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Bioeconomy in rural areas



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**BE-Rural: Bio-based pop-up store
in Poland**

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Bio-based strategies and roadmaps for enhanced rural and regional development in the EU (The BE-Rural Project)

European regions are diverse – economically, ecologically and culturally. These areas are home to a wealth of ecosystems and resources, where the bioeconomy carries the promise of opportunities for rural employment and sustainable growth.

This transition towards a new, bio-based regional economy requires the active involvement of a broad spectrum of stakeholders and the sustainable use of agricultural, forest and marine ecosystems. Building on this idea, BE-Rural will explore the potential of regional and local bio-based economies and support the development of bioeconomy strategies, roadmaps and business models. The bio-based pop-up stores are organised to accompany these activities and to show that bioeconomy is not just an abstract concept, but already part of our everyday life.

Burger



Enjoy your food with insects

In recent years, several insect-based foods, such as insect burgers have entered the market. With a high protein content, unsaturated fats as well as a drastically reduced resource consumption in comparison to conventional beef, insect burgers are a healthy and sustainable alternative. Growing insects produces up to 100 times less greenhouse gas emissions and uses 10 times less feed compared to beef production. The burger displayed in the bio-based pop-up store is made of buffalo worms.



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Pasta



High protein pasta

This macaroni shaped pasta is made of three ingredients: buffalo worm powder, durum wheat and eggs. Thanks to the buffalo worm, which are beetle larvae, this pasta composes of 18,7 percent natural protein and nutrients such as iron, b-vitamins, fibre and essential fatty acids. Also available from the same company: barbecue-flavoured mealworms, curry-flavoured grasshoppers or cereal bars made from crickets.



Countries: **Germany, Netherlands, others**

Country: **France**

1

2

Crackers

2 ZERO
GLADD



Crunchy mealworm snacks

Edible insects are a rapidly growing new protein source on the market. These crackers are made of whole mealworms (10 percent), which are naturally high in complete protein and other nutrients such as iron, calcium, several vitamins and fibre. The mealworms are fed exclusively with ingredients from organic farming. Additionally, all other ingredients – such as the sesame seeds or oatmeal – are farmed organically.



Country: **France**

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Snack

2 ZERO
GLADD



Chocolate snack with crickets

Edible insects are increasingly capturing the mainstream market. Dried house crickets – which are the bioeconomy ingredients in these milk chocolate snacks – have high quality proteins and nutrients such as iron, calcium, vitamins A, E, B, essential fatty acids and more.



Country: **Germany**

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Mayo and ketchup



Vegan mayo and ketchup

These vegan treats are made from vegetables that would have been discarded otherwise. A UK company has made it its mission to save crops that supermarkets reject based on their appearance – providing a practical solution to food waste. The vegan mayo is made with aquafaba as a substitute for eggs. Aquafaba is the protein-rich water left over from cooking chickpeas and would normally be thrown away.

Country: **United Kingdom**

2 ZERO
GOOD



Beer



From bread to beer

Two million tons of baked goods end up in the garbage every year, although they are still perfectly edible. This beer saves bread from the bin. The start-up producing this beer uses bread – mostly sourdough bread – to replace the malt. 700 litres of beer equal about 2000 slices of “saved” bread. Currently, the beer is only produced small-scale and regionally available. The inventors of this beer have already received several prizes for their innovation.

Country: **Germany**

2 ZERO
GOOD



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Ice cream



Plant based ice-cream with lupine proteins

Lupines are green multi-talents. As nitrogen fixers they are great fertilisers for soils. In addition, their seeds are rich in protein, which is why they have come to the attention of food manufacturers as an alternative source of protein. Lupine seeds are usually very bitter-tasting due to their high alkaloid content, which is why blue sweet lupines came into play. In contrast to other types of lupine, they have a low content of bitter-tasting alkaloids. First, the lupine seeds are peeled and processed into paper-thin flakes. The flakes are then de-oiled and unwanted aromas are extracted. Finally, the proteins get extracted. The dairy-free product contains neither lactose nor gluten and is suitable for allergy sufferers.



