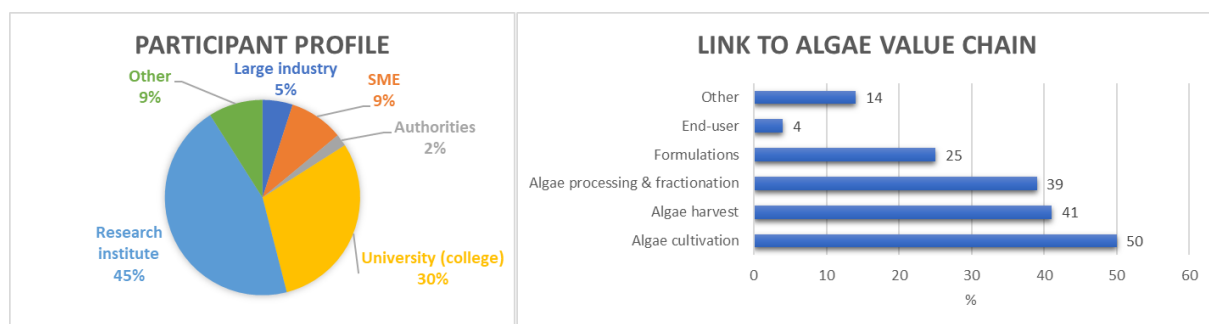


# Conclusions of the IDEA webinar on Algae value chains in (NW)Europe

The **IDEA dissemination event** was organized as an online webinar on July 6<sup>th</sup> to share IDEA findings and interact with other projects like Interreg 2seas ValgOrize and Interreg NWE AlgAD. The algae value chain was the focus of the webinar, with attention for algae growth and harvesting, processing of algae biomass toward ingredients for feed, food and cosmetics, and economic and logistic aspects. Besides plenary presentations, break-out discussion sessions and virtual tours, an e-poster session was prepared. All presentations and videos are accessible via the [IDEA website](#).

More than 120 people were registered and the participation degree during the day varied between 65 and 85 attendees. Based on poll results, the profile of the **participants** was diverse with representatives from industry, authorities and scientists, the latter forming the main body of participants. The poll also revealed that most stakeholders along the value chain were present, which led to interesting discussions from multiple points of views.

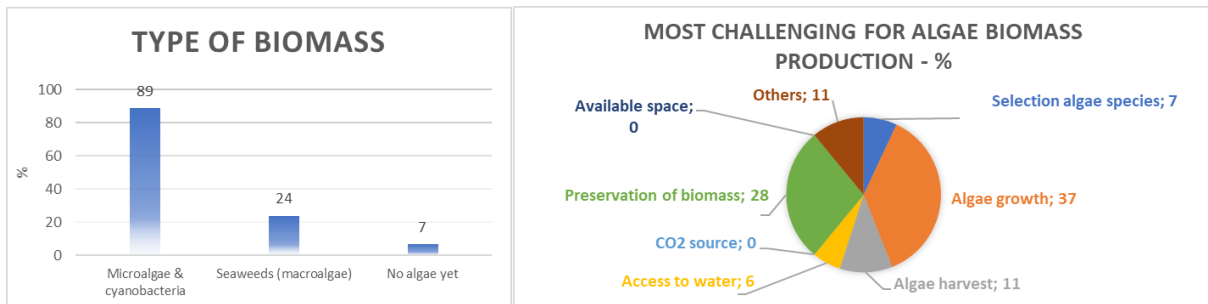


The IDEA project 'as a whole' was presented as **keynote** by the IDEA project coordinator. Besides general and specific objectives towards algae value chain development, a general overview of the IDEA achievements was given. In subsequent sessions these achievements were presented more in detail by the IDEA consortium members.

