



SEAWEED
for **EUROPE**

INVESTOR MEMO

THE CASE FOR SEAWEED INVESTMENT IN EUROPE

ACKNOWLEDGEMENTS

This report was produced with the support of the SUN Institute Environment & Sustainability and authored by the Secretariat of Seaweed for Europe

About the SUN Institute Environment & Sustainability

The SUN Institute was established in 2014 by the Deutsche Post Foundation to strengthen its international activities in supporting institutions, programmes and projects dealing with the environmental challenges and opportunities of globalisation and enhanced cross-border activities. Find out more at: www.sun-institute.org

About Seaweed for Europe

Seaweed for Europe is a Coalition seeking to accelerate and scale the European seaweed industry by driving innovation and investment, with the ultimate aim of unlocking significant economic, environmental and social benefits. The Coalition brings together a range of stakeholders from the seaweed value chain, the investment world, and science and civil society thought leaders. It is headed by a Coalition Secretariat run by SYSTEMIQ as well as Co-Chairs Maria Damanaki, Maren Hjorth Bauer and Vidar Helgesen. Find out more at: www.seaweedeurope.com

About SYSTEMIQ

SYSTEMIQ Ltd. is a certified B Corp. The company was founded in 2016 to drive the achievements of the Paris Agreement and the United Nations Sustainable Development Goals by transforming markets and business models in three key economic systems: regenerative land use and ocean, low carbon energy, and materials and the circular economy. Find out more at: www.systemiq.earth

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The authors would like to thank the following individuals for their proactive, detailed and thoughtful input to this report:

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Ross Brooks, Katapult Ocean
Santiago Cortes, Amerra Capital
Sriram Natarajan, Ocean14 Capital
Steffen Knodt, Fraunhofer-Institut für Graphische Datenverarbeitung IGD
Veronica Yow, Meloy Fund, Rare

The authors are also grateful to the members of Seaweed for Europe who have contributed to this report with invaluable insights

This report was created within the remit of the authors' work for the Seaweed for Europe Coalition. The opinions, findings and recommendations expressed herein reflect the authors' views only and shall not be taken to have the endorsement nor reflect the views of any of the aforementioned organisations or individuals and their affiliated organisations.



INTRODUCTION: REPORT OBJECTIVES

1. Target audiences

The document addresses public and private investors with and without a prior interest in the ocean economy:

Private commercial or financial investors

Private investors with either financial (HNWI, VC funds, incubators, accelerators, private equity firms, large-scale investment funds) or commercial return (corporates) can provide funding and scale effect to a burgeoning seaweed start-up and innovative SME environment.

Public investors

Development Financial Institutions (“DFIs”), sovereign investment funds, and state/regional or local governments are capable as investors of structuring and taking the necessary risks to nudge the European seaweed industry towards success.

Private non-for-profit investors

Philanthropies with an environmental, economic and/or social focus can provide grants or concessional financing, as well as capabilities to de-risk and advocate for the seaweed industry in Europe.

2. Objectives

The objective of the document is three-fold:

- (1) To demonstrate that there is already a solid pipeline of innovative seaweed companies in Europe;
- (2) To help investors better understand the seaweed space in Europe (i.e., where on the value chain innovations are taking place, the commercial maturity of this pipeline, and its geographic distribution, etc.);
- (3) To demonstrate that the seaweed industry in Europe has already attracted investment and is open to a range of investments.

3. Methodology and scope

Scope

Europe (EU and European non-EU countries, including Israel).

Research performed based on:

- Seaweed for Europe network
- European seaweed industry stakeholders’ interviews
- Desktop research
- Phyconomy and Ubuntu databases

Companies sample size

The study was performed on 223 European companies (headquartered and with most of operations in Europe) without distinction of size, business model or industry (with the exception of small-scale wild harvesting businesses, not undertaking any transformation activities, as these were deemed less relevant targets for investors).

During the screening, additional players were identified but are not incorporated in the analysis:

- o 8 non-profit institutions
- o 41 Research Labs and Universities working around the seaweed ecosystem

Investors sample size

The study was performed on the investors of the 223ⁱ European companies. Given the low amount of publicly available information, investors have been identified for only 45 of the 223 European companies, and 1 was identified for a non-European companyⁱⁱ.

The study focuses on 92ⁱⁱⁱ investors from the 46 companies mentioned totalling 138 transactions^{iv} for a total value of €69m invested over 11 years. For the purpose of this study, grant-making entities were also classified as investors.



KEY HIGHLIGHTS

The time is right to invest in a sustainable and booming European seaweed industry

There is strong momentum for the European seaweed industry

The global seaweed market has more than tripled between 2000 and 2018, reaching 32.4 million tonnes of production with a value of USD 13.3 billion (€11.3 billion)^{v.1} in 2018. Most market forecasts anticipate a double-digit CAGR for the next 5 to 10 years to come.

Key points:

- **Its biochemical composition and properties make seaweed a valuable material:**

It is used for a growing range of applications ranging from food products and animal feed to cosmetics and bio-based chemicals for various industries. Many of these applications provide sustainable, low-carbon and less harmful alternatives to existing options, offering diverse environmental and health benefits.

- **The environmental benefits of seaweed:**

Including the absence of need for land, freshwater nor fertiliser, absorption of carbon and excess nutrients, habitat creation for marine animals, etc.

As well as **socio-economic benefits**, including the potential for creating local jobs, increasing the economic resilience of coastal communities, etc., contribute to explaining the boom in the seaweed industry across the globe.

- **European seaweed production benefits from:**

(1) perfect natural conditions, as cold and nutrient-rich waters from the Atlantic Ocean and the North Sea constitute the optimal environment for seaweed growth;

(2) an increasingly strong and wealthy customer base;

(3) a thriving R&D environment, opening new markets to seaweed production every year;

(4) a political momentum, with increasing policy makers' interest in seaweed;

(5) an already existing and increasingly strong investor appetite.

Given the above, non-European investors have already taken steps to position themselves in the market, and contribute to an important part of the capital raised by the industry every year.

- **The European market for seaweed in 2030 has the potential to represent an industry worth up to €9.3 billion.**

Under the right conditions, European producers could capture around one-third of this market (€2.7 billion), generating 85,000 jobs.

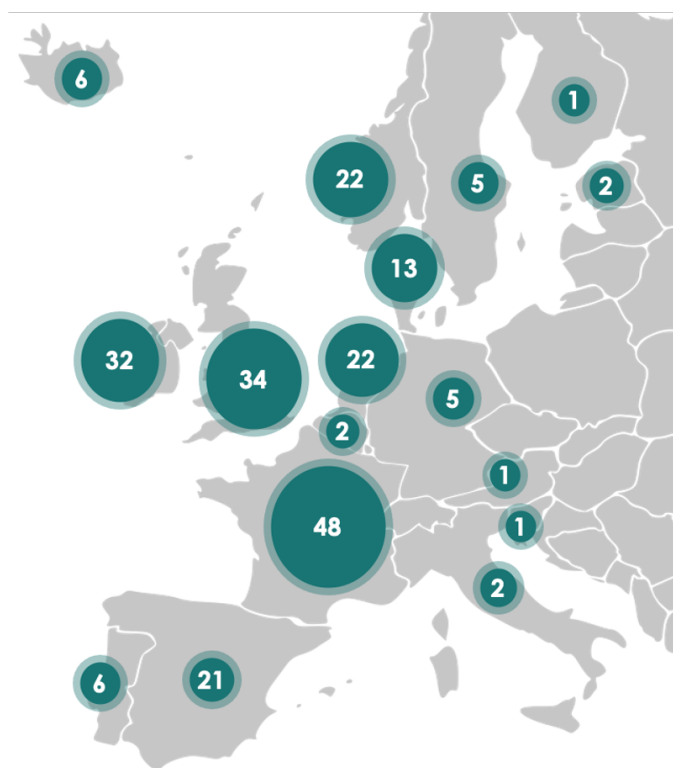
A solid, growing, and diversified pipeline of seaweed start-ups and innovative SMEs in Europe

For this analysis, Seaweed for Europe has sampled 223 European-based seaweed start-ups and SMEs.

The number of seaweed industry players (from production, consumer good development and sales) has almost tripled in Europe in 10 years.

- Despite being relatively nascent (55% or 123 out of the 223 companies in scope were created less than 10 years ago) and small-scale (58% or 130 out of the 223 companies in scope have less than 10 employees), most of the companies of this industry have an advanced Technology Readiness Level (TRL) – 85% or 188 out of the 223 companies in scope have a TRL of at least 8, and are already generating revenues.

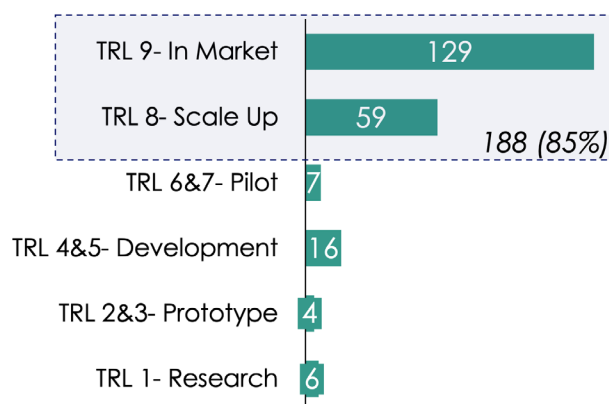
Pipeline breakdown by geographic region



Note: Within the 223 established companies and start-ups in Europe screened by the Seaweed for Europe (S4E) team.

77% of projects surveyed are in 6 countries
65% are in countries surrounding the North Sea
Pipeline weakness: Baltic & Mediterranean Sea

Pipeline breakdown by TRL

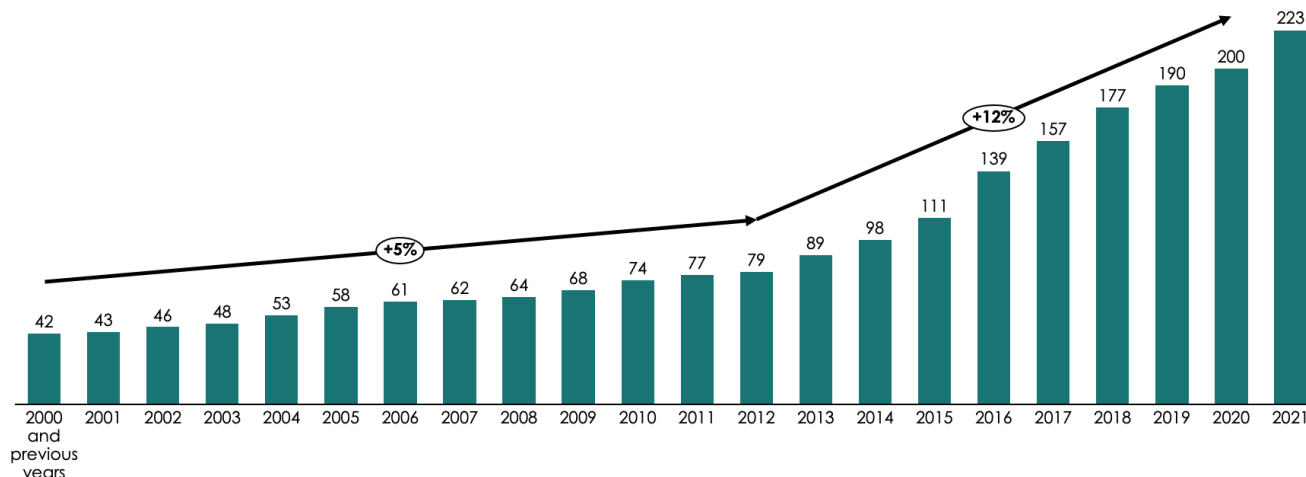


Note: Within the 223 established companies/start-ups in Europe screened by the Seaweed for Europe team.