Country: **Austria**

Spoon



Cutlery from cocoa shell

The fibres of the cocoa shell form the basis of this ice cream spoon. They accrue as residues in the food processing and are usually discarded as waste. In the spoon they ensure the stability and add a chocolate taste. The spoon is on the market since April 2019 – since then the product has succeeded to replace almost 1 million plastic ice cream spoons.



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Country: **Germany**



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Gasoline from straw



Producing gasoline from straw

Biofuels such as bioethanol are derived from renewable raw materials. Oftentimes, sugars from arable crops have been used for biofuel production. To avoid competition with food production, residual materials such as straws have come to the attention of several biofuel manufacturers. Straw or wood is largely composed of lignocellulose fibres, which has a high potential for energy conversion. With the help of enzymes, the lignocellulose is decomposed and recovered from plant fibre into its individual components. The resulting sugar molecules serve as food for yeast and are fermented by fungi into alcohol. This can then be added to premium petrol for petrol engines.

Country: **everywhere**



Rust remover



Eliminating rust with bacteria

Rust is simply atoms of iron which have reacted with oxygen. In nature, there is a mechanism to eliminate rust. Some bacteria are able to metabolise iron. In order to obtain this important element, the bacteria produce siderophores, molecules that trap iron atoms and incorporate them into their structure. Siderophores from the bacteria species *Streptomyces olivaceus* are used in this biodegradable rust remover. Instead of using concentrated inorganic acids, iron parts can be derusted in an environmentally friendly way

Country: **Germany**



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Detergent

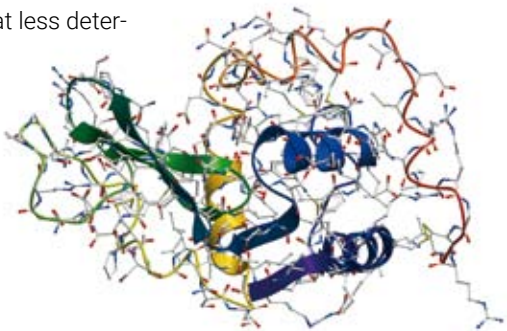
9 INNOWACYJNOŚĆ,
PRZEMYSŁ,
INFRASTRUKTURA



Cleaning with the power of enzymes

Manufacturers of cleaning products such as detergents have been using the power of enzymes for many years.

The biocatalysts accelerate biological processes and are active even at low temperatures. There are several classes of enzymes. Some remove dirt particles, while others work by preventing the fabrics from pilling. The use of enzymes means that less detergent and energy are required. Enzymes for cleaning products and detergents have the biggest market share of industrial enzymes.



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Country: **Belgium**

Packaging

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PRZEMYSŁ,
INFRASTRUKTURA



Mushroom packaging

This mushroom packaging is made from mycelium – the vegetative root structure of a mushroom – and agricultural waste. Growth trays are filled with a mix of substrate (agricultural waste), nutrition (flour), and mycelium. The mixture is then sealed to grow for 6 days. The mycelium acts as the “glue” to bind the agricultural waste. The final stage is to dry the parts to prevent future growth. In contrast to conventional foams this packaging is 100 percent home compostable. The material can also be used to create furniture.



Country: **United States of America**

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Brick



Fibres from root vegetables

Curran – which is Gaelic for carrot – is a material made from nanocellulose fibres of root vegetables. It can be used for different applications such as paints, coatings or even cosmetics. Its raw material base is waste streams produced by the food industry. Because the discarded products such as carrots or sugar beets would otherwise be thrown away, there is no direct competition with food crops for scarce land. The manufacturing of Curran leads to a lower carbon footprint, as it uses vegetable waste and less water, requires fewer chemicals and does not emit toxic gases. While the exact method of production is secret, nanofibres are extracted from the vegetables and then combined with high-tech resins. The paste can be moulded into different shapes.

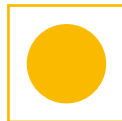


Country: **Scotland**

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INFRASTRUKTURA



Football



A partly bio-based ball

This ball was the official football of the World Cup 2018 and contains Keltan Eco, a bio-based ethylene-propylene-diene monomer (EPDM) rubber. The rubber is the basis for a sponge rubber layer underneath the ball's outer cover. It serves as a mouldable cushion for the ball. It is the world's first EPDM rubber manufactured using bio-based ethylene extracted from sugarcane.



