



# Blue Bioeconomy Forum

*Report on the 7 December 2018 event*

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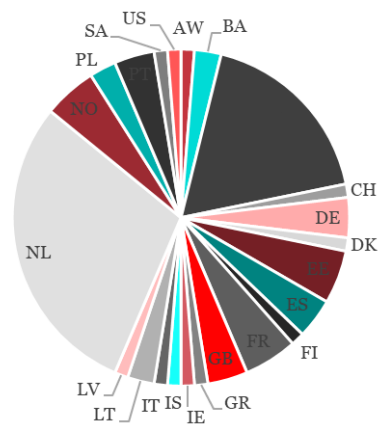
# 1 Background

## 1.1 Goal of the event

This forum was organized for industries, public agencies, financial organizations, researchers and civil society, working on or interested in the Blue Bioeconomy of the EU. The goal of the event was to discuss the current status of the emerging Blue Bioeconomy in Europe and to identify strategic developments, market opportunities, financing possibilities and research priorities. The outcomes of the event will be used for a roadmap on the development of the Blue Bioeconomy in the EU. The forum was also organized to help different stakeholders working on and interested in the Blue Bioeconomy to get in contact with each other.



Countries of attendees



## 1.2 Participants

Of the 118 people who subscribed to the event, a total of 93 people attended the Blue Bioeconomy Forum on December 7th in Amsterdam. Of the attendees, 68% was male and 32% was female. They came from 23 different countries, where as expected the most attendees were from the Netherlands (country where the event was held) and Belgium (including participants from the European Commission).

# 2 Welcome and opening remarks

The event was opened by the moderator, Simone Brummelhuis, who introduced the day by asking the participants what their expected value of the blue bioeconomy in 2030 would be (see figure below).

Next, she invited Mr. Bernhard Friess, Director of the Directorate "Maritime Policy and Blue Economy" of the European Commission's Maritime Affairs and Fisheries Directorate-General, to deliver his opening remarks. Mr. Friess emphasized that the EU wants to promote its new Bioeconomy Strategy both in Europe and worldwide. He highlighted the need to redesign our food system, in order to address the challenges of climate change, and especially the need to mobilize our maritime resources. It is therefore important to understand the framework conditions for promoting the maritime bioeconomy. As a follow up to the AlgaEurope conference during the preceding days, Mr. Friess drew attention to the issue of regulation and public support, for research, business development and consumer protection. He explained that the purpose of the Blue Bioeconomy Forum and of the day's event is to bring people

together to explore these issues. He emphasized that the European Commission wants to ensure that policy and regulatory frameworks allow and support this dynamic sector in moving ahead.

Next, Vitor Verdelho, member of the Blue Bioeconomy Forum Steering Group, provided an introduction to the day by highlighting the importance of algae, which produces more than half of the oxygen on the planet. He pointed out that the Blue Bioeconomy is very diverse, comprised of many different industries, making it almost impossible to say how large it is. The challenge for the day is to focus on the relevance of the Blue Bioeconomy, with the objective of providing a better standard of living for people in Europe and worldwide. In order to do this in a sustainable way, clear strategies are needed. We need a pipeline of ideas, and a roadmap. It is not about one big idea, but about a cluster of ideas in the Blue Bioeconomy. The Forum will work in four working groups on these clusters of ideas. Mr. Verdelho also emphasized the importance of collaboration in developing these clusters of ideas and the themes of the working groups.

### Poll: How much euros is the Blue Bioeconomy worth in 2030?

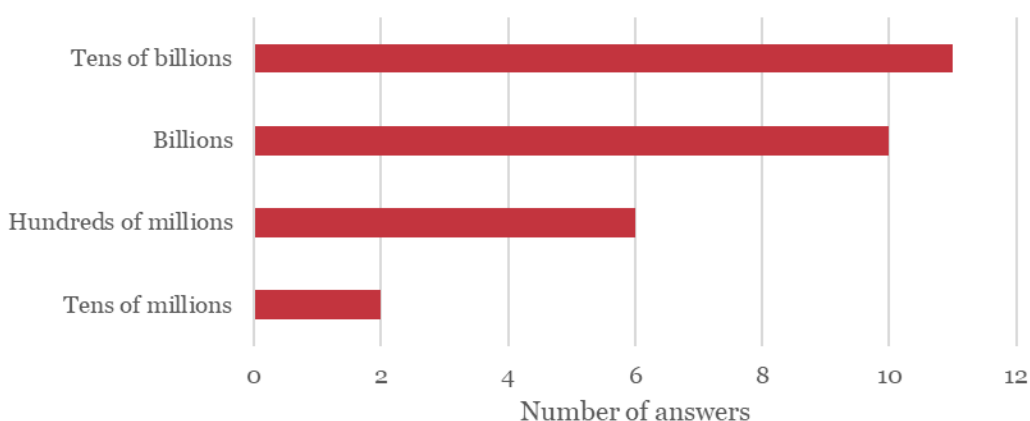


Figure: Poll: how much euros is the Blue Bioeconomy worth in 2030?

## 3 Panel Discussion

The Panelists invited to the workshop included experts from industry, academia, and policy domains.

The following people were the panelists:

- Pierre Erwes, Executive Chairman, BioMarine
- Alessandro Pititto, COGEA and EMODnet (The European Marine Observation and Data Network)
- Martin Poulsen, Managing Director, Acacia Sustainable Business Advisors, member of the Blue Bioeconomy Investment Study team
- Thomas Vyzikas, Project Officer, Bio-based Industries Joint Undertaking (BBI JU)
- Iliaria Nardello, Executive Director, European Marine Biological Resource Centre (EMBRC-ERIC)
- Agostino Inguscio, Marine Resources Unit, Bioeconomy Directorate, DG RTD

## **Pierre Erwes**

Executive Chairman, BioMarine

The definition of Blue Bioeconomy should be flexible and adapting to changes over time. My vision for the BB is to be a future service provider for many other industries, such as food, space, etc. We are extending the scope all the time.

In terms of important and relevant activities, our organisation launched 3 projects addressing various aspects of the BB and soon we will present all projects:

1. One focusing on sustainable aquatic resource management in 28 Members states, where local communities are mobilized through building cooperatives
2. Another is focused on Blue bioplastic and we already have industries interested
3. Third project is on supporting BB business initiatives, where we are raising €200m to invest. We have already selected 17 projects (out of many) that we are sure we should invest in.

Our Fund has good managers and a governance system including private and public stakeholders, finance, from other continents as well. €200m of funds will be invested in selected start-up projects. Focus will be on pre-commercial and commercial activities and SMEs rather than larger organisations.

## **Alessandro Pititto**

COGEA and EMODnet (The European Marine Observation and Data Network)

I am from an Italian consultancy that is involved in the EUMOFA study. Traditionally, we provide information on fish stock, which is a rather old-fashioned perspective of the BB, but we also look into new practices and we have recently produced the EUMOFA report on the Blue Bioeconomy. In

this report we try to establish linkage between old and new traditions of the BB. Europe is not the biggest supplier of biomass from sea. But the striking point is that waste of the fishing products: e.g. 57% of fish in UK was is wasted, including 30% full discard in 2001. Fish waste (skin, bones) is not used and we looked into how this can be used. Norway and Iceland are good examples of looking into how to use fish waste, e.g. use of skin to produce collagen, pharmaceuticals, leather, etc). Shellfish waste can be used for many other things. Challenges and solutions to support the BB: technologies support, policy support, data provision.



## **Martin Poulsen**

Managing Director, Acacia Sustainable Business Advisors, member of the Blue Bioeconomy Investment Study team

I have experience in financing and worked with big investors and young small investors. I have been involved in Blue economy investment study that has been completed recently. The bioeconomy was one of the components of the study and we

looked for the quality demand (are there companies that are good to invest in?). We have filtered 450 projects and, after filtering, created 35 investor dossiers. Challenge comes in the “valley of death” for these projects. On average €2-5m investment is needed for each project. Some specialized BE investors are there along with the mainstream investors (76 investors for BE are identified) – all should be involved and worked with. Involvement of public money is very important, plus technical assistance is needed from the state as investors prefer to invest in projects with technical assistance.

Challenges and solutions to support BBI:

- Valley of death is a true blocker
- Mobilising capital fore BE
- Sector knowledge – BE is not mainstream, and increasing knowledge about the sector is important

### **Thomas Vyzikas**

Project Officer, Bio-based Industries Joint Undertaking (BBI JU)

BBI is a PPP including EC, research organisations, and companies. BBI raised 3.7bn from private companies and 2.7 bn from EU. SIRA 2017 tried to address barriers. BB project portfolio include several projects form research and innovation action, one demonstration project and for now no flagship projects. All projects are located in coastal areas and densely populated inland areas.

Challenges and solutions to support BBI: In BB today food and feed product have a dominant turnover, while cosmetics and pharma have less volume, but high value-added. I want to see more start-ups in high value-added areas than in the food and feed area.

### **Ilaria Nardello**

Executive Director, European Marine Biological Resource Centre (EMBRC-ERIC)

Exploration of the seas is needed to use the potential. Research is important for that and is a part of the economic equation. Researchers should know what industry needs so that they can offer them useful knowledge. Researchers who decide to become an entrepreneur still need research facilities. I would like to see the EC initiate programs using the model of national agencies where they have tiers of finance who can invest in the innovation, as well as support services and actors who can help to bring projects to the next stage.

Challenges and solutions to support the BBI: we have repository of data on marine organisms, but we also need records on their potential for various needs (medical, food, etc.) - all these requires a lot of research. Also, research needs to be streamlined and shared. The marine research community is very active. E.g. one professor wanted to replicate a shell of micro algae material and use for medical purposes. Another developed a cream with a mechanism similar to jellyfish sting, to inject beneficial chemicals into the users’ skin.

### **Agostino Inguscio**

Marine Resources Unit, Bioeconomy Directorate, DG RTD



I have been involved in updating the EU Bioeconomy strategy and believe that BB should deliver growth and jobs. In the new update of the bioeconomy strategy, BB is well represented. R&I is very important in terms of risks in innovations, bringing to market etc. My message would be: we should do more to cover the marine element in the EU Bioeconomy



### Responses of the panelists to the plenary questions

Q: hidden gems in BB:

- There are plenty of gems: e.g. sea cucumber – sustainable, food feed, collagen for cosmetics.

Q: what skills needed:

- Many skills are needed, but communication skill to spread the awareness about BB product is important (novel products need communication)

Q: how to engage youth:

- We should inform youth about opportunities. E.g. Nardello started program EMBRC focused on Master level (Erasmus), European Marine training portal
- Create tangible tools for kids, pupils

Q: Public funding allocation – how this should serve BB?

- Public should address risk, and give political priority, address gaps, steer PPP, involve business in call for proposals.

Q: How to avoid monopolisation of the area:

- The BB should not be privatised and captured by large corporations. Cooperative models are working well. Still, new socio-economic models need to be built.



## **4 Working Group Sessions – Policy, Environment and Regulation**

### **4.1 Complexity of licensing procedures**

#### **4.1.1 WG structure**

Eight participants attended the first session of WG1. Profiles were spread between business and public authorities, with the CEO of Algae for future, the managing director of the Submariner network, representatives from JPI Oceans, from the government of Aruba (NL), from the Brittany region (FR), from the Estonian ministry of rural affairs, and of the Netherlands Standardization Institute. Bernhard Friess from the EC also attended the session. The working group was moderated by Olavur Gregersen, member of the BBF steering group.