The **first session** was dedicated to **activities at algae farm level**, with special attention to IDEA results related to 1) year-round algae cultivation in NWEurope at pilot scale and 2) increasing the sustainability at algae farms. The IDEA results presented showed that year-round algae production in NWEurope is possible, even though during colder and darker periods of the year, the growth rates are slower. To generate algae biomass production year-round, rotation of algae species during the seasons (like for other crop productions) was demonstrated at pilot scale to be a suitable approach. In the Belgian pilot tests, three algae mono-species cultured were altered (*Nannochloropsis* sp., *Porphyridium* sp. and *Chloromonas* sp.), while in the German pilot, a mixed culture was grown where *Chlorella* sp. was dominant in spring/summer and *Scenedesmus* sp. in autumn/winter. In respect to sustainability, the submerged membrane based MAF-technology was demonstrated and found suitable for medium recycling (up to 95%) while simultaneously pre-concentrating the algae biomass. Lab and pilot results related to CO<sub>2</sub> capture from air for supporting algae growth in photobioreactors were presented.

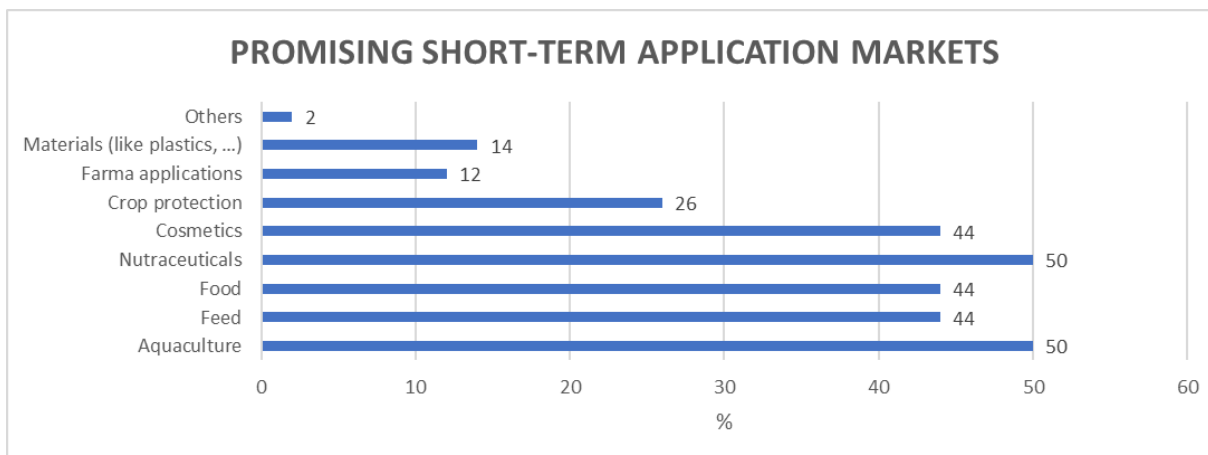
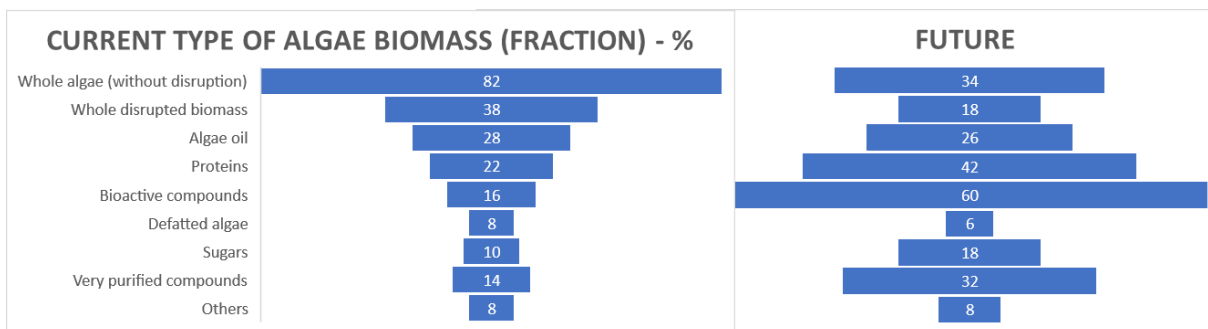
Based on the poll, many of the participants had already a certain level of experience with micro-algae; additionally specialist on macro-algae were present. When participants were asked about the most challenging aspect related to algae biomass production, algae growth and preservation of algae biomass received the most votes. More practical aspects like availability of space and CO<sub>2</sub>, which are

known to become very crucial especially when upscaling, scored very low. This may be explained by the participant profiles that was dominated by researchers.



