



## ENABLING

Enhance New Approaches in Biobased  
Local Innovation Networks for Growth

## Deliverable

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D3.10 40-45 best practices sheets in the EIP-AGRI format

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## DISCLAIMER

The sole responsibility for the content of this publication lies with the ENABLING project and in no way reflects the views of the European Union.

## Acronyms

BBI	Biobased Industry
BBP	Biobased Products
PA	Practice abstract
WP	Work Package
PF	Preliminary Feedback

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## EXECUTIVE SUMMARY / ABSTRACT

The biobased industry (BBI) is moving faster than ever, proposing innovative and sustainable business models able to trigger economic, social and environmental benefits.

Rural areas retain a considerable growth potential based on the high availability of residues from agricultural practices which result in excellent input for the biobased processes.

Research and technology improvements are contributing to enhance understanding of biomass characterization and its application in the biobased industry, while creating new market opportunities for these residues.

However, this potential is held back by the lack of knowledge and systemic frameworks that prevent agricultural businesses and the biobased industry from interacting and promoting new collaboration schemes.

**ENABLING** will contribute to close the gap of knowledge between Research and practitioners, collecting existing best practices of Biobased products (BBP) value chains and make them accessible to stakeholders.

One of the proposed measures is to identify and share successful examples of how sidestreams from agricultural processes are finding new and profitable routes.

The deliverable will start with a short introduction about the mission of the ENABLING project and the aim behind the collection and communication of best practices for biomass valorisation.

Section 1.4 and 1.5 will provide information on the progress and results achieved in the implementation of Task 3.4 “Production of Best Practices Sheets”, including organisation and coordination of the activities by the task leaders.

The Document will conclude with a table listing the practices collected in the third year of the ENABLING project, with information of the biomass and Biobased product identified for each business model.

### SCOPE

The deliverable D3.10 “40 best practices sheets in the EIP-AGRI format”, is aimed to present the results achieved in the collection of the practices for the third year of the ENABLING project.

The Document aims to be a useful and inspirational source of information for practitioners and potential stakeholders of the bioeconomy sector. In addition, the Deliverable completes a set of three deliverables created along the three years of project implementation, which all gather a collection of best practices identified and delivered by project partners.

## 1. Deliverable Description

The Deliverable 3.10 describes the activities implemented by the ENABLING partners in the identification, and collection of more than 40 business models in relation to task 3.4 “Best practices sheets in the EIP-AGRI format”.

The Document illustrates the actions undertaken by task leaders to coordinate and guide the collection of the several cases identified by project partners. It also provides a list of the practices in the form of Best practices sheets that are ready for publication on the ENABLING and EIP-AGRI website.

The list of best practices is also available in Table 1, which outlines the main types of biomass identified in the business models, and the final biobased products or materials – columns “**Biomass source**” and “**Biobased product**”, respectively. This would help the reader to have a quick overview of the main sources of biomass and the type of industry or process requiring them.

The Report will conclude summing up some of the main biomass sources or biotechnology processes identified by the project, main actors involved in the value chain, and benefits emerging for the main practitioners.

### 1.1 Project overview

The ENABLING initiative is based on the consortium’s vision that the biomass to BBPs value chains can enhance economic growth while contributing to a sound management of local and natural resources.

Recent experiences across Europe provide good examples of how biomass for BBPs could represent a viable alternative or a differentiation to most traditional processes, which are typical of bioenergy supply chains.

Research results and technology improvements are contributing to enhance understanding of biomass characterization and its application in the processing and manufacturing industry. In some cases, residues from agricultural, forestry and fishery activities require sophisticated treatments to be converted into value added products. In others, a simple procedure or treatment allows them to be (re)used in the same production process or be addressed towards new markets.

Both approaches aim to create marketable conditions for those residues that would be otherwise discarded, preventing practitioners to create value out of them, while contributing to a negative environmental impact.

New market opportunities are achievable through multidisciplinary structures to enable knowledge exchange and creation of synergies amongst different actors in the value chain.

Yet, this dimension struggles to elaborate systemic frameworks where key actors such as agricultural businesses and the Biobased industry could interact and promote new schemes. The lack of optimized value chains tends to penalize small rural businesses, repressing the commercial and social potential on both sides.

While new and excellent practices are emerging across Europe, their impact on the economic sustainability and opportunities for replication are limited by their small and local configurations. Such arrangements restrain circulation of ideas, with less chances to promote knowledge and networks for the deployment of innovative practices.

It is in this context that ENABLING will act to bridge the gap of knowledge between research and practitioners, scouting and spreading best practices to communicate how sidestreams of agricultural processes are finding new and profitable routes in the circular economy.

### 1.2 Best practices to enhance awareness on bioeconomy value chain

The ENABLING project responds to the EIP “Thematic Networks” and “Operational Groups” scheme, which asks partners to take actions and enhance the use of knowledge and structures affecting a specific agricultural sector in Europe.

ENABLING adopts an identifying-and-sharing approach to collect and divulgate numerous best practices, with the aim of sharing innovative business cases and main factors of success.

The practices identified in the ENABLING project will promote successful business models regarding the valorisation of biomass streams as input for biobased processes.

This activity will contribute to raise awareness on new market opportunities for residues of agricultural activities, providing information on the type of biomass sources and their final industrial/market application.

A specific focus will be given to (but not limited to) rural areas. The high availability of biomass from agricultural operations makes them as a natural target for the identification and communication of gainful value chains.

At this level, the ground to establish successful business models appears still fertile, with opportunities to trigger economic, social and environmental benefits for the whole territory.

The best practices are not only an awareness-raising activity but also an inspirational input for the deployment of structured networks to encourage entrepreneurial endeavours.

All the Practices will be made available in the ENABLING and EIP-AGRI websites as well as shared by project partners during workshops, webinars and coaching services.

### 1.3 Identification of Best practices – III year

ENABLING's WP3 aims at running a comprehensive identification of best practices across Europe through the criteria established in the project. This would result in the collection of high-impact sustainable cases of biomass residues inputs for the BBPs industry. The overall objective is to generate easily replicable models in many different contexts, well beyond the current operational horizon of ENABLING.

During the first six months of the project, the WP3 focused on producing the executive handbook on the identification of best practices (D3.1). 16 partners from different countries and regions undertook a challenging process. They brought up several ideas and opinions and followed the most appropriate methodology, as it had been outlined in the project proposal, to deliver, after 6 months, a handbook that won the support of all the project partners. The handbook was finalized in M7.

*A detailed description about the handbook development phase and the adaptation of the practices to the EIP-AGRI format, is available in the Deliverable 3.8 published on the ENABLING website.*

### 1.4 Collection of best practices – III year

The third and last year of best practices collection has been built on the basis of the successful methodology developed during the first and second year of project implementation.

The Preliminary Feedback (PF) measure confirmed to be a crucial and strategic approach in the identification of business models that would have qualified as best practices for the project.

The PF supported partners in two ways:

- Partners receive a confirmation that the practice they have identified is admissible for the Project
- Partners receive support and guidelines on the type of information they should focus on for each practice.

The solution has been welcomed and widely used by the consortium, which managed to work in a well-established framework of collaboration and supporting guidelines.

The consortium has successfully identified numerous and excellent cases of circular business models from different European countries. Yet, several examples from other regions of the world have been also included in the database, as long as they could show the potential of being replicated or inspire new business models in European regions.



The integration of the PF procedure enhanced the communication flow between task leaders and the rest of the partners in charge of collecting the practices.

Indeed, the activities implemented in task 3.4 experienced a slight delay due to the COVID-19 pandemic. Nevertheless, the hard work and determination put in place by all partners allowed the project to achieve its objectives in the collection of new practices.

All the information collected by partners has been reviewed by EUKNOW, summarized into Practice Abstracts, and transferred into the EIP-AGRI format by partner EUKNOW.

Prior to publication, all the practices have been sent to the regional partner for a final review and translation into the native language of the organisation.

## 1.5 Results of the best practices – III year

In the third year of project implementation, ENABLING has successfully identified 40 business models, which generated a total of 36 best Practice Abstracts (PAs) in the EIP-AGRI format.

The majority of the business cases have been gathered from partner countries. Yet, numerous and interesting examples were also found in other regions of the world, as a confirmation of the consortium's commitment to cover a wider geographical area, and share innovative solutions for Europe.