#### **4.1.2 Discussion summary**

Participants discussed the results of the roadmap made by the Submariner network, which covered licensing issues. The main issue is that the Marine Strategy Framework Directive (MSFD) is interpreted in different ways across regions and countries, with some including algae and mussels, while others do not. In some areas, there is a strong opposition from the administration to give licenses for algae sea farms, despite the existence of research programmes in the area. Even when a legislation framework for permits exists, with guidelines and peer reviews, even with public support, it happens that some administrations simply refuse to provide licenses (this appeared to be the case in Sweden).

In other cases, the lack of knowledge (especially for microalgae) within local administrations hamper licensing: since they do not know how to assess risks, they prefer to stay on the safe side. One solution found by Algae For Future has been to collocate with heavy industries (cement, chemicals), within perimeters where industrial activities are already allowed.

It is still not clear in which sector algae belong: aquaculture or agriculture? Aquatic farms are not well understood (at least in Portugal). In general, the closer the species to fish, the harder licensing gets: algae are supposedly less problematic than mussels, themselves less problematic than fish. But algae are already complicated in terms of permitting procedures. Also, you need a license at all stages: to set up harvesting activities, and to use the product (food and feed being particularly hard to obtain), and only for a certain time period, implying renewals. The need for (small) companies to prove again and again the safety of their product can derail business plans, unless they manage to set up innovative businesses combined with research projects. A way around this would be the development of standards, especially for mussels.

Often, to start a sea farm, permits are needed from several authorities/ministries (6 in Portugal, about the same in Estonia). In some countries, one-stop shops have been set up to ease the process (Norway, Estonia are doing this, Portugal is about to launch one). But although it enables the gathering of all information in one online space, the multiple procedures remain. In Estonia, they started mapping all procedures, to see what is required from companies in each ministry, to identify contradictions in legislation, overlaps and potential for streamlining. But with coming elections, it is not certain that the process will be completed.

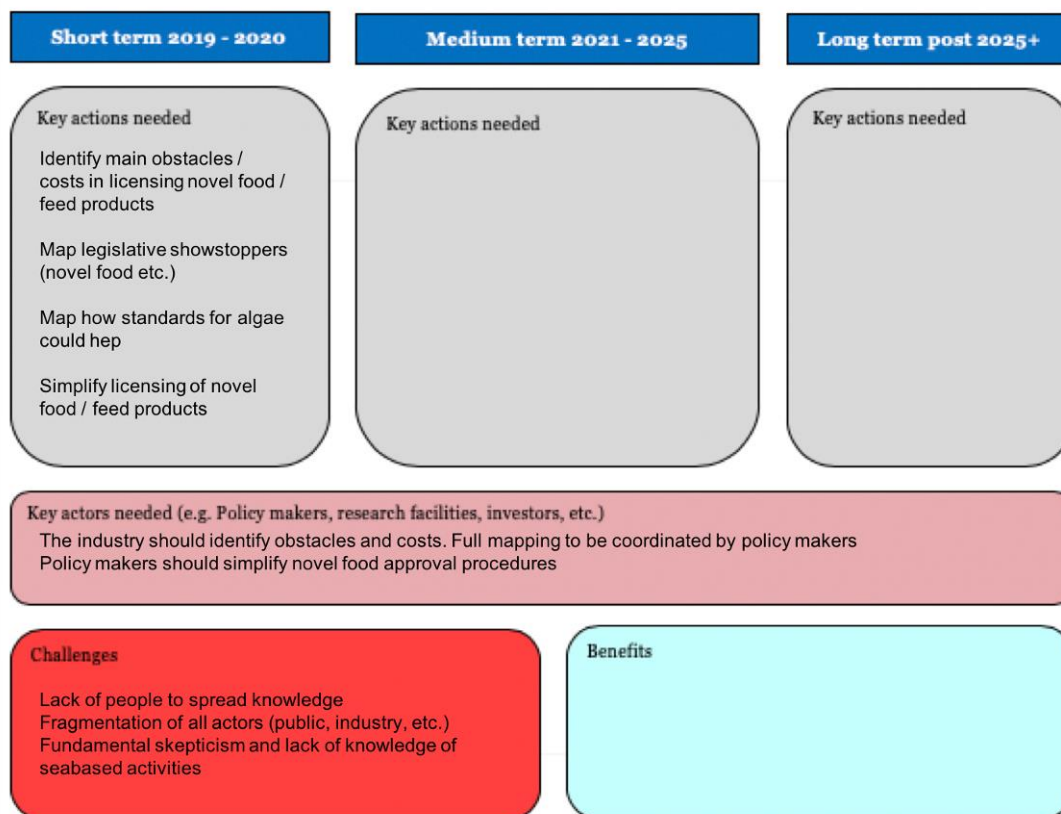
There is also a resistance to more exploitation of ocean space, beyond Maritime Spatial Planning (MSP), especially as the public is not necessarily aware of the (positive) impact that the blue bioeconomy can have on the environment, or of the actual space available further away from the shore. While MSP can serve to solve conflicts, at first it mainly highlights conflicts: bringing more people at the table means that more people get involved and fight for their fair share. Getting support from other industries and from the public is important. In the case of Algae for future, providing a service to the industry has helped them avoid this issue for example.

A good example comes from Brittany: it is the first fishery region in France and a pioneer for marine renewable energy (MRE). Since the beginning they saw conflict for offshore wind farming. To solve this issue, the region and the state set up a regional conference for maritime activities and the coastline, where all actors can take part (anyone can join on a voluntary basis: algae, aquaculture, fisheries, energy, all public authorities). Twice a year, they meet and deliberate on what to do. For each project, they decide on the best area, solving all conflicts in uses, and vote on conflict. The last area for MRE was decided like that at the last conference in May 2017. They are also developing a regional strategy for the maritime sector. It was described as a way to reach some kind of acceptance for MRE. However, participants insisted that while MRE are strong actors, it remains harder for BB projects as there are less companies pushing, and there are other, bigger sectors competing. Without a strong political will to support the BB, it is very difficult for companies to get their share.

Peer learning activities: The EC organises them at the national level but not at the regional level. However, since licensing activities might be done at the regional level, a need might exist. The Submariner network organises peer learning activities as well, also at the regional level. It must be done continuously, and these activities should not be stopped.

Even with peer learning exercises, concerns remain: in Estonia for example, there are simply not enough players to learn from each other, and too many problems to keep up with. Actively attracting businesses to set up in the country would be a way to help: both Germany, Ireland, the UK and Estonia are doing it, to grow the sector, but it takes time. Consultants could be hired to understand what works to attract companies.

Problematic legislations: Novel food often comes up in the discussion (especially raised by the CEO of Algae for future). The issue is that companies simply see it as too complicated, do not have the capacity to even identify what is so problematic. As a result, all algae companies farm the same few seaweeds that are already allowed instead of trying new species. Surprisingly, feed seems to be more problematic than food. The EC asked for a much more detailed description: the EFSA has already tried to harmonise the legislation (the way it is implemented in MS), but they lack the granular view to know what exactly is problematic. The NSI representative mentioned that they currently have a working group looking at this issue, who can help providing details on this. The EABA also has a specific group on novel food.



#### 4.1.3 Key messages from discussion

- We need a granular view of where licensing procedures are problematic
- Map current standards and legislations and how they can be harmonised (EU and national)
- Learn from previous roadmap initiatives to facilitate procedures
- Learn from good examples of stakeholders' cooperation for spatial planning and strategy making
- Improve one-stop-shop models (from single contact and info point to single procedure)

## 4.2 Environmental challenges and solutions

### 4.2.1 WG structure

Six people attended the second session of WG1. Participants included: Seas at Risk (aquaculture), a research development manager from the University of Southern Denmark, Association of biosciences universities, a business lady between two jobs interested in starting a sustainable business, a researcher from Wageningen Food & Biobased Research working on biomass chemicals, Latvian Institute of Aquatic Ecology. The working group was moderated by Olavur Gregersen, member of the BBF steering group.

### 4.2.2 Discussion summary

The notion of ecosystem services appears to be central in the development of the blue bioeconomy sector. For example, in Denmark, legislation has been passed on the development of finfish aquaculture, where farms must now compensate for loss of

nutrients, by installing mussels or algae farming to absorb the excess. The blue bioeconomy can be useful for marine mitigation.

However, when the sole purpose of installing e.g. mussel farming is to clean an area, it must be made profitable in some way. In some cases, the product can be reused (mussels for feed or food if no heavy metals, or use compound or biomass for other purposes), but in many cases it will not be possible. Some payment schemes should be created, to remunerate blue bio activities. They should be financed through taxing marine polluting activities or consumption (polluter pays principle). It could be done through nutrient emission credits. It could replicate what has been done 20 years ago to boost the renewable energy sector, with taxpayers paying a bit more to get renewables. It could benefit lots of low-trophic species exploitation, such as mussels, seaweed (sargassum). However, although this has already been part of the conversation in some countries, there is no public authority to test it already. Political will is missing. Another example of ecosystem services can be found in Latvia, where it is possible to fish and sell without quotas when it is an invasive species.

A main issue to rewarding ecosystem services from the BB is the clear definition of the service provided, and the scale considered. At a farm scale, multitrophic aquaculture did not convince participants. Instead, they insisted on focusing on sea basin scale. Also, mitigation is not about removing exactly what a specific farm has released, but overall balancing (here, the Danish law, itself a transcription of the EU Water Framework Directive seems to be inadequate): this is why looking at the ecosystem services provided by other businesses (the BB ones) is more interesting than insisting on what polluting businesses should do themselves to balance. Regarding the definition of sea basins, the water bodies defined in EU legislation, and that already have legally binding goals, could serve as a basis.

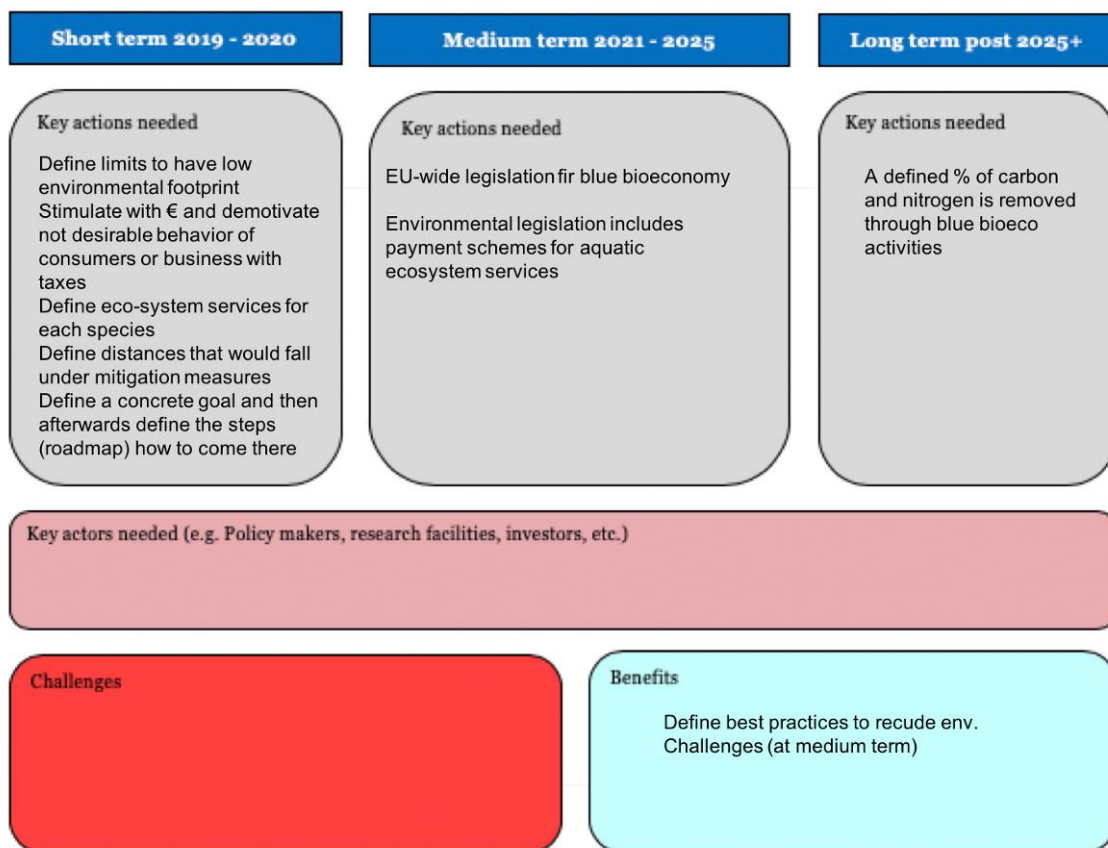
Regarding the valuation of the ecosystem services, it is possible to know exactly what amount of each material is absorbed for different algae or mussel's species. By calculating what is taken up, it is feasible to price it and create a sort of carbon market. Economically speaking, there is no barrier, what is missing is political will to develop bioremediation.