- Despite being part of a nascent industry, most seaweed companies surveyed have some level of vertical integration, proving the industry's robustness – 140 companies (63%) perform more than one of the activities across the seaweed value chain, mostly across production, processing and biorefinery and product development
- Despite a large concentration on a few applications (more than 50% of companies are dedicated to human food and animal feed applications), an increasing number of companies are exploring alternative applications and end markets for seaweed – 68 (31%) have a diverse portfolio, especially combining cosmetics, pharmaceutical and food consumption activities
- The European seaweed industry is supported by a network of public and private research centres providing this environment with new products, research, and innovations necessary to the scale up of seaweed production and transformation. The appetite of non-European investors (e.g., Maabarot) within the European seaweed space is also linked to the strength of the research network in Europe. This network opens the door to disruptive innovations and greater potential for scaling – two keys to attracting investors.

Number of European seaweed innovative companies' broken down by year of creation

(accumulated number of companies, within the 223 established companies and start-ups)



Note: Within the 223 established companies and start-ups in Europe screened by the Seaweed for Europe team. Data sourced directly from companies' website when available, or from their LinkedIn and/ or Crunchbase profile. Founding date information was not available for 23 companies.

- There is room for existing seaweed companies to see their valuation increasing sharply in the next decade. Value to sales ratios of European seaweed companies are still much lower than other industries which have been rapidly growing over the

last decade, and can be considered as peer industries (e.g., insect-based feed, plant-based meat). These industries see high valuation to sales ratios while revenues remain low and within the range of average revenues generated by seaweed companies.

A growing number of investors are betting on the European seaweed industry

We have gathered information on **92 investors** representing a total of €69m disclosed investments over 11 years, with average tickets per investor of about €610k.

In 10 years, the European seaweed industry has seen an exponential growth in both the number and amounts of investments.

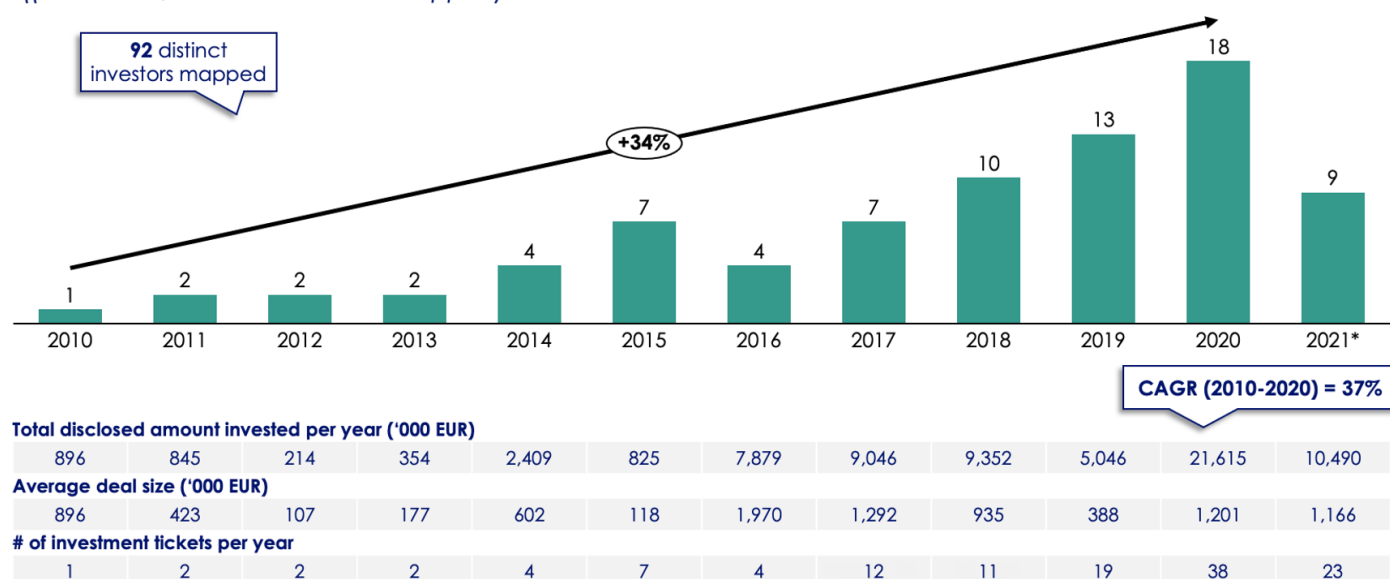
- **The overall amount invested in European seaweed companies has grown by 24x between 2010 and 2020**, growing from less than €900k annually in 2010 to more than €21.6m in 2020. Similarly, the number of investments has grown by 34% on a yearly basis, from 1 to 18 transactions per year. This exponential growth does not even consider more conventional bank financing (as data is less publicly available). Also, the first 6 months of 2021 have already seen a significant important amount invested in European seaweed compared to 2020, which reinforces this optimistic trend.

- **The growth in investments has also opened the door to an evolution of transactions from predominantly VC capital funding in 2010 to being driven by private equity and debt funding; a trend which emerged in 2014 and which has grown steadily over subsequent years.** The appearance of debt and late-stage capital financing shows that the industry is already showcasing some strong business models capable of sustaining long term debt and leveraged capital structures.

The continued growth of grant funding (with a peak reached in 2019 of €3,8m) highlights the recognition by the public sector and philanthropies of the importance of the environmental, economic and social benefits of seaweed, and the need for catalytic funding to help this nascent industry grow.

Number of investors' deal driven by professional investors per year

((in '000 EUR, within the 92 deals mapped))



Note: Within the 92 investors and 138 investment tickets mapped by the Seaweed for Europe team. Considers only deals with disclosed amounts for amount invested data, and considering multiple investors in the same round as different transactions. 13 companies with year of investment not available. *2021 is considering the 6-month period from January to June.

An increasingly attractive business environment to support an innovative seaweed ecosystem

The European seaweed industry benefits from a growing political support at global, national, and local levels as well as an increasing interest from large corporates which are investing in seaweed to secure a sustainable supply from an industry with rapidly growing demand.

- At the global level, seaweed has been considered as a promising ocean-based solution to help counteract climate change **and support the UN Sustainable Development Goals ("UN SDGs")**. At the European Union level, seaweed's climate change mitigation potential is considered by the European Commission (through the DG mare for instance) as a mean to support the **EU Green Deal's** target of a 55% reduction in greenhouse gas emissions by 2030 compared with 1990 levels.
- **Large corporates broadcast the use of seaweed by acting as off-takers, investors, or simply by communicating about the success of seaweed products and new applications.** Based on the study of recent

M&A transactions in the seaweed space, corporates typically take strategic equity investments or majority shareholdings in production or transformation companies. Corporates are also signing long-term and large volumes commercial contracts with seaweed production, harvesting or transformation companies. Out of the 92 investors surveyed, 10 are corporates and their primary interests are in seaweed for consumption as food and in companies involved in seaweed production and processing. Out of the €15.6m invested by corporates, €15.3m is invested in seaweed producers or processors.

- The convergence of the aforementioned positive signals is likely to **lead to attractive risk return profiles with a significant positive impact on nature and people.** Further ROI analysis would need to be developed in the near future to continue to inform investors about this industry's developments.

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I. STRONG MOMENTUM FOR THE EUROPEAN SEAWEED INDUSTRY

1. Seaweed: a hidden champion of the ocean

Seaweed (macroalgae) is a plant-like organism which grows in a variety of forms and colours in the ocean as well as in freshwater environments². It is rich in minerals, vitamins, and polysaccharides, with some species also containing larger amounts of amino acids,

proteins, and fatty acids³. Although there are a vast range of species – with estimates suggesting 72,500 known species (and many more assumed)⁴ – production centres around roughly a dozen, including well-known species such as Japanese kelp, nori and wakame⁵.

Seaweed applications and benefits⁶

♥ Health benefit ♻️ Environmental benefit			
Segment	Example application	Primary functions	Benefits
 Food	Raw salads, crisps, spaghetti, burgers	Source of energy, protein and vitamins	♥ Supports healthier diets due to high minerals, vitamins, protein and fibre contents ♻️ Lower environmental footprint than animal or land-based alternative protein sources
 Additives	Gelatine substitutes, processed meat and dairy	Provision of thickening, stabilising and emulsifying properties	♥ Natural and vegan-friendly ♻️ Lower environmental footprint than animal-based alternatives
 Animal feed	Livestock feed supplements, aquafeed supplements, pet food additives	Promotion of positive immune response and gut health; improvement of digestive processes	♥ Improvement in animal health, production yields ♻️ Reduction of methane emissions from livestock
 Biostimulants	Seed treatments	Stimulation of plant growth, protection against abiotic stress	♻️ Lower environmental footprint than nitrogen fertiliser alternatives ♻️ Promotes plant health, productivity and soil regeneration
 Pharmaceuticals & nutraceuticals	Gastrointestinal protectors, biodegradable wound care products / nutrient health supplements	Source of bioactive and nutrient-rich ingredients	♥ Disease prevention and treatment ♥ Natural health enhancers
 Cosmetics	Anti-aging moisturisers, toothpaste	Source of bioactive and nutrient-rich ingredients; provision of thickening, stabilising and emulsifying properties	♥ Natural and vegan-friendly ♥ Supports skin health
 Bio-packaging	Packaging, coatings and plastic films for food containers	Source of marine-safe and compostable plastic molecules	♻️ Replacement of substances causing environmental damage in production (fossil fuel) and after end-of-life (ocean leakage)
 Biofuels	Biodiesel for use in cars	Source of energy	♻️ Replacement for fossil fuels or land-intensive biofuels ♻️ Made from seaweed processing by-products

Note: This list is not exhaustive but seeks to highlight some of the most exciting applications only. Seaweed can be used in many more promising and innovative applications, including textile fibres, laundry detergents and construction materials. Source: Seaweed for Europe, December 2020 report: “A hidden champion of the ocean: Seaweed as a growth engine for a sustainable European future”.

Its biochemical composition and properties make seaweed a valuable material: it is used for a growing range of applications ranging from food products and animal feed to cosmetics and chemicals for various industries. Many of these applications provide sustainable, low-carbon and less harmful alternatives to existing options, offering diverse environmental and health benefits. Figure 1 shows some examples of the most significant and developed applications for seaweed, highlighting their respective benefits.

Beyond these examples, seaweed has many more innovative applications which are still being developed or scaled, including textile fibres, laundry detergents, construction materials, and biochar for soil improvement and carbon dioxide removal⁷.

Expansion of the seaweed industry in Europe offers many varied environmental benefits and strong social impact:

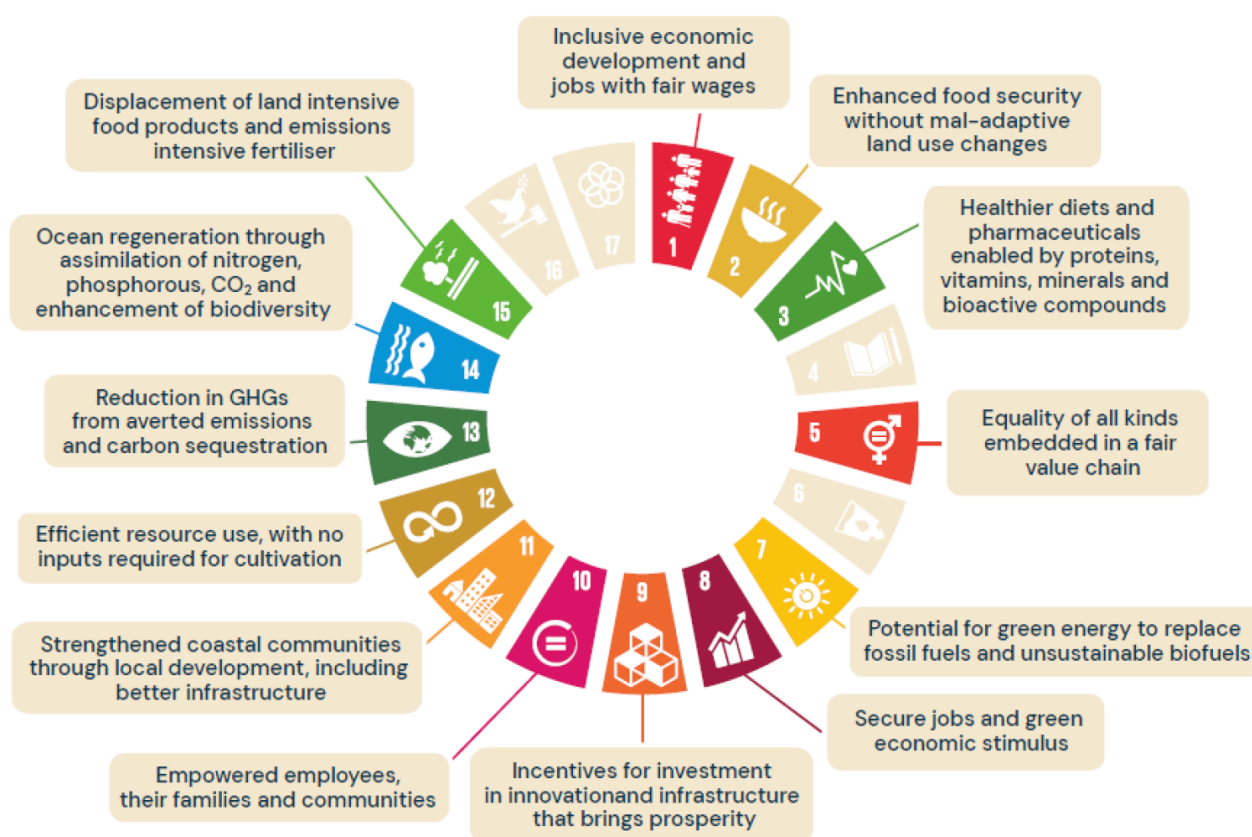
- Seaweed requires far fewer external inputs

than land-based agricultural crops which use fertiliser, freshwater and cleared land space to grow. In addition, growing seaweed absorbs carbon and nutrients which are often found in excessive quantities in coastal waters due to agricultural run-off. Seaweed cultivation also contributes to preserving biodiversity by creating habitats for marine animals, and helps protect European coasts from erosion.