Country: **Germany**

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Brick

9 INNOWACYJNOŚĆ,
PRZEMYSŁ,
INFRASTRUKTURA



Growing a brick

What about saving CO2 emissions by 'growing' a brick instead of firing it! After all, the cement industry accounts for approximately 8 % of global carbon dioxide emissions. An American company employs bacteria to 'grow' a durable cement. At the start of the procedure, sand is packed into rectangular moulds. Afterwards, bacteria (*Sporosarcina pasteurii*) are added, which wrap themselves around the grains of sand. Calcium carbonate crystals begin to form around the grains while an irrigation system feeds nutrient-rich water. The crystals grow larger and after three to five days, they are ready for use. This process was inspired by corals, which grow in all kind of formations and can withstand water and erosion.

Country: **United States of America**

Smartphone

9 INNOWACYJNOŚĆ,
PRZEMYSŁ,
INFRASTRUKTURA



A screen made from sugar

This smartphone has a bio-based plastic smartphone display made from plant-derived isosorbide, which is produced from sugar. The material shows a higher resistance to impact, heat and weather than conventional plastics. The new bioplastic can be used as an industrial material for applications including automobile sunroofs, headlights, transparent highway noise barriers, and exteriors of electronics such as smartphones.

Country: **Japan**



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Shirt



Clothes from wood

Cellulose is a common basis for textile fibres and mainly derives from cotton. But cellulose can also be gained from other raw materials such as wood. The conventional process to obtain wood cellulose fibres – so called viscose fibres – is very chemical intensive. Lyocell is the environment friendly alternative. The wood stems from sustainably managed forests and plantations. The special feature of the production of Lyocell is the almost complete recycling of the solvent used to extract the wood cellulose. Besides the renewable raw materials base, no harmful chemicals are used during the production process.



Country: **Austria**

Charcoal



Coal from olive pomace

For these Greek briquettes, olive pomace – kernels, skins and residues are collected during the industrial production of olive oil. They are first completely pressed out, charred like wood, then mixed with water and natural starch and brought into briquette form. These briquettes ignite quickly, burn for a long time and maintain the heat for hours. They are odourless and have little smoke development.



Country: **Greece**

Scarf



Textiles based on citrus residues

An Italian start-up follows the vision to turn orange and citrus waste into sustainable fabrics. In Italy alone, about 700,000 tonnes of waste materials from citrus production accrue every year. To use this waste, the citrus cellulose is extracted from the so-called "pastazzo", the citrus juice by-product. The result is a polymer apt to be spun and turned into a sustainable fabric. The idea was developed by two students from Sicily and has already won several awards at the national and international level. The innovation was also presented at the Expo Gate in Milan in 2015.



Country: **Italy**



Day cream



A cream made from roses and snail extract

This cream includes Bulgarian rose oil, rose absolute and snail extract. The rose oil and rose absolute are natural products derived from the fresh colours of the Rosa damascene. The extract contains many natural proteins, amino acids and vitamins. According to its creators, this combination of ingredients has a powerful anti-aging and regenerating effect due to its proteins, vitamins and enzymes. They accelerate the skin's ability to recover and improve the skin structure and texture.



Country: **Bulgaria**



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Nail polish



Nail polish made with spider silk proteins

Nail polish in its current form first emerged in the 20's of the last century and was inspired by the invention of the automobile lacquer. Today, nail polish should not only look beautiful, but also care for the nails. One of the latest innovations is a nail polish made of biotechnologically produced spider silk proteins. In contrast to conventional nail polish, which seal the nail so that no oxygen can pass through, the silk proteins form a breathable protective film. In addition to the spider silk proteins, the nail polish contains micro-algae active ingredients, which have an antibacterial, antiviral and cell regenerating effect.



Chewing gum



A biodegradable and plastic free chewing gum

Nowadays, most chewing gums still contain plastics, artificial sweeteners and synthetic antioxidants. Unfortunately, plastic-based spit-out chewing gum hardly rots on the streets. The exhibited bio-based chewing gum is 100 percent biodegradable and vegan. The producers use the juice of the sapodilla tree instead of a conventional plastic-filled rubber base. The gum is sweetened with natural sweeteners such as stevia and xylitol (taken from Finnish birch trees).



