European Commission

Blue Bioeconomy Forum

Highlights

Synthesis of the roadmap and a selection of viable and innovative projects

Maritime Affairs and Fisheries

European Commission
Directorate-General for Maritime Affairs and Fisheries
Directorate A: Maritime Policy and Blue Economy
Contacts: Valentina Mabilia, Andrea Weber
Emails: valentina.mabilia@ec.europa.eu, andrea.weber@ec.europa.eu
Executive Agency for Small and Medium-sized Enterprises
Unit A.3 European Maritime and Fisheries Fund

Contact: Charlotte Jagot
Email: charlotte.jagot@ec.europa.eu

European Commission
B-1049 Brussels

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EUROPEAN COMMISSION

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Synthesis of the roadmap and a selection of viable and innovative projects

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Written by Technopolis Group and Wageningen Research

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All photos are provided by AtSeaNova, Danvos, D-Factory, Eranova, Genis, Hortimare, KeyNatura, MicroSynbiotiX, Musselfeed, Phee, Swedish Algae Factory and Vetik.

LAYOUT:
Arctik – *communication for sustainability*

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Definition of the Blue Bioeconomy

The European Commission defines Bioeconomy as:
"the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy." (European Commission, 2012).

The addition of "blue" entails a focus on aquatic or marine environments, especially, on novel aquaculture applications, including non-food, food and feed. Within the scope of the Blue Bioeconomy Forum, the study does not cover "traditional" uses of biomass, such as fisheries and traditional aquaculture that are mainly aimed at food. Marine organisms that are covered include amongst others: microbes (e.g. bacteria, fungi), microalgae, macroalgae (seaweed), invertebrates (e.g. crustaceans, annelids, molluscs, porifera) and discards of fish and other marine organisms that show potential for the development of innovative and high value products as well as valorisation of co-products.

Further information on the Blue Bioeconomy Forum can be found at the website of DG MARE https://ec.europa.eu/maritimeaffairs/index_en. Here, pdf-versions of this brochure as well as the roadmap may be downloaded.

INTRODUCTION

The Directorate General for Maritime Affairs and Fisheries (DG MARE) of the European Commission and the Executive Agency for Small and Medium Sized Enterprises (EASME) initiated the Blue Bioeconomy Forum (BBF) in 2018 to bring together industry, public authorities, academia, finance and civil society in order to strengthen Europe's competitive position, exploit the potential and ensure the sustainable use of the resources of the emerging blue bioeconomy.

The aim of the BBF was to develop a common understanding of the current status of blue bioeconomy in Europe and to collectively identify strategic developments, market opportunities, appropriate financial assistance, regulatory actions and research priorities. The BBF sought to exploit synergies between blue bioeconomy sectors which can benefit from the innovative and optimal uses of aquatic biomass, by sourcing biomass for a particular purpose (e.g. for high-value applications such as pharmaceuticals), but also by valorising by-products and ecosystem services.

For that purpose, the BBF project team, in a joint effort with its Steering Group members, thematic Working Groups and the active involvement of the wider blue bioeconomy community (the Forum) designed and developed a Roadmap. In that roadmap, the BBF identified 14 challenges that fall within four main themes: Policy, environment and regulation; Finance and business development; Consumers and supply chains; Science, technology and innovation. With the support of the BBF community, solutions were identified to tackle the challenges. A summary of the challenges and solutions per theme can be found on the next pages.

Furthermore, the BBF identified and collected examples of projects and/or start-up companies that not only highlight Europe's potential in the blue bioeconomy, but are also sufficiently close to commercialisation that they would deserve attention from a wide range of stakeholders, ranging from policy-makers to investors. A selection of these examples are shown in the second part of this brochure.

POLICY, ENVIRONMENT AND REGULATION

A range of challenges in the **blue bioeconomy** lie in the legal realm: not only are definitions, rules, governance and activities currently unclear but potential activities and businesses may fall in different policy fields: fishery, aquaculture, marine agronomy, agriculture, bioindustries - are all logical candidates but separately, none of them sufficiently cover the width of the blue bioeconomy.

Clarification can be achieved mostly through formal standards as developed and promoted by standardisation bodies, while some issues will remain of a more political nature.

One-stop-shops, set up by local, regional and European public authorities, for businesses operating in the **blue bioeconomy** can be one way of reducing the burden of operating in this new sector: it would mean that regional or national governments would have to provide support to businesses.

Novel foods offer opportunities to commercialise high-value products. Effective implementation of the Novel Food Regulation (NFR) is important to protect EU citizen's health, but also to protect the sector from unfair competition.

A number of **blue bioeconomy** activities can also provide ecosystem services, that could be valorised as instruments to achieve EU environmental targets.