- Social impacts from growth in the sector could include the creation of 85,000 jobs in Europe by 2030 for a range of different skills and experiences profiles, especially in coastal communities, and more generally improve diets and overall health.

Ultimately, if deployed at scale, the seaweed industry could be an accelerator for sustainable development in Europe as it supports almost the entire SDG agenda, as shown in Figure 2. These synergies are a clear indication that the seaweed industry can promote prosperity while safeguarding the planet⁸.

A thriving and sustainable seaweed industry



Note: Sourced from Seaweed for Europe, October 2020 report: A hidden champion of the ocean: Seaweed as a growth engine for a sustainable European future⁸.

2. Europe is growing as a high potential region for seaweed industry

A. Solid growth in global production and European demand

According to the Food and Agriculture Organization of the United Nations the global seaweed market more than tripled between 2000 and 2018, reaching 32.4 million tonnes of production with a value of \$13.3 billion (€11.3 billion)^{9,vi} in 2018.

This growth is driven by the expanding markets for seaweed-based foods and food additives (hydrocolloids). In 2019, 77% of seaweed produced globally was used for application in human consumption¹⁰. As consumers are increasingly focused on a healthier and more sustainable diets, and with a growing appreciation of the health benefits associated with seaweed, this market is expected to continue to expand significantly¹¹. Consumers' focus on healthy products is also driving demand for traceability in the production and transformation of goods. The demand for traceability offers Europe a unique opportunity to serve its consumer markets by building a large-scale seaweed farming industry abiding by clear regulations and sustainable frameworks.

As a top global importer of seaweed products in terms of value – \$613 million (€554 million¹²)

in 2016, there is clearly a strong demand for seaweed in Europe which is only set to increase in line with health and sustainability trends.¹³ The number of European food and drink products that include seaweed, for example, grew by a factor of 2.5 between 2011 and 2015¹⁴.

While the Asian market has grown significantly over the past decade thanks to the development of seaweed aquaculture, the seaweed production in Europe has stagnated. This stagnation is due to the centrality of wild harvesting practices in the European seaweed industry, and the fact that growth in these practices is constrained due, among other reasons, to excessive harvesting and changing weather patterns¹⁵. The seaweed aquaculture industry in Europe is still very much at a nascent stage – although it began back in the mid-1980s¹⁶. Seaweed production growth in Europe will have to come from the development of aquaculture, although this is currently hindered by factors such as a complex licensing processes, a lack of cost-efficient technologies, missing industry infrastructures and an absence of value chain integration, as well as limited investment¹⁷.

B. Europe benefits from perfect biological conditions to grow more seaweed

Europe is in fact perfectly located to develop a strong regional industry centred around seaweed aquaculture production. Nutrient-rich and cold waters from the Atlantic Ocean and the North Sea provide ideal growing conditions¹⁸. In addition, Europe's coastal regions have been assessed as "high opportunity" by a scientific study analysing factors such as the environmental and socio-economic benefits that could be derived from the development of such an industry¹⁹.

Seaweed, however, suffers from prejudices linked to other types of algae. Indeed, harmful algae blooms thrive in polluted waters and are invading seashore landscapes in Europe. Nitrogen pollution as well as climate change, are directly impacting certain marine ecosystems, causing the exponential propagation and massive stranding of algae, including red algae (United Arab Emirates), green algae (Brittany, China) and Sargasso algae²⁰.

For example, green algae poses a serious problem on France's Brittany coast. This species produces toxic gas (hydrogen sulfide) as it decomposes, which is potentially fatal to humans. Growth of unusually large amounts of green algae has been linked to nitrates in fertilisers and waste from the region's intensive pig, poultry and dairy farming flowing into the river system and entering the sea²¹.

This algae pollution is not related to seaweed production, but they can be conflated, and it is important to stress the difference between the two concepts. Seaweed production might however have an impact on the environment if not carefully managed:

- The harvesting of wild seaweed could be harmful for local biodiversity if water beds are too intensively dredged and if the natural

stocks are not carefully monitored. The dredging of wild kelp forests could cause harm to marine life as the macroalgae play a crucial role in preserving healthy ecosystem²².

- The use of non-endemic species in seaweed aquaculture could disrupt genetic diversity and strength of a local ecosystem.

To mitigate these environmental risks, strict controls of harvesting, breeding and production processes are currently being implemented across Europe. Furthermore, the competitive advantage Europe has relative to other regions' competition, is its capacity to foster, trace and brand sustainably produced outputs.

C. The European seaweed market in 2030: a potential for a large sustainable industry

Significant potential for growth within seaweed core markets

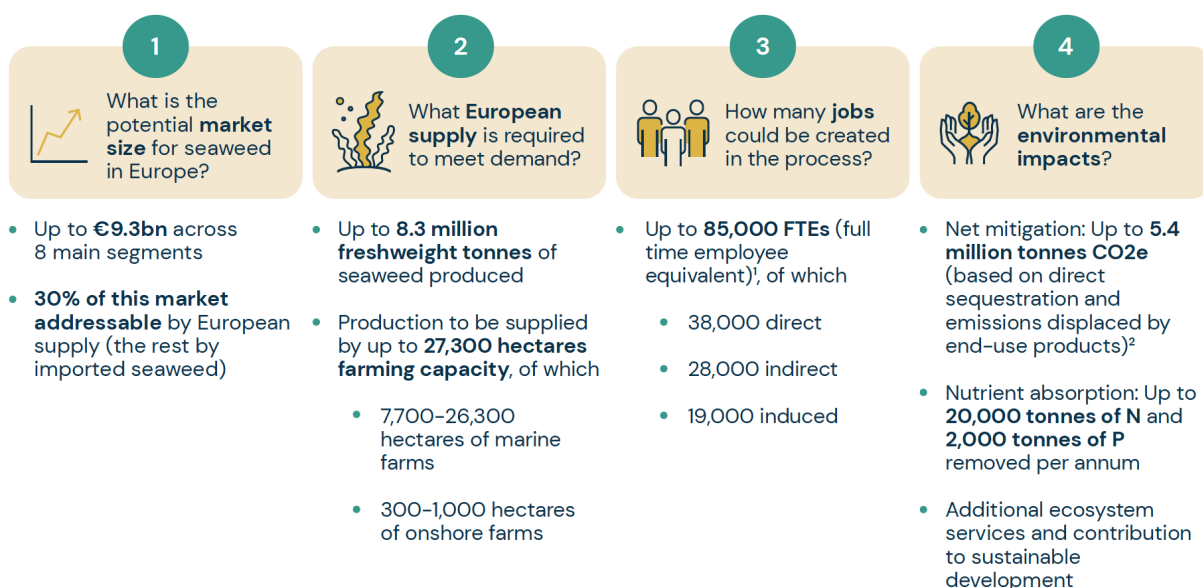
European demand for seaweed is projected to reach €3.0–9.3 billion in 2030 across all industry segments, with feed, food, and bio stimulants being the largest sectors. In a high ambition case, this would mean the seaweed market in Europe would be larger than EU aquaculture production in 2017, worth €5.1 billion, and within touching distance of the overall EU fisheries sector, valued at approximately €12–13 billion in the same year²³.

Of the total projected European market for seaweed in 2030, €0.9–2.7 billion could be captured by domestic producers, equivalent to 30% of total European demand. Achieving this would represent a pivot away from the current situation in which Asian producers dominate,

both globally and in a European context, to one where European producers grow by leveraging core strengths including quality, traceability and innovation and take some of the domestic market share.

As a result, the industry could also boost local economies and provide new employment opportunities. In the scenario described above, the seaweed sector could create up to 85,000 jobs²⁴ on a full-time employee (FTE) equivalent basis in Europe by 2030. Ultimately, this represents a unique opportunity for coastal communities, where jobs in hatcheries, cultivation, harvesting and some processing will likely be concentrated. This employment boom has the potential to diversify livelihoods and revitalise lower income coastal areas.

Key projections for the European seaweed market in 2030 (ambitious scenario)²⁵



1. Equivalent to 115,000 discrete jobs when full time and temporary roles are counted individually. 2. With potential for further avoidance from additional segments, pending research. Note: Values are for high ambition level – see Appendix for low and moderate ambition level outcomes.

New potential revenue streams from monetisation of ecosystem services

New revenues stream can be developed beyond traditional seaweed production business. First, the ecosystem services provided by seaweed farms could be monetised. Thus, carbon and nitrogen uptake could be monitored, accounted for, and traded as credits with companies or municipalities aiming to offset their production of CO₂ or nutrients. In the US for example there is a growing momentum around oyster nitrogen credits in the Chesapeake Bay²⁶.

Moreover, adding seaweed additives derived from select species to feed have the potential for select species to reduce methane emissions in cattle. Should a European emission credit scheme be expanded to include enteric methane emissions from ruminants, this would open an additional revenue stream for farmers²⁷.

The main hurdle for the development of the blue carbon market is a scientifically quantified carbon sequestration standard for seaweed. The NGO Oceans 2050²⁸ is spearheading this quantification work by working with 19 seaweed farms in 12 countries on five continents to measure CO₂ captured by seaweed. Oceans 2050's target is to provide a robust scientific foundation to support the development of a new voluntary carbon

standard for seaweed aquaculture.

The sequestration standard will be finished this July and public as of October. The full commercial credit could be onstream in Q1 2023, following a one-year farm trial. However, it is important to manage expectations regarding the potential of these new revenue streams: they are not expected to constitute a significant share of revenue, but they can nevertheless help seaweed farmers facilitate their social licence to operate and generate additional and diversified income stream while maintaining competitive prices for the seaweed they sell.

Case study example

BlueCs²⁹ is a newly established company specialising in monetising ecosystem services so they can be traded and bought as a virtual service/product by companies or individuals, with revenues redistributed to the producers operating the regenerative practices generating the ecosystem services. This example shows how new revenue streams can be developed beyond traditional seaweed production business models, for example by monetizing the ecosystem services instead of just the seaweed product itself.

3. Some structural inefficiencies are still preventing the European seaweed industry from unlocking its full potential

Despite the benefits it offers, the seaweed industry is still nascent in Europe, and must overcome several hurdles before realising its full potential. However, the growth witnessed in Asia over the last decades, rising momentum around several initiatives (e.g., Seaweed for Europe, EABA, Safe Seaweed Coalition, North Sea Farmers) and increasing support from policy makers like DG MARE offer hope that these barriers can be addressed:

- **Regulatory constraints:** This hurdle manifests in three main ways: (i) seaweed production licence requests are evaluated against inappropriate criteria in many European countries, e.g., those that are usually applied for finfish or shellfish farming, rather than their own set of specialised regulations; (ii) the process is usually extremely complex to navigate – for instance in France applicants

need to verify their request is compliant with regulations at national, departmental and local levels³⁰; and (iii) the process timeline is at odds with the realities of launching a business.