The business models have been collected from 17 different countries: Italy, Belgium, Norway, Ireland, Austria, Bulgaria, The UK, The Netherlands, Switzerland, The Czech Republic, France, Germany, Finland, Israel, Romania, Serbia, Spain and Uganda.

The practices propose a wide range of biomass sources from farming, forestry and fishing practices<sup>1</sup>, and their application into biotechnology processes.

This can be read as a positive result as it contributes to address a wide range of stakeholders, such as farmers, foresters or fishermen producing same or similar agricultural residues as those identified by the project.

Practices show how biomass originates, either as a direct consequence/outcome of an initial process, as side-streams of an industrial process or as a result of a primary production treatment (by-products).

One of the business models identified through the ENABLING project describes how, the residues originated from the processing of berry fruits in the food industry sector can be valorised and create new biobased products such as colouring extracts and compounds for cosmetics products.

Innovative biotechnologies are unleashing huge potential to produce a wide range of products from the same source of biomass. Wool, for instance, is one of nature's most amazing 'smart fibres', with a complex structure and natural properties that cope with extremes of cold and heat. The practices identified by the ENABLING project provide examples of how its unique characteristics are suitable to produce high value products such as biobased materials for the building sector, packaging, absorbents, soil conditioner and clothing.

ENABLING has also contributed to shed a light on the valorisation of biomass streams from rare or less conventional cultures such as brassica oils, sunflower, tobacco, rapeseed, and canola. Extracts and properties of these plants propose excellent ingredients and products to be applied and sold in niche or high specialised markets such as high-tech markets that require biobased lubricants, biobased material for interior design, as well as pharmaceutical and cosmetic products.

Excellent examples are represented by those practices that are implementing a circular business model "From Farmer to Farmer". Numerous types of biomass are used to produce items or ingredients that are required in the same agricultural sector, sometimes in the same farm that has produced those residues.

For instance, the Practice Abstract number PA101 of the ENABLING project describes the value added products derived from residues of citrus production. The extract compounds obtained from the processing of

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<sup>1</sup> See Figure 1. *List of practice Abstracts*

three varieties of blood oranges is used for the formulation of dietetic-nutritional products and anti-aging or after-sun cosmetics.

At the end of the process, the production residues are given back to farmers and used as nutrients for soil.

From the project it emerged that, in some cases, the financial benefit for farmers or biomass suppliers does not come as a direct payment against the material they are offering in the market. Instead, the economic advantage lays in the fact that they don't need to afford the costs of managing and disposing the residues of their production processes.

Therefore, the *economic benefits depend much on the type of collaboration that bound together the biomass suppliers and the buyer.*

In some cases, the benefit is a direct financial compensation for the amount of biomass sold to the processing industry; in others, the economic benefit is given by the possibility for the biomass supplier to find a processing company that takes care of collecting the biomass directly from the farm, unburdening the farmer from paying high costs for getting rid of production residues.

The economic potential of circular business models is not limited to the suppliers (farmers) and buyers (biobased industry) only. Other actors, along the value chain, can benefit of these schemes, providing different skills and services to support and empower the whole business model. Research centres, logistics, technology advisors, extension services and retailers are all critical experts that play a decisive role in the value chain, highlighting how bio-economy can trigger economic benefits in numerous and different sectors.

## 1.6 Conclusions

In the third year of project implementation ENABLING has identified more than 40 business models of biomass application to BBPs production, reaching a total of 132 Practice Abstracts at the end of the project, against the 100 target that was foreseen and planned at its outset.

The whole methodology for the collection of the best practices reached a full maturity since the second year of project implementation with the integration of the Preliminary Feedback (PF), a measure aimed to support partners in the identification of a new practice and relevant information related to it. This led to a better input provided for each practice, while speeding up the process in the collection of the material.

The Technology Readiness level (TRL) of the practices ranges between 7 and 9, proposing business models which processes and products are commercially viable and offer good potentials for scalability.

Task 3.4 of the project has also contributed to enhance knowledge of biotechnology processes requiring types of biomass that are less known in the market but bear a high potential for replication. On the other hand, numerous business models are confirming the market opportunities of more conventional sidestreams from hemp, livestock, cereal, fruit and vegetable farming.

The cases identified by the project represent a useful source of information to communicate how several business models are contributing to create added value products from biomass streams of agriculture and marine origin. In addition, they are emphasising how the collaboration between different actors such as Research, extension services, biotechnology experts and farmer associations is a crucial strategy when developing a new product and setting up the value chain for commercialization.

The practices have been used along the project to support the activities of coaching services and brokerage as well as presented during workshops and webinars.

All the practice abstracts are made available and accessible on the ENABLING atlas and EIP-AGRI websites.

## 1.7 List of Practice Abstracts

The following table provides an overview of the Practices collected during the third year of the project. Starting from the column on your left, the table gives information about the code of the practice (n. Practice Abstract), the name of the practice (Name of the practice), the type of biomass source produced or used in the business model (Biomass source), and the final biobased product, ingredient or material produced by the biotechnology or the process (Biobased Product/material).

A summary of each practice is available in section 1.8 of this document (Best Practices Sheets in the EIP-AGRI format). While a more detailed description about each business model will be available and easy to find in the [best practice ATLAS](#) on the ENABLING website.

**Table 1: List of Practice Abstracts**

n. Practice Abstract	Name of the practice	Biomass Source	Biobased Product / material
<b>PA97</b>	Eco-paper from agro-industrial residues	Citrus fruits, grapes, lavender, corn, olives, coffee, hazelnuts and almonds	Biobased paper
<b>PA98</b>	Luxury textile from Orange pulp	Orange pulp	Textile
<b>PA99</b>	Eco-leather - The business model	Apple residues	Biobased leather textile
<b>PA100</b>	Eco-leather - The process	Apple residues	Biobased leather textile
<b>PA101</b>	Biobased products from citrus	Citrus	Nutritional and cosmetics products
<b>PA102</b>	Bioenergy from olive tree residues	Olive tree residues	Wood pellets
<b>PA103</b>	Plant-based lubricants	brassica oils, sunflower, tobacco, rapeseed, canola	Biobased lubricants
<b>PA104</b>	Biobased resin coatings for sustainable architecture	Soybean oil	Biobased resins
<b>PA105</b>	Bio-cosmetic and Bio-detergents from natural products	Brassical oil Quince and “Chiuri butter”	Biobased cosmetics and detergents
<b>PA106</b>	Cereal residues for the building sector	Cereal straw	Bio-bricks
<b>PA107</b>	Biobased colours	linseed oil, eggs, beeswax, vegetable resins, Canapulo and vegetable pigments	Colours for wall and piece of art painting
<b>PA108</b>	Biobased foam from sugar residues	Sugarcane	Biobased packaging

<b>PA109</b>	Mycelium production for biocontrol agents	Fungi	Biocontrol agents
<b>PA110</b>	Mycelium production for exotic mushroom production	Fungi	Exotic mushroom cultivars
<b>PA111</b>	Soil fertilizer from aquaculture residues	Fish sludge	Soil fertilizer
<b>PA112</b>	Biochar and Active Charcoal	Agriculture and forestry residues	Biochar and Active Charcoal
<b>PA113</b>	Beeswax tissue	Beeswax, sunflower oil and tree resin	Beeswax tissue
<b>PA114</b>	Eco-razors	Wood residues	Biobased razors
<b>PA115</b>	Felt and wool shoes	Merino wool fibres	Wool shoes
<b>PA116</b>	Organoid Technologies	Rosebuds, lavender stems or cornflower blossoms	Several fragrances
<b>PA117</b>	Natural colouring	Elderberry	Natural colourings for the food industry
<b>PA118</b>	Stone pine products	Wood shavings, sawdust and pine oil	Home decoration objects
<b>PA119</b>	Hemp Cluster	Hemp	Several biobased products
<b>PA120</b>	Phytotherapy from herbal products	Different types of medicinal herbs	Herbal products
<b>PA121</b>	Eco-friendly coffee cups	Bran, coffee grains and coffee residues	Coffee cups
<b>PA122</b>	Biobased clothing	Wood cellulose fibres and other agricultural residues	Textile products
<b>PA123</b>	Biobased building materials	Distillers grains and algae	Resin adhesive
<b>PA124</b>	Eco-friendly egg tray	Corn gluten	Egg tray
<b>PA125</b>	Paper bags from agricultural waste	Banana and pineapple residues; cotton waste and other farming residues	Paper bags
<b>PA126</b>	Briquettes made from agricultural wastes	Rice and peanut husks, coffee pulp and corn stalks	Biomass briquettes

<b>PA127</b>	Bio-composite materials for packaging	Wood chips and flour	Bioplastic packaging
<b>PA128</b>	Woodcast - Revolutionising Orthosis	Wood chips from Finnish aspen	Orthosis components
<b>PA129</b>	Mycelium bio-composites in industrial design	Mushroom mycelium and wood waste	Biobased foams
<b>PA130</b>	Biobased products from viticulture residues	Residues from viticulture	Cosmetic and nutraceutical products
<b>PA131</b>	Biobased coffee capsule	Sunflower seed hulls and corn starch	Coffee capsule
<b>PA132</b>	Sustainable and vegan products from the tinder fungus	Transylvania, Romania and Berlin, Germany	Vegan materials and textile

## 1.8 Best Practices Sheets in the EIP-AGRI FORMAT

The following pages provide the list of the best practices in the EIP-AGRI format.

