European Commission

The European Commission's Knowledge Centre for Bioeconomy

Report on the Community of Practice Workshop: Algae production in Europe: status, challenges and future developments

This publication is a Conference and Workshop report by the European Commission's Knowledge Centre for Bioeconomy. The points presented in this report summarise the views expressed by the participants and do not imply a policy position of the European Commission, nor any person acting on behalf of the Commission are responsible for the use that might be made of this publication.

The workshop took place on the 27 February 2019,
Venue: Joint Research Centre
CDMA -1/SDR1 & -1/SDR/2
Rue du Champs de Mars 21
1050 Brussels, Belgium

Contact information
Name: Rita Araujo
Email: Rita.ARAUJO@ec.europa.eu
Tel.:+39 033278-5034

JRC Science Hub
https://ec.europa.eu/jrc

Brussels, Ispra: European Commission, 2018

Contents

Background & purpose of the workshop

A workshop connecting relevant specialists from the algae industry, Commission services and other organisations related to algae biomass in Europe was held in Brussels on the 27th of February.

This workshop was organized in the context of the growing interest in Europe for the bio-based sectors in which algae biomass plays an important role.

In the context of the European Union's updated Bioeconomy and Blue Growth Strategies, algae biomass is becoming increasingly important as a resource for a variety of commercial applications (e.g. food, feed, cosmetics, nutraceuticals, fertiliser and bio-based products) and is attracting a growing interest. At the same time, algal communities are important components of marine ecosystems and provide additional ecosystem services to coastal communities such as the promotion of biodiversity and the uptake of nutrients in excess. Key aspects like ensuring the sustainable exploitation of these resources while supporting the marine economic activities, creating jobs, searching for alternative food and energy sources and protecting the environment should be addressed.

In spite of the growing interest on algae resources, production in Europe lags behind the marked increase in algae biomass production at the global level (driven by the Asian algae aquaculture) and suffers from scarce and fragmented information on the sector. Furthermore the existing regulatory framework for this emerging sector might need to be optimised to safety requirements and market developments. The constraints, needs and opportunities to support the sector development need to be identified.

The workshop on Algae production in Europe focused on the following topics:

- Availability and quality of information on the algae production in Europe;
- The regulatory framework related to algae production and commercial applications with a particular focus on food but also non-food algae uses;
- The constraints, needs and opportunities for the sustainable development of the sector.

Structure and set-up of the workshop

Following the welcome of participants by the Head of the Bioeconomy Unit in the JRC, the workshop structure was presented.

The workshop was divided in 3 thematic session focusing in different topics:

- **SESSION 1**: Availability and quality of information on algae industry in Europe and needs for policy;
- **SESSION 2:** Regulatory framework related to algae production and commercial applications;
- **SESSION 3:** Constraints, needs and opportunities for the sector development.

Each thematic session consisted of a series of introductory presentations (approximately 10' each) to set the scene and establish a framework for the group discussions that followed (approximately 1,5h). In Session 3, where only 2 discussion groups were organised, the introductory presentations were extended and the duration of the group discussions shortened. The participants received in advance the topics and questions to be addressed during the discussion groups so that the input to the discussions could be prepared in advance. All the additional material needed for the workshop, together with relevant publications with background information (including publications from the Knowledge Centre for Bioeconomy and the JRC), were delivered to the participants during the day (Figure 1).

Figure 1. KCB and JRC material dissemination

The participants were split into fixed groups and each group contributed separately to the discussion in a specific topic. The composition of the groups was designed upfront aiming at balanced expertise, both geographical and technical e.g. target organisms (macro and micro algae-focused) and commercial use of algae biomass (food, feed, cosmetics, etc.). The discussions were organised in a rotating configuration to allow all the participants to contribute to all topics (Figure 2). Each group discussion was managed by a moderator who presented the topics and articulated the discussion while the secretariat was taking notes and minutes (Figure 3).

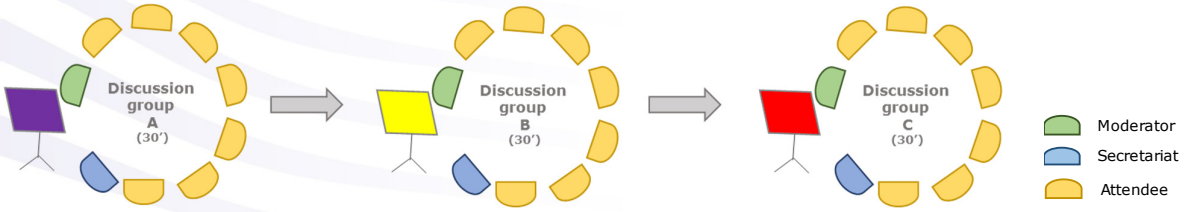

Figure 2: Breakout group discussions configuration: participants from group 1 contributed to the topic of Discussion group A for the first 30' discussion period, moved to Discussion group B for the second 30' discussion period and to Discussion group C for the last 30' discussion period. The same approach was followed by groups 2 and 3.