- **A necessary change of paradigm from harvest to culture:** Seaweeds' 2030 supply projections imply an expansion in annual production in Europe to 2.4–8.3 million tonnes of fresh seaweed. This would transform Europe's seaweed industry, not just in terms of scale, but also with respect to source. In 2015, 296,194 tonnes of seaweed were harvested in Europe, of which 99.5% was from wild stocks and just 0.5% was cultivated³¹. However, while wild harvesting may well continue in 2030, its volumes are reaching the safe ecological ceiling^{32,vii}. Growth in the European seaweed industry will therefore need to emerge rapidly from the aquaculture sector. There is no

doubt that this is a major challenge. However, the recent history of Asian seaweed supply would suggest that it is eminently possible: in just 10 years between 2005 and 2015, annual production in Asia grew by over 16 million fresh tonnes³³.

To reach the above-mentioned objectives, a cultural change is necessary among the different economic actors of the blue economy, whether it is transforming wild harvesting practices into farming or improving understandings of the ocean in terms of its water column potential and not just as a horizontal surface (e.g., transforming concession agreements calculated in square metres / kilometres of mono-activities like energy production or fishing into concession agreements understood in cubic metres / kilometres of potential pluri-activity, enhancing the value of the entire water column from surface to sea-bed).

- **A necessary scaling-up to reach a competitive cost base:** focusing on high value added seaweed crops and outputs, on sustainable production chains and on innovation (e.g., in biorefinery processing to enable efficient co-production of multiple applications at low cost) will help in building the European industry by stimulating supply and demand at the same time.

Three elements are critical to allow the European seaweed industry to enter this scale-up / fast growth cycle:

- » **De-risking mechanisms:** for investors through the intervention of catalytic capital providing junior capital, grants or guarantees. These mechanisms retarget commercial investments towards seaweed as they allow commercial investors to enter and / or to grow in this new industry by alleviating risks and cost of capital (e.g., EASME grant programs, WWF^{viii} investments).
- » **Offtake agreements:** Although seaweed farms and processors are on the rise in Europe, the industry still faces a “chicken and egg” challenge preventing it from growing at the rate needed to unlock its potential. Put simply, the challenge is that farmers and processors want to scale

production capacity so they can increase volumes and drive costs down, but to increase capacity they need to receive long-term guarantees from off-takers for large volumes at a good price. On the other hand, potential off-takers – for instance food and beverage, cosmetics, or feed incumbents – see the value in sourcing high-quality, traceable European seaweed, but they complain they cannot find desired volumes at a decent price today and therefore naturally turn to cheap, imported seaweed from Asia (even though concerns are on the rise regarding its quality, traceability, respect of human rights and environmental standards).

Large scale offtake agreements binding producers with distributors is a key solution to this chicken and egg challenge. These agreements would enable development of market for production, and a long term and high-volume demand for seaweed. Securing these contracts is key as they provide the long-term revenue visibility needed for producers to invest in their production capacities to scale up and change size (e.g., Symphony Environmental Technologies³⁴ signing offtake agreement with Eranova³⁵, a French biotechnology start up extracting starch from green algae to produce compostable plastics).

- » **Vertical integration:** Some M&A transactions where large food / retail groups buy stakes into producers to secure the supply of high demanded products (e.g., Orkla³⁶, a leading consumer goods company focused on the food sector, investing into Norwegian seaweed producer Arctic Ocean) are already occurring within the European seaweed industry. In addition, seaweed players are growing their activities through the purchase of smaller producers (e.g., Algolesko purchasing Aleor³⁷), through the purchase of specific assets to extend their capabilities (e.g., Algaia with the purchase of Cargill’s plant), and eventually through the purchase of distributors to secure offtakes (e.g., Arctic seaweed purchasing Nordisk Tang).

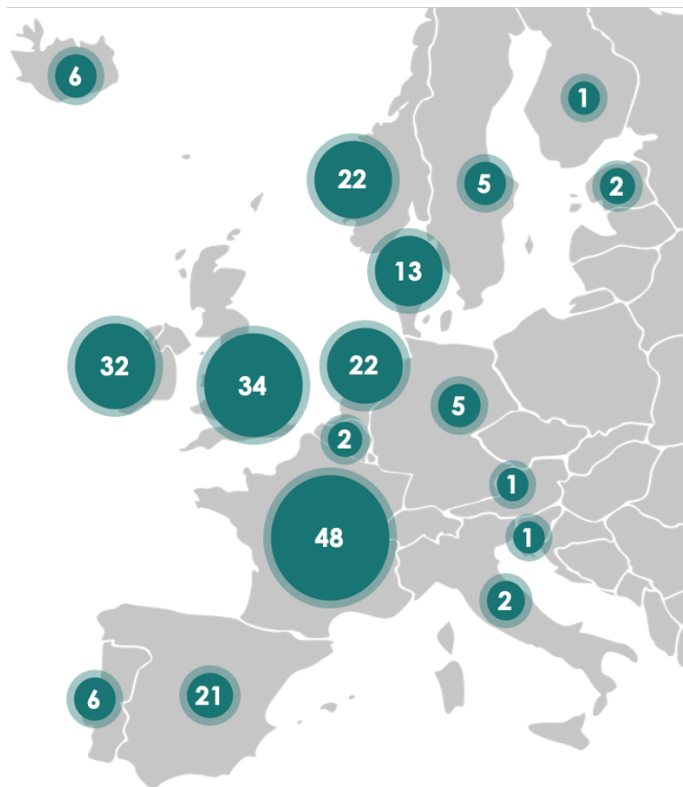
II. THERE IS A SOLID AND DIVERSIFIED PIPELINE OF EUROPEAN START-UPS & INNOVATIVE SMES

1. Key features of the European seaweed pipeline

A. An industry concentrated in a few European countries

Out of the 223 companies European-based identified in this analysis, 77% are based in 6 countries (France, Ireland, England, Netherlands, Spain, and Norway) and 65% are in countries surrounding the North Sea. In contrast, the pipeline seems weaker around the Baltic Sea and the Mediterranean Sea.

Pipeline breakdown by geographic region

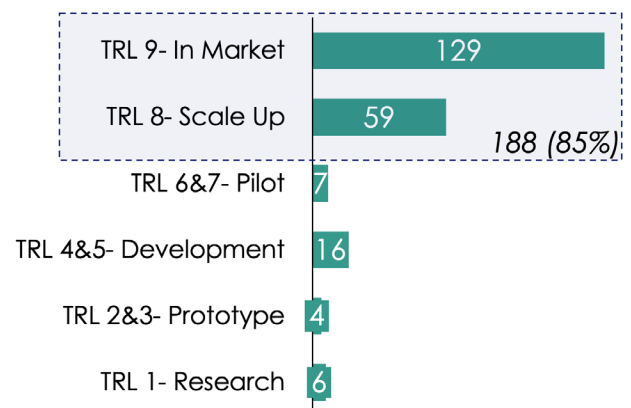


Note: Within the 223 established companies and start-ups in Europe screened by the Seaweed for Europe team.

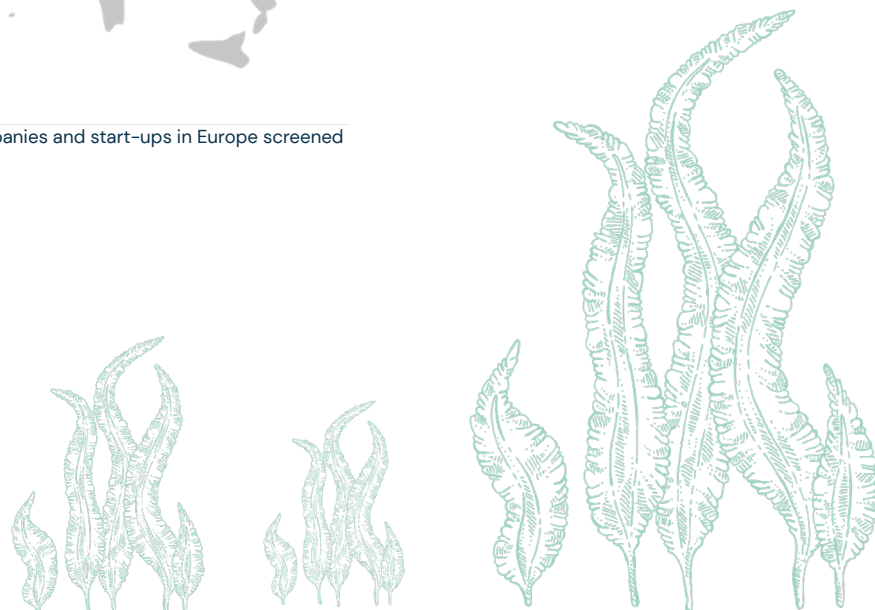
B. A solid pipeline of already established and profitable companies exists in Europe

Out of the 223 companies surveyed, it is estimated that 188 companies (85%) have a TRL > 7, indicating that a large majority of companies are already in the market and represent potential targets for commercial and/or financial investments.

Pipeline breakdown by TRL



Note: Within the 223 established companies and start-ups in Europe screened by the Seaweed for Europe team.



C. The seaweed industry in Europe is supported by strong R&D capabilities

The European seaweed industry is supported

by a network of public and private research centres generating the new products, research, and innovations necessary to scale up seaweed production and transformation.



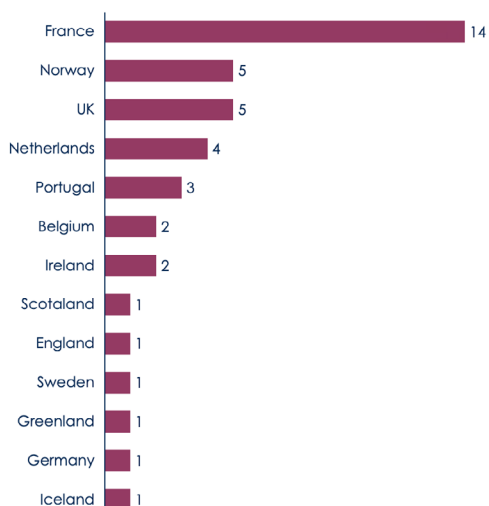
Out of the 41 research centres identified, most of them are concentrated in 4 countries (France, Norway, UK, Netherlands) and their research is focused primarily on production and cultivation optimisation. The hatching / reproduction cycle is at the core of seaweed research programs, to enable domestication of new species and the identification, selection, and development of the

most productive and resilient strains of seaweed.

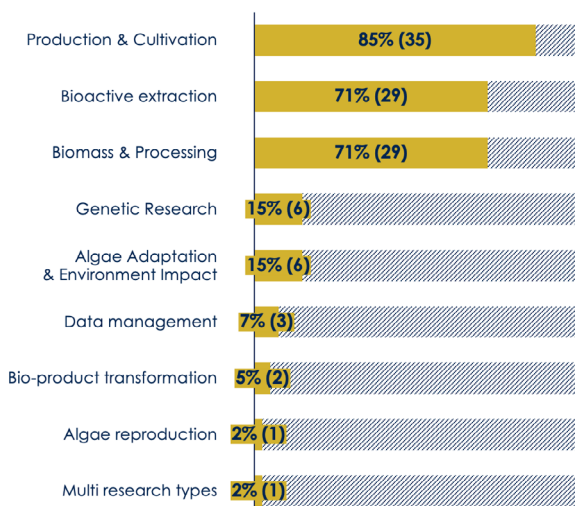
The other applications and sectors for R&D are:

- Resilient and large-scale infrastructure for offshore and deep-sea farming
- Optimization of processing lifecycles (through the development of bio-refineries)
- New product development (e.g., seaweed-based protein food).

Research centres breakdown by geographic region and seaweed focus (within the 41 research centres and universities sourced)



Research centres breakdown per seaweed focus (% of number of the 41 research centres and universities sourced)



Note: Developed by the Seaweed for Europe team based on information from websites from research centres and universities.