### **PA97 - Eco-paper from agro-industrial residues** **Veneto, Italy**

The increasing need for sustainable production practices together with that of closing the loop of circular economy, generated the idea of integrating fruits and nuts in the production of paper.

Crush is an eco-friendly range of papers by Favini, made by replacing up to 15% of virgin tree pulp with the process residues of organic products. Crush paper includes by-products from citrus fruits, grapes, cherries, lavender, corn, olives, coffee, kiwi fruits, hazelnuts and almonds. These natural raw materials are saved from landfill and used to make these distinctive and vivid papers.

By employing what would be otherwise wasted products, the farmers can increase their revenues substantially, decrease their costs of wasting and enhance their market share.

Crush uses an eco-friendly manufacturing process that is far more advanced than standard recycling processes. It contains 40% post-consumer recycled waste. Both the production process and the product are protected by European patents. Crush is suitable for all applications, including luxury packaging, brochures, stationery tags, cards and labels. Furthermore, the process utilizes 100% of green energy and replaces 15% of tree pulp.

### **PA98 - Luxury textile from orange pulp** **Sicily, Italia**

The Brand Orange Fiber is the only brand to produce the first sustainable citrus fabric in the world. Orange Fiber aims to meet the needs of innovation and sustainability of fashion, interpreting its creativity and visionary spirit. The process concerns the wet residue that remains at the end of the industrial production of citrus juice and that can anything but be thrown away. In Italy only, every year 700.000 tons of by-product from the orange industry is wasted.

Orange Fiber has developed and patented an idea on how to produce textile from oranges, protected under

Italian and international patents. From the pulp, the company can extract cellulose, which is then transformed into a textile and sewn into clothing. It combines sustainability and innovation with the textile quality of Made in Italy.

The farmers collect and provide the orange pulp without having to dispose it themselves. In addition, the processing industries provide the pulp or the unsold oranges. The by-product is shipped to Orange Fiber and processed in order to create the textile they also sell to further industries.

Some of the elements that contributed to the success of this business model are: the patent protection, the abundance of orange crop in the region, the abundance of orange crop by-products, investments in Research and capital, partnerships, as well as increasing demand for sustainable clothing production.

#### PA99 - Eco-Leather - The business model

Trentino Alto Adige-Tuscany, Italy

Operating in the footwear, furniture, leather goods and bookbinding sectors, MABEL SRL has expanded its offer with sustainable leather goods. The innovative product, called Apple Skin™, can fall within the category of ECO-LEATHER with strong elements of sustainability, such as: reduction of up to 50% -of the use of solvents and synthetic compound based on polyurethane.

Apple Skin™ was born from the collaboration with the Frumat srl company (from Bolzano) which owns a generic patent on the use of residues from the apple juice industry. In Trentino Alto Adige, the high production and processing of apples (over 3 million tons per year) causes problems for the correct disposal of the residues of their industrial transformation. Instead, these biomasses, which are easily stored and conservable, involve different production chains to obtain two distinct products: paper and Apple Skin™. Apple Skin is a sustainable product of textile engineering, which has taken a few years of research to fully meet the needs of the market. Apple Skin™ is a valid alternative to traditional animal skin or synthetic skin (derived from petroleum and with heavy use of solvents). Currently Apple Skin™ is exported to various countries from North America, to the Far East but also to Europe and Australia.

The actors involved are represented in Italy by the Consortium of Fruit and Vegetable Cooperatives (VOG), born in 1945. VOG is the largest organization for the marketing of apples in Europe. Composed of 12 associated fruit and vegetable cooperatives and 5,000 farmers who, on an area of about 11,000 hectares, produce about 600,000 tons of precious fruit and related by-products. Processing industry in Germany and Italy, special logistics companies for transport.

#### PA100 - Eco-Leather from apple residues - The process Tuscany, Italy

Apple Skin™ is an innovative product obtained, for about 50%, from the transformation of apple residues, which is why it is considered ecological and vegan-friendly. It can be used to produce bags, footwear, sofas and armchairs covers, and diaries bindings. Among the technical characteristics the high breathability of this material results of high interest for the fashion and furniture sectors.

In addition, the powder derived from dried apple residues has useful properties to limit accidental spills of hydrocarbons. These powders, inserted in the containment barriers laid at sea, have a high ability to absorb oil (1 kg of dried apple powder absorbs 5 liters of oil).

The use of by-products for the creation of a product with high added value, such as Apple Skin™, takes place in the logic of the circular economy. Trentino Alto Adige is the ideal place for this activity, considering that Italian apple production is around 3 million tons (the third in the world after China and Poland) and 70% of this takes place in this region. The problem of disposing of apple scraps (deriving from the production of juices and jams) was deeply felt here. In fact, for a long time, these residues were buried,

creating negative impacts on the ground.

The production of Apple Skin™, in addition to being eco-friendly, also has the merit of helping to reduce the management costs of apple residues from the industrial production of fruit juices. These, in fact, are considered "special waste", which disposal is very expensive. The growth of a recycling-based industry is generating positive repercussions in environmental and employment terms.

#### PA101 - Biobased products from citrus

Sicily, Italy

Italy is the seventh largest citrus producing country in the world, third in the Mediterranean basin, with 3 million tons of citrus fruit produced annually, 50% of which in Sicily. The transformation of Italian citrus fruit generates over 600 thousand tons of by-product (citrus pulp).

Following the results in the extraction of active components from blood oranges, in 1997, the BIONAP company was founded with the aim to produce chemical formulations extracted from cultivated and residual agricultural biomass. These formulations are marketed internationally by industries operating in the field of nutraceuticals, cosmetics and even veterinary medicine.

Since the study of the properties of the blood orange, Bionap has achieved its first success, the "Red Orange Complex": a standardized extract in powder obtained from the juice of three varieties of blood oranges exclusively available in the area around the Etna volcano. Red Orange Complex is used for the formulation of dietetic-nutritional products and anti-aging or after-sun cosmetics.

The agricultural sector plays a double role, both as suppliers of incoming organic matrices and as users of the residues from Bionap's production; They constitute, in fact, an important source of nutrients for the soil. Bionap is committed to improving the agricultural land, therefore, bringing the production residues back to the countryside. Local farmers are primary actors of this short supply chain and constantly involved in the activities of Bionap. The close collaboration between BIONAP and the local farms has led to a significant improvement in the quality of agricultural soils, an increase in biodiversity and an increase in organic production.

#### PA102 - Bioenergy from olive tree residues

Apulia, Italy

FIUSIS starts operating in 2010 as a 1 MWe cogeneration plant that produces about 8 million kWh of electricity and heat through the energy conversion of 10,000 t/year of olive tree pruning. In addition to energy, it produces wood pellets and aims to create an agricultural soil fertilizer from the ashes generated by the plant.

The strength of FIUSIS, which makes it similar to a biorefinery, lies in the fact that it has been able to create a supply chain of biomass perfectly integrated into the territory. To this end, Fiusis offers a free collection and transfer service for pruning from more than 2,000 farms.