Figure 3: Breakout discussion group of session 3.B

The specific input of the group to each question was noted down by the moderator and/or the participants and posted on the walls where the topics of discussion were displayed (Figure 4).

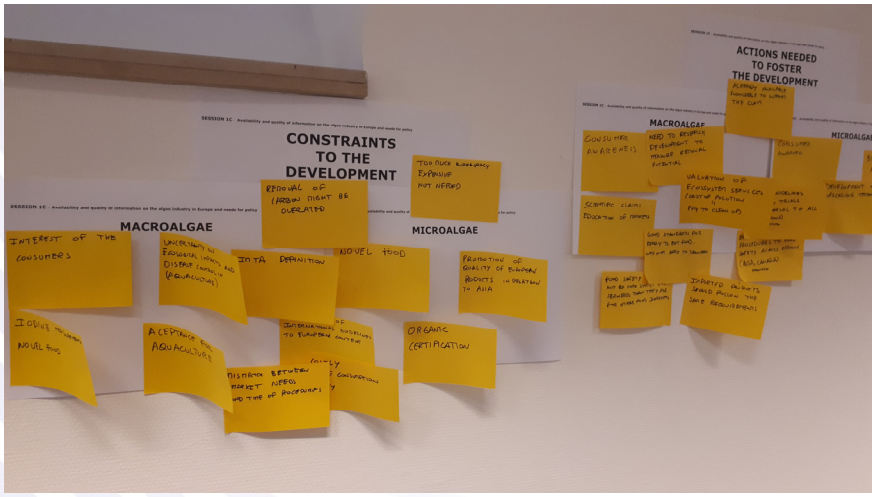

Figure 4. Sample of the input compiled from one of the group discussions.

Each discussion group was focused on a specific topic, broken down into three sub-topics which were then discussed and addressed separately for both sectors, macro and microalgae, or jointly if no differences between sectors were identified by the participants. The topics of the breakout group discussions were the following:

SESSION 1: Availability and quality of information on algae industry in Europe and needs for policy

- GROUP 1A: Information on biomass production:
    1. Coverage, accessibility and usefulness of available information;
    2. Additional information needed;
    3. Expected constraints to collect the needed information.
- GROUP 1B: Current markets for algae biomass:
    1. Which markets are already established in Europe;
    2. Challenges for upscaling these markets;
    3. Actions to solve the identified constraints.
- GROUP 1C: Future markets for algae biomass
    1. Which markets have potential to be explored in the future;
    2. Constraints for development of future markets;

3. Actions needed to foster the development of these markets.

SESSION 2: Regulatory framework related to algae production and commercial applications

- GROUP 2A: European regulation in relation to algae production:
    1. Interpretation, access and application;
    2. Gaps;
    3. Needs for additional regulation;
- GROUP 2B: European regulation in relation to food and novel food:
    1. Interpretation, access and application;
    2. Gaps;
    3. Needs for additional regulation.
- GROUP 2C: European regulation in relation to other uses (pharmaceuticals, cosmetics, fertilizers, energy, etc):
    1. Interpretation, access and application;
    2. Gaps;
    3. Needs for additional regulation.

SESSION 3: Constraints, needs and opportunities for the sector development

- GROUP 3A: R & D European projects or initiatives
    1. Access to information, participation and impact;
    2. Future priority research topics.
- GROUP 3B: Other EU level algae related initiatives:
    1. Knowledge about other EU level initiatives related to the algae sector;
    2. Access to information, participation and impact;
    3. Future priority topics.

Content of the workshop

SESSION 1: Availability and quality of information on algae industry in Europe and needs for policy

Session 1 included 4 introductory presentations to the topic. The first presentation explained why data on algae biomass production are important to inform EU policies on different sectors and how aquatic and marine resources will play an important role in future EU initiatives related to Bioeconomy, Blue Growth, the long term vision for a climate neutral European economy and the Circular Economy. The second presentation described the current status of data and knowledge availability on algae production in Europe. This presentation also pointed out the gaps and needs for additional data to produce reliable and robust analysis on the sector at the EU level to adequately inform EU policies and support the sustainable development of the algae industry. The third presentation focused on the European Marine Observation and Data Network (EMODnet) and its Human activities portal (EMODnet Human Activities) presenting the recent initiatives on the algae sector, specifically the mapping of algae production facilities in EMODnet (in collaboration with the JRC) and the EUMOFA report on the blue bioeconomy. The last presentation of Session 1 dealt with the activities developed by the European Algae Biomass Association and how the joint efforts among industry players can increase the synergies between the macro and microalgae sectors (Figure 5).

Figure 5. Snapshot of the introductory presentation on the EABA activities.

After this series of presentations, participants were led to the breakout group discussions from which the following outcomes were gathered according to the structure of the topics discussed. The main points raised during the discussions are presented below as bullet points for each question raised (separately between "Macroalgae" and "Microalgae" sectors or "Common" if no difference between them was presented) with as little editing as possible. Some of the issues were raised repeatedly in different sessions. This duplicated input is reported because we considered to reflect the importance given to some of the issues discussed by the participants.