The appetite of non-European investors (e.g., Maabarot) within the European seaweed space is also linked to the strength of the research

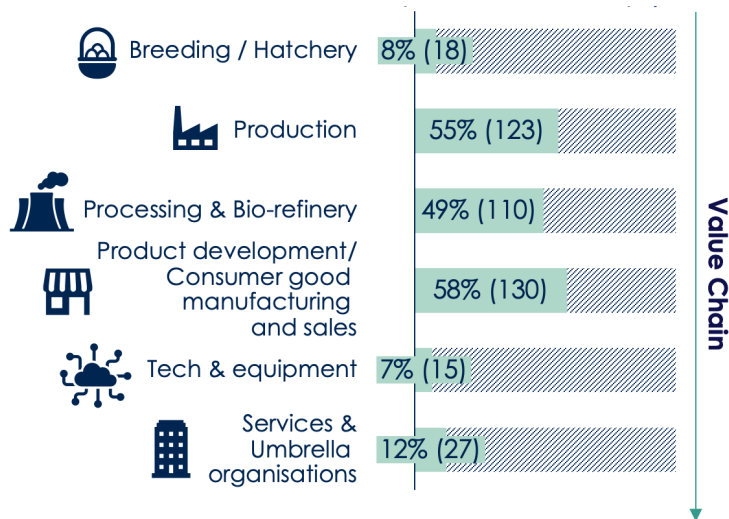
network in Europe. This network opens the door to disruptive innovations and greater potential for scaling – two keys to attracting investors.

D. A vertically integrated value chain, highlighting the seaweed industry’s robustness

Out of the 223 companies reviewed, most of the companies are vertically integrated from processing to product development.

Despite the nascence of the seaweed industry, actors have already reached a notable level of vertical integration, demonstrating the industry’s robustness.

Pipeline breakdown by stage of the value chain

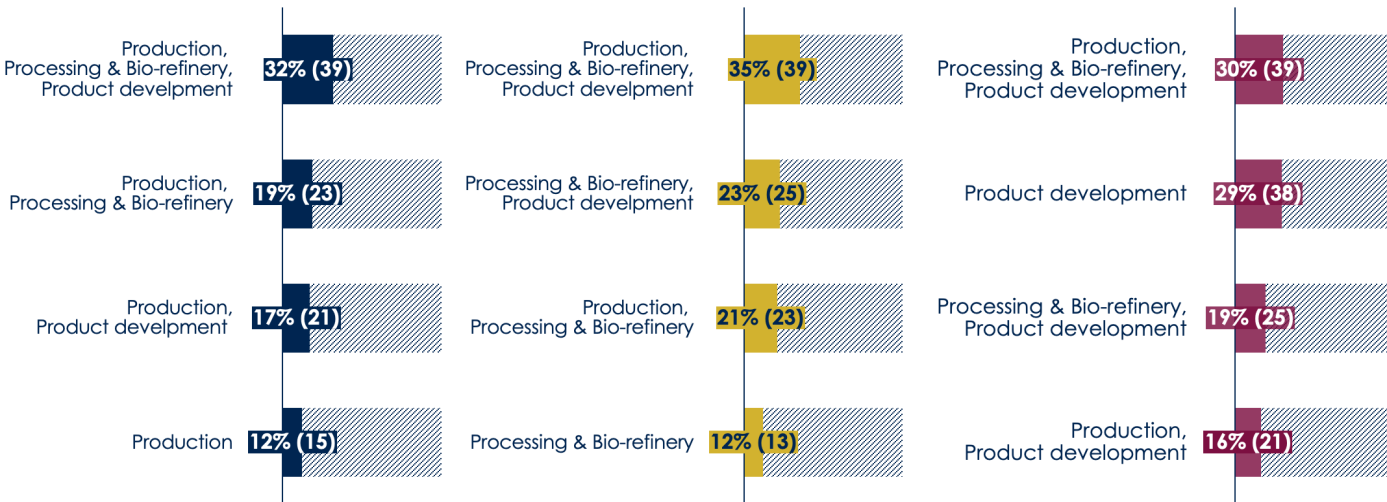


Note: Within the 223 established companies and start-ups in Europe screened by the Seaweed for Europe team.

140 (64%) of the surveyed companies are vertically integrated (performing more than one of the activities listed in the value chain breakdown) on the seaweed value chain. Vertical integration happens mostly between Production

and Processing & Bio-refinery or Product development. Out of 123 producers surveyed, 108 (89%) perform another activity, mainly Processing & Bio-refinery or Product development (68%).

Activities performed by producers, processors and manufacturers



Note: Within the 223 established companies and start-ups screened by Seaweed for Europe team in Europe.

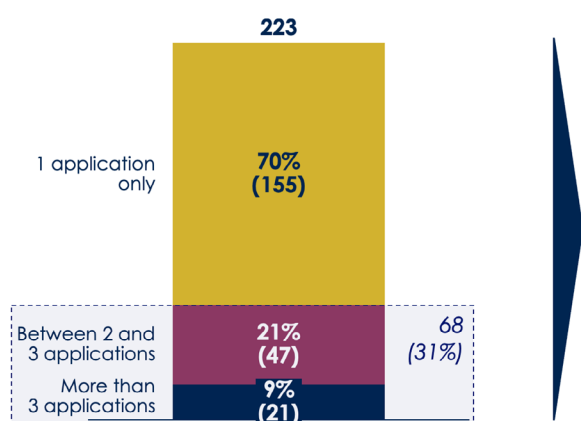
E. An industry with diversified applications

Despite a large concentration on a few applications (more than 50% of companies are dedicated to human food and animal feed

applications), an increasing number of companies are exploring alternative applications and end markets for seaweed.

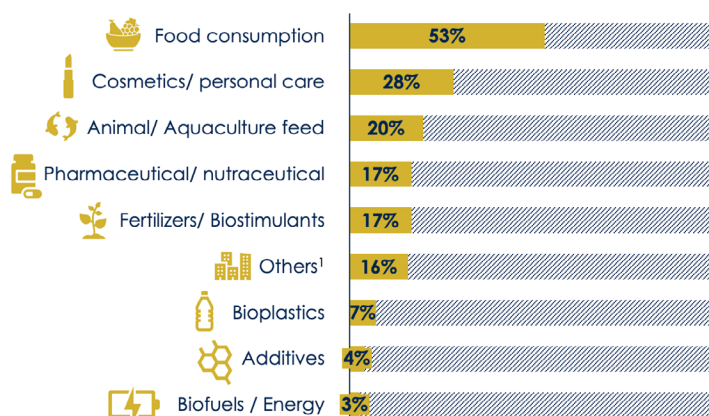
Multiple and versatile industry applications within the pipeline

Application diversity of the companies



Pipeline breakdown by type of application

(% of companies within the 223 organisations screened)



Note: Within the 223 established companies and start-ups screened by Seaweed for Europe team in Europe. *Other applications refer mostly to textile material, tourism activities and pigments, inks, dyes, coatings.

Out of the 223 companies reviewed, 68 (31%) have a diverse portfolio.

Out of this sample of companies with diverse applications for seaweed (horizontally integrated):

- 10% are in the cosmetics, pharmaceutical and food consumption businesses
- 10% are in the cosmetics and food consumption businesses

- 9% are in the pharmaceutical/ nutraceutical and food consumption businesses

- 7% are in the animal feed and fertilizers businesses

These multiple offtake opportunities for companies engaged in the seaweed industry show their potential for revenue growth and the resilience of their business model (based on the diversity of potential revenue sources).

F. A booming industry, still made of relatively new and small actors

Regardless of its diversity and vertical integration, the European seaweed industry is still comprised mostly of relatively recent companies with small number of employees. Indeed, seaweed is still a nascent industry in Europe as 55% of the 223 companies surveyed are less than 10 years old.

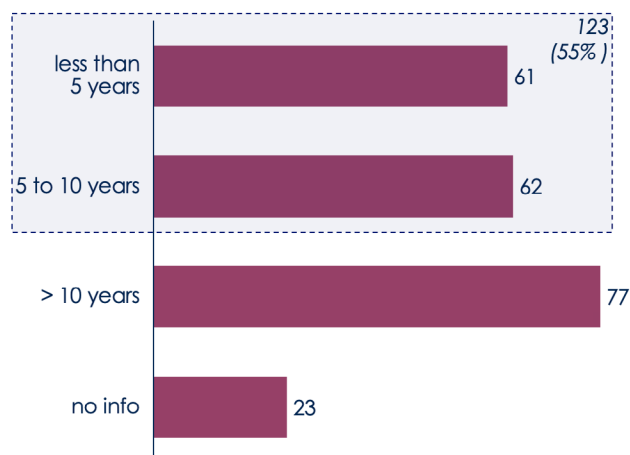
If the seaweed industry is nascent in Europe, it nevertheless, shows signs of rapid growth. The number of companies created is increasing rapidly every year. From 2000 to 2011, the CAGR for companies created remained at around 5%,

while from the 2012 to 2020 it has more than doubled compared to the previous decade.

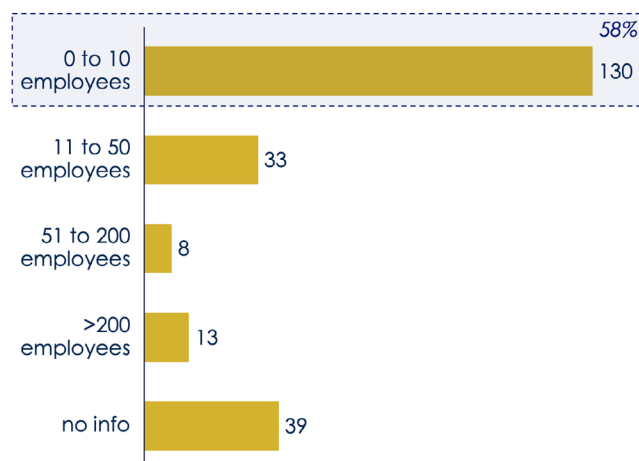
58% of the 223 companies surveyed employ less than 10 people. This could mean two things:

- 1) the industry is still made of small non-industrialized actors which gives room for growth and consolidation;
- 2) the bedrock of the European seaweed industry is made of small local and coastal small holders which are an important part of the European coastal SME network and of coastal livelihoods.

Pipeline breakdown by age

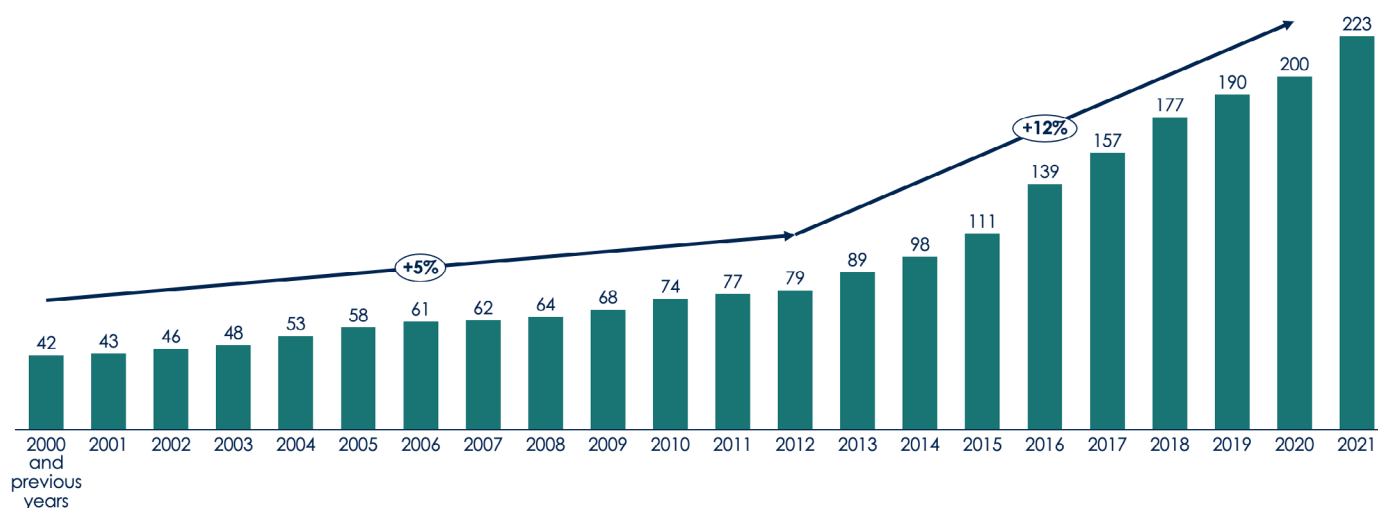


Pipeline breakdown by number of employees



Note: Within the 223 established companies and start-ups in Europe screened by the Seaweed for Europe team. Data sourced directly from companies' website when available, or from their LinkedIn and/ or Crunchbase profile.