The question of the negative impact of the blue bioeconomy was also discussed. While concerns exist regarding what is happening in China, the European sector is still very far from being comparable. Space seems to be more an issue than ecosystem pressure, as European water space is already more used than in Asia, at least near shore. Offshore areas still offer a lot of potential and could significantly contribute to capture global CO<sub>2</sub> emissions. However, this potential should be put in perspective with other environmental issues: algae harvesting cannot account for rainforest removal. In addition, the blue bioeconomy is itself affected by pollution: the presence of heavy metals in the water is a challenge to develop a healthy bioeconomy.



However, bigger investments are necessary to develop the sector. Cultivation systems have already been tested (e.g. in open ocean conditions in the North Atlantic for 8 years), and worked, taken that the resource is effectively valued and exploited beyond cultivation stage. It is estimated that the total value of aquaculture (currently 6bn\$) could increase by 10-15% with the inclusion of ecosystem services, which could be used as a mechanism to boost the sector in the short to medium term.

Participants also mentioned the double standard between blue bioeconomy at sea, and on land. While at sea activities are highly regulated, there is no discussion of compensating for the installation of destructive agriculture exploitation.



### 4.2.3 Key messages from discussion

- Defining limits to the BB activity, to have low environmental footprint
- Defining concrete environmental targets for the BB activities
- Defining ecosystem services / costs for each species; incorporated in EU legislation
- Reward ecosystem services of blue bio activities (e.g. mussels farming) / set up payment schemes at EU level, financed by end-users of polluting activities (e.g. fish farming)

## 5 Working Group Sessions – Finance and Business Development

The Working Group on Finance and Business Development was moderated by Wilco Schoonderbeek of the Netherlands Investment Agency. There were two separate sessions of the group to consider respectively two topics:

- The mismatch of private investors expected timeline of returns with Blue Bioeconomy initiatives
- Lack of understanding from private market investors of the Blue Bioeconomy potential
- Approximately 20 participants took part in each session of the working group discussions, with little overlap. Participants included representatives of companies (including some start-ups), investors (fund managers), as well as from platform organisations, such as BioMarine, JPI Oceans.

### 5.1 Mismatch of private investors expected timeline of returns with Blue Bioeconomy initiatives

#### 5.1.1 WG structure and discussions

Wilco Schoonderbeek introduced the discussion and pointed out that there were a number of related questions:

- Why is there a mismatch of expected timeline of returns?
- How to get from public-private to next stage?
- How to get banks on board?
- How to scale up financing?
- What can we learn from other sectors?

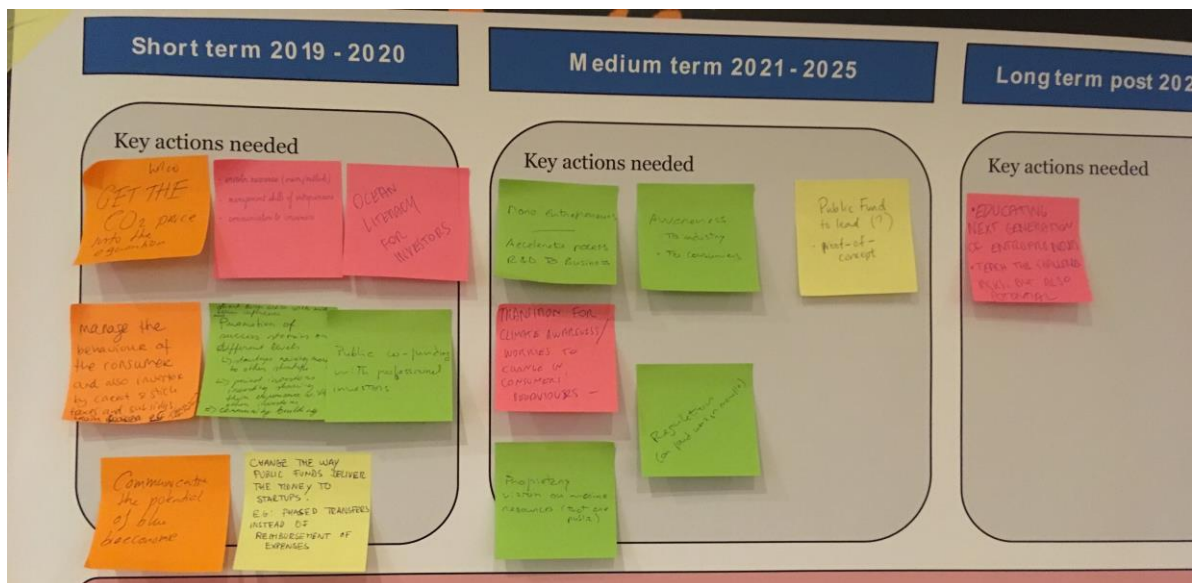
The Working Group followed an open discussion format around these themes. The comparison with the pharmaceutical sector was discussed, particularly as concerns the 10+2 timeframe for venture capital. It was noted that the pharmaceutical sector found a way to cut long lead times for R&D into clear milestones which could attract the confidence of investors and reduce the timeframe of individual investment vehicles. Thus, the mismatch of timing was questioned. Instead, the sector needs to understand that investors need to be confident of exit possibilities and to demonstrate attractive risk-reward possibilities.

It was pointed out that R&D in the sector has changed considerably in the past decade. Much R&D is now outsourced by major pharmaceutical companies, which invest in independent projects or small or start-up companies, offering some examples for the Blue Bioeconomy. This suggests that it will also be important to attract the interest of large food, feed or pharmaceutical companies at some stage. Some participants felt that these downstream investors or clients were sufficiently aware of the potential opportunities.



The discussion considered the balance between companies and investors: are there enough companies and investment possibilities? Or are there too few funds? One participant suggested there were only three Blue Bioeconomy-oriented funds in the whole world, although it is difficult to assess this given varying interpretations of scope. Some experiences were related by investors. In the case of one Portugal-based VC fund, in which 50% was provided by the government, all of the investors were foreign, highlighting a lack of funds, interest or knowledge by domestic investors. This also reinforces the potential for government to help shift the risk-reward ratio.

This example from Portugal also highlighted quite regional differences in the interest of investors. A Portuguese company (also present) that entered into a partnership with Dutch company noticed how many more financing opportunities appeared to be available in the Netherlands. One participant noted the disincentives for investors arising from some specific administrative barriers in some countries. This fund manager indicated that their research had revealed a shortage of companies. There are a number of researchers, but these seem to lack management skills, suggesting a need for more accelerators. A comparison was made with the agri-food sector and its historical development, which also began with very few funds. A number of participants commented on the need to support the development of entrepreneurial and management skills among those establishing start-ups and seeking funding. Some of these essential skills include building a commercial team and growing an international network. Similarly, some entrepreneurs seem to focus their attention on banks as investors, yet they are likely to be too risk-averse for investing in early-stage Blue Bioeconomy opportunities.



### 5.1.2 Key messages from discussion

The key messages were summarized by the moderator as follows:

- A need for the companies in the BB sector to define clear milestones to divide up investment timeline;
- Companies need to understand the importance of offering a clear value creation point for investors, who need to be ensured of having an exit strategy; and
- Management skills need to be developed among companies so that they can move to effective execution. Accelerators may be able to play a role here.

## **5.2 Lack of understanding from private market investors of the Blue Bioeconomy potential**

### **5.2.1 WG structure and discussions**

The second session of the working group also took the form of an open discussion, beginning first with an identification by participants of some key actions. The resulting discussions can be distilled into the following main points.

More attention is required on defining and promoting investment readiness of projects and companies. There is a lack of a common language to promote this and to support upscaling. This suggests a need for more pre-selection processes. Platforms, such as BioMarine, can assist with this process. Showcasing success stories can provide insightful and motivating examples.

The concept of an “assembly line” for building Blue Bioeconomy companies was discussed, reflecting on the experiences of other segments of the life sciences sector. The current set of stages is relatively immature.

One participant from Taiwan indicated that there are investment funds – including public funds – available in a number of Asian countries which European Blue Bioeconomy companies could access.

A number of participants from a research or start-up perspective highlighted the need to raise consumer awareness, in order to help support demand and business development. It was suggested that this could also be a role for platforms.

Many participants from a research or start-up perspective emphasized the importance of finding a way to incorporate ecosystem benefits into finance and business models. One of these benefits is reduction of greenhouse gas emissions, though there are many others. Integrating these incentives can change the tipping point for economic viability. At the same time, it was also pointed out that additional benefits to society cannot be shoe-horned into a venture capital model. There is a need for public financing, for example in the form of a first-loss facility, to complement private capital, whether venture capital or from impact investors.

Finally, a regional and local government representative emphasized the need for guidance to understand the financial ecosystem and what the appropriate role of government is in supporting the financing process. This highlights that Blue Bioeconomy opportunities might often be seen as important economic opportunities at the level of regional public authorities. Yet these government representatives and agencies may have less experience or understanding in promoting the development of an innovative bio-based sector.

### **5.2.2 Key messages from discussion**

The main key priorities from the second session of the Working Group were summarized by the moderator as follows:

- Improve investment readiness
- Support development of “assembly line” of building companies
- Awareness: Platforms, pre-selection processes, other investment opportunities

## **6 Working Group Sessions – Value Chains, Markets and Consumers**

The Working Group on Value Chains, Markets and Consumers was moderated by Helena Vieira, executive director of BLUEBIO ALLIANCE, professor at University of Lisbon and an entrepreneur. The sessions focused on the lack of consumer awareness and consumer acceptance on bio-based products from aquatic or marine environments, and on the lack of valorisation of side products from marine origin materials.

The first session was attended by 20 forum participants, while the session on the lack of valorisation of side products reached 26 participants. Both sessions were attended by a variety of stakeholders, including researchers, entrepreneurs and representatives of public organisations as well as policy organizations. A good balance between different type of participants ensured that discussions were enriched by a diversity of perspectives, ideas and experiences.

### **6.1 Lack of consumer awareness and consumer acceptance on biobased products from aquatic or marine environments**

#### **6.1.1 WG structure and discussions**

Helena Vieira introduced the topic of discussion, highlighting the fact that European consumers are not aware of the difference between bio-based and fossil-fuel based products, their ecological impact and recyclability of bio-based products compare to fossil-based products. The discussion focused on four key questions:

- To what extent does consumer awareness of bio-based products hinder uptake?
- What type of products are generally accepted and for what type of products is there a lack of consumer acceptance?
- What channels are useful to gain consumer acceptance? (e.g. cooperation with academic, public or private parties)
- What can be done to increase awareness and acceptance from a local/national perspective? And at the EU level?

