Baltic Blue Biotechnology Alliance
Case analysis report

ALLIANCE project – O2.6 Analysis of case studies

Comparative case analysis

Preface

During the project implementation phase, the ALLIANCE consortium has developed a broad spectrum of services which were offered to the client cases. The following document provides in the first section a comparative cross-case analysis regarding the advancement in the value chain, the types of support used by the ALLIANCE cases, transnationality aspects, their target applications and markets, the biological resource used for the case development as well as assignment of to the UN Sustainable Development Goals. This is followed by a section on lessons learned from the mentoring program and an analysis of each of the 26 ALLIANCE cases each encompassing 6-8 pages.

Type of support provided by ALLIANCE

When joining the ALLIANCE mentoring program after successfully pitching to internationally composed expert panels during four dedicated pitching events (Helsinki, Gothenburg, Copenhagen) and one recruitment event after case presentations (Berlin), each case was attributed two mentor organizations. These mentors were responsible for guiding the case owner, introducing the various possibilities of support offered by the ALLIANCE and acting as a mediator between the case owner and the consortium. However, in many cases, the mentors were also the crucial contacts helping in actual implementation of the respective case. All 26 selected cases received this mentoring support offered by regular ALLIANCE partners. Moreover, 11 cases in total were assigned partner status within the project, 5 (CRM, Biovento, Geoterma, Baltic Probiotics, Kalundborg) from the beginning of the project and 6 (Biome, Furcella, Biofisk, KosterAlg, SFTec, UKSH) after the pitching event in Helsinki. The other 15 cases did not receive financial support from the ALLIANCE. However, support to advance their product development was provided which can be grouped in different categories such as scientific/technical, business support, legal support (IPR/patent research, national implementations of EU regulations), networking and case promotion. Figure 1 shows these different categories of support offered to the cases. Beyond the mentoring support, the most frequently provided types of support were networking (22 cases) and scientific/technical support (20 cases, incl. planning, setup and conduction of experiments, data analysis, providing equipment for analysis etc.). This impressively shows the need for scientifically sound data and proven concepts for advancing blue biotechnology product development in the BSR. This was followed by business support (17 cases) and promotion of the cases on different types of events (13 cases). The least frequently requested support category was legal support (7 cases). On average, the cases received 4 different support

categories, with Biofisk being supported in all 7 categories and the cases Maresome and Enymicals requesting only networking support beyond the mentoring.

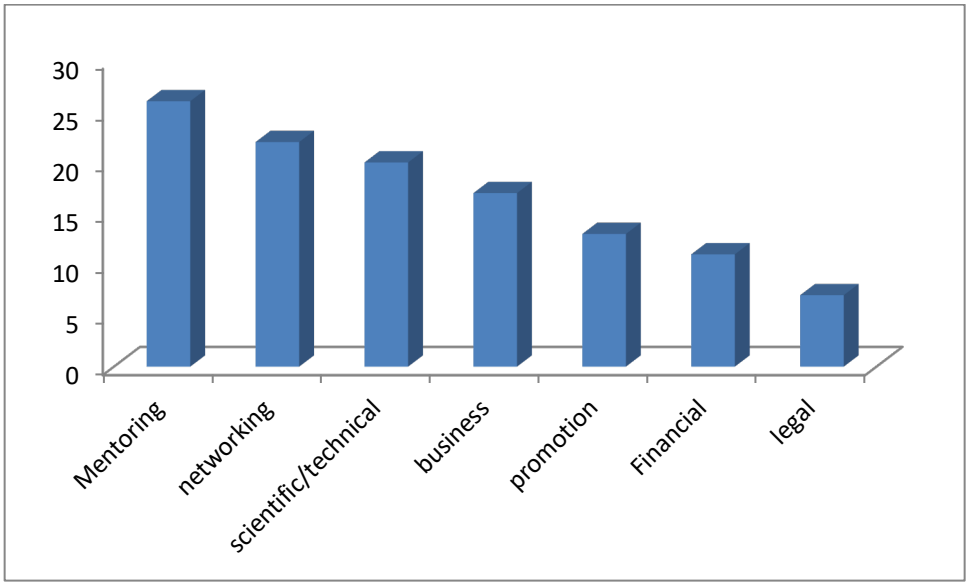


Figure 1. Number of cases vs. different categories offered by ALLIANCE in frame of the mentoring program.

Notably and intendedly, the ALLIANCE succeeded also in its ambition to form a sustainable network connecting Blue Biotechnology actors on a transnational scale. Actors being part of the ALLIANCE as case owners from the beginning have evolved into mentors (case owners of CRM, SFTec, Furcella) for cases joining the ALLIANCE at a later stage and facilitated transnational cross-case collaborations. These cross-case collaborations were realized or initiated in 12 cases (CRM-Organic Seaweed, CRM-LoondSpa, CRM-Vetik, CRM-Koster-Alg, KosterAlg-SFTec, KosterAlg-Organic Seaweed, KosterAlg-DoS, Furcella-Vetik, SFTec-Vetik, Kalundborg-PowerAlgae, PowerAlgae-Phytolinc, EHP-Kalundborg).

Promotional support

A special type of support is provided by the ALLIANCE by promoting the successes of its client cases to different audiences. Promotional activities were of course realized via case profiles on the ALLIANCE website but also by promotion on events on different scales (Figure 2) , i.e. events organized by the EU such as the European Week of Cities and Regions 2018 (Furcella products, Biome prototypes and macroalgae of KosterAlg), or the International BioMarine Convention (CRM, Vetik, PowerAlgae, Furcella). Another efficient promotion of the cases was realized during the international conference organized by the ALLIANCE in Greifswald, on which selected cases were given the opportunity to give a pitch talk or present their case on a poster (CRM, Furcella,

UKSH, Biofisk, Uni Gdansk Smart Bloom, Phytolinc, Hoekmine). Regional events like e.g. the sTARTUp day co-organized by ALLIANCE partner Tartu Biotechnology Park also contributed to the promotion of the cases at regional level (e.g. KosterAlg products and EHP panelist at Better off Blue conference, DoS-Exhibition at Tjärnö co-organized by ALLIANCE partners University of Gothenburg and KTH): One special type of support was the promotion of the cases to existing national and international accelerator programs such as realized for the Hoekmine and Vetik. Hoekmine succeded in winning the Portuguese BlueBioValue accelerator program and Vetik succeeded in securing national funding for building a prototype. In conclusion the ALLIANCE has applied various types of promotional support to advance the cases to move forward and to secure funding for the next step in product development.

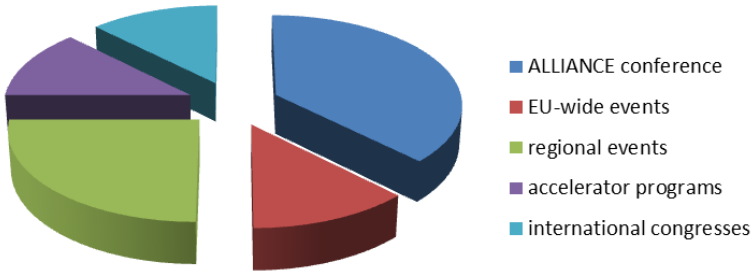


Figure 2. Types of promotional support provided by ALLIANCE

Transnationality

The concept of ALLIANCE is based on a transnational approach, coming from the recognition of the fact, that blue biotechnology expertise is present in the Baltic Sea Region but fragmented. Therefore, the approach for advancing the cases´in their product development, also relied on a transantional approach. Figure 3 shows the transnational bonds in the ALLIANCE consortium. Most case owners were based in Germany (6), followed by Denmark, Finland and Estonia (4 each). This highlights the success of the recruitment strategy and the plethora of innovative Blue Biotech ideas especially in a small country like Estonia. On average, 3,5 transnational connections/collaborations were made per case throughout the mentoring program of ALLIANCE. Most international connections were realized by Hoekmine, followed by Biome, SFTec and Movable Biogas Factory. During the ALLIANCE, a tight transnational network was formed between blue biotechnology actors in the BSR as shown in Figure 4, which reflects the transnational cooperation during the mentoring program.

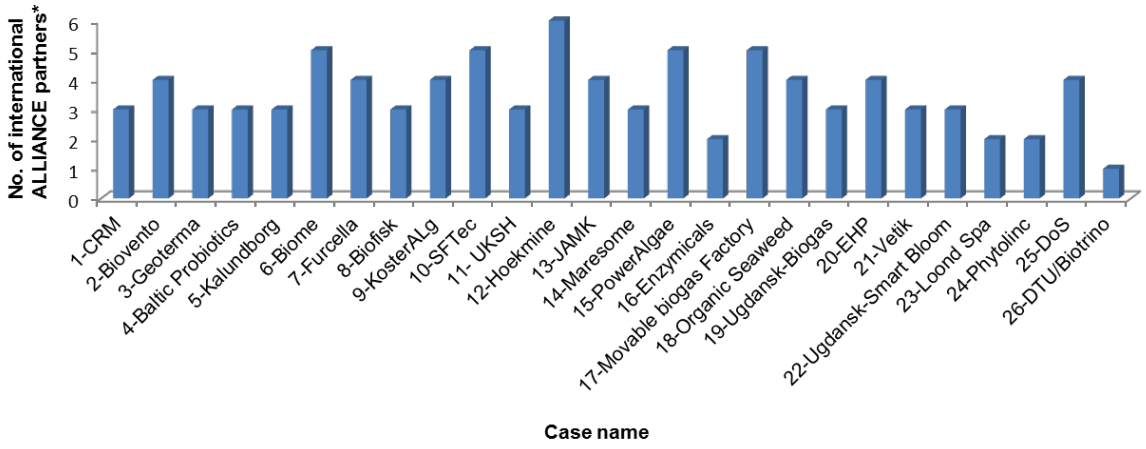


Figure 3. Number of transnational connections for all ALLIANCE cases. *: country of origin of the case owner is included in the calculation

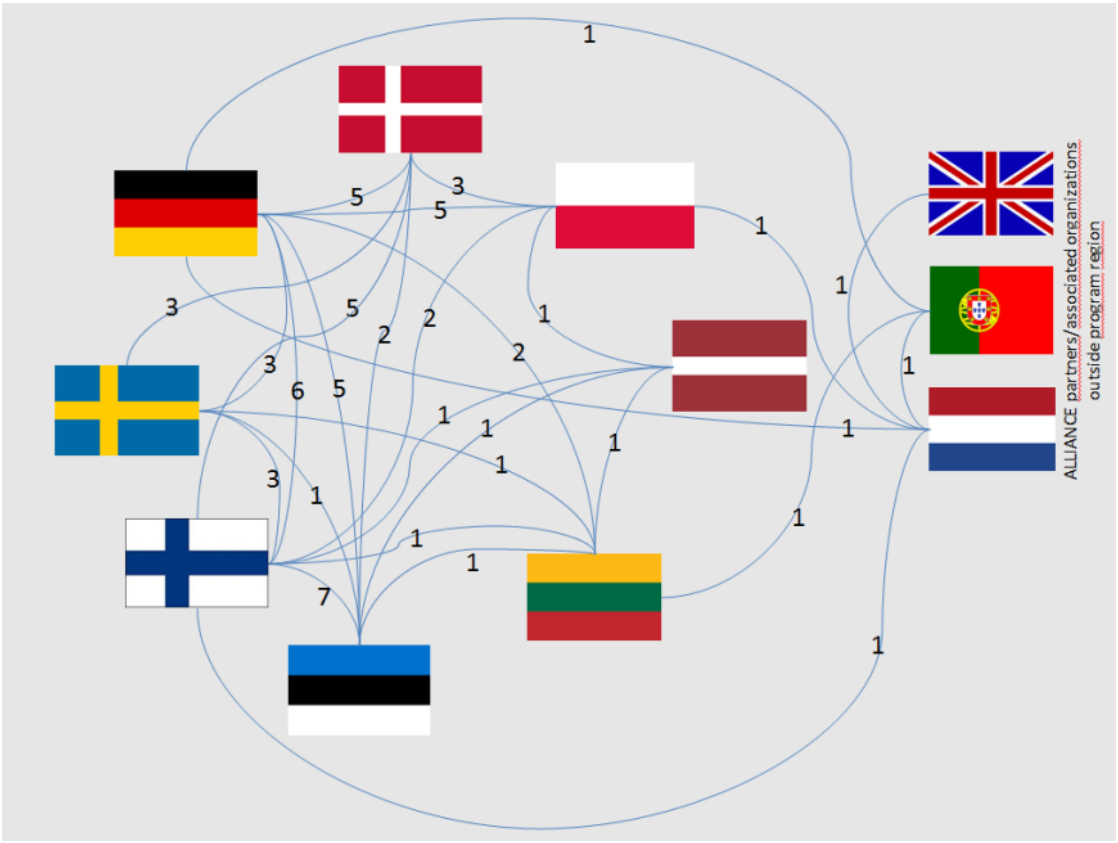


Figure 4. Network showing the transnational connections between ALLIANCE partners and cases. Numbers on lines reflect the number of cases in which these countries are cooperating.

Target application/ Market

As foreseen, various types of products were in the scope of product development in frame of the ALLIANCE. This did not only include direct blue biotechnology products for sale (i.e. cosmetic products), but also services and/or energy products. Some special cases did not try to develop biotechnological products but rather technical devices enabling production, control of production or valorization of blue biotechnlology relevant biomass (i.e. SFTec – drying seaweed/seagrass biomass, Phytolinc and PowerAlgae – own developments of Photobioreactors for microalgae cultivation, EHP- remotely controlled sensor). As displayed in Figure 5a, most of the ALLIANCE cases (21) aimed at the development of products, only few were offering a service (4) or aiming to develop alternative energy supply (3).

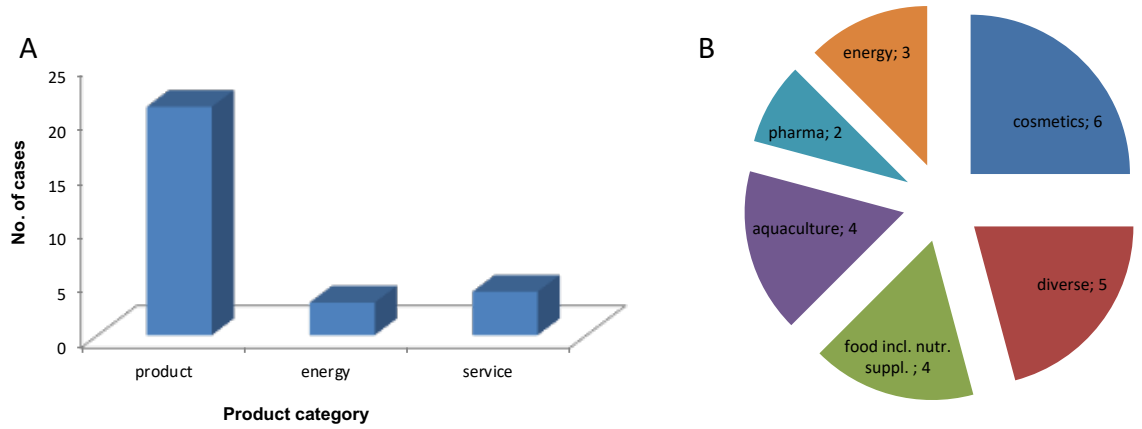


Figure 5 A. Product categories in development by ALLIANCE cases. **B**. Different industrial sectors targeted by ALLIANCE cases.

As shown in Figure 5, notably, the cosmetic sector was the target market for most products in development by ALLIANCE cases, followed by food (incl. nutritional supplements, case UKSH) and products for use in aquaculture. More than one market or diverse applications were targeted by 4 cases (e.g. Vetik developing red-algae based prodcuts for application in the cosmetic but also the food colourant market). Only 2 cases targeted the development of products for the pharma sector, which promises high revenues but is spiked with high regulatory obstacles. As the cosmetic sector promises quick revenues opposed to much lesser costs for product development and lesser regulatory hurdles compared to the pharma sector, it is probably the most attractive market for the ALLIANCE cases, most of which (14) are startups with limited start capital resources.

With regard to the target customers, interestingly most cases (13) aim to develop their products for sale to other companies or enterprises, so they envisage Business-to-Business (B2B) relationships rather than selling their products to the end customer (Business-to-Customer, B2C, Figure 6). Seven cases were estimated to sell their products (in the widest sense, incl. energy or services) to both, including the end customer.

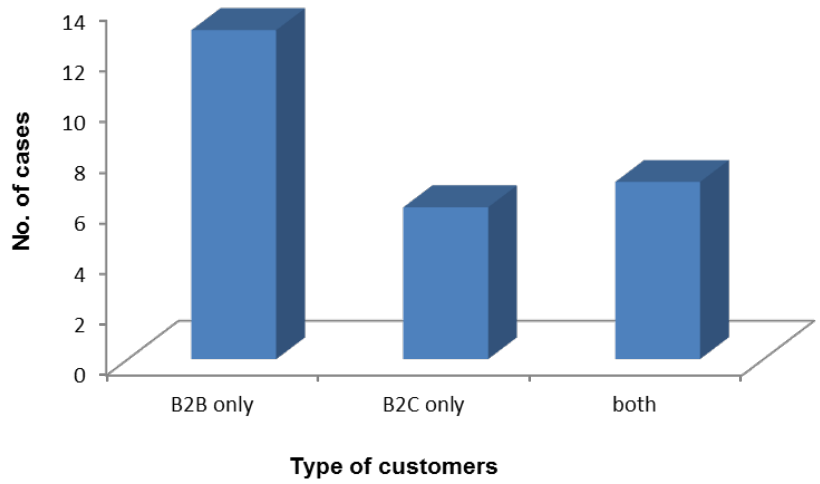


Figure 6. Number of ALLIANCE cases and their intended type of customer. B2B: business-to-business, sale intended to another company or enterprise; B2C: business-to-customer, sale intended to target the end customer.

Biological Resource

The ALLIANCE case owners used different types of biological resources for advancing their blue biotechnology-based product development. As Figure 7A shows, an almost equal number of cases (7) used different Baltic macroalgal species and microalgae (8 cases) as biological resource, both knowingly featuring valuable ingredients (e.g. phlorotannins, phycoerythrin or fucoidan in macroalgae, omega-3-fatty acids in microalgae) with high biotechnological application potential and consequently, also high potential to be integrated in circular economy concepts. Microorganisms, which are also scientifically recognized as versatile producers a variety of natural products and easily lend themselves for blue biotechnology since they are cultivable in large quantities, are only used as biological resource in 4 cases. Notably, fungi are not used as a biological resource by any case.

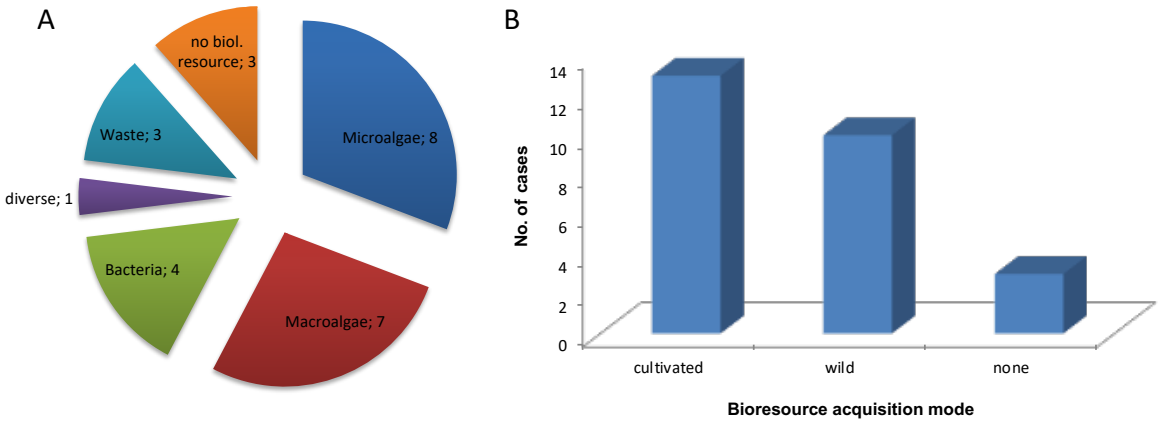


Figure 7A. Biological resources used by ALLIANCE cases. **B**. Mode of harvest or acquisition of the biological resource differentiating between wild harvest and harvest based on cultivated bioresources.

Only one case, Biome, is using an animal-derived product, mussel shells, for product development.

With respect to blue bioeconomy, it is interesting to note, that 3 cases focus on the development of products using biomass generally considered as waste. This is true for Biome (mussel shells), Biofisk and Movable Biogas Factory (both: beachcast consisting of macroalgae and seagrass). Also novel cultivation methods of well-known organisms (i.e. heterotrophic cultivation of microalgae, case DTU) may become a high relevance in future circular economy concepts. The bioresources used for product development were mostly obtained by cultivation (Figure 7B), 10 cases used wildly collected biological resources. 3 cases (Geoterma- hydrothermal water, EHP-water, LoondSpa-Water/Mud) did not use any biological resource. Notably, the case KosterAlg represents a special case in this respect, since it relies on macroalgae which are cultivated in an offshore algal farm in the Koster Fjord in Sweden.

The sustainability aspect was one of the decisive criteria for acceptance of ALLIANCE cases and all case owners strived for further improving the sustainable supply of their biological resources also by mutual agreements or finding new partners for delivery of sustainably harvested bioresources (e.g. CRM, UKSH, Vetik).

Progress in product development

When joining the ALLIANCE, each case was assessed with regard to the respective stage in product development via a simplified value chain shown in Figure 8.

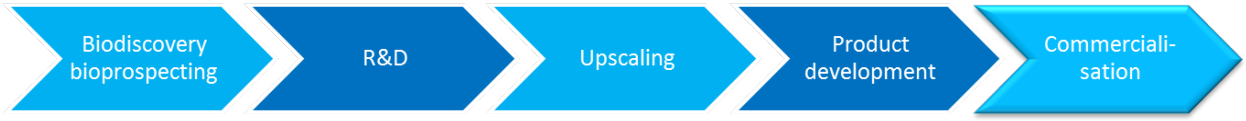


Figure 8. Simplified value chain used for assessing the TRL stages of cases applying to the ALLIANCE.

After case implementation period, this assessment was repeated to evaluate the progress in product development due to ALLIANCE contribution.

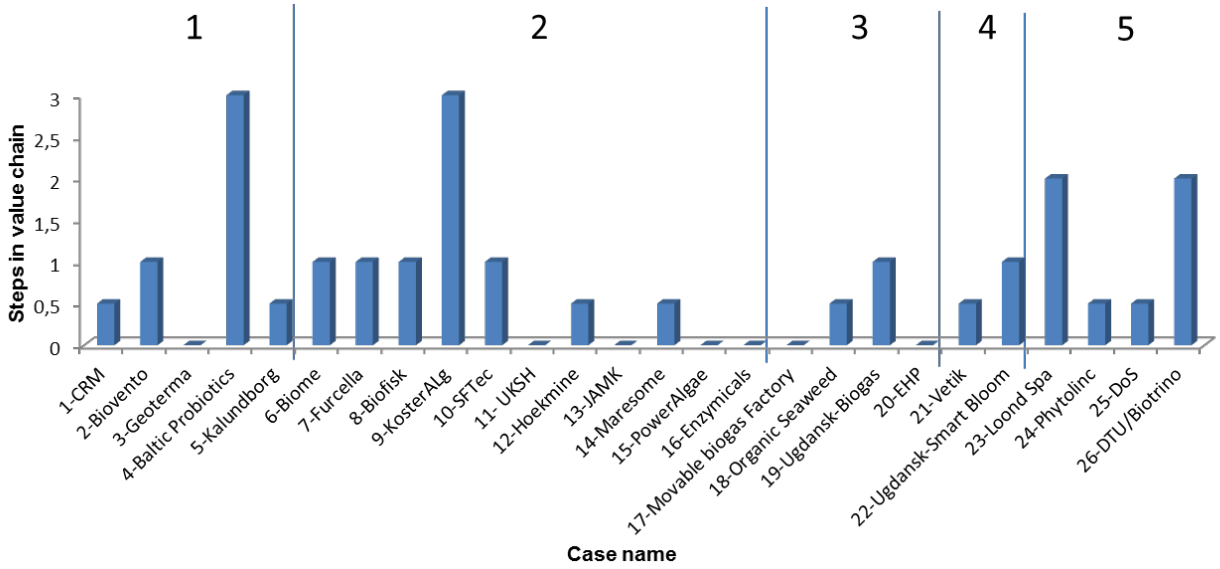


Figure 9. Individual progress of cases in the value chain. Numbers reflect different case cohorts. 1. Reserved partners cohort one (from March 2016), 2. Cohort recruited at pitching event in Helsinki (October 2016), 3. Cases recruited in pitching event in Gothenburg (April 2017), 4. Cases recruited during partner meeting in Berlin (November 2017), 5. Cases recruited during pitching event in Copenhagen (April 2018).

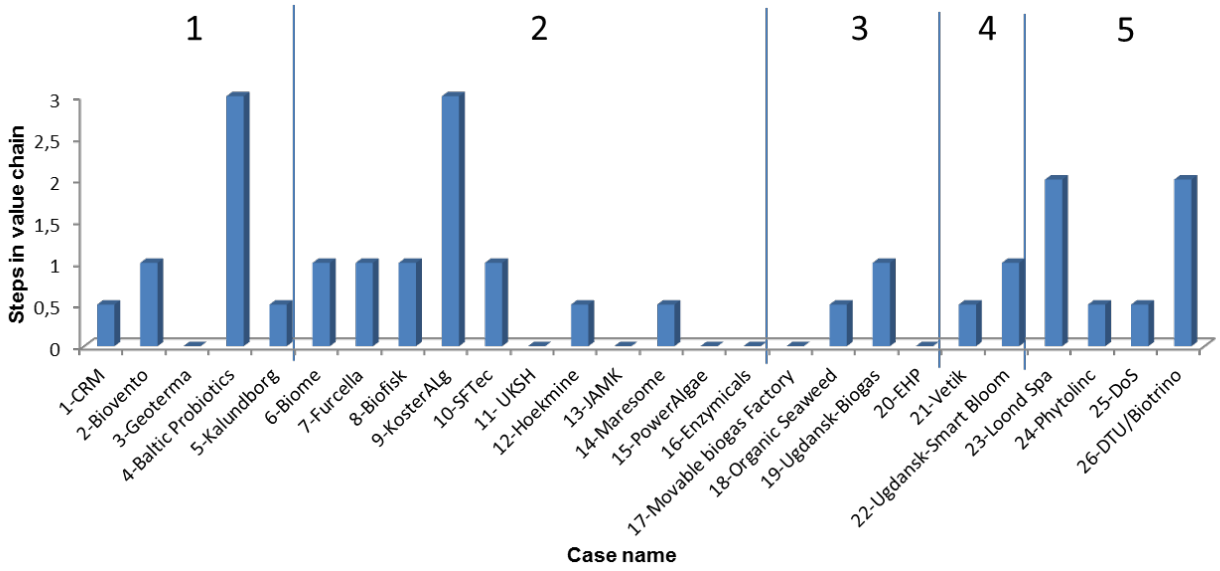


Figure 9). This is an average calculated over all cases; since they were recruited in 5 different cohorts, the progress naturally differed between the cohorts due to several factors, i.e. establishment of the mentoring program and process, implementation, duration of experiments, type of support and documentation, motivation of case owners to collaborate etc. However, Figure 9 hardly reflects the real success of the ALLIANCE cases, since it cannot take into account all the interwoven side aspects leading to significant mutual progress in many cases (e.g. CRM/Organic Seaweed: bilateral agreement generating revenues for Organic Seaweed, provision of a sustainably harvested biological resource for CRM, Furcella launching the first cosmetic products). Moreover, due to feasibility analyses which were often performed with the help of the research institute partners, several cases changed the direction or broadened their product development activities. Although this is a major contribution by ALLIANCE to the case development and for the case owner represents a notable progress (e.g. PowerAlgae, Uni Gdansk Smart Bloom), they are still in the same stage as they were when joining ALLIANCE. With respect to Figure 9, the most pronounced progress was made by the cases Baltic Probiotics (before ALLIANCE: R&D, after ALLIANCE: commercialization), being able to develop two probiotic products for application in aquaculture to improve fish health (which carry the ALLIANCE/Interreg label, see case analysis of Baltic Probiotics) and KosterAlg (before ALLIANCE: R&D, after ALLIANCE: commercialization), which has also succeeded in selling macroalgae for food purposes.

Figure 10 shows the different progress steps made by ALLIANCE cases. Notably, most (9) steps still involve R&D aspects underlining the importance of knowledge-based product development and proof-of-concept studies for blue biotech-based product development. Six cases, who were in bioprospecting stage before joining ALLIANCE have moved forward to R&D in frame of ALLIANCE and 5 advanced from R&D to upscaling, which nicely underlines the success of

ALLIANCE in taking blue biotechnology development in the BSR one step further. By the help of ALLIANCE, commercialization of newly developed products started in 3 cases (Baltic Probiotics, Furcella, KosterAlg) and prototypes are ready from 2 more cases (CRM, Biome).

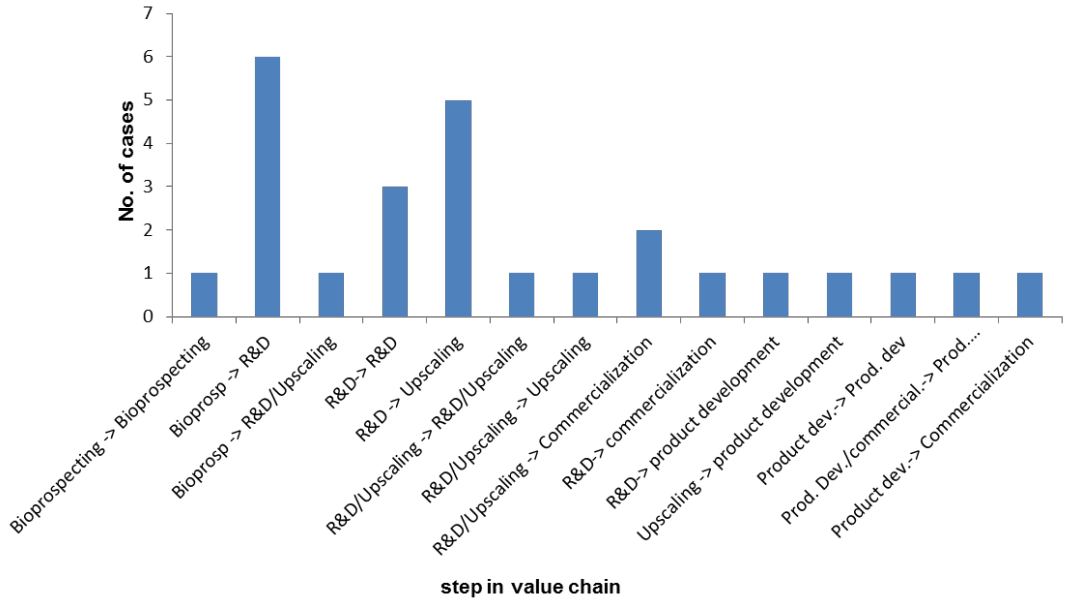


Figure 10. Cases progress in the value chain with respect to different steps.

Sustainability

Sustainability was a key aspect for ALLIANCE for accepting cases for the mentoring program. Sustainability is a criterion which is hard to measure. Sustainability was assessed with respect to the mode of acquisition of the biological resources used for product development (comaparatively evaluated in the respective chapter on bioresources). Moreover, the mentors often did sustainability and feasibility assessments in frame of case implementation, e.g. with respect to energy input in form of light and heat needed for microalgae cultivation in relation to the expected revenues. Finally, each case was categorized according to the UN Sustainable Development Goals (SDG), displayed as matrix in

Figure ***11***.

	1-No Poverty	2-Zero Hunger	3-Good health and Well-being	4-Quality Education	5-Gender Equality	6-Clean Water and Sanitation	7-Affordable and Clean Energy	8-Decent Work and Economic Growth	9-Industry, Innovation and Infrastructure	10-Reduced Inequalities	11-Sustainable Cities and Communities	12-Responsible Production and Consumption	13-Climate Action	14-Life Below Water	15-Life on Land	16-Peace, Justice and Srong Institutions	17-Partnerships for the Goals
1-CRM								■				■		■			■
2-Biovento													■	■			■
3-Geoterma			■				■		■								■
4-Baltic Probiotics								■				■		■			■
5-Kalundborg								■				■					■
6-Biome									■			■		■			■
7-Furcella														■			■
8-Biofisk								■	■			■		■			■
9-KosterALg		■	■						■				■	■			■
10-SFTec							■	■	■			■	■	■	■		■
11- UKSH			■					■						■			■
12-Hoekmine								■	■					■			■
13-JAMK				■			■		■					■			■
14-Maresome			■									■					■
15-PowerAlgae							■	■	■								■
16-Enzymicals												■	■				■
17-Movable biogas Factory							■	■	■			■		■			■
18-Organic Seaweed								■				■		■			■
19-Ugdansk-Biogas							■		■								■
20-EHP								■	■					■			■
21-Vetik			■						■					■			■
22-Ugdansk-Smart Bloom									■			■		■			■
23-Loond Spa			■					■	■								■
24-Phytolinc			■			■	■					■					■
25-DoS									■			■		■			■
26-DTU/Biotrino		■										■					■

Figure 11. Matrix of cases assigned to the United Nations Sustainable Development Goals. Blue cells represent the SDGs to which the cases contribute.

All cases contributed to SDG17-Partnerships for the goals (

Figure ***11*** and 12), since they formed partnerships with other actors in the blue biotechnology sector to achieve product development in a sustainable way. Naturally, in a consortium focused on marine or blue biotechnology, many cases (17 out of 26) contributed to SDG14-Life below water, followed by SDG9-Industry, Innovation and Infrastructre. On average, each case contributes to 4 SDGs, and all cases contributed to >1 SDG, thus showing the high respect towards sustainability in the ALLIANCE.

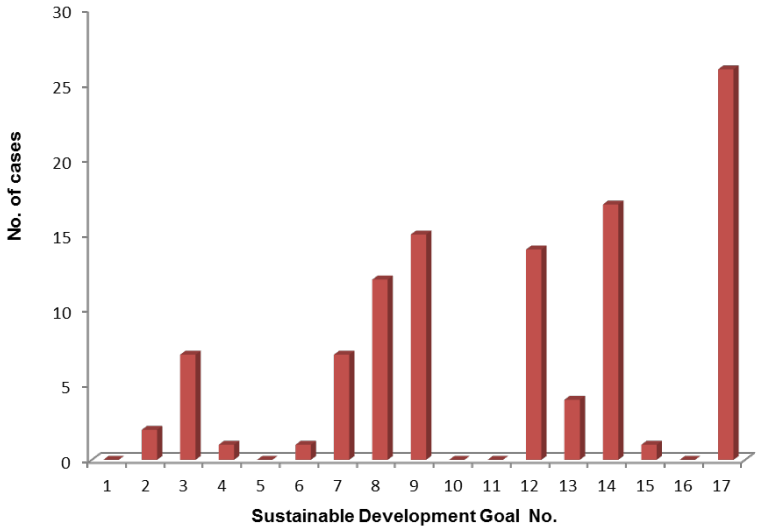


Figure 12. Number of cases contributing to the different UN Sustainable Development Goals.

Lessons learned

During the setup of the mentoring program and during implementation of the cases, the ALLIANCE consortium and the cases were able to acquire significant experience and expertise in transnational collaboration in multi-actor environments. One critical factor for case progress was often geographical proximity between case owner and mentors. The setup using a combination of two mentors, one national contact point and one having expertise in the target field or market, proved to be highly successful. Furthermore, mediation of case-to-case relationships was often crucial for the case success on more than one side; all mentors should have a broad overview on all mentored cases (realized by monthly mentors´ telephone conferences) and also cross-linking of mentors is important. Readiness of case-owners to cooperate and cross-link with other cases was also important to broaden their future customer

bases. The mentors were very often not only acting as mediators, but were also crucial also for providing support during case implementation, mostly in terms of scientific/technical, networking and business support. Moreover, joint interests of scientists/mentors and case owner are a tremendous driving force for case progress (example: Baltic Probiotics). On the other hand, transnational and cross-institutional (R&D/SME) cooperation is necessary already at very early stages like R&D, and it has proven to be also beneficial for the research institute with regard to mediation of contacts, focus on market-relatedness. Clear communication of aims from the case owner to the mentors proved absolutely necessary in order to enable the partners to provide the right type of support needed for by the case. It is difficult for mentors to contribute to case progress when the progress is not driven by case; as communication/mutual trust is absolutely indispensable for progress even if legal documents (NDA etc.) are existing.

The R&D stage often requires costly investments and in some cases was prolonged due to a change of direction or broadening of the scope of a case. However, a sound R&D is considered as the basis for almost all blue biotechnology products. Therefore, many ALLIANCE cases are constantly addressing R&D aspects also if they have advanced to other stages of the value chain. Knowledge-based product development is a selling point which is gaining importance also in sectors like cosmetics, nutritional supplements, aquaculture. The R&D stage should also involve other aspects such as an assessment of feasibility and sustainability, which is crucially important for sound blue biotech product development.