Pipeline breakdown by company's year of creation

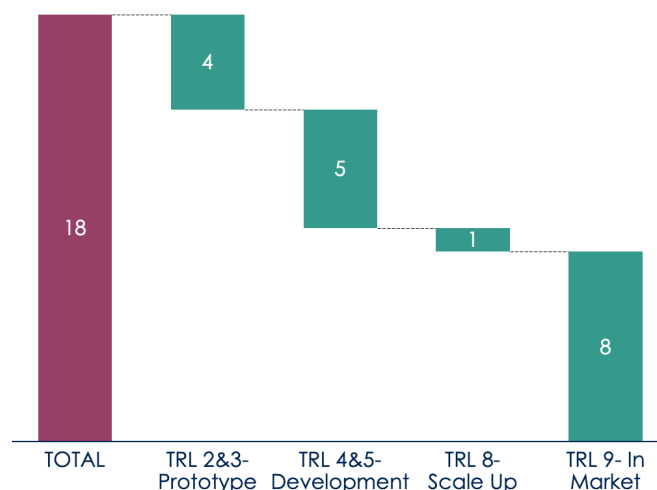


Note: Within the 223 established companies and start-ups in Europe screened by the Seaweed for Europe team. Data sourced directly from companies' website when available, or from their LinkedIn and/ or Crunchbase profile. Founding date information was not available for 23 companies.

G. Seaweed industry players are mostly looking for expansion and offtake opportunities

Within the 223 companies surveyed, only 54 specified their needs. Out of the 54, more than 30% are looking for funding: these 18 companies are mostly start-ups (10 companies) but 8 of them already have a TRL above 8, opening the door to a diversity of investment opportunities ranging from seed funding to late-stage equity investing or debt financing.

Breakdown by TRL out of the 18 companies looking for funding



Note: Within the 223 established companies and start-ups in Europe screened by the Seaweed for Europe team. From the 223 established companies and start-ups as previously presented only 54 (24%) companies indicated their needs on the survey.

H. Seaweed companies are still valued at relatively low prices compared to peer industries

Based on recent transactions and on publicly available data, we managed to build valuation multiples based on company value / sales ratio for a selection of European seaweed companies, and compared them to companies in other fast-growing sustainable industries (e.g., insect-based feed/ plant-based protein food producers).

The seaweed companies analysed fit into three different categories: (1) Production; (2) Innovative products; and (3) Biorefineries. The EV / sales multiples analysis was performed considering an average among all the companies sourced.

The analysis shows that:

- There is room for existing seaweed companies to see their valuation increasing sharply in the next decade: within industries which have already grown significantly and are considered as game changers by the investor community (e.g., insect-based protein like Ynsect and Innovafeed), valuation to sales ratios is very high (118x on average for the insect-based companies) while revenues remain low and within the range of average revenues generated by innovative seaweed companies.
- Some seaweed players are already entering this upward cycle as we see a number of companies already benefiting from strong Valuation to Sales ratio. They are either seaweed transformation companies offering new types of food or products for the health industry (e.g., Marinomed, Algiknit) or a seaweed producer benefiting from a very strong catalytic funding from a global and well-funded philanthropy (Ocean Rainforest, which received investment from WWF).
- Given the past and present growth strategies

of comparable industries (e.g., insect-based feed), it is possible to anticipate the potential growth and exit strategies for seaweed companies in the next decade:

- » IPO (e.g., Beyond Meat)
- » Growth capital financing through late-stage venture capital / private equity rounds (e.g., Impossible Foods, Oatly)
- » Purchase (M&A operation) by another corporate (e.g., see recent M&A operations within the seaweed space in section III. 2. a. and b.).

However, the below data needs to be interpreted carefully, given that:

- For some companies, the data is based on publicly available information.
- Years of valuation might differ from years of sales, thereby creating an artificial ratio (the case with Algo Paint, InnovaFeed, for example).
- Companies within the sample have heterogeneous business models and scale (yearly revenues spanning from less than €500k to more than €300m for Beyond Meat, for example).
- For some of the companies, valuation estimation was sourced as a range, and therefore a simple average value was used for the analysis below.
- For some of the companies, valuation and revenue figures were sourced directly with our coalition partners and due to confidentiality, the exact number cannot be disclosed.



Valuation and sales ratio from companies sourced

		Seaweed companies	Alternative food / feed companies
Valuation/revenue		Companies sourced	
Seaweed companies*	X [4-22]		
Plant-based food**	X 22		
Insect-based feed**	X 118		

Note: For some of the companies, valuation estimation was sourced as range and therefore a simple average value was used for the analysis above. Estimated valuation sourced directly from companies' website or Dealroom when information available. Estimated revenues sourced directly from companies' website or Dun & Bradstreet Business Directory when information available. *Range considering the different types of seaweed companies. **Simple average from companies sourced. More details on the sources can be found at Annexe V.

Case study examples

- Beyond Meat** is an American company specialized in providing plant-based meat. Notable investors include Baillie Gifford & Co., The Vanguard Group, Inc., BlackRock Fund Advisors. The company Beyond Meat went public in 2019 and is registered under NASDAQ. The same year, the company's turnover reached \$406m. Current market cap (14/04/2021) is \$8.5b (valuation of \$7.6b)³⁸.
- Impossible Foods** is an American company developing plant-based substitutes for meat, dairy, and fish products. The total funding amount disclosed reaches \$1.5b, including the most recent Series G equity round of \$200m by Mirae Asset Global Investments. The company's previous investment round – a \$500 million "Series F" announced in mid-March 2021, was one of the largest investment rounds for a food tech start-up and was oversubscribed due to excess demand from investors. Notable investors include venture capital firms Khosla Ventures and Horizons Ventures. Impossible Foods's estimated 2020 annual revenue is \$151.5m. According to PrivCo, Impossible Foods currently has a post-money valuation in the range of \$1b to \$10b^{39,40}.
- Oatly** is a Swedish company turning oats rich in fibre into a drink with high nutritional value. The total funding amount disclosed reaches \$241m, including the most recent private equity round of \$200m. Notable investors include Blackstone Group. In 2020, the company reported \$195m of revenues. Oatly's current valuation is estimated at about \$2b, in 2020⁴¹.
- Odontella** is a French company developing food products based on microalgae and marine algae. Odontella currently produces a smoked algae-based salmon substitute but has a range of other algae-based seafood substitutes under development. In 2017, they raised €830k in funding, with OLMIX Group being a notable investor. According to Dealoom estimations, Odontella's valuation ranges from €3 to 4m. In 2020, Odontella announced that it had signed 2 contracts with large vegan food retailers worth several million euros^{42,43,44}.

2. Deep dive on seaweed farming

A. Two main models prevail for seaweed farming

Historically, seaweed produced in Europe has relied predominantly on wild harvesting. As mentioned in previous chapters, the future growth of the seaweed production in Europe will rely on the development of seaweed farming. Two types of seaweed cultivation exist in parallel:

- **At sea:** this is the simplest and most common cultivation method consisting of seeding and growing seaweed on ropes or nets that are suspended in the sea, often near the coast. Cultivation surfaces in Europe are usually around several hectares but there is an

increase in the number of large-scale farms and projects (several hundred hectares).

- **Onshore:** seaweed is cultivated in onshore greenhouses with controlled inputs of light and water to optimise quantity and quality of production. This is a CAPEX and OPEX intensive method of production, but it allows to year-round production and offers potential to address quality-sensitive and higher value industries, such as pharmaceuticals and cosmetics.

Business models analysis for seaweed farming

TYPE OF BUSINESS		BUSINESS MODEL	RISKS	MITIGANTS	CAPEX / OPEX INTENSITY
Farming	At-sea farming	<ul style="list-style-type: none"> - <i>Revenues:</i> sale of wet / conditioned algae (core markets: food, animal feed, fertilizers, nutraceuticals, cosmetics, and packaging production) - <i>OPEX:</i> vessels, ropes, and seeds - <i>CAPEX:</i> mooring, boats 	<ul style="list-style-type: none"> - <i>Environmental risk:</i> introduction of invasive species - <i>Operational risks:</i> <ul style="list-style-type: none"> • Crop loss due to extreme events (external pollutant, storm, heat waves) • Variability of crop yields variability of intrants (water quality and UV production) • Seasonality of production 	<ul style="list-style-type: none"> - <i>Environmental risk:</i> use of native species - <i>Operational risks:</i> <ul style="list-style-type: none"> • Use of technological and technical solutions for farm structure • Selective breeding to maximize resilience and yield • Complementarity of species covering multiple harvesting seasons 	Low CAPEX Medium OPEX Low revenue per unit sold (if no transformation)
	Onshore farming	<ul style="list-style-type: none"> - <i>Revenues:</i> sale of high quality and high added-value wet and/or conditioned algae or extract (core markets: pharmaceutical, healthcare and cosmetics) - <i>OPEX:</i> heating, light (UV for photosynthesis), water filtering, seed selection and breeding - <i>CAPEX:</i> onshore cultivation facility and processing unit 	<ul style="list-style-type: none"> - <i>Fixed-cost intensity:</i> High fixed cost base to operate facility 	<ul style="list-style-type: none"> - <i>Fixed-cost intensity:</i> <ul style="list-style-type: none"> • High productivity per square meter • Production all year long • Addressable market of high added-value products compensates for high costs 	High CAPEX High OPEX High revenue per unit sold

B. A production concentrated in north-western Europe engaged in the vertical integration of the seaweed value chain

Of the sample of 223 companies surveyed, 123 are seaweed producers (55% of total companies surveyed) are scattered across 15 countries. The production is concentrated in 6 countries as 80% of seaweed producers (harvesting and cultivating) are located in Atlantic and North Sea neighbouring countries: France (21), Norway (18), Spain (18), England (17), Ireland (17), Netherlands (8).

Most of these producers are combining seaweed production with a form of 1st or 2nd transformation of the raw commodity: out of the 123 producers, 73 (59%) are also involved in processing and biorefineries activities and 66 (53%) are involved in product development and/or manufacturing of consumer goods.

C. Case studies of seaweed farms recent investments

- **Algolesko** is a French seaweed farming company that raised €1.2 million in 2020. Algolesko provides an example of how cultivation at scale in Europe can be sustainable and support the wider ocean agenda. In 2013, the company secured the right to **farm 150 hectares of ocean** off the coast of Brittany. This **farm sits within a Natura 2000 site** – a nature protection area designated by the EU to promote biodiversity. Investors in the company are combination private business angels and conventional financial investors.
- **Ocean Rainforest** is a Faroe Islands-based company **cultivating seaweed in the open ocean**. In August 2020, the company closed a US\$1.5 million (€1.26 million^{45,ix}) investment round, of which \$850k, (€716k^{46,x}) was invested by WWF, a conservation NGO which also led the process. The investment will enable Ocean Rainforest to grow its operations and support its ambition to more than double its harvest next year. While much more investment is still needed, this success demonstrates the potential for NGOs and the private sector to together deliver blended finance that can simultaneously scale up and de-risk investment in the seaweed space⁴⁷.
- **Arctic Seaweed** is a Norwegian seaweed company **cultivating, processing, and distributing Kelp** with new sustainable and scalable technologies. The company, which was formed in 2016, has developed and patented a technology which is now gradually rolling out to several facilities along Norway's west coast. In September 2020, Orkla (a leading consumer goods company focused on the food sector) has purchased 24.9% of Arctic Seaweed⁴⁸.
- **AtSeaNova** is a Belgian company which **provides technology to seaweed farmers**, including industrial solutions to mechanise and automate seaweed farming. These include, for example, a floating machine that can seed, harvest, and clean the substrate.