Table 1: Challenges and solutions in Policy, Environment and Regulation

Policy, Environment and Regulation	
Challenges	**Solutions**
Licences / Permits	**Simplify licence and permit applications** - Harmonise regulatory and legislative requirements - Improve clarity about activities through the establishment and adoption of standards - Provide clarity on the status of underutilised marine biomass - Create one-stop-shops where businesses can obtain (free) advice on regulations in blue bioeconomy sector and product requirements - Work towards the harmonisation of marine spatial planning and multi-use
Novel food and feed	**Offer support for applications under the Novel Food Regulation** - Conduct the necessary studies for the authorisation of more types of biomass - Ensure the accuracy and consistency of the EU novel food list - Provide necessary support to novel food applicants
Ecosystem services	**Valorise ecosystem services** - Take stock of ecosystem services pilots and support their deployment - Secure high-level support for payments for ecosystem services and create cohesion between Common Agriculture and Common Fishery Policies - EU strategy for an institutional framework for ecosystem services across European sea basins - Incorporate marine ecosystem services into macro-regional strategies, projects and initiatives - Ensure that ecosystem valuation studies become an integral part in decision models for specific marine management decisions

FINANCE AND BUSINESS DEVELOPMENT

Financing is required for start-ups and small businesses in the **blue bioeconomy** when moving through the different phases of technology development and commercialisation. Many businesses do not have this expertise in-house, and it is recommended that financial planning & resources are brought in at the appropriate time.

Investments in the **blue bioeconomy** will require significant amounts of capital and a strong involvement of both private and public stakeholders. To address the lack of financing for **blue bioeconomy** start-ups and SMEs, dedicated investment funds should be established. This has been proposed within the framework of the new BlueInvest platform. National, regional and local authorities should consider contributing to such a platform and establish a matching fund mechanism.

New national and regional funds dedicated to the blue bioeconomy could be envisaged, although earmarking EU structural and investment funds is also an option. Blended finance models will continue to develop in this sector and any of these initiatives or mechanisms should provide the opportunity for investment management companies to participate as investing partners.

Over the longer term, the **blue bioeconomy** sector could benefit from policy instruments, such as technology subsidies or partnership initiatives, to partially offset high production costs. This is particularly important for sub-sectors offering social and environmental benefits, including ecosystem services.

The skills required for blue bioeconomy business success become more complex with each phase of product development. Whereas in initial phases the needs are for specialised technical skills, in latter phases, these are expanded to include business skills. Members of the investment community active in the **blue bioeconomy** have remarked that entrepreneurs and project leaders often lack necessary business skills for growing a small startup or business. The lack of multi-disciplinary skills can constitute a bottleneck to innovation.

Table 2: Challenges and solutions in Finance and Business Development

Finance and Business Development	
Challenges	**Solutions**
Understanding finance	**Increase understanding of investment landscape for projects and businesses** - Provide blue bioeconomy start-ups with advice on business and financing
Funding mechanisms	**Promote uptake of existing funding mechanisms and set up new ones to support projects and start-ups** - Establish investment funds for blue bioeconomy - Provide additional support to SMEs in the blue bioeconomy sector
Skills and qualifications	**Ensure availability of skilled and qualified human resources** - Upcoming sectors and start-ups require more flexible skilled people (including basic business skills)

CONSUMERS
AND VALUE CHAINS

The qualities, health benefits, functionalities and utilities of blue biomass/products are still hotly debated. As a result, the type and amount of public support, as well as consumer awareness and acceptance of novel products is limited. To raise consumer acceptance of blue products, the value of these products needs to be more widely understood, and reciprocally, producers should recognise concerns among potential consumers (such as price, sustainability, and health benefits).

Reinforcing the need to find solutions to rest raw material valorisation is important, as currently the discards in the fish processing industry reach up to 75 % of the total volume of processed products.

Entrepreneurs in the blue bioeconomy sector face relatively high production costs, due to a lack of available and accessible production/processing facilities, as well as risks and expenses during the R&D phase.

35% of consulted **Blue Bioeconomy** Forum stakeholders face logistical challenges, of which 80% are technical in nature (and not legal or policy issues). Technical challenges include complex and expensive operations throughout the entire supply chain, including harvesting, storing, processing, transport and delivery.

Lack of access to data on pollution, quality and temperature of water prevents entrepreneurs from optimising their production process. Ensuring open access to such data, as well as integrating various monitoring data sources in one platform, requires joint action by public, research and industry actors.

Dissemination and exchange of existing good practices on distributed harvesting, processing of biomass, optimisation of the logistics of by-catch fishing resources would be helpful.