SESSION 1A – Availability and quality of information on the algae industry in Europe and needs for policy

- **TOPIC 1: Available information on algae production Coverage/accessibility/usefulness**

COVERAGE
- The information currently available (Eurostat, FAO) is not sufficiently disaggregated. Need to pressure governments to collect good quality data; - Need to improve quality control of the collected data. Reliability of data provided must be ensured to avoid data rigged or biased for marketing reasons; - Reliability of data depends greatly on the compilation agent/institution, e.g. figures provided to investors may differ from those for tax authorities or associations. Need for an authority/institution/agency (single entry point) to compile the data accurately and reliably; - Harmonisation of reported data, e.g. wet vs dry weight (very relevant issue when comparing macro with microalgae sectors) needed. Standardised methods / CEN-ISO and private certification schemes (e.g. BRCGS Global Standards for Food Safety) should be able to cohabit.

ACCESSIBILITY
- Need for a national contact point to represent and transmit the information available; - Better liaison/collaboration between national authorities and EC to collectively compile the information needed. Check at the national level if reporting mechanisms are in place; - Create a single entry point where producers can upload and retrieve their data; - Data policy/confidentiality should be clearly stated when collecting the data, i.e. what data is used for policy making and which will be openly published.

USEFULNESS
- Need to better explain to the industry the usefulness of data for policy making (e.g. 2050 long-term strategy for a climate-neutral economy); - Even if appreciated, there is no real need for the industry to have data accessible; - To help consumer's choice, reliable information on the end product is valuable .

- **TOPIC 2: Additional information needed**

COMMON
- Common information at EU and world level down to species level; - Data on production need to be further detailed, e.g. not only the production system (especially relevant for macroalgae) used but how it is grown (inputs, energy, etc.). Also scalability of the process needs to be documented; - Database on algae production should also cover algae products and markets; - Quality control of reported data (e.g. data on *Odontella* sp. industry is not correct. Need to cross-check reported figures with other sources (e.g. tax declaration, chamber of commerce, etc.); - Need to debrief back to the companies about the compiled information, its outcome and use; - Need for policy makers (European and national level) to better communicate what the algae sector is and what it represents.

- **TOPIC 3: Constraints to collect needed information**

COMMON
- Time and resource demanding process; - Pre-established criteria for data collection (units, measures, etc.) are limiting; - No collaboration in certain MS among regulators, producers and government; - Confidentiality: during the process of collecting the information from companies, differentiate clearly the sections that will be made publicly available (disclosed information) from the private data that would be eventually presented only at aggregated (national) level.

SESSION 1B – Current markets

- **TOPIC 1: Which markets would you consider as established at a commercial scale in Europe?**

COMMON	
- Feed; - Food; - Hydrocolloids; - Cosmetics; - Fertilisers; - Nutraceuticals.	
MACROALGAE	**MICROALGAE**
- Colour applications; - Dietary complements.	- Food colouring agents - Functional food ingredients; - Waste water treatment.

- **TOPIC 2: Challenges for upscaling these markets**

COMMON	
- Lack of higher education programs on food and biotechnology which are also addressing algae products; - No certification of origin of products (European labelling needed); - Lack of strategic view: the algae sector being an environmentally friendly production system with a potential bioremediation role should benefit from a differentiated status compared to established industry competing sectors with a poorer environmental footprint (e.g. palm oil for biodiesel).	
MACROALGAE	**MICROALGAE**
Product composition: - Iodine: dissimilar and (generally) very low iodine thresholds in European MSs, which make industry difficult to comply. Besides, it is not clear how these levels are set; - Arsenic: no differentiation between organic and inorganic arsenic (when organic arsenic is more abundant and less toxic.). Difficulty in establishing thresholds on arsenic content.	Procedures: - Health claims heavily regulated by EFSA
Technology: - A biorefinery approach for the processing of algae biomass is needed to increase the efficient biomass use across the value chain. There is knowledge and experiences available on this but they need to upscaling from the lab to the industrial level;	Technology: - Low cost efficiency of production system; - Need to expand inland culture in EU; - Diverse requirements at EU and non EU level (procedures and standards to introduce a product in the market in USA are different from EU); - Need for start-up companies for marketing of more appealing products; - Missing incentives to set- up inland aquaculture;

	- Need for development of applied research for optimized uses of algae aquaculture; - High costs for testing of novel products or ingredients.
Regulation: - There is no control on imported products from Asia (products are not analysed at borders).	Regulation: - Novel food application is a market barrier (time and money).

- **TOPIC 3: Actions needed to solve constraints**

COMMON
- Better support for the applications under the novel food regulation; - Higher education programmes on food and biotechnology focused on algae; - More transparency in identification of the product origin; - Better support for product development (claims, regulation, harmonisation); - Deeper harmonisation of parameters across MS and in relation to imported products (due to the lower thresholds in European MSs than in Asia), which would require a regulatory action; - Enforcement of control of imported products to assess compliance with European rules (random analysis required to assure safety); - Marketing support and education of consumers to increase consumer awareness; - Scientific evidence to support market claims.