Companies sourced for producers' case studies



3. Deep dive on food consumption

A. A variety of human food applications and business models

Seaweed has increasingly been used in human nutrition as either a minor or major component of food products and is more and more considered as an alternative source of protein to land-based products which suffer from a larger ecological footprint (CO₂, land use, freshwater use, etc.).

Human food applications for seaweed are very broad, and consumption has been steadily increasing over the years benefiting from increased public attention and growing interest from food business companies or chefs. Two main types of human food applications can be distinguished:

- **Directly consumed:** algae are increasingly used as a direct food product by European consumers, catching up with Asian countries that have a long-lasting tradition of algae consumption. According to a report from the FAO issued in 2018, Japan consumers eat 4kg per person p.a. (11g per person per day) of algae⁴⁹. If European consumers are still far from Japan ones, these above figures show
- the potential for seaweed as a direct food product.
- **Used as protein base:** algae are also used as a protein base either as a replacement to animal proteins or as a food supplement. Protein-rich red seaweeds such as *Palmaria palmata* (common name Dulse) and *Porphyra* (common name Sleabhac or Laver) species may potentially be used in the development of low-cost, highly nutritive diets that may compete with current land-based protein diets such as those based on soya bean. For example, in *Porphyra* species, the amino acid profile is similar to those reported for leguminous plants such as peas or beans.
- **Used as a flavouring agent:** A growing number of products are available on European supermarket shelves using seaweed as an ingredient to flavour the product: crisps, snacks, prepared meals (usually associated with fish or shellfish), but also alcoholic beverages like beer or gin.

Business models analysis for seaweed human food applications

TYPE OF BUSINESS	BUSINESS MODEL	RISKS	MITIGANTS	CAPEX / OPEX INTENSITY
B2B	<ul style="list-style-type: none"> - <i>Revenues:</i> sale of processed seaweed as core food product or as protein base - <i>OPEX:</i> processing and distribution costs to retailers - <i>CAPEX:</i> processing facility 	<ul style="list-style-type: none"> - <i>Market risk:</i> addressable customer base evolving too slowly for increased seaweed consumption - <i>Price risk:</i> <ul style="list-style-type: none"> • Variability of raw commodity price due to little domestic market (mostly imported or wild seaweed) • Downward price pressure from retailers 	<ul style="list-style-type: none"> - <i>Market risk:</i> booming European market appetite for plant-based, healthy, and sustainable food - <i>Price risk:</i> commodity prices remain low compared to prices of processed goods 	Low CAPEX Low OPEX Low to Medium revenue per unit sold / large amounts of unit sold
B2C	<ul style="list-style-type: none"> - <i>Revenues:</i> sale of raw or processed seaweed (B2B and/or B2C) as core food product or as protein base - <i>OPEX:</i> processing and distribution / marketing costs to direct consumers - <i>CAPEX:</i> processing facility and distribution network 	<ul style="list-style-type: none"> - <i>Market risk:</i> <ul style="list-style-type: none"> • Market risk: addressable customer base evolving too slowly for increased seaweed consumption - <i>Price risk:</i> variability of raw commodity price due to little domestic market (mostly imported or wild seaweed) 	<ul style="list-style-type: none"> - <i>Market risk:</i> booming European market appetite for plant-based, healthy, and sustainable food - <i>Price risk:</i> commodity prices remain low compared to prices of processed goods 	Low CAPEX Low OPEX Low to Medium revenue per unit sold / large amounts of unit sold

B. Human food applications of seaweed is a market growing exponentially driven by changes in consumer behaviours and increased interest from food professionals

Today, human food products represent the biggest demand driver for European seaweed: out of the 223 companies surveyed, 118 (53%) have human food applications.

As for seaweed production, companies focused on human food applications are concentrated in a few countries: 68% of the 118 companies are concentrated in France, Spain, Norway, the Netherlands, and England.

Out of the 118 companies engaged in the human food applications of seaweed, 47 (41%) are also transforming seaweed for other applications. This shows the versatility of seaweed applications and the commercial potential for seaweed producers from selling to various industries (hence hedging against commercial risk). Most of secondary applications are pharmaceutical, nutraceutical and cosmetics which are markets which offer lower volumes but higher margins than direct food consumption.

C. Case studies on innovative food products

- **Betterfish** is a German start-up Nordic Oceanfruit is one example of a venture bringing innovative seaweed products to market. Already present in large supermarket chains with its range of seaweed salads which reflect the ocean flavours of countries as diverse as Norway, Italy and Korea, its next foray focuses on the creation of a plant-based alternative to tuna under the brand Betterfish – using seaweed as an ingredient. Nordic Oceanfruit's initiative is supported by leading tech-accelerator TechFounders⁵⁰.
- **Cavi-art** is a Denmark family-owned and run SME Cavi-art is producing fish meat alternatives made from seaweed produced in

France and Norway. Its main product, vegan caviar, can replace lumpfish roe, capelin roe, herring roe, salmon roe, flying fish roe and more.

- **Happy Ocean Foods:** German start-up Happy Ocean Foods develops sustainable plant-based seafood. The first product is a plant-based shrimp, which looks, feels, and tastes similarly to a real shrimp and is rich in protein and omega-3 fatty acids. Main components of the plant-based shrimps are seaweed, mung beans and soy. The company raised €118k in May 2020 in its pre-seed round.

Companies sourced for innovative food products' case studies



4. Animal feed based on seaweed combines environmental and economic benefits

A. Large potential market

Animal applications of seaweed range from livestock feed additives to pet food in the form of oil additives or powdered seaweed. Of the 2030 European seaweed market, animal feed supplements are projected to constitute the largest segment, with a value of €540–2,220 million⁵¹ by 2030 (Seaweed for Europe ambitious scenario).

This growth will be driven principally by the livestock feed additive sector, in particular for cattle, swine and poultry, on account of the many health and yield benefits that seaweed supplements offer. A further benefit from seaweed additives in feed is the potential for

select species to reduce methane emissions in cattle.

Should this solution be scientifically validated, and a European emission credit scheme be expanded to include enteric methane emissions from ruminants, this would open a revenue stream for farmers that would undoubtedly galvanise the sector and offer opportunities both for seaweed-based additives and for alternative plant-based additives, for which research is currently underway. Ultimately, such a policy could bring the high ambition value for the cattle feed additive market, representing €800 million by 2030, even closer⁵².

Business models analysis for seaweed animal feed applications

TYPE OF BUSINESS	BUSINESS MODEL	RISKS	MITIGANTS	CAPEX / OPEX INTENSITY
Feed additives	<ul style="list-style-type: none"> - <i>Revenues</i>: sale of processed seaweed (powdered or oil) as feed supplement - <i>OPEX</i>: processing and distribution costs - <i>CAPEX</i>: processing facility 	<ul style="list-style-type: none"> - <i>Market risk</i>: addressable customer base not willing to pay a premium for seaweed-based additives - <i>Price risk</i>: variability of raw commodity price due to little domestic market (mostly imported or wild seaweed) 	<ul style="list-style-type: none"> - <i>Market risk</i>: consumers demanding more guarantees on animal welfare and organic farming 	Low CAPEX Low OPEX Low revenue per unit sold
Methane reduction	<ul style="list-style-type: none"> - <i>Revenues (still WIP)</i>: sale of processed seaweed to reduce cattle methane emissions with a still to be built emission credit scheme - <i>OPEX</i>: processing and distribution costs - <i>CAPEX</i>: processing facility 	<ul style="list-style-type: none"> - <i>Technology risk</i>: still at lab stage/ limited at scale trials - <i>Market risk</i>: European emission credit scheme to be expanded and GHG price scheme to be established to build relevant market 	<ul style="list-style-type: none"> - <i>Market risk</i>: increasing public and regulator interest in GHG reduction schemes 	Low CAPEX Low OPEX TBD revenue per unit sold

B. An industry concentrated in Ireland and Norway

The incorporation of seaweed into animal feed serves two main objectives: (1) improve production yields; and (2) find protein alternatives to crops with significant negative environmental impacts (e.g., soy, corn, forage fishing for aquaculture, etc.). Further research additionally demonstrates that seaweed feed additives could also drastically reduce greenhouse gas emissions from ruminants.

Out of the 223 companies surveyed, 44 (20%) are engaging with animal feed activities which can range from pet food to cattle supplements or aquaculture feed. 45% of these animal feed companies are concentrated between Ireland and Norway, where among the world's largest aquaculture industries exist.

It is interesting to notice that 55% of the 44 animal feed companies are seaweed

producers and most of them are present in Norway and Ireland. Seaweed production, as described previously, offers numerous positive environmental benefits, including absorbing excess nutrients from the sea. Thus, combining seaweed production and aquaculture is a way to decrease the environmental footprint of the latter while simultaneously providing access to locally produced animal feed and supplements.

Ultimately, companies engaged in the animal feed sector rarely focus exclusively on this industry, as only 23% of the 45 companies surveyed are focusing just on animal feed. Secondary activities mostly related to animal feed are fertilizers / bio-stimulants or human food consumption. This aggregation of outputs is likely attributable to the similar processing needs of these sectors, as well as to the same raw commodity quality needs.

C. Case studies on innovative animal feed products

- **Folla Alger AS:** this Norwegian SME is developing the capacity to farm seaweed at industrial scale and to produce ingredients for fish feed from the seaweed biomass. The company is also developing a fully integrated installation to combine the production of seaweed and salmon (IMTA) at an industrial scale.
- **SeaLAC:** this Irish SME SeaLAC specializes in the collection and manufacturing of *Ascophyllum nodosum* for animal and plant nutrition. SeaLAC has developed a unique process, drying seaweed at low temperature using air, saving all the nutritional values, green coloration, and typical seaweed odour. They have developed a diverse line of products for farmers, including products to improve the nutrition of pigs, horses, cattle, and other livestock.
- **NUQO:** this French SME develops and promotes natural ingredients and feed additives – including from macroalgae – to improve farm yields and animal health. In February 2021, NUQO has appointed Barentz Animal Nutrition as its preferred distribution partner for its range of feed additives allowing NUGO to expand its activities in Europe and globally.
- **Volta Greentech:** this Swedish start-up has developed a feed supplement which when fed to cows at a daily dose of 100 grams, reduces their enteric methane emissions by up to 80%. Based on the red seaweed *Asparagopsis taxiformis* that contains high amounts of bioactive compounds blocking one of the enzymes needed by the methane-producing bacteria in the rumen, it naturally prevents enteric methane production. Volta Greentech's last funding round was closed in May 2021 with a €1,7m investment⁵³.

Companies sourced for innovative animal feed products' case studies



5. Processing facilities and biorefineries: a key industry to enhance the competitiveness of European seaweed production

A. Business model description

Processing facilities and biorefineries are critical for the European seaweed value chain as they enable maximum value to be extracted from the raw commodity and support the development of higher value add products. Developing high value add products is key for the structuring and development of the European seaweed industry, as it will allow European companies to avoid competing with Asia on low cost, commoditised seaweed.

Macroalgal biorefinery processes are capable of processing multiple feedstocks, by deploying a range of mechanical, physicochemical, and enzymatic techniques in order to generate a diversity of high value-add products for markets within the food, feed, cosmetics, pharmaceutical and fine chemicals sectors. Furthermore, this approach contributes to a “zero waste” circular

approach as the left-over residuals from the biorefinery process can be valorised through their conversion to products in lower value sectors, such as fertilizers and/or for bio-energy conversion.

In 2017, a consortium of European companies and research institutions received €4,2m in grant funding to evaluate and prove the concept of a cascading marine macroalgal biorefinery. Under the project title MACRO CASCADE⁵⁴, the collaborating partners have explored the viability and bioeconomic impact of processing cultivated seaweed to create a diverse range of high-value products by creating a production platform that covers the whole technological chain for processing sustainable cultivated seaweed to produce highly processed value-added products.