This prevents farmers from burning pruning in the field, thus reducing widespread and uncontrolled emissions. From the recovery of the thermal waste of the plant, virgin forest wood is dried to be destined for a line dedicated to the production of high-quality pellets for stoves (1,000 kg/day).

FIUSIS is also activating research aimed at recovering the ashes produced by the combustion of biomass to produce fertilizers according to the law.

To carry out its activities, the FIUSIS plant has created work for about 33 employees, both direct and indirect, in addition to the tangible benefit it generates to farmers (more than 2,000 companies involved) in terms of reducing the management costs of residual biomass. The short supply chain is guaranteed by an agreement already signed with the CIA (Italian farmers' confederation) of Lecce.

The FIUSIS plant, thanks to its technology, has recorded emissions levels well below the authorized limits

in these years of operation. Considering the neutral CO<sub>2</sub> impact of wood, emissions between 4.5 and 8 million kg of fossil CO<sub>2</sub> are avoided every year.

### PA103 - Plant-based Lubricants

Piedmont, Lombardy, Apulia (Italy)

Foundry Alfe Chem has a background of over 30 years of experience in research and development of raw materials and high-performance compounds. The company has created plant-based and biocompatible lubricants in addition to other biobased chemical auxiliaries of vegetable origin in order to offer customers alternatives with less impact on the environment and on the health of operators. The production is divided in two lines mainly:

1. Green Line: lubricants of vegetable origin formulated with bases and additives compatible with the environment, derived from renewable and biodegradable raw materials;
2. Ecofood: line of ecological products compatible with food-hygiene regulations, formulated for the food sector and for other specific uses.

The vegetable raw material originates from: brassica oils, sunflower, tobacco, rapeseed, canola and others. In addition, glycerin, esters and fatty acids from vegetable residues are also used in the process.

Biobased lubricants offer the triple advantage of using renewable raw materials, easily biodegradable and much less toxic than petrochemical ones, both for the environment and for end users.

By measuring the difference in emissions between a bioproduct manufactured in Foundry Alfe Chem and an analogue prepared by the petrochemical industry, a reduction of 30% is observed. Furthermore, the use of vegetable and renewable raw materials leads to a 20% reduction in the cost of production.

### PA104 Biobased resin coatings for sustainable architecture

Apulia, Italy

Pepe&Con created an innovative process to create Mosaic made of sustainable resin films to be applied in building walls. The resin film is perfectly suited to the texture of the wall target, corners or bends, where traditional mosaics could not be supported.

The resin obtained from a mix of raw materials of plant origin mixed with natural minerals, in addition to being biobased, is 100% recyclable.

The collaboration between farmers, architects and construction industry together with the involvement of the public administrations resulted crucial for the success of this business model.

The production of the resins starts from the use of soybean oil, which is currently mainly of foreign origin (USA, Argentina, Brazil, China, etc.). In the future, the company intends to increasingly supply itself with vegetable oils from local agricultural supply chains. As of today, part of the soybean already comes from a farm located in Apulia region.

An important result of Pepe & Con's activity will be a greater use of high-tech bioproducts in the construction sector, creating a close link with sustainable agricultural supply chains.

The company received a total funding of 1.5million from the Apulia Region (INNONETWORK 2017 funds) to carry out the MOSAICOS project "Interactive eco-sustainable mosaics".

In the sector of composite biomaterials, finished products have a high added value and good market outlets because they are economically sustainable. In fact, the chemistry of biopolys is extremely important compared to that of biopolymers because it has as its destination a market niche that guarantees interesting



profits compared to bioplastics for disposable products.

### PA105 - Bio-cosmetic and Bio-detergents from natural products Emilia Romagna, Italy

Valuing the experience of many years in the chemical-pharmaceutical sector and the common passion for environmental sustainability, the founders of Officina Naturae has been able to produce exclusive organic and eco-friendly cosmetics and detergents with an ethical and low-impact production cycle.

*The ingredients* derived from raw materials of plant or mineral origin, exclude petrochemical or animal origin and synthetic substances with harmful action.

*Raw materials* include Brassica oil for detergent surfactants and Quince for functional extracts collected from national and local productions, whenever possible, to favour the short supply chain principle.

Another raw material used in the process is the “Chiuri Butter” which is bought from Nepal through fair trade agreements.

Local organic farmers are also involved in this business model, in particular for the supply of quinces which is used for product lines dedicated to children.

Some of the final products derived from these raw materials include: anti-redness cream for children, body oils (children, mothers); toothpastes, mouthwashes, baby cleansers (shower gel, shampoo, toothpastes); solar; home cleaning (citric acid, fabric softener, laundry, bleaching, stain remover, dishes, rinse aid, dishwasher, descaler, multipurpose detergent, degreaser).

The company has strongly focused on promoting a sustainable production approach and all products are approved by the specification “EcoBioControl”.

### PA106 - Cereal residues for the building sector Apulia, Italy

Prespaglia <sup>TM</sup> is a startup operating in the green building sector. It produces bio-bricks by using cereals straw combined with clay, white cement or hydraulic lime.

Prespaglia has managed to valorize the Cereal Straw that represents one of the by-products more available in Southern Italy, particularly in Apulia Region. By exploitation of Cereal Straw, it developed eco-friendly material for the building sector, which contributes to reducing GHG and improving people's quality life.

The Modular Eco-brick is principally made by using straw, clay and hydraulic lime ensuring highest thermo-acoustic levels of insulation and perspiration for a healthier environment. Eco-Brick is entirely made up of renewable, recyclable and biodegradable materials.

Furthermore, these precast modules, have got interlocking connection structure, able to facilitate their installation.

Cereal farmers might see strengthened their revenues by straw sale, which residues is not more considered waste but as a new high added value resource. During last year, straw supply for eco-bricks was around 10 tons. Prespaglia is demonstrating the relevance of improving sustainable chains in the bio-building sector using residual biomass (straw) from cereal crops, one of the most abundant rural residues not only in Southern Italy but worldwide.

**PA107 - Bio-based colours**
**Marche, Italy**

Spring Color makes products for green building and for the restoration of piece of arts, formulated with natural ingredients without petrochemicals or harmful substances in general. All the ingredients used are listed on the label and data sheet. This procedure, which is not mandatory, is a voluntary choice of Spring Color. The main products are:

- Pigments, obtained from natural lands, oxides and plants
- Binders (adhesives), obtained from milk, eggs, wax, oils, fibers and vegetable gums
- Adjuvants, essential oils, plant extracts
- other important substances are carbonates, sands, cellulose, vegetable solvents.

Spring Color is a pioneer in the green building and conservative restoration sector, where it has collected much success. There are countless interventions made on works of high historical, artistic and architectural value, in Italy and abroad (France, Portugal, Germany, Denmark, Cameroon, Israel, Australia, etc.).

Many of the products are derived from the local agricultural sector such as milk and eggs, linseed oil, beeswax, vegetable resins, Canapulo and vegetable pigments. This approach allowed the Company to start new value chains and establish collaboration with local farmers that provide the raw materials to obtain sustainable and high-quality products.

Spring Color has been a pioneer in orienting the sector towards the conversion from the production of conventional mortars and paints to bio-building products free of petrochemical synthesis substances. In this process, the company suffered the loss of some old customers, but has established itself in sustainable green building becoming a reference company for private individuals, entrepreneurs and researchers active and sensitive to this sector.

**PA108 - Biobased foam from sugar residues**
**Tuscany, Italy - The Netherlands**

BEWiSynbra RAW is a leading producer of Expanded Polystyrene (EPS). In 2009 the company launched the production of BioFoam, a new patented foam that is comparable to Airpop (EPS-expanded polystyrene).

The raw material for BioFoam consists of biopolymers, which are made of vegetable materials (a renewable resource). This makes it the first foam to have an organic base, suitable to be recycled and reused. In addition, it is biodegradable and it can be industrially composted at high temperatures under the influence of moisture and bacteria. BioFoam is durable and is suitable for long-term use in virtually all technical and packaging applications.

The BioFoam® material is already used in a series of productions for the white goods sector, ice cream packaging and the pharmaceutical sector, amongst others.

Besides its own production facilities, Bewi Synbra is setting up a network of pioneering partner companies in the USA, the UK, Italy and in other European countries and is seeking coverage in strategic markets.

Biofoam at the present time is the only alternative to EPS which respect two principles: it uses biobased agriculture residues only (sugarcane); it does not add any synthetic additive or catalysers during all process. Biofoam is totally biodegradable and is approved compostable according to law EN13432.