Table 3: Challenges and solutions in Consumers and Value Chains

Consumers and Value Chains	
Challenges	**Solutions**
Consumer acceptance	**Increase consumer awareness and acceptance** - Improve understanding on the value of blue products - Define a communication strategy to raise consumer awareness of blue products - Design more supportive regional policies on blue sector - Support the blue sector advocacy groups in the EU
Side products	**Increase the valorisation of rest raw material from fisheries and other aquatic biomass** - Enforcement of the landing obligations given by the EU fishery policy - More research on use of underused fish and other marine biomass - Develop regionally: pilot plants for proof of concept at semi-industrial scale; bio-refineries as 'lighthouse' projects to encourage further investment
Production costs	**Support the reduction of blue production costs** - Provide partial coverage of R&D costs for entrepreneurs in the blue sector - Planning and building of clusters of blue production in the EU with biorefineries and other production / research facilities - Provide investment in silos and biorefinery facilities that can stabilise the input into processing industries
Logistics and seasonality	**Support solutions for biomass processing** - Support further scientific research on: impact of seasonality on biomass characteristics; crops and harvesting optimisation; logistical challenges and pre-processing techniques (biomass specific) - Set up knowledge exchange on developing system of distributed production of marine biomass - Open data platform with data (e.g. from ongoing monitoring of water quality)

SCIENCE, TECHNOLOGY AND INNOVATION

Better links and collaboration are needed to develop and deliver successful products to consumers. Furhtermore, improved cooperation between research and industry can have cross-cutting effects on the other specific challenges that have been identified.

More collaboration would also help to reduce exploration costs, optimisation of multi-purpose screening on hotspots or sampling programs.

The availability of research infrastructures is essential to continue the development and use of outputs from marine biotechnology. The most urgent technological challenges are in the demonstration plant phase, and the upscaling to flagship/first-of-a-kind, when economies of scale have not yet been achieved.

Access to data, research results (including data from unsuccessful experiments) and data banks is considered a challenge that, when tackled, may further stimulate the development of the **blue bioeconomy**. Research and industry need to be incentivised to share data. A big challenge is to unify / streamline the data sources and portals that are available. Therefore, it is proposed to link **blue bioeconomy** projects with European initiatives to share and standardise data, making use of existing structures such as the European Open Science Cloud.

Table 4: Challenges and solutions in Science, Technology and Innovation

Science, Technology and Innovation	
Challenges	**Solutions**
Research-industry dialogue	**Facilitate dialogue and cooperation between research and industry** - Develop measures to incentivise researchers / companies to collaborate - Launch exchange programmes for students and staff in industry
Marine exploration	**Support solutions for marine exploration** - Facilitate exploration of marine environment
Research infrastructures	**Support a network of research infrastructures** - Mapping: optimise use of research infrastructures - Reduce gap of qualified people for running and maintaining research infrastructures – especially engineering profiles - Build a European blue bioeconomy ecosystem - Build research infrastructure and financial tools to sustainably use / operate (joint) facilities
Access to data	**Promote open data and access to research findings** - Define structure of an open access results database, making use of existing data structures (e.g. EMODnet, EOSC) - Construct an open access results database

EXAMPLES OF BLUE BIOECONOMY ACTIVITIES

The BBF also aimed at identifying and showcasing examples of projects and/or SMEs that not only highlight Europe's potential for the blue bioeconomy, but are also sufficiently close to commercialisation so that they would deserve attention from both public and private investors.The criteria for selection were:

- ~ Resources are microalgae, seaweed, fish by-products, organic materials from the sea, or novel sources (e.g. genetic information)
- ~ Value added applications are high value non-food (cosmetics, pharmaceutics), chemical building blocks, functional food or functional feed
- ~ Activities are undertaken after 2010

To assess the potential for industrial application, the BBF examined the commercial potential, the potential for investors and estimated the technology readiness levels (TRL) (which is 4 or higher for all examples, with targets of TRL 5 and higher). Preferably, the examples also have Intellectual Property (IP) in the shape of patents. The estimates and expert judgement are based on a combination of desk research and interviews. For the examples chosen, the BBF sees a realistic potential for industrial application.

For each of the examples, the solutions from the Roadmap from which they will benefit the most are presented, based on the judgement of the BBF project team. Beside the examples mentioned in this brochure, there are many more projects and companies in the blue bioeconomy in Europe with great potential.

SEAWEED
AT YOUR SERVICE

Belgian seaweed breeding business eyes off future markets for its full-service solutions

AtSeaNova is a Belgian company that supplies turnkey solutions for industrial seaweed farming. The farms can be set up anywhere suitable for growing seaweed, and they can adapt to different sea and weather conditions, which makes them a particularly viable and flexible option. The farms are sustainable, increase biodiversity, pick up excess nutrients from land-based activities, and generate a CO_2 mitigation effect as part of the seaweed breeding and growing process.