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Country: **Germany**

Country: **Denmark**

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Clock



Using eggshell residues

This clock is made from eggs shells. The shells are bonded with organic and biodegradable substances that can be handled through different production techniques such as extrusion, pressing and injection moulding. All shells are cleaned, dried, grinded, hammered and combined with other bio-adhesives. This clock will decay if buried in the garden.



Country: **Germany**



Coffee cup



Transform old coffee into new products

A German company manufactures coffee cups and saucers that consist of used coffee grounds. Up to 40 percent of the product is made from recycled coffee grounds. Each cup is made of 60 grams of coffee grounds, which is equivalent to eight espressos. The recycled material, called Kaffeeform, consists not only of coffee grounds, but also of plant fibres, cellulose and a resin made of biopolymers. For the manufacturing process, the company uses an injection moulding procedure. The resulting products are stable, washable and can thus be easily reused.

Hier ist was los...



Was meinst du?

Country: **Germany**



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Backpack



A backpack from apple residues

What about carrying your things in a backpack that consists of 50 percent apple residues? The base material of the bag is apple skin. First the apple remnants are dried, then milled to fine powder and mixed with 50 percent polyurethane. The mixture is placed on a tear resistant roll of cotton fabric and then heated to produce a weather resistant and durable fabric. The apple bag is 100 percent vegan and Öko-Tex Standard 100 certified.



Country: **Germany**

Wallet



Carrying your money in fungus

Tinder fungus rediscovered! Already in the 18th century, small family businesses used the tinder fungus to produce a soft, leather-like material that was further processed into textiles or hats. A Berlin-based designer now revived the old craft. The tinder fungus used for wallet comes from Transylvania. The fungi are harvested naturally, dried for up to a year, peeled and then processed. Although it looks like animal leather, it is a vegan product with absorbent, antibacterial and antiseptic properties. The Berlin-based founder attached great importance to the complete use of the tinder product thereby avoiding waste.



Country: **Romania, Germany**

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Bag



A bag tanned with olive leaves

Tanning agents based on environmentally damaging chromium salts are commonly used in the industrial production of leather. Olive leaves are a natural and environmentally friendly alternative. They contain secondary compounds which the plants use as a pest defence. This forms the basis for a biodegradable tanning agent, which was used for this bag. Tonnes of olive leaves fall every year at harvest time in the Mediterranean, and until now, most of it was burned as green waste. Two companies have developed a process that extracts the tannins from the olive leaves in an aqueous solution. This process eliminates the use of toxic acids and salts during the procedure.

Country: **Germany**



Plant pod



Biodegradable plant pod

Plants in plastic cups are a thing of the past. The exhibited flowerpots are made out of natural fibre-reinforced biodegradable material. The raw materials are bamboo fibres and rice husks – natural fibres that biodegrade. Besides not contaminating the soil, the pots act as organic fertilizer once the natural ingredients break down. And – as the traditional pots – they protect the plant from garden pests.

Country: **Slowenja**



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Dishes



Eating from wheat bran dishes

The dishes are produced by a Polish company selling disposable and biodegradable wheat bran tableware products in all forms and sizes. According to the company, all products can compost in 30 days. From 1 ton of edible wheat bran the company claims to be able to produce up to 10,000 units of plates or bowls. The production process does not require significant amounts of water, mineral resources or chemical compounds. The company's currently produces 15 million pieces of biodegradable disposable plates or bowls a year.



Country: **Poland**



Paper and packaging



Write on agricultural waste

Why burn agricultural waste when it can be processed into paper? The exhibited paper is made from cellulose from agricultural waste – stems and leaves – using 100 percent green energy. The amount of agricultural waste replaces tree fibres. This way, less trees have to be logged and can continue to grow and fix CO2.



Country: **The Netherlands**



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Packaging



Turning bio-waste into biomaterial

This idea comes from a Polish company that takes agricultural waste and weaves it into a biodegradable packaging material. This packaging can serve as a wrap for soap or a sachet for spices. Although it consists of pure cellulose and no fossil fuels or other non-biodegradable substances are added, it has a two-year shelf life. If not needed any more, the nutritious membrane can be eaten or composted – serving as natural fertilizer.

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Country: **Poland**

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Shoes



Walking on pineapple leaves

The pineapple leaf fibres which provide the raw material base for these shoes have been produced by an English company that works with local farmers in the Philippines. Only pineapple leaves from pineapples that are consumed are used for the shoes – hence focusing on the leftovers from the production process. The pineapple fibres are waterproof and breathable. To further reduce waste and litter, the sole of the shoe is made of recyclable compounds, which are in turn made up of 20% chewing gum.

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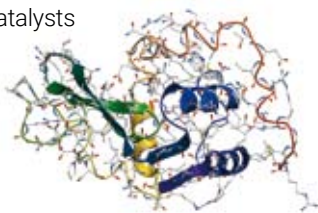
Country: **Portugal**

School uniform



Enzymes for clothes

Kids can be rough on their clothes, especially when they wear the same school uniform day in and day out. A British and a Danish company have developed a school uniform that is produced with a special enzyme technology that keeps the kids' uniforms looking like new longer. At the same time, the production process is more sustainable. The enzymes are produced by industrial microorganisms. As the enzymes are added during the textile bleaching and dying process, the whole industrial process saves water and reduces energy. The enzymes work as biocatalysts and help the fibres strengthen from the inside out, helping to eliminate fibre ends that stick out from the surface. This keeps the surface smooth, reduces pilling and ensures consistent bright colours.



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Dress



Dressing in milk

Milk is a popular food product, but not all milk proteins are actually used by the food industry. Every year, millions of tonnes of raw milk are accrued. Two companies have started to use the milk protein Casein from milk waste for the production of textile fibres and clothing. In order to produce an entire dress it takes about six litres. The clothing is silky to the touch, naturally antibacterial and can be easily dyed. It has long been known that Casein can be spun into fibres. However, not only a lot of water, but also a lot of chemicals were required for this. Today, the fibres can be spun sustainably.



Country: **Germany**

Country: **United Kingdom**

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Dress



Dressing in roses

A dress that smells like roses? The new fabric innovation has emerged out of a cooperation between a German designer and a Portuguese fabric manufacturer and is a creation of viscose fibres from roses. Cellulose is extracted from the leaves of organically grown roses and blended with cotton to a silky, low-maintenance blended fabric. The precious raw material gives the garments a soft rose scent.

Country: **Germany**



Floorboard



Floorboard made of grass

You wouldn't expect it when looking at the delicate stalks, but meadow grass is held upright by its robust fibres. A German company uses them for an innovative production cycle. The procedure is that of a 'green biorefinery', in which wet, fibrous biomass is separated into a liquid phase and a solid phase. Subsequently, the fibres are mixed with bio or recycled plastic at a ratio of three to one. What emerges: a robust and lightweight material that can be processed into – among other things – floorboards for terraces. The residues are used for the production of biogas or plant fertilizer. This way, all parts of the plant are utilised in the best way.

Country: **Germany**



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Carpet



Carpet made of recycled fishing nets

Nylon is a synthetic fibre made from fossil resources and a common base material for clothing or carpets. An Italian company has created a sustainable alternative to nylon – Econyl – which is based on regenerated waste such as used fishnets. The company has developed a process of depolymerisation and repolymerisation, so the yarn can be recycled over and over again without losing any quality. This carpet is made of Econyl and has been created by a Danish company.

Country: **Italy, Denmark**

14

ŻYCIE
POD WODĄ



Shirt



Turning ocean plastic into sportswear

Plastic pollution in the oceans is constantly increasing. Already a number of large ocean garbage patches have agglomerated in different parts of the world. Besides, tiny plastic particles get rubbed off larger pieces and accumulate in the water. Both macro- and microplastic pose a serious threat to the organisms inhabiting the oceans. A German sports brand has teamed up with an environmental organisation to address this problem. The brand has developed sportswear made of recycled plastic. To some extent, the clothes contain ocean plastic collected at coastlines. The used plastic is cleaned and processed into yarns which are then turned into shoes or clothing.

Country: **Germany**

14

ŻYCIE
POD WODĄ



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Freepik

Shirt



Wearing algae

This plant and algae t-shirt emerges from pulped eucalyptus and beech wood from sustainably managed forests as well as algae grown in bioreactors. The t-shirt is made from nature and returns to nature: it biodegrades in the soil within 12 weeks and turns into food for all animals living in there – you can hence either bury it in your garden or put it out with the compost.