The material can be applied on numerous applications, is durable and can be used for an extended period of time. It is also applied in moulded parts, in beads (bean bags) and in (contour) cut products. This allows

a wide range of technical products and packaging solutions to be made with unprecedented freedom of design.

### PA109 - Mycelium production for biocontrol agents

Flanders, Belgium

Mycelia is a fungi propagation company, that develops, produces and commercializes mycelium products for different purposes. Mycelia rigorously keeps a large collection of strains. Of these, it produces mother cultures, mother spawn and spawn which are sold all over the world. They produce around 260 fungal species and varieties based on 35 recipes.

The company has already developed at least 10 carriers to grow, preserve and resell fungi, including parasitic fungi like *Beauveria bassiana* and *brognartii*, *Metarhizium anisopliae* and *brunneum* among many others, with some of them capable of eradicating grubs. This works as a biological pest control and was developed under subcontracting for Switzerland.

Next to their core business, they are innovating and performing a lot of research to enter new markets with focus on biocontrol (mycelium as biological pesticide).

The reason why Mycelia sees growing opportunities in this bio control agents' market, is because the use of chemical pesticides and insecticides is continuously becoming more and more restricted, especially in Europe. Using fungi as pest control is environmentally friendly and can be very effective.

At the moment, the production of biocontrol agents is rather limited, mainly due to governmental restrictions. In the R&D department they already have many fungi ready to start producing on a larger scale as soon as the approval process is more accessible. Biocontrol agents bear enormous benefits for more sustainable farming processes and are necessary and crucial for farmers to be able to continue with their food production, as the conventional chemical pesticides and insecticides are becoming less and less available.

### PA110 - Mycelium production for exotic mushroom production

Flanders, Belgium

Mycelia is an international market player in production of mycelium for a large number of exotic cultivable mushrooms. In addition, next to their core business, they are innovating and performing a lot of research to enter new markets; biocontrol (mycelium as biological pesticide), the construction sector (mycelium as building material for high isolation), soil remediation, etc. Fungi could start playing a key-role in the biobased and circular economy! Now it is the time to use their knowledge and expertise to become better known within the biocontrol and bio stimulant sectors.

In fact, Fungi can also be used to remediate contaminated soils, to create new materials such as mycelium leather, to combat plant diseases and to process waste, creating indispensable connections with the circular economy principles. Mycelia has also a school for spawn, sterilised substrate and lignicolous mushroom producers (wood fungi). They offer lab design / individual training courses, substrate group trainings and spawn group trainings. The past 5 years mushroom growers from more than 75 countries have followed individual or group trainings.

The benefit for the farmers was already created a long time ago, as Mycelia made this new market possible on larger scale, as they provide an essential part of the mushroom cultivation.

Next to this, they provide trainings to mushroom growers and other clients, which is quite unique and attracts a lot of international farmers. In the future, if their R&D succeeds in developing new and more biological pest control solutions this will also create benefits for other sectors, such as agriculture and vegetable growers, but also in forestry and nature.

**PA111 - Soil fertilizer from aquaculture residues Norway**

The company HØST was established in 2000 with a public-private ownership. They have become the leading player in Norway within producing fertilizers from biological waste streams. Their annual production is more than 250.000 tons of bio and mineral residues-based growing media and crop-care products. The biofertilizer is rich in phosphorous and carbon. Requirements and regulation concerning fertilizer products in Norwegian agriculture has led to the development of a business model for exportation to especially carbon and phosphorous depleted soil areas in Asian countries, especially Vietnam.

The surplus biomass from aquaculture, sediment from land-based fish farms and smolt plants are collected, processed and recycled in an organic fertilizer production plant. The process includes sanitation through thermal drying of the sludge and marine biomass; a mineral organic fertilizer is produced and blended with other sanitized biomass from other sources (biosolid waste from biogas plants, biodegradable organic waste and industrial biowaste). The mineral organic fertilizer is packed in jumbo bags and shipped to be used in Asia, more specific Vietnam. The agricultural soil in Vietnam is short in organic carbon and lacking phosphorous. The HØST fertilizer has a perfect mix of the organic and inorganic nutrients needed.

The benefit for the fish framers is that they can deliver their fish sludge to a well-functioning value chain that make use of these residues, getting paid 250 NOK pr. ton fish waste delivered at the factory in Mekjarvik.

The company is experiencing an increase in demand for its fertilizer due to change in regulation for the use of bio-based fertilizer in Norway, and the rise of costs of fossil based mineral fertilizers.

**PA112 - Biochar and Active Charcoal Norway**

Standard Bio is a science-led company that creates valuable biochar-based products from bio-waste streams in agriculture and forestry. They capture the carbon and create energy to help farmers produce more effectively while contributing positively to the climate solution by storing carbon in the soils, bringing carbon back to life. With competence and technology, the Standard Bio team of global scientists, engineers, and strategists came together to create state of the art bio-refineries with a proprietary design and technology involving a flameless combustion system and a rotating kiln in order to upcycle bio-waste streams and produce high-quality biochar across the temperature range as well as sustainable renewable energy.

The bio-refineries produce right quality biochar and active-chars as well as sustainable renewable energy from diverse biological sources including waste from bio-slurries, agriculture, production animals, aquaculture, food, forestry, wood and paper factories, mining industries, and more.

Farmers, foresters and industrial players deliver biowaste to Standard Bio pilot facility in Bø. The factory produces biocarbon and biocarbon based products and sell them to farmers, municipalities/park, homegarden market and other end-users.

The final outputs are new, high quality biochar and active charcoal, that may be used as climate gas mitigation measures, animal feed supplements, soil fertilizer and soil remediation actions, and which products hold a high commercial potential.

Together with own employees, the company also works with universities, research institutes and private companies in order to develop, test and verify their products, processes and solutions.

**PA113 - Beeswax tissue**
**Niederösterreich, Waidhofen/Ybbs, Austria**

Earlier generations have used cloths soaked with beeswax to store food. Beeofix was developed to actively contribute to reducing waste and creating an environmentally friendly, resource-saving alternative to plastic and aluminium foils.

Beeofix is handmade from upcycled cotton fabrics, regional organic beeswax, regional organic sunflower oil and tree resin from Lower Austria.

The fabrics are impregnated with organic beeswax, organic sunflower oil and tree resin to give them the desirable and practical properties of other cling films.

This special mixture also allows the beeswax cloths to "breathe".

The product has already reached the commercialisation phase and the whole value chain sees the involvement of the following actors:

- Farmers (Beekeepers):

Providing beeswax from organic beekeeping. The excess wax is used, which is not needed in the in-house wax circuit

- Recycling industry:

The tissues are made by hand from OEKO-TEX 100 certified residual stocks from a traditional Austrian textile company. These fabrics are actually produced in Austria and would otherwise no longer find a market.

- Manufacturing company:

Making the product

- Retailers:

Selling the product. Most of them are having the focus on the market segments for organic products

Beeswax from organic production achieves a 30 to 40% higher price than wax from conventional beekeeping. Furthermore, in organic beekeeping, natural comb construction (at least 10%) is preferred, which results also in a higher yield of beeswax (but less honey) at the end of the season. Selling the wax in this case equilibrates the beekeeper's income.

**PA114 - Eco-razors**
**Vienna, Austria**

Currently, around 5 billion disposable razors are used and disposed in household waste worldwide every year. This means that up to 100,000 tons of different types of plastic are produced, processed and eventually incinerated. ecoSHAVE is the first sustainable disposable razor and saves up to 75% plastic compared to standard disposable razors. This meets a growing demand of customers for environmentally friendly products.

Together with partners, the company has managed to develop a unique manufacturing process for disposable razors in 18 months. With a high-tech raw material, the company has succeeded in replacing a large part of the plastic in disposable razors with wood residues from sustainable forestry. This keeps the price for the consumer the same. The ECO razor can even be disposed in household waste and significantly reduces CO2 emissions.

The product is already available in the market. A large part of the plastic in the disposable razor is replaced by wood residues from sustainable forestry. The wood fibres come from certified, renewable wood resources and are a by-product of paper production. The new compound material reduces the plastic com-

ponent by 75%.