AtSeaNova has fully validated the technology and is ready to commercialise the seaweed farms. Geographically, the firm has set its sights initially on European sales, where the market for seaweed is currently small but with good growth potential. The Asian market also shows great promise.

Marketing efforts are focused on clients who can see the potential in seaweed farming. So far, the company has identified two potential targets. First, customers with knowledge or a background in the field, but with limited financial means to invest; and second are those able to invest, but with no expertise in seaweed breeding who may need *AtSeaNova*'s support services.

The main competition faced by *AtSeaNova* and its customers in Europe comes from wild seaweed-harvesting companies.
However, the natural presence of wild seaweed is uncertain due to climate change, some species have already disappeared in places. This phenomenon makes industrial seaweed farming solutions like *AtSeaNova*'s all the more important. ■

Country of origin
Belgium

TRL-level
9

Website
www.atseanova.com

AtSeaNova will benefit from the promotion of existing and new funding mechanisms.

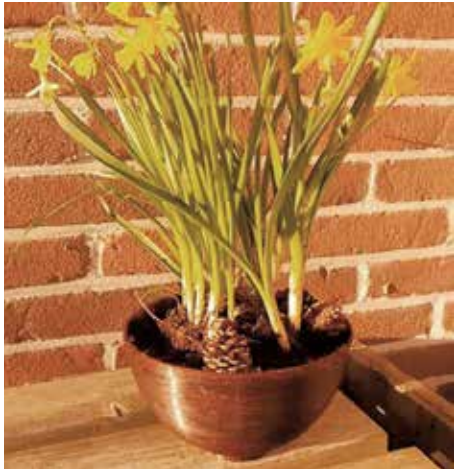
BIOREFINING SEAWEED TO **TACKLE** CLIMATE CHANGE

Dutch group targets three climate change challenges: proteins, plastics and biodiversity

Danvos is a Dutch private company founded by a food technologist whose mission is to develop a biorefinery for seaweed and design applications with the new compounds. The seaweed-refining products have the potential to address three major societal challenges related to climate change: protein transition, biodiversity and bioplastics.

Firstly, proteins extracted from seaweed by *Danvos* can replace proteins produced on land from both plant and animal sources. Secondly, biodiversity is affected by widely used toxicagro chemicals, and *Danvos*' seaweed products provide an alternative way to fertilise soils and leaves without disturbing the environment. Thirdly, plastic can be created from seaweed, which makes it an eco-friendly substitute to fossil fuel-based plastics. The seaweed-refining process is replicable in other countries, especially because the company is willing to share the technology.

Danvos is at an early commercial stage and actively looking for partners to enter the



market. The commercial potential of the product is considerable because fertilisers and animal feed represent up to 40% of the world agrobusiness, and with investors *Danvos* will be in good position to capture some of this vast market. The team is also working on scaling up the volume it is able to produce in order to meet demand for large quantities.

DANVOS

Danvos wishes to see a change in legislation that would encourage farmers to use more organic fertilisers and natural methods. They have tested the impact of replacing chemicals by seaweed organic fertilisers and, over a three-year period, observed tremendous biodiversity gains, especially for soil life, insects and birds. ■

Country of origin
The Netherlands

TRL-level
6

Website
www.danvos.nl

Danvos will benefit from valorised ecosystem services.

BIOTECH
BONUS TIME

A unique algae tackles climate change and promises a biotech bonus at the same time

D-factory is a research and development project gathering experts from nine different European countries to grow, bio-refine and commercialise components developed from a unique species of algae, called Dunaliella.

Dunaliella grows not by consuming natural resources but by absorbing CO_2 and solar energy, both available in abundance. Cultivated and properly handled and extracted, it can be used to create a high-value material, called 9-cis-β-carotene. This specific type of carotene has a range of applications, the most important and value-generating one being its pharmaceutical and medical uses. Indeed, 9-cis-β-carotene has the potential to cure patients with eye diseases and skin conditions like psoriasis.

By-products can also be commercialised as food additives or animal feed. There is also notable interest from the pigment industry because 9-cis-β-carotene offers different possibilities, notably as natural food colorants.

The main *D-factory* production is located in Spain, but could be replicated in other locations with similar meteorological conditions and infrastructure. A high market potential is expected. Due to current legislation, short term applications within Europe will most likely focus on high value-added oils.

To capitalise on this innovation and gain market share, *D-factory* must raise awareness about Dunaliella's unique qualities,

clearly differentiating it from other types of beta-carotene produced, notably chemical ones. The 9-cis-β-carotene refined from Dunaliella is of higher quality than equivalents on the market, which explains its higher price. The product is not on the market yet as *D-factory* is still conducting clinical trials.■

D-Factory

Country of origin
European Union; production location Spain

TRL-level
6

Website
www.d-factoryalgae.eu

Increased consumer awareness and acceptance would help D-factory.