SESSION 1C – Future markets

- **TOPIC 1: Which markets have potential to be explored in the near future?**

COMMON	
Food will be the main future market due to its higher selling prices	
MACROALGAE	MICROALGAE
- New products for cosmetics; - Biorefinery for high-value products; -Ingredients for health products (nutraceuticals and pharmaceuticals); -Ecosystem services: create a system for nutrient credits (=carbon credits; example of Denmark). Producing algae should be rewarded because of the associated environmental benefits; -Feed: replace soya and fish feed in combination with vitamins. Also potential on reduction of methane emissions; -Food: not established market in Europe but potential to become, if combined with other ingredients; -Bring macroalgae into existing products; -Bioplastics: algae sector cannot compete today with other carbon providers.	- Fertilisers; - High value biofunctional compounds (not less than 100USD/kg); - Whole algae; - Food market (quantities): need for development of markets to include the biomass as food ingredient (powder, soup, etc.); - Currently biofuel production is not profitable with the current market conditions. However, the biofuel market should not be discarded (not expected to emerge within the next 10 years though).

- **TOPIC 2: Constraints for development of future markets**

COMMON	
- Need to promote the EU high-quality biomass (in comparison to algae biomass from Asia); - Need to expand the market out of European borders; - The production in Europe is too marginal to match the demand; - Difficult to prove health claims of algae raw biomass or products; - Price of protein of land based products not comparable to algae; - Novel food: costly, time consuming and risky procedures to submit an application; - No harmonisation between non-European and European guidelines which leads to a decrease in market alignment and fairness; - Organic certification: lack of harmonisation of criteria for organic certification at EU and non- EU (mainly Asia) level and stricter requirements at EU level; need of EU organic labelling to increase competitiveness of the sector.	
MACROALGAE	MICROALGAE
- Lack of interest of consumers;	

- Aquaculture: issues with social acceptability, uncertainty of ecological impacts and problems with disease control; - No agreement on definition of Integrated Multi-Trophic Aquaculture (IMTA); - Limitations related to iodine content threshold and inorganic *versus* organic arsenic; - Mismatch between market needs and length of the administrative procedures; - Removal of carbon might be overrated.	

- **TOPIC 3: Which concrete actions are needed to foster the development of the sector?**

COMMON	
- Promote consumers' awareness; - Development of the biorefinery approach; - Scientific evidence to support claims related to algae biomass; - Harmonization of requirements for European and imported products; - Need to change the organic regulation (see Topic 2); - Development and harmonisation of guidelines: translation of international guidelines to the European context (for example to consider establishing an equivalent to the US process) ; - Stability in the pool of experts advising about the algae sector at the EU level; - Need to solve the problems related to the novel food regulation that is preventing the development of new products; - Streamline the mismatch between national and European regulatory frameworks and facilitate the implementation of EU directives at national level; - Increase control at the borders for imported products.	
MACROALGAE	**MICROALGAE**
- Research developments on quantification of removal capacity (nutrients, etc.) by seaweed biomass; - Transfer the good standards already available for other food sources to seaweeds; - Harmonise the safety requirements with other food ingredients (food safety should not be stricter for seaweeds); - Valorise the ecosystem services provided by the cultivated seaweed biomass: assigning costs to pollution and payments for cleaning.	- Technological developments for upscaling of the production (high biomass production currently limited to fermenters); - Development of environmental services combined with production plants.

SESSION 2: Regulatory framework related to algae production and commercial applications

The second session started with a presentation on the EU legal and policy framework related to algae production (Common Fisheries Policy, Environmental Impact Assessment, Alien species, Maritime Spatial Planning and Organic production and labelling) and the recent initiatives with connection to the algae sector (Bioeconomy Strategy, Research investment and the Blue Bioeconomy Forum). The second presentation addressed the steps and procedures of the Novel food regulation and the specific aspects related to algae. The third presentation explained the revised Fertilising Products Regulation and the rules, requirements and procedures applying to the use of algae biomass (Figure 6). The last presentation of this session described the regulatory framework related to the use of algae biomass on cosmetics in connection to the work being develop under CEN/TC454 WG5 on Algae standards.

Figure 6. Snapshot of the introductory presentation on the Fertilising Products Regulation.

SESSION 2A – European regulation in relation to algae production

- **TOPIC 1: Interpretation/Access/Application**

COMMON
- Guide to EU legislation related to algae needed; - National legislation requirements add an extra administrative burden (PT, IT, DK); - Maritime Spatial Planning: there may be a possible mismatch between EU regulation and national authorities interpretation and guidelines.

- **TOPIC 2: Gaps**

COMMON
- Lack of a clear and consolidated definition of what is considered as algae cyanobacteria, etc. in the legislation, which can lead to unfair market competition (e.g., considering erroneously Labyrinthomycetes as algae); - No specific framework for seaweed aquaculture (commonly transferred from other aquaculture sectors without adaptation to the seaweed specificities); - No regulation on production for microalgae and for seaweeds in some countries (e.g. IE, ES and NL); - Administrative processes and licensing not adequate (terms and framework) to the seaweed sector; - Need for underlying data (e.g. economic impact data, data on imported algae products); - Need for coordination of efforts between sectors (macro and micro-algae); - Need for better enforcement of custom controls for imported algae products.