There was discussion on the lack of clarity to consumers on the definition of bio-based products, the perceived overlap with other concepts (often more mainstreamed, such as 'organic') and the lack of clarity of what is or is not considered bio-based. Participants noted that the association with other concepts could lead to a negative image (e.g. bio-based products from waste; covering under the same image food and non-food products) and that geographical differences are important modulators of interpretation of concept and acceptance. The discussion around the definition of bio-based products led to the conclusion that more effective branding is needed to clarify to European consumers what bio-based products are and the benefits of their use/consumption. Participants agreed that being bio-based did not mean being sustainable and this could be addressed by providing a framework/guidelines to assure that bio-based products are sustainable, and that the association of bio-based with 'sustainable' could be claimed unequivocally. The concept of 'green' products is significantly better advertised than 'blue' – aquatic-based. 'Green' products gained trust of European consumers, due to association with high quality, nutritional, healthy and safe products.

The debate on how to communicate the benefits of 'blue' products led to a discussion on branding and labelling needs within the bio-based products. The possibility of the

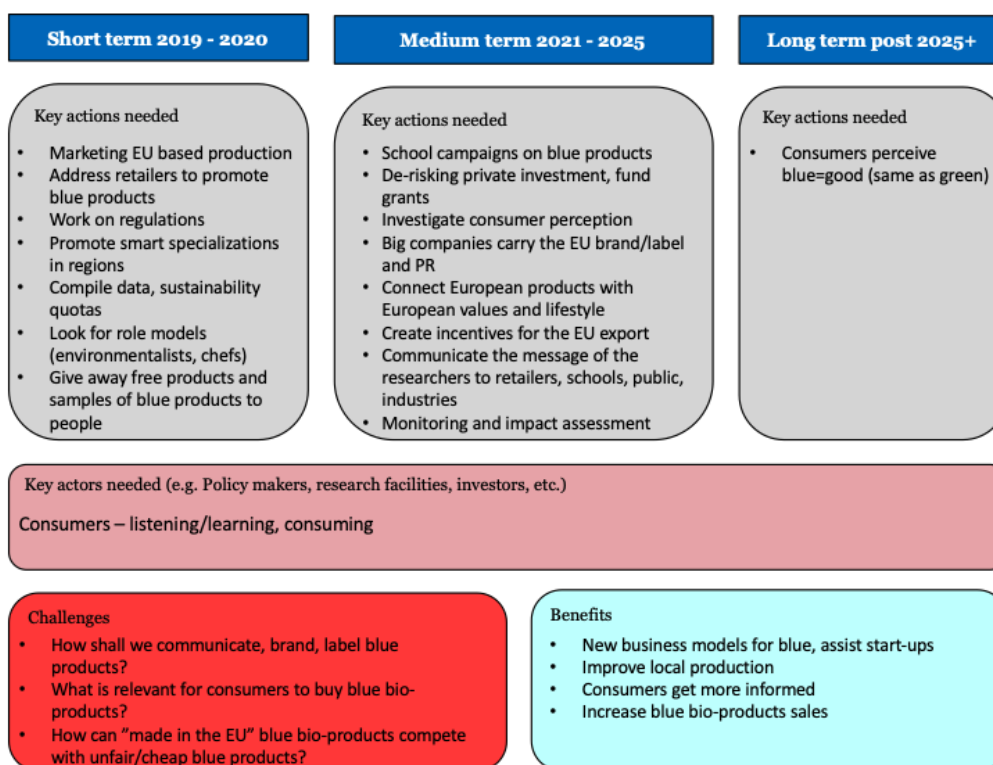
creation of a single EU-wide label for all bio-based products was debated, with diverging opinions on its usefulness, comparatively to actions by companies in support of targeted and research-informed marketing strategies. Favourable arguments stood on proving an easily identified 'unified image' of EU bio-based products, while concerns related to strength of such a labelling (e.g. in comparison to some highly regarded independent labelling, or geographically-linked branding), lack of supporting research and effectiveness in an already crowded labelling landscape. There was an agreement however on the strong need for improved communication with the consumer and need for action by businesses, government and civil society. The differences between bio-based products will likely require different marketing approaches per segment (e.g. food vs. non-food products) and consumer group. The moderator noted that fear-based marketing that highlights that European bio-based products are free of harmful components for health assists in convincing consumers and changing their preferences. Large companies (suppliers), retailers and NGOs should take the lead in marketing bio-based products, both 'green' and 'blue', due to strong influence on the market and/or connection to consumers. For food products, health advocacy organisations and renowned chefs were also noted as important product advocates.

Among the major points of discussion was the realization that there is a lack of understanding of factors that influence purchasing decisions of European consumers. Research on consumer perception and behaviour is needed to examine these factors and inform communication pathways and messages; the findings will be used to leverage production, branding and marketing of 'blue' products.

The challenge of transforming consumer perception of 'bio-based' products should be addressed through education, especially for the younger generation, and through public campaigns. Some participants of the Working Group suggested that shops and local markets should create separate sections/stalls of 'bio-based' products, where only 'bio-based' products would be offered to consumers.

Local entrepreneurs should be encouraged to produce 'blue' products. The de-risking of private investment for the development of 'blue' products is expected to stimulate business community across the EU. Such financial instruments as SME vouchers, tax breaks for 'blue' or bio-based companies could be helpful. The competition with foreign 'blue' products undermines the development of aquatic-based products domestically and its trade potential outside the EU. Financial instruments could improve the competitiveness of European 'blue' products within the EU, while an eventual EU-wide label could assist in branding and differentiating European bio-based, particularly 'blue', products internationally as high quality, safe products.

Lastly, the potential of the blue bioeconomy is limited due to a lack of collaboration between the science and business communities. The researchers in the marine sector should better communicate research findings to stimulate development of new products and approaches. In addition, the collection of data regarding aquatic environments is needed to stimulate more research and ensure the sustainability of the blue bioeconomy.



### 6.1.2 Key messages from discussion

- A clear definition of bio-based products is needed to support effective branding and the scope for association with established/positive concepts (e.g. sustainable) should be explored.
- There is a need to identify key relevant consumer factors that influence perception and purchasing behaviour and apply research results to the marketing and branding of bio-based products. Improved collaboration between academia and businesses is necessary.
- Better branding and marketing are needed to transform consumer perception of 'blue products'. Companies, retailers and NGOs should take the lead in marketing bio-based products, involving role models and key opinion leaders. An EU-wide label for bio-based products could possibly help attach the 'blue' to high-standard EU values.
- Local companies should be financially encouraged (e.g. through tax breaks, vouchers, other financial instruments) to produce 'blue' products and increase exports, competing with foreign products on EU markets.
- Consumer education, especially of the younger generation, is needed through school campaigns, local supermarket campaigns and near-to-consumer action campaigns.

## 6.2 Lack of valorisation of side products from marine origin materials

### 6.2.1 WG structure and discussions

Helena Vieira introduced the issue of suboptimal use and production of blue bio co-products, by-products or side products, and pointed out that only a small fraction of

marine biomass is presently used outside the food and feed sectors. Among the key issues that were discussed during the session were:

- What are the main challenges to valorise co-products, by-products or side products?
- Is there an increasing demand for side products originating from blue bio products?
- Is the value chain for side products from the blue bio economy developed enough to valorise new innovative products? What are the hurdles?
- Are there enough opportunities to find the parties needed to valorise innovations?

The Working Group started the discussion about the perception of by-products as a waste. Both consumers and entrepreneurs do not recognize the potential of blue by-products and co-products, assuming that they are of low quality and with a questionable effect on health. More research should be conducted to show the usability, value and health benefits of side stream products, thereby assisting in changing the perception.

The development of the market of by-products is rarely considered a viable business idea by current traditional business owners that produce those streams, due to a lack of realization of their business potential. Many business opportunities are neglected, a lot of 'blue' produce that could be transformed into a product is thrown away, written off by producers. In addition, entrepreneurs are not aware of effective business models that facilitate collaboration within the 'blue' value chain. Public assistance is needed in training of entrepreneurs and in financing marketing efforts for changing the perception of the value of side stream products near the traditional producers.

The major difficulties in production of by-products are related to logistics/transportation of products, due to geographic scattering of blue bio industries. The storage facilities and delivery of by-products should be adequate to ensure that by-products do not get spoiled before reaching a producer or a consumer. To improve infrastructure and to assist in logistics of by-products, the Working Group suggested that public incentives are needed for co-investment in facilities.

Many participants of Working Groups recognized that there is a mismatch between several regulations related to production and trade of bio-based products. The difficulties in compliance with several regulations. Also, there is a general lack of knowledge of what regulations should be considered before developing a product and while placing it on the market represent significant barriers for producers. Researchers, in particular, admit that they are disincentivized to transform an idea into a product, due to these barriers. Hence, various stakeholders would welcome the creation of a one-stop-shop where they can obtain free advice on regulations in blue bioeconomy sector. In addition, a greater dialogue is needed among regulatory bodies to ensure complementarity and harmony between regulations. The food regulation authorities should always be an active stakeholder in discussion of 'blue' regulations.

In light of under-development of the blue bio value chain and above-listed difficulties, the attention of the investment community should be drawn towards the market of 'blue' and its side stream products. This could be achieved through stimulation of dialogue between 'blue' entrepreneurs and investors, as well as, by explaining the community of investors the nature and potential of the market of 'blue' by-products.

### **6.2.2 Key messages from discussion**

- Public incentives are needed to foster blue side stream valorisation, such as co-invest in infrastructure (e.g., biorefineries, logistics).



- The perception of side stream 'waste' should be re-defined as well as new business models should be developed to meet consumer and market demands.
- The research community should focus on addressing real market needs (e.g., biorefining algae or fish side streams).
- Raise the awareness of investment community for the market value of side stream blue products.
- Create the one-stop-shop for regulatory advice service for the community of researchers and start-ups.

## **7 Working Group Sessions – Science, Technology and Innovation**

The Working Group on Science, Technology and Innovation was moderated by Liina Joller-Vahter, researcher and lecturer at the University of Tartu, Estonia. The session topics were:

- Collaboration between academia (researchers) and industry; responding to the needs of end-users
- Development, coordination, networking and improvement of technological research infrastructures to support marine biotechnology

Around 25 participants attended the STI Working Group sessions, with a fair geographical balance and representing universities, research centers, marine sciences associations, public administration, private companies, and industry associations. To name a few, the STI working group counted with the active participation of representatives of the following key Blue Bioeconomy initiatives: BBI JU, JPI Oceans, EMBC-ERIC, Nofima, Bluebio Alliance, Submariner Network.

### **7.1 Collaboration between academia (researchers) and industry; responding to the needs of end-users**

#### **7.1.1 WG structure**

Ms. Joller-Vahter, introduced the topic by giving a short presentation on the structure and ambition of the session. Following the introduction, four speakers were given the floor to give a short presentation on the discussion topic, related to their own experience.

#### **7.1.2 Summaries of short presentations**

Mr. Oyvind Fylling-Jensen, representing Nofima, brought up recommendations for the Blue Bioeconomy Roadmap.