It has proven to be important, that legal prerequisites are clarified before starting mentoring to avoid long phases until implementation. Unclear legal situation significantly affected case progress. Moreover, national implementation of EU regulations has become highly relevant; on the one hand with regard to the transnational exchange and utilization of biological resources regulated by the Nagoya protocol, on the other hand with regard to novel uses of organic raw materials commonly regarded as waste for the industries related to human consumption such as feed/food.

ALLIANCE has taught us, that gap-closing technologies are highly important (e.g. drying of biomass) and that a technique/equipment yet missing but providing an important service/prerequisite for development of biotechnology products (e.g. drying of seaweed material), was crucial for moving other cases forward.

As foreseen by bioeconomy concepts, positive aspects for ecology and economy can go hand in hand in blue biotechnology: as some goals (establishment of offshore macroalgae cultivation) contribute positively to ecology (nutrient, carbon removal, oxygenation of the sea). Only few cases needed external support (expertise which could not be provided by the ALLIANCE consortium). As a conclusion we can state, that the ALLIANCE represents a unique consortium uniting the knowledge and the joint power to move biotechnology development forward in the Baltic Sea Region at transnational scales.

Case Highlights and Summaries

Case 01- CRM: Highlights

The Kiel-based company CRM (Coastal Research & Management) was founded by economics and marine ecology experts in 1994. The company's aim is to achieve the sustainable use of living marine resources through modern environmental management of the coastal zone and through research on marine natural products. CRM has since specialized in developing sustainable mariculture systems and investigating marine natural substances. These include various different seaweed extracts as antiviral and antitumoral agents as well as collagen from marine invertebrates as bio scaffold material. It has established the first certified organic mussel and macroalgae farm in the Baltic Sea, following the principles of Integrated Multitrophic Aquaculture (IMTA). CRM's sister company ocean BASIS, founded in 2001, processes the marine natural resources into extracts which find application in different areas, e.g. as active ingredients for cosmetics and food. As well as selling the natural algae extracts to cosmetics companies as an active ingredient, CRM also has its own line of finished cosmetics products called Oceanwell. So far, the active ingredients developed by CRM have been mainly bioactive compounds sourced from algae and collagen from jellyfish. Recently, CRM has been developing a new extract, based on polyphenols found in up to four different species of brown algae (fucales) including *Saccharina latissima* (sugar kelp). The polyphenol-based extract – already identified and tested by CRM – is a powerful antioxidant and can be used in skin care products as a natural "buffer" against harmful free chemical radicals. CRM now hopes to develop these polyphenols into marketable active ingredient. Several challenges remain before the bioactive ingredient can be used in cosmetic products. The main difficulty is presented by the method of extraction, which currently necessitates the use of chemicals that are unsuitable to meet the EU compliance rules for ingredients used in cosmetics. These so-called "simple" extraction methods do not focus on the extraction of a specific compound, but rather provide a "representative" cross-section of compounds in the seaweed, depending on the solvent used.

Once a new method has been found, the second challenge is "upscaling" production of the active compound. Currently, the brown algae from which the polyphenols are being extracted are from wild (sea-based) stock, native to the Kieler Förde. CRM already has extensive experience in the sustainable, organic farming of other species of macroalgae (such as sugar kelp), which it rears

in land-based nurseries and then transfers to its farm in the Baltic Sea. The company is now exploring cultivation methods to facilitate larger-scale use of the active ingredient.
With the help of the ALLIANCE, CRM is developing a new product based on macroalgae extracts. The active compound will be used in cosmetics to protect the skin from free radicals. The company is collaborating with ALLIANCE researchers to find an alternative method of extraction.

Contribution of mentors and ALLIANCE to case progress

CRM is collaborating with ALLIANCE partners to overcome the difficult extraction process. Beyond mentoring, the primary mentors Danish Technological Institute (DTI), as well as the secondary mentors Royal Institute of Technology (KTH) and the University of Gothenburg from Sweden were also involved in implementation of this case. Together with the case owner, the mentors and further ALLIANCE partners (GEOMAR) provided alternative solutions for chemical environmentally friendly extraction of the target compounds. Cross-linking between ALLIANCE cases was crucial for this case, since it resulted in a bilateral agreement between the case owners of CRM and Organic Seaweed (case 18) for sustainable and certified supply of raw material. Notably, case 1 did not only receive mentoring support from the ALLIANCE network but also was involved in mentoring of other cases, i.e. case 18-Organic Seaweed and case 7-Furcella. Here, CRM considerably advanced product development of a natural cosmetic product for an Estonian startup. CRM´s contribution towards ALLIANCE reflects in a specific way the commitment of the ALLIANCE partners to generate a viable and self-sustaining network.

Contribution to Sustainable Development goals (SDG)

The case CRM contributes to SDG-12 Responsible consumption and production and 14-Life below water and furthermore to SDG-8 Decent work and economic growth.

Comparative case analysis

Transnationality. With regard to transnationality, this case is cross-collaborating with ALLIANCE partners in Denmark and Sweden.

Type of ALLIANCE service provided. CRM received primarily technical support from the ALLIANCE in terms of optimizing the extraction method, just like 19 other ALLIANCE cases. CRM further received financial support like 11 other cases. Although originally not foreseen, the case also successfully managed to cross-link with another ALLIANCE case, the Denmark-based startup Organic Seaweed, resulting in a bilateral agreement, for supply of raw material. Since the case owner participated in the business workshops held during the Copenhagen and Berlin partner meetings, the case took also advantage of the business support offered by ALLIANCE. Generation of a business plan was not necessary since it the case is a well-established SME with an existing business plan.

Target application/market and customers. CRM aims at developing natural cosmetic products with antioxidant potential. CRM was one out of 6 cases accepted to ALLIANCE with the cosmetic sector as target market. The products are not only sold directly to end-customers, which are the selected target customer group for 5 other ALLIANCE cases but also on a B2B basis to spas and beauty salons (only cosmetic-focused case focusing on B2B).

Biological resource used. CRM uses brown macroalgae as biological resource. These algae are either harvested sustainably (connection to case 18-Organic Seaweed) or cultivated onshore in the lab or offshore on a farm in the Kiel fjord.

Type of product. At the end of the ALLIANCE project, a prototype of the desired product, an extract with desired skin-protective activities is existing. This prototype can be classified as a product rather than energy or service.

Individual progress. When joining the ALLIANCE, the case was in R&D stage. Due to ALLIANCE involvement the case is now in the product development stage, which means a significant advancement. Moreover, the case owner has transformed from a case owner into a mentor giving support and advice to other client cases within the frame of the ALLIANCE project and is also applying for the ALLIANCE extension.

SUMMARY: Case CRM

Case and mentor information

Case Name: CRM, case #1

Product: Skin protecting bioactive extract for use in cosmetics

ALLIANCE mentor(s): DTI, Hilary Lewis Karlson (primary), Fredrik Gröndahl, KTH and Göran Nylund, UGOT (secondary)

Type of ALLIANCE support (mentoring/implementation of case/financial support):

Mentoring, financial support, technical support, (business support)

Duration of ALLIANCE support: 3 years

Success factors

- Receiving valuable hints and exchange of knowledge and experience (mentors)
- Economically and ecologically feasible raw material (own macroalgae cultivation and supply by Organic Seaweed, another ALLIANCE case)
- Scalable extraction method for anti-oxidative seaweed compounds (use of ASE at GEOMAR)
- Meaningful activity tests at University Kiel for marketing purposes

Barriers to be overcome

- though using email, Skype or telephone with the mentors frequently, it was more practical to do lab or practical work with a regionally available partner (e.g. GEOMAR in our case)
- while CRM made a big step forward during the ALLIANCE project towards a sustainable supply of seaweed for the case's purpose (see success factors), it is still difficult to establish a reliable, stable and sufficient supply of fresh/frozen Fucus, as the Fucus belt at the coast is protected in Germany
- Marketing of the developed product has to be performed and production as well as distribution have to be established

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Research institute: DTI, ALLIANCE partner, Denmark. DTI was the primary mentor of the case and facilitated contacts to seaweed growers in Denmark ultimately resulting in a bilateral agreement between a Danish startup and case owner of case 1 for sustainable raw material supply thus facilitating access to and reliable supply of biomass

Research institute: KTH, ALLIANCE partner, Sweden. Discussions on extraction methods

Research institute: University of Gothenburg, ALLIANCE partner, Sweden. Discussions and testing of extraction methods.

Research institute: GEOMAR, ALLIANCE partner, Germany. Performing and optimization of differential extraction methods using GEOMAR´s accelerated solvent extraction (ASE) device, Knowledge transfer, networking

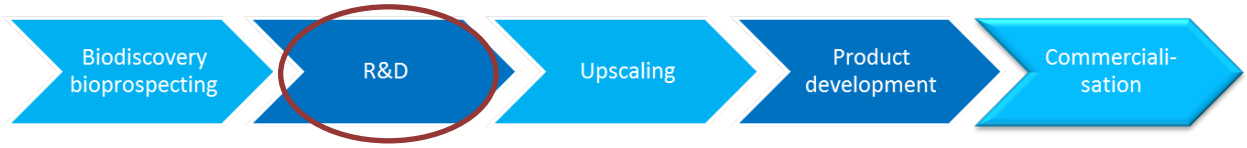
Research Institute, Kiel University, Germany, no role in ALLIANCE: bioactivity tests of extracts

Startup: Organic seaweed, Denmark, ALLIANCE case owner: provision of sustainably harvested raw material

Initial Case Needs when approaching the ALLIANCE

- Support with providing some contacts of seaweed growers in Denmark
- Analysis & development of the seaweed extract and cultivation issues, with seaweed networks. Assistance with analysis of high-value compounds and documenting effects
- Expertise in terms of EU regulations with regards to marine biomass products

TRL estimation when approaching ALLIANCE



R&D

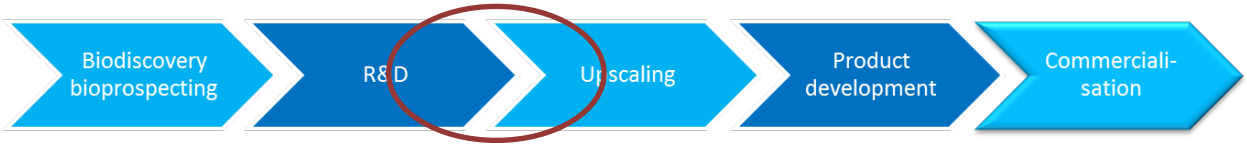
Estimated time frame for realisation:

□ short term (<1 year), **X midterm (1-3 years)**, □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Extraction (ASE)	GEOMAR	
2.	Antioxidative activity tests		Kiel University
3.	Biomass supply	Organic Seaweed	

TRL estimation after ALLIANCE involvement



Product development

Estimated time frame for realisation:

X short term (<1 year), □ midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

Transnational impact

The transnational impact was significant, because of the success factors i) commendable project management, ii) excellent networking and iii) fruitful events in general. The impact included also direct bilateral business opportunities (biomass supply: ”Organic Seaweed AP” and marketing: ”Furcella”).

Scientific successes, most prospective blue biotech areas within BSR

No measurable scientific success, however, strengthening the sustainable use and production of regional marine biomass (macroalgae) within one of the most prospective blue biotech area, natural cosmetics in the BSR.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

Fostering sustainable cultivation and sampling of Fucus sp. relieving the pressure on natural marine biotopes.

Financial/Legal barriers and solutions found

Legal barrier: No sampling of *Fucus* sp. brown algae possible from German coast because of environmental protection status
Solutions: i) Supply by the Danish company ”Organic Seaweed”, which established a sustainable harvesting theme, ii) Own cultivation of Fucus, iii) sampling of beach cast

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.))

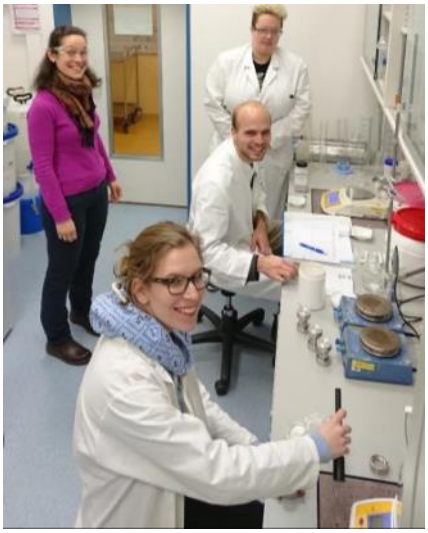
One big progress was finding innovative enthusiastic scientific institutions and companies from the BSR, with whom we are able to find solutions for different problems.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

CRM recommends to integrate more actively relevant stakeholders from the industries, where the cases are players or want to be players, as well relevant stakeholders from the target markets the cases want to approach. Despite some IP issues or reservation against contacts with ”big players”, which are manageable, the integration of these stakeholders will give extremely important insights into the demands, principles and peculiarities of specific industries and markets. In consequence, understanding the industries and markets better, the developments can be oriented more targeted and access to the market will be easier.

Images showing CRM employees collecting seaweed and

in GEOMAR labs preparing extraction by the ASE.



Case 02-BioVento: Highlights

The case study of Biovento was undertaken to explore the antifouling (AF) potential of at least two species of marine microalgae. Marine biological fouling can be defined as the accumulation of microorganisms, plants, and aquatic animals on artificial surfaces immersed in sea water. In the case of ships, biofouling is an unwanted phenomenon which may cause several problems such as increased fuel consumption due to increased water resistance, as well as increase in weight; in aquaculture - reduction of water exchange through net mesh. The main objective of Biovento was to assess the antifouling potential of its extract as a natural antifoulant, and the second objective was to identify the molecular structures of those antifouling compounds. The impact of biofouling in marine habitats drives a number of the significant problems that our society faces in both water pollution and the emission of greenhouse gases. Most notably, accumulation of biomasses on ship hulls increases drag, which directly correlates with increased fuel consumption. Biofouling on structures like ships not only increase ownership costs but are also accompanied with environmental pollution through increased emission of gases like carbon dioxide, carbon monoxide, and sulfur dioxide and is also involved with transport of invasive species. Remediation of biofouling on ship hulls only costs approximately € 120 billion per year.

The results of Biovento´s case confirmed the potential antifouling activity of the extracts from *D. salina* and two other microalgae species, observed for a diatom species and in the extracts a series of unsaturated and saturated 16- and 18-carbon fatty acids was successfully identified. In contrast to the persistent toxic effects of tri-butyl tin (TBT) and other biocides, natural antifouling products have reversible or low toxicity and non-residual effects, which could be a promising source of environmentally friendly antifoulants.

Contribution of mentors and ALLIANCE to case progress

The mentors contributed to the case progress by actively promoting communication and mediating the specific ALLIANCE service offer towards the case owner. The mentors further advanced the case by providing support in terms of IPR regulations. One of the central questions for this case was to learn how EU regulations (pesticides) are translated to national guidelines/regulations in this case in Poland, and it was therefore crucial to have a Polish business park as a primary mentor who is specialized in the development of entrepreneurship.

Both mentors jointly organized telephone conferences including all ALLIANCE partners which offered help; implementation of this offer was however partially delayed due to communication problems.

Contribution to Sustainable Development goals

The area of Biovento´s research covers strictly the following sustainable development goals: 13-Climate action and 14-Life below water. The majority of antifouling paints currently in use are based on biocidal agents that induce general toxic responses in the marine environment associated with heavy metal toxicity and antibiotic toxicity, among others. Considering this, a need to develop alternative non-toxic and environmentally friendly AF agents arise in line with the EU Biocidal Product Regulation (EU) 528/2012.

Comparative case analysis

Transnationality. The case owner of Biovento comes from Poland and the case received ALLIANCE support from Germany, Denmark, and Finland.

Type of ALLIANCE service provided. The ALLIANCE supported the case by consultation on the experimental progress and by feedback and advice on product development. Beyond mentoring, the type of support received by Biovento was technical support (like 19 other ALLIANCE cases) as well as legal support (6 further cases), business support (16 other cases) and networking (21 cases).

Biovento´s aim is to develop an antifouling paint on the basis of microalgal extracts. Therefore the target market is the maritime sector as well as the acquaculture sector, both of which are strongly affected by biofouling. Since most antifouling paints nowadays contain metal (copper)-based ingredients as biocidal agents after the ban of tri-butyl tin (TBT), the development of a biobased antifouling paint has high market potential. There are however already “big players” as competitors on the market selling biobased antifouling paints; none of them is however relying on an microalgal extract. The range of potential customers for products from this case is very broad; it includes B2C, i.e. private end customers (sports yachts), the maritime sector on a B2B basis such as shipbuilding/wharfs and potentially also the aquaculture sector where these paints could be applied to prevent biofouling on pipes. The private sector was targeted by 10 other ALLIANCE cases, whereas B2C relationships were envisaged by 21 ALLIANCE cases.

Biological resource used. Biovento uses microalgae as biological resource just as 6 other ALLIANCE cases.

Type of product. Biovento aims at development of a product, rather than a service or energy. This is also true for 20 other ALLIANCE cases.

Individual progress. When Biovento became a partner in the ALLIANCE, it was estimated to be in Biodiscovery/Bioprospecting stage. After 3 years of ALLIANCE support, it now is in R&D stage which means it has advanced 1 step.

SUMMARY: Case Biovento

Case and mentor information

Case Name: Biovento, case #2

Product: A fresh coat of paint: Biovento's search for algae inhibitors.

ALLIANCE mentor(s): PSEZ Pomeranian Special Economic Zone, BioCon Valley GmbH

Type of ALLIANCE support (mentoring/implementation of case/financial support): Mentoring (PSEZ Pomeranian Special Economic Zone, BioCon Valley GmbH), financial support (25 000 €), technical support, business support

Duration of ALLIANCE support: March 2016 until end of project

Success factors

Marine biological fouling, usually termed marine biofouling, can be defined as the accumulation of microorganisms, plants, and aquatic animals on artificial surfaces immersed in sea water. In the case of ships, biofouling is an unwanted phenomenon which may cause several problems such as increased fuel consumption due to water resistance, as well as increase in weight; in aquaculture, reduction of water exchange through net mesh, occurs. To prevent the attachment of fouling organisms, antifouling paints have to be developed and used.

The isolation of biogenic agents produced by several species of micro- and macroalgae and marine invertebrates with antibacterial, antialgal, antiprotozoan and antimacrofouling properties may be the most promising and effective method for the prevention of biofouling. The isolated substances with the most potent antifoulant activity are fatty acids, terpenes, terpenoids, lipoproteins, glycolipids, phenols, lactons, peptides and steroids. The advantage of the utilization of micro- and macroalgae for the isolation of biogenic agents is that algae can be cultivated in a short time in mass culture, independent of season. Furthermore, they can be manipulated to a large extent in the direction of the 'production of biogenic agents'. The present study was undertaken to explore the antifouling potential of at least two species of marine microalgae. The

main objective was to assess the antifouling potential of its extract as a natural antifoulant, and the second objective was to identify the molecular structures of those antifouling compounds.

Barriers to be overcome

Due to the difficulties in producing natural anti-fouling compounds at a reasonable cost to meet practical needs, natural antifouling paints are not currently in commercial use.

The industries certainly request a potent antifouling system with long durability (at least 5 years), cost effective, easy for application and non-toxic to marine ecosystem.

Natural products can be successfully used for antifouling applications by incorporating in a suitable paint. However, preparation of an antifouling coat using microbial products is a major challenge as these compounds will breakdown rapidly in the environment. Finding a best way to increase the durability of the compound when applied as antifouling coating may provide more opportunities for natural product based antifouling systems.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Research institute: SYKE, ALLIANCE partner, Finland. SYKE offered supply of microalgae as bioresources/raw material

Research institute: DTI, ALLIANCE partner, Denmark. DTI offered support in growth characteristics of microalgae and bioactivity tests of different forms of coatings.

Research institute: GEOMAR, ALLIANCE partner, Germany. GEOMAR offered support in identification of microorganisms, extractions and bioactivity tests.

Research institute: University of Gdansk, ALLIANCE partner, Poland. UGdansk offered support in chemical analyses.

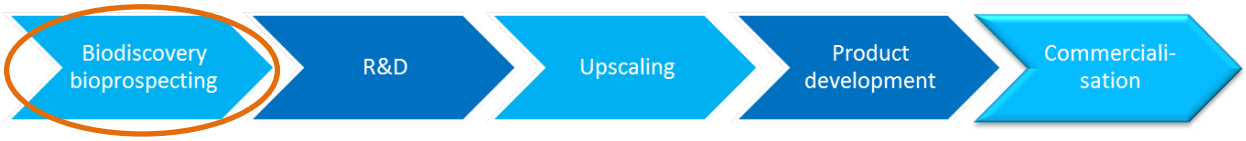
Business support organization: Pomeranian Special Economic Zone, ALLIANCE partner, Poland. PSEZ acted as primary mentor and provided support on IPR issues in Poland and offered support in generation of a business plan.

Business support organization: BioConValley, ALLIANCE partner, Germany. BioConValley acted as secondary mentor and furthermore offered support in patent profiling and advice on EU pesticide regulations.

Initial Case Needs

- Provide contacts for analysis of biofilm/ development/ antifouling on national level
- Consultation on IPR issue
- How Poland is interpreting EU regulations regards to new products which can be called ”a pesticide”
- Consultation and networking, business development
- Promotion of the case
- ”Pesticides” and biofilm/antifouling market research

TRL estimation when approaching ALLIANCE



Estimated time frame for realisation:

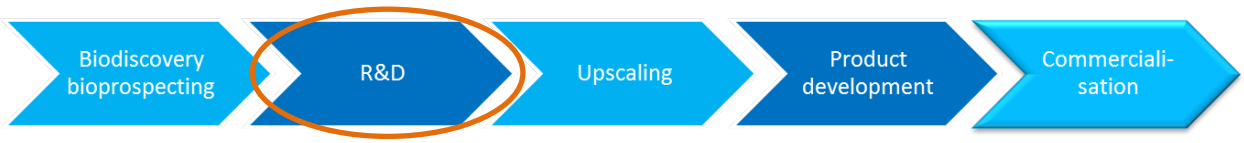
□ short term (<1 year) ■ midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Propose optimal pathway for Biovento’s case	PSEZ Pomeranian Special Economic Zone	n/a
2.	Consultation of IPR issue	PSEZ Pomeranian Special Economic Zone	n/a
3.	Consultation and networking, business development	PSEZ Pomeranian Special Economic Zone	n/a
4.	Ongoing consultations on project issues	PSEZ Pomeranian Special Economic Zone	n/a
5.	Support in identification of microorganisms,	GEOMAR	n/a

	extraction, bioactivity tests		
6.	Supply of bioresources (microalgae)	SYKE	n/a
7.	Analysis of growth characteristics of microalgae, bioactivity tests	DTI	n/a
8.	Support in patent research, advice on EU pesticide regulations	BioConValley	n/a

TRL estimation after ALLIANCE involvement



Estimated time frame for realisation:

□ short term (<1 year) ■ midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

Transnational impact

Biofouling on structures like ships not only increase ownership costs but are also accompanied with environmental pollution through increased emission of gases like carbon dioxide, carbon monoxide, and sulfur dioxide and is also involved with transport of invasive species. Remediation of biofouling on ship hulls only costs approximately € 120 billion per year.

Scientific successes, most prospective blue biotech areas within BSR

Besides the need to assure efficient anticorrosive protection painting that is compatible with cathodic protection, it is necessary to keep the ship's surface as smooth as possible in order to minimise drag resistance when the ship is in movement and thus reduce fuel consumption, which

means the need to prevent the attachment of a wide variety of marine organisms, both plants (flora) and animals (fauna). Furthermore, in recent decades the antifouling paints applied on ship hulls must not only prevent the fouling of underwater areas but must do this in compliance with emerging regulations and legislation and furthermore are required not to release biocides into the sea water. Thus, a fight against time is on (demanded by the International Maritime Organization, IMO), in an ongoing search for practically “miraculous” antifouling products.

Many marine organisms produce biogenic agents with antibacterial, antialgal, antifungal, antiprotozoan and antimacrofauling properties to defend themselves against robbers and settlement in the marine environment. Therefore, the production and isolation of biogenic substances from marine organisms seem to be the most promising and effective methods for the prevention of biofouling.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

The impact of biofouling in marine habitats drives a number of the significant problems that our society faces in both water pollution and the emission of greenhouse gases. Most notably, accumulation of biomasses on ship hulls increases drag, which directly correlates with increased fuel consumption. Thus increased fuel consumption due to biofouling has become an important topic in recent years as global warming pushes academia and industry to find alternative approaches for lowering greenhouse gas emissions.

Financial/Legal barriers and solutions found

The majority of antifouling paints currently in use are based on biocidal agents that induce general toxic responses in the marine environment associated with heavy metal toxicity and antibiotic toxicity, among others. Considering this, a need to develop alternative non-toxic and environmentally friendly AF agents arise in line with the EU Biocidal Product Regulation (EU) 528/2012, which led to increasing investigation on the field of natural AF compounds. A wide range of natural products have been screened for their potential to substitute the efficient but extremely toxic tributyltin (TBT), now banned in 27 countries.

Recent investigations on this topic permit us to recognize that microorganisms in particular are promising potential sources of non-toxic or less-toxic AF compounds, as they produce a wide-range of potentially bioactive metabolites and also have the advantage of being easy to culture and to produce in large scale in short periods of time, easily ensuring product supply renovation for commercialization.

Due to the environmentally harmful action of the well known, efficient and versatile TBT self-polishing paints, and the consequent prohibition of their application after 1 January 2003 and of their presence on ship surfaces after 1 January 2008, paint manufacturers have been forced to urgently study and develop new more environmentally friendly antifouling paints. Without seeking to be complete or exhaustive, the products with biocides that have recently been marketed for this purpose may be grouped under three main headings, namely controlled depletion paints (CDPs), tin-free self-polishing paints (TF-SPCs) and hybrid systems.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.))

The goal of this study was to find new antifouling products to replace the more environmentally damaging toxins in current use, in particular against non-target species. A detailed literature analysis was carried out in terms of scientific publications and patents. The research methodology has been developed. A series of aqueous, ethanol and dichloromethane extracts of 10 marine algae from the Culture Collections was tested for their *in vitro* anti-algal activity against the growth of 12 strains of benthic and aggregating Baltic Sea microalgae. Benthic and aggregating microalgae were cultivated (inter alia *D.salina*), which had the highest potential for production of secondary metabolites with anti-fouling activity. Microalgae cultures were not optimized for the highest productivity, because only a qualitative analysis was made. Subsequently, cultures of 12 selected microalgae species in a statistically significant amount were prepared, extracts of microalgae were prepared, bioactive components were extracted and isolated, antialgal bioassay was carried out, and components with antifouling activity were identified. Within the next two months, a business analysis is planned, the completion of a basic feasibility study to assess the profitability of scaling-up and the production of compounds with antifouling activity with application to the maritime sector.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

Microalgae are considered to be the producers of certain highly bioactive compounds found in marine resources that couple the potential prevention of biofouling with economic viability.

The results confirmed the potential antifouling activity of the extracts from *D. salina* and two other microalgae species, observed for a diatom species and the extracts were identified as inter alia a series of unsaturated and saturated 16- and 18-carbon fatty acids. In contrast with the persistent toxic effects of TBT and other biocides, natural antifouling products have reversible or low toxicity and non-residual effects, which could be a promising source of environmentally friendly antifoulants.

Case 03- Geoterma: Highlights

Geothermal water supply in Klaipeda has been operational only during the cold months of the year (December to April). To make the operation of the geothermal water facility more sustainable and profitable, the company Geoterma is exploring potential new activities and uses for the summer and autumn/spring months, when no heating services are needed in Klaipeda. Ideas to valorize the geothermal water and energy range from aquaculture – fish or shrimp cultivation – to health applications such as a thermic spa resort. For these purposes, the geothermal water has been thoroughly analyzed. In 2015 it was certified by the National Institute of Public Health-National Institute of Hygiene in Poland to be suitable for use as therapeutic water and as water for swimming pools. Several other institutes have also carried out further testing which has e.g. excluded the presence of harmful microorganisms and determined the level of radiation to be normal.

The idea of the Geoterma case was to valorize the geothermal water and energy range from aquaculture – fish or shrimp cultivation – to health applications such as a thermic spa resort. KSTP is also pursuing this target being currently on the process of preparation of the feasibility study.

Heat energy impact analysis for biological processes in closed cycle recirculation systems;

Analysis of aquaculture organism species and their justification for assessing the potential of the use of geothermal recourses for their growing in closed cycle recirculation systems;

Descriptions of the technological processes that use geothermal resources in closed cycle recirculation systems;

The analysis of the chemical composition of the geothermal water of the Klaipėda region (Geoterma) and possibilities how to use these resources in the closed cycle recirculation systems for water mineralization.

Contribution of mentors and ALLIANCE to case progress

JSC Geoterma was collaborating with scientific ALLIANCE partners such as Klaipeda Science and Technology Park (KSTP), the Finnish Environment Institute (SYKE) and the ALLIANCE lead partner GEOMAR Helmholtz Centre for Ocean Research Kiel as mentors to develop a biological model for potential uses of the geothermal water. Based on the results of these surveys,

Geoterma and its mentor KSTP within the ALLIANCE will develop a business model to transform it into a facility operating all year round. Besides looking at the uses for the geothermal water itself, Geoterma has also taken samples from the water at more than one kilometer depth, from which GEOMAR scientists have isolated microorganisms to evaluate the water as a resource for potentially novel producers of secondary metabolites and as potential cultivation medium for thermophilic/halophilic organisms. After Geoterma's withdrawal, KTSP finalizes the case of geothermal waters.

Contribution to Sustainable Development goals (SDG)

Geoterma´s case contributes to SDG-7, Affordable and clean energy, 9-Industry, Innovation and infrastructure, and 3-good health and well-being.

Comparative case analysis

Transnationality. With regard to transnationality, Geoterma (Lithuania) is collaborating with Finland and Germany.

Type of ALLIANCE service provided. Besides mentoring (25 other cases) and financing (11 other cases), Geoterma has received business (16 other ALLIANCE cases) and networking (21 other ALLIANCE cases) support from ALLIANCE mentor KSTP as well as scientific/technical support (19 other cases) from its two scientific mentors SYKE and GEOMAR.

Target application/market and customers. Initially, the target application for this case was aquaculture. However, cultivation of microorganisms / novel secondary metabolites did not yield promising results as well as analysis of the water for cultivation of microalgae; thus, the target application turned from applications in aquaculture/biotechnology towards use as a spa. Thus, from the customer field of R&D or aquaculture companies (B2B) focusing on halophilic organisms (e.g. brine shrimps, or the green microalgae *Dunlaiella salina*) towards directly targeting the end customer to improve well-being.

Biological resource used. N/A, this case does not use a biological resource, but water from a geothermal plant.

Type of product. The product envisaged at the start is the geothermal water as a combined source for energy and water in recirculating aquaculture systems (RAS) but then turned into a service for human well-being. Only 3 other ALLIANCE cases (Baltic Probiotics, EHP, Phytolinc) targeted the aquaculture sector and apart from cosmetics/nutrient additives, human well-being in a broader sense is not targeted by any other case.

Individual progress. When joining the ALLIANCE, JSC Geoterma was in R&D stage. At the timepoint of partner dropout, the case was in the same stage, since the service offer provided by ALLIANCE did not provide the expected results with regard to cultivation of microorganisms/algae or use of the water/energy in RAS. It can however be seen as a success, that the case owner decided to switch the focus of application of the water to human health/well-being.

SUMMARY: Case Geoterma

Case and mentor information

Case Name: Geoterma, case #3

Product: Geothermal waters and energy for microalgae cultivation for high value products

ALLIANCE mentor(s): KSTP (Andrius Sutnikas), GEOMAR (Prof. Dr. Deniz Tasdemir), SYKE (Dr. Jukka Seppälä)

Type of ALLIANCE support (mentoring/implementation of case/financial support): Mentoring, Financial support, technical support, business support

Duration of ALLIANCE support: 24 months (March 2016-February 2018 (dropout))

Success factors / Nonsuccess factors

Highly qualified ALLIANCE mentors could be a success indicator for this case. To reach the final result of the case it requires more funding from the owner of the case itself. Due to deteriorated economic conditions the case owner was forced to stop the company's activities.

Barriers to be overcome

The highest barriers which could in the end not be overcome, were financial barriers which also led to the partner dropout.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Research Institute: GEOMAR, ALLIANCE partner, Germany. Technical support; GEOMAR performed isolation of microbial strains from hydrothermal water, OSMAC, chemical analysis of extracts, bioactivity assays of extracts

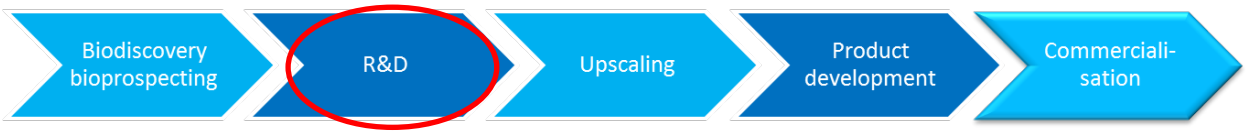
Research institute: SYKE, ALLIANCE partner, Finland. Selection of microalgae species for cultivation in geothermal water.

Business Park: KSTP, ALLIANCE partner, Lithuania. Creation of business plan, Networking, Contact brokerage to external RAS expert

Initial Case Needs when approaching the ALLIANCE

- Business model and energy utilization technologies
- chemical profiling of extracts from cultivable microbial strains; bioassays (anticancer, antimicrobial) on these extracts
- direct evaluation and utilization of cultivable thermal water bacteria for biotech purposes
- selection of species and technological solutions
- Extraction of minerals from thermal water for biotech purposes.
- Evaluating chemical content of thermal water for mineralization purposes of - Recirculating Aquaculture Systems (RAS).
- Assessment of the potential of geothermal water for cosmetic products.

TRL estimation when approaching ALLIANCE: R&D



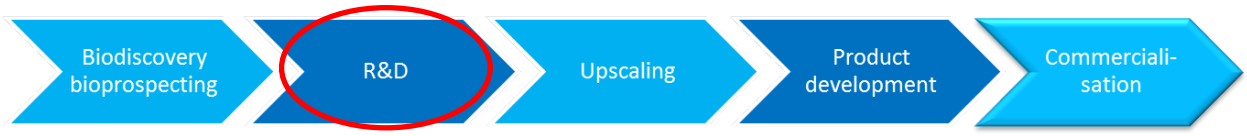
Estimated time frame for realisation:

□ short term (<1 year) ☒midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Research assistance – microbiological/chemical analysis of microorganisms cultivated from thermal water	GEOMAR (PP1)	
2.	Mentoring for business model and energy utilization technologies	KSTP (PP11)	
3.	Analysis of the commercial potential for cultivating algae using geothermal energy and thermal waters	SYKE (PP6)	
4.	Analysis of geothermal waters for shrimp cultivation/application in RAS	KSTP (PP11) -> mediating contacts	Alfred Wegener Institute, Germany

TRL estimation after ALLIANCE commitment: R&D



Estimated time frame for realisation:

□ short term (<1 year) □ midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

Transnational impact

It is important to exploit all renewable energy sources in the economic development of the Baltic Sea Region from blue biotech perspective. Depending on the source geothermal resources can provide significant amounts of heat, electricity and thermal water. It is very important for Blue biotech in transnational aspects.

Scientific successes, most prospective blue biotech areas within BSR

In this case, all the necessary geothermal water studies were not fully completed (water analysis involving a technical specialist in fish/crustacean aquaculture was not carried out). This expertise was not available within ALLIANCE and an external expert was contacted by the case owner. Partly due to the disappointing scientific results from cultivation/chemical profiling of the microorganisms from the geothermal water and the reduced potential for microalgae cultivation, the case owner changed the scope of the case towards spa/well-being applications.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

In this case, all the necessary geothermal water studies were not fully completed. However, there is no doubt that research on geothermal water will provide opportunities for biotech purposes, for mineralization purposes of RAS system and health.

Financial/Legal barriers and solutions found

The Geoterma case has not been fully implemented (partner dropout, change in application area), so the answer financial/legal barriers is not entirely possible.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.)

ALLIANCE delivered an evaluation on the cultivated bacteria from the geothermal waters and the chemical profiling of these cultivated microorganisms (GEOMAR) as well as an evaluation on suitable microalgae species (SYKE). Unfortunately, an analysis concerning fish/crustacean aquaculture (ALLIANCE external) was not completed. Both results were important components to decide for another direction concerning the case (Spa). Therefore, this case shows the importance of thorough scientific analysis before going to product development phase.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

The case did not reach the intended goals and final product/study material are not available. Future prospects are developing in the direction of using the geothermal water in spa applications.

Image showing sampling for microorganism cultivation and evaluation of microalgae by ALLIANCE partners GEOMAR and SYKE.