- **TOPIC 3: Need for additional regulation**

COMMON	
- Legislation to manage the supply of raw material: determination of leases/quotas (e.g. established seaweed quotas for IS) establishing harvesting limits at the national level (foster economic and environmental sustainability); - Transparency in the identification of product's origin; - System of subsidies for ecosystem services (e.g. uptake of nutrients from waste waters); - National subsidies related to environmental footprint: nutrient credit, environmental impact of production, possible fossil fuel replacement on packaging (e.g. bioplastics in line with the EU plastics strategy); - Labelling to indicate environmental impact of production; - If national regulations are missing learn from EU-level or neighbouring countries guidelines; - Emerging sectors more heavily regulated than established ones: an easier regime should be established for algae companies starting their activities;	
MACROALGAE	MICROALGAE
- Need for guidelines for MS authorities on seaweed requirements and specificities.	- Microalgae: harmonization of regulation across stakeholders and between EU and outside EU countries.

SESSION 2B – European regulation in relation to food and novel food

- **TOPIC 1: Interpretation/Access/Application**

COMMON
- Access: there is sufficient access to the relevant EU legislation - Interpretation and Application: o Interpretation and application of the novel food regulation is considered problematic; o Only big companies have the resources to cope with the regulation and prepare an application; o Difficult application of the novel food regulation for algae extracts to which many EU provisions may apply; o Difficult to assess if a specific product is novel or was consumed before May 1997; o Important interpretation issue for products from biorefineries: classification under novel/non novel very dependent on the process and concentration levels; o Important to anticipate market uptake before investing in the application process; o The limitations related to the application of novel food legislation reduce very much the possibility for diversification of the market (very few novel food application so far) and promotes by-passing of regulations by industry; o Legislation is more simplified than before but still very challenging.

- **TOPIC 2: Gaps**

COMMON
- Need to develop research projects performing food safety studies on algae and certain applications to facilitate industry applications under the novel food regulation; - Mismatch between what is requested from producers for the novel application and their real capacity and resources; - Guidelines for contaminant levels should be developed, triggered by industry; - Labelling with indication of the name of the producer is not obligatory; - There is the need to differentiate between organic and inorganic maximum levels of arsenic for seaweeds.

- **TOPIC 3: Need for additional regulation**

COMMON
- Regulation on thresholds for contaminants; - Labelling with indication of the name of the producer should be obligatory (or an indication on the production area); - Regulations on imported products to establish comparable control on European and imported products.

SESSION 2C – European regulation in relation to other uses (pharmaceuticals, cosmetics, fertilizers, energy, etc)

- **TOPIC 1: Interpretation/Access/Application**

COMMON
In general no issues related to interpretation, access or application of algae related EU regulation regarding non-food uses. Issues related to the novel food Regulation arose (see Group discussion 2B). Exception for organic certification: requirements are simple to interpret but difficult to apply from a production point of view; in the EU the raw materials are identified in a list and only those in this list can be used (85% of the microalgae organic production is not real).

- **TOPIC 2: Gaps**

COMMON
- Need to reinforce EU regulations already in place to protect the EU market: very difficult to export European products to Asian countries but Asian products of uncertain quality are entering the EU market; - Need to harmonise rules for EU and Asian products: heterogeneous requirements for organic certification and food safety in EU and Asia. See strict European regulation on the use of nitrates for producing *Chlorella* sp. opposite to China where higher nitrate levels are allowed. No control in practice by companies, customs, audits in place; - Need to harmonise criteria between food and feed applications; - Need to reinforce control at the borders and across countries; - Need to improve traceability of algae products; - Need to develop quality standards at the European level; - Lack of standardisation between laboratories performing analysis on algae products. There is the need to inter-calibrate methods and analysis; - No regulation at the national level for some countries; - Lack of control in online purchases of algae products (even less than at the borders where products that do not comply (in the forms) with EU legislation are not accepted whereas on the web there is no control in place); - Lack of harmonisation of regulations for different uses under the same application (food, feed, etc.): e.g. currently some regulations in force related to products might be different from the ones related to ingredients for the same application; - Need to create more transparency at the market (details on the origin of the product, testing methods, control of testing); - Difficulties to cope with the organic certification requirements (e.g. other metrics than distance should be used) but organic production needs to be developed since organic labelling represents an added value in terms of market penetration and value; - Different requirements and lack of control at national level for organic labelling; - Need to develop more knowledge on daily health intakes of algae to support health claims. Bio-viability trials are done by companies but absorption of compounds is not studied enough.

- **TOPIC 3: Need for additional regulation (or actions)**

COMMON
- European labelling certifying the compliance with specific safety standards; - Control of contaminants content on imported products; - Regulations on imported products to establish comparable control on European and imported products; - Tools for quality control at the borders: analytical methods applied in randomly taken samples should be in force instead of paper (forms) control; - Create reference labs for standardisation of the analysis.