One of the main benefits for foresters is that wood is one of the main resources for the biobased industry. The more the demand, the better are also the prices, especially for wood from sustainable forestry. Since the prices have been volatile in the last decade (with a variability of +/- 10%), a steady demand can contribute to better prices and thus to an appropriate income for the farmers.

### PA115 Felt and wool shoes

### Tirol, Brixlegg, Austria

Giesswein is Europe's largest producer of 100% virgin wool clothing. The main products are shoes, apparel and blankets. The company treats wool fabrics differently than other companies, focusing specifically on treatment of wool and sustainable wool use. This creates unique fabrics made of 100% merino-wool.

The processing of wool takes a lot of time than the production of conventional textiles. This process is more complex, but you get a much more functional product.

To produce the Merino wool end product, high-quality virgin wool from the Merino sheep is used. In contrast to normal sheep's wool, Merino wool's fibers are much finer—in fact, they're only half as thick.

These products absorb and can carry away more moisture - and can keep you warmer - than other wool. In the footwear industry, 20% of cut material is pure waste and is lost forever. We've found a new way to process our wool while producing 0% waste.

The company is buying only wool from certified mulesing-free sheep. This alternative do, however, present significant time and financial burdens to farmers. Yet, the company is paying better prices for wool from non-mulesing, which allows them to produce in a non-harmful way, without having the disadvantages of less income.

The main drivers for a successful development of this business model are, on one hand, the constant company-internal research regarding wool processing, and, on the other hand a growing demand for natural materials in footwear.

### PA116 Organoid Technologies

### Tirol, Fliess - Austria

The idea for Organoid Technologies started around ten years ago during the process of developing inflatable directional gates for the Red Bull Air Race.

The process entailed this "inflatable" know-how to produce "freely formed" elements from natural fibres such as wood chips, reed or straw.

An important impulse was the successful application for a PreeSeed funding and later a Seed funding by the Austria Wirtschaftsservice GmbH.

The original idea is to use the patented process to design large areas, from carports to buildings, everything would be possible.

The platform technology has now developed into a very successful business segment, with fragrant surfaces made of many different natural materials such as rosebuds, lavender stems or cornflower blossoms. Around 500 different raw materials are now available for processing.

Farming in high alpine regions is very different from farming in flat lands. It is not only focussed on food (mainly dairy) production, but has also a function of landscape protection from natural dangers. The supply of an industry with high herbal flower contents is creating a new income branch for the farms, since dairy prices are steadily lowering. This stabilizes the viability of alpine farming.

Several factors contributed to the success of this business model such as the participation in the "founders' competition adventure X", preparation of a patent application, support for the foundation of a company by CAST - Center of Academic Spin-offs Tyrol, successful application for a PreeSeed grant and later a Seed

grant by Austria Wirtschaftsservice GmbH, as well as elaboration of business areas that can be marketed faster than the original idea.

**PA117 Natural colouring**
**Burgenland, Güssing, Austria**

Vulcolor attends to the increasing demand for natural colourings in the foodstuffs industry and produces extracts, organic fruit juice concentrates and natural fruit juice concentrates from berry fruits (mainly elderberry - sambucus nigra).

The main products are fruit juice concentrates and colouring extracts. Vulcolor fruit juice concentrates and colouring extracts contain the natural red colouring substance of berry fruits. In the production of concentrates, the natural water content of the fruit juice is extracted through vaporisation. The Brix content of the concentrate varies according to the quantity to be extracted.

The production process also produces a large quantity of elderberry pomace, which was initially treated as waste, but in the course of time has been recognised as a valuable raw material for the food industry, but above all for the cosmetics industry, which oil, extracted from the kernels, is used in skin care products.

A further product is a material for juice fining, which is a registered soil additive for organic farming.

Farmers are having the security, that their product is bought by a strong company at a good price. Furthermore, there is an advantage in logistics, since the company is located in the centre of the largest elderberry area in Europe.

Critical to the successful of this practice is the location of the company and of the production plant, which are located in the centre of the largest elderberry area in Europe and make transport distances short. Furthermore, there is a demand for the residues of the elderberry, which was considered as a waste before and now a resource for the current industries.

**PA118 Stone pine products**
**Tirol and Wattens, Austria**

The business model focusses on the production and retail of stone pine articles. This includes the full exploitation of all side stream resources (including wood shavings, sawdust and pine oil in combination with other materials like glass, textiles or semi-precious gems) as well as on individualizing the products in design.

Up to a few years ago, the main application for stone pine wood was in the furniture industry and for sauna construction. In some regions of the alps it was also used for construction and roofing.

A part of the innovation lies in the extension of utilization to the wellness sector. Stone pine wood is used for decoration objects with the specific aroma, to which also the distilled oil can be added, but also as fillings for pillows and seat rests.

All parts of the tree can be used and the waste from wood processing has become a valuable resource for providing other products.

The stock of Swiss stone pine that is stocking up in the Tyrolean productive forest has a volume of about 2.6 million cubic metres. A sustainable harvest of the wood does not endanger this valuable resource. On the contrary, old forest stands can be rejuvenated through the correct use of this tree species. This is valuable and desirable for protective reasons. The mixture of old and young forest areas with thick and thin trees is more stable against the various influences of nature.

New products create also more demand for the stone pine and thus are mobilizing unused stocks, leading to better income for farmers and forestry communities.

**PA119 - Hemp Cluster**
**NOVI SAD, Serbia**

Cluster "HEMP" was founded in 2015 year. Its main purpose is breeding industrial hemp - unfairly neglected plant species in Vojvodina region. The number of interested farmers in breeding industrial hemp is increasing permanently. The initiative is contributing to raise the competitiveness of the farmers and helping to the preservation of ecological stability, job creation and investment in agriculture. Hemp cultivation is also fostering modern production of industrial hemp every day to find new use of these versatile plant, so far over 20,000 products.

The business model sees the cooperation of farmers and other specialists interested in hemp growth and production of articles from it. Their efforts are united by the cluster Konoplja (Hemp) and represent the interests of all its members.

Cultivating hemp preserves nature, enrich the air, and produce large amounts of green mass for food, fibre and products for other purposes.

On the other hand, the intensification of growing industrial hemp is requiring the development of larger processing capacities.

The benefit for farmer is expanding the list of plant growing opportunities. Farmers have the possibility to substitute highly distributed plants with new ones and to use set aside land for its production.

**PA120 Phytotherapy from herbal products**

**Sofia, Pazardzhik, Rhodope mountains - Bulgaria**

Tomil Herb Ltd. was created for the production of herbal tablets following the recipes of his predecessors who were engaged with herbs and medicinal plants for more than 120 years.

This business model allows to use Bulgarian natural plants and medicine herbs as a basis for the production of pharmaceutical products.

The company produces over 50 herbal products, each of them with strong curative effect for treating different diseases. The company has its own factory in Pazardzhik, Bulgaria, equipped with the most modern European machines and packing lines.

The automated production cycle and the best herbs of Bulgaria allow Tomil Herb Ltd. to offer products with sustainable high quality for 15 years already. The products result in strong curative effect and no undesired side effects.

Farmers produce, collect, and sell the plants to the processing industry. This value chain is expanding their list of plant growing opportunities; Farmers have got the possibility to substitute highly distributed plants with new ones and to use set aside land for its production.

Highly specialised staff works in the factory of Pazardzhik, equipped with the most modern European machines and packing lines in the pharmaceutical industry. The storage and transportation are performed by the producer. Most important factors are both the geographical position of Bulgaria, assuring abundance of natural plants with strongly manifested medicinal properties, and the experience of the ethnic medicine in healing with herbs.

**PA121 Eco-friendly coffee cups**

**Plovdiv, Bulgaria**

Cupffee is an Eco-friendly type of coffee cup created by the Bulgarian startup in 2010. It is made from natural grains which makes it consumable. It can be used for both hot and cold drinks. Cupffee is a combination of a cup and food and the product is reaching more and more countries. It is available in different



cup sizes and stirrers as well and preserve best its properties before 6 months from the date of production.

The production of Cupffee is patented and received copyright in 2015. The innovation in the process is that it offers an alternative usage of grain and grain residues. Cupffee company got both the patent and copyright in 2015.

From this business model farmers reached a new market for their production. In fact, besides coffee grains Cupffee is also using bran as a raw material. The rising market for Cupffee means rising market for farmers' production, too.