- Academia and industry have different motivators. For Academics, the results are open, there is more time for research, and risks of failure are low. For industry, the tendency is to protect and not disclose results that can bring a competitive advantage, the risks of failure are higher and returns on investment need to be achieved faster. All these reasons make it difficult for research and industry to conduct joint collaboration without specific frameworks that control the expectations and risks of each party. We need to find the means to support and incentivize those who are implementing research results into products and new technologies. The successful collaboration between academia and industry is based on trust, long-term

competence building, ability to listen to industry needs and the ability to gather market insight and knowledge.

- To boost the Blue Bioeconomy sector, the stakeholders need to start talking about Blue Business and not only the Blue Economy. The area needs to be made attractive to investors and to the industry, not only academia and research organizations.
- Mr. Fylling-Jensen also pointed out that there are limitations on the volume-value pyramid model, many factors enter in the equation to assess the complexity of development of different types of products in the Blue Bioeconomy sector, such as time to market, cost of development, need for equipment, resource availability, need for documentation, need for specific skills and competences, various challenges with scalability (See Figure).

Products	Time to market Years	Cost of development	Resource availability	Need for documentation	Potential market value	Skills and competencies
Pharmaceuticals	10 – 15 +	Very high	Limited	Very high	Very high	Extensive medical and market
Cosmetics	3 – 5 +	Low to high	Fair	Medium	High	Toxicology, effects
Nutraceuticals	3 – 5 +	Medium to high	Fair	Medium to high	High	Nutrition and medicine
Food	2 – 5 +	Low to medium	Good	Medium	Medium to High	Nutrition, Food science
Feed	2 – 5 +	Low to medium	Very good	Medium	Medium to high	Nutrition, animal science
Bioenergy	2 – 5 +	Low to medium	Very good	Low to medium	Moderate	Energy
Fertilizers	1 – 2	Low	Very good	Low to medium	Moderate	Agriculture, agronomy etc

Source: Nofima (Whitaker & Fylling-Jensen)

Mr. Simon Gerrard, from the University of Nottingham, emphasized that academia and industry are constantly looking to work together. The academic/research sector demands the support of industry, and strong relationships between these two depend on:

- A clear understanding and management of expectations of the parties in advance
- Building long-term relationships, with a plurality of stakeholders. The NGOs and academics need to come earlier in the processes to ensure that the outcomes will be sustainable.
- Strengthening the resilience of partnerships. Ensure that work and collaboration carries on not only when funding is available.

Finally, Mr. Gerrard emphasised the importance of ensuring sustainability in the Bioeconomy sector.

The floor was then given to Fons Janssen, introducing the Centre of Sociological Research (CeSO), an NGO for a circular sustainable Europe. Mr. Janssen raised the importance that academia, NGOs and industry need to collaborate since the early stages of project development in order to tackle the major societal challenges, ensure a sustainable business model in the Blue Bioeconomy sector and avoid the mistakes that major industries have done in the past.

Finally, the floor was given to Thalia Arvaniti, who presented the Submariner Network and shared her views on the session topic related to her experience with the Baltic

BlueBiotech Alliance. For Ms. Arvaniti, four key elements allow to build strong Public Private Partnerships:

- Critical mass in the sector
- Building long term networks (to keep the knowledge and integrate it)
- Transferring knowledge to the private sector
- Build multi-stakeholder networks

### **7.1.3 Key messages from discussion**

Following the round of presentations, an interactive exercise was carried out where participants discussed in groups and shared their thoughts on the session topic. The primary objective of the exercise was to collect information on the key challenges and alternative solutions that could be implemented to foster more active and fruitful collaboration between academia and industry in the Blue Bioeconomy sector. The discussions were organized per sector (referring to the volume-value pyramid) and also taking into consideration the different TRL levels (see background note for more information on the interactive exercise).

The first overarching results of the session is that the main challenges were difficult to classify per sector or value chain stage. Most of the challenges and solutions that were suggested by the audience are transversal. It could be also that the allocated time was too short, therefore a more detailed discussion on the specific subtopics will continue on the next Forum events.

The main results from the session can be summarized as follows:

- 1) Facilitating and funding academia (researchers) and industry in building strong and long-term partnerships. This entails taking into account the different motivators and level of risk-averseness that hamper the collaboration between these parties:
  - Facilitating open access of data banks research results;
  - Ensuring continuity of funding after a project ends – the ‘gateways’ in EU funding;
  - Supporting not only lower TRL level activities but also upscaling projects, e.g. pilot plants.
- 2) Better communication and engagement of stakeholders along all TRL levels.
  - The idea that universities work only at lower TRL levels and industry only at higher levels is limiting the development of the sector. There should be a close cooperation between both parties during the entire technology development path.
  - Targeted communication on Blue Bioeconomy projects at all TRL levels to the wider society can help in engaging stakeholders from academia, industry but also NGOs (e.g. for sustainability aspects).
  - To ensure the appropriate legacy of results and engagement of stakeholders along the whole technology development process, specific communication mechanisms need to be established.
  - A better communication would also facilitate attracting industry and investors in the Blue Bioeconomy sector.
- 3) Ensuring the sustainability of the sector.
  - The collaboration should include NGOs and researchers to assess the impact of production of marine, freshwater and other aquatic products, and the long-term sustainability of the whole sector.
  - Life Cycle Assessments need to be conducted for ocean/sea activities. These elements of research need to be integrated into the business planning process.

4) Shifting the mindset of researchers. Most universities and academics conduct fundamental research that may be disconnected from the expectations and needs of the industry.

- Already during their studies graduate students need to be taught how to turn their research into applicable solutions for the industry.
- More communication, exchanges between industry and academia or educational EU programmes can support in shifting this mindset.

## 7.2 Development, coordination, networking and improvement of technological research infrastructures to support marine biotechnology

### 7.2.1 WG structure

Ms. Joller-Vahter introduced the topic by giving a short presentation on the structure and ambition of the session. She emphasized the main issues regarding research infrastructures in the blue bioeconomy sector. The availability of relevant and accessible

research infrastructure comprising of both physical and human resources is crucial to continue the development and utilisation of outputs from marine biotechnology. There are several pre-identified areas where progress could be achieved, such as:

- Increasing networks and collaboration;
- Developing infrastructure to support marine exploration; and
- Creating access to research infrastructures and data.

Following the introduction, the moderator gave the floor to the audience for a quick round of remarks on the session topic.

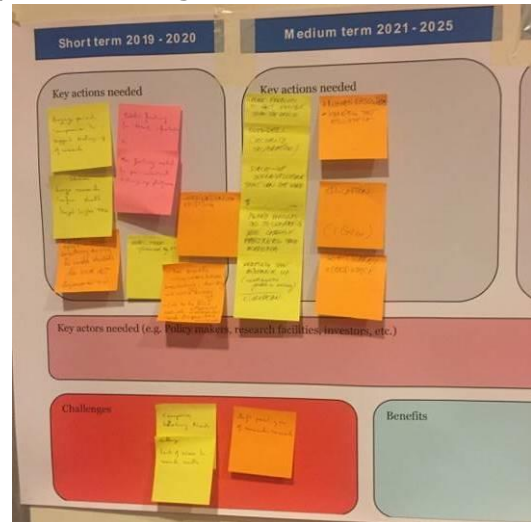
### 7.2.2 Key messages from discussion

The session was organized around an interactive exercise. The participants were split in three groups, and each group was asked to discuss and come up with key challenges regarding research infrastructure in marine biotechnology, and suggested key actions for overcoming these challenges in the years to come. The main messages from the discussions can be summarized as follows:

#### Challenges

Underuse of research infrastructures in higher TRL levels. Tackling the challenges of efficiency gains when scaling up from lab to pilot, and further from pilot to full scale should benefit also from research and research infrastructures.

Lack of infrastructure for scaling-up. Start-ups and industry need access to versatile and flexible pilot plants and demo-facilities which can run pilot, pre-market scale-up projects at an acceptable cost to the new industry. It is not sufficient to finance only the building of pilot



plants. A key cost driver is the operational expenses - this is a part of the equation that is often forgot. There is need for more sites for testing the scalability of technologies (e.g. catapult).

Lack of relevant human resources. The long-term sustainability of research infrastructures is linked to the availability of qualified personnel. There is a lack of qualified personnel to run existing research infrastructure and long-term vulnerability, since in most case scenarios, qualified personnel are given project-based short-term contracts.

Geographical discrepancy in the availability of research infrastructures. The participants pointed out that there is a lack of equipment in some regions, while others who have sufficient resources did not see this as a challenge. This can lead to the under exploitation of opportunities in some territories that are exposed to the potential of the blue bioeconomy (e.g. inland regions with potential for aquatic non-marine developments, remote/overseas territories, etc.).

Lack of access to data and research results, usability of the results. This can be connected to both lack of availability of research results because of restrictions or inefficient communication, or the different motives of stakeholders for conducting research. For example, private companies tend to protect their interests by patenting their research results, which makes it publicly accessible, but not freely usable.

Lack of openness of biobanks. Biobanks collect, process, store, multiply and distribute biological samples and associated data. Biobanks are widely recognized as valuable resources for research, as access to samples and their related data is essential for research. The participants pointed out that in the Blue Bioeconomy sector, there are still bottlenecks in accessing the resources of biobanks.

### **Key actions**

- 1) Public funding and policy measures are needed at several levels:
  - Creating research infrastructures that will support scaling-up of the technologies from research stage to industrial application. While this should be supported by public funds, the working group members agree that the prioritization of the needed infrastructures should to be consulted with the industry stakeholders of the Blue Bioeconomy sector.
  - Ensuring sustainable and efficient use of existing research infrastructures by attracting and securing qualified personnel with long-term contracts.
  - Increasing measures for mapping and improved communication about existing infrastructures and their accessibility.
- 2) Increase education on aquatic technologies and Blue Business, to prepare new generations of qualified human resources.
- 3) Support for existing coordinated activities:
  - Interdisciplinarity: connecting Blue Bioeconomy industry with research facilities in life sciences, energy, etc., for using the infrastructures for developing final products from aquatic resources.
  - Specific to food and feed: There is a need for increased EU funding for cross-sectoral R&I investigating a broad range of solutions – from agri to aqua.
  - Collaboration between academia and industry in cross-use of infrastructures.

## **8 Wrap-up of the day**

The day ended with a plenary wrap-up, where the main results of the working group sessions were presented by the moderators of the sessions, followed by two short presentations of Lolke Sijtsma, (researcher and project leader at Wageningen University & Research) and Tom Redd (scientific advisor at JPI Oceans).

### **8.1 Presentations of the working group sessions**

Olavur Gregersen started with a summary of the working group sessions on Policy, Environment and Regulation.

#### **Complexity of licensing procedures**

- We need a granular view of where licensing procedures are problematic
  - Concrete problems dealing with this
- Map current standards and legislations and how they can be harmonised (EU and national)
  - Learn from good examples and stakeholder coop for spatial planning and strategy making
  - Valid for getting products on the market
- Learn from previous roadmap initiatives to facilitate procedures
- Learn from good examples of stakeholders' cooperation for spatial planning and strategy making
- How to improve one-stop-shop models (from single contact and info point to single procedure)

#### **Environmental challenges and solutions**

- Defining limits to BB activity to have low environmental footprint
- Defining concrete environmental targets for the BB activities
- Defining ecosystem services / costs for each species; incorporated in EU legislation
- Reward ecosystem services of blue bio activities (e.g. mussels farming) / set up payment schemes at EU level, financed by end-users of polluting activities (e.g. fish farming)

The second moderator to present the results of the working groups was Wilco Schoonderbeek, on the topic Finance and Business Development.