Case 04-Baltic Probiotics: Highlights

The Latvian company Baltic Probiotics has a successful track record of developing probiotics-based products to improve animal health. Since its foundation in 2013, the Rucava-based company has so far developed products for a number of applications in this field – uses range from veterinary medicine for domestic pets to animal husbandry such as cattle rearing. These all-natural products contain a powerful blend of beneficial microorganisms (up to 11 per product), enzymes and antioxidants, cane molasses, sea salt and plant extracts. The products promote animal health by improving digestion and boosting the immune system. With several successful products already on the market, Baltic Probiotics has now set its sights on the blue economy.

In a healthy natural ecosystem, about 5%-10% of bacteria are probiotics, balancing out a roughly equal number of potentially harmful pathogens at the other end of the bacterial spectrum. When setting conditions in an artificial ecosystem such as indoor fish aquaculture, it is important to bear in mind this natural balance. Baltic Probiotics is therefore developing two probiotics-based products for healthy and viable ecosystem formation in aquaculture. One product aims to improve water quality and hinder the spread of harmful bacteria, the other aims to improve fish health and digestion.

Applying the same principles as in the development of their earlier successful products, Baltic Probiotics' scientists are developing these aquaculture products combining microorganisms and probiotics. The product fed to fish will improve digestion and appetite. It will also boost the immune system of fish, making them less vulnerable to diseases and significantly shortening the recovery time after illness. As the second aquaculture product will improve water quality, in combination they will be an environmentally friendly, natural alternative to the use of antibiotics. With the help of the ALLIANCE, Baltic Probiotics hopes to bring both these products to market within two to three years.

Contribution of mentors and ALLIANCE to case progress

In the ALLIANCE project, Baltic Probiotics is collaborating with the Coastal Research and Planning Institute (CORPI) from Klaipeda, Lithuania. Baltic Probiotics is carrying out initial testing of the products in its own laboratories, fine-tuning their chemical composition. CORPI, meanwhile, is able to offer its more extensive research facilities (including a number of fish tanks) and

scientific experts during the second – broader and applied – testing phase. The aquaculture products will therefore benefit from having been tested under various conditions and on multiple species of fish. Adding a further dimension to ALLIANCE involvement, the University of Gdansk from Poland and the Pomeranian Special Economic Zone Ltd. are involved in the development process as "case mentors" providing dedicated points of contact for Baltic Probiotics within the project, able to offer advice and represent the company's interests. The dedication of the mentors and the scientific and technical support provided mostly by the mentors were critical for this case.

Contribution to Sustainable Development Goals

The case Baltic Probiotics contributes to SDG-12 Responsible consumption and production, SDG14-Life below water and furthermore to SDG-8 Decent work and economic growth.

Comparative case analysis

Transnationality. The Baltic Probiotics case is developed in Latvia in cross-collaboration with Lithuania and Poland.

Type of ALLIANCE service provided. Besides financial and mentoring support, Baltic Probiotics's case mainly received scientific/technical support from its mentor CORPI, PSEZ and the University of Gdansk. Moreover, the case owner attended the business workshops offered by the ALLIANCE thus receiving also business support.

Target application/market and customers. Baltic Probiotics aims at development of probiotics-based products to improve animal health; target market is the aquaculture sector like 3 other ALLIANCE cases. Baltic probiotics is targeting private customers (B2C) as well as the commercial (B2B) aquaculture sector. This is true for 7 ALLIANCE cases in total.

Biological resource used. Baltic Probiotics is relying on a synthetic community of bacteria which are used as probiotics to improve fish health. Since bacteria can be fermented in the lab in large quantities, the case product relies on a fully sustainable resource. Bacteria are also used as biological resource in 3 other ALLIANCE cases.

Type of product. In frame of the ALLIANCE, this case developed a marketable product which was presented to the ALLIANCE partners during the Klaipeda partner meeting and is currently on sale. 3 other cases (Furcella, CRM, Biome) showed similar progress and have a prototype or a ready-to-sell product after ALLIANCE support.

Individual progress. When joining the Alliance, Baltic Probiotics case was initially allocated at R&D. After ALLIANCE involvement, it is now in commercialization of the product, thus reflecting a significant advancement of this case

SUMMARY: Case Baltic Probiotics

Case and mentor information

Case Name: Baltic Probiotics, Case #4, PP21,

Product: Development of probiotics for agriculture (indoor aquaculture), waste-water treatment, odor control, livestock and pet supplement. A biological preparation containing effective microorganisms, fermented herbs and phyto-ferments for improving the microbiological quality of water - Smart Fishery

ALLIANCE mentor(s): Coastal Research and Planning Institute (primary), University of Gdansk and Pomeranian Special Economic Zone

Type of ALLIANCE support (mentoring/implementation of case/financial support):

Besides, mentoring and financial support, Baltic Probiotics primarily received scientific/technical support from the ALLIANCE but also business support and networking.

Duration of ALLIANCE support: during entire project implementation period (2016-2019)

Success factors

Success factors in this case were the complementarity of the interests of scientists (CORPI, support provided in frame of ALLIANCE has high potential for further own development after the project implementation period) and the case owner (SME, development of new product). Thus, the activities resulted in a product development up to marketing stage. For marketing purposes, scientifically based information is available. Positive feedback of product users was already received by the case owner.

Barriers to be overcome

Regulatory Framework for the registration of specific products in the European Union.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Research institute: CORPI, ALLIANCE partner, Lithuania. CORPI acted as primary mentor and furthermore provided mainly scientific and technical support (experiments)

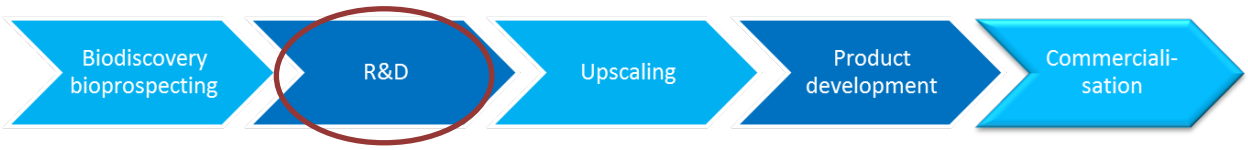
Research institute: University of Gdansk, ALLIANCE partner, Poland. UniGdansk provided scientific and technical support (DNA analyses) to the case owner.

Business support park: PSEZ, ALLIANCE partner, Poland. PSEZ provided business support to the case owner.

Initial Case Needs when approaching ALLIANCE

- Laboratory experiments in model system to develop effective products for aquaculture: prevention of diseases, higher survival and growth rates of organisms
- Scientifically based information for product marketing

TRL estimation when approaching ALLIANCE



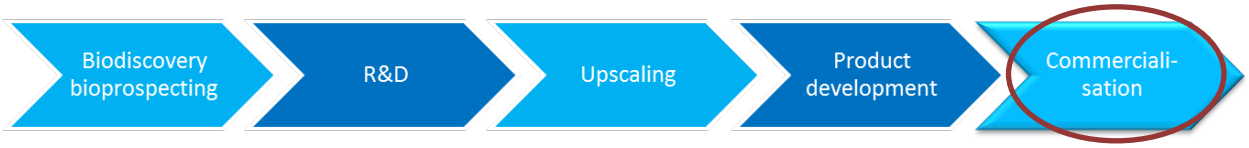
Estimated time frame for realisation:

□ short term (<1 year) ■ **midterm (1-3 years)**, □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	**Involved ALLIANCE partner**	**External expertise**
1.	Scientific testing of the product	Coastal Research and Planning Institute	n.a.
2.	Scientific analysis (DNA)	University of GDansk	n.a.
3.	Networking, business support	PSEZ	n.a.

TRL estimation after ALLIANCE commitment



Estimated time frame for realisation:

□ short term (<1 year) ■ **midterm (1-3 years),** □ long term (>5 years), □ very long term (>15 years)

Transnational impact

Considering the specificity of the product developed within the project, the involvement of an international experts is very important for successful development of the product and information preparation for marketing purposes.

Scientific successes, most prospective blue biotech areas within BSR

The scientific experience of the case development will became a background for further development of blue biotech applications in RAS and open aquaculture systems. Several ideas for further testing are in development stage and will be developed after the project implementation (complementary effects of salinity and probiotics in RAS, development of shelfish aquaculture, etc.)

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

Use of product developed within the project has positive impact on the environment and food chain in general. Benefits of use of Smart Fishery (a biological preparation containing effective microorganisms, fermented herbs and phyto-ferments for improving the microbiological quality of water):

- ✓ Limit the spread of pathogens and fish diseases. Scientifics researches concluded that Smart Fishery reduces spread of following pathogens: *Aeromonas hydrophila, E.coli, Staphylococcus aureus, Streptococcus pyogenes, Enterococcus faecalis, Pseudomonas aeruginosa, Pasteurella multocida*, *Mannheimia haemolytica etc.*
- ✓ Creates favorable feeding conditions to increase fish weight. Researches show significant impact of use of probiotics-based products on pikeperch (*Sander lucioperca*) and common

carp (*Cyprinus carpio*) length, mass and general conditions both in recirculating aquaculture system and pond system. In case of use of probiotics-based products fishes were longer (up to 6.4 %) and mass was bigger (up to 18.6%) comparing with control (growing without probiotics).

- ✓ Positive impact on morphology of fish digestive system. Researches confirm a positive impact of use of probiotics-based products on morphological parameters of two fish species (carp and zander) such as diameter of intestine, villi and crypt depth length.
- ✓ Eliminates the causes of pollution (inhibits the formation of ammonia and hydrogen sulphide).

Financial/Legal barriers and solutions found

Legal barriers are related with registration of the product as complementary feed for fishes. The legislative framework is limited for the registration of specific microbiological products. During the project implementation it was decided that product for improving water microbiological quality will be developed instead of complementary feed.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.)

Support by ALLIANCE is mostly related with consultation of experts and scientific testing of the product. This allowed to process the product development significantly from R&D up to the marketing stage.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

For development of specific products like probiotic based preparations, financial investment and scientific support is crucially important to make justification of benefits of use of product.

Images showing the effect of the probiotic product developed by Baltic Probiotics on fish biomass (upper left), a tank where the experiments were conducted (at CORPI premises, upper row, middle) and the label of the two newly developed product in frame of ALLIANCE (bottle in upper row, right and lower row).

Case 05- Kalundborg Utility: Highlights

Kalundborg Utility owns facilities with a large microalgae testing and production capacity (ten separate photo bio reactors, of which 8 are operational. Further, Kalundborg Utility has access to different water sources such as industrial waste waters, municipal waste waters, fresh water and sea water as well as different advanced waste water treatment facilities and possibilities to supply water “designed” for specific purposes.

The facility was established under a previous EU funded research project, and run by the Municipality of Kalundborg. Presently, Kalundborg Utility would like to ensure the continued operation of the microalgae facility by making it a test and research facility for product development by various actors from around the Baltic Sea. Therefore, the case needs cooperation and expertise to evaluate the facility’s real potential as well as identify organizations that might be interested in renting the facility.

ALLIANCE support resulted in a technical evaluation of the facility, including an overview of the functionality/operability within the facility and technical needs for improvement. In terms of business support, the development of this case was substantially impeded by a long process of transferring the legal ownership of the facility to Kalundborg Utility. This also affected the

mentoring process, as the mentors often had to await development on the case owner´s side. However, cooperation in general and the technical part of the mentoring went well and as planned.

Contribution of mentors and ALLIANCE to case progress.

As stated above, progress in this case was hampered due to unclear legal situation of ownership of the facility and the necessity to transfer the ownership to the case owner. This is a process in which even the mentors could not be of much support since it involves only two legal entities, namely the case owner and the vendor of the facility requiring a purchase which is entirely falling under national, in this case Danish, law. After this was clarified, the primary, national mentor (DTI) was crucial for technical support in terms of experience in microalgae cultivation and evaluation of operability of the facility and the secondary mentor significantly supported the case in networking, so that the availability of the facility for microalgae cultivation is now marketed on a BSR- and even EU-wide scale.

Contribution to Sustainable Development goals (SDG)

The case Kalundborg Facility contributes to SDG-8, Decent work and economic growth (generation of jobs for technicians and scientists for operating and optimizing microalgae production in the facility for various biotechnological applications), SDG-12, Responsible Consumption and Production (microalgae cultivation can serve as a sustainable basis for numerous biotechnological applications).

Comparative case analysis

Transnationality. Although mainly focusing on the national Danish market, the case collaborated with Germany (SUBMARINER Network, network and promotion of the facility) and Estonia.

Type of ALLIANCE service provided. Beyond financial support, case Kalundborg received technical support primarily by their primary mentors (DTI) as well as business support (development of a business plan) from the Estonian ALLIANCE partner Tartu Biotechnology Park. Pan-European networking support was offered by the case´s German secondary mentor, SUBMARINER Network.

Target application/market and customers. This case aims at providing a service for acquiring customers who then use the facility for cultivating microalgae. For addressing several different questions, the facility has access to different sources of water for cultivation, which opens up a plethora of different potential uses. Target customers of Kalundborg are R&D but also the commercial sector (SMEs, startups) for development of biotechnological since microalgae are among the most diversely used bioresources for creating added value. In the ALLIANCE case portfolio, this was one out of 5 cases aiming at providing a technical solution .

Biological resource used. Biological resource to be cultivated in Kalundborg Utility are microalgae. Microalgae are also the biological respource used in 6 other ALLIANCE cases.

Type of product. Kalundburg case aims at providing a service (4 ALLIANCE cases) rather than development of products or energy from a biological resource. Implementation of the service, i.e. using the facility for microalgae-cultivation and valorization of the cultivated algae may in the future lead to both contribution to bioenergy and many products.

Individual Progress. Kalundborg is a case of the first generation of ALLIANCE cases. When joining the ALLIANCE, it was between R&D and Upscaling but could be advanced until it reached the upscaling status.

SUMMARY: Case Kalundborg

Case and mentor information
Case Name: Kalundborg Utility, case #5

Product: Putting the microalgae cultivation test facility to new use

ALLIANCE mentor(s): DTI, SUBMARINER Network

Type of ALLIANCE support (mentoring/implementation of case/financial support):

Mentoring, financial support (as case partner), technical evaluation and support, promotion and communication activities to attract potential new users on BSR and EU level – develop description and information material about the facility, technical specifications, available side-streams, running costs and rental prices (these last two concern information known only by the case owner) business development support

Duration of ALLIANCE support: 03/2016 – until the end of project

Success factors

The technical possibilities and limitations for algae cultivation in the facility is known
The rental of the facility is possible (ownership issues are overcome)
The facility is marketed on the EU and BSR market and available for hire/contractual agreements.
Kalundborg Utility receives some form for income originating from the facility.

Barriers to be overcome

Ownership needs to be clarified between Kalundborg Utility (which owns the land surrounding the facility) and Kalundborg Municipality (which owns the facility)
Transfer of knowledge regarding the running of the facility and operative functions of the equipment needs to be de-mystified
Legal practicalities regarding the types of water used in the facility and the water cleaning plant management and access to the facility need to be clarified

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Research institute: DTI, ALLIANCE partner, Denmark. DTI was mentoring the case as primary mentor and provided technical support (expertise in microalgae cultivation, evaluation of operability)

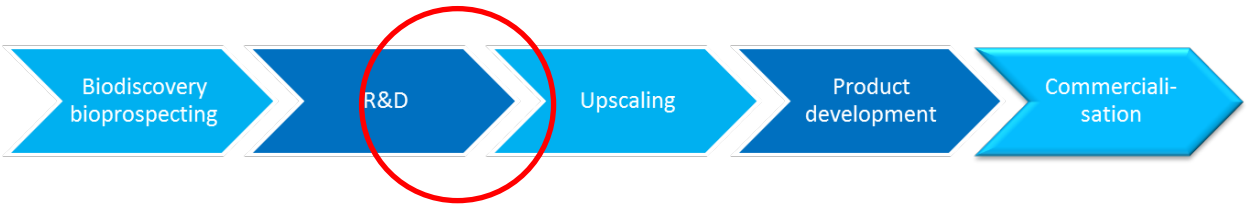
Business Park: Tartu Biotechnology Park, ALLIANCE partner, Estonia. TBP gave support in creating a business plan

Network: Submariner Network, ALLIANCE partner, Germany.

Initial Case Needs

- Technical Analysis and algae culture expertise to determine state of condition of equipment and functional capacity
- Regulation to clarify potential operational restrictions and possibilities
- Business development to define the level of development and maturity for a business model for the rental of the facility
- Communication and dissemination to create information materials, disseminate to new networks at EU and BSR level for increasing the visibility of the facility and attracting potential customers for its rental

TRL estimation when approaching ALLIANCE



Estimated time frame for realisation:

□ short term (<1 year) **X** midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Technical analyses and algae culture expertise	DTI	
2.	Regulation	Kalundborg Utility	
3.	Business Development	TBP, Kalundborg Utility	GAIA
4.	Communication and dissemination	SUBMARINER	

TRL estimation after ALLIANCE commitment

Estimated time frame for realisation:

□ short term (<1 year) **x** midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

Transnational impact
Facilities of this size and type are not to be found anywhere – opening the facility to transnational collaboration will increase the capacity of the BSR for micro algae cultivation on large pilot scale or semi-commercial production scale

Scientific successes, most prospective blue biotech areas within BSR
Technical successes: Kalundborg Utility has now an overview of what is functioning within the facility and what needs to be improved or replaced in order to function.

Administrative success: Kalundborg Utility is now the legal owner of the facility

Prospective blue biotech areas: production for algae biomass for specific application or compound extraction

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

Although the case results do not have direct impact to a certain industrial sector, this case represents a good example for an indirect potential contribution to a variety of sectors. Due to

the wide applicability for valorization of microalgal products, the results of this case (an operable, functioning microalgae culturing facility) may be the basis for sustainable transnational production processes and value chains.

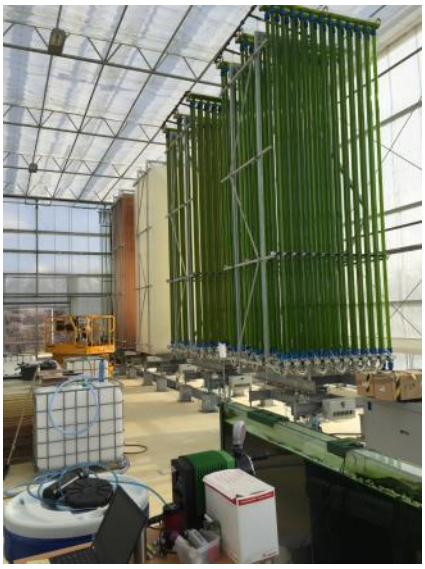
Financial/Legal barriers and solutions found

The largest barrier in this case was the unclear ownership and the tedious process to transfer the legal ownership of the facility to the case owner. This was finally solved by acquisition of the ownership to the case owner. As soon as this was settled, the case owner could start with acquisition of customers for using the facility.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.))
The most substantial outcome is the transfer of legal ownership to the case owner. First customers showed already interest in using the facility. The most important lesson which can be learned from this case study is, that clarity about the legal status/ownership of a company/enterprise/facility is absolutely critically important for a successful implementation of the case. This is especially true for such a fast-developing sector like blue biotechnology. Many cases within the ALLIANCE project have been focusing on valorization of microalgae for various applications. Cross-linking these cases with Kalundborg would have significantly advanced all sides, but was impeded by the unclear legal situation. This also hampered transnational cooperations.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development
For this case, a transnational approach is believed to be crucial. Within the Baltic Sea region, there is a plethora of biotechnology ideas relying on microalgae cultivation but the lack of cultivation facilities for generating the biomass required in a sustainable way. This is offered by this case so the future economic prospects for the service provided by this case are immense.

Image showing microalgae cultivation devices at Kalundborg facility during a mentor´s visit.



Case 06- Biome: Highlights

During the ALLIANCE project, BIOME, a Lithuanian start-up, has developed a method which allows to prepare hydroxyapatite from blue mussel shells with high yield by means of hydrothermal synthesis. Reusing and transferring blue mussel shells, commonly regarded as waste, into a valuable biomaterial - nanohydroxyapatite - is an innovative approach of sustainable use of marine resources, and a perfect example of a circular economy. Although there are some farms culturing blue mussels within the Baltic Sea region, the infrastructure for collection and reusing of mollusk shells is weakly developed or non-existent. As stated above, mollusk shells are regarded as sea waste without further use and therefore the market potential for using them e.g. in regenerative medicine can be regarded as very high. The method developed by BIOME will allow a reuse of mussel shells with ca. 98.7% output.

The quality of the products generated by the BIOME method can be regarded as very high, the biogenic nanohydroxyapatite BIOME has obtained, meets the requirements of the ISO 13779 standard. This opens potential markets for for biomedical applications, including but not limited to bone tissue regeneration, coating, tooth pastes, etc.

In frame of the ALLIANCE, the case has developed two prototypes – hydroxyapatite obtained from mussel shells and a bone graft substitute made from modified cellulose and shell-derived hydroxyapatite. Both prototypes were presented by Submariner Network on 09.10.2018 in Brussels at the European Week of Regions and Cities to promote successful network's products.

Contribution of mentors and ALLIANCE to case progress

As primary mentor, KSTP fostered transnational collaboration in mediating contacts to the ALLIANCE network: BioConValley, Germany for patent research and Submariner Network for presentation of the developed prototypes. The primary mentor further supported the case by generating a business model and in finding new potential markets. The international secondary mentors (CIIMAR, Portugal) contributed with detailed information on the use of blue mussel shells and established contacts outside the Baltic Sea region, which may be relevant during further product development. Tartu Biotechnology Park, Estonia, who co-organized the sTARTUp day, and invited the case to present their developments on a regional scale thus significantly contributing towards visibility and promotion of the case.

It can be stated without doubt, that participation in ALLIANCE has substantially advanced BIOME´s product development. Furthermore, ALLIANCE provided legal support in terms of a patent research and networking support (22 cases in total). Professional advices concerning business development (also given to 16 other cases), IPR and product development questions, B2B sessions with ALLIANCE business consultants were the most important for this case.

Contribution to Sustainable Development goals (SDG)

This case clearly contributes to SDG9- industry, innovation and infrastructure, since it aims at developing an innovative product out of a biomaterial which is otherwise regarded as waste. By this, it further contributes to SDG12-Responsible consumption and production and 14-Life below water.

Comparative case analysis

Transnationality. From a transnational point of view, BIOME is situated in Lithuania; ALLIANCE cross-collaborations have been established to four other countries, Sweden, Germany, Estonia, and Portugal.

Type of ALLIANCE service provided. Beyond the mentoring, BIOME received from the ALLIANCE technical support (just like 19 other cases), legal support (provided to 7 cases in total), business support (17 cases in total), networking (22 cases in total) incl. promotion of the products/prototypes (13 cases in total).

Target application/market and customers. BIOME's target application is the development of medical products, using marine animals (mussel) as a biological resource. Within the ALLIANCE case portfolio, only two cases aimed for development of medical products as a final product. Target costumer of BIOME is not necessarily restricted to one sector. The medical/pharma as well as the cosmetic sector can be identified as potential target markets, since hydroxyapatite products from mussel shells cannot only be used as a natural material for bone grafts in regenerative medicine, but also open up new application areas like toothpaste etc.

Biological resource used. BIOME´s approach represents the only ALLIANCE case aiming at a use of marine animals or their by-products. However, it is one out of three cases which searches a utilization of material which is generally regarded as waste.

Type of product. The two prototypes developed during ALLIANCE by BIOME, i.e. hydroxyapatite obtained from mussel shells and a bone graft substitute made from modified cellulose and shell-derived hydroxyapatite, can be classified as products rather than service or energy just like 20 other cases within the ALLIANCE aiming at development of a product.

Individual Progress. When joining the ALLIANCE, BIOME´s case was in bioprospecting/biodiscovery stage. They were in need for technical and legal help as well as support in business development, and networking. Due to the ALLIANCE´s contribution, BIOME could finish the R&D stage with development of two prototypes and is now ready for upscaling their production. This is in accordance with their own plan and estimation, which initially estimated 3 years until the upscaling or further commercialization.

SUMMARY: Case Biome

Case and mentor information

Case Name: Biome, case#6

Product: Baltic Sea Mollusc Shells for Bone Tissue Engineering

ALLIANCE mentor(s): Andrius Sutnikas, KSTP; Joana Moreira-Silva, CIIMAR; Mariann Nõlvak, TBP.

Type of ALLIANCE support (mentoring/implementation of case/financial support): Mentoring, business support, networking, financial support

Duration of ALLIANCE support: October 2016 until end of project

Success factors: Generally, mollusk shells are sea waste. We have developed the method which allow to prepare hydroxyapatite from blue mussel shells with high yield by means of hydrothermal synthesis. Characteristics of biogenic nanohydroxyapatite we've obtained meet the requirements of the ISO 13779 Standard. It means it can be used for biomedical applications, including but not limited to bone tissue regeneration, coating, tooth pastes, etc. Reusing blue mussel shell waste into a valuable biomaterial - nanohydroxyapatite - is an innovative approach of sustainable use of marine resources, and a perfect example of a circular economy.

Barriers to be overcome: Need further funding to:

1. Upscale developed technology for the preparation of nano-hydroxyapatite from blue mussel shells.
2. Outsource market technical feasibility research in order to prepare market feasibility study for futher product commercialization.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation).

Business support organization: KSTP, ALLIANCE partner. Lithuania. KSTP was primary mentor and was involved in market research and generating a business model.

Business park: TBP, ALLIANCE partner, Estonia. TBP promoted the developed prototypes on a regional scale and were secondary case mentors.

Research institute: University of Gothenburg, ALLIANCE partner, Sweden. UGOT delivered several kg of mussel shells as raw material to the case owner.

Network: Submariner Network, ALLIANCE partner, Germany. Providing network links within the BSR, promoting the prototypes on an international scale

Network/Business support: BioConValley, ALLIANCE partner, Germany. Conducted patent research.

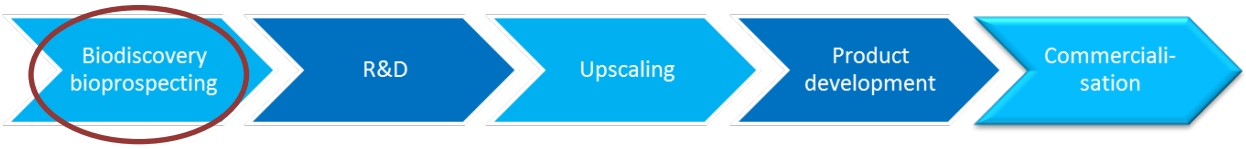
Research institute: CIIMAR, ALLIANCE associated organization, Portugal. Secondary mentor and support in application fields for mussel shells as well as provision of contacts

Research institute: DTI, ALLIANCE partner, Denmark. Searched for additional contacts for provision of raw material

Initial Case Needs when approaching the ALLIANCE

- To study the scaling of developed technology for the preparation of nano-hydroxyapatite from blue mussel shells
- To test the scaffold *in vitro* with osteoblasts for its osteoconductivity

TRL estimation when approaching ALLIANCE



Estimated time frame for realisation:

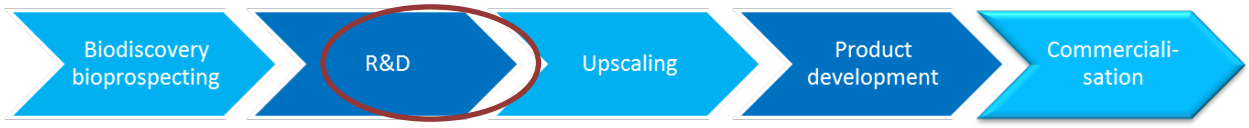
□ short term (<1 year) ☒ midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

TRL: Biodiscovery bioprospecting. Time frame for realization: midterm

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Provided blue mussels (*Mytilus edulis)*	Göran Nylund, University of Gothenburg	
2.	Patent research	BioCon Valley GmbH	Rostock University Patent Normen Zentrum
3.	Provided good contacts for future product development	CIIMAR; BioCon Valley GmbH	
4.	Mentoring for business model	KSTP	
5.	Search for shells producers	Hilary Karlson, DTI	

TRL estimation after ALLIANCE involvement



Estimated time frame for realisation:

□ short term (<1 year) ☒ midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

TRL: R&D. Time frame for realization: midterm

Transnational impact

Infrastructure of mollusk shells collection in Baltic region is weakly developed and generally, mollusk shells are sea waste. BIOME method will allow to reuse mollusk shells with 98.7% output. Characteristics of biogenic nanohydroxyapatite we've obtained meet the requirements of the ISO 13779 Standard. It means it can be used for biomedical applications, including but not limited to bone tissue regeneration, coating, tooth pastes, etc. Reusing shell waste into a valuable biomaterial - nanohydroxyapatite - is an innovative approach of sustainable use of marine resources, and a perfect example of a circular economy.

Scientific successes, most prospective blue biotech areas within BSR

1. The complete characterization of blue mussel shells was performed using different innovative analytical equipment. It was found that the shells are composed of calcium carbonate in calcite and aragonite form. Total amount of elements, such as calcium, sodium, magnesium, strontium, sulphur, silicon, chlorine, phosphorus iron, bromine and zinc was evaluated.
2. Technology for the transformation of shells powder (calcium carbonate) to hydroxyapatite was developed by hydrothermal synthesis with ammonium hydrogen phosphate.
3. It was found that the reaction results in rod-like nano HAp. The size of the crystallites depends on the synthesis time and temperature.
4. Hydrothermal synthesis at 200^{o}C for 2-4 hours is preferable for the preparation of nanoHAp from ground shells
5. Three-dimensional cellulose-based composite scaffold with shell-derived nanohydroxyapatite for bone tissue engineering was prepared.
6. Apparatuses for production of hydroxyapatite (HAp) from mussel shells were proposed.
7. Recommendations:
   - to study the scaling of developed technology for the preparation of nano-hydroxyapatite from blue mussel shells.
   - to test the scaffold *in vitro* with osteoblasts for its osteoconductivity.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

Usage of Baltic Sea waste products and conversion to high-tech products.

Financial/Legal barriers and solutions found.

To use shell-derived hydroxyapatite for biomedical applications, like bone graft substitute, means very high costs for preclinical and clinical trials. To generate revenues, the solution is to follow in parallel a low-hanging fruit strategy e.g. use the shell-derived hydroxyapatite as ingredients for tooth pastes and coatings.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.))

Product development:

- Development of technology for raw material (blue mussel shells) preparation, e.g. grounding;

- Developing of the method for transformation of calcium mineral aragonite to hydroxyapatite to enhance octeoconductive properties;
- Prototype development, e.g. formation of 3D cellulose scaffolds with hydroxyapatite derived from blue mussel shells

Patent search:

Two-step patent research provided by German patent research institution agreed with PP3 - BioCon Valley GmbH. Patent database done upon the preparation of hydroxyapatite and use in biomedical applications. Patent search has been done by Rostock University Patent Normen Zentrum. Patent search did on theme "Production and Usage of Hydroxyapatite". It was done very wide and deep patent screening in databases DEPATIS Ext. Client and DEPATISNET. The patents were searched in classes A61K/033, A61K35/618, B01J20/048, C01B25/32, C01P2004/61, C01P2004/62, C01P2004/64

Networking:

- Professional advices concerning business development, IPR and product development questions, sessions with the business consultants.
- Lead to market opinion leader from German MedTech. Very important professional advices concerning product properties and product development. The contact and connection with the company was provided by PP3 - BioCon Valley GmbH.
- Lead to director of Vilsund Blue, Mr. Søren Mattesen identifying that can processing factory has no waste disposal problem - they sell both the mussel meat and the mussel shells.
- Session between CIIMAR and Biome at Interdisciplinary Centre of Marine and Environmental Research. Collecting data about blue mussels, especially their shells usage / mussels shells as a sea waste management / plants processing. Few professional contacts from our secondary mentor CIIMAR. Possible positive impact on product development.
- By invitation from mentor we have partivipated in sTARTUp Day 2017, early-stage business festival in Tartu, and sTARTUp 2017 BioTech as a pre-event. The event focuses on business development and execution of the ideas through intensive mentoring program on site. Activities: project presentation and business matchmaking, seminars & workshops at festival.
- Two prototypes – hydroxyapatite that is obtained from mussel shells and bone graft substitute that is made from modified cellulose and shell-derived hydroxyapatite was exhibited on 09.10.2018 in Brussels at the European Week of Regions and Cities.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

It is necessary to perform market technical feasibility research identifying suppliers, material costs analysis, ISO, legal questions, industry need for outsourcing and partnerships, possible complimentary product lines, IP regime; capturing industry participants' insights and recognizing business opportunities. Technical feasibility research is needful to make market feasibility study and action plan how to uptake prepared technology to use Baltic Sea mollusk shells for bone tissue engineering.

Image showing the two BIOME prototypes (bone graft & hydroxyapatite obtained from blue massel shells) as presented during the European Week of Regions and Cities, 09.10.18

Case 07- Furcella: Highlights

Furcella OÜ is an Estonian startup, owning, developing and manufacturing the “Berrichi” products which is an Estonian natural cosmetics brand. The products combine macroalgae-based antioxidants and super oils that make a perfect blend of vitamins, minerals and fatty acids. “Berrichi” products – facial moisturizers for women and men: Day Cream, For Men, Night Cream – were developed with cooperation of the ALLIANCE partners, such as Tartu Biotechnology Park (TBP), who is the primary mentor (business support) of Furcella and Coastal Research and Management (CRM) acting as the secondary mentor (business support, product development). Furthermore, Furcella is advised by the ALLIANCE mentor Levent Piker, who has given “Berrichi” good contacts for further raw material suppliers, e.g. the retinol from the night moisturizer of “Berrichi” comes from the German supplier Chem2Market and the natural and organic oils come from All Organic Treasures GmbH (AOT). “Berrichi” is also applying for the certificate from the NaTrue certification company that is known all over the Europe. In cooperation and support on business development with CRM (Levent Piker) and scientific background of KTH for bioplastics “Berrichi” is working towards the possibility to pack the products in algae-based tubes or packages.

After one year of fruitful collaboration with ALLIANCE, partners Furcella OÜ launched its first product line, “Berrichi” in October 2017. This is also a Baltic Blue Biotechnology Alliance first marine bioproduct success - first natural cosmetics product on the market in Interreg-BSR project. With the support from ALLIANCE whole consortium partners, Furcella has managed to get international attention for their products and brand and got first international sales (Germany, Denmark, Finland, UK) in 2018.

Contribution of mentors and ALLIANCE to case progress

The role of the mentors was crucial for case progress, since both primary and secondary mentors were actively involved in implementation of the case. The case received technical as well as networking support from their mentor CRM, a German SME focusing on natural cosmetics. This case is a prime example for a potential economic competitor acting as a promotor of product development in the cosmetic sector and thus for the well-functioning ALLIANCE network. The

primary mentor significantly contributed to visibility and promotion of the case (sTARTUp Day) besides being indispensable for the case´s progress in business development.
Furcella is an example for a case, in which participation in the ALLIANCE has significantly advanced product development; within the frame of the ALLIANCE they have commercialized 3 cosmetic products and have broadened their market to Germany, where they are selling their products via an online platform.

Contribution to Sustainable Development goals
The case contributes to SDG14-Life below water.

Comparative case analysis

Transnationality. Furcella is situated in Estonia and received transnational support from Germany, Finland and Sweden.

Type of ALLIANCE service provided.
Beyond mentoring and financial support (12 cases in total) Furcella received from the ALLIANCE technical support (provided to 20 cases in total) as well as networking (22 cases) incl. promotion of the case and its products (13 cases in total).

Target application/market.
Furcella´s aim is to develop natural cosmetic products. The case addresses end consumers as clients (B2C, like 5 other cases). In the ALLIANCE case portfolio, it was one of 6 cases targeting the cosmetic sector.

Biological resource used.
The Furcella case uses Baltic Sea native red macroalgae as a biological resource. Although the case relies on wild collections, they own a permit for collection of the raw material so that sustainable harvest is ensured. Within the ALLIANCE, 7 other cases used macroalgae as bioresource.

Type of product.

Furcella clearly aims at development of a product and not a service or a form of energy. 20 other partner cases or cases accepted for mentoring in the ALLIANCE were also aiming at developing a product.

Individual Progress.

When Furcella applied to ALLIANCE, the case was in product development stage. Due to contribution from ALLIANCE, this case succeeded in commercialization of its products reflected in a marine-resource based natural cosmetic line comprising 3 products.

SUMMARY: Case Furcella

Case and mentor information

Case Name: # 7 FURCELLA OÜ

Product: natural cosmetics: anti-ageing creams (brand: Berrichi)

ALLIANCE mentor(s): Mariann Nõlvak – Tartu Biotechnology Park (TBP), Levent Piker – Coastal Research Management (CRM) and Fredrik Gröndahl - The Royal Institute of Technology (KTH)

Type of ALLIANCE support (mentoring/implementation of case/financial support):

Mentoring, financial support, technical support, business support, networking and matchmaking

Duration of ALLIANCE support: October 2016 until end of project

Success factors

Crucial for the case success was good communication and support from mentor´s side. Great support was also provided from other project partners, especially Submariner Network has helped with promotion and dissemination of information about our products and brand Berrichi. One success factor is the innovative and science-based blue bioproduct made of natural ingredients. Impressive branding and package design.