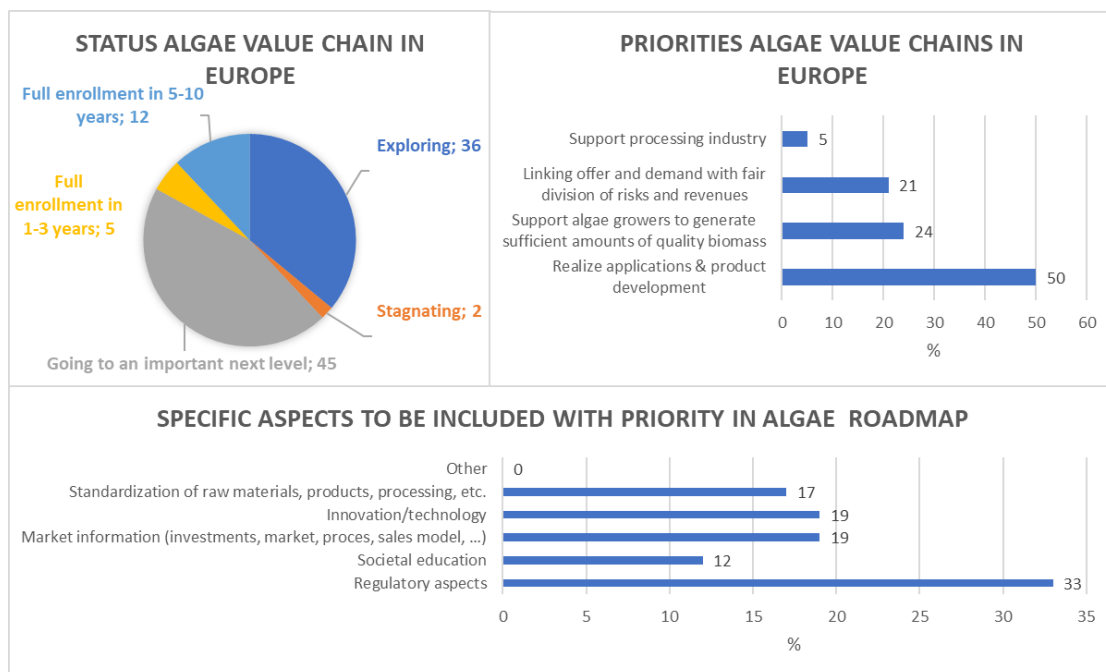
During the **second session** the focus was on **algae biomass processing and formulation** of algae biomass (fractions) into marketable products. Within IDEA, (disrupted) whole cells and algae fractions were prepared and evaluated for feed, food and cosmetic applications. For most algae species, cell disruption was found necessary to make the algae components accessible. In respect to fractionation, it was decided to focus on oil extracts for cosmetic application, while using the defatted biomass for feed/(dog) food applications. In vitro and in vivo application test results were presented.

Poll results revealed that whole non-disrupted algae are being handled by 82% of the participants. Also, fractionation of algae biomass receives attention as is indicated by the experience of participants with algae fractions like algae oil (28 %) and proteins (22 %). Participants were also asked which type of algae biomass they would like to explore further. For the future, algae biomass fractions and especially bioactive compounds seem to gain interest. This indicates that high value products are mainly targeted, which is also reflected in the poll related to promising short-term application markets. Aquaculture and nutraceuticals received top scores (50%), followed by cosmetics, feed and food applications (44%).



In **session 3**, the **whole value chain** was considered with focus on 1) techno-economic and logistic considerations and 2) a roadmap towards implementation of algae value chains in (NWE-)Europe. IDEA. The techno-economic and logistic evaluations that are being performed within IDEA cover the whole value chain and are intended to compare scenarios and to define as such parameters/aspects that influence the costs to a large extent. Intermediate results of these evaluations were presented as well as elements to be included in a the roadmap towards enrolment of algae value chains in Europe. Accepted applications were identified as the driver of the value chain, and the importance of good interactions between stakeholders along the value chain was underlined.