Business models analysis for seaweed processing facilities and biorefineries

TYPE OF BUSINESS	BUSINESS MODEL	RISKS	MITIGANTS	CAPEX / OPEX INTENSITY
Bio refineries	<ul style="list-style-type: none"> - <i>Revenues</i>: sale of heavily processed seaweed to all types of industries from low to high value add (low: energy, fertilizers / medium: food, feed / high: cosmetics, pharmaceuticals). Valorisation of all by-products - <i>OPEX</i>: sourcing, processing and distribution costs, energy - <i>CAPEX</i>: processing and refining facility 	<ul style="list-style-type: none"> - <i>Processing / technology risk</i>: risks inherent to the industrial processing of an organic commodity (variable quality of output, gas emissions, etc.) - <i>Price risk</i>: variability of raw commodity price due to little domestic market (mostly imported or wild seaweed) - <i>Fixed-cost intensity</i>: High fixed cost base to operate facility 	<ul style="list-style-type: none"> - <i>Processing risk</i>: high level of regulation and control in Europe - <i>Price risk & fixed-cost intensity</i>: <ul style="list-style-type: none"> • High price of final outputs covering largely fixed and commodity costs • Diversity of outputs allows for a diversity of incomes and thus market risk hedging 	Medium (modular/ small scale facilities) to high CAPEX Low OPEX High revenue per unit sold

B. Biorefinery is still an emerging technology

Today, many seaweed industry players are involved in seaweed processing whether it is simple processing (e.g., drying, freezing) or more complex extraction activities. However, only few have developed an integrated model extracting the maximum value from the algae:

- Out of 223 companies, we managed to identify just 5 which can truly be considered as bio refineries (Alginor, Goa Ventures, Kelpi, Origin by Ocean, Oceanium) given the wide range of processing activities and outputs they offer.
- However, out of the 223 companies, 110 (50) are involved in some form of processing activity which could vary from basic transformation (e.g., drying or freezing of raw seaweed) to more complex processing using

both mechanical and biological properties of seaweed to produce manufactured goods. 79% of processing facilities are concentrated in 6 countries: France, Ireland, England, Norway, Spain, and the Netherlands.

Out of the 110 companies involved in processing activities, 59% focus on only one industrial output (25% food consumption, 11% cosmetics, 9% fertilizers and bio-stimulants and 5% on bioplastics), showing a wide range of capabilities and economic outputs. Bio-refineries are at the core of this multi-output and high value add strategies. Within the 110 companies surveyed, respectively 41 (37%) and 21 (19%) have cosmetic / personal care and pharmaceutical / nutraceutical outputs, which are the industries generating the highest economic value add for seaweed.

C. Case studies on biorefineries businesses

- **Algaia:** a French bio marine ingredients company with a focus on seaweed extracts, is developing extracts and solutions for the Agro-Nutrition, Personal Care & Nutraceutical Industries. It acquired an alginate manufacturing plant from Cargill in 2016. Under Cargill's management, alginate was the plant's sole output, and residual seaweed left over from processing was discarded. On acquiring the plant, Algaia stated its intention to leverage its core skills in extraction to valorise by-products of the alginate production process, thereby maximising revenue and resource efficiency while minimising waste.
- **Oceanium:** UK-based (Scottish) company Oceanium extracts the maximum value from raw seaweed biomass (sustainably sourced from seaweed farmers) to produce and sell a number of products to B2B consumers, including protein and fibre for food, nutraceuticals for the pharmaceutical industry and bio-packaging materials.

Oceanium raised \$150k from venture fund Katapult Ocean and \$100K from Sky Ocean Ventures in 2019 during seed rounds. More recently in 2021, they have raised £2m in funds to scale up their innovative biorefinery technology and enable further product development.

- **Origin by Ocean:** Finish start-up Origin by Ocean is processing sea and ocean-grown biomass to produce natural sustainable ingredients for the food, beverage, cosmetics, and pharmaceutical industries. Based on industrial-scale collection of blue-green algae and large-scale bladderwrack farming, Origin by Ocean is planning scaling up to 80.000 wet tonnes of algae per year by 2025 resulting in annual total nutrient removal from the Baltic Sea of roughly 90 tonnes of phosphorous and 900 tonnes of nitrogen. Origin by Ocean was shortlisted in 2021 as belonging to the top 10 highest potential Finnish start-ups.

Companies sourced for seaweed processing and biorefineries' case studies



III. A GROWING NUMBER OF INVESTORS ARE BETTING ON THE EUROPEAN SEAWEED INDUSTRY

1. A diverse and growing number of investors are interested in the European seaweed industry

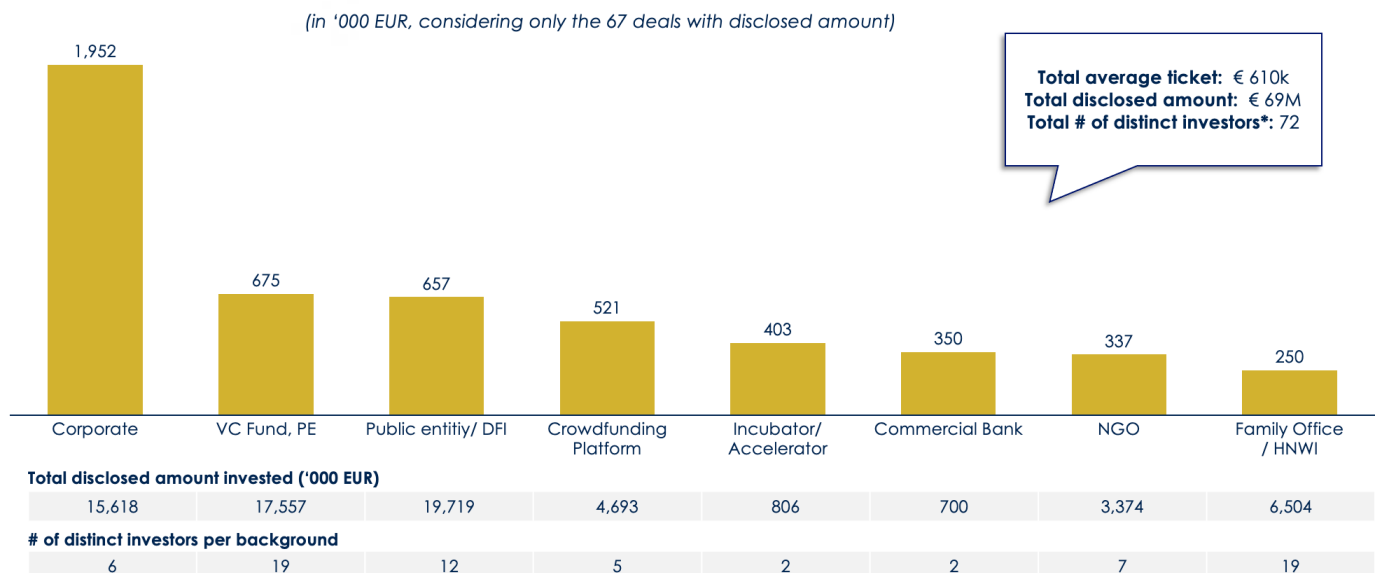
Out of the 223 seaweed companies surveyed in Europe, we mapped investment information for 41. In addition, 1 non-European company was also reviewed⁵⁵. Out of these 41 companies, we have gathered information on 92 investors representing a total of €69m in disclosed investments, with average tickets per investor of about €610k. The chosen universe of investors remains relatively small with few tickets, and is mostly driven by small venture equity transactions and grants.

Given the relatively small number of transactions and limited size of the overall investment pool in this industry, data collection is complex and subject to interpretation, given that most of transactions are still not disclosed (out of 92

investment deals surveyed, complete financial data has been collected for only 67).

Furthermore, the analysis has a bias towards equity financing, given that bank debt is not / is less publicly available information when compared to equity and grant financing data. It is also important to note that information on the amounts invested by each investor out of the total funding raised in each round is rarely public. Thus, for transactions with multiple investors, total transaction value was assumed equally distributed among the investors for this analysis, except for the cases when information has been explicitly disclosed for each investor. Beyond the transactions previously described,

Average ticket size in seaweed business per background



Note: *Considering only the investors from the deals with disclosed amounts. Within the 92 investors and 138 investment tickets mapped by Seaweed for Europe team. Total transaction value was equally distributed among the investors except for the cases when information was explicitly disclosed for each investor.

two important investments were also identified. These investments were made into two European seaweed companies and involved blended finance capital to promote innovative projects within the seaweed landscape:

- Alginor, a Norwegian seaweed processor, has

been awarded a total of €17.5m from the EIC Accelerator programme's "Green Deal" to be used for activities ranging from research, development, and piloting to full-scale industrialisation and commercialisation.

The amount of €17.5m awarded will be

received as “blended finance”, including €2.5m in grants (70% of project costs) and €15m in long-term financing in the form of equity/quasi-equity⁵⁶.

- Kelp Blue, a Dutch kelp producer, is partnering with Climate Investor Two (managed by Climate Fund Managers), Kelp Blue and the Namibia Infrastructure Development and Investment Fund (NIDIF), managed by Eos Capital, for the commercial development of the world’s first large-scale kelp farm. For this project, an investment of approximately

\$60m will be required over a five-year period, funded by both international and local Namibian sources⁵⁷.

Both examples illustrate that both the private and public sectors are interested in expanding the seaweed industry, and are deploying meaningful amount of capital. As these types of investments are very project-specific, and given the size of the other deals mapped, they were not included into the analysis that will be presented in the following sections.

A. Growing momentum in investments

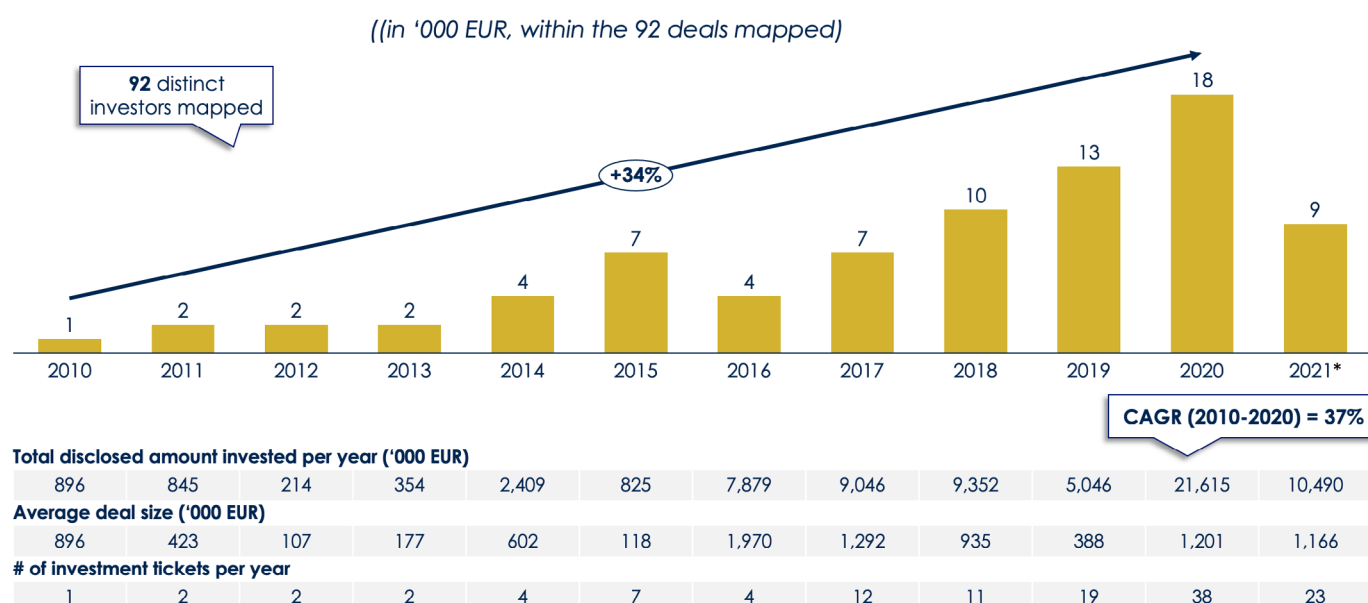
In 10 years, the European seaweed industry has seen growth in both the number and value of investments. From 2010 to 2020, the CAGR of investment value was 37% p.a., growing from less than €900k in 2010 to more than €21.6m in 2020. Similarly, the number of investments has grown by 34% on a yearly basis, from 1 to 18 transactions per year.

Despite the pandemic, 2020 was among the most prolific years in both number of investments and amounts invested. Moreover, