Developers should follow the requirements secured in the contracts.

ENVIRONMENTAL BENEFITS



The Ydalir project will reduce CO₂ emissions by imposing stricter requirements than set in current regulations (TEK). Requirements regarding energy, material use, mobility and spatial planning will be included.

SOCIETAL BENEFITS



The Ydalir concept was developed in close consultation with various groups of society. Six workshops were organised with the participation of architects, engineers, municipal employees, representatives of transport management companies, and others. The concept development process was funded by ENOVA SF, owned by the Ministry of Climate and Environment, and contributes to reduced greenhouse gas emissions, the development of energy and climate technology and a strengthened security of supply. The Ydalir neighbourhood will be built to take our common future into account in the context of climate change. In order to promote the concept of people choosing environmentally friendly housing, Elverum Vekst signed an agreement with SpareBank1Østlandet (savings bank) on green mortgages in January 2018. Private individuals, who wish to buy housing in Ydalir, can get favourable "green loans" with lower interest rates.



Seed-nursery gardening farm for renewing forests and saving biodiversity



Daleszyce State Forest Administration (State Forests)

www.radom.lasy.gov.pl

The Seed-Nursery Gardening Farm, the most modern place of its kind in Central Europe, was established in 2017. It is located in Suków-Papiernia near Kielce. The farm consists of a seed-nursery container with a seedling storage site and seed storage site, foil tents with seedlings, a sowing hall and production field. It is oriented to produce seedlings of pine, beech and oak, which have been used for the renewal of forests and the afforestation of land. The area of the farm is 6 hectares and it produces approximately 3 million seedlings per season. Seedlings, in the farm, are produced in controlled climate conditions with the use of foil tents and optimum fertilization. Such production has many advantages, among which the most important is its short production cycle, which is possible as seeds are sown and seedlings grown in special containers (joint styrofoam pots), not directly in the soil. The method also enables more efficient seedling storage and transport.

Young seedlings, especially those dedicated to reforestation and area recultivation undergo the mycorrhiza process – the artificial imitation of root cooperation with mushrooms, where small parts of mycelium surround the roots and help nutrients from the soil access a tree and, at the same time, the mushroom uses some saccharides produced by the plant, taken from the roots' tissue. Conditions on the seed-nursery farm, where there is enough water and mineral substances, are much better than conditions in forestland. Container seedlings have a covered root system, that is of high importance for healthy and fast tree growth. A mud clod that covers the root system, protects the plant from “stress” when a seedling is moved to another place. Seedlings with a covered root system take root in all planting conditions in almost 100% of cases. Due to the development of the farm, preconditions for ensuring biological diversity and the stability of the forest ecosystem in the region are created.

TECHNOLOGY INNOVATION



The farm applies state-of-the-art knowledge on forestry. Automatic, computer-controlled processes are introduced for watering, fertilizing and maintaining the atmospheric condition in tents. Environmentally friendly solutions, such as drop water recapture, storage in special tanks and use for watering, are introduced. Seed storage sites can store about 6 tonnes of beechnuts for several years and more than 20 tonnes of acorns for a shorter period.

ENVIRONMENTAL BENEFITS



The process of reforestation on a wide scale is particularly important – trees are natural CO₂ absorbers, undertaking this task while growing, as well as preserving the absorbed CO₂ after their cutting. The usage of wood decreases the need to use other materials, the production of which emits a significant amount of CO₂. It is estimated that, for each tonne of wood products, used instead of non-wood products, emissions reduce for about 2 tonnes. Another significant environmental benefit – the processes in the farm are organized in a way in which so-called technological water, used chemical substances and fertilizers do not get to the soil.

SOCIETAL BENEFITS



Awareness of the society and individuals on forest value, on the significance of taken actions and role of humans on forest ecosystem sustainability are playing a great role. Daleszyce State Forest Administration shall introduce measures which promote the involvement of diverse groups of society in actions aimed at renewing forests, such as the action “1000 trees per minute”, paying great attention to the involvement of families with children, sharing knowledge on tree planting and forest management as well as other activities. This contributes to the benefit of society through the involvement of the public itself.



Increasing business competitiveness

Bioeconomy involves a broad spectrum of economic stakeholders, starting from traditional sectors, such as agriculture, forestry and fisheries, to highly innovative companies dealing with biorefinery – the extrusion of high added value compounds from biological resources and conversion into innovative food and feed compounds, construction materials, cosmetics, pharmacy products, and others. Their growth and competitiveness depend on the most direct way of a company's ability to understand and react quickly to societal and market demand, create and accumulate knowledge and new approaches needed to produce products and create services, as well as their ability to uptake markets.

Increasingly, companies need not only be able to compete with a “good product or service at a reasonable price” but also with a well justified and honest message about what resources and methods were used in the development of offered goods and services as consumers require it. In order to satisfy the demand of consumers, enterprises have to demonstrate that they use natural resources in a sustainable manner.

Five cases, provided by responsible Norwegian, Finnish and Estonian enterprises demonstrate how businesses are increasing their competitiveness through taking societal challenges as opportunities and are producing goods in response to the demands of markets and customers.

3D printing with saw dust



3CULAR Ltd (start-up)

www.3cular.com

SUSTAINABLE USE OF RESOURCES



Technology creates preconditions for recycling manufacturing waste materials and turning them into high value-added products.

TECHNOLOGY INNOVATION



New technology has given the possibility of replacing conventional plastics, used in 3D printing, with low-value waste product - sawdust. Sawdust is combined with non-toxic binders and extruder technology, which is a novel solution.

ENVIRONMENTAL BENEFITS



Wood products can capture and store carbon and thus contribute to relieving climate change. Turning sawdust into materials and being able to capture and store carbon will be preconditions for the reduction of CO₂ emissions. The technology creates preconditions for the reduced use of plastic, thus reducing the accumulation of pollution in the environment and decreasing its negative effects on nature and humans.

About 88% of materials, currently used in 3D printing, are plastics. Though plastic is a cheap and convenient material, there are difficulties in recycling all of it. There is increasing pressure globally for decreasing the use of plastics and instead innovating with other, preferably bio-based materials. Since there has not been any sustainable material available for 3D printing up until now, the case demonstrates an exciting opportunity for material innovation.

There are 220 million tonnes of sawdust produced every year as a by-product of wood industries globally. Generally, this waste is burned or turned into wood pellets, yet while the use of biomass for energy is preferred over its fossil counterparts, it still emits greenhouse gases during the process. Wood products, on the other hand, can capture and store carbon, thus contributing to climate change relief. This means that turning sawdust into valuable, sustainable materials not only creates high value products, but also saves several tonnes of CO₂ from being released into the atmosphere.

An Estonian Start-up 3CULAR has developed a technology for replacing conventional plastics with sawdust in 3D printing. It generates value from timber waste - sawdust, which, in combination with non-toxic binders and extruder technology is used to produce sustainable printing materials used for FDM 3D printers.

3D printing, compared to crafting, gives the possibility of printing different objects faster and easier, thus saving money, resources and the environment. The benefits arising from this technology are three-fold: it replaces plastic, adds value to a low-value waste product, and contributes to resource efficiency.



Custom wood surfaces



Jukola Industries Ltd

www.jukolaind.com

Jukola Industries was established in 2017, after five years spent on product research and development. The company is designing and manufacturing custom wood structures for construction - ready textures as well as custom made ones. Permanent, business-driven innovation is seen as a decisive force.

The enterprise combines the technologies of industrial design with innovative milling techniques and cutting-edge design software. The idea of the use of milled wood came from Jouni Lehmonen, the company's CEO and designer, who came across it while working within metal processing. Recently, the company obtained an international patent for production methods. "The algorithm-aided design is the key method to generating geometric and variable structures", says architect Toni Österlund of Jukola Industries.

A new part of Jukola Industries is the company Jukola Lumber. It harvests and saws wood sustainably, thus taking care of the preservation of biodiversity. Growing demand for timber produced in an environmentally and nature-friendly process increases demand for services and materials provided by the company. Global sustainability agreements boost business.

SUSTAINABLE USE OF RESOURCES



Raw material flows, used for production, come from nearby forest owners, therefore creating a local resource base and well-functioning production chains. Reusable materials are used for final product packaging as much as possible. The optimisation of material use takes place by taking advantage of digital modelling and algorithms.

TECHNOLOGY INNOVATION



Traditional wood processing technologies are combined with modern design utilising new algorithm-aided design.

BUSINESS MODEL INNOVATION



The business model offers a flexible response to the demands and needs of customers - besides standardized products, the company offers custom made solutions, created with the support of digital modelling and algorithms.

Raspberry seed oil production



Tedre Talu Ltd

www.tedretalu.ee

SUSTAINABLE USE OF RESOURCES



The case demonstrates how a smart approach and knowledge enable the utilisation of food production waste, turning it into a highly valuable ingredient demanded by and used in another industry.

TECHNOLOGY INNOVATION



The enterprise, together with researchers, has developed and introduced new technology for extracting oil from raspberry seeds, at the same time preserving valuable bioactive components.

BUSINESS MODEL INNOVATION



The search for new solutions for the use of production waste has led to the development of a novel technology and new product, which has become the main value stream.

A local raspberry grower in the rural area of Southern Estonia was thinking about what could be done with the side product of the production of raspberry juice – seeds. After a quick search on the Internet, it was found that raspberry seeds are a highly valued ingredient in the cosmetics industry, but neither knowledge nor production experience were anywhere to be found in Estonia.

In order to find a solution, the farmer turned to the Estonian University of Life Sciences. The entrepreneur and researchers compared different methods used for extracting oil from raspberry seeds with the purpose of finding the most appropriate and efficient technology enabling the preservation of all valuable bioactive components. As a result of the trials, a non-waste solution was found and introduced in production, enabling the use of 100% of the berries grown on the farm. Raspberry seed oil production has now become the main value stream for the small enterprise with juice production rather considered to be a side product.

The cooperation and innovative results it helped to create have promoted new projects in other sectors, which are looking into the prospects of using the novel technology to extract oils of other types of biomass, as well.



Healthy and environmentally friendly wood-based materials and technologies for construction



Innlandet Elementfabrikk Ltd

www.innef.no

Innlandet Elementfabrikk maintains an increased focus on the use of wood in construction. It aims to create healthy homes, where wood fibre is used for walls and insulation and for this purpose has chosen a partner - Hunton Fiber, which produces wood based, environmentally certified products.

The new wood-based fibre wall has many benefits and environmental qualities. It is excellent for solutions striving to create breathable building with an excellent indoor climate and avoiding the use of dense plastic in walls and ceilings. The new wall is especially suitable for premises, where the indoor temperature varies a lot. The material can either be used for new buildings or the reconstruction of old ones. The product was recently introduced into the market.

TECHNOLOGY INNOVATION



The industrial production of building elements and wood fibre insulation is well known, however the combination of materials and technologies described in the case is novel. The new wood fibre wall is an alternative to cross laminated timber (CLT). The production technology and line offer the application of solutions that have been used by other industries for years but are novel to the construction industry. LEAN-production and management, and just-in-time (JIT) deliveries are important parts of the total concept of the production to be competitive.

ENVIRONMENTAL BENEFITS



The use of 100 % wood leads to the increased storage of carbon. Good insulation reduces the use of energy for cooling and heating. The use of locally produced raw material reduces transportation, and therefore the use of fossil resource-based fuels.

SOCIETAL BENEFITS



The product was developed and introduced to meet the market demand for “greener” products, produced sustainably with care for the environment and humans. The indoor climate is a significant factor for the health and wellbeing of households as well as workplaces. Though scientific justification on the health effects of the new product is still limited, Norwegian scientists are carrying out studies to provide solid scientific justification.



Drinking straws from the local reed resource



SUCKÖRS Ltd

www.suckors.com

Eutrophication, caused by nutrient accumulation, is a great Baltic Sea challenge. However, while excess nutrients cause many issues for the Sea ecosystem, it also causes the major spread of a valuable natural resource - reed - around coastal areas. Though, in some cases, reed is considered an invasive species due to its regenerative capacities, there are a lot of possibilities for its application. While, historically, reed was mainly used in construction and for animal bedding, a novel approach has been added to the list in recent years. Reed is used for the production of natural, biodegradable and reusable drinking straws, while taking advantage of its natural shape and characteristics, which means it does not require a lot of processing. Another significant aspect to be noted is that reed does not require cultivation.

Use of reed instead of plastic contributes to the relief of plastic pollution in the world. The plastic straw requires 200 years to decompose after only being used for a couple of minutes. A straw from reed is already a part of nature, thus it can easily be composted.

The company is looking for solutions to make the waste from straw production efficient. Novel applications for the use of leftover parts of straw have now been developed. Prototypes of business cards and plates made of reed are already produced and waiting to be commercialized.

SUSTAINABLE USE OF RESOURCES



Reed is traditionally present in coastal areas of the Baltic Sea in a natural environment, thus it does not require specific cultivation. The production of drinking straws from reed requires limited energy and water. The residue obtained from the production process may be processed into other products.

ENVIRONMENTAL BENEFITS

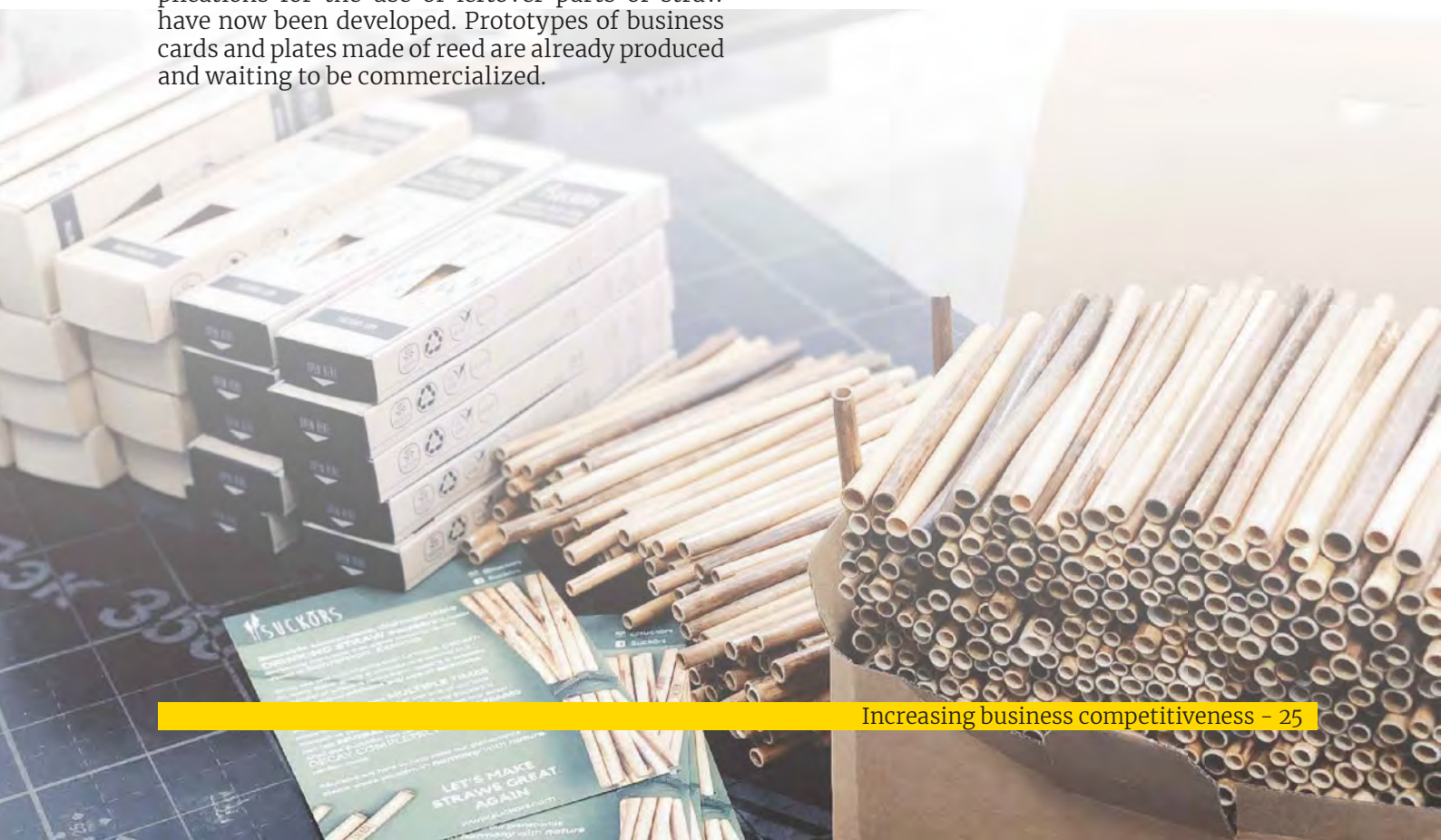


Plastic straws require 200 years to decompose, and the process creates a negative impact on nature. Straws from reed are a part of nature, thus they can easily be composted or even better - used straws can be used to produce other products.

SOCIAL BENEFITS



The production of reed straws provides the opportunity to create small businesses and new jobs in rural areas. The availability of jobs has a significant impact on the welfare of rural inhabitants and balanced regional development.





Unlock potential

Plant or animal origin raw materials, their side streams or even waste – contain a lot of unlocked potential – valuable ingredients, which extracted or synthesized with others can be used as compounds of different food, feed, textile, pharmaceutical products and construction materials, among others. Unlocking and realising this potential require the ability to see the value of every resource, the know-how of transferring this value into a product or service, and often combining knowledge across different traditional and novel fields of bioeconomy.

Seven cases presented in this section demonstrate the unlocked potential of Finnish, Latvian, Norwegian and Estonian resources and stakeholders. You will be surprised at what hidden values can be discovered and unlocked in well-known natural resources and we hope that you will get inspiration from the ability and skills of those, who discovered and were able to wisely transform traditional resources into novel products and solutions.

Innovative production and exploitation of medicinal and aromatic plants



Field and Forest Ltd

www.fieldandforest.lv

TECHNOLOGY INNOVATION



Drones, remote sensors and spectral data from satellites and aircrafts are used to transcend human sensory limitations and gather additional information about the fields and plants. Robots are developed to reduce menial work. In-house engineers and mechanics adapt technologies for specific needs. Tractors are customised to increase the efficiency of agricultural processes (e.g. cultivating) for specific fields and species.

ENVIRONMENTAL BENEFITS



Organic farming does not use synthetic fertilisers, pesticides or insecticides. Their production is energy intensive. A 25.5 Kg CO₂ eq. /kg is indicated by the Food and Agriculture Organization of the United Nations regarding pesticide production. The avoidance of synthetic chemicals helps preserve soil health, thus maintaining a long-term competitive advantage of the region and business.

BUSINESS MODEL INNOVATION



An in-house laboratory is used to evaluate chemical characteristics of grown produce in different conditions in experimental fields, thus searching for higher added value rather than relying on maintaining existing methods. New products are developed from waste-streams. Research is conducted to generate new revenue streams. Essential oils are produced from scraps and herbal water from the medicinal and aromatic plants drying process. Both products retain a high medicinal and cosmetic value. Over 90% of produce is exported to the EU. The company builds on partnerships in food, health and cosmetics. It is developing a biological ingredient line for a regional household cleaning product firm.

It is a knowledge and technology-intensive agriculture enterprise specialising in the organic growth and exploitation of medicinal and aromatic plants, established in 2005. The owner of the company has more than twenty years of experience in developing and managing innovative niche businesses. The company is known for its entrepreneurial culture and creative business solutions. It is one of the largest organic chamomile growers in Eastern Europe exporting over 90% of its produce to the EU market for food, pharmaceutical and cosmetic applications.

Nowadays, Field and Forest's organic farming has reached 338 hectares of agriculture land and 644 hectares of forest land certified under the Forest Stewardship Council and Council Regulation (EC) No 834/2007. The company regularly initiates and participates in research and development activities focusing on herb cultivation methods, biorefining and new product development. It uses unique in-house developed machines and tools to improve production process efficiency. The chemical laboratory equipped with liquid and gas chromatographs, mass spectrometer and spectrophotometer perform quality assessments to ensure product compatibility with premium sector demands. Experimental fields are used to search for the best genetic plant varieties for the highest added value. A biorefinery approach is used to turn waste and by-products into new products. Folklore is studied to rediscover other uses for plants and latest technologies (drones, robots, sensors, etc.) are used to increase the understanding of agricultural conditions and improve work efficiency.

The Weed as a useful plant



Crenoco Green Sole Proprietor

www.nordicforyou.fi crenoco-green.business.site

The idea to offer the market products originating from specific and cultured plants, especially those normally perceived as weeds, was the basis in the development of Crenoco Green. One of the first steps taken was to find fields, forests and buildings located far from main roads and industrial plants to make sure that plants are as pure as possible.

At present Crenoco Green has 10 hectares of fields, where plants like nettle (*Urtica dioica*) and common yarrow (*Achillea millefolium*) are grown, a forest where wild berries and herbs are harvested, and facilities, where plants and berries are dried using bioenergy, and packed.

Sustainable and organic production is especially important for Crenoco Green. The enterprise is certified as an organic producer in the whole production chain, from growing and picking to producing. Entrepreneurs are appreciated of their innovativeness, systematic development of products, marketing and branding.

“Finland’s pure natural resources have a huge value. The farmers should produce cultured products instead of selling raw material for industrial purposes”, say entrepreneurs of Crenoco Green. “Of course, there are challenges, like a lack of testing facilities and limited ability to do marketing. But, if you have a strong vision, believe in yourself, be patient and have people who help you through difficulties, you can succeed.”

SUSTAINABLE USE OF RESOURCES



Plants are grown in their natural area and can grow and provide yield without special care, for example without fertilization. Water is only needed when new seedlings are planted. The drying of plants is done with the use of bioenergy.

ENVIRONMENTAL BENEFITS



Production uses natural plants in their natural growing areas, which supports biodiversity. Production is carbon-free.

BUSINESS MODEL INNOVATION



Innovativeness lies in the plants used: weeds. Value comes from the multiple ways of naturally refining growing plants, inter alia weeds, into organic products.



Arctic Red



Klosser Innovasjon Ltd

www.royeforum.no

SUSTAINABLE USE OF RESOURCES



The new land-based aquaculture systems will utilize available fresh water sources not in use today. The parts of the char left after processing will be used in other protein production or biogas. The sludge can be used as land fertilizer.

TECHNOLOGY INNOVATION



New species-specific genetic tools for genotyping arctic char will be developed. To make a new genetic marker panel, the whole genome of the arctic char was sequenced and reassembled to draw out SNP markers. This has not been done in Norway before, – the marker panel will be all new and designed especially for Norwegian char.

BUSINESS MODEL INNOVATION



The end product is fish and their growth provide farmers with access to the retail market as well as local sale platforms. With arctic char being a freshwater fish, the sludge does not contain sea salt. It is, therefore, extremely easy to use for agricultural fertilizer. This might be another source of income for char farmers. In addition, the genetic marker panel is planned to be licenced out for use in research on wild or other char populations.

The project, Arctic Red, aims at establishing a new national breeding programme for Arctic Char (*Salvelinus alpinus*). The breeding programme will accommodate new char producers with quality eyed roe from a breeding strain that is better suited for land-based aquaculture and food production.

Simultaneously, new producers all around the inland region are being recruited. The strain is selected towards faster growth, better use of feed and later maturation time. The establishment of necessary genetic tools to operate a modern breeding programme for fish, a genetic marker panel for genotyping and kinship control is ongoing within the project.

Up to now, arctic char is being obtained from several different populations with a genetic pool big enough to establish the first parent generation. The next generation will be produced in 2020, at the same time the genetic marker panel is finished and ready for use in the breeding programme.

Beauty from nature



AESTI Ltd

www.aesti.ee

The AESTI brand originates back to 2007 and was started as a quest for healthy, natural cosmetic products, which would help tackle issues concerning the scalp and hair. The method of using peat for deep cleansing of the scalp was recommended. In order to get evidence on peat health benefits, the AESTI team joined forces with two Estonian Universities and began research. At this time, peat was mainly used for energy and the fertilization of fields with no real understanding of the valuable composites locked in this natural resource.

The product development team soon realized that peat is a rather difficult resource, as it did not mix well with other compounds necessary for beauty product development. A novel filtrating technology was elaborated and introduced successfully. A long product development process followed and resulted in the first natural, organic peat shampoo being released into the market in 2015.

The research and product development process, lasting a decade, showed that peat obtained from Estonian bogs has remarkably high concentrations of humic substances. The substances and minerals are easily absorbed into skin cells and have multiple health benefits. The humic acid and minerals bind harmful substances in the deep layers of the skin and remove toxins from the organism. Fulvic acid balances and prolongs the life of skin cells, thus helping to slow the skin's aging process. This kind of peat is often considered the best natural medicine for human skin, as it has absorbed minerals and bioactive substances from the bog for over thousands of years.

SUSTAINABLE USE OF RESOURCES



Peat is a widely available natural resource in Estonia and Northern Europe, however scientists have concerns about the sustainability of this resource. The amount of peat used to produce beauty and cosmetic products is relatively small, thus by getting the required amount of raw material has a minimal impact on peat swamp ecosystems, which are essential to the sustainability of natural resources.

TECHNOLOGY INNOVATION



A novel filtrating technology to tame dominant features of peat was elaborated and introduced.

SOCIETAL BENEFITS



Using a natural resource in the beauty and cosmetics industry as an alternative to chemicals can have a positive impact on human health and well-being.

From wood fibre to textile fibre



Spinnova Ltd

www.spinnova.com

SUSTAINABLE USE OF RESOURCES



Agricultural and forestry waste can be used to produce Spinnova fibre, therefore promoting the sustainable use of natural resources for the circular economy.

TECHNOLOGY INNOVATION



A totally new technology on cellulose based textile fibre production has been developed.

ENVIRONMENTAL BENEFITS



Fibre's raw material is micro fibrillated cellulose made of wood, managed responsibly according to Forest Stewardship Council standards. The manufacturing process uses 99% less water than cotton production. There are no harmful chemicals used in the production process. The Spinnova fibre development phase has already created approximately 20 new jobs. By developing production sites, there will be a growing opportunity for new jobs. As Spinnova fibre can replace harmful fibres, it has the potential to have a positive impact on consumer well-being globally.

The story of Spinnova begins in 2009, from an idea of combining research of nanocellulose, its rheology and paper production with spider web attributes: how to spin wood fibre without dissolving it first? Solutions were developed after years of research in the VTT Technical Research Centre of Finland, and the company Spinnova was founded in 2015 to bring innovation to the market. The technology of cellulose based textile fibre production was scaled up from a small pilot to an industrial scale. The company's employees are mainly scientists at present, but marketing and sales professionals will be required in the nearest future.

Market research shows that cotton, and especially viscose, can be replaced with Spinnova fibre. This provides a huge opportunity for the circular economy in the EU and the world: agricultural waste, cotton waste and other cellulose based waste can be used in the production of Spinnova fibre. For example, in Delhi, India, stubble is waste that, against local regulations, is burned. It could be used by Spinnova in fibre production, thus reducing CO2 emissions remarkably.

The company is developing its future business models, which will likely include joint ventures to produce the fibre, however Spinnova will remain the owner of the trademark. In choosing partners, Spinnova has emphasized respect to nature and sustainability, above all. In ideal cases production has to be located close to the raw material. It is planning to develop an industrial scale production plant producing the fibre approximately in two years.

AMR-Diag



Inland Norway University of Applied Sciences

www.brage.inn.no

The emergence and spread of antibiotic resistant (ABR) bacteria are defined by the World Health Organisation as a global health problem. An estimated 25 000 patients die annually from ABR bacteria in Europe. The situation is at its gravest in low- and middle- income countries (including India), where antibiotic consumption is high and largely unregulated. Treating resistant infections results in extra costs and productivity losses, for example, in Europe losses amount to 1.5 billion Euro and in the USA 18.8 – 30.4 billion Euro annually.

Studies show that up to 70% of antibiotics are prescribed incorrectly. This is due to physician's inability to diagnose accurately in real time (within a few hours). The current time necessary for the identification of bacterial infections by using standard methodology is 2 – 4 days. This duration results in the prescription of antibiotics for viral infections, or the prescription of broad-spectrum antibiotics that should ideally be kept in reserve. Lack of rapid point-of-care diagnostic tests is central to this problem.

The test AMR-Diag, currently under development, will help determine more quickly and precisely whether or not an infection is bacterial and to which antibiotics it is resistant. It aims to develop a cost efficient, easy to use kit deployable in every doctor or veterinary surgery/bag and will enable physicians to more quickly and precisely choose the correct antibiotic, thus increasing the survival of those who need antibiotics (the right medicine at the right time). AMR-Diag can also be used on animals, thus reducing the use of antibiotics and resistance to it. It is significant as resistant bacteria can be transmitted between animals and humans.

TECHNOLOGY INNOVATION



The case integrates the use of new technology by taking advantage of advances in whole genome sequencing, bioinformatics, proteomics, and machine learning methods, combined for the development of a decision-making tool – the AMR-Diag, for the detection of bacterial infection, including a profile on its resistance.

ENVIRONMENTAL BENEFITS



Early diagnostics could help avoid the unnecessary prescription and use of broad-spectrum antibiotics for humans as well as diminish their use in agriculture and aquaculture, thus reducing the availability of antibiotics of pharmaceutical origin in sewage and waste water treatment systems, from where they often end up in freshwater and marine environments. It is a challenge, requiring diverse solutions, and the AMR-Diag could contribute to the solution of the problem.

SOCIETAL BENEFITS



Antibiotic resistant bacteria are one of the biggest health threats of the future. The forecasts, provided by scientists, are that in 2050 more people will die because of antibiotic resistant bacteria than of cancer. The treatment of cancer can become almost impossible due to a lack of effective antibiotics. The development of the early diagnostic test will make a significant contribution to maintaining public health in the present and future.



Eco-leather from gelatine waste



Gelatex (start-up)

www.gelatex.com

Gelatex Technologies is a material technology start-up enterprise in Estonia. Its mission is to create eco-friendly materials and technologies. The start-up enterprise has developed a technology to produce nano-fibrous textile material from gelatine - a natural protein, derived from the meat and leather processing industry's low value waste. The technology is energy efficient, eco-friendly, easily scalable and cheaper than alternative technologies. The proprietary production process starts with making a substance from gelatine. Then, nano-fibrous, non-woven material is created from this substance and after lamination and finishing with sustainable ingredients to give the material final touch and durability, an eco-friendly leather-like textile is obtained.

The amount of meat industry waste produced in the world annually is enormous. Estonia's meat processing industry every year produces an amount of waste sufficient enough to make two million square meters of Gelatex textile. Yet, instead of its use, it is currently incinerated. Accordingly, it can be argued that resources are available to produce eco-friendly leather-like textile from gelatine.

Gelatex technology uses no toxic chemicals and 78% less water compared to leather production. There is also 28% less energy used, meaning that to produce 2 million square meters of material almost 5000 metric tonnes of CO2 emissions would be avoided. As the material is coloured by adding pigments before creating fibres, there is also no wastewater from the dyeing process, which is a major source of pollution in the textile and leather industry.

SUSTAINABLE USE OF RESOURCES



The technology has enabled meat and leather processing waste to be transformed into a new product - nano-fibrous textile material.

TECHNOLOGY INNOVATION

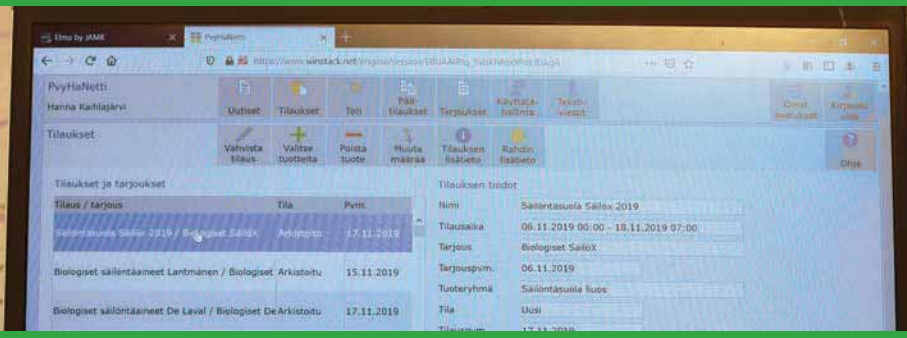


The production of nano-fibrous textile material from a natural protein is a novel, previously non-existent technology.

ENVIRONMENTAL BENEFITS



The Gelatex process uses no toxic chemicals and 78% less water compared to leather production. There is also 28% less energy used meaning that to produce 2 million square meters of material almost 5000 metric tonnes of CO2 emissions will be avoided.



Collaborate for positive change

Collaboration is a tool used to acquire the necessary knowledge and skills to create novel solutions for the development of bioeconomy and achieve results that would not be achievable alone. The forms of cooperation are diverse and depend on the objectives and scope of stakeholders. Where solutions are needed to develop the bioeconomy ecosystem, the most effective will be the triple helix approach, involving research-industry-government, ensuring close links and interaction between practitioners and decision makers. In the practical development of innovation, technology and products, cooperation is developed either between business enterprises, between research institutions and companies or sometimes just between research institutions.

Whatever the range of partners involved, the collaboration purpose, clarity of contribution and benefits of each of the involved actors are important. Wonderful novel products, technological solutions and innovation are created quicker and more often and results are better if knowledge, experience and new ideas are shared and blended among partners.

Six cases from Finland, Norway and Latvia presented in this section will show you how business companies, research institutions and public authorities are collaborating in their intentions to create the most advanced products, technologies and business models to develop the regional bioeconomy ecosystem. And it is worth remembering – even the sun collaborates with the soil to assist in flowers growing from the earth.

Farmers' joint procurement ring



Koskenkylä Small Farmers Association in Saarijärvi

www.hanetti.fi

ENVIRONMENTAL BENEFITS



Well organised logistics for the delivery of goods to farms reduces fossil fuel consumption, which has a positive impact on the environment. Knowledge on carbon neutral farming, disseminated via the digital platform, raises the awareness of farmers on the role and impact of sustainable farming on the environment.

SOCIETAL BENEFITS



The existence and competitiveness of small farms are a matter of inhabiting rural areas. Creating preconditions for small farms to work more efficiently is conducive to job creation, increasing the income of rural inhabitants and the attractiveness of the rural environment as a place to live.

BUSINESS MODEL INNOVATION



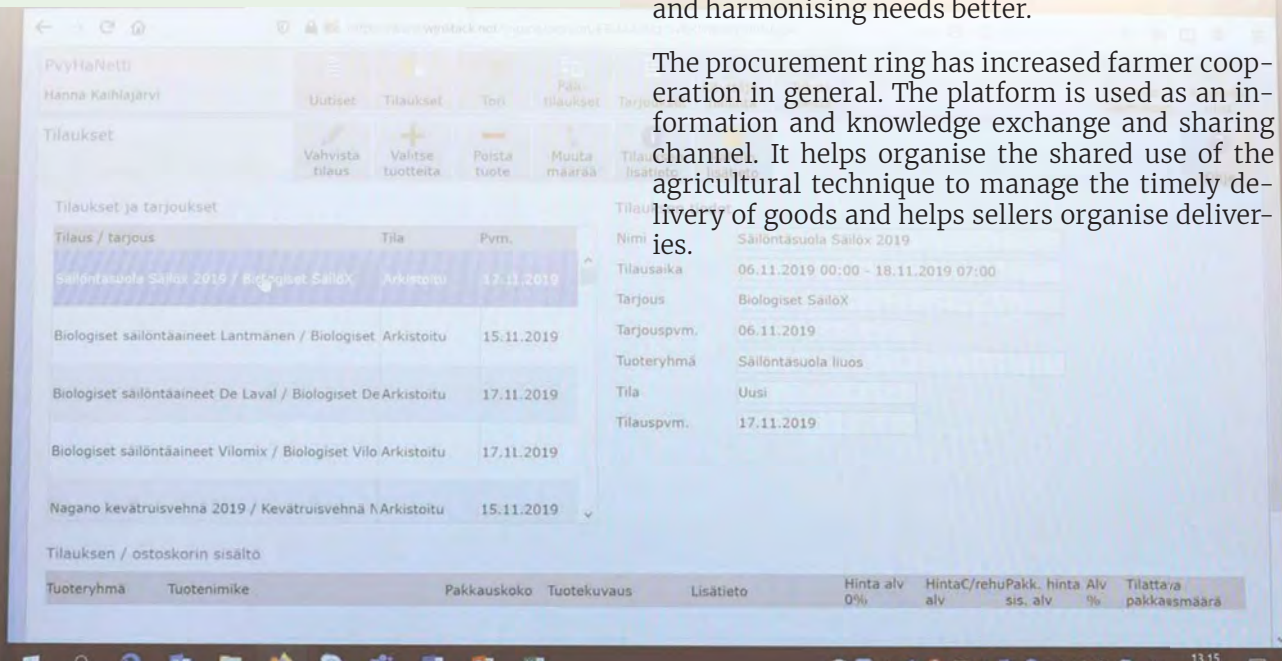
The establishment and maintenance of a common procurement system for the needs of small farmers has enabled the development of a business solution which, through cooperation, increases the competitiveness of still separate business units. This business model can be applied in different economic areas and geographic boundaries.

The Koskenkylä Small Farmers Association (Koskenkylän pienviljelijäyhdistys) has been running a joint procurement ring since 2003. It serves members in the joint purchase of goods and services, for example feed. Due to larger volumes, vendors offer a good price, therefore farmers get goods and services for the most competitive price. It often guarantees that farmers get goods and services as cheaply as large farms, who get competitive bids directly. This approach has created significant savings for small farmers. In 2015, the average saving in costs was about 2000 euros per 50 hectares of farm.

The number of associated members has constantly been increasing and reached 170 members at the beginning of 2020. Farmers have committed themselves to buying all feed for cattle through the joint procurement ring. Buying all other goods and services is voluntary.

Due to the increase of members, the association had to improve the purchasing system. Initially, it was organised in the form of letters, text messages and emails, and now for several years it is a digital platform, developed and maintained in cooperation with a local IT company. The platform has had two updates since the beginning. In practice it has proven that the joint procurement ring functions better, if it involves farms located nearby, thus getting the most out of local knowledge and harmonising needs better.

The procurement ring has increased farmer cooperation in general. The platform is used as an information and knowledge exchange and sharing channel. It helps organise the shared use of the agricultural technique to manage the timely delivery of goods and helps sellers organise deliveries.



Development and management of the organic potato starch production chain and competence centre



Aloja Starkelsen Ltd

www.aloja-starkelsen.lv

Starch is a product consumed by households and industries and can be produced from several agricultural crops. One of them is the potato. Potato starch is used worldwide in the production of food, the manufacture of paper, pharmaceutical, textile and construction materials. The global demand for organic potato starch has grown rapidly over the last 10 years as it demonstrates many valuable characteristics: a superior water binding capacity, the ability to build excellent viscosity, low temperature swelling, lack of taste, transparency, GMO and gluten-free qualities as well as lack of allergens.

Aloja Starkelsen Ltd started the production of organic potato starch in 2008, and since 2013 the company is the second world's largest organic potato starch producer. The company strives to satisfy world market demand and, to do it, must have access to the raw material – organic potato, meeting certain quality requirements and delivered in volumes, satisfying company production targets. In order to ensure all of the abovementioned, the company has created a network by joining organic potato growers, breeders and researchers in one chain, and has established an organic potato starch competence centre, whose main objective is to promote knowledge based organic potato breeding and growth in Baltic states. More than 100 Latvian and Estonian farmers are growing and delivering organic potato annually to the enterprise, and due to the world market's growing demand, volumes purchased from farmers are still growing.

SUSTAINABLE USE OF RESOURCES



Starch production creates two by-products – potato juice and potato pulp. Up till now, both have been utilised in a sustainable way. Products are given to farmers, who use the juice for the fertilization of fields, and potato pulp for feeding animals. Therefore, waste volumes are minimised, indirectly reducing the use of energy and water to produce fertilizers and feed. However, knowing that there are a lot of valuable compounds in the waste, the company is doing research and making trials to find new application possibilities for them.

SOCIETAL BENEFITS



Organic potato starch, as a non-allergenic, GMO and gluten-free product can be used to produce organic and functional food, baby food, having a direct positive impact on the health and wellbeing of customers. Besides processing, the enterprise provides a service to organic food producers in the whole world. It develops new recipes and technologies, where the application of organic potato starch enables the creation of products responding to diverse groups of consumers, while avoiding the application of conventional food additives.

BUSINESS MODEL INNOVATION



Innovation lies in the approach in which the interested processor has initiated, established, and maintains the organic starch potato production chain, in which each involved participant receives necessary support, gains economic benefits, is sustainable and maintains growth potential. 3-year agreements are signed with organic potato growers, thereby guaranteeing the sale of all potatoes. Growers receive seed potatoes from the processor, are trained regularly in organic starch potato production technology as well as receive advice on plant effects and fertilizers. It helps growers increase farming efficiency, achieve greater profitability and ensures raw material for the processor.

REKO – local food network



Local food producers organized through the Norwegian small farmers organization

www.smabrukarlaget.no

SUSTAINABLE USE OF RESOURCES



REKO has created many vibrant local food communities engaged in fruitful dialogue about the ethics of food, and how to increase local food production and consumption. Nowadays, consumers are shaping food market trends by the kinds of agricultural production systems and methods they accept and what kind of food they want to consume. They are also more and more interested in knowing where their food comes from and by means of what kinds of growing methods food has been produced. Increase of consumption of local food, produced in a sustainable way, reduces the need for packaging and transport and minimises food losses, which is significant from the perspective of sustainability.

SOCIETAL BENEFITS



The case has shown that the establishment of an easy way of selling motivates small-scale farmers to produce, invest and grow. REKO helps farmers, especially at small farms, to earn more, thus promoting the creation of jobs and socio-economic development in rural communities.

BUSINESS MODEL INNOVATION



REKO is an organized sales-purchase model that is free and not owned by anyone. Besides Norway, it is established in 7 countries and 400 places. It is growing fast and might be introduced in more communities, where people care for sustainable local development.

The purpose of a REKO-ring is to establish an on-line local food market, offering an effective, direct and easy way for local food producers and consumers to sell and buy. The interaction is direct, without any intermediaries. The local food market is co-created by producers, consumers and facilitators, termed administrators, through a process of facilitated interaction. Communication takes place by means of a closed Facebook group, where consumers pre-order local food directly from local food producers. Thus, the main communication and interaction medium of a REKO-ring is Facebook. The transaction process takes place at a fixed time, at a predefined place, without any fees. Producers are responsible for distribution and, as such; they are obliged to follow local regulations on food safety, accounting and tax. Both the administrative work on the Facebook page and the transaction process is based on the voluntary work of administrators, consumers and producers of local food. In this respect, REKO-rings defy standard market models as well as other alternative direct agriculture markets by selling directly to consumers without any expensive intermediaries.

The case has demonstrated how collaboration helps to create and maintain an efficient food delivery system where many local producers can sell and consumers can buy qualitative, locally produced food by reducing costs to be paid additionally to the middlemen and reducing time spent on delivery and pick-up.



Joint venture in dairy farming



HRV Farm Ltd

HRV is one of Finland's biggest dairy farms in Saarijärvi, Central Finland. It was built in 2018, and milking started in December the same year. The foreseen size of the herd is 600 cows, with the aim to milk 500 cows daily. The number of cows reached at the beginning of 2020 is 550, out of which 480 are being milked.

The farm is a joint venture, owned by three businessmen Heikki Hiironen, Jukka Ruunaniemi and Jari Valkola, each having previously run a farm. A few years ago, they realized that if they want to succeed as entrepreneurs, they could achieve more if they merge their farms into a joint venture, and so they joined together.

Each of the three owners has a specific role: Heikki is responsible for machines and grows feed, Jukka takes care of animals, and Jari deals with economics and marketing. Partners are flexible and roles, when needed, can be changed. All decisions are made jointly.

In order to develop the business, a new farm was recently built by using the best European and Finnish practices. In the construction process, solutions that are both economically viable and environmentally friendly were used: geothermal heating is applied and a water circulation system is installed.

In addition to introducing an environmentally friendly infrastructure, partners also care about the use of local resources and the welfare of the herd. 95% of the grass used for feed is produced locally by farmers and SMEs – within 10 kilometres of the farm. Rules on animal health and welfare have been strictly observed. Digital solutions are used to monitor cows remotely, all data – from harvest maps to milk samples – is saved and managed digitally.

TECHNOLOGY INNOVATION



The HRV farm has introduced geothermal heating and water circulation systems, which is a novel solution for the traditional dairy farm sector enterprise. The application of digital solutions at all production process steps have increased productivity. The company is planning to introduce data analyses solutions for production optimisation.

SOCIETAL BENEFITS



Merging three smaller companies in a joint venture created business development opportunities for other local businesses. A growing business requires more resources. The HRV farm procures feed, other goods and services from farmers and SMEs nearby. Thus, it supports the creation and sustenance of jobs to rural inhabitants and regular business activities and income to small companies.

BUSINESS MODEL INNOVATION



A joint venture, as a business model, is quite rare in agriculture, at least in Finland. By merging resources and capacities, preconditions for business growth were created.



Inland – Värmland cross-border collaboration



Inland County (Norway) and Region Värmland (Sweden)

www.interreg-sverige-norge.com

SUSTAINABLE USE OF RESOURCES



Norway is a well-developed sawmill industry, while in Sweden the paper industry is well developed. Both industries use the same resource – wood, however, at the same time, they are interested in joining forces to make use of all of the timber in the most efficient way and produce, from it, the most profitable products, reducing waste to a minimum or even excluding its occurrence. Timber that cannot be used for building materials is, for example, delivered to paper mills, therefore avoiding the loss of raw material or its use for low value product production.

SOCIETAL BENEFITS



The implemented and ongoing cross-border projects and initiatives, in all cases, address and involve several groups of society, such as businesses and their organisations, non-governmental organisations, educational and cultural institutions, public authorities and sometimes informal groups of citizens, organised by individuals in order to solve specific challenges or make positive improvements related to bioeconomy, the use of natural resources, the availability of services and others. Economic cooperation has helped create many new jobs and secure existing ones in areas of bioeconomy, especially those related to agriculture, forestry, food processing and wood processing.

BUSINESS MODEL INNOVATION



The mutual harmonisation of the use of production resources and labour, taking into account the interests and needs of companies operating in each country, is a model that has been applied both within the framework of the cooperation of individual companies and the implementation of measures involving a larger and more diverse range of stakeholders across the border. It has helped improve business performance, reduce transaction costs for businesses and ensure jobs. Cooperation has promoted an exchange of knowledge for the development and implementation of innovation.

The border region between the Inland region in Norway and Värmland and Dalarna in Sweden in many ways is one region, but with an existing border-between them. The flow of labour, goods and services, used by the industry and business are ongoing between regions of both countries. These business routes and flows started in the 16th century when logs from Norway were floated down the river of Trysilelva/Klaraelven to Karlstad in Sweden. Nowadays, the Norwegian wood mechanical industry and foresters are completely dependent on the market for sawdust and parts of timber exported to Värmland, while Norway has an importing labour force and sawn timber from Värmland.

he cooperation, started between individual organisations and companies, has now been strengthened by even more serious links and mechanisms. The Norwegian and Swedish public authorities have strengthened socio-economic cooperation, including trade, through a variety of projects available to the border territories, such as the Interreg programme, the Nordic Council's support instruments and the regional programme "Grensekomiteen". Projects have been implemented for the development of entrepreneurship, improving the accessibility and quality of transport services, cultural and educational development, and promoting public engagement and participation.

The measures implemented have a positive impact on the development of national border territories. They have contributed to creating an attractive environment for life and work.



Knowledge-driven bioeconomy innovation ecosystem development in the Vidzeme region, Latvia



The Vidzeme Planning Region and Institute for Environmental Solutions

www.vidzeme.lv www.videsinstituts.lv

Ignited by the Interreg Baltic Sea Region project “Rural RDI milieus in transition towards smart bioeconomy cluster and innovation ecosystems”, a knowledge-driven bioeconomy innovation ecosystem (BIE) is being developed in the Vidzeme region, Latvia. The process is led by the public authority – Vidzeme Planning Region – and the private research entity Institute for Environmental Solutions in collaboration with a wide range of actors. Collaborators are enterprises involved or planning to have business activities in any field of bioeconomy. These encompass clusters, research and higher education institutions, vocational and lifelong learning education institutions, organizations supporting and encouraging business, innovation and technological development, national authorities as well as regional and local public authorities.

Building Vidzeme BIE is based on a co-created regional action plan and a wide range of activities, such as awareness raising and education of various stakeholder groups on bioeconomy, networking for the development of new products and technologies, the development and internationalisation of the Latvian Food-based Bioeconomy Cluster, the improvement of bioeconomy-related statistics and others. The Vidzeme region case represents institutional innovation aimed at creating favourable preconditions for those who deal with bioeconomy in the region, inter alia, promoting the improvement of policies, strategies and plans related to bioeconomy as well as the elaboration and implementation of tools for achieving set targets. The Action Plan for the Development of the Bioeconomy Innovation Ecosystem in the Vidzeme region was elaborated and adopted by the Council of Vidzeme Planning Region in 2019. It contains a number of actions to be realized at local, regional, national and transnational levels.

SUSTAINABLE USE OF RESOURCES



Natural resources are one of the key elements of the bioeconomy ecosystem in Vidzeme. The process of building an ecosystem focuses on raising awareness and knowledge among stakeholders on how to manage and use these resources more wisely and sustainably, ensuring their availability and quality at present and also for the needs of future generations. Knowledge has been developed or exchanged within the ecosystem increasing the capacity of businesses to produce high-added value products and services. The use of waste and by-products for the production of new products, the production of a full life cycle, the combination of knowledge and methods from different fields of science to improve production, recycling and business management: ecosystem developers contribute to the inclusion of these and other issues on the agenda of stakeholders, thereby pursuing the development of awareness and responsibility for natural resources in society as a whole.

SOCIETAL BENEFITS



Promoting knowledge-based economic activities creates preconditions for setting up and developing businesses as well as creating new and better-paid jobs, which means increasing the quality of life for inhabitants. At the same time, knowledge-based economic activities attract highly qualified specialists, especially youth, to the region, which is important for the Vidzeme region in terms of the demographic situation and population of the region.

BUSINESS MODEL INNOVATION



Networking, benchmarking, knowledge and skill share as well as exchange are the main methods used by the region's bioeconomy innovation ecosystem developers. Local, regional, national and transnational actions, aiming at encouraging and supporting innovation in products and technology development; research, especially multidisciplinary; knowledge exchange among enterprises, among enterprises and RTDs and innovation bodies, are core measures. All of the abovementioned aims at extending the general awareness on bioeconomy and empowering each involved party on the way to achieving individual targets.





BIOBORD
PLATFORM

BIOBORD COMMUNITY





Regions, particularly those covering large rural areas, now, more than ever, need knowledge, skills and the best practices promoting and ensuring a region's economic development in a rapidly changing global environment, while taking care of societal needs, natural resources and the environment.

An open virtual innovation hub – the Biobord platform – was created to respond to this need. The platform forms an open community of bioeconomy developers that a) promotes the exchange of expertise, resources and talents necessary for the development and introduction of natural resource based products and services, b) helps to assess and choose the most appropriate solutions on the path to the development and commercialisation of bioeconomy innovations and renew business operations in traditional bio-based sectors. Bioeconomy stakeholders: businesses, researchers, inventors and developers, as well as public authorities from different countries use the platform for co-working, peer learning, matchmaking and networking. The platform connects users by offering tools for knowledge and information on bioeconomy resource management and shares, promotes networking, and provides innovation support services.

Biobord is developed in a partnership of five rural regions: Central Finland, Inland (Norway), the Świętokrzyskie Voivodeship (Poland), Vidzeme (Latvia) and Estonia. They are represented on the platform by businesses, research institutions, public authorities, innovation facilitators and other stakeholders of the regions.

You are welcome to become a member of BIOBORD:

www.biobord.eu

OUTRO



Creators of the brochure express their gratitude to the “owners” of 25 cases, who agreed to share their experiences and achievements, and to the Nordic Council of Ministers for the support it provided.

We also thank you, the readers, and hope that the 25 stories were able to demonstrate the diversity and opportunities of bioeconomy and create confidence that the natural resources of Baltic Sea region countries hold huge unlocked potential. Every individual, organisation and company, regardless of scope to date, and location, can take part in its discovery and smart use. Significant positive changes arise where creative vision is combined with knowledge, skills and experience or is acquired through joint action.

We invite anyone, whose ideas are or might be related to bioeconomy, to find or create a community, where those ideas can be transferred into new products or services or can encourage the smart and sustainable use of natural resources. We will be more than happy if you decide to join the bioeconomy community.

Publication coordinators: Irina Kulitāne, Santa Vitola, Magdalena Karpińska

Contributing organisations:

JAMK University of Applied Sciences (Finland)

The Regional Council of Central Finland (Finland)

SSYP Kehityks Oy Ltd. (Finland)

Inland Norway University of Applied Sciences (Norway)

The Inland County Council (Norway)

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The Regional Science and Technology Centre (Poland)

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The Foundation for Education and Social Dialogue PRO CIVIS (Poland)

The Institute for Environmental Solutions (Latvia)

The Vidzeme Planning Region (Latvia)

Stockholm Environment Institute Tallinn Centre (Estonia)

The Nordic Council of Ministers



Innlandet
fylkeskommune



**REGIONALNE CENTRUM
NAUKOWO-TECHNOLOGICZNE**



**WOJEWÓDZTWO
ŚWIĘTOKRZYSKIE**



25 CASES FOR BIOECONOMY INNOVATION AROUND THE BALTIC SEA REGION

The regions, particularly those covering large rural areas, now, more than ever, need knowledge, skills and the best practices promoting and ensuring the regions' economic development in a rapidly changing global environment, while taking care of societal needs, natural resources and the environment.

This brochure contains inspirational stories about how private and public sector players, in five European countries, have sought and found, and continue to develop knowledge-based, smart and efficient solutions aimed at promoting the development of bioeconomy – to sustain biodiversity and ecosystem services, increase competitiveness of businesses, and unlock the unexplored potential of well-known and appearing resources. And, in most cases, this positive change grounds on one of the most effective tools – collaboration, which has no borders or limits, and which opens horizons for the most novel knowledge and approaches, available inside and outside the regional ecosystem, creating preconditions for innovation necessary for more effective and sustainable development of bioeconomy.

The publication was prepared by a consortium of 12 organisations from 5 European countries with support from the Nordic Council of Ministers. The development of the publication is funded by the European Regional Development Fund, Interreg Baltic Sea Region programme 2014-2020 in the project entitled “Rural RDI milieus in transition towards smart Bioeconomy Clusters and Innovation Ecosystems (RDI2CluB)”.



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