Added value of Cupffee production includes not only new opportunities such as new type of market segments, but also benefits for the environment.

Cupffee has a clear environmentally-friendly content – less harmful plastic waste, less CO2 emissions. The product includes specific properties – it is edible and after drinking your coffee you can eat the cup. The complete breakup of the cup takes 20 hours.

### PA122 Biobased clothing

### Jyväskylä, Finland

Spinnova textile products are produced using cellulosic fibres from Agri-waste streams and FSC certified wood. The wood or agri-cellulose waste streams such as straw comes into the process as a pulp, which is then mechanically refined into a fine paste-like-material called micro fibrillated cellulose (MFC). This ultra-fine pulp then flows through Spinnova's unique nozzle which rotates and aligns the fibres and fibrils with the flow to create an elastic durable fibre network.

Spinnova collaborates with textile industry brands by supplying their unique cellulose fibres to these brands to produce textiles. As such these fibres act as a supplement/replacement to cotton fibres in the production of textiles. With both mixed organic cotton and Spinnova fibre products.

Using this raw material in the production of fibres allows farmers to free land and water from the need to grow cotton, thereby increasing their ability to produce other high value crops to sell, including food crops which also increases the food security of their region.

The 100% biodegradable and non-toxic nature of Spinnova's brand partner's textile products mean they can be composted once they reach their end of life, and could in the future through the expansion of this value chain be returned to farmer's soils as a soil enhancer. This adds a use and thereby higher value for agri-waste biomass streams such as stubble, straw, horticultural wastes and other crop and biomass residues.

This value chain provides a sustainable and guaranteed use for farmer's straw, thereby providing an additional secure income stream in addition to the main crop, creating a circular system and allowing greater utilisation of the straw.

### PA123 Biobased Building Materials

### Cambridge region, UK

Cambond offers a radical solution which consist of a low-nontoxic adhesive that can be used in the construction of wood panelling as well as to produce biomass composites for both construction and packaging. Cambond is made from protein containing biomass such as DDGS (distillation by-products) and algae. As such Cambond wood panels or Cambond based composites are entirely comprised of biomass and thus recycling of waste is both easy, entire, and theoretically limitless.

The resin is the result of the extraction of proteins and fats from biomass waste streams with a high protein content. They have continued to develop both this resin adhesive and a wide variety of possible commer-

cial uses.

Cambond resin is made from distillers' grain and/or algae. The use of distiller's grain for a higher valued purpose if upscaled would provide a secondary income to distilleries from the sale of spent grain, thereby increasing their demand for malting grains to distil alcohol from. This would then have the effect of raising the price for malting grains such as high-quality barley, increasing the profit for farmers producing these crops.

The development and production of Cambond resin-based composites provides an additional market for agricultural co- and by-products such as cereal straw to produce these composites. The wide variety of biomass which can be used, and the large potential market could lead to a significant increase in the value of these secondary biomasses (e.g. straw, hemp etc)

The entirely biobased characteristics of Cambond based products allows for a circular economy of their products through recycling of spent panels and packaging to produce new panels and packaging.

### PA124 Eco-friendly egg tray

### Uden, The Netherlands

One2Born decided to develop a sustainable, safe egg tray for 50 eggs that is made of corn gluten, and that holds special patented properties, which helps chicks to safely hatch at the farm instead off the hatchery. Hatching chicks have direct access to feed and water.

The innovation is an egg tray, made of corn gluten (a residue product of compound feed production) and reinforced with residue bamboo fibers (a residue of other bamboo applications). The egg tray is a sustainable and affordable replacement for the traditional recycled paper egg tray. The egg tray is edible and biodegradable in the stable once the chicks have hatched. It measures 10x5 eggs, is fully compatible with all hatchery systems, truck trolleys and every henhouse.

The innovation is two folded: 1) One2Born will use biobased materials (bamboo fibers and corn gluten) for the production of the egg trays. 2)The egg tray is specifically designed to safely transport the incubated eggs and hatch the eggs in the stable.

The businesses involved in the value chain are poultry hatching firms, that raise broilers and laying hens. The benefits for them include:

- Lower mortality rates in day-old chicks due to hatching of chicks in the stable instead of transporting live chicks;
- Reduction of costs for hatcheries and same costs throughout the supply chain for hatching eggs, thus disrupting the hatching part of the value chain;
- Decrease in the use of antibiotics;
- Better feed conversion, daily gain;
- Higher profits;
- Increased employee welfare due to better results in chick hatching.

This leads to cost savings of up to €6 ct. per chick, also due to health advantages of chicks hatching in the stable.

### PA125 Paper bags from agricultural waste

### Kampala, Uganda

Excessive use of plastic packaging and bags and their insufficient disposal causes increasing pollution of the surface of continents and the world's oceans. At the same time, the problem of using waste from agricultural production is growing. The example from Uganda shows the possibilities of using agricultural

waste for the handmade production of paper bags, which can be a great alternative to environmentally-hazardous polyethylene bags.

Wastes from primary agricultural production, such as banana or pineapple residues, cotton waste and other farming residues are collected and bought from local farmers. This waste is further processed at the incubation center of the Uganda Industrial Research Institute (UIRI), where handmade paper is produced from the waste. It is then used to produce end products, such as eco-bags, various types of cards, decorative papers, etc.

Local farmer groups provide raw materials and benefit from skills training and outreach programmes.

Oribags Innovations Ltd. is responsible for waste collection, processing and marketing the products, while Uganda Industrial Research Institute provides processing facilities and technical support as well as marketing support. A special contribution to this business model is given by the Uganda Women Entrepreneurs Association, which supports the initiative in terms of networking, mentoring and entrepreneurship training.

In addition to producing eco-friendly paper bags as an alternative to the environmentally hazardous polythene bags, this practice is creating employment for the local communities in the production facilities, empowering women and youth through training in paper making, jewellery manufacturing and entrepreneurship skills.

**PA126 Briquettes made from agricultural wastes**

**Kampala, Uganda**

Kampala Jellitone Suppliers (KJS) is coffee processor that uses firewood stoves. This has led to the need to look for different fuel sources. One of the possibilities was the production of non-carbonated fuel briquettes made from waste.

The processing of commercial crops produces large amounts of biomass residues, including rice and peanut husks, coffee pulp and corn stalks. KJS started to transform this waste into clean fuel.

The company buy agricultural waste from farmers such as rice, wheat, g-nut husks, coffee husks, etc, and process them to obtain fuel biomass briquettes for cooking, baking and roasting as an alternative to firewood and charcoal. This technology reduces deforestation and thus saves the environment. KJS performed various experiments with the production and use of fuel briquettes.

Local farmers provide raw materials and benefit from skills training and outreach programmes. In addition, they can valorise waste from primary production.

This practice is contributing to reduce deforestation, using the residue-based briquettes instead of fuelwood and charcoal and which saves about 6.1 tonnes of CO<sub>2</sub> per tonne of briquettes used, or 9,300 tonnes/year CO<sub>2</sub>. The briquettes are clean, easy to handle and reduce cooking time.

**PA127 - Biocomposite materials for packaging**

**Helsinki, Finland**

Sulapac® provides sustainable biocomposite materials designed to replace conventional plastics in a variety of applications including luxury packaging and food contact products.

The products are bio-based and recyclable via industrial composting. The materials are processable with existing plastic product machinery, making sustainability an easy choice. The current recipes are based on wood chips and biodegradable binders. The wood ingredient comes from wood industry's processing side streams, wood chips and wood flour, which are turned into valuable end-products. Global bioplastic packaging market is projected to be valued at € 30.2 billion in the next few years, and this is only one application range, in which Sulapac materials can be adopted.

The Sulapac portfolio also includes ready-made products, such as premium packaging for the cosmetic industry and a drinking straw.

Sulapac supports its customers throughout the customer journey, from material selection and technical support to go-to-market activities.

Stora Enso (licensor and partner) - develops and produces solutions based on wood and biomass for a range of industries and applications worldwide, leading in the bioeconomy and supporting customers in meeting demand for renewable eco-friendly products.

### **PA128 Woodcast - Revolutionising Orthosis**

**Lohja; Finland**

Woodcast is a fabric-like material made from woodchips and biodegradable polymer. It is used to splint injured bodyparts, as a substitute for castings.