Based on poll results, the status of the algae value chain in Europe is moving to an important next level with still some exploration to be done. A full enrolment of the algae value chain in 5-10 years was considered more realistic than an enrolment in 1-3 years. The poll confirms that achieving applications and product development are to be considered as the priority in a roadmap towards implementing algae value chains in Europe. Support to algae growers and linking offer and demand of algae biomass are also to be considered important, while support to the processing industry seems to be rather for a second phase. Especially regulatory aspects are to be included in the roadmap, besides other aspects like innovation and availability of market information.



The **fourth session** was organised as a **discussion session** in break-out rooms allowing participants to exchange ideas related to specific discussion topics. Hereby a summary of main conclusions:

1. Which algae species (micro & macro) are promising to grow in Europe for short-term & medium-term valorization?
  - a. Technically, many species can be grown in Europe. Macroalgae mentioned comprise *Ulva* and *Saccharina* species. Further a diverse list of microalgae was mentioned (*Tetraselmis*, *Spirulina*, *Chlorella*, *Synechococcus*, *Pavlova*, *Dunaliella*, *Rhodomonas*, *Nannochloropsis*, *Porphyridium*, *Scenedesmus*, *Chloromonas*, etc.) as well as consortia of microalgae that may cope better with stress.
  - b. Each species has specific growth requirements, allowing them to grow either seasonally and or all year-round.
  - c. Towards valorization, the legal aspects relevant for the intended application fields need to be taken into consideration. Legislation is reactive, but it requires time. Several algae species are being

considered for approval. Also, by-products present (bacteria, pollutants, ...) are to be considered in this evaluation, which increases the complexity.

2. Which scalable harvesting approaches are promising for commercial algae farms? Needs?
  - a. Scalable harvesting technologies for microalgae mentioned comprise centrifugation, membrane filtration, coagulation and sedimentation. Centrifugation is the most frequently used. Filtration is gaining more interest, especially for *Spirulina* (open mesh, vibrating sieves) and as pre-concentration step for other algae species (membranes). Coagulation is possible for specific algae species and requires additives.
  - b. At large scale, medium re-use is an important aspect that is to be integrated in the microalgae harvesting approach. Stepwise harvesting offers potential with (1) pre-concentration and medium recycling via a membrane-based technology (like MAF-technology) followed by (2) a further concentration via for instance centrifugation at location or more central are possible options.
  - c. Harvesting approaches of seaweeds are very different from the ones mentioned above.
3. What would be the preferred harvesting approach at microalgae commercial farms: batch or continuous mode? Impact on medium re-use?
  - a. During the discussion there was a consensus that at commercial scale continuous harvesting is preferred above batch harvesting. Especially when the harvest can be automated and linked to algae growth.
  - b. Determination of the preferred harvesting time point in case of batch harvesting was less clear as it depends on many aspects like illumination, pH, need to avoid light/temperature stress. For microalgae harvest during the night may be beneficial, while for operators, daytime harvesting would be more convenient.
4. How to preserve the harvested algae biomass until use? Currently used? Needs?
  - a. Dried algae are preferred for some applications (like food), while other application (e.g. feed) prefer wet concentrated algae biomass. Desalting of algae biomass prior to drying was identified as a point of attention for e.g. food and feed applications.
  - b. Drying technologies mentioned during the discussion comprised freeze-drying, oven drying, spray-drying, steam-drying, microwave-based (vacuum) drying and refracted window drying (RWD). As drying requires energy, the need of drying is to be evaluated well. This aspect requires additional future exploration.
  - c. Wet storage of algae biomass was investigated within IDEA. The preservation duration could be increased with lower temperature and with lower algae densities. Preservation of 10-20 times pre-concentrated algae biomass at the farm up to 7 days was found to be an acceptable approach based on lab and pilot scale data.
  - d. For all approaches, quality control of the preserved algae biomass is important.
5. Use of whole (disrupted) biomass versus algae biomass fractions as ingredients for formulations in food & feed
  - a. There was a consensus that the envisioned application determines to a large degree the need for cell disruption and/or fractionation. In aquaculture whole intact cells are crucial, while for other applications disruption is required to increase the accessibility of algae compounds.
  - b. Fractionation was considered useful to remove lipids and colours, influence taste and to generate higher value products. The preservation of antioxidant properties is a point of attention. In vitro and in vivo tests were found useful to verify the (bioactive) properties and digestibility of fractions.
6. How to come to good marketable products with algae ingredients to boost algae value chains?
  - a. For marketable compounds, sufficient amounts of algae biomass (fractions) need to be available. Also the sustainability of the biomass is important to compete with other sources. For each application field, the relevant legislation is to be taken into account, as well as the customer needs.
  - b. In respect to food applications, masking of colour and taste may be required. Consumer analysis and taste panels are considered useful to tailor ingredients and food formulations. Algae offer potential for the growing vegan market, as seafood alternatives and in other premium markets