#### **Mismatch of private investors expected timeline of returns with Blue Bioeconomy initiatives**

- Clear milestones to divide up investment timeline
- Clear value creation point -> exit strategy
  - Inflection points are not clear in a young industry like this
- Focus on management skills -> execution
  - More efficiently, less time wasted on finding money

#### **Lack of understanding from private market investors of the Blue Bioeconomy potential**

- Improve investment readiness



- Missing a common language, so need to know upfront what to deliver at each stage
- Milestones have too much a scientific or business perspective, rather than an investment perspective
- Support development of “assembly line” of building companies
  - From an early stage on
- Awareness: Platforms, pre-selection processes, other investment opportunities
  - There is a basket of different things and people are looking for money in the wrong places
  - Address the right instrument for the right task
  - Help each other to know what’s there

Next, Helena Vieira presented the finding of the working group sessions on Value Chains, Markets and Consumers.

### **Lack of consumer awareness and consumer acceptance on bio-based products from aquatic or marine environments**

- Identify key relevant consumer factors that influence the purchasing decision and apply it to blue bio products.
- Better branding (safe, free of, fear marketing) is needed to transform consumer perception of ‘blue products’. An EU label is needed to attach the blue to high standard EU values.
  - An EU label is a premium brand
- The EU should support local companies to increase exports, competing with lower quality foreign products.
- Education of younger generation is needed through school camping, local supermarket campaigns.
- Big companies should take the lead in branding blue products. We should involve role models and key opinion leaders.

### **Lack of valorisation of side products from marine origin materials**

- Public incentives are needed to foster blue side stream valorisation, such as co-invest in infrastructure (e.g., biorefineries, logistics)
- The perception of side stream “waste” should be re-defined as well as new business models should be developed to meet consumer and market demands
- The research community should focus on addressing real market needs (e.g., biorefining algae or fish side streams)
- Raise the awareness of investment community for the market value of side stream blue products
  - Opportunities for new businesses
  - Value chain of side streams
  - Perceive not as waste
- Create the one-stop-shop for regulatory advice service for the community of researchers and start-ups
  - They are not aware of regulation hurdles until it’s too late

The last moderator to present was Liina Joller-Vahter, who moderated the working group sessions on Science, Technology and Innovation.

### **Collaboration between academia (researchers) and industry; responding to the needs of end-users**

- Different motivators of academia and industry
  - Results open in academia, close in industry (need for open access and data banks)
  - Academia has time to find results / Industry wants results now
  - Risks in industry are higher
- Communication:
  - The sector needs to be made attractive to investors
  - Communication plans should include wider society
- Limitations of the value pyramid, many factors enter in the equation to assess applicability: Time to market, skill-set, need for regulation, need for equipment, scalability, risks
- Researchers should contribute also to scaling-up and industry should be involved at earlier research stages
- Ecosystem services should be included in the business models
- Demand-driven view, which oil-based products can be replaced?
- Importance of building strong relationships between academia and industry
  - Long-term
  - Resilient
  - Manage expectations
- Implementing gateways for EU projects
  - Follow-ups
- At University level: students need to be trained on how to produce research for industry needs and end-users
- Sustainability
  - We need to think how to involve NGOs in the earliest stages of research, to avoid/undue problems that industry did
- Insufficient supply of primary biomass for bio-based products

### **Development, coordination, networking and improvement of technological research infrastructures to support marine biotechnology**

- Challenges
  - Lack of equipment in some regions
  - Lack of infrastructure for scaling-up
  - Lack of relevant human resources and long-term contracts of qualified personnel
  - Lack of access to research results
  - Lack of openness of biobanks
  - Under-use of RI in higher TRL levels
- Key actions:
  - Public funding is needed for infrastructures (creating, sustaining, communicating)
  - Scaling-up stage infrastructures supported by public funds
  - Industry sector should have a say in where public funds are allocated
  - Education on aquatic technologies and business
  - Coordination activities should be supported
  - Increase interdisciplinarity

## **8.2 Project pipeline**

The project pipeline was shown by Lolke Sijtsma through a powerpoint presentation. The presentation showed the aim of the Blue Bioeconomy Forum, the roadmap

development process and where to find relevant projects. Following, it showed the selection for the project pipeline:

Scope:

- Completed after 2010
- Value added applications
  - High value non-food (cosmetics, pharmaceuticals)
  - Chemical building blocks
  - Functional food
  - Functional feed

Prioritization criteria:

- Soundness of the concept
- Impact in creating new markets / business opportunities for SMEs
- Investment readiness
- Sustainability (economic, environmental)
- Implementation / potential for scale-up

The presentation ended with the next steps:

- Evaluate current (+ possibly additional) pipeline projects
- Getting insight in their challenges, increasing their maturity
- Feed the knowledge into the roadmap

### **8.3 Cofund**

Tom Redd, scientific advisor at JPI Oceans, was asked to give the last presentation of the day on the ERA-NET Cofund for the Blue Bioeconomy. In a few minutes he gave the audience information on this new call, which will be open from pre-proposals from 17 Dec 2018.

The goal of the fund is to generate knowledge for Blue Bioeconomy value chains and improve the transfer of bio-based products and services from research, innovation and demonstrations to production scale.

The total call budget is €29m, available to researchers and companies in 16 countries. The requested budget per proposal cannot exceed €2m. Projects can address Technology Readiness Levels up to 7 and must involve both research organisations and industry. Also, the consortium must consist at least three independent eligible legal entities from at least three BlueBio partner countries.

The proposals should address at least one of the priority areas:

- Priority area 1: Exploring new resources
- Priority area 2: Exploring improvements in fisheries and aquaculture
- Priority area 3: Exploring synergies with other sectors
- Priority area 4: Exploring Biotechnology and ICT

## Appendix A: Agenda

### Registration and welcome coffee (8.30-9.00)

### Opening plenary session (9.00-9.25)

Welcome note by **Bernhard Friess**, *Director of the Directorate "Maritime Policy and Blue Economy" of the European Commission's Maritime Affairs and Fisheries Directorate-General*

Introduction by **Vitor Verdelho**, *on behalf of the Blue Bioeconomy Forum Steering Group*

### Panel Discussion (9.25-11.00)

Interactive discussion with 5 panel members, starting with introductory remarks from each providing an overview of current activities and trends in the blue bioeconomy. Questions from the plenary.

Panelists confirmed:

- **Pierre Erwes**, *Executive Chairman, BioMarine*
- **Alessandro Pititto**, *COGEA and EMODnet (The European Marine Observation and Data Network)*
- **Thomas Vyzikas**, *Project Officer, Bio-based Industries Joint Undertaking (BBI JU)*
- **Iliaria Nardello**, *Executive Director, European Marine Biological Resource Centre (EMBRC-ERIC)*
- **Martin Poulsen**, *Managing Director, Acacia Sustainable Business Advisors, member of the Blue Bioeconomy Investment Study team*
- **Agostino Inguscio**, *Marine Resources Unit, Bioeconomy Directorate, DG RTD*

### Coffee break (11.00-11.20)

### Thematic / working group sessions (11.20-12.45)

Topics by theme:

<b>WG1: Environment and Regulation</b>	<b>Policy, and</b>	<b>WG2: Finance and Business Development</b>	<b>WG3: Value Chains, Markets and Consumers</b>	<b>WG4: Technology and Innovation</b>	<b>Science, and</b>
Complexity of licensing procedures		Mismatch of private investors expected timeline of returns with Blue Bioeconomy initiatives	Lack of consumer awareness and consumer acceptance on bio-based products from aquatic or marine environments	Collaboration between academia (researchers) and industry; responding to the needs of end-users	
Field meeting room 1		Polder meeting room 3	Polder meeting room 2	Polder meeting room 1	

**Lunch (12.45-14.00)**

**Second working group session (14.00-15.15)**

Topics by theme:

<b>WG1: Environment and Regulation</b>	<b>Policy, and</b>	<b>WG2: Finance and Business Development</b>	<b>WG3: Value Chains, Markets and Consumers</b>	<b>WG4: Science, Technology and Innovation</b>
Environmental challenges and solutions		Lack of understanding from private market investors of the Blue Bioeconomy potential	Lack of valorisation of side products from marine origin materials	Development, coordination, networking and improvement of technological research infrastructures to support marine biotechnology
Field meeting room 1		Polder meeting room 3	Polder meeting room 2	Polder meeting room 1

**Coffee break (15.15-15.35)**

**Short summaries of sessions by moderators/rapporteurs and presentation of projects pipeline (15.35-16.30)**

**Networking (16.30-18.00)**

## Appendix B: Participant list

<i>Title</i>	<i>Last name</i>	<i>First name</i>	<i>Organization</i>	<i>Function</i>
Dr	ADDAMO	Anna Maria	European Commission, Joint Research Centre	Scientific Officer
Mr	ALSAHTOUT	Haydar	Saudi Aquaculture Society	Adviser
Dr	ARVANITI	Efthalia	SUBMARINER Network	Programme manager
Ms	BAKKER	Marije	Scholten Holding	COO
Ms	BAYLISS-BROWN	Georgia	AquaTT	Senior Knowledge Transfer Officer
Dr	BENEMANN	John	MicroBio Engineering Inc.	CEO
Dr	BERGSETH	Steinar	The Research Council of Norway	Special Adviser
Mr	BREMNES	Emil	Nofima	EU & Communications Adviser
Mr	BROUWERS	Eef	Stichting Noordzeeboerderij	Operational Manager
Mr	BRUDEVOLL	Anders	JPI Oceans	Advisor
Mr	BUCKHOUT	Marc-Philip	Seas At Risk	Aquaculture Policy Officer
Mr	CHIRIVELLA	Jeronimo	Universidad Católica de Valencia	Professor
Mrs	CHREPTOWICZ-LISZEWSKA	Magda	State Water Holding Polish Waters	Senior Expert
	COELHO	Nuno	A4F	
Dr	CRAMM	Rainer	BioCon Valley	Project Manager
Mr	DALBERT	Benoît	OCTA - Overseas Countries and Territories Association	EU Programmes Officer
Ms	DEGTYAREVA	Tatiana	PNO Consultants	Communication & Dissemination Officer
Mrs	DORANOVA	Asel	Technopolis Group	consultant
Mr	DORPMANS	Dennis	Circle of Sustainable Europe (CoSE)	Chairman & Sustainopreneur
Dr	EATON	Derek	Technopolis	Senior Consultant
Prof	EINARSSON	Hjorleifur	University of Akureyri	Professor
Dr	ENZING	Christien	citizen	
Mr	ERWES	Pierre	BioMarine	Chairman
Mr	ESCUDERO	Pedro	Buggypower	CEO
Mrs	FALKIEWICZ	Karolina	State Water Holding Polish Waters	Senior Specialist
	FRANCO	Sofia	European Commission	
	FRIESS	Bernhard	European Commission	
Dr	FYLLING-JENSEN	Øyvind	Nofima AS	CEO