SESSION 3: Constraints, needs and opportunities for the sector development

The third session covered five introductory presentations. The first one presented the initiatives in the framed of the Executive Agency for SMEs (EASME) and the European Maritime and Fisheries Fund (EMFF) with potential connection with the algae industry and the ongoing initiatives focusing on algae resources (e.g. Blue Labs calls, DEMO projects, Blue Economy call, Market study for the blue economy and the Blue bioeconomy forum). The following presentation introduced in details the Blue Bioeconomy Forum activities, aims and roadmap and the key challenges in different areas (e.g. policy, environment, regulation) already identified in relation to the algae sector. The third presentation introduced the upcoming H2020 tender FORAlgae that intends to support the market development of algae and their products. The objectives, general principles and planned schedule for this initiative were detailed. The fourth presentation showed the work developed by the European Committee for Standardization for algae and algae-based products or intermediates (CEN/TC454). The background for this initiative and the ongoing work in the six working groups of the topics for standardisation were described. The last presentation described the initiatives in the framework of RTD activities and the Bioeconomy Strategy related to the algae sector. The relevant key instruments in force (H2020-Blue Growth, H2020- SME instrument, BBI-JU algae projects and Circular Bioeconomy Thematic Investment Platform) were presented in detail.

SESSION 3A – Constraints, needs and opportunities for the sector development

- **TOPIC 1: Participation in European R&D projects or initiatives**

COMMON
- High rate of participation of industry in R&D calls, namely H2020, Fast track innovation programme (SME) and BBI-JU; - Grade of satisfaction depends greatly on the call and specific case, e.g. evaluation criteria for SME calls is not clear and transparent and success rate is low. On the other hand, SME instrument does not require a consortium and the application procedure is smooth and complemented with funding. BBI Macro Cascade: process good, evaluators competent; - In some MS (e.g. BE) national calls are better considered (more freedom to develop the proper idea) by companies; - Evaluators are well trained and invest a lot of time in FP proposals.

- **TOPIC 2: Access to information, participation and impact**

COMMON
- Complexity and controversy on IPR issues: projects fund research but also exploitation of results (i.e. patents) that may hinder the development of the sector by preventing other companies (not involved in the project) to use the developed technology. Patents as the result of EU funding is unfair to non-winners and being the development of the patent supported by public funding the results should be open; - Need for more open topics for blue economy calls: topics are currently too strict and set very specific requirements that may not be useful to the industry; - Information on R&D calls is accessible and transparent but also too dense (lengthily instructions: too much documentation to read); - Need for better and more clear regulation on the use of GMOs in research; - Research funding helps the development of new ideas with cyclical application; - Some criteria not applicable to the algae sector; - BBI facilitates the access to information; - EU projects are more theoretical than national calls but effective for networking; - Small companies wait to be invited to participate in consortiums because they don't have the resources required to prepare a full proposal.

- **TOPIC 3: Future priority research topics**

COMMON
- Continue to fund research in energy efficiency; - Valorisation of whole biomass (no waste); - Environmental gains and ecosystem services (specially from seaweed aquaculture; e.g. bioremediation of waste streams) and their integration in business plans; - Screening and characterization of new algae strains (non GMO); - Cost-effectiveness of quality control (analytical aspects); - Application of valuable compounds from algae biomass (novel food, bioactive compounds, new macroalgae substances, etc); - Selective breeding of macroalgae; - Pilot demonstration of bio refinery; - Exploitation of cultivation methods to expand the array of methods available currently in Europe; - Marine vessels for low-trophic seafarm operations (harvest, deployment, transport); - Fundamental research needed to boost breakthroughs; - Novel food.

SESSION 3B – Other initiatives

- **TOPIC 1: Are you familiar to European level activities related to the algae sector? Which ones?**

COMMON
- Some participants claimed to be very familiar while others were only involved on R&D projects; - Higher participation in activities targeting regional development (INTERREG) and business development coordination (e.g. Baltic Blue Technology Alliance); - Some participants involved in the Algae standardisation working groups; - Marginal knowledge of the Blue Bioeconomy Forum.

- **TOPIC 2: Access to information, participation and impact**

COMMON
✓ INFORMATION - Dependent on initiative: e.g. BBI requires very detailed information while EUREKA/Eurostars becomes simpler but presents some constraints related to national funding (some EU countries do not participate); ✓ PARTICIPATION: -Limitations: o Budget availability for participation in some of the EU level activities related to the sector (e.g. CEN meetings (there are now ongoing national CEN activities for some countries which facilitates participation)); o The preparation of information for e.g. CEN is highly time and resource consuming; o Resource investment is too high in some initiatives to go through the different steps of the application; o Size of H2020 projects not manageable for small companies to participate. ✓ IMPACT ➢ LOW - Mismatch between research and regulatory priorities; - Companies need to prioritise the business over other initiatives (with less immediate impact); ➢ HIGH - Participation is important to have the possibility to provide input to the regulations being developed; - Potential impact of SMEs but low success of applications; - Networking.

- **TOPIC 3: Future priority topics**

COMMON
- Simplification of the procedures; - Novel food: project (tender) to reduce the cost of the application procedures by supporting the technical dossiers (e.g. assessment of safety issues) for a selected number of species (industry survey to prioritize the algae to be selected); - Launch small projects focusing on product and market development (for broader topics big platforms would work); - Support testing of market acceptance before submitting application or going through product development; - Onsite meetings are important to prepare applications (support for organising);

- Tools to put algae industry in contact with capital investment are still premature (investment would need to be multiplied in short time);
- Tender to help the Commission to shape the initiatives related to the sector.

Figure 7. Breakout discussion groups of session 3.

Evaluation of the workshop

The workshop was attended by 38 experts from Commission services, algae biomass producing companies and other stakeholders (associations, agencies, consultants, etc.). The composition of the attendance to the workshop is shown in Figure 8. Out of the total 19 companies present in the workshop, the balance in the share Macro / micro algae was almost 1:1 from 13 different countries (BE, DE, DK, EE, ES, FO, FR, IE, IS, IT, NL, NO and PT). The markets of their products are divided in food (or food applications) (29%), feed (20%), nutraceuticals (17%), cosmetics (17%), fertilisers (12%) or a portfolio of other products (5%)

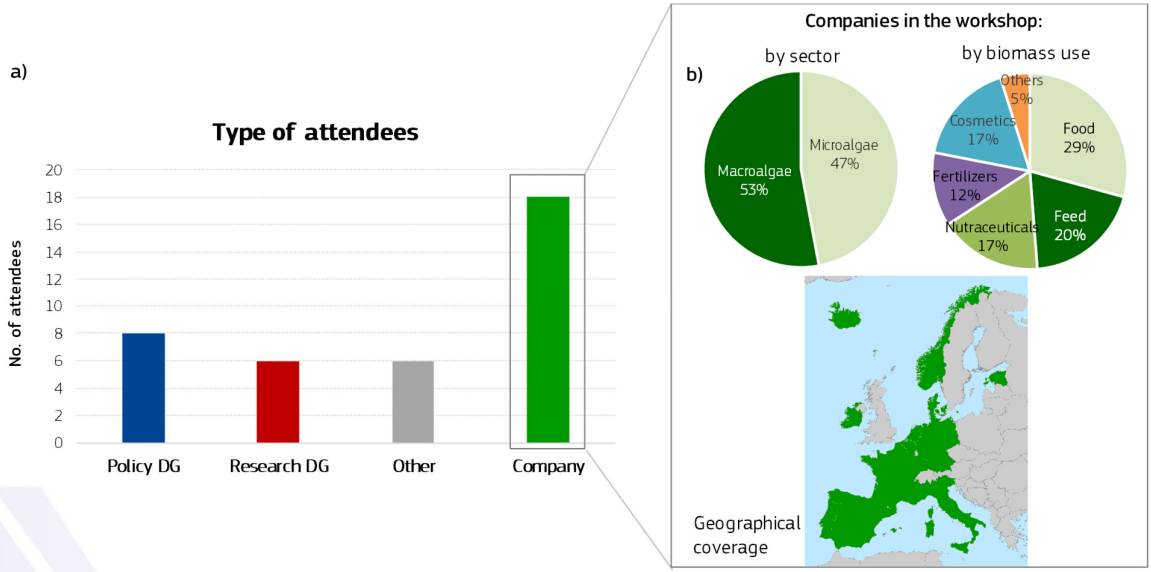

Figure 8. Number of the attendees to the workshop by a) type and b) breakdown of the companies by Macro vs. microalgae, biomass uses and geographical coverage.

At the end of the event, participants were invited to give their feedback on the organisation and outcomes of the workshop following a JRC standard template. Different aspects of the workshop (e.g. agenda, speakers, documentation, facilities and services, before the event and overall outcome of the event) were assessed in a scale from 1 (completely disagree) to 5 (completely agree). The average figure obtained for each question is shown in Figure 9.

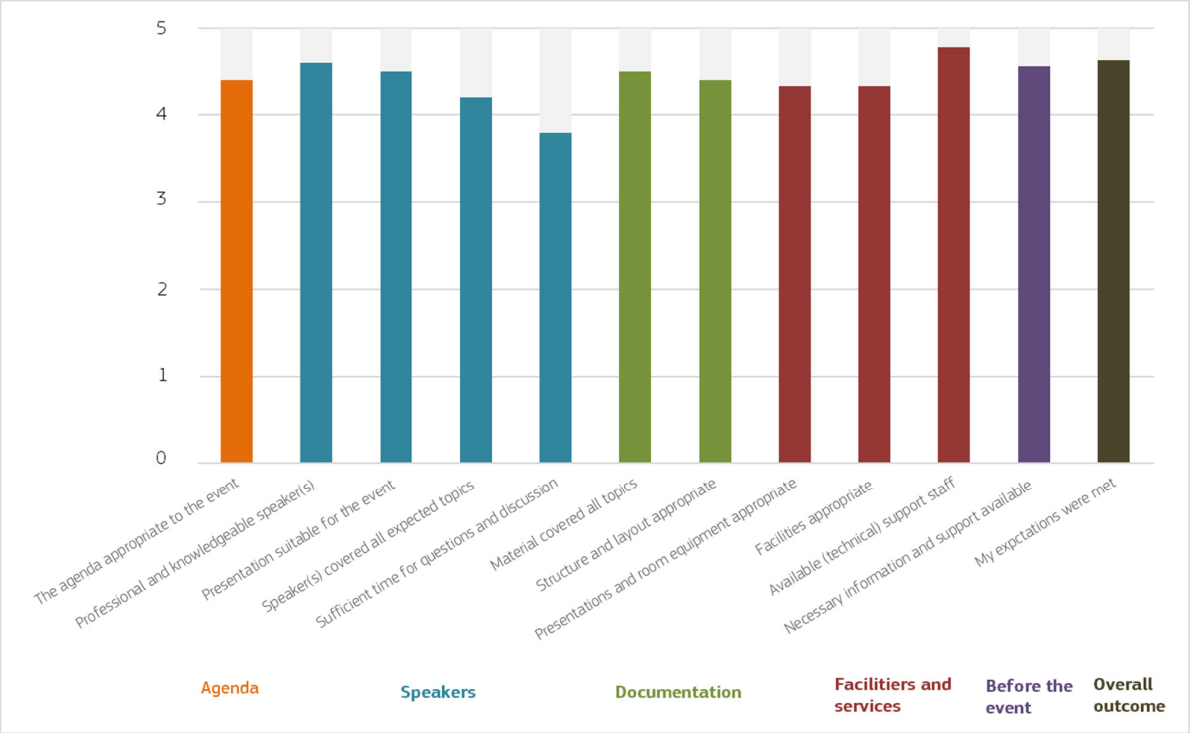

Figure 9. Assessment of different aspects of the workshop by the attendees in a scale from 1 to 5 (average values).

After some reflection on the assessment of the compiled surveys, and following the comments received, the lessons learnt regarding organisational aspects are summarized as follows, which could be useful for forthcoming workshops:

- The composition of the discussion groups was defined at the beginning of the workshop and did not change along the entire workshop (except for session 3 when one of the groups was split in two and each half joined one of the other two groups). This circumstance boosted the self-confidence of attendees and thus, their will to participate to the discussions and simplified the workshop organization. On the other hand, it stimulated less the fertilization of the discussions with new points of view potentially resulting in a more-dynamic exchange of ideas along the day.
- Additional participants from other types of organisation could have been invited to foster synergies and networking, namely experts from national authorities of MS and investors. However, given the time constraints of a one day workshop we see this point as a potential idea for a future follow-up workshop.
- Extend the length of the workshop and/or reduce the topics to cover would provide more time for discussion, especially to the given presentations.

Annex 1

Workshop Agenda

08:30 - 08:50 **Welcome**
Presentation of the workshop objectives and structure

SESSION 1: **Availability and quality of information on the algae industry in Europe and needs for policy**

08:50 – 09:30 'Setting the scene' presentations:
- Policy needs for information on algae production
- Knowledge on algae production in Europe: progress and existing gaps
- Recent initiatives: algae production portal and EUMOFA report
- EABA activities

09:30 – 11:00 Breakout group discussion (rotatory) with the experts from industry
- Group 1.a: Information on production of biomass
- Group 1.b Current markets
- Group 1.c: Future markets

11:00 – 11:15 Coffee Break

11:15 - 11:30 Presentation of results from group discussion by the moderator in each group and plenary discussion

SESSION 2: **Regulatory framework related to algae production and commercial applications**

11:30 - 12:00 'Setting the scene' presentations:
- Regulatory framework related to algae production
- Novel food and food regulation
- Cosmetics and chemicals

12:00 – 13:00 Breakout group discussion (rotatory) with the experts from industry
- Group 2.a: Legislation on production of algae biomass
- Group 2.b: Legislation on novel food
- Group 2.c: Legislation on other uses (e.g. pharmaceuticals, cosmetics, energy, etc.)

13:00 – 13:45 **Lunch Buffet**

SESSION 2 (continuation)

13:45 – 14:15	Breakout group discussion with the experts from industry (cont.)
14:15 - 14:30	Presentation of results from group discussion by the moderator in each group and plenary discussion

SESSION 3: Constraints, needs and opportunities for the sector development

14:30 – 15:10	'Setting the scene' presentations: • EASME/EMFF current initiatives and future opportunities • The Blue Economy Forum • H2020 tender on Support for market development of algae and their products • The European Committee for Standardization on algae and algae products • Initiatives to boost the algae sector in the framework of RTD activities and the new bioeconomy strategy
15:10 – 15:30	Coffee Break
15:30 – 16:45	Breakout group discussion (rotatory) with the experts from industry ○ Group 3.a: R&D projects ○ Group 3.b: Other initiatives
16:45 - 17:00	Presentation of results from group discussion by the moderator in each group and plenary discussion

17:00 – 17:30 Closure of meeting