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Norbert/stock.adobe.com; Freestockcenter - Freepik.com;



Underwear



Underwear originating from the sea

This underwear is made from four different compounds, including Icelandic algae, beech wood and medical zinc. Dried and ground seaweed, zinc powder and the cellulose from wood are blended and processed into natural fibres. According to the producers, the production of this fibre uses 97% less water and causes 90% less CO2 when compared with cotton products.

Country: **United Kingdom**

Country: **Germany**

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Bathing shoe



Algae-based shoes

Algae bloom is a worldwide ecological threat to the ecosystems in our seas. An abundance of algae remove oxygen and do not allow sunlight to pass through – a problem for many aquatic species. For this shoe, algae biomass was harvested from fresh water sources at high risk of algae bloom. The algae-based material can replace petroleum-based materials which are still used in many modern products. The “amphibian shoe” is flexible, durable and lightweight. According to the producers, each pair of shoes prevents the equivalent of 40 balloons of CO2 from entering the Earth’s atmosphere.

Country: **United Kingdom**

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Baking powder



Baking with algae

Baking a cake with algae, instead of butter and egg? Yes, that works! This vegan powder is based on the microalgae golden Chlorella. The freshwater alga is obtained in a special fermentation process, gently dried and broken down. The resulting golden-yellow algae powder is rich in proteins and fat and suited as an egg and butter substitute. Its special fatty acid pattern is particularly striking – per 100 g it provides 41 g of healthy unsaturated fatty acids.

Country: **Germany**

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Norbert/stock.adobe.com;

Drink



Drinking algae

Helga is a vegan soft drink based on Chlorella algae. Chlorella contains a variety of valuable ingredients, such as vitamins, minerals and vegetable protein. What is notable about algae in general: They grow ten times faster than plants on land and contain dried up to 60 percent protein. Further, this green multi-talent has a high vitamin B12 content. The exhibited drink is produced in Austria. The company behind has sold more than 600,000 bottles already, mainly in Germany and Scandinavia.



Fish



Revive forgotten flavours

Traditional food is fashionable again - more and more food producers from the Vistula and Szczecin Lagoon come back to regional recipes and start manufacturing traditional marinated fish products. Innovative dishes are fish sausages and fish pâtés, as well as traditional products of Polish regional cuisine, in which animal meat has been replaced by fish meat. These recipes use low value fish that are not easily integrated into the food market. Reviving these forgotten recipes facilitate integration of the low value fishes into the value chain and saves them from getting discarded.



Country: **Austria**

Country: **Poland**

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Norbert/stock.adobe.com; Richard Whitcombe

Jewellery



Jewel from the sea

Jewellery is mainly made from metals and stones. But why not use bio-based materials to create these decorative items? A polish company uses salmon leather to decorate jewellery. The salmon leather is a by-product of the food industry and made without the use of chemicals.



A purse from salmon leather

The main material behind this purse – salmon leather – is a by-product of the food industry and has its origin mostly in organic fish farms. The skins are received from both German and Icelandic tanning factories. The products are designed in Norway and produced in Krakow, Poland.



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Country: **Poland**

Country: **Norway, Poland**

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Sailko3P - Freepik.com

Skin care



Face cream with fish collagen

Collagens are skin proteins that are often used in face cremes to prevent wrinkles. This skin care is made of natural fish collagen obtained from freshwater and marine fish skin. The face cream is free of artificial dyes and fragrance additives. According to its producers, the product slows down the ageing process and does not cause allergic reactions, irritation or other side effects.



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stock.adobe.com/Richard Whitcombe;

Country: **Poland**

Insulation



Sustainable insulation from the sea

On the Mediterranean coasts you can find brown kiwi-shaped balls in summer and spring. These balls consist of the dead fibres of the seagrass *Posidonia oceanica*. The so-called "Neptune balls" get their typical shape from the billowing waves before they are washed onto the beach. They are ideal for insulating buildings. The material is flame-retardant, resistant to mould, does not rot and binds excess water to release it when the moisture content of the insulated room has decreased. Until their insulation potential were discovered, the "Neptune balls" were collected from the beach with heavy machinery and then burned to keep the coasts clean for tourists. Using them for insulation is a sustainable alternative.



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Country: **Germany**