NEW **WIN-WIN** PERSPECTIVES ON A **GREEN NUISANCE**

French firm takes a source of aggravation and transforms it into bio-friendly plastic

Eranova is a French start-up that creates plastic from green macroalgae. The presence of this macroalgae in coastal regions is a major source of pollution and the toxic gasses they emit pose a risk to oceans, marine wildlife, and human health.

Limiting the impact and spread of green algae is also a major cost for local authorities. The technology developed by *Eranova* transforms this nuisance into a new-generation bioplastic, with diverse industrial usages such as cosmetics and packaging. In other words, *Eranova* provides a win-win solution to reduce coastal pollution and an alternative to much-maligned fossil fuel-based plastics.

Besides its positive environmental effects, *Eranova* expects to be able to generate employment, through the creation of up to 320 new jobs. It has the potential to be replicated in other coastal environments suffering from green macroalgae, but also in desert land, industrial wastelands and land unsuitable for agriculture.

Pre-orders and letters of intent from future customers illustrate the commercial potential of *Eranova*'s solution. Before being formally launched on the market, however, *Eranova*'s technology first needs to pass a pre-industrialisation phase, which requires funding.

Therein lies a problem. Although the unusual industrial usage of bio-sourced plastics is promising and desirable, it also makes *Eranova* ineligible for most public funding programmes that are not designed for hybrid industrial sectors. Private investors, and more specifically industrialists and commercial banks, have shown interest in the project, so the prospects still look bright. ■

Country of origin
France

TRL-level
7

Website
www.eranovabioplastics.com

Eranova will benefit from valorised ecosystem services and advice on business and financing.

SHRIMP SHELLS THREE **WAYS**

Innovative Icelanders transform a common fisheries bio-waste into a big bio-opportunity

Genis is a company from Iceland that has developed several clever business opportunities associated with a common fish-processing by-product, namely shrimp shells. Given their special properties, shells from these crustaceans can be transformed into a range of high value-added products.

Firstly, *Genis* sells food supplements made from shell components for people suffering from ageing-associated problems such as stiffness, aches and lethargy. Those products are already available on the market in Iceland, Ireland and the UK under the brand Benecta®. Secondly, the firm is developing medical devices containing chitin derivates from shell components. The market for this activity is mainly in Europe. In their clinical studies they also collaborate with Danish hospitals. Thirdly, *Genis* is working on active pharmaceutical ingredients, but this activity is a work in progress and takes many years. The commercial potential of these three sectors of activity is considerable and high profits are anticipated.

Genis employs 30 people, and they all work in R&D and manufacturing. Commercialisation of the company's products is currently outsourced. The team has already filed several patents and owns its technology. In order to grow faster, *Genis* would like to see legislation in the food and nutraceutical markets harmonised across Europe. Currently, rules are country dependent and there are inconsistencies between them, which makes it difficult to find a location for testing and to comply with the legislation.

Environmental issues are an important concern for *Genis*' business as well. Climate change is triggering a displacement of

shrimps to the North and this directly affects the availability of biomass (the shells) and associated activities within the company. ■

Country of origin
Iceland

TRL-level
7

Website
https://simecos.benecta.is/about-us/

Simplified licence and permit applications and support for Novel Food Regulation will help Genis..

BENECTA
SIGLUFJORDUR ICELAND

FUTURE-PROOFING WITH **SEAWEED**

Unusual as it sounds, the future is in sustainable seaweed; one company is gearing up for it

Hortimare is a leader in the breeding and propagating of sustainable seaweed. For five years it has been selling high-quality starting material used to grow healthy seaweed. It also provides advice and support to novice seaweed farmers, helping them develop and expand their activity.

Hortimare positions itself as the first step in the value chain of a burgeoning seaweed sector. While the technology is ready and the sector is gaining traction, *Hortimare* is working on reinforcing it, in particular by improving the yield predictability of seaweed harvests. This aspect is crucial to convince farmers but also large companies to grow this marine crop.

There are many uses for seaweed and experts are forecasting huge market growth potential – up to 100-fold in harvest volumes within ten years. *Hortimare* is gearing up for this increased demand, and adapting to international markets by developing different seaweeds according to diverse geographical conditions.