(pleasure, high end healthy, sport nutrition, etc.). Health benefits and techno-functional assessments are important to determine end food carrier/application.

- c. For feed applications, generally, current prices of algae biomass are too high to include algae biomass as nutritional ingredients, while inclusion as bioactive ingredients are within reach. For the latter, the added value needs to be clearly documented, preferably with in vivo trials besides in vivo test results. A good marketing can make customers aware of algae benefits.
  - d. Also other markets offer potential like crop protection, cosmetics and pharma. Tailoring of the products and strong data to support the beneficial effect are crucial.
  - e. Cost-competitiveness with competing source is a challenging. Currently niche markets offer potential. To move towards mainstream products, reduction of production costs is required.
7. Impact of taste on use of algae-based ingredients?
- a. Algae have a pronounced flavour. The fishy and umami flavour are considered positive and offer potential as alternatives for fish and meat products, respectively. Taste can be influenced via fractionation and/or fermentation of algae biomass.
  - b. Masking agents are important in case tastes are too pronounced and cannot be removed. For instance, for techno-functional applications “white, tasteless powders” are mostly preferred that can be easily combined in different food products.
8. Which ingredient types are promising towards algae-based products in Europe?
- a. Ingredient types mentioned during the discussion are fractions enriched in proteins or oil, peptides, sugars, bioactive compounds, vitamins, left-over biomass (after extraction, and whole (disrupted) algae biomass.
  - b. The application markets can be diverse: food, feed (for poultry, pigs, pets, fish), cosmetics, bioplastics, fertilizers, crop protection, nutraceuticals, etc. The function of the ingredient may be related to preservation, bioactivity, techno-functional properties, nutritional, etc.
  - c. Functionality & sustainability are important to compete with cheap ‘traditional bulk ingredients’
9. How can policy makers facilitate the enrollment of algae based value chains?
- a. Clear legislation related to relevant topics such as 1) use of specific algae species, 2) the use of side-streams in algae production, 3) algae import & export, and 4) legal status of algae farmers.
  - b. Continue funding research & development (application) projects to close knowledge gaps and develop improved technologies in collaboration with SME’s.
  - c. Support organization of trading platforms and encouraging of sustainable biomass.
  - d. Increase social awareness and consumer’s knowledge about algae.
10. Which animals are #1 animal species for inclusion of algae in feed?
- a. Most promising market at this moment is aquaculture (fish, shellfish)
  - b. Next markets to approach (in order) are pet food, young poultry, piglets, laying hens, pigs, ...
11. How to link offer and demand of algae? What is required from an formulator/end-user perspective?
- a. Customer friendliness: one stop shop solutions
  - b. Research should focus on selected application/cases with high probability of success. By focusing on limited well-selected cases, the time required to connect stakeholders and develop technologies and products can be reduced, resulting in a faster time to market.
  - c. Standardization of quality definitions.
  - d. Getting the maximum out of the algae biomass: quality & quantity.

The event was concluded by Vitor Verdelho, general manager of EABA, with some general conclusions. Algae are not yet part of the European food basket (due to flavor, color issues). IDEA realised a comprehensive work by not only covering technical issues but also techno-economic and logistic solutions. This approach results in smart technical solutions. Good end-products are crucial for the implementation of the algae value chain.

The IDEA consortium would like to thank all presentors, moderators and participants once more for their contribution that resulted in a successful event.