Casting can be done with your bare hands and without masks, ventilation hoods or water baths.

The chips used in Woodcast are mainly from Finnish aspen and these must be certified for medical purposes.

The fabric is produced by fine-chipping the wood. Then the chip mass is heated up, spores from cryptogams are removed and it is combined with bioplastic. Woodcast is produced in one, two or four millimetres thicknesses and it is used in hobbies crafting as well.

Woodcast can be burned to bioenergy after use, or it can be disposed of as compostable waste.

Woodcast's plastic components are listed in the European Directive 2002/72/EC for plastic materials and articles intended to come into contact with foodstuffs.

The safety of all Woodcast products has been tested in accordance with ISO 10993, the standard criterion for evaluating the biocompatibility of medical devices.

### **PA129 Mycelium bio-composites in industrial design**

**Galilee, Israel**

Recent convergence of biotechnological and design tools has stimulated an emergence of new design practices utilizing natural mechanisms to programme matter in a bottom-up approach. In this project, the fibrous network of mycelium - the vegetative part of fungi - is employed to produce sustainable alternatives for synthetic foams as board materials for buildings.

The use of mushroom mycelium as a "glue" to combine wood waste for producing bio-composites is unique, depicting a clear effect on material density, water absorbency, and the compressive strength of the final bio-composite. The new composite material is biodegradable. It will be used as replacement to synthetic materials that are not degradable and cause waste problems.

The use of mushroom mycelium can combine the cellulosic materials of the wood waste and therefore the final product will be commercial. It can solve waste disposal and benefit farmers and forest owners by using waste to a commercial product.

For the bio-composite sector, it will produce a product that is cheaper and can be used in the market. It demonstrates implications for mycelium-based composites for circular design and architectural applications. It shows that in order to produce desirable designs and performance within an inclusive circular approach, parameters such as material composition and fabrication conditions should be considered according to the target function of the final product throughout the design process.

### **PA130 Biobased products from viticulture residues - Savoie Mont Blanc region, France**

The VITIVALO project aims to recycle viticultural waste and viticultural nurseries on the Savoie Mont Blanc territory in order to offer an alternative to the practice of burning it in the open air. This project, launched in June 2017, is directly linked to a national environmental issue of air quality and agricultural waste management.

The first beneficiaries of this project will be wine professionals and wine nurseries, thanks to the creation of new ways of recovering their waste that they can no longer burn in the open air. The development of new practices in their activities, more in line with the environmental expectations of citizens, also allow them to communicate on this aspect.

Waste management and recovery companies are also very involved in the project, particularly for the collection and transport of this waste. The logistical organization that will be put in place will be part of the industry's economic model.

Finally, exchanges with several cosmetic and nutraceutical companies were established to develop the activity. Indeed, the challenge was to have local businesses to limit transport with an economic and environmental impact in the sector.

The VITIVALO project involves a number of important partners, making it possible to ensure the medium-term development of a real sector of territory, which associates the upstream (viticulturalists and nurserymen viticultural via their professional unions, French Institute of Vine and Wine), with downstream (cosmetics and nutraceutical companies which have shown a strong interest in these bio-based molecules).

#### **PA131 Biobased coffee capsule**

#### **Ladbergen, Austria**

HOMEcap coffee capsule consists of the innovative material “Golden Compound green” made of sunflower seed hulls, a mineral filler and BioPBS™. The hulls of sunflower seeds are a waste product from the extraction of sunflower seeds, while BioPBS™ is a starch-based and biodegradable plastic. The innovative HOMEcap product, consists of the “Golden Compound green” capsule and an environmentally friendly cellulose-based lid that needs no additional glue for sealing the capsule. Extra barrier packaging is unnecessary due to excellent oxygen transmission rates of the overall material composition, thus saving further waste. The whole product completely degrades on the home compost within 12 months.

Starch (sugar polymer) from corn plants is used in the production of BioPBS™. Given the ready availability of corn in terms of production and processing in Europe, its sugar molecules are used as raw material. The valuable proteins of the plant are not used and can be further processed, for example as animal feed. Hence, there is no conflict with the food industry and a double income for corn producers is generated.

Other farmers can specialise in or complement their production (processes) with sunflower seeds and providing opportunities for business diversification.

A critical factor for the success of this practice is the geographical position, as production of sunflower seeds in Europe is high (9.9 million tonnes), there are less costs concerning the import/transport and logistic of the biomass feedstock.

#### **PA132 Biobased products from tree's fungus**

#### **Romania and Germany**

ZVNDER develops innovative products from a tree fungus. The fibres of the mushroom were originally used as "tinder" for lighting fires. Later in the 18<sup>th</sup> century, the velvety material weave was used for tex-

tiles and wound dressings. Today the craft is almost extinct, but the fabric is still produced in Transylvania, Romania.

The tree fungus – “Fomes Fomentarius” is a parasite, a decomposer and a well-known plant. It grows on weakened deciduous trees and decomposes their wood components. ZVNDER produces vegan materials and textiles from this raw material with modern technologies and the inclusion of traditional processing methods.

The material is procured in Romanian Transylvania, a region with large forest areas and a high occurrence of scale sponges. Accordingly, tinder sponge processing has been practiced for generations and ZVNDER relies on the many years of knowledge and the unique qualitative processing of the family businesses based there. The local foresters harvest the fungi manually and dry it for up to one year. It is then peeled and further processed by hand. The trees on which the fungi grow for up to thirty years are also cared for to ensure a successful harvest for a long period of time. No chemicals are used in the entire production process. Each business cannot deliver more than 20kg of weave per year, so there are natural limits to business growth.

The businesses receive certificates for collecting the tree fungus. As a result, the fruiting bodies of the mushrooms can be harvested with care and species conservation can be ensured. In addition, the residues generated during processing are used, for example, as smoked goods in beekeeping.

## 2 Annexes

### Annex 1: Template for the Enabling’s practices

<b>Format for best practice collection</b>	
<b>Defining the Background context:</b>	
<b>Why have you developed this practice/process?</b>	
<b>What have been the reasons that prompted, led or encouraged the realisation of the business model, process or activity?</b>	
<b>Short summary of the practice:</b>	
<b>Description of the process, activity or business model.</b>	
<b>Region(s) involved</b>	
<b>List the main actors involved and what activities they cover, or have covered, in the practice or business model.</b>	
<b>In what phase is the innovation? (What is the Technology Readiness Level? See Figure 2 in the handbook).</b>	
<b>What is innovative in the process?</b>	
<b>How has it been developed?</b>	
<b>What is the expected or final outcomes of the activity?</b>	
<b>What is the benefit for the famers involved in the value chain? How is this value created?</b>	
<b>What is the benefit/added value for the biobased product companies involved in the value chain? How is this value</b>	

<p><b>created?</b></p>	
<p><b>What is the benefit/added value for other practioners or end-users involved in the value chain (retail, logistics, service markets, consumers)? How is this value created?</b></p>	
<p><b>Identify and describe other factors that have made possible, or can make possible, a successful realisation of the practice/activity.</b></p>	

**Annex 2:** Practice Abstract Template

<p><b>Practice "abstract" 40:</b></p>	<p><i>Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.</i></p>
<p><b>Short title in English</b> ( 0-150 characters)</p>	
<p><b>Short summary for practitioners in english</b> on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). <i>Do not complete if the summary below is completed in English</i></p> <p>This summary should at least contain the following information:</p> <ul style="list-style-type: none"> <li>- Main <b>results/outcomes</b> of the activity (expected or final)</li> <li>- The <b>main practical recommendation(s)</b>: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?</li> </ul> <p>This summary should be as interesting as possible for farmers/end-users, using <u>a direct and easy understandable language</u> and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.</p>	
<p><b>Short title in native language</b> ( 0-150 characters)</p>	
<p><b>Short summary for practitioners in native language</b> (<i>can be the language of the coordinator / one of the partners - otherwise in English</i>) (1000-1500 characters, word count – no spaces).</p> <p>This summary should at least contain the following information:</p> <ul style="list-style-type: none"> <li>- Main <b>results/outcomes</b> of the activity (expected or final)</li> <li>- The <b>main practical recommendation(s)</b>: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?</li> </ul> <p>This summary should be as interesting as possible for farmers/end-users, using <u>a direct and easy understandable language</u> and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.</p>	