Hortimare has a dedicated R&D team working on cross-breeding programmes to make more resilient seaweed species. With more funding, they would also like to work on mitigating biological threats posed by microorganisms that can attack seaweed. Unfortunately, the legislation regarding research on seaweed, including cross-breeding, is unclear and lacks the flexibility *Hortimare* needs going forward. ■

Country of origin
The Netherlands

TRL-level
7

Website
www.hortimare.com

Hortimare will benefit from advice on business and financing and the promotion of existing and new funding mechanisms

BRINGING OUT THE **NATURAL BEAUTY**

Nutraceutical firm's ambitious plan for scaling up production and scaling down waste

KeyNatura specialises in pure and natural antioxidant products made from microalgae. The products are already available on the food supplements market, which includes nutraceuticals. The demand for those is high because consumers are increasingly looking for natural and nutraceutical beauty products. *KeyNatura* is in the process of scaling up its production to meet this demand.

In order to produce and extract antioxidants from microalgae, *KeyNatura* uses a unique technology. Microalgae are grown in a closed tank-based photobioreactor with artificial light, through a process that is entirely carbon negative. The production takes place 24/7 and all year round. It is not location dependent, which means it can be replicated in other countries.

KeyNatura has patented its algae cultivation technology and aims to further commercialise it. In the long run, *KeyNatura* anticipates two kinds of customers emerging: retail customers of its antioxidant products; and algal biomass companies interested in its cultivation technology.

KeyNatura also plans to make its production a zero-waste process by adding value to every part of the biomass.

The company plans to hire more than 35 employees to achieve its ambitious goals. Candidates would need to be highly skilled, which might be difficult to find, management acknowledges. In the future, *KeyNatura* is also seeking closer collaboration between industry and universities, to facilitate clinical trials needed to move forward and improve marketing efforts.■

Country of origin
Iceland

TRL-level
6

Website
https://keynatura.com/

Availability of skilled and qualified human resources is an important Roadmap solution for KeyNatura. More cooperation between research and industry would help as well.

FISH FARM VACCINE-DELIVERY LOOKS TO SCALE UP

Microalgae turned into a clever vehicle for delivery of therapeutic agents to fight disease in aquaculture

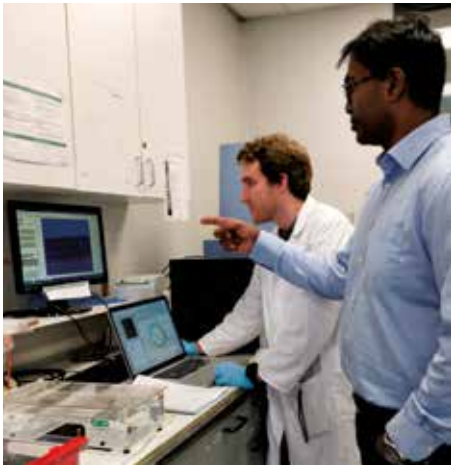
MicroSynbiotiX is a biotechnology start-up company aimed at developing a novel oral drug delivery technology. The technology enables farmers to incorporate therapeutic agents in animal feed in order to protect the animals against a target disease. The primary market for *MicroSynbiotiX* is aquaculture since it is the fastest growing market and the technology has an excellent product-market fit.

This new kind of vaccination is a direct competitor to traditional injection methods, and is likely to become increasingly popular. Seafood producers currently use hand held injection techniques to vaccinate individual fish which is labour-intensive and expensive. Furthermore, existing injection vaccines for livestock are not always viable for the aquaculture sector and as they do not necessarily provide complete protection, the farmer will still have to use antibiotics. In addition, the problem with conventional vaccines such as live / inactivated bacteria (bacterins), is that they also contain other toxins from the bacteria, which can also generate an immunosuppressive effect, preventing a long-term protective immune response. Finally, there are no oral delivery strategies available to vaccinate or administer therapeutic agents to shrimps. As a result, there may be as much as 1.5 Billion USD in losses of shrimp stocks each year.

Given the stakes and the high costs seafood producers face in preventing and dealing with disease, global investment in fish health

is big business, making the commercial opportunities for *MicroSynbiotiX* considerable. With the increase in fish diseases induced by global warming, the market will only grow bigger.

It would help *MicroSynbiotiX* if funding and support from European funding agencies were easier to find and apply for. The funds are often too risk-averse to invest in a project as ambitious as *MicroSynbiotiX*'s. ■



Country of origin
Ireland

TRL-level
5

Website
www.microsynbiotix.com

MicroSynbiotiX will benefit from advice on business and financing and the promotion of existing and new funding mechanisms.

ADD A **PINCH** OF **BLUE MUSSEL** POWDER!

Award-winning Swedish start-up looks to grow its mussel extracts business internationally

Musselfeed is a Swedish start-up that has developed an industrial process to extract valuable products from blue mussels. The mussel meat is a high-quality nutritional product rich in proteins and in omega-3 fatty acids. The company transforms it into a dried powder that can be used in food products, in collaboration with chefs, and in pet food.