Dr	GERRARD	Simon	University of Nottingham	Senior Executive Corporate Partnerships
	GREGERSEN	Olavur	Ocean Rainforest	
Ms	GUZNAJEVA	Tatjana	Technopolis Group	Consultant
Dr	HEATH	Simon	Association for European Life Science Universities	Secretary General
Mr	HEREDIA	Miguel	Oceano Azul Foundation	Manager
Ms	HOOGENBOSCH	Lianne	Samenwerkingsverband Noord Nederland (SNN)	Project member
Dr	IKAUNIECE	Anda	Latvian Institute of Aquatic Ecology	
Mr	INDRA	Te Ronde	Netherlands Standardization Institute (NEN)	Standardization Consultant
Dr	INGUSCIO	Agostino	European Commission	Policy officer
Mrs	JAGOT	Charlotte	EASME	Senior project advisor
	JANSSEN	Fons	KNCV	
Mrs	JOLLER-VAHTER	Liina	University of Tartu / Power Algae Ltd	researcher
Dr	JUBEAU	Sebastien	Xanthea	Research Director
Dr	KALS	Jeroen	Wageningen livestock research	Researcher Seafood, Aquaculture & Fish Nutrition, Wageningen Livestock Research
Mr	KHAN	Sultan Riaz	Tavlon Environmental Technologies Inc	
Mr	KIUDULAS	Eimantas	UAB Klaipeda Free Economic Zone Management Company	General Manager
Mrs	KIVILO	Reili	Ministry of Rural Affairs	Adviser
Mr	KOUTROUMPAS	Anargyros	CLEOPATRA'S SPONGES PC	Founder & CEO
Mrs	KÜLMALLIK	Eve	Ministry of Rural Affairs	Adviser
Ms	LE GALLOU	Margaux	Technopolis Group BBF	Consultant
Mr	LEITE	Nuno	SEAentia	Founding Partner
Mr	LIGTVOET	Andreas	Technopolis	Consultant
MRS	LISANDRA MEINERZ		EABA European Algae Biomass Association	
Mr	LUBOVAC	Amir	Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina	Expert advisor
Mr	LUND-LARSEN	Jesper	United Federation of Danish Workers	Political Advisor
Ms	MABILIA	Valentina	European Commission	Policy Officer
Mr	MAIER	Frederic	Technopolis Group	Consultant
Ms	MARIC	Snjezana	Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina	Expert Advisor for Tourism

MRS	MEINEZZ	Lisandra	EABA	
Mr	MUIZELAAR	Wouter	Wageningen Livestock Research	Researcher
Dr	NARDELLO	Ilaria	EMBRC-ERIC	executive Director
Mr	NAVA	Hector	Synergy Cooling Towers	Owner
Mr	NIELSEN	Christian	BBF news	Journalist
Mrs	NÕLVAK	Mariann	Tartu Biotechnology Park	Program Manager
Ms	NOVOTNY	Melissa	Sea Going Green	Business & Partnership Development Manager
Mr	PARIS	Eddy	Aruba	Government Representstive
	PETERSEN	Jens Kjerulf	Danish Technical University	
	PITITTO	Alessandro	COGEA and EMODnet	
Mr	POELMAN	Marnix	Wageningen Marine Research - Wageningen University & Research	Projectmanager Blue Growth
Mr	POHJOLA	Tuomas	University of Turku, School of Economics, Pori Unit	Researchers
Mr	POULSEN	Martin	Acacia Sustainable Business Advisors	Director
	RAINS	Laurent	Autodesk	
Mr	REDD	Tom	JPI Oceans	Scientific Advisor
	REITH	Hans	Wageningen University	
Mr	REMMAN	Tore	CFEED AS	CEO
M	RÉVEILLON	Kévin	OneTec Group	IT Technical Support
Ms	SAES	Lisanne	Technopolis Group	Consultant
Mr	SAMPAIO SANSÃO	Guilherme	Scottish Association for Marine Science	Msc student
Dr	SASSI	Jean Francois	CEA	R&D group manager
Mr	SCHOONDERBEEK	Wilco	Blue Biobased Forum	Steering Group Member
Mrs	SCHULTZ-ZEHDEN	Angela	SUBMARINER network for Blue Growth EEIG	Managing Director
Mr	SGARBI	Federico	Regional Council of Brittany	EU Policy Officer
Dr	SIJTSMA	Lolke	Wageningen University and Research	senior scientist / project leader
Mr	STOMMELS	Aleksandr	EJVO	Co-Founder & Treasurer
Mr	TAMOSAITIS	Gediminas	UAB Metal Production	CEO
Mr	TARRAGA	Manuel	Buggypower	Project Development Director
Mr	VAN BARNEVELD	Joost	Barnebies	Founder
Dr	VAN DEN BROEK	Lambertus	Wageningen Food & Biobased Research	Researcher/project leader

	VAN DER VEEN	Geert	Technopolis	
Mr	VAN LEEUWEN	John	Seaweed harvest Holland	MD
Mrs	VAN LEEUWEN	Myrna	Wageningen Economic Research	Project manager bioeconomy
	VERDELHO	Vitor	European Algae Biomass Association	
Prof	VIEIRA	Helena	BLUEBIO ALLIANCE	Executive Director
Dr	VYZIKAS	Thomas	BBI JU	Project Officer
	WU	Kai Ti	EJVO	



## Appendix D: Background notes to the sessions

### Overview of Working Group session topics

#### Policy, environment and regulation:

- Session 1: Complexity of licensing procedures
- Session 2: Environmental challenges (e.g. nutrient pollution, spreading of diseases, genotypical impacts on wild species, alien species invasion)

#### Finance and Business development:

- Session 1: Mismatch of private investors expected timeline of returns with Blue Bioeconomy initiatives
- Session 2: Lack of understanding from private market investors of the Blue Bioeconomy potential

#### Value chain, markets and consumers:

- Session 1: Lack of consumer awareness and consumer acceptance on bio-based products from aquatic or marine environments
- Session 2: Lack of valorisation of side products from marine origin materials

#### Science, technology and innovation:

- Session 1: Collaboration between academia (researchers) and industry; responding to the needs of end-users
- Session 2: Development, coordination, networking and improvement of technological research infrastructures to support marine biotechnology

### Working Group: Policy, environment and regulation

**Moderator:** Olavur Gregersen

**Rapporteur:** Margaux Le Gallou

#### Session 1: Complexity of licensing procedures

##### Background

Blue Bioeconomy projects meet complex legal procedures, primarily the **complex and lengthy licensing procedures managed by public authorities**, concerning the location (marine or coastal areas), development and operation of projects (development, construction, operation, technologies, product certifications, environmental, health, etc.) as well as their products and outputs. The complexity of licensing procedure varies greatly among member states, suggesting the possibility to simplify most complex without diminishing the quality of regulations. Administrative burdens could be reduced through more institutional oversight, consultation and planning (Innes et al., 2017). Negative impacts are: loss of economic opportunities and hindered growth for the sector, unfair competition for businesses operating in the same sea basin but with different regulations, lesser environmental and health protection where the procedures hinder the development of sustainable facilities.

Licensing and permits procedures have been mainly studied for the aquaculture sector (see Innes et al. 2017, reviewing 40 procedures across the OECD). However, the maricultural sector, and especially mollusks and macroalgae businesses could greatly benefit as well, as their growth potential is significant (SAM report Food from the Ocean 2017).

Macroalgae example: while in France each type of macroalgae requires a specific licence to be harvested, in Ireland there is to date no licencing system, and in Norway it only exists for vessel-based algae collection. Similarly, some member states might apply quota (national or by geographical area) based on regular biomass stock estimates, others do not perform such scientific studies and might use data already decades-old.

quaculture example: starting up or expanding an aquaculture farm requires permits and authorisations that are not harmonised at the EU level, a procedure deemed "in general, slow, complex and lacking legal certainty and economic predictability [...] hindering the development of the sector [and] indirectly encouraging imports from third countries." Paradoxically, regulations regarding especially environmental protection seems to not even ensure such protection by "making it difficult to establish socioeconomic, environmentally sustainable and quality aquaculture farms". The existence of different regulation between countries also results in businesses having different legal requirements even though they might be active in the same sea basin, therefore distorting competition (European Parliament P8\_TA-PROV(2018)0248).

### Key questions

- In which subsectors are licensing procedures problematic? (e.g. algae cultivation and wild harvesting or transformation, waste recycling, food or cosmetics, etc.)
- When problematic, which part of the licensing could be improved?
- In which countries / regions are stock estimates and other key data outdated/have been recently updated?
- Can you cite a good example where licensing procedure is balanced between resource/consumer protection and ease of doing business?
  - What part of it is replicable?
- Are there peer-learning exercises organised between public authorities?
- How to organise stakeholders' consultation in ways that build-up consensus between competing industries instead of building up conflict?
- In which situation would EU-wide harmonisation be beneficial?
- Are there any outdated EU-wide legislation or regulation?
- Can you cite an example where there is an EU harmonised procedure, and does simplify licensing? If not, why?

## Session 2: Environmental challenges (e.g. nutrient pollution, spreading of diseases, genotypical impacts on wild species, alien species invasion)

### Background

The main environmental challenges faced by the industry today are:

- **Nutrient pollution:** Included as one of the priorities of the Sustainable Development Goal n°14 to "conserve and sustainably use the oceans, seas and marine resources for sustainable development", one of the main targets is to "prevent and significantly reduce marine pollution of all kinds, in particular from



land-based activities, including marine debris and nutrient pollution". Eutrophication, or in other words – the excessive loading of water with nutrients – can have negative effects on marine ecosystems, such as: algal blooms, increased growth of macroalgae, increased sedimentation and oxygen consumption, oxygen depletion in lower water layers and, sometimes, mortality of benthic animals and fish. Mitigation of the negative effects of eutrophication requires reduction of nutrient inputs and an ecosystem-based management strategy (Dronkers & Van Beusekom, 2018).

- **Spreading of diseases:** One major constraint is the spread of disease within an aquaculture facility. Pathogens can be introduced from natural sources or through the introduction of new individuals to farm stocks. These animals have also been known to escape, spreading disease to wild populations. When animals are confined to a relatively small space, it is common for diseases and parasites to proliferate and spread rapidly (Deep Maps Cork, 2017).
- **Genotypical impacts on wild species:** The production of transgenic animals raises concern regarding their potential ecological impact should they escape or be released to the natural environment.
- **Alien species invasion:** Alien species are non-indigenous organisms introduced into an ecosystem that is not their native habitat either by accident or intentionally. While some alien species may have little impact within their new habitat, others can become invasive and pose a serious threat to marine biodiversity, coastal economies, local cultures and livelihoods, and human health (Ocean Health Index, 2018).

### Key questions

- How is your activity affected by environmental degradation?
- What measures have your sector introduced to reduce the degradation of its own resource / of other resources affected by your activity?
- Which regulations are supposed to improve the environmental status of your resource?
- Is their implementation sufficient?
- Which blue bio activities are more likely to lead to environmental degradation?
- Which activities can be used to restore and strengthen the environment and how? (e.g. valorisation of invasive algae, wild harvesting creating habitats for other species, etc.)
- What key actions should be taken within the blue bio sector (policy and self-regulation) to avoid further degradation and restore the resource and its habitat?
- What is currently impeding the development of proper environmental protection of blue bio resources?

### Working Group: Finance and business development

**Moderator:** Wilco Schoonderbeek

**Rapporteur:** Derek Eaton

### Session 1: Mismatch of private investors expected timeline of returns with Blue Bioeconomy initiatives

## **Background**

Private investors consider that the combination of volatile profitability/cashflow generation and the large capital expenditure required is not attractive from a risk/reward perspective. For private investors the risks associated are difficult to quantify and the funding conditions - if available - cannot be met by Blue Bioeconomy projects/companies.

Another challenge is the fact that venture capital and private equity use a 10+2-year timeframe. Normally they have an investment period of 5 years followed by a 5-year period to try to monetize the value created. Due to the nature of Blue Bioeconomy initiatives this timeframe is often too short. This can be solved by implementing a new type of more 'holistic' long term (30 years+) cooperation between public and private funding, which can overcome the silo approach (R&D, Seed, Start, Scale), currently hampering an appropriate risk/reward structure.

The ability to create the appropriate capital structure is crucial. A broad mix of financial instruments could provide a solution. Non-dilutive instruments such as grants could act as a 'first loss' facility, de-risk the investment profile of Blue Bioeconomy initiative and leverage other financial instruments such as loans and equity. Loans, and especially equity, are important to ensure financial discipline and a focus on value creation. Such a capital structure could maximize the crowding-in of market investors.