Barriers to be overcome

Sometimes it is hard to find suitable time for discussions with mentors as both sides are very busy.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Business park: TBP, ALLIANCE partner, Estonia. TBP promoted the developed products on a regional scale and served as primary case mentor. TBP also generated a business plan for the case

SME: CRM, ALLIANCE partner, Germany. CRM, although a potential competitor, served as secondary mentor and provided valuable technical and business advice concerning raw material supply

Research institute: KTH, ALLIANCE partner, Sweden. KTH started discussions on sustainable packaging material for their products.

Research institute: GEOMAR, ALLIANCE partner, Germany. GEOMAR launched a press release on occasion of the launch of Furcella´s product line, which were the first products developed in frame of the ALLIANCE project. This press release was distributed to more than 300 stakeholders thus contributing to the visibility and promotion of the products

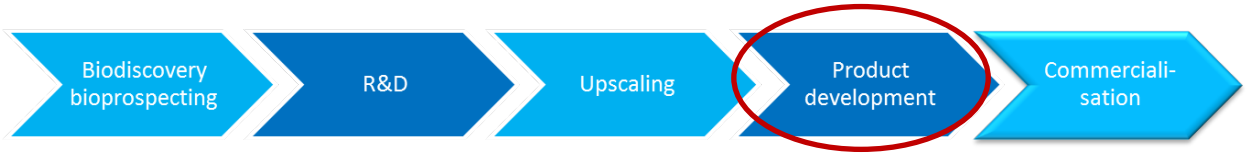
Network: Submariner Network, ALLIANCE partner, Germany. Submariner promoted Furcella´s products on an international scale.

Research institute: SYKE, ALLIANCE partner, Finland. SYKE found contacts within educational instances and universities in Finland who could make tests confirming that the Berrichi creams are allergen free and suitable to use for allergy sufferers.

Initial Case Needs when approaching ALLIANCE

- Find suppliers for raw materials – completed, CRM contribution
- Provide advice and information concerning natural cosmetics market situation and product development ideas – completed, CRM contribution
- Find sustainable package solutions – ongoing, KTH contribution
- Business plan development – completed, TBP contribution

TRL estimation when approaching ALLIANCE



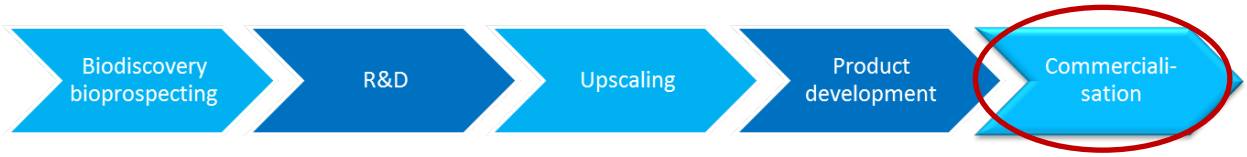
Estimated time frame for realisation:

x short term (<1 year) □ midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	**Involved ALLIANCE partner**	**External expertise**
1.	Networking, matchmaking	Case owner, TBP, CRM, SubNet and other ALLIANCE partners	
2.	Business development	Case owner, TBP, CRM	
3.	IPR and legal issues	Furcella (case owner), TBP, KTH (Legal Expert Marius Kuningas)	Trade Mark registration
4.	Marketing and promotion	All mentors supported: TBP, CRM, KTH	Branding, logo, package desig, e-shop, website, market research
5.	Product development	CRM	Product development (recepies, key ingredients), certificates

TRL estimation after ALLIANCE involvement



Estimated time frame for realisation: commercialisation is ongoing but product development is always on going

x short term (<1 year) □ midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

Transnational impact

Thanks to ALLIANCE partners and their networks Furcella is now connected with world-wide raw material suppliers. They have managed to get international attention for their products and brand and first international sales (Germany, Denmark, Finland, UK).

Scientific successes, most prospective blue biotech areas within BSR

It has been confirmed that natural cosmetics with compounds with algae are trend. Furcella´s formulas and key ingredients functions are scientifically proven.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

Ingredients are certificated and the case is working on new sustainable packaging solution (bioplastic made of seaweed)

Financial/Legal barriers and solutions found

Great support was the fact being an ALLIANCE partner with own budget. Informative discussions with Marius Kuningas concerning legal advice of IPR has helped us to sort out some concerns and start to protect own IPR.

In general Furcella´s case owners have been very open with ALLIANCE partners and *vice versa*, only using NDA is sufficient for such kind of cooperation.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.))

Products are ready and available on the market, which is really a great success. The main lesson learned is that it is very important to find appropriate and committed collaboration partners

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

Mentoring is very useful but for starting small scale enterprises like us some funding support is very important.

Images showing the case owners Janno and Berit Joosep in the labs of Tallinn University as well as the products developed during the ALLIANCE project by Furcella


BERRICHI
NIGHT
Furcellaria
50 ml / 1,76Fl.0
BERRICHI
DAY
AGE DEFENCE
Furcellaria
50 ml / 1,76Fl.0z
BERRICHI
FOR MEN
Furcellaria
50 ml / 1,76Fl.0z

Case 08- Biofisk: Highlights

The aim of the Denmark-based project "BIOFISK" is to develop new biomass-based products and create local jobs by developing the whole value chain of innovative aquaculture and sustainable fish farming in a local perspective with the island of Falster as a showcase. BIOFISK is in alignment with Guldborgsund Municipality's bioeconomy development strategy and builds upon a line of workshops and business development meetings since 2015 and is therefore strongly supported at local policy level.

The case is focused on the potential of beach cast as a cultivation media for insects for feed and needs technical assistance in analysis of high value compounds present in the beach cast and insect biomass and how they can best be utilized as well as documented for a future feed product. Further, the case needs assistance within regulation (documentation required for a new product from recycled biomass); complementary input to business plan and support in disseminating BIOFISK as a bio-economy showcase.

ALLIANCE support resulted analysis of beach cast, showing that the cast is not problematic in terms of heavy metals and can be used in bioconversion with insects for new proteins. Regulations may be problematic to the business case. Dialogue and cooperation between case owner and mentors has been excellent throughout the entire process.

Contribution of mentors and ALLIANCE to case progress

The close collaboration between the primary mentor (DTI) and the case owner was also crucial for advancing product development in this case. The contribution of DTI to this case was not only mentoring but also active technical and legal support (analysis of heavy metals in beach cast, development of formulations for insect feed). The secondary mentor Submariner Network mediated new network contacts (regional, international) which resulted in the successful participation in a new Interreg BSR project and a substantially increased visibility of the newly founded *Bioeconomy Hotspot.*

Contribution to Sustainable Development goals (SDG)

The Biofisk case contributes to SDG-14-Life below water, 12-Responsible consumption and production, 8-Decent work and economic growth and SDG9- industry, innovation and

infrastructure, since it aims at developing an innovative product out of a biomaterial which is otherwise regarded as waste.

Comparative case analysis

Transnationality. The case Biofisk cooperated most closely on a national basis with its mentor DTI, but on an international base, business support was provided by the ALLIANCE business assessment tool (SYKE (Finland), KTH (Sweden), GAIA (Finland)). Submariner Network based in Germany provided support in regional and international networking (Better off Blue conference, Smart Blue Regions conference (both Berlin, Germany), ALLIANCE conference (Greifswald, Germany).

Type of ALLIANCE service provided. Beyond financial (11 cases) and mentoring support (all 26 cases), Biofisk formally scientific/technical support (20 cases in total), business support (17 cases) and networking support (22 cases).

Target application/market and customers. The target application is an ingredient for a feed product. Accordingly, the target market is the feed market. Target customer is the commercial sector, using the formulations from the beachcast for further valorization (insect feed), which could then serve as protein source e.g. in aquaculture.

Biological resource used. Since beachcast is naturally a mixture of marine plants (mainly seagrass) and various macroalgae, it is difficult to specify a clear biological resource. Notably, like two other cases in the ALLIANCE (case 6- Biome, case 17-Movable Biogas Factory), it is valorizing biological material which is otherwise regarded as waste, thus significantly contributing to advancement in bioeconomy.

Type of product. Like 20 other ALLIANCE cases, Biofisk is aiming at the development of a product rather than a source of energy or a service. Two other ALLIANCE cases also aim at valorization of waste streams, among them one other aiming at primary producers (microalgae, cyanobacteria). The final product can be used in aquaculture applications as feed. The

aquaculture sector is targeted by 3 other ALLIANCE cases, i.e. case 24-Phytolinc, case 4-Baltic Probiotics and case 20-EHP.

Individual progress. When approaching ALLIANCE, the case was in Bioprospecting/Biodiscovery level, and at the project end it is in the transition between R&D and upscaling.

SUMMARY: Case Biofisk

Case and mentor information

Case Name: #8 BIOFISK – Bioeconomy In Organic Feed Innovation for Coastal Municipalities

Product: Beach cast as an ingredient for food or feed

ALLIANCE mentor(s): DTI, KTH, SUBMARINER Network

Type of ALLIANCE support (mentoring/implementation of case/financial support):

Mentoring, technical support, business support, financial support

Duration of ALLIANCE support: 10/2016 –until end of project

Success factors

Several factors were critical for the success of this case, especially numerous scientific/technical experiments, i.e. developing a methodology regarding collection of beach cast for analysis; collection and assessment of content and purity, analysis of beach cast for problematic compounds (heavy metals etc), identification of suitable residual biomasses in Guldborgsund Municipality for insect cultivation including beach cast, suitability test. Other success factors were the facilitation of access to a wide network and information gathering ALLIANCE partner SUBMARINER Network and project exposure in form of invitations to participate in international events as well as increased business awareness by participating in the business workshops offered by ALLIANCE. Through ALLIANCE, Guldborgsund case BIOFISK received a branding which contributed to strengthening of Bioeconomy Hotspot activities – on the international, regional and local level (Dissemination through ALLIANCE website and ALLIANCE conferences and workshops). In conclusion, participation in the ALLIANCE project has served as a stepping stone to the next blue bioeconomy collaboration “Blue Platform” and membership in the SUBMARINER EEIG Flagship Network

Barriers to be overcome

One severe barrier were regulatory restrictions concerning the cultivation of “animals” (insects) on residual biomasses – Danish interpretation of the EU regulations regarding the re-use of organic waste (e.g. deep fry oils from catering, animal fats and blood from slaughterhouses, other agricultural residuals, beach cast) for new feed formulation development due to fear of transfer of pathogens/bacteria. Generation of the business plan was a long-lasting barrier since it was dependent of the outcome of the insect cultivation (implemented in Nov/Dec 18)

Documentation for consequences of using beach cast for different applications (garden fertilizer, green manure). One possibly upcoming barrier is still to raise consumer awareness and acceptance for insects as a source of protein and other nutrition.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Research institute: DTI, ALLIANCE partner, Denmark. Technical support, heavy metal analysis of beachcast, legal support concerning regulations

Network: SUBMARINER Network, ALLIANCE partner, Germany. Networking, promotion of the case.

Research institute: SYKE, ALLIANCE partner, Finland. Business support realized via Gaia.

Initial Case Needs

- Analyses of beach cast concerning heavy metal content
- Clarifying Danish implementation and restrictions on EU regulations for re-utilization of organic waste for feed and food
- Business plan to evaluate if there is an economical prospect
- Communication and dissemination to create new networks and future collaborations

TRL estimation when approaching ALLIANCE

Estimated time frame for realisation:

□ short term (<1 year) **X** midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Methodology and analyses	DTI	EUROFINS
2.	Regulation	DTI	
3.	Communication and dissemination	SUBMARINER, DTI	
4.	Business Development workshop	SYKE	GAIA

TRL estimation after ALLIANCE commitment

Estimated time frame for realisation:

□ short term (<1 year) **x** midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

Transnational impact

If this case results in a successful value chain model, it could easily be transferred to other regions and nations in the BSR and elsewhere facing similar challenges with beach cast. Therefore, this case can be regarded as a highly economically and environmentally relevant proof-of-concept study by successful valorization of beachcast.

Scientific successes, most prospective blue biotech areas within BSR

Analyses revealed that the beach cast is not problematic concerning pathogens and heavy metal content. It can therefore be used in bioconversion experiments serving as food for insects which then serve as protein sources for feed of higher trophic levels in the feed and food sector.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

This case has clarified that beach cast can consist of very different types of marine biomass. In our case, we primarily have eel grass (zostera), which has a greater tendency to collecting problematic compounds (e.g. heavy metals), (which is good for the marine environment!). Other countries could be inspired by our work and discover that they have marine biomass that is easier to work with. The positive contribution can be seen on many levels: on the BSR level, we will reduce the dependency on soya meal transported from the other side of the world for our animal husbandry. On the BSR level, we will reduce our emission levels as the beach cast will not lie and rot on the beaches or be pushed back into the sea at the end of the season. On the local level, we will be able to valorize the beach cast by creating a PPP model for new jobs with new bio-products, based on the municipality's collection of beach cast.

Financial/Legal barriers and solutions found

Regulatory restrictions concerning the cultivation of "animals" (insects) on residual biomasses – Danish interpretation of the EU regulations regarding the re-use of organic waste

(e.g. deep fry oils from catering, animal fats and blood from slaughterhouses, other agricultural residuals, beach cast) for new feed formula development due to fear of transfer of pathogens/bacteria. If there are no positive changes in the regulatory restrictions, this may result in financial consequences for the business model regarding the uses and commercialization of the product

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.))

Substantial analysis (pathogens, heavy metals) of the biological raw material are necessary to establish valorization/novel uses of waste material. Although scientific evidence has proven, that the beachcast does not contain elevated concentrations of heavy metals, and furthermore that the Black Soldier Fly larvae are accepting a proportion of 25% eelgrass in their diet without affecting their growth rate (proof-of-principle!) existing regulations may still impose a hurdle for implementation of this case. The case is also still looking towards other possible utilization of beachcast.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

Not relevant – the case is not close to commercialization.

Images showing collection of beachcast (left) on the coast and Black Soldier Fly larvae which are fed with the beachcast.

Case 09- KosterAlg: Highlights

The company KosterAlg originates from three research projects with several Swedish universities. The enterprise was set-up by six marine biologists, specialized in marine botany, ecology and chemistry, cultivation and breeding of macroalgae and a sustainable use of marine resources. With the gathered experience of all involved in KosterAlg, the company has become an important contributor in the development of the Blue Economy, focusing on large-scale and sustainable production of macroalgae. The extensive research projects studying macroalgae as part of a biobased society initiated cultivation of macroalgae in Skagerrak (on the Swedish west coast) but also in tanks on land using deep-sea water. The cultivations produced an overabundance of biomass and the idea to take care of the surplus not used by the research, offering it as raw material on the market was born. The business idea of the company KosterAlg is to sell the biomass of several species of macroalgae to clients refining the algae to consumer products, such as food, skin/hygiene products and animal feed. The interest from the market has shown that KosterAlg has a great potential to grow and for that needs to establish its own cultivations, both in the sea and in tanks. Highlighted achievements from this case are:

- Establishment of a spin-off company from research in seaweed cultivation.
- Establishment of the first seaweed cultivation plant in a National Park in Sweden
- The company started with minimal private investment.
- An evaluation of the market structure has been initiated (new market)
- Ecological sustainable activity (no irrigation, no fertilization, no pesticides). Growing seaweeds has positive effects on the environment by nutrient and carbon uptake, oxygenation of the sea, providing habitat of marine life.
- Cooperation with the Alliance has given valuable networks and vital financial support in addition to fulfilling all case requests to the Alliance.

Contribution of mentors and ALLIANCE to case progress

Like for many successful ALLIANCE cases (e.g. Baltic Probiotics, Furcella, SFTec, Biofisk), the collaboration between case owner and mentors was extremely close. Here the mentors were actively involved into implementation of the cases. This is reflected by scientific analyses, which were performed by the University of Gothenburg; the mentors also were important in networking,

i.e. linking the case to other relevant cases (piloting with SFTec) and the business development procedure developed within ALLIANCE for generation of a business plan.

Contribution to Sustainable development goals (SDG)

The case KosterAlg contributes to SDG- 2 zero hunger, -14 life below water, -13 climate action, -9 industry, innovation and infrastructure, and -3 good health and well-being.

Comparative case analysis

Transnationality. KosterAlg represents the only Swedish case, which is cross-collaborating with ALLIANCE partners in Denmark and Germany. Case Kosteralg was one of the cases which underwent the piloting of the ALLIANCE business assessment procedure by Gaia (Finland). Products were also delivered to the German company oceanBasis (spin-off from ALLIANCE partner CRM) and sold on a special occasion related to ALLIANCE in Germany (Better off Blue conference in Berlin, Germany).

Type of ALLIANCE service provided. The KosterAlg case received ALLIANCE support in all service categories offered by the ALLIANCE, i.e. (mentoring, financial, scientific/technical, business support, legal support, networking).

Target application/market and customers.

KosterAlg's target market is the Scandinavian (short run) and European (long run) food sector; the macroalgae produced on the farm in Swedish waters are supposed to be sold to restaurants but also end users. Customers are thus the wider public (B2C) but the selling activities also involve B2B as customers (just like 6 other ALLIANCE cases). Among all cases, KosterAlg was one out of 4 cases targeting the food sector.

Biological resource used. KosterAlg uses brown macroalgae as biological resource. Macroalgae are used as biological resource in 7 other ALLIANCE cases. These algae are sustainably cultivated within the area of the Kosterhavet National Park in the Koster fjord on the Swedish West coast. Experiments for improving cultivation conditions are done in tanks in the

Sven Lovén Centre for Marine Infrastructure at Tjärnö (field research station operated by the University of Gothenburg).

Type of product. The macroalgae are used themselves as a product for selling it to the food sector. Diversification can be generated by selling the algae as a raw material for other biotechnological developments, i.e. cosmetic applications. This was already achieved by cross-linking to ALLIANCE case 1-CRM.

Individual progress. When joining the ALLIANCE, the case was in R&D stage and within the frame of ALLIANCE, they achieved commercialization of some products, although further products are still in the stage of R&D, upscaling and product development.

SUMMARY: Case KosterAlg

Case and mentor information

Case Name: KosterAlg, case #9

Product: Cultivated macroalgae for food

ALLIANCE mentor(s): University of Gothenburg (Göran Nylund, primary mentor), DTI (Hilary Karlson, Lars Jorgensen)

Type of ALLIANCE support (mentoring/implementation of case/financial support): Mentoring, scientific/technical support, financial support,business support, networking, promotion of the case

Duration of ALLIANCE support: October 2016 – February 2019

Success factors

Several success factors were crucial for the success of this case, namely:

- Developed business plan
- Products in place
- Distribution and sales to customers
- Developed network of customers
- Established dialogue with stakeholders within blue economy
- Partner in new applications with municipalities and Västra Götaland Region (SmartOcean, Marint gränsforum)
- Established organic certification (EU and national level)

Barriers to be overcome

In this case, the barriers were of differential nature: They included financial investments, legislation, i.e. permits for algae cultivation in the sea, technical aspects within the production chain. Some aspects are still existing, i.e. (preservation after harvest) needs improvements as well as production/cultivation in tanks.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Research Institute: University of Gothenburg, ALLIANCE partner, Sweden. Primary mentor, scientific/Technical support, i.e. cultivation experiments in tanks, field cultivation, nutritional analysis

Research Institute: DTI, ALLIANCE partner, Denmark. Secondary mentor, legal support, i.e. support in organic certification, clarification of food regulations

ALLIANCE business support procedure (piloting by Gaia)

SME: SFTec Oy, ALLIANCE partner, Finland. Mutual technical support; i.e. piloting drying process for algal material. ALLIANCE Case-to-case collaboration.

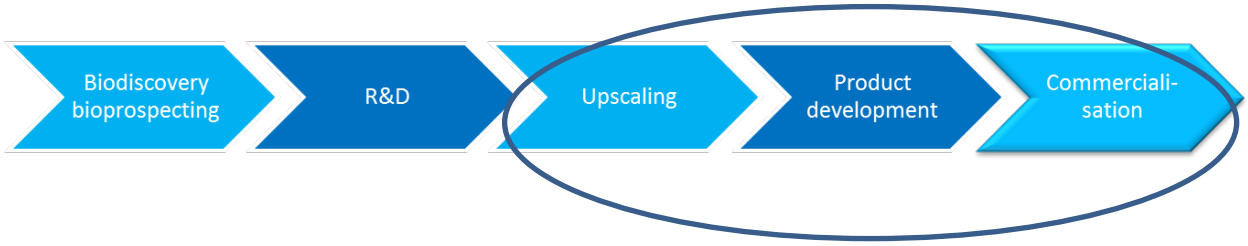
SME: CRM/oceanBasis, ALLIANCE partner, Germany. Business support, i.e. sale of seaweed (acquisition of new customer. ALLIANCE Case-to-case collaboration.

Network Support: Submariner Network, ALLIANCE partner, Germany. Promoting KosterAlg´s products as food on the International Better off Blue conference, September 2017, Berlin, Germany

Initial Case Needs

- Nutritional analysis
- Organic certification
- Food regulation
- Business plan development

TRL estimation when approaching ALLIANCE



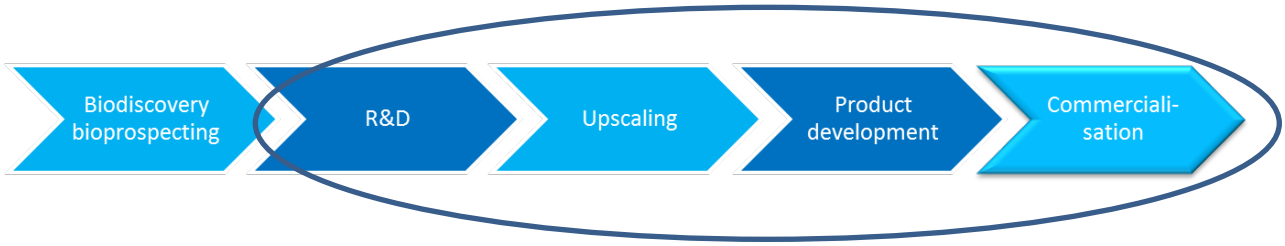
Estimated time frame for realisation:

□ short term (<1 year) □x midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Organic certification	DTI	KIWA
2.	Business plan	GAIA	Innovatum
3.	Food regulation	DTI	Swedish Board of Agriculture, Swedish Food Agency, Västra Götaland County Administrative Board
4.	Nutritional analysis	UGOT	

TRL estimation after ALLIANCE commitment



Estimated time frame for realisation:

□ short term (<1 year) x□ midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

Transnational impact

KosterAlg has promoted their seaweeds as food source in the BSR region. KosterAlg has participated in a workshop at the European Maritime Day Conference in Poole, UK 18-19 May 2017. Outside Sweden KosterAlg has delivered seaweeds to:

- OceanBasis, Germany
- Submariner for Better of Blue conference in Berlin

Submariner for promoting their network at the European Week of Regions and Cities October 9th, 2018.

Scientific successes, most prospective blue biotech areas within BSR

Not relevant for KosterAlg

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

Algae cultivation is a very sustainable way of producing biomass and perfectly in accordance with the EU Blue Growth strategy

Financial/Legal barriers and solutions found

Seaweed cultivation needs investments (€ 100 000 – 300 000). Through help from financial advisors KosterAlg is ready to seek investors within the coming 6 months.

The process for getting permits for seaweed cultivation in Sweden is complicated, unpredictable and time consuming. Together with research institutes, local and regional authorities KosterAlg is actively lobbying for making simplification of the relevant legislation.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.)

The KosterAlg case is a good example for significant advances in product development when all service types (scientific, technical, business, networking) go hand in hand. The case received from the ALLIANCE all types of support, from which the lesson learned is, that all these different types are crucially important for successful products development and commercialization, even when very short value chains (no conversion of the raw material, but direct application as food) are intended.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

It is important to conduct comprehensive market analysis

Development of cost-effective harvest and preservation techniques

Images showing a harvest barge for sugar kelp in Kosterfjord at the cultivation site (upper row left). Second picture (upper row right) shows cross-case collaboration between ALLIANCE cases SFTec (case 10) and KosterAlg (loading of KosterAlg sugar kelp to a test dryer). Lower row: Selling of KosterAlg-harvested algae on the Better off Blue conference in Berlin.

Case 10-SFTec. Highlights

SFTec Oy is a Finnish company that has developed a modular dryer that can use industrial waste heat in the drying process. It is scalable and can be transported. In ALLIANCE project they wanted to find partners to help them to develop their system further, so that it can be used to dry biomass for subsequent applications in blue biotechnology.

In ALLIANCE project a biomass market study was prepared to answer their questions about the market potential in blue biotechnology. This study presented the most important blue biomass types in Baltic Sea Region. This helped them to understand their focus areas.

By the help of BioCon Valley, SFTec visited several German companies who were in the need of a dryer technique. This did not lead to immediate partnership but was an important marketing tour and can generate business later. Contacts were also created to Swedish companies by University of Gothenburg and Estonian companies by Tartu Biotechnology Park.

Many of the other ALLIANCE cases were very interested in the dryer. With case#9 Koster Alg and case#21 Vetik OU, SFTec performed small scale pilot tests. With these tests, very important information on the drying and analysis needs was achieved. However, external funding is needed to be able to perform large scale pilots.

SFTec was also acting as a mentor to the case#17 Movable Biogas Factory, helping them to develop their technology further.

This was a success case, because they were able to open up a totally different market for their technique, blue biotechnology, received lots of information about the sector, were able to develop their process further, created new useful contacts and found a network where their product is highly needed.

Contribution of mentors and ALLIANCE to case progress

In this case, the mentors strongly facilitated the entrance into a sector which was completely new to the case owner. SYKE and the University of Gothenburg both were crucial to mediate contacts towards potential customers by cross-linking to other case needs thus mediating the generation of transnational value chains. This led to pilot experiments and cross-case collaboration with case 9-KosterAlg and case 21-Vetik.

Like in case 1-CRM, due to the experience gained during the mentoring program (translating into potential new customers and a network in the Baltic Blue Biotechnology sector) in frame of the ALLIANCE, this case owner developed into a mentor and contributed to mentoring case 17-Movable Biogas Factory.

Contribution to Sustainable Development goals (SDG)

SFTec's dryer can be related to many of the sustainable development goals depending on their customer. The most relevant for the application in blue biotechnology are: 14-Life below water, 12-Responsible consumption and production and SDG-8 Decent work and economic growth, 9-Industry, Innovation and Infrastructure and 7- affordable and clean energy. Moreover it is related to SDG 13-Climate action (if it is used in processes that store carbon), 15-Life on land (not really our target, but the dryer has already been used in nutrient recycling projects).

Comparative case analysis

Transnationality. The case SFTec Oy is based in Finland and cross-collaborates with actors from 4 other countries, namely Germany, Denmark, Sweden and Estonia.

Type of ALLIANCE service provided. Beyond the financial and mentoring support, SFTec received primarily technical and networking support. Notably, this case was also one of two cases (the other is case 1-CRM) using the experience made with the ALLIANCE mentoring program and passed it on by becoming a successful case mentor. Generation of a business plan was not necessary since it the case is a well-established SME with an existing business plan.

Target application/market and customers. The case SFTec is not developing a biotechnological product in itself but offering an important service for preparing raw marine biological material for further applications in biotechnology, i.e. drying. This drying process is often absolutely critical especially when upscaling a process for production of a blue biotech product relying on macroalgae as a biological resource. Target customers are R&D as well as SMEs, so B2B rather than B2C (like 12 other ALLIANCE cases). A single target application cannot be clearly defined for this case, since there are diverse downstream applications.

Biological resource used. The SFTec case relies on diverse resources, i.e. macroalgae and marine plants as a biological resource for their drying process.

Type of product. Since manifold downstream applications/products are possible in this case, a clear definition of a product is difficult. SFTec is developing rather a service than a product/energy just like 3 other ALLIANCE cases (4 in total).

Individual progress. When SFTec joined the ALLIANCE, it was in R&D stage and proceeded to upscaling (like 4 other ALLIANCE cases), which means a progress of 1 step. Notably, piloting experiments with potential future partners/customers have already been performed in frame of ALLIANCE (case 9-KosterAlg, case 21-Vetik) representing a further successful cross-case collaboration like in 10 other cases.

SUMMARY: Case SFTec

Case and mentor information

Case Name: SFTec Oy, case #10

Product: ModHeat dryer – affordable and efficient dryer for all needs in Blue Biotechnology

ALLIANCE mentor(s): SYKE, University Gothenburg

Type of ALLIANCE support (mentoring/implementation of case/financial support):

Mentoring and financial support, networking, technical support (cross-case collaboration)

Duration of ALLIANCE support: October 2016 until the end of the project

Success factors

First drying pilots have been implemented with blue biomass thanks to contacts provided by the ALLIANCE mentors. New business contacts have been created from different countries in Baltic Sea Region (Germany, Sweden, Estonia).

Barriers to be overcome

Providing finances.since high costs of full pilots (transportation of the equipment, staff travel costs) are not easily covered by the potential customers.

Information lacking on how the different heat sources (waste heat from industries) affect the end product (e.g. food quality)

Food eligibility of the technology needed in many cases.

Scale of the pilot is large – need of a smaller industrial scale pilot.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Research Institute: SYKE, ALLIANCE partner, Finland. Mentoring and establishment of cross-case contacts, promotion of the case via magazine article, coordination of market study

Research institute: University of Gothenburg, ALLIANCE partner, Sweden. Mentoring, Establishment of cross-case contacts to case 9-KosterAlg for pilot study.

Research institute: Danish Technological Institute, ALLIANCE partner, Denmark. Networking support

Business park: Tartu Biotechnology Park, ALLIANCE partner, Estonia. Networking support, Establishing of business contacts in Estonia

Business park: BioConValley, ALLIANCE partner, Germany. Networking support, Establishing of business contacts in Estonia.

Startup: Vetik, ALLIANCE case, small pilot study

Startup: KosterAlg, ALLIANCE case, pilot study

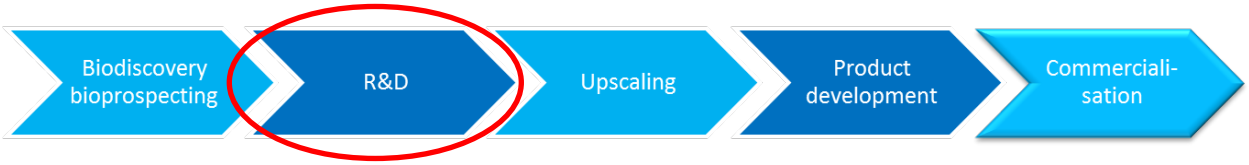
Network organization: Submariner Network, ALLIANCE partner, Germany. Providing information on marine biomass and their use for biotechnology

Initial Case Needs

- Networking
- Assistance in marketing
- Possibility for piloting

Evaluation of drying needs for different biomass sources

TRL estimation when approaching ALLIANCE



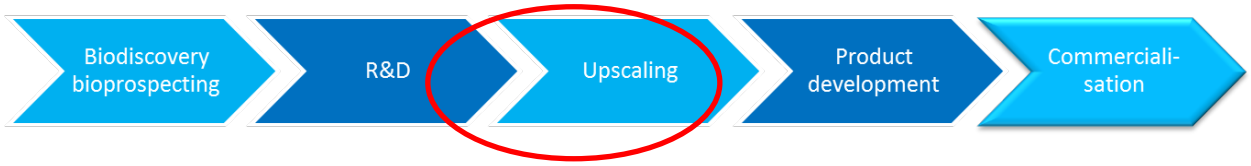
Estimated time frame for realisation:

□ short term (<1 year) **x <u>midterm (1-3 years),</u>** □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	assistance in national marketing	SYKE	n.a.
2.	evaluation of biomass drying needs	SYKE, U Got, SUB Net	n.a.
3.	networking	SYKE, U Got, BioCon Valley, TBP, SUB Net, DTI	n.a.
4.	evaluate potential R&D projects, cooperative partners, assistance in finding suitable calls for funding	SYKE	n.a.
5.	connect to piloting partners	U Got, BioCon Valley	Vetik (ALLIANCE case)
6.	help in marketing in Estonia	TBP	

TRL estimation after ALLIANCE commitment



Estimated time frame for realisation:

□ short term (<1 year) x **midterm (1-3 years).** □ long term (>5 years), □ very long term (>15 years)

Transnational impact

Creating new contacts in different BSR countries and implementing pilots with them was of crucial importance for the success of this case. Moreover, before ALLIANCE, information about different (required/used) biomass sources from different countries was lacking but was provided by ALLIANCE consortium partners. Since applicability of a drying technique offered by SFTec may be limited in one country despite the manifold applications, the success of this case strongly depended on the transnational approach.

Scientific successes, most prospective blue biotech areas within BSR

During the case implementation, the technique was proven to be suitable for drying macroalgae in the conducted pilot experiments, thus offering great business perspectives, since macroalgae cultivation is a growing industry in the BSR.

Most prospective BSR blue biotech areas are in a short term perspective the large scale blue biomass utilization for bioenergy production and in a long term perspective the utilization of blue biomaterials for food production. Due to regulations for the food sector, a technology change is however needed.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

The drying technique could be a solution to dry seaweed biomass energy efficiently with excess heat from industry. Positive impact via possibility to enable wider utilization of blue biomasses and that way decrease the need of land area for biomass production. Possibility to utilize waste heats from e.g other industry sectors for drying of blue biomasses. Enabling new technology for the essential phase of processing materials to more valuable products. Mobile version of a dryer enables local drying of material and minimize transportation of unseccessary water, which decrease the CO2 emission of material transportation.

Financial/Legal barriers and solutions found

Piloting in industrial scale is costly and as the blue biotech sector is still evolving, the customer density in the blue biotechnology sector is growing but still low, so targeted project funding is needed for a large scale piloting.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.)

First pilots with blue biomass were implemented, analyzed and reported. Reports can be used for further optimization and marketing. Several business contacts created around the Baltic Sea Region. Knowledge of the bio blue sector needs are now clearer and network in the sector widens up due to ALLIANCE support. After ALLIANCE support case had straight contacts to potential customers and R&D organisations to proceed with the development. Clear need of development of the technology for applications in the food sector. Gap-closing technologies like drying of biomass are crucial for advancing the blue biotech sector. Like in this case, it is not directly a biotechnological product to be sold, but a technique/equipment providing important services/prerequisites for development of biotechnology products. Cross-case collaboration/networking proved to be vitally important to acquire new customers.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

There is a lack of safe drying methods for algae biomass meeting quality criteria for the food sector quality and safety drying method. In general, this technique is proven to be suitable for drying macroalgae biomass and will be further developed to meet requirements of the food sector. However, larger pilots are still needed to optimize the algae drying process, and waste algae material (for example from beach casts) could be used for that. Also, the heat source for food production needs to be chosen carefully and it has to be tested that it won't compromise the food safety. Drying is a material-specific process and one of the first essential process phases of the material handling also in blue biosector. Need of dryer techonology piloting in wider scale has clear need in the field to be able to evaluate more specifically effectiviness of the technology.

Image of drying equipment from SFTec (Images © 2019 SFTec)

Case 11-UKSH: Highlights

Scientific basis of this case is the fact, that fucoidan, a structurally complex sulfated polysaccharide ususally found in the cell walls of brown macroalgae, was found to have an inhibitory effect on the vascular endothelial growth factor (VEGF). VEGF has been identified to be crucially important for the development of age-related macular degeneration (AMD, Klettner 2016), one of the most important blinding diseases in industrialized countries, which even gains importance due to societal change. Beyond this, fucoidan has many other nutraceutically relevant activities, i.e. antioxidant, antiobesity (Kim et al. 2013). Hence, the product idea of the case is to develop a nutritional supplement containing sustainably obtained fucoidan extract contributing to prevention of AMD onset. A proof-of concept is available based on results from *in vitro* experiments.

Concerning the economic situation, this case is different from other ALLIANCE cases, since the case owner leads her own research group in a German University hospital (UKSH Kiel, Group Experimental Retinology). Basic research based on vitro experiments yielded highly promising results. However, for further development of the product further research was needed incl. funding and partners, with which the case owner approached the ALLIANCE. It was not envisaged, that a product from this case would reach the market within the lifetime of the ALLIANCE project but that ALLIANCE would contribute in finding the right partners for advancing product development. The case owner was in need for suitable partners for providing raw material and extracts as well as possible collaborators and research funding opportunities. The case owner further needed an assessment of the current European patent situation regarding fucoidan as nutritional supplement.

Several nutritional supplements containing fucoidan are already on the market, mostly from Far East Asia or Australia. They mostly contain fucoidan extracts from unknown origin or non-sustainable wild harvest. Current worldwide key players are Marinova (Australia), MYM International (Japan), Kanehide Bio Co. (Japan), the last two being fucoidan dietary supplements companies. Patent situation on the European market is unclear. On the European market, there is no nutrient supplement available containing a reliable and sustainable source of fucoidan, so the market potential for sustainably harvested and produced high quality fucoidans was (2016) and still is (2019) high.

Contribution of mentors and ALLIANCE to case progress

The primary achievement of the ALLIANCE for case UKSH was to provide new contacts for supply of sustainable raw material and novel extracts. Through the ALLIANCE partnership, the case owner was able to establish new national and international contacts, especially to relevant SMEs. These contacts initiated during the project will presumably serve as new partners for further joint projects incl. funding applications. Moreover, a patent research was performed (subcontracted by

BioConValley, DE). Transnationality is a key factor for marine biotechnology product development also in very early stages and the ALLIANCE network was crucial to mediate these novel contacts. The same is true for business readiness assessment (ALLIANCE business assessment performed by case mentors) to avoid pitfalls in business setup. The needs specified by the case owner were met with the help of the service offer and mentoring program of the ALLIANCE.

Contribution to Sustainable Development goals (SDG)

The case of UKSH is related with 3 of the sustainable development goals (SDG) proposed by the United Nations, which those are: SDG 3-Good Health and Well Being (Fucoidan-containing nutrient supplements which prevent or delay the onset of AMD, one of the major causes for blindness in industrialized countries, clearly contribute to this SDG in an ageing population), SDG 8- Decent work and economic growth (Through finding new ways of sustainable production, extraction and valorization of the raw material and the high economical potential for a fucoidan-based nutrient supplement for AMD prevention, it is highly probable that it will generate jobs and thus contribute to economic growth) and SDG 14- Life below water. The case intends to use sustainably produced and extracted fucoidan to produce dietary supplements. This can include off-shore algal cultivation, thus contributing to nutrient reduction in marine environments. Unlike wildly harvested algae from unknown resources which are currently sold and the resulting ecosystem impacts, this case clearly contributes to SDG14.

Comparative case analysis

Transnationality. In terms of transnationality, the German case owner collaborated with mentors in Poland and Portugal. Through networking in ALLIANCE, new scientific contacts and potential partners for funding applications have been found in Norway.

Type of ALLIANCE service provided.

Besides mentoring and financial support, the case UKSH received mainly networking support in order to find the right partners for further research. Moreover, the mentors provided business support by conducting the business assessment procedure established in frame of ALLIANCE. Finally, UKSH received legal support by performing a patent research.

Target application/market and customers.

UKSH's target application is the development a fucoidan-based dietary supplement. Among the ALLIANCE cases, this is the only case aiming at the development of a dietary supplement. The target costumer of the UKSH case is the end customer (B2C); comparably to CRM, the products to be developed should also be sold via pharmacies (B2B) like other 8 cases in the Alliance

Project. However, since the case owner is a public institution (university clinic) and is still in R&D stage, a concrete business model and appropriate sale channels still need to be developed.

Biological resource used.

The case UKSH targets a fucoidan-based application, which is produced by macroalgae. For sustainable acquisition of the biological resource, the case owner has teamed up (in frame of another project) with ALLIANCE partner CRM and has acquired also contacts outside ALLIANCE. Macroalgae as biological resource are used in 6 other ALLIANCE cases.

Type of product.

The targeted product is a nutritional supplement which will be sold via pharmacies and directly to customers (B2C relationship), so no energy or service. Products for sale via B2B and B2C relationships are also the target of 6 other ALLIANCE cases.

Individual progress.

When joining the Alliance, the case UKSH was in R&D stage and still is due to the necessity of further research involving e.g. animal in vivo studies or other algae. Although from this perspective it looks as there was no progress in this case, the real situation is completely different. Participation in the ALLIANCE enabled the case owner to find the correct partners for further grant applications, to find new suppliers of alternative, sustainable cultivated or harvested algae species and/or extraction methods. Moreover, the case owner is now aware of the previously unclear situation concerning fucoidan application in the nutritional supplement sector.

SUMMARY: Case UKSH

Case and mentor information

Case Name: UKSH, Case #11

Product: Age-related macular degeneration-specific fucoidan-based dietary supplements (AMD-FDS)

ALLIANCE mentor(s): GEOMAR, University of Gdańsk, CIIMAR – Interdisciplinary Centre of Marine and Environmental Research (Associated Organization)

Type of ALLIANCE support (mentoring/implementation of case/financial support):

Mentoring, networking, financial support, business support, legal support

Duration of ALLIANCE support: October 2016 (case selected during pitching event in Helsinki) until end of the project

Success factors

Through ALLIANCE, the case owner was able to establish new contacts. These contacts initiated during the project will presumably serve as new partners for further joint projects together with the case owner, thus fostering product development towards a fucoidan based dietary supplement. These potential new partners are SMEs situated in Norway and Germany and the contacts were primarily mediated through the ALLIANCE SME partner and case CRM. This cross-link shows the critical importance of networking and the success of interaction not only between mentors and case owners but also between case owners. The functioning transnational ALLIANCE network was a crucial success factor for this case.

Barriers to be overcome

Finding correct partners for provision of appropriate amounts of fucoidan in needed quality for serving as a nutritional supplement. Improving the difficult funding situation

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Research institute: GEOMAR, ALLIANCE partner, Germany. Primary mentor. Networking, suggestions of (German) national funding options. Leading the business assessment procedure

Research institute: Uni Gdansk, ALLIANCE partner, Poland. Options on research funding for further research (in vivo studies), initial patent research, supporting business assessment procedure

SME: CRM, ALLIANCE partner, Germany. Networking, establishing contacts with potential supplier of sustainably harvested raw material as well as supply of extracts with sufficient purity

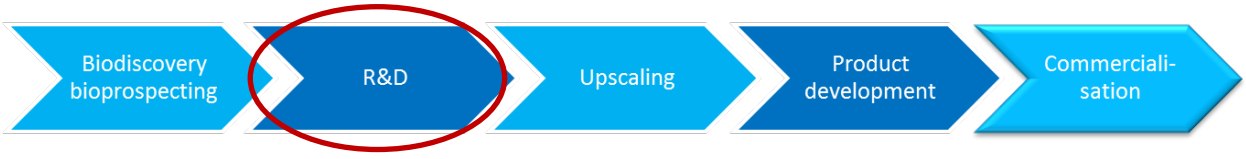
Research institute: CIIMAR, ALLIANCE associated partner, Portugal. Options on research funding for further research (in vivo studies), supporting business assessment procedure

Business support Organization: BioConValley, ALLIANCE partner, Germany. Patent research on fucoidan as nutritional supplement.

Initial Case Needs

- Suggestions of funding, establishing contact to possible funding bodies
- Reliable and reproducible supply of fucoidan (from a specific and sustainable algae source): algal material, fucoidan extract/fractions or pure fucoidan (sufficient quantity)
- Bioavailability studies
- Networking, finding new partners
- Patent research on fucoidan as nutritional supplement

TRL estimation when approaching ALLIANCE



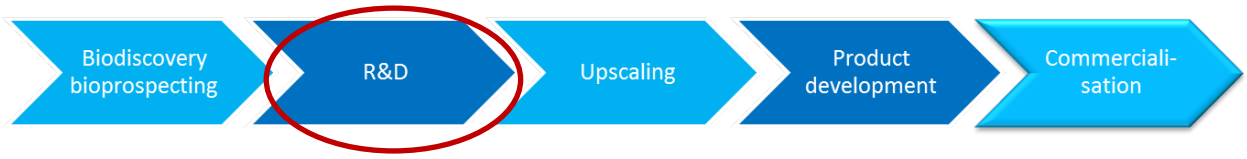
Estimated time frame for realisation:

□ short term (<1 year) □ midterm (1-3 years), x long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1	Patent research on existing patents on fucoidan as nutrient additive	Uni Gdansk, BioConValley	Uni Rostock patent office
2	Networking/contact to relevant actors in the nutritional sector	CRM, Submariner, GEOMAR	New contacts potentially developing into new partnership
3	Options on research funding for further research (in vivo studies)	GEOMAR, Uni Gdansk, CRM	No
4	Establishment of contacts to other blue biotech networks and accelerator programs	CRM, GEOMAR, Submariner	No
5	business assessment procedure	GEOMAR, CIIMAR, UniGdansk	No

TRL estimation after ALLIANCE commitment



Estimated time frame for realisation:

□ short term (<1 year) x midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

Transnational impact

Patent research provided by Polish partner (UGdansk). Negotiations with potential company partner in Norway in progress for further studies and product development. Transnationality is a crucial aspect for the product development phase due to environmental protection regulations for several brown algae in Germany. So, transnational links to Norway have been found for sustainable raw material supply. It can furthermore be assumed that the final product will raise interest, since AMD is not a national problem.

Scientific successes, most prospective blue biotech areas within BSR

During the project, the case owner has completed a study on crude fucoidan extracts of the brown algal species *Fucus evanescens*. A scientific publication is in preparation by the case owner.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

The contact to potential partner (Norway) is very promising since it may lead to 1) a sustainable supply of raw algal material, since these algae are sustainably harvested and 2) novel extraction methods which will yield fucoidan in the requested purity. This can be regarded as major positive contribution/prospect for sound and sustainable transnational blue biotech production processes.

Financial/Legal barriers and solutions found

1) Legal barriers, initial status: no IP protection possible, since relevant data on *F. vesiculosus* were published.

Solution: through new company contacts and change of algal species and use/development of novel extraction procedures for fuoidan, IP may become protectable. Option and type of possible IP protection is still subject of ongoing discussion between the case owner and the new Norwegian company contact (will not be finished by end of ALLIANCE project).

2) Financial barriers, initial status: high costs for in vivo animal studies, lack of suitable partners and funding opportunities

Solution: different national as well as international calls from different funding organizations and (ALLIANCE-mediated) connections to new national and international partners (applications currently planned or in progress) will possibly enable financing and realization of these studies.

3) Business, initial situation: setup of a business plan was an initial need of the case.

Solution: as the case is still in R&D stage, towards this aim, business readiness of the case was assessed using the business assessment procedure/tools developed within the ALLIANCE project. This business assessment provided valuable insights and considerations which need to be taken account in further stages of product development.

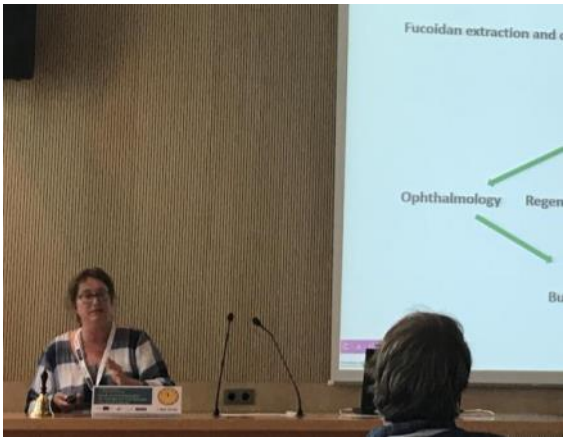
Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.)

Networking outside the research community with SMEs is most important also for application-oriented research groups to accelerate product development and to benefit from company expertise. Moreover, transnationality is a key factor for marine biotechnology product development, the ALLIANCE network was important to mediate these novel transnational contacts . An early business assessment is crucial also for cases in R&D stage or focusing on R&D, the business assessment procedure established during the ALLIANCE project is very useful for this case.The ALLIANCE mentoring program facilitated networking within the partnership and provided valuable contacts to external companies with expertise in the nutritional sector.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

The case and the product which will be developed, a dietary supplement for prevention of age-related macular degeneration, has enormous economic potential in an aging society, internationally and also in the BSR. Although no products are in final stage of development in the case, ALLIANCE involvement has contributed to taking the case one step further towards implementation of product development; i.e. new collaboration partners are now almost in place providing new resources and extracts.

Image showing Prof. Dr. Alexa Klettner giving a lecture on the ALLIANCE conference: From Science to Business in Greifswald, 22.-24.8.2018



Case 12- Hoekmine: Highlights

Scientific basis of this case is the phenomenon of iridescence, i.e. the changing of color depending on the angle of view or illumination angle. These structural colors are common in all domains of life incl. bacteria (Johansen et al. 2018). Among bacteria, iridescence is most commonly found in members of the phylum Bacteroidetes (Silva et al. 2019). High concentrations of the algal polymer fucoidan and the plant polymer starch in the medium seem to promote iridescence and addition of fucoidan even restored iridescence in older bacterial colonies. The phenomenon of iridescence is highly linked to bacterial gliding motility. Hence, there is a huge biotechnological potential for genetic engineering, or for establishing these organisms as platform organisms or for photonic biomaterial production (e.g. paints).

The company is a startup and was in need of funding/acceleration programs for developing the product. The case was dependent on fresh samples for isolation of new strains of iridescent bacteria. Due to difficult funding situation in the Netherlands, the case was further looking for partners for transnational cooperative projects. The case was also searching bioinformatics support and help for a business plan.

Contribution of mentors and ALLIANCE to case progress

The primary achievement of the ALLIANCE for case 12-Hoekmine was to provide new samples (algae, bacterial enrichment cultures from algae, sediment, water) for isolation of new iridescent bacterial strains. Biological resources were provided by ALLIANCE partners from Finland, Poland, and Germany. Moreover, ALLIANCE mediated the case owner´s application to a Portuguese business accelerator program (BlueBioValue), which the case won in December 2018 (endowed with 15.000 EUR in services). Partly aided by the business assessment procedure conducted in frame of ALLIANCE, the case owner was able to set up a business plan. Like in other cases, the ALLIANCE has mainly served as a central hub mediating contacts. Discussions on further international collaborations and potential joint project applications are currently ongoing (GEOMAR/Hoekmine) and are envisaged to be realized after the end of the ALLIANCE project.

Contribution to Sustainable Development goals (SDG)

The case of Hoekmine BV could be related with 3 of the sustainable development goals (SDG) proposed by the United Nations, which those are SDG 8-Decent work and economic growth (Through finding new ways for bio-based paint production it is highly probable that this case will generate jobs and thus contribute to economic growth); as well as SDG 9-Industries, innovation and infrastructure. Development of a product based on this idea will use biotechnological approaches (genetic engineering) which will result in a highly innovative product, thus perfectly fitting to 9.4 (increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes). It is notable that the textile (dye) industry is extremely damaging to the environment (energy and water use, release of pollutants) are dangerously unsustainable and a shift to biodegradable structurally colored based product range

is a potential solution to some of these issues. Moreover, it contributes to SDG 14-Life below water (marine bacteria as producers of structural color, which can be fermented in large volumes, thus the foreseen products will be sustainably produced without any impact on the marine ecosystem. The case significantly contributes to sustainable valorization of marine resources.

Comparative case analysis

Transnationality.

The case of Hoekmine BV case is developed in The Netherlands. ALLIANCE partners and associated organizations offering service for this case are in Germany, UK, Poland, Finland and Portugal.

Type of ALLIANCE service provided.

Beyond mentoring, Hoekmine received technical support (in total 20 cases, in this case by sample delivery of algae and microorganism cultures), business support (17 cases in total, Hoekmine was a pilot case for ALLIANCE business assessment procedure) and networking support (22 cases). Hoekmine received also promotional support (also 12 other cases); GEOMAR established contacts to the Portuguese BlueBioValue accelerator program, in which Hoekmine won the first price together with a Portuguese company. Hoekmine did not receive financial support by ALLIANCE.

Target application/market and customers.

It is difficult to define a sole target application for this case, since there are numerous application areas for structural color. The most obious is the dye sector but it is again difficult to find market forecasts for iridescent paints and colorants. Rapidly growing automobile and construction industries make the Asian Pacific Region the most prospective market for dyes in general. However, new nanomaterials with novel properties like e.g. UV protection will possibly augment future growth in the paint industry. If it is assumed that iridescent paints or other colorants can disrupt the dye industries (textiles, multitrillion Euro market) or paints (88 bn Euros/year with 25% automobile) or cosmetics then the potential sales may be substantive.[1] Hoekmine clearly targets the commercial sector, probably mostly relying on other companies as customers (B2B). This is also true for 13 other cases in the ALLIANCE. Hoekmine is one out of 2 ALLIANCE cases focusing on colors in the wider sense (incl. pigments), the other being the Estonia-based Vetik OÜ.

Biological resource used.

[1] https://www.grandviewresearch.com/industry-analysis/paints-coatings-market

Hoekmine BV relies on bacteria as biological resource. Since these bacteria can be grown in the laboratory, the products of this case are sustainably produced without impact on the marine ecosystem. Bacteria are the relevant bioresource in 3 other ALLIANCE cases.

Type of product.

At the end of Hoekmine´s value chain stands a product with manifold potential applications, in which the iridescent structural colour can be used as ingredient. Like 20 other ALLIANCE cases, Hoekmine primarily focuses on a product rather than energy or a service.

Individual progress.

When joining the ALLIANCE, the case was between biodiscovery and R&D. After the end of ALLIANCE it has established firmly in R&D stage. Although this means already a significant advancement, further research is necessary before actual product development can start.

SUMMARY: Case Hoekmine

Case and mentor information

Case Name: Hoekmine BV, Case #12,

Product: Baltic Iridescence – from macroalgal microbiota to new enzymes and optical materials, Product: Coloured biomaterials (structural color) derived from Flavobacteria.

ALLIANCE mentor(s): GEOMAR, Scottish Association for Marine Sciences

Type of ALLIANCE support (mentoring/implementation of case/financial support):

Mentoring, Provision of raw materials, Networking, business support

Duration of ALLIANCE support: October 2016 (case selected during pitching event in Helsinki) until end of the project, Case receives no financial support from ALLIANCE

Success factors

Easy transnational cooperation with partners delivering the algal material, good contact between case owner, mentors and contributing partners. The ALLIANCE business assessment piloting was a useful contribution towards business plan

Barriers to be overcome

Finance, business plan and market acceptance in an unusual area of biotechnology.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Research institute: GEOMAR, ALLIANCE partner, Germany. Providing access to microorganisms, promotion of case for pitching to BlueBioValue Accelerator program. Discussion on common projects (ongoing beyond ALLIANCE). Suggestions of companies delivering fucoidan

Research institute: SYKE, ALLIANCE partner, Finland. Providing Baltic macroalgae for isolation of bacteria.

Research institute: Uni Gdansk, ALLIANCE partner, Poland. Providing Baltic macroalgae for isolation of bacteria. Initial bioinformatics support.

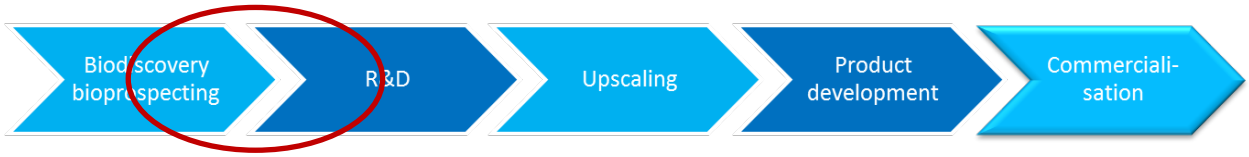
ALLIANCE business support team: piloting business assessment procedure. Contribution to business plan.

Research Institute: CIIMAR, ALLIANCE associated partner, Portugal. Suggestions of companies delivering fucoidan, Promotion of case: BlueBioValue Accelerator program.

Initial Case Needs when approaching the ALLIANCE

- Access to Baltic macroalgae and to fucoidan
- Business partners
- Financial support
- Business plan
- Bioinformatics support

TRL estimation when approaching ALLIANCE



Estimated time frame for realisation:

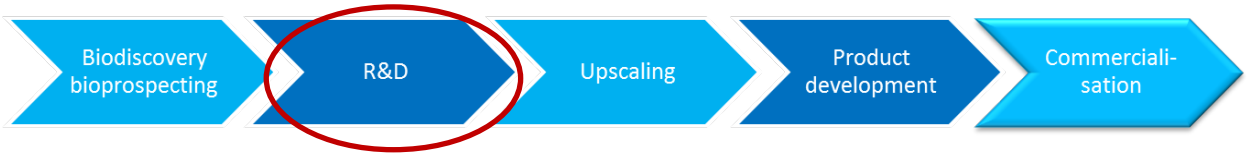
□ short term (<1 year) □ midterm (1-3 years), x long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Algal material received from SYKE and University of Gdansk	SYKE, University Gdansk	No
1.	Suggestion of companies supplying fucoidan	GEOMAR, CIIMAR	No
2./3.	Promotion of case	GEOMAR	No direct financial support, but facilitation of contacts to accelerator programs
3.	Establishment of contacts to other blue biotech networks and accelerator programs	GEOMAR	Blue Bio Alliance, Portugal

4.	Pilot case for business assessment procedure within the ALLIANCE project	GEOMAR, SUBMARINER	Gaia (subcontracted by ALLIANCE)
5.	Bioinformatics support	University of Gdansk	No

1.1. TRL estimation after ALLIANCE commitment



Estimated time frame for realisation:

□ short term (<1 year) x midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

Transnational impact

Advances applicable within and outside the Baltic area (scientific, business) in marine bioprospecting and scientific cooperation were made.

Scientific successes, most prospective blue biotech areas within BSR

A prominent publication with significant press attention – in many ways the biggest gain of the project. Additional, follow-up publications are in progress. Caton, L, Johanson V., Ingham CJ et al (2018) “Living Colours: Genetic modification of structural colors in bacteria”. PNAS 201716214.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

The product to be developed will have substantial impact on the sustainability of the dye industry (which has major water and energy waste issues). Prospects are early stage but promising.

Financial/Legal barriers and solutions found

Nothing significant though dealing with the Nagoya Protocol remains an issue. The case Hoekmine did not receive financial support, therefore financial issues could not be solved. However, promotion of the case resulted in contacts to accelerator programs (won Portuguese BlueBioValue accelerator program).

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.)

When contacting ALLIANCE, the case was in a very early stage of development, i.e. between biodiscovery/bioprospecting and R&D. The case had not a single business strategy but the idea gave rise to a wide range of application areas. Two phases of were decided for implementation of the case, namely bioprospecting in the Baltic Sea and support with the business plan. Both of these needs were met during the implementation. The ALLIANCE could not help with direct financial support. Due to ALLIANCE and other support, the case made progress in networking within the Baltic Sea region. The case is now in R&D stage.

Lessons learned:

Financial support and/or access to labs is crucial for cases in R&D stage, since lab research preceding the actual product development is often very expensive especially for startups/SMEs. This could not be accomplished and ALLIANCE should provide further information on relevant transnational funding calls, e.g. within H2020.

The ALLIANCE mentoring program facilitated transnational collaboration between research organizations and the SMEs, which was crucial for the success of this case; biomaterial from the Baltic Sea was delivered to the case owner which now serves as basis for further research and potential product development in later stages (beyond ALLIANCE project).

The business assessment procedure established during the ALLIANCE project was regarded as useful. In combination with other external support, a business plan was now developed.

Legal barriers: the implementation of the Nagoya protocol in transnational collaboration still causes uncertainties and can hamper transnational research collaborations

Involvement of ALLIANCE has contributed to progress of the case: time frame for realization is now regarded midterm (1-3 yrs); when entering ALLIANCE it was regarded as long-term.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

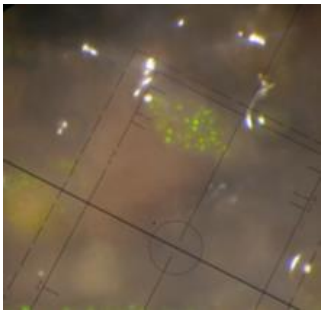
n.a., no products are in final stage of development.

References:

Johansen VE, Caton L, Hamidjaja R, Oosterink E, Wilts BD, Rasmussen TS, Sherlock MM, **Ingham CJ**, Vignolini S. Genetic manipulation of structural color in bacterial colonies. Proc. Natl. Acad Sci USA, 2018, 115: 2652-2614(2), 31; https://doi.org/10.3390/md14020031

Silva TR, Canela-Garayoa R, Eras J, Rodrigues MVN, dos Santos FN, Eberlin MN, Neri-Numa IA, Pastore GM, Tavares RSN, Debonsi HM, Cordeiro LRG, Rosa LH, Oliveira VM. Pigments in an iridescent bacterium, *Cellulophaga fucicola*, isolated from Antarctica. Antonie van Leeuwenhoek, 2019,112:479-490

Images showing the case owner in GEOMAR´s labs isolating bacteria from Baltic Sea samples (left); iridescent bacterial culture resulting from isolation effort (right).



Case 13- JAMK: Highlights

JAMK University of Applied Sciences came to ALLIANCE mentoring program with their idea of a closed energy and nutrient cycle in microalgae cultivation. It was decided that their idea will be evaluated during the mentoring program and that the implementation of the case consists of giving guidance for the microalgae based energy production.

SYKE as the primary mentor, provided a report on the algae growth potential in biogas reject water. This report included a simulation study of algae cultivation, estimating the algae growth potential under the climatic conditions of central Finland. As a main forcing factor, simulation used nutrient inputs from biogas factory reject water as estimated by literature review and as observed at existing biogas factory by JAMK.

SYKE also participated in the supervision of a JAMK student thesis, which evaluated the potential of algae as part of recycling nutrients in biogas factory.

ALLIANCE mentoring helped JAMK to evaluate their idea and possibilities and gave them an overview of the subject which helps them to target the next steps on their development.

Contribution of mentors and ALLIANCE to case progress

As stated above in the highlight description, the mentoring was crucial in this case to conduct a feasibility analysis also taking into account the climate conditions at the case´s location. Thus the case owners received a scientific evaluation including sustainability aspects and clear science-based advice on how to implement the cultivation. Moreover, cooperation between mentor and case owner resulted in co-supervision of a master thesis, i.e. a scientific co-operation SYKE and JAMK.

Contribution to Sustainable Development goals (SDG)

This case contributes to SDG7-Affordable and Clean Energy, SDG14-Life below water, 4-Quality education and 9-Industry, innovation and infrastructure.

Comparative case analysis

Transnationality. With regard to transnationality, ALLIANCE partners from 3 countries (Germany, Estonia and Denmark) contribute to the development of a case situated in Finland.

Type of ALLIANCE service provided.

Beyond mentoring support, the ALLIANCE provided JAMK with scientific advice and technical support. Moreover, JAMK benefitted from networking support (funding opportunities). The case did not receive financial support from ALLIANCE.

Target application/market and customers. JAMK aims to produce lipids for the production of biodiesel by cultivating microalgae in a closed energy and nutrient cycle. The target market is clearly the energy/fuel sector. The biomass produced by the microalgae should be the basis for exraction of lipids for selling to biofuel suppliers; thus, the case clearly targets B2B relationships. Compared to other ALLIANCE cases, JAMK was one of 3 ALLIANCE cases specifying on energy rather than a product or a service.

Biological resource used. JAMK uses microalgae as biological resource. This is true for 6 other ALLIANCE cases.

Type of product. The case JAMK targets a sustainable way of producing biofuel by cultivation of microalgae. Similar approaches on energy from microalgae were followed by 1 other case, i.e. case 19-University Gdansk-Biogas

Individual progress. When joining the ALLIANCE, JAMK was in R&D stage. Similar to case UKSH, it also finishes at the same stage. At first glimpse, this does not look like an advancement, but due to ALLIANCE involvement, JAMK can now rely on results from a model simulation and a feasibility study including the climate situation in central Finland which may guide construction of microalgae photobioreactors, which is a considerable step forward towards upscaling.

SUMMARY: case JAMK

Case and mentor information

Case Name: JAMK University of Applied Sciences, Institute of Bioeconomy (BTI)

Product: Closed energy and nutrient cycle in the microalgae cultivation.

ALLIANCE mentor(s): SYKE, DTI

Type of ALLIANCE support (mentoring/implementation of case/financial support):

Mentorship, scientific and technical support, networking. Case received no funding.

Duration of ALLIANCE support: October 2016 until the end of the project

Success factors

Nutrient recycling is an important factor in all circular economy concepts. Thus, nutrient recycling and use of all side-stream products in biotechnology will become an important concept in future bio-based industries relying on aquatic resources.

Barriers to be overcome

Based on the feasibility studies and the model simulations, a closed system needs to be developed further and the calculations need to be verified by experimental results.

The quality of the intended high-value products from microalgae may be affected if reject water is used for the cultivation of microalgae.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Research institute: SYKE, ALLIANCE partner, Finland. Feasibility analysis, algae growth simulations, scientific collaboration (joint supervision of master thesis). Scientific support concerning the photobioreactor. Networking, information on scientific seminars on the topic

Research institute: DTI, ALLIANCE partner, Denmark. Offer on growth tests for microalgae

Research institute: GEOMAR, ALLIANCE partner, Germany. Networking, providing information on EU H2020 funding portal/partner search tool

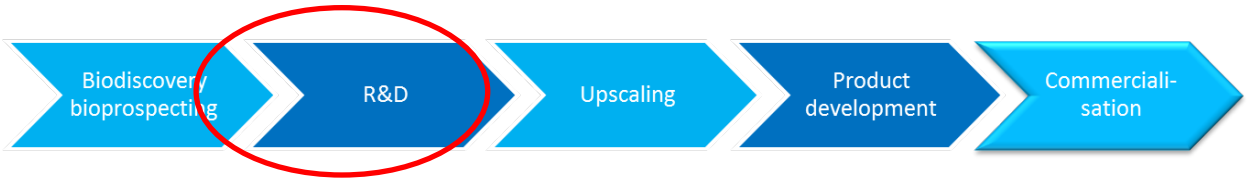
Business park: Tartu Biotechnology Park, ALLIANCE partner, Estonia. Networking, providing information on potential transnational partners

Network: SUBMARINER Network, ALLIANCE partner, Germany. Networking, providing information on funding opportunities, potential transnational partners

Initial Case Needs

- cooperation for refining ideas, opportunities and challenges in microalgae biomass production
- algae growth simulations
- laboratory tests of cultivation media
- Evaluation (and testing) of new concept for algae photobioreactor

TRL estimation when approaching ALLIANCE



Estimated time frame for realisation:

□ short term (<1 year) □ midterm (1-3 years), x **long term (>5 years)**, □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Cooperation for refining ideas, opportunities and challenges in microalgae biomass production using liquid from biogas production	SYKE, DTI, TBP, GEOMAR (networking)	n.a.
2.	Laboratory tests and simulations when needed	SYKE, DTI	n.a.
3.	Evaluation (and testing) of the new PBR concept	SYKE, DTI	n.a.
4.	Mass balance modelling	DTI	n.a.
5.	Help with algae cultivation and upscaling	DTI	

TRL estimation after ALLIANCE commitment

Estimated time frame for realisation:

□ short term (<1 year) □ midterm (1-3 years), **x long term (>5 years),** □ very long term (>15 years)

Transnational impact

The ALLIANCE offered the opportunity to to discuss the ideas and the feasibility of the concept in an international scientific community and experts specialized in related issues.

Scientific successes, most prospective blue biotech areas within BSR

A master study project was set up to investigate algae growth potential in reject water. This project is currently in progress by a JAMK student, who is supervised by SYKE. Nutrient recycling is an important part of a sustainable blue bioeconomy and will be crucially important in the near future.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

Since the case aims at the implementation of a closed energy and nutrient cycle for microalgae cultivation, this will contribute significantly to sustainability because it promises a minimum water and nutrient waste. By linking the microalgae cultivation, e.g. to fish aquaculture (microalgae or their added-value products as fish feed, produced energy as heat energy for cultivation of fish), the case may represent an important part of a (transnational) integrated circular economy concept.

Financial/Legal barriers and solutions found

Funding/Investors are needed for realizing the concept. For this, the idea needs to be developed further to attract investors. Next step is to acquire international partners and funding for further research.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.).

Profound scientific evidence incl. feasibility studies are crucially important before scaling up or developing the intended product. The microalgae growth potential using reject water as resource is currently studied by a JAMK student, who is supervised by SYKE.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

The case mentors suggest that the calculations of biomass and lipid production for biodiesel should be experimentally verified based on the simulation results. Taken together, these scientific results will then allow future economic prospects of potential products (lipids for biodiesel conversion) to be developed.

Case 14- Maresome: Highlights

Millions of people around the world suffer currently on chronic, not curative wounds. A special problem at chronic wounds represents the settlement of multi-resistant pathogens. On the basis of microparticles of algae (Maresome®) from the Baltic Sea, the case will develop new formulations for wound healing and reduce infections. Furthermore, Maresome® will be tested as antimicrobial feed additive.

The case needs cooperation partners for testing the application of novel antibacterial and nontoxic algae in a medical field study and as feed additive, for developing innovative application forms including novel wound dressing formulations, and for large scale cultivation of algae. Moreover, access to relevant networks and marketing partners are needed. Once scientific testing has been successfully passed and partners have been identified, the Maresome® product could be commercialized in many regions of Europe. Most prospective areas within the BSR are regions with intensive livestock farming (Maresome® as feed additive) and regions with a prominent healthcare infrastructure.

Contribution of mentors and ALLIANCE to case progress

ALLIANCE support resulted in the identification of a number of potential cooperation partners. Further steps are currently explored in ongoing negotiations on IPR issues. The mentors were critically important for networking and providing contacts to the case owner.

Contribution to Sustainable Development Goals (SDG)

Successful application of Maresome® in health care and as feed additive will help to reduce the usage of antibiotics and will further stimulate research for and application of antimicrobial substances in general. Thus, case development relates to the UN SDGs 3 and 12.

Comparative case analysis

Transnationality The Maresome® case resides in Germany; cross-collaboration took place in ALLIANCE with partners in Poland and Finland.

Type of ALLIANCE service provided. The Maresome® case requested mainly networking form the ALLIANCE which was fully fulfilled by ALLIANCE mentors and partners. However, expertise on medical devices incl. regulations is limited in the ALLIANCE, which partly hampered technical advancements.

Target application/market and customers. The case Maresome® aims to develop i) medical devices and ii) feed additives. Target markets are thus the pharma sector for the medical device (2 ALLIANCE cases in total) and the feed sector concerning the feed additive (1 other ALLIANCE case, namely Biofisk). Although the target sectors are different, customers in both cases are rather other businesses (pharmacies, feed distributors) than the end customer. 12 other ALLIANCE cases are also targeting B2B relationships.

Biological resource used. The Maresome® case uses microalgae as biological resource just like 7 other ALLIANCE cases.

Type of product. This case aims at a diversification of its product portfolio; Maresome® is already patented and a medical device (cream against methicillin-resistant *S. aureus*) is already on the market. The case clearly wants to develop products rather than energy or services like 20 other ALLIANCE cases.

Individual progress. When joining ALLIANCE, the case was between bioprospecting and R&D stage. After ALLIANCE support especially in terms of networking, it is now estimated to be in R&D. This reflects the success of ALLIANCE to find the right partners for a case´s need even if no support was requested/provided from the scientific/technical point of view.

SUMMARY: Case Maresome

Case and mentor information

Case Name: Maresome, case# 14 (Institute of Marine Biotechnology e.V., IMaB)
Product: Microparticles of algae (MARESOME®) from the baltic sea

ALLIANCE mentor(s):

Primary mentor: BioCon Valley GmbH (BCV)

Secondary mentor: Pomeranian Special Economic Zone (PSEZ)

Type of ALLIANCE support (mentoring/implementation of case/financial support):

Networking, identification of cooperation partners for upscaling and testing

Duration of ALLIANCE support: October 2016 until project end

Success factors

Identification of suitable industry/research partners for upscaling MARESOME® production

Identification of suitable industry/research partners for testing MARESOME® application as antimicronial feed additive

Identification of suitable industry/research partners for a medical field study to investigate potential of MARESOME® in health care

Barriers to be overcome

- Acquiring venture capital to finance various testing of MARESOME®
- Limited expertise of the ALLIANCE consortium in health care (wound-healing)
- Search for potential partners should not be limited to ALLIANCE / BSR

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Business support organization: BioConValley, ALLIANCE partner, Germany. Business support, Networking and matchmaking, suggestion of new partners

Business support organization: PSEZ, ALLIANCE partner, Poland. Business support

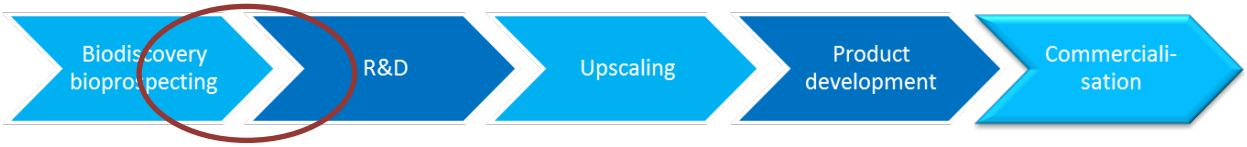
Research institute: SYKE, ALLIANCE partner, Finland. Negotiations on joint master thesis project involving SYKE´s microalgae collection (could not be realized).

Network: Submariner Network, ALLIANCE partner, Germany. Networking, attracting potential partners for a medical field study

Initial Case Needs

- Partners for identification / in vivo testing of novel antibacterial and nontoxic algae
- MARESOME® production upscaling
- Developing innovative product application (wound treatment)

TRL estimation when approaching ALLIANCE



For compounds from novel antibacterial and nontoxic algae: TRL 1-2

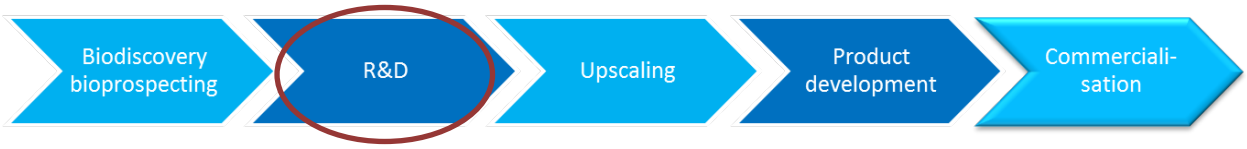
For MARESOME® product: TRL 3-4,

Estimated time frame for realisation: mid term (1-3 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Networking & matchmaking	BioCon Valley	
2.	Providing biological resource (strain collection)	SYKE?	
3.	Attract partners for a medical field study	BioCon Valley, Submariner network	

TRL estimation after ALLIANCE commitment



For compounds from novel antibacterial and nontoxic algae: TRL 2

For MARESOME® product: TRL 4-5

Estimated time frame for realisation: Long term (>5 years)

Transnational impact

The MARESOME® product has a great potential for the whole blue growth sector in the BSR. Its algae-derived antimicrobial capacities could be beneficial for both agriculture and the human health sector at least in whole Europe.

Scientific successes, most prospective blue biotech areas within BSR

Once scientific testing (medical field study, feed additive) has been succesfully passed and a partner for upscaling has been identified, the MARESOME® product could be commercialized in many regions of Europe. Most prospective areas within the BSR are regions with intensive livestock farming (MARESOME® as feed additive) and regions with a prominent healthcare infrastructure.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

Positive contributions: MARESOME® could help to reduce the usage of antibiotics. Successful application of MARESOME® in health care and as feed additive could stimulate research and startups in the marine biotech sector in search for antimicrobial substances in (marine) organisms.

Financial/Legal barriers and solutions found

As known for many product development attempts in the biomedical sector, also MARESOME® development by the IMaB could not be driven forward beyond a certain point, since safety and regulation issues require extensive studies to be conducted – a prerequisite beyond the financial

capacities of SMEs like the IMaB. A solution for this financial barrier is not in reach within the framework of the ALLIANCE.

Outcomes and lessons learned for the case study

ALLIANCE support resulted in the identification of a number of potential cooperation partners. However, a first attempt for large scale production of MARESOME® was established outside of the ALLIANCE network. Potential cooperations for feed additive tests and for medical field studies were not put into practice by the case owner due to the lack of appropriate funding/venture capital. Further steps could not be supported by the ALLIANCE due to lack of financial resources.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

A possible solution for the financial barrier could be an increased implementation of dedicated funding sources, thereby enabling SMEs to initiate medical field studies. Very few examples for such fundings do exist, e.g. on the national level in Germany the G-BA trial regulation (§ 137 e SGB V) or the BMBF funding programme (”Förderung klinischer Studien mit hoher Relevanz für die Patientenversorgung”)

Image showing microalgae cultivation for Maresome® production at IMaB.

Case 15- PowerAlgae: Highlights

Power Algae is an Estonian company which aims to develop an automated photobioreactor (PBR) for microalgae farming and CO2 emission reduction and to sell these photobioreactors. When coming to ALLIANCE mentoring program, they had a PBR prototype which has already been used in test trials at the Estonian University of Life Sciences, but needed optimization for its measurements and management. PowerAlgae requested collaboration in product development with alternative algae-based biomass users and high-end algae product developers, piloting partners for their upscaled photobioreactor and collaborators across the value chain.

During the ALLIANCE mentoring program, there were discussions about the business opportunities among many of the mentors, mainly SYKE and Tartu Biotechnology Park. Power Algae had difficulties in finding customers for buying photobioreactors. This issue was discussed and confirmed with ALLIANCE case Kalundborg, which faces similar difficulties.

During the ALLIANCE partner meeting discussions, case was introduced to a new business idea: to use their photobioreactor to produce valuable microalgae-derived compounds. They were introduced to other ALLIANCE cases in need of these compounds.

Contribution of mentors and ALLIANCE to case progress

Like in other cases, in this case the mentors did not only provide important contacts to other actors in the relevant value chain, but also were crucial for case implementation. Tartu Biotechnology Park offered contacts for their needs to analyze algae oil composition and for business plan development and refining. Technical support concerning measurement systems was provided by the mentor SYKE (incl. offering a light meter and CO2 meter as loan).The case owner also visited SYKE, where multiple issues on microalgae cultivation, photobioreactor systems and requirements of research institutes for photobioreactors were discussed in detail. SYKE's own different algae cultivation systems and their functions were presented to the case owner.

ALLIANCE partners offered different contacts including cross-case collaboration (to case 5 - Kalundborg and case 24-Phytolinc,) and information on investment events. SUBMARINER Network provided them a request to find partners for Horizon 2020 call in their newsletter and also information about the partner search in the same call.

ALLIANCE mentoring program gave them a valuable network to find the right companies, institutes and people to evaluate their idea and help them build their business.

Contribution to Sustainable Development goals (SDG):

PowerAlgae is contributing to SDG 9-Industry, Innovation and infrastructure, -8: Decent work and economic growth and -7: Affordable and clean energy.

Comparative case analysis

Transnationality. With regard to transnationality, the Estonian company PowerAlgae is cross-collaborating with ALLIANCE partners in Finland, Denmark, Latvia, and Germany.

Type of ALLIANCE service provided. Beyond the mentoring support which was received by all cases, Power Algae received scientific and technical support (20 cases in total) as well as legal support (7 cases in total) and networking (22 cases in total).

Target application/market and customers.

Target application is the technical development of photobioreactors which was amended by production of high-value oils based on microalgae (due to discussions with ALLIANCE partners and other case owners). The photobioreactors can clearly only be sold to other companies, so the customer field for this application is the commercial sector. High value products from microalgae have numerous application areas, such as food/feed, nutritional supplements, cosmetics. For oil products from microalgae, both customer types are possible; i.e. cosmentic companies or a company specialized on nutritional supplements for further valorization of the oil (B2B), but also the private sector. A mixed target market B2B/B2C is also applicable for 6 other ALLIANCE cases.

Biological resource used. The case PowerAlgae is relying on microalgae as biological resource. This is also true for 7 other ALLIANCE cases.

Type of product. This case joined the ALLIANCE with the aim to sell a self-developed photobioreactor for cultivation of microalgae. During the ALLIANCE the case focus broadened

towards high value products from the cultivated microalgae in the self-developed PBRs. Since (to our knowledge) a service of cultivating microalgae is currently not intended, PowerAlgae is aiming to sell different products, one being a technical development and the other a high-value extract from the cultivated microalgae. Product development rather than service or energy provision is also aimed in 20 ALLIANCE cases and 1 other case (case 24-Phytolinc) aims at selling a photobioreactor for microalgae cultivation; however PowerAlgae is the only case aiming at selling of two products of very different origin.

Individual progress. When joining the ALLIANCE, the case was estimated to be between R&D and upscaling. Since diversification of products took place in frame of ALLIANCE, the case finalizes at the same stage. Scientific/technical support was given by ALLIANCE to refine functionality of the PBR including growth simulations, recommendations on use of other microalgal resources, technical support concerning the sensor system of the PBR. Thus ALLIANCE partners helped in knowledge-based optimization of the photobioreactor, before upscaling which is a great success even if not directly reflected in advancement in TRL.

SUMMARY: Case PowerAlgae

Case and mentor information

Case Name: Power Algae OÜ

Product: Microalgae-based symbiosis for CO2 sequestration

ALLIANCE mentor(s): SYKE, TBP, Kalundborg

Type of ALLIANCE support (mentoring/implementation of case/financial support):

Mentoring, technical/scientific support, networking, business support, legal support, promotion of the case. The case did not receive financial support.

Duration of ALLIANCE support: October 2016 until end of the project

Success factors

During the mentoring process, case has been able to discuss with the scientific experts in the field of microalgae cultivation. These discussions were important to clarify and tackle existing problems. problems and given advise on where to concentrate. Access to other transnational actors focusing on microalgae cultivation within the ALLIANCE network is considered as very useful for potential future collaborations.

Barriers to be overcome

Currently, the case faces difficulties on generating revenues based only on business with photobioreactors.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Business Park: Tartu Biotechnology Park, ALLIANCE partner, Estonia. Business support, help with European patenting, support in networking

Business Park: BioConValley, ALLIANCE partner, Germany. Networking, cross-linking with Germany-based case Phytolinc.

Research Institute: SYKE, ALLIANCE partner, Finland. Scientific/technical support, i.e. algae growth simulations, upscaling, support in optimizing the optical regime of the PBR (together with DTI)

Research Institute: DTI, ALLIANCE partner, Denmark. SYKE, ALLIANCE partner, Finland. Scientific/technical support, i.e. algae growth simulations, upscaling, support in optimizing the optical regime of the PBR (together with SYKE), networking.

SME: Kalundborg Utility, ALLIANCE partner and case, Denmark. Review and feedback of the pilot factory.

Network. SUBMARINER Network, ALLIANCE partner, Germany. Support in networking, promotion of case for finding partners for EU grant application.

Initial Case Needs

- Algae growth simulations and use of resources in PBR operation, simulating upscaling process
- Review and feedback of the pilot facility
- Help with PBR optical regime
- Help in networking and finding finance
- Help in defining sensors, controls, monitoring schemes for PBR
- Help to define different use scenarios for PBR
- Help with European patenting and CE certification process
- lab analyses during pilot runs
-

TRL estimation when approaching ALLIANCE

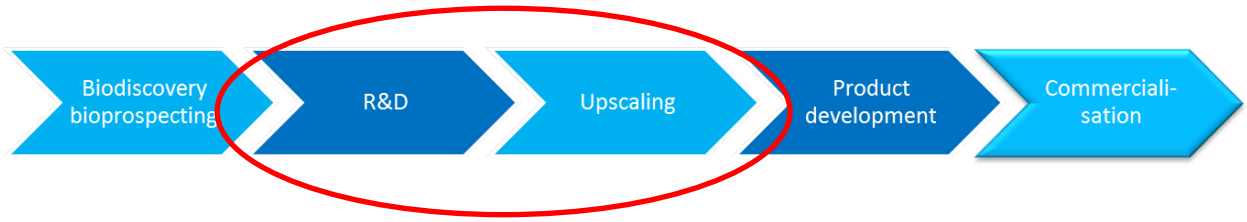
Estimated time frame for realisation:

□ short term (<1 year) x **midterm (1-3 years)**, □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Algae growth simulations	SYKE, DTI	
2.	Simulating upscaling	SYKE, DTI	
3.	Review and feedback of the pilot factory	SYKE, DTI, Kalundborg	
4.	Help with optical regime of PBR	SYKE, DTI	
5.	Help in networking and finding finance, Help with European patenting and CE certification process	TBP, SUB Net	Marius Kuningas (ALLIANCE subcontracted legal advisor), TechDevCo Lab
6.	Defining sensors, controls and monitoring schemes for PBR	CleanTech LV	

TRL estimation after ALLIANCE commitment



Estimated time frame for realisation:

□ short term (<1 year) x **midterm (1-3 years)**, □ long term (>5 years), □ very long term (>15 years)

Transnational impact

Microalgae cultivation and valorization of microalgae-derived biotechnological products is key to many circular economy concepts not only limited to the BSR. Therefore, transnational networking in this area is crucially important to join scientific, technical and business expertise and to generate a BSR-wide microalgae biotech network. First steps towards this end were already achieved during implementation of this case, since experts from different countries in Baltic Sea Region have shared information and advice about photobioreactors and potential business opportunities.

Scientific successes, most prospective blue biotech areas within BSR

Currently, microalgae cultivation in Northern countries is impeded by seasons (short light period, long dark and cold seasons) and thus, many photobioreactors currently need additional light and heat energy to operate in an economically feasible mode. Thus, currently, it is difficult to sell photobioreactors to companies, who are facing potential high additional costs before getting revenues from the microalgae cultivation or the biotechnological valorization of the products. However, technical advancements may lead to improved PBR setups resulting in improved cultivation conditions. Moreover, microalgae cultivation is an integral part of most circular bioeconomy concepts, which has high market prospects as Europe is in transition towards biobased economy. Thus, it is likely, that this business will become more important and profitable in the near future.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

In general, cultivation of microalgae for production of blue biotechnology products contributes positively to the environment, since CO2 is sequestered and transformed into biomass. Moreover, excess nutrients are removed. However, sustainability in frame of a sound blue biotechnology process needs to take into account also eco-friendly transport to the partner valorizing the biomass as well as the light and heat energy for operation of the photobioreactor. Thus, a sound biotechnology transnational production process based on microalgae should not be seen isolated but always as part of a transnational circular economy concept.

Financial/Legal barriers and solutions found

Upscaling and piloting microalgae cultivation needs funding. Currently, a profitable business plan is however still missing.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.):

During the mentoring process, the case has been able to discuss with ALLIANCE scientific experts in the field on their photobioreactors. This has clarified existing problems and the case has been given valuable advice on which aspects to concentrate in further development.

Moreover, the case has diversified its business idea in the direction of producing high-value substances from microalgae cultivated in the photobioreactors, which is supposedly currently a more profitable business idea than selling the photobioreactors themselves. Existing *de minimis* regulations were a problem for implementation of this case.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

It is important to perform a market/customer study before starting production/development of an expensive technical device such as a photobioreactor, since costs for development and production are high, which is probably reflected in the price. Thus, it is important also to take low hanging fruit strategies (using the developed equipment) into account, which may generate lesser but sooner revenues. The case has done this by considering microalgae production in the photobioreactors for production of high value compounds but now needs to focus on a certain (set of) compounds which can be produced in the photobioreactor in a profitable way.

Case 16- Enzymicals: Highlights

The Enzymicals AG offers a broad biocatalytic toolbox, and is an outstanding resource of enzymes suitable for research and development, production, and diagnostics. The company has strong expertise in developing and piloting of biocatalytic processes on customer demand. The company looks for partners who can supply a bioresource that can be screened for promising enzyme activities.

Many customers, including big players in the biochemical field, are actively seeking for enzymes suitable for low temperature processes in industrial scale. Marine strains are a promising source to identify new cold-adapted enzymes. A prerequisite for enzyme identification is a strain collection or a gene library that can be screened. In addition, exploitation of the resource awaits establishing a funding concept for screening. A second step will upscaling to meet the demands of partners from industry.

Contribution of mentors and ALLIANCE to case progress

The mentors of Enzymicals case were highly successful in contributing to the achievement of the case´s needs, which were basically access to the ALLIANCE network and mediating contacts. Thus, the ALLIANCE support for Enzymicals resulted in the identification of a suitable biological resource and suitable cooperation partners. Further steps in product development await appropriate funding.

Contribution to Sustainable Development goals (SDG)

Identification of new resources for white biotechnology, in particular cold-adapted enzymes, will improve a variety of processes, including synthesis of fine chemicals, special catalysis or washing powders. Thus, case development relates to the UN SDGs 12 and 13.

Comparative case analysis

Transnationality. In comparison with other cases, Enzymicals has only few transnational connections. Within the ALLIANCE, the case is only collaborating with SYKE in Finland.

Type of ALLIANCE service provided.

For this case, the only request made to ALLIANCE was networking (22 cases in total) and mediation of contacts for possible novel biological resources for enzymes. This was primarily implemented by the primary case mentor BioConValley. Contacts were established to SYKE, which offered access to their bioresources for bioprospection on enzymes under the condition of a joint student supervision. Establishment of this collaboration is still in progress and maybe implemented beyond ALLIANCE.

Target application/market and customers.

Enzymicals is developing tailor-made enzymes for a variety of biotechnological applications. Potential target sector is the life science sector, but also the detergent sector constantly looking especially for cold-adapted enzymes. Potential customers are biotech companies and big detergent manufacturers, hence the case is targeting B2B relationships rather than selling the products to the private end customer. B2B relationships are targeted in 13 ALLIANCE cases in total. Notably. Enzymicals was the only ALLIANCE case aiming at the development of novel enzymes.

Biological resource used. Enzymicals uses bacteria as a biological resource for their enzyme bioprospection. Bacteria were also applied as biological resource in 3 other cases.

Type of product. The case aims at the biotechnological development of enzymes, which are sold as a product to customers. Sale of a product is also the aim of 20 other ALLIANCE cases. The case does not intend to provide a service or energy.

Individual progress. When joining ALLIANCE, the case Enzymicals was in product development stage. ALLIANCE provided networking support, but no technical support for this case. The case did get valuable contacts within the network but is still in product development phase.

SUMMARY: Case Enzymicals

Case and mentor information

Case Name: ENZYMICALS

Product: Enzymes from different classes e.g. lipases and galactosidases for the use in industrial low temperature processes

ALLIANCE mentor(s):

Primary mentor: BioCon Valley GmbH (Rainer Cramm & Valentin Eckart)

Type of ALLIANCE support (mentoring/implementation of case/financial support):

Networking, identification of cooperation partners. Case did not receive financial support

Duration of ALLIANCE support: October 2016 until end of project

Success factors

Knowledge transfer to connect the right cooperation partner, technology transfer to find an application for the given biological resource.

Barriers to be overcome

The case development suffers from the fact that the case was supported only by mentoring. While a successful matchmaking of cooperation partners could be achieved and a promising technological application was envisaged, a lack of funding was the limiting factor. Although only a comparatively small amount of investment is needed, the ongoing search for funding possibilities (student exchange perhaps via ERASMUS programme, still no solution for paying the cosumables needed) has turned out to be difficult and time consuming.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

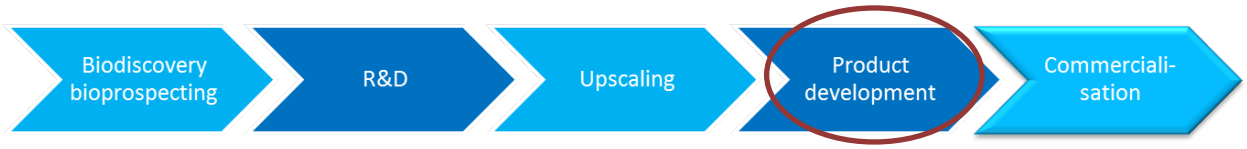
Business support organization: BioConValley, ALLIANCE partner, Germany. Networking, providing contacts

Research institute: SYKE, ALLIANCE partner, Finland. Discussions on accessing SYKE´s collection of cold-adapted microorganisms for bioprospecting cold-adapted enzymes. Student exchange, joint supervision

Initial Case Needs when approaching the ALLIANCE

- Consulting and networking
- Screening of strain collections for genes or activities
- Student exchange

TRL estimation when approaching ALLIANCE

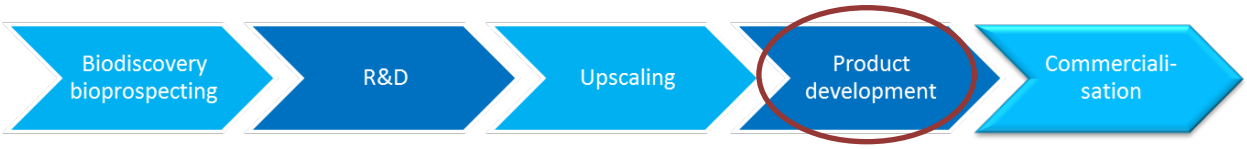


Estimated time frame for realisation: long term (>5 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Networking & matchmaking	BioCOn Valley	n/a
2.	Providing biological resource (strain collection)	SYKE	n/a
3.	Enzymatic screening	Enzymicals AG	n/a
4.	Job offer (student)	ALLIANCE	n/a

TRL estimation after ALLIANCE commitment



Estimated time frame for realisation: Long term (>5 years)

Transnational impact

This case is a paradigm for a transnational cooperation. A strain collection of SYKE (Finland) will be used as a screening source for cold-adapted enzymes by Enzymicals AG, Germany

Scientific successes, most prospective blue biotech areas within BSR

Identification of a potential source for cold-adapted enzymes. Relevant blue biotech area: Novel enzymes from marine resources. However, exploitation of the resource awaits establishing a funding concept. Search for suitable funding is still ongoing.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

Positive contributions: Identifying new resources for the industry sector of white biotechnology. Cold-adapted enzymes could be used in a variety of processes, including synthesis of fine chemicals or special catalysis. In this case, a probable application is the use of Lipases in washing powder for the asian market.

Financial/Legal barriers and solutions found

Transnational legal barriers with respect to access/benefit sharing are present but relatively low due to liberal provisions of Finland an Germany. Substantial barriers have been found in financing. Initial steps (planning, first screening) could perhaps be financed by the project partners (thouh not in the framework of the ALLAINCE, since the Enzymicals case was adopted only without funding). Further steps, i.e.gene identification, overexpression, and purification, need financial resources that could neither be provided by the ALLIANCE nor by the cooperation partners.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.)

ALLIANCE support resulted in the identification of a suitable biological recourse and a suitable cooperation partner. Further steps, i.e. product development, could not be supported by the ALLIANCE due to lack of financial resources.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

The financial barrier encountered in the development of this caset is a commonly known gap. Big biotech companies, which are targeted by this case development, will not invest in projects until certain initial development steps have been taken. However, conducting development steps are usually beyond the financial capacities of SMEs. A possible solution could be a national or EU-driven funding programme dedicated to SME product development.

Case 17- Movable Biogas Factory: Highlights

Movable Biogas Factory Team had an idea of a mobilable unit that can use different biomass types to produce biogas and use the reject as fertilizers. The biogas factory could be transported to the raw material source, minimizing the transportation costs of the raw material. The factory could be used to remove nutrients by removing excess biomass from the Baltic Sea and turning it to profitable products.

From ALLIANCE the case requested cooperation in small scale process development, automation development, technical development, identification of available and viable biomass fractions and information about the usability of fertilizers from different raw material sources. They also wanted to have their business model validated, service concept developed and help in finding financing.

Contribution of mentors and ALLIANCE to case progress

As in many other cases, the mentors were highly relevant not only for providing contacts and safeguarding the progress, but also for technical implementation. Accordingly, ALLIANCE offered to provide most of these services. It was decided that a study will be prepared about the potential biomass sources and the use of the reject as fertilizers, including business opportunities and legal issues for biomass usage and biogas handling and transportation. This study was originally planned to be provided by KTH, but at the end it was prepared by SYKE. Case SFTec offered to consult in technology development and movability of the factory, which has been done. Contacts were provided by the ALLIANCE partners DTI (biogas actors from Denmark, other cases in biogas business), Tartu Biotechnology Park (contacts from Estonia), Clean Tech Latvia (contacts from Latvia) and KTH (contacts from Sweden and scientific studies on the issues). Business assessment will be done by the ALLIANCE method before the end of the project.

Contribution to Sustainable Development goals (SDG)

The case Movable Biogas Factory contributes to the following SDGs: 14-Life below water, 12-Responsible consumption and production and SDG-8 Decent work and economic growth, 9-Industry, Innovation and Infrastructure and 7- affordable and clean energy.

Comparative case analysis

Transnationality.

The Finnish case owner is collaborating with ALLIANCE partners from 4 other countries, namely Sweden, Denmark, Latvia, Estonia. Since the case contributes to utilization of waste (beachcast) which is a problem in almost all Baltic Sea States, a transnational perspective is crucial for this case.

Type of ALLIANCE service provided. As all ALLIANCE cases the case received mentoring support. Beyond this, the ALLIANCE provided business support (like 16 other ALLIANCE cases), legal advice (like 6 other cases), technical support (like 19 other cases), and networking (like 21 other cases). This case did not receive financial support.

Target application/market and customers. The case intends to use biomass otherwise considered as waste, namely beachcast (macroalgae and plants) to convert it into biogas and use the residues as fertilizer for agriculture. Due to the special setting of this case (a movable biogas reactor), there are three types of target markets and customers. On the one hand, the case targets municipalities (public sector) in which beachcast removal is a problem generating high costs but is necessary for improving touristic attractiveness. On the other hand, customers for the produced biogas are energy providers, which are either public and/or commercial depending on the country. Last, the case aims to sell the residues after biogas conversion as a fertilizer, thus clearly targeting the agricultural sector. Except for the fertilizer, where also sale to farmers (B2C) is possible, the case targets a B2B relationship. This is true for 12 other ALLIANCE cases.

Biological resource used. Like 2 other cases, the used bioresource for Movable biogas factory are macroalgae and other plant material (e.g. seagrass). This case intends to valorize waste streams. This is similar to e.g. case 8-Biofisk, but differs in that respect, that here, the beachcast

is used as a source for bioenergy and not as a feed additive. Both cases represent interesting and relevant approaches for beachcast management.

Type of product. The case MBF targets the production of energy from beachcast, which can be then sold to energy providers. Moreover, it intends to use the residue material after biogas conversion as a fertilizer product. By offering a movable device for removing the beachcast to municipalities confronted with the problem of efficient beachcast removal, this case can also be considered to provide a service. This is the only ALLIANCE case targeting all three product types (energy, product, service).

Individual progress.
MBF joined the ALLIANCE after the pitching event in Gothenburg. Due to many technical hurdles, the case was in the bioprospecting/biodiscovery stage. During the ALLIANCE project, the case significantly advances due to valuable advice from its mentors and the case owner from case #10-SFTec; however, still significant financial and technical hurdles including a safe transport of the biogas remain at the end of the ALLIANCE project. Therefore the case remains at the bioprospecting/biodiscovery stage.

SUMMARY: Case Movable Biogas Factory

Case and mentor information

Case Name: Movable Biogas Factory (MBF), Ritva Nilivaara-Koskela

Product: Movable Biogas Factory (MBF)

ALLIANCE mentor(s): SYKE, KTH

Type of ALLIANCE support (mentoring/implementation of case/financial support):

Mentoring, networking, scientific/ technical support. The case received no financial support from ALLIANCE.

Duration of ALLIANCE support: from April 2017 until the end of the project.

Success factors

The utilization of excess biomass to product biogas and fertilizers, i.e. valorization of waste streams is part of most circular economy approaches and thus probably will be an important process in future. The unique possibility of transportability offered by this case, i.e. bringing the biogas process to the raw material avoids transportation costs of the beachcast. If floating plant material (e.g. after heavy storms) is collected directly at sea and then converted to biogas on-site, this method could even reduce eutrophication. Moreover, this case contributes to touristic attractiveness of beaches by removing high proportions of beachcast.

Barriers to be overcome

Significant barriers are related to handling and transportation of biogas from a technical and safety aspects.

Moreover, since the beachcast is always composed differently (different species composition, different proportions of seagrass/algae), the properties of the raw material used for biogas conversion will most probably affect the quality of the end product. This certainly affects also the business model and profitability.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Research institute: SYKE, ALLIANCE partner, Finland. Providing biomass study (done for case#10 SFTec), discussing other sources in the biogas report. Networking, providing contacts to Finnish actors in the biogas sector

Research institute: KTH, ALLIANCE partner, Sweden. Networking, providing contacts to Swedish actors in the biogas sector, support in legal issues

Research institute: DTI, ALLIANCE partner, Denmark. Networking, providing contacts to Danish actors in the biogas sector. Providing business opportunities

Business support organization: CleanTech Latvia, ALLIANCE partner, Latvia. Networking, providing contacts to Latvian actors in the biogas sector

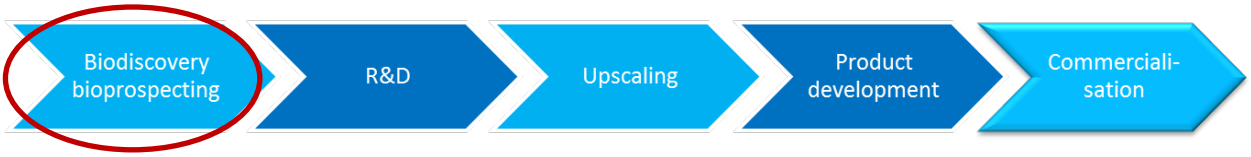
Business Park: Tartu Biotechnology Park, ALLIANCE partner, Estonia. Networking, providing contacts to Estonian actors in the biogas sector

SME: SFTec, ALLIANCE partner and case owner (case #10). Providing help in technical issues

Initial Case Needs

- Defining available biomass sources
- Networking
- Defining business opportunities for the reject as a fertilizer
- Help in legislation issues
- Information on how to handle and transport biogas in different countries
- Possible customers for biogas
- Help in technical issues (effect of varieting raw materials to the process, transportation of the working process)
- Help in finding the best sector of customers for a pilot.

TRL estimation when approaching ALLIANCE



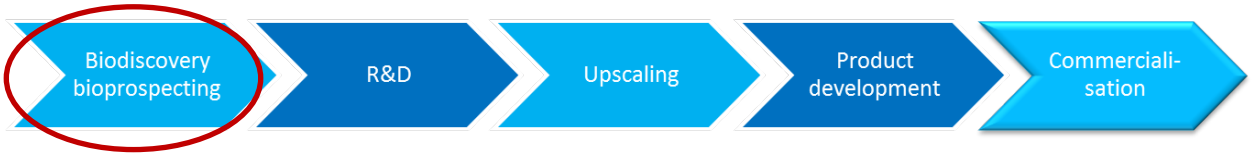
Estimated time frame for realisation:

□ short term (<1 year) x midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Defining the available biomass sources	KTH (lead), SYKE (assist)	n/a
2.	Help in networking	SYKE, KTH, DTI, Clean Tech LV, TBP	n/a
3.	Business opportunities for the reject as a fertilizer	KTH, DTI	n/a
4.	Help in legislation issues	KTH	n/a
5.	Help in handling and transporting biogas in different countries	KTH	n/a
6.	Consulting the technology development and mobility	SFTec	n/a

TRL estimation after ALLIANCE commitment



Estimated time frame for realisation:

□ short term (<1 year) □ midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

Transnational impact

Circular economy concepts are often transnational approaches. Since this case contributes to waste management, which is integral to all circular economy approaches, this case has a huge economic potential. When linked to the right transnational partners, it can impact beachcast management around the Baltic due to the transportability of the system. The first step on this path is made, since contact information for different actors working in the biogas sector was provided by Latvian, Danish and Estonian partners to the biogas report.

Scientific successes, most prospective blue biotech areas within BSR

SYKE wrote a report, where the idea of the case, its possibilities and challenges are discussed in detail. This report was handed over to the case owner.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

If the (mostly technical) challenges of this idea can be solved, the technology could help to produce biogas from waste biomass. It could be incorporated to other (transnational) circular economy bioprocesses to produce energy for them.

Financial/Legal barriers and solutions found

Biogas plants are heavily regulated in Finland. When planning a biogas plant, environmental impact assessment, construction and environmental permits, plant certificates and possible permits to store hazardous chemicals are needed. If the digestate-derived products will be marketed as fertilizers, a permit for that is also needed. Mobile configuration may also call for specific permits.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.)

The report identified those issues that should be examined further and those decisions that have to be made before moving to next stage. Now the case should have a clearer idea what should be done next, if they want to proceed. These issues cover technical, socio-economical and legal considerations.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

First, the case owner needs to make decisions on issues related to the technical and profitability issues. They should also examine the possibilities to incorporate the technology to other circular economy processes.

Case 18- Organic Seaweed: Highlights

Established in 2015, the startup Organic Seaweed farms organic coastal seaweed, as the first in Denmark. Currently the seaweed is converted into organic dietary supplements, but the case wants to develop a natural organic sunscreen extract from seaweed, which can replace the chemical and physical filters used as sunscreens today, and which is expected to be free of CMR (carcinogenic, mutagenic or reprotoxic) substances, is not allergenic and which reduces negative environmental impacts. The basis for are phlorotannins, constituents of brown algae, which protect the algae against harmful UV-A and -B sun rays. The aim of the case is to extract these active substances.

The case needed help for a range of challenges: Documentation of phlorotannin content; sustainable method for extraction of the bioactive substance, storage and test of the product for sun protection factor (SPF) and allergic reactions.

Contribution of mentors and ALLIANCE to case progress

The ALLIANCE support for this case resulted in experiments showing a good phlorotannin content of the Organic Seaweed macroalgae and a feasibility study for the phlorotannin extraction process using standard methods. Both ALLIANCE mentors supported this case by fostering transnational cross-case collaboration (Koster Alg, case #9 and CRM, case #1) and scientific/technical support. Mentoring the case was facilitated by an active case owner. Notable for this case is, that on top of mentoring, a collaboration developed with CRM, a German SME representing one of the ALLIANCE first-generation cases which will be ongoing beyond ALLIANCE. Interaction and knowledge transfer from a well-established SME with substantial expertise in the cosmetic market was crucial for advancing this case.

Contribution to Sustainable Development goals (SDG)

The case Organic Seaweed contributes to SDG-12 Responsible consumption and production, 14-Life below water and furthermore to SDG-8 Decent work and economic growth.

Comparative case analysis

Transnationality. The case owner of Organic Seaweed is based in Denmark. Mentors came from Denmark and Sweden, and case-to-case cross-collaboration was also realized with CRM from Germany and KosterAlg case from Sweden.

Type of ALLIANCE service provided. The case received intense mentoring and networking by DTI as first and CRM as second mentor. The business development envisioned was somewhat limited due to lacking financing/investments. Business-wise, an agreement with CRM for supply of raw algal material was made, thus generating a new customer for Organic Seaweed. Scientific/technical support on phlorotannin analysis from the algae was provided by UGOT.

Target application/market and customers.

The target application of case Organic Seaweed is a marine-based, organically produced and sustainable harvested cosmetic providing sun protection. The case is targeting the end customer with the product and it targets the cosmetic market. This is true for 6 ALLIANCE cases in total.

Biological resource used.

The case Organic Seaweed uses sustainably harvested macroalgae for its product development. Macroalgae are the biological resource in 6 other ALLIANCE cases.

Type of product.

The target product of Organic Seaweed is a phlorotannin-containing organic sunscreen for direct sale to the end-customer (B2C). B2C relationships are aimed at in 6 ALLIANCE cases in total. Sale of a product rather than a service or energy is also the aim of 20 other ALLIANCE cases. Notably, during the involvement in the ALLIANCE, the case owner has also agreed with the ALLIANCE case/partner CRM on delivery of the raw material for development of own cosmetic products, thus representing a broadening of the sales perspective and a B2B link.

Individual progress.

When Organic Seaweed joined the ALLIANCE, it was in bioprospecting stage. Due to the mentorship and the support provided by the ALLIANCE, the case has advanced towards R&D stage.

SUMMARY: Case Organic Seaweed

Case and mentor information

Case Name: Organic Seaweed Sunshield, case #18

Product: Developing a natural organic sunscreen extract from seaweed phlorotannin

ALLIANCE mentor(s): Danish Technological Institute (DTI), University of Gothenburg (UGOT), Coastal Research Management (CRM)

Type of ALLIANCE support (mentoring/implementation of case/financial support): Mentoring, networks and collaboration development, scientific/technical: content analysis of harvested biomass

Duration of ALLIANCE support: April 2017 until end of project

Success factors

Analysis made by UGOT of harvested seaweed shows a good content of phlorotannin. Determination of the success of standard extraction methods for the seaweed biomass. New collaboration regarding Organic Seaweed existing product TANG (seaweed) tablet and harvesting of biomass for the German market via CRM portfolio.

Barriers to be overcome

Determination of effectiveness of phlorotannin extraction methods which are equally acceptable for the organic consumers.

Determination of effectiveness of the extract on the skin regarding UV protection and EU/Nordic regulations applicable need to be described and understood

Lack of risk capital/investors

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Research Institute: DTI, ALLIANCE partner, Denmark. Mentoring, networking.

Research institute: University of Gothenburg, ALLIANCE partner, Sweden. Scientific/technical support on extraction methods and scalability, phlorotannin content analysis

Research institute: SYKE, ALLIANCE partner, Finland. Evaluating market demand and support on business plan using the ALLIANCE business assessment procedure (external support: Gaia)

SME: CRM, ALLIANCE partner and case, Germany. Expert advice on cosmetic applications, harvesting synergies

Initial Case Needs

- Extraction methods and scalability (Feasibility of extraction methods)
- Analyses of phlorotannin content (determeination of phlorotannin amount)
- Suitability of extracted phlorotannins for use in cosmetic applications (product quality)
- Harvesting synergies (reduce production costs and increase chance of selling the product
- Market demand, Business plan

TRL estimation when approaching ALLIANCE

Estimated time frame for realisation:

□ short term (<1 year) **X** midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	**Involved ALLIANCE partner**	**External expertise**
1.	Extraction and analyses	UGOT	
2.	Product suitability	CRM	
3.	Harvesting synergy	CRM	
4.	Market demand and business plan	SYKE	GAIA

TRL estimation after ALLIANCE commitment

Estimated time frame for realisation:

□ short term (<1 year) **X** midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

Transnational impact

If this case results in a phlorotannin extract which can be applied in new bio-products (cosmetics, etc.) with an economically viable business case, it could result in the motivation for establishment of more seaweed farms around the Baltic Sea (critical mass) and raise awareness in the public for the wide applicability of seaweed products beyond application as food and feed.

Scientific successes, most prospective blue biotech areas within BSR

The macroalgae sustainably harvested by Organic Seaweed have a good level of phlorotannins. Beyond this, the ALLIANCE has proven, that these phlorotannins can be extracted with standard methods. Most prospective blue biotech areas within the BSR are further steps in product development towards cosmetics and nutrient supplements.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

As the Baltic Sea is considered to suffer from eutrophication, sustainable harvest of primary producers like macroalgae this case contributes to nutrient remediation followed by a valorization strategy of these bioresources in a cosmetic or nutritional supplement on a commercial basis. Success of this case may result in increased seaweed farming in the BSR (and globally), which can be part of circular economy concepts and provide the basis for other sound transnational blue biotechnology processes.

Financial/Legal barriers and solutions found

Venture capital for establishing the seaweed farms is lacking. In this case, one of the solutions found for stabilizing the economy of Organic Seaweed can the possible collaboration with another seaweed producer, already working with cosmetic applications in another Baltic Sea country.

Regulation regarding the establishment of seaweed farms varies from country to country depending on the interpretation of the EU directives regarding aquaculture, although seaweed and mussels are now being treated differently than fish aquaculture.

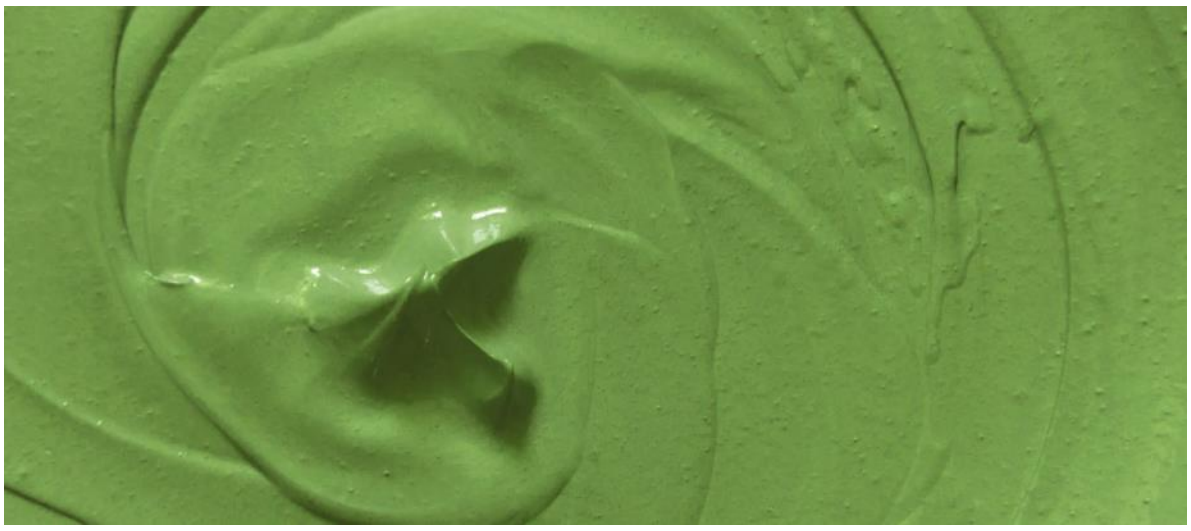
Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.)

Dialogue with Baltic Sea actors from the same sector and with similar challenges has been facilitated. Collaboration opportunities between the actors across the Baltic Sea have been supported. Methodology for extraction of active compounds has been successfully tried and documented. Content analysis of the active compound in the harvested seaweed has been made and levels confirmed.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

The product still needs to be tested for effect (SPF and dermatological tests, etc.) before conclusions regarding the economic implications and future prospects of the product developed can be made.

Image showing extracts from Baltic macroalgae in a cream.



Case 19-Biogas from microalgae: Highlights

Biogas produced from algal biomass fulfills the conditions of a most attractive fuel in the BSR region. It is also easily convertible into electrical energy, the basic power supply for modern technologies. It was shown that the biochemical composition of algae is strictly determined by culturing conditions and can be improved (i.e. energetic lipids content) by the controlled application of stress factors. Given the rapidly advancing technology of cultivation and possibility of costs reduction using environmental waters or wastewater, reconsideration of microalgae biomass as a biogas substrate is highly recommended. By combining the features of rapid growth of microalgae and their susceptibility to stress factors, access to a great source of biomass produced during photosynthesis can be gained, the greatest natural ally in capturing atmospheric carbon dioxide and its transformation into a source of energy. The case needed cooperation partners for performing chemical tests including Batch Biochemical Methane Potential tests of biomass from single or mixed strains as well as cumulative methane production estimation over time.

Contribution of mentors and ALLIANCE to case progress

ALLIANCE mentoring and support resulted in the identification and characterization of four most promising Baltic algae strains. The mentors did not only provide valuable contacts but united to support actual implementation of the idea, which was realized by a 3 months research stay of the case owner, Marek Klin, at DTI labs for conducting chemical analyses. Further steps are currently explored in ongoing support in developing a business plan negotiations and finding possible markets.

Contribution to Sustainable Development goals (SDG).

This case contributes to SDG7- Affordable and clean energy, and -9: Industry, Innovation and Infrastructure.

Comparative case analysis

Transnationality. In terms of transnationality, this case, which is situated in Poland, is collaborating with ALLIANCE partners in Denmark and Germany and received business support from the external business advisor Gaia (Finland) during ALLIANCE workshops. A specific transnational aspect is present in this case by realizing a 3 months research stay at DTI for chemical analysis of the produced biogas.

Type of ALLIANCE service provided. ALLIANCE provided – beyond mentoring – scientific/technical support (like 20 cases in total), business support (17 cases in total) and networking support (22 cases in total). Here, especially the scientific support contributed to the case success.

Target application/market and customers.
The target application is the production of energy in this case biogas, based on a biological resource. The market is clearly the energy (biogas) sector and potential customers can be energy providers in the BSR or biogas producers. Thus, the intended type of customers relationships are rather B2B relationships than B2C connections (like in 13 ALLIANCE cases in total).

Biological resource used.
This case aims at cultivating microalgae for the production of biomass, which can then be used for biogas production. This approach is fully sustainable, since no ecosystem is affected and the biological resource is produced by cultivation. Microalgae are also the biological resource used in 7 other ALLIANCE cases.

Type of product.
In this case, biomass is generated to produce biogas, which is a type of energy rather than a product or service. Energy is the rarest product type which followed by the ALLIANCE cases, it is the aim of product development for 3 cases in total.

Individual progress. The ALLIANCE partners involved in this case considerably helped to move this case forward. When joining the ALLIANCE, it was in bioprospecting stage, but especially due

to the scientific support provided by the mentors it advanced to R&D stage, which is in implementation now and will be ongoing beyond the ALLIANCE.

SUMMARY: Biogas from microalgae

Case and mentor information

Case Name: Biogas production using biomass derived from Baltic microalgae

Product: Biogas

ALLIANCE mentor(s): University Gdansk, DTI

Type of ALLIANCE support (mentoring/implementation of case/financial support): Mentoring; scientific/technical support during case implementation; business support, networking

Duration of ALLIANCE support: from April 2017 until end of project

Success factors

During the ALLIANCE, with the help of UniGdasnk and DTI, four Baltic microalgae strains with very promising biochemical characteristics have been identified and characterized concerning their biochemical properties.

Barriers to be overcome

Financial support for piloting/upscaling are still issues and a barriers for this case as for many other ALLIANCE cases, which could not be overcome during case implementation. The funds for the 3 months research stay in Denmark were acquired via ERASMUS.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Research institute: DTI, ALLIANCE partner, Denmark. Scientific/technical support concerning chemical analyses of the biogas, hosting the case owner for a research stay.

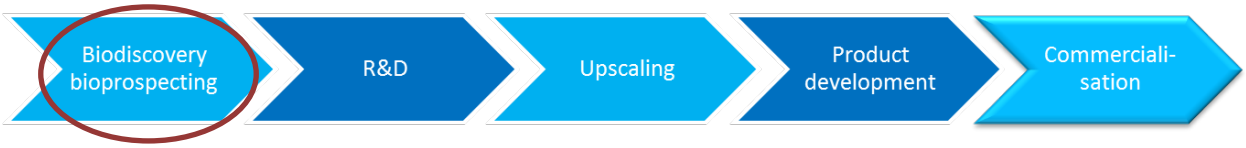
Research institute: University of Gdansk, ALLIANCE partner, Poland. Scientific support: biochemical profiling of the microalgae

Network: SUBMARINER Network, ALLIANCE partner, Germany. Providing contacts, networking.

Initial Case Needs

- Biochemical methane potential (BMP) tests
- chemical analysis of AD products
- biochemical profiling of delivered biomass (% lipids, proteins, carbohydrates and others if possible)
- new openings in networking; help in networking and finding markets;
- support in developing a business plan
- consultation on NDA and IPR

TRL estimation when approaching ALLIANCE



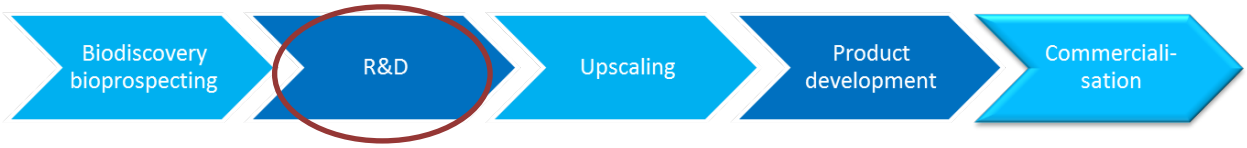
Estimated time frame for realisation:

□ short term (<1 year) x midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	biochemical profiling of microalgae biomass (% lipids, proteins, carbohydrates	UG	
2.	Bench BMP tests, chemical analysis of resulting biogas	DTI	
3.	support in developing a business plan;	ALLIANCE business procedure	Gaia
4	Networking	SubMariner Network	

TRL estimation after ALLIANCE commitment



Estimated time frame for realisation:

□ short term (<1 year) x midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

Transnational impact

Biogas production from microalgae can be an alternative to biogas production from crop biomass in a transnational circular economy concept. Therefore, it constitutes a promising approach which may have in the long run a high impact on the entire Baltic Sea region. The transnational cooperation especially with DTI, but also on the business side with GAIA and with SubNet as transnational network linking to suitable partners are first steps into this direction.

Scientific successes, most prospective blue biotech areas within BSR

By combining the features of rapid growth of algae and their susceptibility to stress factors, we gain access to a great source of biomass produced during photosynthesis, our greatest natural ally in capturing atmospheric carbon dioxide and its transformation into a source of energy. The best microalgal species for further trials (in terms of growth and stress resistance) are selected on a scientific basis with the help of the ALLIANCE partners.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

Biogas produced from algal biomass fulfills the conditions of a most attractive fuel in the BSR region. It is also easily convertible into electric energy, and thus constitutes the basic power supply for modern technologies. Conditions for a sound blue biotechnology process are of course a reduction of energy costs for microalgae cultivation (light, heat). Sustainability is addressed well by this case, since it relies on cultivation of Baltic algae, which does not affect the environment. Moreover, microalgae from the Baltic may be able to grow in cold-temperate conditions thus reducing the necessary energy input of light and heat for their cultivation. Another requirement is the use of waste streams from the biogas production (residual biomass),

but transnational partners for this can be found within the BSR. The case hence meets most preconditions for a sound blue biotechnology transnational production process.

Financial/Legal barriers and solutions found

Financial barriers concerning upscaling and solutions can only come from project applications, since the case is still in R&D stage. Finding financial solutions concerning piloting and upscaling are still ongoing. Funding for a transnational research stay was enabled by an ERASMUS application.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.)

The case has made significant advances towards product development; although products from this case are not market-ready, but await pilot trials, the case has moved from bioprospecting towards R&D stage. Like for other cases, the lesson learned from this case is, that selection of the biological resource should be knowledge-based and therefore, extensive research is needed. Although this may appear like a slow progress, but a thorough scientific analysis and the selection of the right strains may prevent pitfalls and drawbacks in later stages of the product development.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

N/A, since no product is already developed or in final stage of development. Future economic prospects are high, especially in circular economy concepts. The ALLIANCE is seen as a catalyst for cooperations between individuals willing to move forward with innovative projects in blue biotechnology.

Case 20- EHP: Highlights

EHP Environment Ltd is a Finnish company developing and selling real-time monitoring buoys to measure water parameters, and providing measurement data. When coming to ALLIANCE mentoring program, their request was to find new customers from Baltic Sea Region from aquaculture target market. For that they needed information about the required measurement parameters in different sectors. Real-time monitoring could help the aquaculture farmers to reduce the negative environmental effects and detect the problems in the system faster.

Contribution of mentors and ALLIANCE to case progress

ALLIANCE case Kalundborg was interested in the buoys for their own purposes and these two cases started negotiations. SYKE as primary mentor was in contact with EHP regularly answering their questions when needed. SYKE also again was relevant for actual implementation, realized by an on-site visit to EHP and giving a training session about fluorescence sensors and measurements. During the visit, also accreditation, validation and traceability issues of the continuous field measurements were discussed in detail and information about practical issues connected to the equipment was shared. The secondary mentor CORPI performed a study about the measurement requirements for aquaculture ponds and fish farmers interest in investing to the real-time monitoring based on the EHP prices. This study will be ready before the end of the project.

Tartu Biotechnology Park provided contact information (Estonian fish farmers, scientists from Estonian University of Life Sciences). Moreover, Jaakko Seppälä from EHP was invited to the Better off Blue conference by SUBMARINER Network as a panel discussion member to discuss about online monitoring. This opportunity created new contacts for them.

For this case the most important benefit was the access to the network and the information that was provided from it.

Contribution to Sustainable Development goals (SDG)

This case is contributing to SDG8-Decent work and Economic growth, 9-Industry, Innovation and Infrastructure, and 14- Life below water

Comparative case analysis

Transnationality. With regard to transnationality, the Finnish case EHP is collaborating with ALLIANCE partners in Lithuania, Denmark, Estonia and Germany.

Type of ALLIANCE service provided.

For the case EHP, the ALLIANCE provided several types of support. Besides mentoring, the case received scientific/technical support by its mentors CORPI and SYKE. Moreover, networking support was provided and the case was promoted on the Better off Blue conference in Berlin by SUBMARINER Network. Moreover, Tartu Biotechnology Park also offered contacts to Estonian colleagues thus broadening the network of potential customers. Cross-case collaboration was initiated by cross-linking the case to case #5-Kalundborg Utility.

Target application/market and customers.

EHP is developing technical devices equipped with sensors to remotely monitor water quality/properties. Thus, target applications and markets clearly lie in the aquaculture sector. Target customers, for whose this technology is probably highly interesting, are fish farmers operating on- or offshore aquaculturing systems around the Baltic Sea Region. The case therefore targets a B2B relationship like 12 other cases.

Biological resource used.

The case EHP does not use any biological resource, since it is developing sensors for water monitoring. This is also the case for 2 other ALLIANCE cases (Geoterma and LoondSpa).

Type of product.

The product in development by EHP is a buoy, and during ALLIANCE project, the case owner received important advice for improvement of the sensor system. Thus, the aim of this case is to develop a product, but if constant remote monitoring of the buoys is included, it can of course also be seen as a service.

Individual progress.

When the case approached ALLIANCE, it was already well advanced in the value chain, i.e. between product development and commerzialization. The case mainly requested networking support from the ALLIANCE, which was provided. Moreover, technical/scientific advice was given by the mentors SYKE and CORPI, which may lead to improvement of the buoy. At the end of the project, the case is thus at the same level.

SUMMARY: Case EHP

Case and mentor information

Case Name: EHP Environment Ltd, Jaakko Seppälä

Product: Environmental monitoring of aquaculture sites implemented online at the sea

ALLIANCE mentor(s): SYKE, CORPI

Type of ALLIANCE support (mentoring/implementation of case/financial support): Mentoring, networking, scientific/technical support. The case did not receive financial support.

Duration of ALLIANCE support: April 2017 until the end of the project.

Success factors

Cost efficient real-time monitoring of marine environments is a growing field and could create many different products from the sensors themselves to the services produced from the measured data.

Barriers to be overcome

Validation, accreditation and traceability of the measurement data.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Research institute: SYKE, ALLIANCE partner, Finland. Mentoring and scientific and technical support (online monitoring needs and parameters to be monitored, Assessing the need for accreditation, validation and traceability of continuous field measurements), networking

Research institute: CORPI, ALLIANCE partner, Lithuania. Mentoring, scientific and technical support (Evaluate the needs for data processing to create higher value information products)

Business Park: Tartu Biotechnology Park, ALLIANCE partner, Estonia. Networking, providing novel contacts

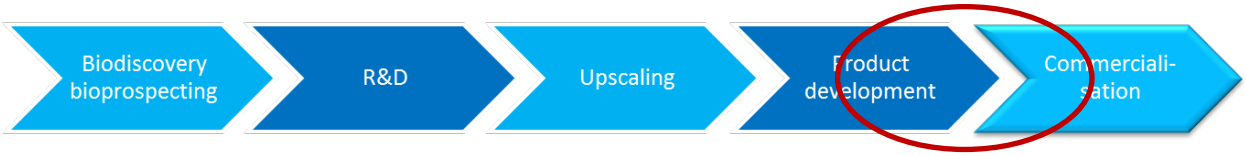
Network: SUBMARINER Network, ALLIANCE partner, Germany. Promoting the case on conference, providing contacts/networking

SME: Kalundborg Utility, ALLIANCE partner and case, Denmark. Discussions on the monitoring systems, potential partner

Initial Case Needs

- Assessing the need for accreditation, validation and traceability of continuous field measurements
- Evaluation of the online monitoring needs and parameters to be monitored
- Evaluate the needs for data processing to create higher value information products
- Networking and finding partners

TRL estimation when approaching ALLIANCE



Estimated time frame for realisation:

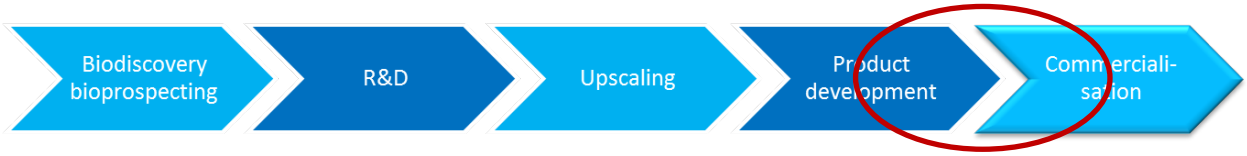
□ short term (<1 year) **x <u>midterm (1-3 years)</u>**, □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Assessing the need for accreditation, validation and traceability of continuous field measurements	SYKE	
2.	Evaluate the needs for online monitoring in different sectors and the needed parameters	SYKE, Kalundborg, TBP	
3.	Evaluate the needs for data processing to create information products	SYKE	
4.	Survey of market and actors for online monitoring	TBP, SUB Net, Kalundborg	

5.	Possibility to test the sensors	Kalundborg	
6.	Cooperation in development	CORPI	
7.	Networking and marketing	TBP	

TRL estimation after ALLIANCE commitment



Estimated time frame for realisation:

□ short term (<1 year) **x <u>midterm (1-3 years)</u>**, □ long term (>5 years), □ very long term (>15 years)

Transnational impact

Before ALLIANCE, the case had mostly Finnish customers. The ALLIANCE network opened up the possibility for networking all over the Baltic Sea Region. Since the buoys can be used in aquaculture and the aquaculture sector is an emerging sector in frame of blue bioeconomy/circular economy, the transnational impact for the BSR for this case is high

Scientific successes, most prospective blue biotech areas within BSR

The function of the buoys can be used to monitor water quality in a variety of natural and artificial systems. Moreover, remotely controlled, automated measurements will be important in monitoring the status of the marine environments. Offshore farms for algae, mussel or fish cultivation - a growing industry in the BSR - are prospective areas for the products from this case. The products from these farms will not only be sold as food but also serve as resource for product developments in blue biotech (i.e. cosmetics, nutrient additives). Thus, the economic potential for the products or the service offered by this case his high in the BSR and has a close link to blue biotech.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

The automated measurements will be important tools for monitoring the status of the marine environments. Therefore, they contribute positively to the status of on- and offshore aquaculture sites. These buoys can be crucial for managing water quality. Since many blue biotechnology value chains (especially cultivation of macroalgae, but also mussels or fish) rely on the water quality in which the biological resources are growing, monitoring this is a precondition for all further developments.

Financial/Legal barriers and solutions found.

n/a

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.).

Unfortunately, de minimis regulations are hindering complete implementation of the cases. Scientific advice by experts in the field is an important also in product development stage to possibly improve the product. Hence, a report of measurement needs and the requirements for the measurement parameters is implemented by the end of the project (SYKE). Moreover, a training session for the case about optical sensors will be arranged in November by SYKE.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

The measurement data needs to be validated, accreditated and traceable. Developing measurement data to higher value information products could be a profitable business.

Image showing one of the monitoring buoys in development by EHP.

Case 21- Vetik: Highlights

Vetik OÜ is an Estonian start-up founded in 2017. The company has access to a unique source of wild red seaweed (*Furcellaria lumbricalis*) located in the sea area of the West Estonian Archipelago. The main priority of Vetik is to develop a competitive process for large scale extraction of R-phycoerythrin (R-PE) from red algae. First, joining the ALLIANCE mentoring programme the idea was that this red pigment can be an alternative to existing food colorants and/or diagnostics or laboratory studies. During the ALLIANCE, the company developed a new focus for product development and their first application field will be natural cosmetics. For that purpose, they have opened up discussions for further collaboration with two ALLIANCE members – CRM and Furcella OÜ.

Contribution of mentors and ALLIANCE to case progress

Via their primary mentor – Tartu Biotechnology Park – Vetik got access to the ALLIANCE and SubMariner network experts and knowledge, who both provided support and promotion for the case, i.e. via conference participation. Moreover, the ALLIANCE facilitated Vetik´s participation in several events and trainings/coaching to promote the case owners´ development of business and entrepreneurial skills. The ALLIANCE partners have further provided scientific and technical support to Vetik, such as seaweed drying (SFTec and SYKE), crushing, and pigment extraction technologies (GEOMAR, CRM). Vetik has alyso received guidance for cost estimations (to build a large-scale production line) and support for business development, finding the right markets, networking and matchmaking for useful contacts and potential collaboration partners from the whole ALLIANCE members' network.

So, guided by the mentors, the ALLIANCE has given this case valuable support and insights, has opened doors and guided their focus to significantly promote their product development.

Based on promotion by ALLIANCE, Vetik applied to the Portuguese Blue Bio Value accelerator program, which they successfully completed in Autumn 2018. Afterwards, they even won a national Estonian competition – Prototron – valued at 20 000 EUR - for creation of a prototype. Furthermore, Vetik's success story continued when they received further funds valued 137 000 EUR in frame of a grant from Estonia and the EU for upscaling their technology.

Contribution to Sustainable Development goals (SDG)

The case Vetik contributes to SDG-14, Life below water and furthermore to SDG-12: responsible production and consumption, -9 Industry, Innovation and Infrastructure and 3-Good health and well-being.

Comparative case analysis

Transnationality.

From a transnational perpective, this case is collaborating with ALLIANCE partners in Germany and Finland.

Type of ALLIANCE service provided.

The ALLIANCE provided almost all types of support to Vetik´s case. Scientific and technical support was provided by GEOMAR, i.e. optimization of sample preparation and extraction method for red algal pigments and chemical expertise, as well as CRM, i.e. technical and business support for finding the right markets. Moreover, Vetik received networking and promotional support (Portuguese Blue Bio Accelerator program, ALLIANCE conference Greifswald), and business support (mentors Tartu Biotechnology Park and case Furcella). Cross-case collaboration was fruitfully working in this case, i.e. collaborations were established to 3 other ALLIANCE cases, i.e. case #10-SFTec, case #1-CRM and Case #7-Furcella.

Target application/market and customers.

With the original idea Vetik targets the food sector, since they aim at the development of red-algae-based food colorants. Towards this aim, target customers are food companies, so a B2B relationship is envisaged by Vetik. Due to establishment of fruitful contacts to cosmetic companies in Estonia (Furcella) and Germany (CRM) in frame of ALLIANCE, the focus has broadened towards development of a cosmetic product containing phycoerythrin from Estonian red algae, targeting the natural cosmetics market. For this product, B2C relationships directly with the end customer are envisaged. Both B2B and B2C relationships are also targeted by 6 other ALLIANCE cases. The food sector was targeted by 3 other ALLIANCE cases.

Biological resource used.

For the development of dyes for application as food colorants or cosmetic applications, Vetik has a license to sustainably harvest red macroalgae which is their biological resource. Macroalgae are also used as a biological resource in 6 other cases.

Type of product.

Vetik aims at the development of two different products, one for the food sector and one for the cosmetic sector. Both can be classified as products (like 20 other ALLIANCE cases); Vetik does not plan to sell energy or a service.

Individual progress.

When joining the ALLIANCE, the case was in R&D stage. During ALLIANCE commitment, the case advanced significantly towards upscaling and is now considered to be between R&D and upscaling.

SUMMARY: Case Vetik

Case and mentor information

Case Name: **Vetik OÜ (case #21)**

Product: Red algae based products for cosmetics, food and biotechnology.

ALLIANCE mentor(s): Tartu Biotechnology Park (Mariann Nõlvak), CRM (Levent Piker), Furcella OÜ (Janno Joosep)

Type of ALLIANCE support (mentoring/implementation of case/financial support):

mentoring/implementation of case, technical and scientific support, financial support through partners, business support

Duration of ALLIANCE support: November 2017 until end of project

Success factors

During the ALLIANCE mentoring process, the case has been able to get access to cooperation partners with very useful technical and scientific expertise. Participation in regular ALLIANCE meetings and other events (conference, business workshops) has provided most useful support. Especially during these events fruitful discussions and valuable advice on future research and development resulted in clarification of existing problems – so direct communication at the meetings impacted the progress the most. Great help has been provided from ALLIANCE partners as they have provided possibility (incl. funding) to attend the meetings. Added value has been the ability of ALLIANCE to fund the experiments conducted in the labs of the experts (e.g. at GEOMAR).

Barriers to be overcome

Vetik entered the ALLIANCE mentoring program at half-time of the project, limiting the time for experiments. Therefore, the case could have advanced even further if there had been more time. Availability of the ALLIANCE service offer in the database is crucial to learn what the ALLIANCE partners offer.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Business Park: Tartu Biotechnology Park, ALLIANCE partner, Estonia. Mentoring, networking, promotion of the case to accelerator programs.

Research institute: GEOMAR, ALLIANCE partner, Germany. Providing scientific support on pigment extraction, developing and conducting experiments for optimization of extraction procedure. Networking, promotion of the case

SME: CRM, ALLIANCE partner and case, Germany. Technical support, i.e. testing seaweed crushing technologies, support in finding the right partners

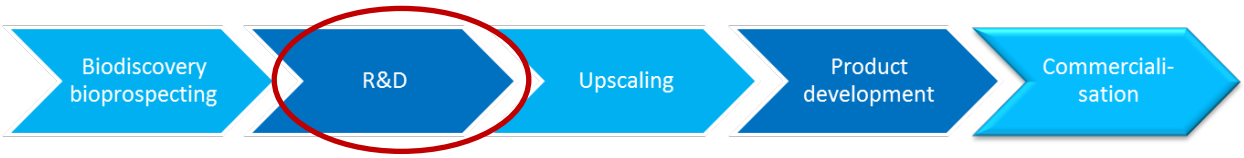
Startup: Furcella, ALLIANCE partner and case, Estonia. Mentoring, providing valuable support concerning development of cosmetic products for Estonian market

SME: SFTec, ALLIANCE partner and case, Finland. Providing support on drying techniques for macroalgae.

Initial Case Needs

- Testing seaweed crushing technologies (introduction and methodology for different technologies)
- Developing and optimizing Methodology for large scale extraction of R-Phycoerythrin
- Usage of size exclusion chromatography column for preparative purification of proteins
- Support for business development and finding the right markets
- Support for guidance for cost estimations, to build a large scale production line
- Support for networking and matchmaking for useful contacts and potential collaboration partners

TRL estimation when approaching ALLIANCE



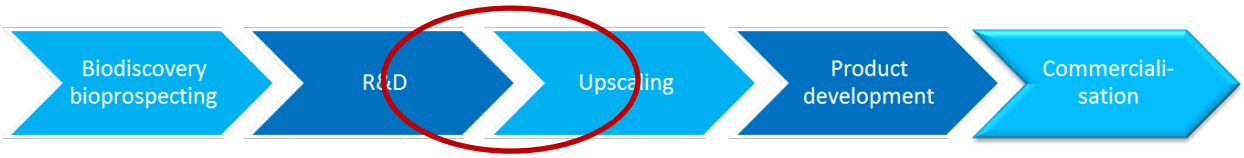
R&D

Estimated time frame for realisation:

X short term (<1 year) □ midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)**ALLIANCE service offer**

	Type of offer	**Involved ALLIANCE partner**	**External expertise**
1.	Testing of seaweed crushing, extract producing experiments, analyses and detailed information for entering to the cosmetic industry	CRM	UCL - Umwelt Control Labor GmbH
3.	Seaweed drying experiments	SFTec	
4.	Optimizing pigment extraction	GEOMAR	
5.	Support for business development	Tartu Biotechnology Park	Gaia
6.	Networking	Mostly TBP, GEOMAR, CRM, Furcella, but many others also.	Gaia
7.	Different kind of seminars/workshops to develop companies in many directions	Mostly TBP, GEOMAR.	

TRL estimation after ALLIANCE commitment



R&D/Upscaling

Estimated time frame for realisation:

□ short term (<1 year) **X midterm (1-3 years)**, □ long term (>5 years), □ very long term (>15 years)

Transnational impact

The case Vetik is trying to valorize the only commercially usable stock of wild red seaweed in the Baltic Sea. Due to ALLIANCE, the case has now obtained contacts in all BSR countries in which the ALLIANCE is active. Not every expertise and all techniques for valorization of the rre seaweed are available in Estonia, therefore, transnational partners are of high relevance for advancing this case. On the other hand, the red seaweed is commercially explorable and represents a sustainable resource for further transnational collaborations with Vetik possibly targeting other application fields in blue biotechnology.

Scientific successes, most prospective blue biotech areas within BSR

During the ALLIANCE, an optimized protocol for the pigment extraction from red seaweed was developed in collaboration with scientists at GEOMAR, where the experiments were conducted. These results fueled further research towards product development, so that extraction is now performed in a knowledge-based way. The same is true for drying and crushing methods of the seaweed before extractions which were performed in close collaboration with the ALLIANCE partners CRM and SFTec.

The most prospective blue biotech areas in BSR from the case owner´s perspective is the application of marine resources for development of cosmetics. For a startup or small company, which depends on generating revenues without the necessity of high investments into own infrastructure, dvelopment of a cosmetic is most straightforward and easiest to implement. There are also very good and beneficial ideas in other sectors but most of them are in the idea stage and require high time and financial investments before market readiness.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

As the harvest of seaweed is conducted in a sustainable way, product development of this case relies on a sustainable resource. Sustainability aspects are further implemented in the production process. Implementation Vetik´s case will positively contribute to strengthening the marine organic cosmetic sector. The cosmetic sector is often seen as a low hanging fruit strategy, generating early revenues which in turn may fuel new transnational collaborations based on the red seaweed as biological resource in other blue biotech fields. The case owner stated that there is a plethora of collaboration possibilities and new connections existing within the ALLIANCE, which may lead to future success stories.

Financial/Legal barriers and solutions found

There are always many financial barriers in the field of biotechnology, especially for early stage startups. It was possible to find financial support through ALLIANCE for attending different workshops and also conferences from which we obtained new contacts, ideas and opportunities, like e.g. the access to Blue Bio Value accelerator program.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.)

Substantial progress was made due to the collaboration with the German SME CRM. During this collaboration (based on mutual trust), the case got to the stage of a highly promising new pilot product. This collaboration is intended to be continued and intensified, and may soon lead to development of the final product.

By the help of GEOMAR´s scientists, the case was able to optimize extraction procedures for pigments and furthermore received valuable scientific support.

Finally, the case obtained contacts with Portuguese Oceano Azul Foundation and through it got a chance to participate in Blue Bio Value accelerator.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

n/a

Image showing one of several extract from the red seaweed extracted by GEOMAR´s pressurized liquid extraction

Case 22- Uni Gdansk Smart Bloom: Highlights

Biomolecules from harmful and potentially toxic cyanobacterial blooms' biomass may have a high potential in their application as natural bioplastics, or in the cosmetic and pharmaceutic fields of blue biotechnology. Regular harvesting of blooms would help in stopping harmful effects of eutrophication e.g. decrease in nitrogen and phosphorus ions in Baltic waters, increase in water transparency, and decrease of anoxic, dead zones. Further, Baltic blooms could be collected by fisherman who otherwise suffer from small fish stocks.
The case needs support in identifying key partners with contact to (bio)plastic manufacturers, and who potentially would be interested in the industrial process of turning cyanobacterial blooms into bioplastics. Further, to create an overview with 3 main end-user groups/applications for which bioplastics would be interesting/attractive (opportunities & barriers listed per application group).

Contribution of mentors and ALLIANCE to case progress

With the help of ALLIANCE starting from November 2017, chemical analysis of cyanobacterial biomass collected during blooms in the last years was completed implemented by the primary mentor, the University of Gdansk was completed. Interestingly, the analysis revealed high interannual similarity. The primary mentor also identified the major metabolites/substances (highest concentrations) in the cyanobacterial bloom biomass. Moreover, molecules with potential market value were further identified. Therefore, the ALLIANCE mentor was not only important for guiding the case owner but also a crucial cooperation partner for case implementation.

Contribution to Sustainable Development goals (SDG)

This case clearly contributes to SDG-14-Life below water, since it aims at removal of potentially harmful cyanobacterial biomass to create added value from this (waste) biomass. This further contributes to removal of nutrients from the Baltic. Moreover, the case contributes to SDG-9, Industry, Innovation and Infrastructure and 12-Responsible Production and consumption.

Comparative case analysis

Transnationality.

The Smart Bloom case is based in Poland. Besides tight collaboration with Uni Gdansk, their primary mentor, the case is cooperating with partners from Denmark and Germany in frame of the ALLIANCE.

Type of ALLIANCE service provided.

The ALLIANCE provided mostly scientific and technical support. Moreover, the case was able to report and promote individual progress on the ALLIANCE conference in Greifswald, which also served as a forum for networking. SUBMARINER also served as a hub for networking for this case providing important contacts.

Target application/market and customers.

Aim of the SmartBloom case was originally to develop bioplastic based on algal blooms occurring in the Baltic, targeting the packaging industry as target market and customers. Due to scientific results, the focus of this case has changed towards the development of cosmetic products and/or medical products. Hence, the target market for a cosmetic product is of course the cosmetic sector incl. direct sales to the end customer (B2C, low hanging fruit strategy) and the pharma sector, which of course requires longer development phases and mainly B2B relationships with pharma companies.

Biological resource used.

The case Smart Bloom uses cyanobacteria as biological resource. Bacteria are also the biological resource used in 3 other ALLIANCE cases; this is however the only case explictily targeting cyanobacteria as a biological resource.

Type of product.

The case Smart Bloom will not be able to provide a prototype at the end of the ALLIANCE project, since due to the change of direction towards pharma/cosmetics, further R&D is needed before the actual product development. The case is aiming at the development of a product which can be directly sold rather than an energy or service. Removal of the potentially harmful cyanobacterial excess biomass can however also be regarded as an environmental service.

Cosmetics are also the target of 5 other ALLIANCE cases, whereas only 2 cases in total target the pharma sector. Products rather than energy or services are the aim of 21 ALLIANCE cases in total

Individual progress. As mentioned above, the case changed its direction from bioplastic towards cyanobacteria-derived proteins with the aim to develop them as cosmetic and or pharmaceutical products respectively. Substantial progress was achieved during the ALLIANCE project in this direction and the case progressed from bioprospecting stage to R&D stage. This is also the case for 5 other ALLIANCE cases.

SUMMARY: case Smart Bloom

Case and mentor information

Case Name: From bloom to smart bioproducts

Product: bioplastic (changed towards cosmetics/pharma)

ALLIANCE mentor(s): University of Gdansk, Danish Technological Institute (DTI)

Type of ALLIANCE support (mentoring/implementation of case/financial support):

Mentoring; implementation including scientific and technical support, networking

Duration of ALLIANCE support: from April 2018 until end of the project

Success factors

- chemical analysis of the bloom biomass showed high similarity between years (feasibility study to develop stable products)
- identification of group of substances of highest content in bloom biomass
- identification of molecules of market value for further research

Barriers to be overcome

For small ideas at an early stage of product development, it is often difficult to find funding to support the necessary and often expensive R&D stage. Change in direction due to scientific results obtained during ALLIANCE, i.e. the case focus turned from use of cyanobacterial biomass for bioplastic towards proteins for cosmetic and pharmaceutical applications. Moreover, cyanobacterial blooms are a natural assemblage of microorganisms, which is a highly variable system. Stability concerning the ingredients is however a prerequisite for selling a cosmetic product. Hence chemical analysis of the bloom biomass, yielding highly similar compounds in blooms collected during different years, was very important. Development of cyanobacterial blooms requires certain environmental conditions and the occurrence and location of cyanobacterial blooms cannot be exactly predicted. This remains a barrier for further product development, which can only be overcome by cultivation.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)**:**

Research institute: University Gdansk, ALLIANCE partner, Poland. Networking, providing contacts, refining the scientific focus, scientific analysis (providing protocols for scientific analysis)

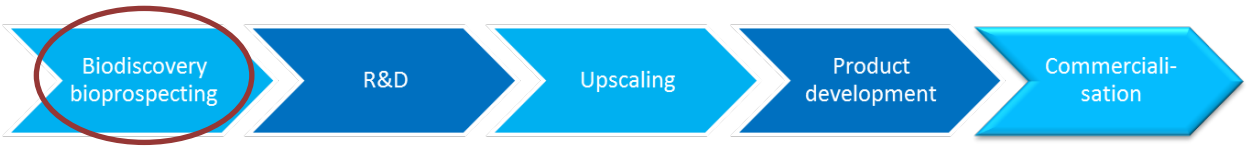
Research institute: DTI, ALLIANCE partner, Denmark. Scientific/Technical support, i.e. offering feasibility analysis, providing contacts, business support.