The mussel shells are high in calcium and have applications in agriculture, especially in fertilisers for now, but other possibilities are envisioned. Given its many applications, the market potential of *Musselfeed*'s products is huge. Similar products are imported to Europe from New Zealand today.

Musselfeed is a recognised player in Europe, as highlighted by the two awards it garnered from Swedish and European institutions. Its activity is not only sustainable but also regenerate nature, since mussel cultivation in organic farms has a low CO_2 and environmental footprint and also bring nutrients back to land.

Musselfeed started out as a research project in 2013 and was then transformed into a B2B company, which has now set its sights on scaling up. The products are already being commercialised, but only at the kilogram-level. However, *Musselfeed* is working on scaling them up to tonne-volumes. Also other production facilities could be introduced in Europe, especially where mussel production is well established.

Scaling up will also go hand-in-hand with building up awareness and trust among customers, as the mussels are a traditional source of protein, but the form of dried powder is a unique way of using it. ■

Country of origin
Sweden

TRL-level
4

Website
http://musselfeed.com/

Increased valorisation of side products would help Musselfeed.

SEAGRASS PRODUCTS, AS NATURE INTENDED

Greek company rides blue bioeconomy wave as interest grows in its sea plant-based materials

Phee is a Greek start-up that has created and sells a new sustainable bio-composite material. Made from the dead leaves of a Mediterranean sea plant, it has various commercial applications.

This material is used to produce smartphone cases, sunglasses and wooden boxes that are already sold on the market. Most products are co-branded with design companies. Other industrial applications are also possible for the material, and *Phee* is currently expanding its activities into the interior design, architecture and construction sectors. *Phee* is also working with a luxury hotel to help it become more sustainable.

Phee's compass is set on global expansion. Products are currently sold by several retailers in Greece, but it is developing exports to Benelux, Australia and North America. *Phee* is now fundraising in order to further develop its product line and launch the first store (retail point) in Greece with a plan of opening more stores in Europe in the next three years. A big advantage is that *Phee*'s products cannot be replicated anywhere, since the seagrass used is only located in the Mediterranean Sea, and production depends on its collection by local municipalities. *Phee* takes care to harvest the seagrass in a sustainable way, not in an industrial fashion.

Competition from less sustainable materials is still a challenge for *Phee*, allowing competitors to sell cheaper products. Public

awareness of sustainable solutions like *Phee*'s must increase to encourage customers to buy quality 'green' and 'blue' products.

There are good signs ahead, though. *Phee* has gained recognition as an up-and-coming player, having recently won several start-up awards, including being selected in the Forbes 30U30 industry list in 2018. ■

PHEE

Country of origin
Greece

TRL-level
4

Website
https://phee.gr/

Phee would benefit from increased consumer awareness and acceptance.

BLUE **BIOPHARMA**-BASED DRUGS TO TARGET **CHRONIC PAIN**

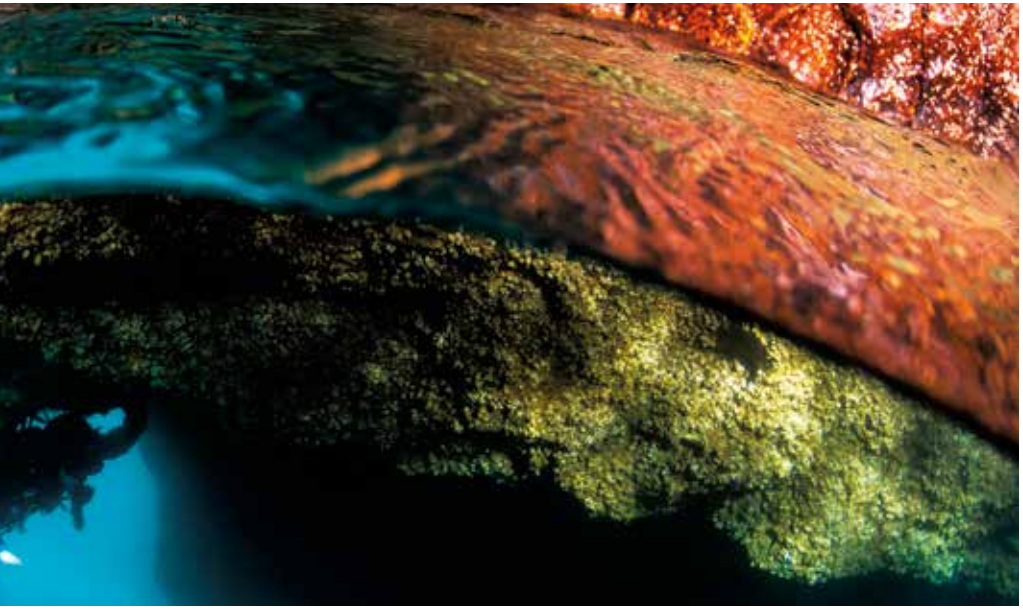
Biopharma-based company sets its sights on the vast market for novel chronic pain drugs

Sea4Us is a biopharmaceutical company which uses marine compounds for therapies of unmet clinical needs. More specifically, it is exploiting the potential of invertebrates, namely sponges and anemones to cure chronic pain. Since 20% of the global population is estimated to suffer from some form of chronic pain, the market is vast.