## **Key questions**

- How does the Blue Bioeconomy sector fit into the existing framework of investors?
- What difficulties are experienced by Blue Bioeconomy companies in accessing finance?
- What types of capital have Blue Bioeconomy companies accessed or tried to attract?
- What types of financing and capital structures have been created?
- Have there been attempts to access blended finance or PPPs?
- What changes are needed in the finance sector?
- What changes are needed by Blue Bioeconomy companies?

## **Session 2: Lack of understanding from private market investors of the Blue Bioeconomy potential**

### **Background**

'Blue Bioeconomy' projects appear to face difficulties raising finance. The lack of interest from private market investors is related to the lack of understanding of the Blue Bioeconomy in general. Many investors are likely not aware of some of the potential benefits and may find it difficult to appreciate some of the technologies. They may also not be aware of the broader social benefits provided and how to internalise or monetise those. In addition, most investors are not well informed about the risks of blue bio-business. Transparency, clarity and effective communication are central for gaining both interest and trust from investors.

### **Key questions**

- Is there sufficient understanding of investors of the technologies, their market potential and broader benefits?

- How can awareness among investors of the Blue Bioeconomy be increased?
- What is the role of companies, as well as other actors, in increasing awareness?

## **Working Group: Value chain, markets and consumers**

**Moderator:** Helena Vieira

**Rapporteur:** Tatjana Guznajeva

### **Session 1: Lack of consumer awareness and consumer acceptance on bio-based products from aquatic or marine environments**

#### **Background**

The public perception and consumer acceptance of bio-based products in Europe is not fully developed. The main barrier that prevents the rise of consumer acceptance in bio-based products is that the majority of European consumers is not aware of the difference between bio-based and fossil-fuel based products, their ecological impact and recyclability of bio-based products compare to fossil-based products.

In contrast to other world regions, Europe generally lacks a consumer history with bio-based products from the oceans (e.g. micro-algae). A well-defined labelling system for bio-based product could enhance consumer acceptance of these products (KBBPPS, 2018; OpenBio, 2018; SAPEA, 2017). Companies that commercialise products using biomarine components are not incentivised to advertise it, and only include their code name (e.g. E400, E408), which is then interpreted as a chemical component by consumers.

In 2017, the consortium of Bio-based industries found that in Europe there is a misconception on the definition 'bio-based'. A majority (63.7%) of consumers are not fully aware what the concept 'bio-based' means, what type of products it includes and what kind of characteristics a product needs to have to be called 'bio-based'. The lack of reliable and sufficient information about bio-based products, and education is a barrier for bio-based product producers (Bioways, 2017). These findings are supported by the report on '*opening bio-based markets via standards, labelling and procurement*' (Meeusen et al., 2015). This report presented the opportunities on how to develop customer acceptance of all bio-based products and concluded that information on recyclability and biodegradability should be further disseminated to a larger audience to support the demand for bio-based goods. Consumer acceptance could be driven by emphasizing on the ability of bio-based products to gain and ensure stronger independence from fossil-based sources.

#### **Key questions**

- In your opinion, how good is consumer awareness of bio-based products?
- What type of products do you experience to be generally accepted?
- For what type of products do you experience a lack of consumer acceptance?
- Do you work together with academic/public or private parties to gain consumer acceptance or consumer awareness?
- What channels did you find useful to gain consumer acceptance?
- Is your local or national government collaborating in the development of consumer acceptance? What can be done to increase this awareness from a local/national perspective? And at the EU level?

- What kind of public policy would strengthen consumer acceptance for bio-based products from aquatic or marine environments products?

## **Session 2: Lack of valorisation of side products from marine origin materials**

### **Background**

Each year the European blue bio sector produces tons of side products. These side products can be used for a variety of adaptations: bio-based fertilisers, pharmaceutical & medicine, polymer & textile and food & nutraceutical products. The development of blue bio co-products, by-products or side products is not optimal. The EUMOFA report of the European Commission describes that, for example, in the Shellfish industry an absence of waste management is a barrier for the development of valorisation of side products from marine origin materials.

Only a small fraction of marine biomass is presently used outside the food and feed sectors. Emerging market opportunities and completely novel applications for marine-derived compounds exist. The health sector, which targeted marine-derived molecules as new pharmaceutical entities, continues to emphasise the potential of marine biomass in drug discovery; filling gaps that more traditional sources of small molecules have not been able to fill. Seas are a home to a myriad of biological materials of interest to the engineering and medical devices sectors.

Not only can marine biomass be the source of new product applications; considerable scope also exists for it to contribute to new processing methods. Extensive marine biodiversity is an excellent source of novel biocatalysts. Initially pioneered by the foods sector, marine-derived enzymes have attracted the attention of the chemical, pharmaceutical, cosmetics, agriculture and environmental sectors, and can support an expansion of industrial bioprocessing.

### **Key questions**

- What are the main challenges for you to valorise co-products, by-products or side products?
- Do you experience an increasing demand for side products originating from blue bio products?
- Is the value chain for side products from the blue bio economy developed enough to frequently launch new innovative products? What are the hurdles? Logistic? Process/separation methods?
- Are there enough opportunities to find the parties needed to valorise your innovations?
- What are the barriers that you encounter when you want to valorise a side product from marine origin materials?

## **Working Group: Science, technology and innovation**

**Moderator:** Liina Joller-Vahter

**Rapporteur:** Frédéric Maier

## **Session 1: Collaboration between academia (researchers) and industry; responding to the needs of end-users**

### **Background**

Major opportunities exist to extend the use of ocean bioresources in markets for industrial enzymes, pharmaceuticals, functional foods, cosmetics and agricultural products. Further, there are fast emerging applications in new end-use areas including bioprocessing, environmental remediation and monitoring, chemicals, cosmeceuticals, biomaterials and in medical devices. A 2015 market report from market analysts Smithers Rapra "*The future of marine biotechnology for industrial applications to 2025*" indicates the global market for marine biotechnology has the potential to reach \$4.8 billion by 2020, rising to \$6.4 billion by 2025.

As an example, biopolymers of marine origin have received increasing attention from the medical, pharmaceutical and biotechnology industries for their numerous applications ranging from biodegradable plastics to food additives, pharmaceutical and medical polymers, wound dressings, bio-adhesives, dental biomaterials, tissue regeneration and 3D tissue culture scaffolds. However, marine-derived biomaterials science is still relatively new and the marine environment is, as yet, a relatively untapped resource for the discovery of new enzymes, biopolymers and biomaterials for industrial applications (Marine Biotech ERA-NET).

Although European marine biotechnology activity has made significant progress over the past decade in building a research community to support research and innovation there remains an acute need to establish better links between researchers, industry and the array of end-users. Therefore, there is a need to develop mechanisms that are conducive to promote technology transfer and support industry/academic collaborative approaches to develop markets and businesses (Hurst, Børresen, Almesjö, De Raedemaeker, & Bergseth, 2016).

**Key questions**

- What holds back researchers in finding practical applications for their discoveries?
- Do the firms prefer to increase in-house R&D or rather intensify collaboration with academia?
- From the firm’s perspective, in which part of the value chain is the biggest need to increase collaboration?
- From the firm’s perspective, in which stage of the technology development is the biggest need for collaboration (TRL scale can be used)?
- Could the new market be created by new start-ups or rather by incumbent firms?

**Interactive format for the discussion on the ways forward**

The session will start with a short introduction given by the moderator. Following the introduction, the floor will be given to a few Working Group members for short thematic presentations. The session will then move to an interactive group exercise. Two matrices will be used for mapping the outcomes of the session, one based on the stages of a product value chain, and one other based on the TRL levels.

The objective of the exercise will be to agree upon problems/challenges and make suggestions on needed actions for solutions.

According to the volume-value pyramid	TRL1	TRL2	TRL3	TRL4	TRL5	TRL6	TRL7	TRL8	TRL9
Pharma/flavors/cosmetics									

Food / feed									
Fine chemicals / functional materials									
Bulk chemicals / fibers									
Fuel /fertilizer									

Technologies related to the stage in the value chain	TRL1	TRL2	TRL3	TRL4	TRL5	TRL6	TRL7	TRL8	TRL9
Bioprospecting									
Harvesting (wild) – <i>this includes access</i>									
Cultivation									
Valorization / extraction of specific compounds									

The following definitions apply for the TRL:

- TRL 1 – basic principles observed
- TRL 2 – technology concept formulated
- TRL 3 – experimental proof of concept
- TRL 4 – technology validated in lab
- TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 7 – system prototype demonstration in operational environment
- TRL 8 – system complete and qualified
- TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

## Session 2: Development, coordination, networking and improvement of technological research infrastructures to support marine biotechnology

### Background

As pointed out in the “*Marine Biotechnology Strategic Research and Innovation Roadmap*”<sup>1</sup>, the availability of relevant and accessible research infrastructure comprising physical and human resources is essential to continue the development and utilisation of outputs from marine biotechnology. New technologies have evolved to explore marine environments, however, the need to enhance the array of physical,

<sup>1</sup> See: [http://www.marinebiotech.eu/sites/marinebiotech.eu/files/public/ERA-MBT\\_Roadmap\\_FINAL.pdf](http://www.marinebiotech.eu/sites/marinebiotech.eu/files/public/ERA-MBT_Roadmap_FINAL.pdf)



chemical and genetic analytical tools, on which marine biotechnology relies, remains. Increasingly, marine biotechnology relies on scientific and technological developments from other disciplines. The provision of new and improved infrastructures can lead to the creation of new scientific expertise, stimulate research activity and facilitate greater collaboration (Hurst, D.; Børresen, T.; Almesjö, L.; De Raedemaeker, F.; Bergseth, S., 2016).

We point out below three areas where significant progress could be achieved regarding the research infrastructures in marine biotechnology:

- Increasing networks and collaboration:

Although there are world class infrastructures and cutting-edge marine biotechnology facilities in Europe, these human capacity and infrastructure resources in marine and biotechnology research and development are not always very well connected. A coordinated effort is needed at pan-European level to mobilise human resources and optimise available infrastructure. Such efforts should address both fundamental research and advanced application-oriented research and take an approach which supports industry-academia collaborations for new innovations and industrial developments (Calewaert, J-B.; McDonough, N., 2013).

- Developing infrastructure to support marine exploration:

Marine exploration is largely dependent on collaborative research activity and technologies developed outside the area of biology. The development of new tools and methods is behind the renewed focus on marine exploration and bioprospecting. Using an array of modern analytical approaches, it is possible to explore the potential of chemical compounds from within marine organisms. Expanding the exploration of marine environments, some of which had previously remained out of reach, will provide researchers and industry with greater access to novel marine organisms thus enlarging the discovery pipeline.

- Creating access to research infrastructures and data:

The ERA-MBT survey of research infrastructure identified opportunities to improve the research environment by providing better access and strengthening collaboration. This could include among others the creation of pilot facilities to support scale-up activities and the provision of shared and open access marine data and biological repositories.

### **Key questions**

- Where is the lack of infrastructure most severe?
- Geographically as well as in which part of the value chain (e.g. bioprospecting, harvesting /capture/cultivation or the extraction/valorisation side)
- What is working and what not in the current clusters and joint infrastructure initiatives, e.g. EMBRC, EMBRIC?
- Are there some places where the existing infrastructure is underused?
- What could be the way forward – a “marine CERN” or rather several smaller facilities, closer to the end users (both from academia and industry), or even more but smaller sites (e.g. in each major university).