Network: SUBMARINER Network, ALLIANCE partner, Germany. Networking, promotion

Initial Case Needs

- Chemical analyses of cyanobacterial biomass content
- Expertise in the field of material design and industrial processing
- Help to perform life cycle assessment (LCA) of the prospective products

TRL estimation when approaching ALLIANCE



Estimated time frame for realisation:

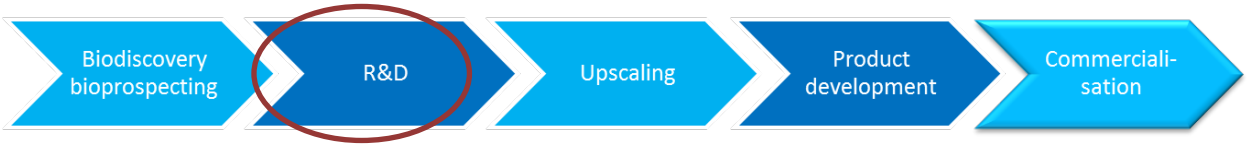
□ short term (<1 year) x midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Support with providing contacts relevant for chemical analyses and biomass testing	UG	n/a
2.	Cooperation for refining ideas; scientific focusing; mentoring;	UG	n/a
3.	Protocols for chemical analyses	UG	n/a
4.	Support for feasibility analysis, supply chain analysis, technology assessment, policy and regulatory landscaping, value-cost analysis	DTI	n/a

5.	Support in developing Business model canvas, e.g. 1) analysis of competitive environment in the field of bioplastics (rough estimate of competitors), or 2) check of profitability of the bioplastics compared to traditional manufacturing methods of non-degradable plastics	DTI	n/a
6.	Support in identifying key partners and developing value chains 1) Provide a list with plastics manufacturers, who potentially would be interested in the industrial process of turning blooms into bioplastics (who could add the technology suggested by University of Gdansk to their portfolio) 2) Create an overview with 3 main end-user groups/applications for which bioplastics would be interesting/attractive (opportunities & barriers listed per application group)	DTI	

TRL estimation after ALLIANCE commitment



Estimated time frame for realisation:

□ short term (<1 year) x midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

Transnational impact

Due to ALLIANCE, and mediated by SUBMARINER and DTI, international contacts were made which will be important for further product development. Promotion of the case during the ALLIANCE conference allowed networking on an international basis. Cyanobacterial blooms occur not only in Polish waters, but around the Baltic; hence having a Baltic-wide transnational network is important to further accelerate product development.

Scientific successes, most prospective blue biotech areas within BSR

Validation of the idea of use of cyanobacterial blooms for industrial use. Showing that not bioplastics but proteins are the most attractive source of valuable molecules. Potential clients for these active biomolecules are identified: most prospective customers are actors in the cosmetic and pharmaceutical industries.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

Biomolecules from blooms' biomass are potentially of high application in cosmetic and pharmaceutic fields of industry. Exploitation of blooms can help in stopping harmful effects of eutrophication as e.g. decrease in N and P ions in Baltic waters, increase in water transparency, decrease in dead zones spread. Baltic blooms could be exploited by fisherman that suffer from small fish stocks.

Financial/Legal barriers and solutions found

In Poland harvesting algae is comes under the same regulations as fishery and could be done for scientific and fishery purposes with no limiting quota.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.)

Due to support by ALLIANCE, significant progress was made in idea development, focusing and refining of the basic idea based on scientific results (bioplastic-> protein for cosmetic or pharmaceutical applications). Also finding suitable partners for co-operation, gaining know-how in the fields of IP and business development was made due to support by ALLIANCE.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

This is not applicable, since no products are in final stage of development. The case is in R&D stage.

Case 23- LoondSpa: Highlights

Loond SPA OÜ brand loond° is producing natural cosmetics from Nordic raw material. Within the ALLIANCE mentoring program the main focus has been on innovative use of Värska lake mud and mineral water in cosmetics due to its proven excellent features for skin. LoondSPA aims to extract beneficial compounds from the out of the mud and mineral water mix and use these in high quality cosmetics products.

Contribution of mentors and ALLIANCE to case progress

Via its primary mentor – Tartu Biotechnology Park – Loond SPA OÜ has got access to ALLIANCE and SubMariner network experts and knowledge and also to several business and entrepreneurial skills development trainings and coaching. The ALLIANCE mentoring has provided LoondSPA OÜ with support in business development (potential commercialization channels via CRM), product development, define better target markets (new potential collaboration opportunities for them with wellness Spas in Germany), support in networking and matchmaking to reach out to suitable collaboration partners.

As LoondSpa joined the ALLIANCE mentoring programme with the latest batch – in April 2018 – there is lot of more potential collaboration opportunities to discover for LoondSPA before the end of ALLIANCE programme.

Contribution to Sustainable Development goals (SDG)

The case LoondSpa contributes to SDG-8 Decent work and economic growth, 3-Good health and Well-being as well as 9-Industry, Innovation and Infrastructure.

Comparative case analysis

Transnationality.

The case is based in Estonia and due to ALLIANCE contribution it has broadened its network towards other BSR countries. The case is collaborating with ALLIANCE partners in Germany (SME, Research institute, Network).

Type of ALLIANCE service provided.

The case LoondSpa received mostly support in business development (marketing) from the ALLIANCE. Moreover, networking support was provided by ALLIANCE partners as well as scientific support and promotion of the pilot products. Moreover, mediated (subcontracted) by ALLIANCE the case owner got into contact with a legal expert who was able to provide legal support concerning open IPR issues. The case did not receive financial support.

Target application/market and customers.

The target market for the LoondSpa case is the cosmetic market. They aim to sell their products directly to the end customers, thus primarily aiming at B2C relationships (like 5 other cases). However, based on ALLIANCE support, they also got into contact with Spas interested in their products, which represent B2B customers. The mixture of B2B and B2C relationships was also aimed at by 7 ALLIANCE cases in total. The cosmetic sector is targeted by 5 other ALLIANCE cases.

Biological resource used.

LoondSpa does not use any biological resource but applies mud and water in a cosmetic mask and facial water, respectively. This is also true for 2 other ALLIANCE cases, who do not use any biological resource for their product development.

Type of product.

A prototype of the product is existing, namely a cosmetic facial mask and facial water. Like 20 other ALLIANCE cases, LoondSpa aims at selling products rather than generating energy or a service.

Individual progress.

This case has experienced a tremendous advancement in the time since it joined the ALLIANCE. The case started in R&D stage and advanced until product development stage.

ALLIANCE case achievement report

Case and mentor information

Case Name: # 7 LOOND SPA OÜ

Product: natural cosmetics from Nordic raw material. Within ALLIANCE these are cosmetics based on Värska lake mud and mineral waters from South Estonia.

ALLIANCE mentor(s): Tartu Biotechnology Park (TBP), GEOMAR Helmholtz Centre for Ocean Research Kiel (GEOMAR), Coastal Research and Management (CRM)

Type of ALLIANCE support (mentoring/implementation of case/financial support):

Mentoring, scientific/technical support during implementation of case, business support, legal support. The case did not receive financial support

Duration of ALLIANCE support: April 2018 (since Copenhagen pitching event) until end of project

Success factors

The case has joined ALLIANCE at a late stage of the project. The success and the advances of the case are thus due to very good communication between parties, and the willingness and readiness to support from mentors side. The Submariner Network has helped with promotion and dissemination of information about Loond products (e.g. via the profile on ALLIANCE website). Other success factors for advancement of the case are the well-thought-out conception of innovative and science based products made of natural ingredients from Nordic resources and the impressive package design.

Barriers to be overcome

n/a

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation):

Business support: Tartu Biotechnology Park, ALLIANCE partner, Estonia.

SME: CRM, ALLIANCE partner and case, Germany. Support in business development and finding the right markets on a transnational level

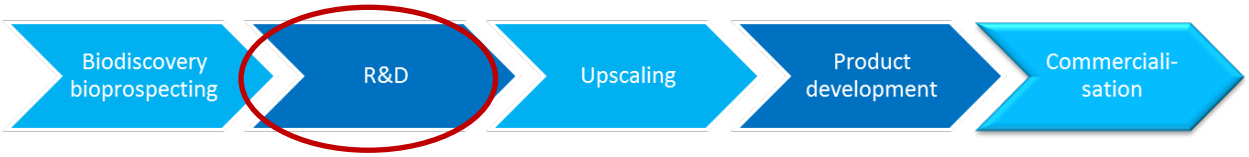
Research institute: GEOMAR, ALLIANCE partner, Germany. Scientific support on extraction methods for fulvic and humic acids and bioactivities

Network: SUBMARINER network, ALLIANCE partner, Germany. Networking, matchmaking, promotion of LoondSpa products

Initial Case Needs

- Support for business development and finding the right markets
- Support for networking and matchmaking for useful contacts and potential collaboration partners
- Help in product development
- Perform a literature survey on 1) the extraction methods commonly used for fulvic and humic acids, and 2) the bioactivities known for these 2 compounds
- Based on the information found, plan to run some tests
- Support for running some analytical tests and to suggest appropriate institutions for the running of other tests needed

TRL estimation when approaching ALLIANCE



Estimated time frame for realisation:

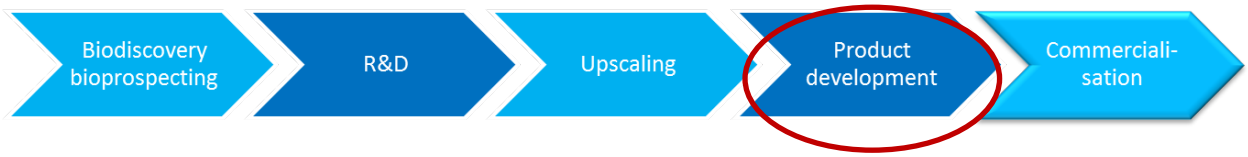
□ short term (<1 year), **x midterm (1-3 years)**, □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Networking, matchmaking	Case owner, TBP, CRM, GEOMAR, SubNet and other ALLIANCE partners	
2.	Business development	Case owner, TBP, CRM	Tallinn Creative Incubator, EstLat BioBoost coaching programme
3.	Market overview and support to enter new markets	Case owner, CRM	

4.	Marketing and promotion	Case owner, TBP, CRM, GEOMAR, SubNet and other ALLIANCE partners	
5.	Extended knowledge about mineral water potential application for other products e.g. facial water or mist	Case owner, CRM	Tallinn University
6.	Product development	Case owner, CRM, GEOMAR	Tallinn University
7.	Legal support on IPR	TBP	Marius Kuningas, subcontracted by ALLIANCE

TRL estimation after ALLIANCE commitment



Estimated time frame for realisation:

□ short term (<1 year), **x midterm (1-3 years),** □ long term (>5 years), □ very long term (>15 years)

Transnational impact

Being in the ALLIANCE means for Loond getting help in business development, define better the target markets, get support in networking and matchmaking to reach out to the suitable collaboration partners. Case mentors have already opened up some new collaboration opportunities in Germany, with only with their own efforts they would not be so far so soon.

Scientific successes, most prospective blue biotech areas within BSR

It has become increasingly important to work out natural cosmetics recipes in a knowledge-based way. Cosmetics is most prospective and the fastest way to the market for blue biotech and to generate revenues although the sector is very competitive also in the BSR. Therefore, it is important especially for small companies to find specific niches and differ from other offers.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

Key ingredients are collected in sustainable ways. The idea is to use the full potential of every component, thus to valorise the raw materials.

Financial/Legal barriers and solutions found

Informative discussions with Marius Kuningas (subcontracted legal expert by ALLIANCE) concerning legal advice with respect to IPR has helped case owner to sort out some IPR concerns and start to concretely plan to protect the company's IPR. The case owner has been very open with ALLIANCE mentors and *vice versa* which has made cooperation easy and fast leading to a speedy advance of the case. On the legal side, only using NDA (provided by ALLIANCE) is sufficient for such kind of cooperation for now.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.)

It is a bit early to make complete conclusions for the case study. But the general principle in such kind of collaboration is to be open and find time to contribute for communitaction. And it also works for the case.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

As the market gets enriched in natural cosmetics, it is important to work with scientifically proven components to provide high quality products and keep the company's good reputation on this. This is expensive, but for long term purpose it is essential for the company to be competitive and explore new markets.

Image showing facial mask developed by LoondSpa.

Case 24- Phytolinc/PhytoBoX: Highlights

The PhytoBoX is a new photobioreactor establishing a surface based cultivation method. Water and algae are separated through a micro-membrane such that the biomass grows directly on the layer surface. Aquaculture farmers will easily be able to extend their product portfolio with algal products. Furthermore this system that can be directly linked to any existing land-based recirculating aquaculture system (RAS). Current cultivation methods (suspension cultures) are not well suited for algae-aquaponics due to the mixing of algae and process water. The introduction of a membrane-photobioreactor into an algae-aquaponic-system is of world-wide interest. For the PhytoBoX system, a proof-of-concept for a lab-scale aquaponic-system with microalgae and shrimps has been established. For further development of the system, the case owners are looking for cooperations with aquaculture and algae experts to establish a proof-of-concept at industrial level and to improve their business model.

Contribution of mentors and ALLIANCE to case progress

The ALLIANCE supported the case by finding partners for testing the bioreactor with new algae strains, by consultation on the experimental progress and by feedback and advice on component optimization of the pilot reactor. This was primarily enabled by their mentors, BioConValley and DTI, who contributed scientifically (provision/selection of strains for cultivation in the bioreactor, DTI) and by networking (BioConValley) to the aquaculture sector.

Contribution to Sustainable Development goals (SDG)

Algae cultivation in aquaponics system works without external nutrients and with very low water consumption. This attempt closes the nutrient cycle and makes aquaculture facilities more ecological and sustainable. New strains will become cultivable by this technology. Moreover it allows for sustainable production of various food additives (i.e. Chlorella vulgaris as source for vegetarian omega 3 and 6 fatty acids). Thus, case development relates to the UN SDGs 3 and 12 and indirectly contributes to 6 and 7.

Comparative case analysis

Transnationality.

With respect to transnationality, the case is based in Germany and cooperates with ALLIANCE partners in Denmark.

Type of ALLIANCE service provided.

Beyond the mentoring, the PhytoBox case was supported by networking and matchmaking in frame of ALLIANCE and moreover, received scientific/technical support by its mentor DTI.

Target application/market and customers.

PhytoBox aims at providing a microalgae photobioreactor for integration into algae-aquaponic-system. The target market for this case is the aquaculture sector. The intended customers are aquaculture companies focusing on integrated aquaculture systems. So this case is clearly focusing on a B2B relationship. Besides this, added-value products from the microalgae (omega-3- fatty acids) are intended to be sold, targeting the food and feed sector on a B2B basis. B2B customers are in focus of 12 other ALLIANCE cases.

Biological resource used.

PhytoBox uses microalgae as biological resource. 7 other ALLIANCE cases also valorize microalgae.

Type of product.

The type of product to be sold in this case is a technical device, i.e. a specific type of photobioreactor which should be used in the aquaculture sector to support algae-aquaponics systems. This photobioreactor can then be used to produce microalgae biomass which then can be valorized as food or feed products. Although the underlying concept of the photobioreactor is different, the case shows similarities to the PowerAlgae case, which also initially aimed at the development and sale of the photobioreactor before changing the focus towards valorizing the

microalgae biomass cultivated in the photobioreactor. Production and sale of a technical device for blue biotechnology purposes is the aim of 2 other ALLIANCE cases.

Individual progress. When joining the ALLIANCE, the PhytoBox case was in the stage of upscaling and has advanced towards product development (prototype existing). At the end of the ALLIANCE project, 4 other cases have reached this stage.

SUMMARY: Case PhytoBox

Case and mentor information

Case Name and number: Arne Maercker, Phytolinc; Case #24

Product: PhytoBoX, Membrane-Photobioreactor (MPBR)

ALLIANCE mentor(s):BioCon Valley GmbH (BCV), Danish Technological Institute (DTI)

Type of ALLIANCE support (mentoring/implementation of case/financial support):

Networking, identification of cooperation partners for and testing strains, identification of potential future customers for the MPBR device. No financial support.

Duration of ALLIANCE support: April 2018 to present

Success factors

- Construction of a pilot device
- Identification of suitable industry/research partners for testing the pilot device (e.g. strains for testing)
- Upscaling and large-scale algae production
- Establishing aquaponics system (connection to aquaculture system)
- Identification of potential customers for the Membrane-Photobioreactor

Barriers to be overcome

One of the barriers that needs to be overcome is the necessity to find partners that run aquaculture facilities suitable for connection to algae aquaponics. Although there are no direct customers for the Membrane-Photobioreactor within the current ALLIANCE consortium, important links to other projects/consortia could be made.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Business support: BioConValley, ALLIANCE partner, Germany. Mentoring, networking, providing contacts to aquaclulture companies with interest in the photobioreactor.

Research institute: Danish Technological Institute (DTI), ALLIANCE partner, Denmark. Mentoring, scientific and technical support, providing test strains for cultivation/growth experiments in the pilot photobioreactor.

Initial Case Needs

- Construction of a prototype (financial support)
- Improvement and optimization of the prototype at a testing facility

TRL estimation when approaching ALLIANCE

Estimated time frame for construction, optimization and upscaling of the prototype: mid term (1-3 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Networking & matchmaking	BioCon Valley	
2.	Providing strains for testing	Danish Technological Institute	

TRL estimation after ALLIANCE commitment

Estimated time frame for large scale algae production, adaption to aquaponics, and selling the device: Long term (>5 years)

Transnational impact

Aquaculture is a growing sector worldwide and also within the BSR. In parallel, the interest in realizing aquaponics systems in the aquaculture sector is also growing. Hence, the introduction of a membrane-photobioreactor into an algae-aquaponic-system is of high interest to realize a closed system with minimum nutrient impact on the environment. Integrating the photobioreactor into circular economy concepts, which are also of growing interest at a transnational scale in the BSR and beyond, will generate high impact.

Scientific successes, most prospective blue biotech areas within BSR

Integration of a membrane-photobioreactor in a running aquaponics system. The microalgae biomass can be further valorized as food/feed/valuable compounds (such as e.g. omega-3 fatty acids)

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

Algae cultivation in aquaponics system works without external nutrients and with very low water consumption

Financial/Legal barriers and solutions found

The case owners successfully applied for an EXIST Business Start-up Grant (a support programme of the German Federal Ministry for Economic Affairs and Energy) to build a Membrane-Photobioreactor prototype.

Outcomes and lessons learned for the case study

The case has installed a running prototype reactor. Testing with various algae strains has started and will go on for the next month until the end of the ALLIANCE project. Since the main challenges are ahead and will take time to implement beyond the end of the ALLIANCE project, it is impossible to compile further ”lessons learned” at this stage.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

It has to be demonstrated as soon as possible that the unique advantages of the reactor result in economic benefits for future customers. This will be achieved by 1. identification of suitable strains in the ongoing experiments and 2. by connecting the reactor to an aquaculture system to show the aquaponics potential. Thus, a crucial step in the near future will be to find a suitable partner that runs an aquaculture system, either on research basis or at commercial scale. Once these development steps have been taken, the market potential of the reactor is presumably huge.

Case 25- Department of Seaweed (DoS): Highlights

The case #25 Department of Seaweed (DoS) is a transdisciplinary platform for the exploration of seaweed as a sustainable resource. It is a broad, transparent and collaborative institution that does research and design encompassing the whole range of algae and seaweed: from macro algae to phytoplankton. The DoS produces content in dialogue with experts from science, justice, crafts, politics, philosophy and advice how to use algae as material. DoS successfully organizes workshops with various guests and other public events.

Contribution of mentors and ALLIANCE to case progress

The ALLIANCE support to the case DoS included two-dimensional offer: help in creation of a legal form and the respective business coaching related to the matter, as well as a matchmaking to organize common raise awareness events that present algae as material around the whole Baltic Sea Region (BSR). The first goal to create an independent legal form has not been succeeded yet, as for now the case owner represents the DoS as Aalto University, therefore the research and the relevant events are done under the umbrella of the Finnish university. The second goal could be implemented in the best way under the ALLIANCE mentoring especially after the match of DoS with the ALLIANCE partner KTH (in Sweden). Both organizations prepare, plan and carry out events about algae that include exhibitions, workshops and lectures about algae and their use as material. The collaboration was performed so far in Sweden and Finland and aims to be continued also in other countries within the BSR and outside it. Moreover, the DoS obtained seaweed from the Baltic Sea delivered by the ALLIANCE partner and case KosterAlg, further highlighting the importance of cross-case collaboration. Thanks to ALLIANCE, DoS could find suitable collaboration partners for the future, e.g. Submariner Network for promotion and communication of the planned events and results achieved with seaweed as material, KTH as collaboration partner for organization of events related to seaweed and its promotion for various sectors (food, design, art etc.).

Contribution to Sustainable Development goals (SDG). Since DoS is not producing a product, but rather intends to raise awareness for the multiple applications of macroalgae/seaweed, it is difficult to clearly assign SDG to this case. With the actions of DoS, the case contributes to SDG-

14-Life below water and indirectly to 12-Responsible production and consumption and 9-Industry, innovation and infrastructure by demonstrating the versatility of macroalgae.

Comparative case analysis

Transnationality. The case owner is a German citizen now appointed a professorship at a Finnish University. The intention is to found the Department of Seaweed as an association under German legal regulations. The case owner is cooperating with ALLIANCE partners in Sweden, Estonia and Finland.

Type of ALLIANCE service provided. Beyond the mentoring, the ALLIANCE provided support concerning networking and promotion of the multiple uses of algae and the case´s aims (exhibition planned together with KTH in Sweden). Moreover, Submariner Network gave advice on the options of legal entities in Germany, therefore, the case also received legal support.

Target application/market and customers. It is difficult to name a target application or market for this case. However, the target customer is clearly the wider public including designers, artists, but also policy makers, so the case is aiming at B2C relationships, just like 5 other ALLIANCE cases.

Biological resource used. The case DoS does not directly use a biological resource for valorization and sale of products, but aims to raise awareness for the multiple potential applications of macroalgae as material also in design and art. Macroalgae are also used as biological resource in 6 other ALLIANCE cases.

Type of product. The case DoS does not clearly aim at selling a product, but the aim of raising awareness can be rather classified as a service. Services (in the widest sense) are intended in only 4 ALLIANCE cases in total.

Individual progress. Again, the categories are not really applicable to this case, since the case is not developing a product using biotechnological methods but trying to establish a legal entity promoting the multiple uses of valorizing seaweed even beyond blue biotechnology. In the widest

sense, it can be grouped into product development when joining the ALLIANCE and it has advanced towards commercialization due to ALLIANCE support.

SUMMARY: Case DoS

Case and mentor information

Case Name: DoS – Department of Seaweed

Product: platform/network

ALLIANCE mentor(s): SubNet (primary mentor), KTH (secondary mentor), SYKE, TBP, GEOMAR, KosterAlg

Type of ALLIANCE support (mentoring/implementation of case/financial support):

Mentoring/coaching, networking, promotion of the case. The case did not receive financial support

Duration of ALLIANCE support: April 2018 until end of project

Success factors

One of the success factors is the uniqueness of this case. Beyond blue biotechnology there are even further ways of valorizing seaweed. The case presents a new way of working with seaweed as design material used for art (for the exploration of seaweed as a sustainable resource). One additional success factor is, that DoS is not restricted to macroalgae, but open to the whole range of algae and seaweed: from macroalgae to phytoplankton. After forming a legal form, the DoS may be part of the Submariner Network. Again, cross-case collaboration proved to be relevant (DoS-KosterAlg) also for opening up new resources.

Barriers to be overcome

One barrier is represented by the difficulty in setting up an organizational structure that is self-financed (choose the right legal form and get funding for it). Further it is challenging to handle an international crowd (as platform). Moreover, central for success of this case is raising awareness not only of the public but also of policy makers about seaweed as sustainable resource as a design material.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

Network: SUBMARINER Network, ALLIANCE partner, Germany. Networking, providing advice on formation of legal entities in Germany, providing support for awareness raising events

Research institute: KTH, ALLIANCE partner, Sweden. Promotion of the case via technical and organizational support in providing space for setting up an exhibition planned to take place in spring 2019.

Research institute: GEOMAR, ALLIANCE partner, Germany. Networking, providing contacts

Research institute: SYKE, ALLIANCE partner, Finland. Networking, providing information on awareness raising events

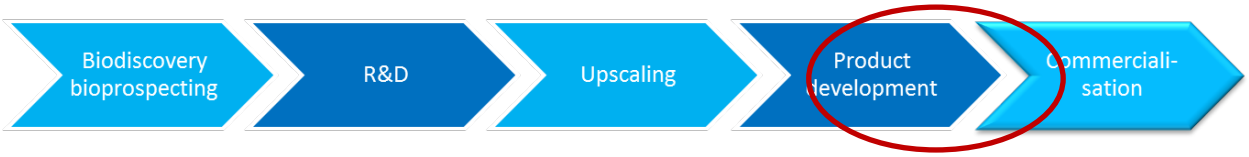
Business organization: Tartu Biotechnology Park, ALLIANCE partner, Estonia. Networking, providing information on awareness raising events

Start-up: KosterAlg, ALLIANCE partner and case, Sweden. Providing raw algal material.

Initial Case Needs

- Legal advice to set up the association ("Verein") and the limited company ("GmbH") in Germany
- Financial support for meetings

TRL estimation when approaching ALLIANCE



Estimated time frame for realisation:

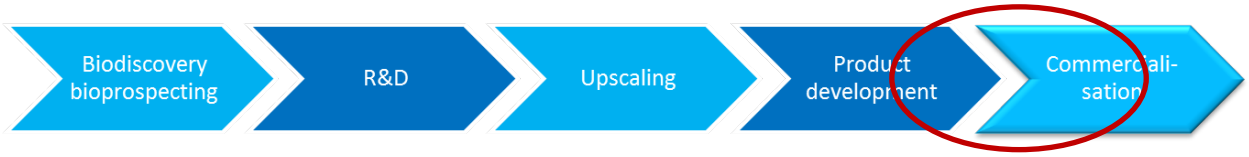
□ short term (<1 year) **X midterm (1-3 years)**, □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise

1.	Networking	SubNet, GEOMAR	n/a
2.	Support in awareness raising events	KTH, SubNet, TBP, SYKE	n/a
3.	Consultancy/legal advice	SubNet	n/a
4.	Providing of the material seaweed	KTH, KosterAlg	n/a

TRL estimation after ALLIANCE commitment



Estimated time frame for realisation:

□ short term (<1 year) **X midterm (1-3 years)**, □ long term (>5 years), □ very long term (>15 years)

Transnational impact

The transnational impact is significant since the DoS should operate as an international platform forming an international crowd. Also, the different events for promotional reasons should take place in different countries.

Scientific successes, most prospective blue biotech areas within BSR

The case owner Julia Lohmann was appointed the position of Professor of Practice in Contemporary Design at the Finnish Aalto University and is making further scientific research about seaweed to be used as a design material.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

Using seaweed as sustainable resource for another application (design & art) than the uses known so far (cosmetics, health industry etc.).

Financial/Legal barriers and solutions found

The creation of the legal form for DoS is problematic so far, because to obtain the funding some signatures from other countries (like France) are missing and this is why the application for the funding could not be completed. For now, DoS does not have any legal form. Once the DoS network is created, need to find out the proper business model, if a membership fee of being in the transnational platform should be required or which financing model would work to make DoS a self-financing platform.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.)

The primary mentor SubNet offered business coaching to the case owners, also made promotional activities as including the case owner description in the newsletter of the Submariner Network. Cross-national contacts are important: forwarding of suitable contacts towards KosterAlg as sustainable producer of seaweed in the BSR and of seaweed designer – Shisa brand have opened up new possibilities. The case owners do not seem to need that much the coaching support of the ALLIANCE, but show more the need to be a member in the Submariner Network.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

n/a, since no biotechnological products are intended to be developed by the case. However, one recommendation is not to be limited to biotechnological applications which of course can contribute to human health and well-being but to broaden the applicability of seaweeds also to further application areas like e.g. arts and design.

Case 26- DTU Biotrino: Highlights

The case #26 DTU/Biotrino is a spin-off start-up company from the Technical University of Denmark. The case owner aims to produce protein and oil-rich microalgae cultivated in heterotrophic conditions using side products from food production as nutrient source for the algae. The products produced by this case could serve as a vegan alternative to protein and fat-rich animal products such as butter or eggs. The case owner has already found a source for the nutrients as well as a candidate microalgal strain and successfully conducted first lab-scale cultivation experiments, which yielded promising results. The ALLIANCE was approached in need of upscaling the production and experience for growing microalgae in heterotrophic conditions for food production. The case has high potential for integration into circular economy concepts, since it uses i) an unusual, alternative method for cultivation of the microalgae which is commonly neglected in microalgae-based biotechnology and ii) side or waste streams of the food industry as nutrients to feed the microalgae and to stimulate production of higher protein contents.

Contribution of mentors and ALLIANCE to case progress

The ALLIANCE support to the case DTU/Biotrino included initial mentoring and limited scientific/technical (like in 19 other cases) support. DTI, as primary mentor supported the case with their expertise in growing microalgae; experience amongst the ALLIANCE partners in growing microalgae in a heterotrophic way is however very limited. Moreover, DTI provided business support (provided for 17 ALLIANCE cases in total) to the case owner by providing some information and support on funding possibilities for upscaling the production.

Contribution to Sustainable Development goals (SDG). The case DTU/Biotrino contributes to SDG2- Zero hunger, since it aims at the sustainable production of microalgae-based protein. With this, the case further contributes to SDG12-Resonsible production and consumption, since it also uses side streams from the food industry as nutritional source for the cultivation of microalgae.

Comparative case analysis

Transnationality.

The case is based in Denmark and within the ALLIANCE has only linked up with DTI, another Danish partner. Although the potential for transnational collaboration is great, this case did not have transnational links in the frame of the ALLIANCE.

Type of ALLIANCE service provided.

Beyond the mentoring, the ALLIANCE provided support in networking (22 ALLIANCE cases in total), business support (17 cases in total) and scientific/technical support (20 cases in total) concerning expertise in cultivation of microalgae. The case did not receive financial support from ALLIANCE.

Target application/market and customers.

The target application is a food product, which is able to replace animal protein. Thus, the target market is clearly the food sector. Food products are rarely targeted within the ALLIANCE, only 4 cases in total have the food sector as target market. The case intends to sell the product to food-producing companies, so it aims at B2B relationships like 12 other ALLIANCE cases.

Biological resource used.

The case DTU/Biotrino uses microalgae as a biological resource. The biological resource is used in a sustainable way, since it is cultivated in a heterotrophic way. Microalgae are also used as biological resource in 7 other ALLIANCE cases.

Type of product.

DTU/Biotrino aims at generating a protein-based food product for sale to food companies, which can clearly be classified as a product rather than a service or energy. Marketable products are also the aim of 20 other ALLIANCE cases.

Individual progress.

The case joined the ALLIANCE in April 2018. Regarding the value chain, it was estimated to be situated between R&D and upscaling. In the timeframe of the ALLIANCE project the case has advanced to upscaling to pilot scale and is currently planning further upscaling to commercial scale.

SUMMARY: Case DTU/Biotrino

Case and mentor information

Case Name: DTU/Biotrino

Product: Microalgae for food

ALLIANCE mentor(s): Danish Technological Institute (DTI), KTH (secondary mentor)

Type of ALLIANCE support (mentoring/scientific support to implement case/financial advice):

Mentoring/coaching, networking, scientific/technical support. The case did not receive financial support

Duration of ALLIANCE support: April 2018 until end of project

Success factors:

Despite the limited amount of scientific and technical support provided, the case has been able to proceed to pilot scale and has contact with providers of nutrients and to sales channels (niche health food companies). The case is now ready to scale up to commercial production.

Barriers to be overcome

Location for full commercial production which fulfill food production hygiene standards and which are close to the source of nutrition for the heterotrophic algae production. Supply of food-acceptable ammoniac is difficult.

Types of actors involved in value chains and their specific role (process chain and role of the ALLIANCE in facilitating the transnational value chain creation)

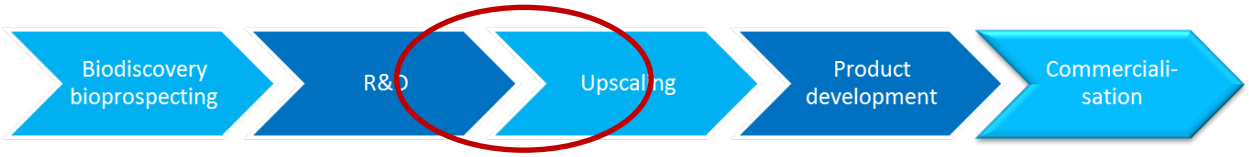
Research institute: DTI, ALLIANCE partner, Denmark. Providing expertise on microalgae cultivation, providing information on suitable funding programs for financing the upscaling.

Research institute: KTH, ALLIANCE partner, Sweden. LCA Assessment

Initial Case Needs

- Input on validating microalgae cultivation in lab scale (contaminations, nutrients etc)
- Scientific/technical support in upscaling of microalgae production
- Support regarding approval for food production, incl. EU regulations
- LCA for sustainability of the production. Initial assessment at lab/pilot scale
- Funding opportunities for upscaling

TRL estimation when approaching ALLIANCE



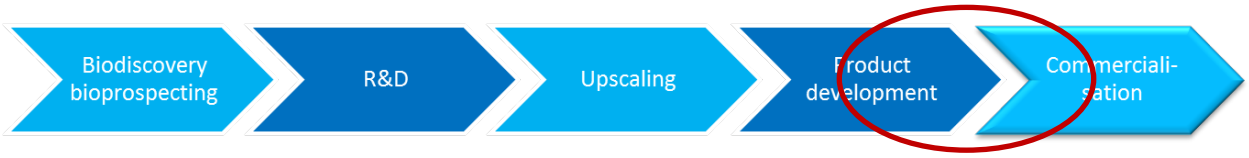
Estimated time frame for realisation:

□ short term (<1 year) **X midterm (1-3 years)**, □ long term (>5 years), □ very long term (>15 years)

ALLIANCE service offer

	Type of offer	Involved ALLIANCE partner	External expertise
1.	Scientific/technical advice, expertise in growing microalgae	DTI	n/a
2.	Funding opportunities for upscaling	DTI	n/a
3.	LCA	KTH	n/a

TRL estimation after ALLIANCE commitment



Estimated time frame for realisation:

□ short term (<1 year) X midterm (1-3 years), □ long term (>5 years), □ very long term (>15 years)

Transnational impact

The case owner is currently looking for new commercial size production facilities and will discuss financial support possibilities from the national and international funding programs together with DTI.

Although this stage of the development has been purely on the Danish national level, the potential for duplication transnationally is enormous and must be considered a case where the transnational impact is of great importance when regarding the production of healthy and sustainable protein, nutrients and fats in a circular methodology.

Scientific successes, most prospective blue biotech areas within BSR

The case owner has made impressive developments with very limited input from the ALLIANCE and has successfully produced micro algae food products on a pilot scale.

The case owner is currently looking for new commercial size production facilities and will discuss financial support possibilities from the national and international funding programs together with DTI.

Environmental impacts, i.e. positive contributions to given industry sectors as well as conditions for a sound blue biotechnology transnational production process, sustainability

The sustainability of this case is to be found in the circular economy principles and the reduction of food production residuals.

Although this stage of the case development has been purely on the Danish national level, the potential for duplication transnationally is enormous and must be considered a case where the transnational impact is of great importance when regarding the sustainable production of healthy and vegetal protein, nutrients and fats.

Financial/Legal barriers and solutions found

The case owner is currently looking for new commercial size production facilities and will discuss financial support possibilities from the national and international funding programs together with DTI.

As long as the case adheres and complies by the Danish Food Authority regulation regarding hygiene, the algae food is acceptable on the market.

Outcomes and lessons learned for the case study (Progress made due to support by ALLIANCE (e.g. in product development, market readiness, etc.)

The progress made due to support by ALLIANCE was limited in this case due to the nature of the algae species and cultivation techniques. This shows that there is still a requirement of creating a critical mass of experts within the biotechnology sector of the ALLIANCE. The scientific and technical assistance offered was also subject to individual expertise and when these individuals were absent due to illness a bottle-neck effect was unavoidable.

Recommendation for overall economic implications and future prospects of the products developed and/or in final stage of development

As primary mentor to this case, DTI believes that the product developed by this case has enormous potential to become a real economic and environmentally beneficial product, both on the national and global scale, once having attained commercial scale.