The drugs are still in the development phase, so they are not being commercialised yet. Two promising components/compounds are currently under investigation, both come from marine organisms but, importantly, can be replicated, either by chemical-synthesis or through bacteria.

Before launching the eventual products on the market, *Sea4Us* will perform the first stages of clinical tests, which require investment and partnering with bigger 'Pharma players'. *Sea4Us* has already managed to gather funding from different sources, including European funds and private pharmaceutical investors.

Pollution is a concern for *Sea4Us* because of its effects on biodiversity. At the species level, even the loss of one organism, which may produce a unique or interesting molecule, has repercussions. The displacement of marine species might have negative impacts on their ability to produce these molecules of interest. Hence, the location of Sea4US'



activities is crucial; marine-organism prospecting takes place in very specific locations. Minimising the distance between the harvest and laboratory is also essential, to cut transport costs and keep carbon emissions down.

The *Sea4Us* team is made up of 13 people who work in two laboratories, but they also own a marine station and are building a research centre with diving and prospecting facilities. This equipment allows the team to continue the hunt for new molecules from marine organisms to further develop novel biopharma products. ■

Sea4Us

Country of origin
Portugal

TRL-level
4

Website
http://sea4us.pt/

Sea4Us will benefit from support for marine exploration.

ALGAE ALCHEMY, FROM SOLAR PANELS TO MOISTURISER

Silica derived from algae is yet another clever blue bioeconomy application, the story behind it

The main product developed by **Swedish Algae Factory** is silica, an advanced nano-porous material extracted from microalgae. Silica has two major usages: firstly, it is used in solar panels as efficiency enhancer; and secondly, it is applied in luxury personal care products as an absorbent and moisturising agent. The remaining organic biomass can be put to good use in animal feed, fertiliser or fuel, to name a few. *Swedish Algae Factory* has already filed a patent to protect its unique technology.

Currently, silica is available on the market, but only under its personal care application. To be commercialised for solar energy purposes, larger volumes of silica need to be produced. This is very likely to happen, since a scale up is planned for 2021 thanks to funding from the European Union. The funds will help to expand *Swedish Algae Factory*'s production and expand its market globally; sales are currently concentrated in the Nordic countries.

The team is aware that entering new markets with an innovative technology can be quite challenging because customers often need some convincing, but in general the sustainability of the products motivates the public. The company also faces an uphill battle dealing with legislative issues, obtaining permits and the associated administrative costs.

Undaunted, and with its sights set on growth, the company plans to hire five additional people, which will create jobs for marine biologists who sometimes struggle to find employment in their sector. ■

Country of origin
Sweden

TRL-level
4

Website
https://swedishalgaefactory.com/

Simplified licence and permit applications will help the Swedish Algae Factory.

ANOTHER **COLOURFUL** USE FOR **SEAWEED**!

Award-winning Estonian project sees red seaweed as the future in natural colourants

Vetik is an Estonian project exploring the potential of using red seaweed biomass. The team is extracting red colourant from the sea plant for use in cosmetics and as a natural substitute to today's unhealthy synthetic colorants.

Most of the colourants in cosmetics today are made from petroleum or insects, and there is a growing demand for natural and vegan alternatives. Over 20 cosmetic companies have already shown interest in *Vetik*'s work.

Before being commercialised, the colourants and prototypes will be further analysed to assess their usability and specific cosmetic applications. Small-scale commercialisation is expected by the summer of 2020. *Vetik* benefits from a considerable advantage because it has good access to a stock of seaweed that can be harvested sustainably at an industrial scale.

However, they are also looking to grow their own seaweed. For further scale-up, it will be necessary to develop their own production, and a more efficient extraction process that uses all of the leftover biomass as well. They are looking for partners for these steps, including bringing in outside help because the necessary expertise about seaweed might not be available in Estonia.

Vetik is already well recognised in the blue bioeconomy sector, as it has won several awards and competitions from different European countries. The company has been invited to participate in business accelerator programmes and benefited from public funding. ■

Country of origin
Estonia

TRL-level
4

Website
www.vetik.eu

Vetik would benefit from support for a network of research infrastructures and the availability of skilled and qualified human resources.

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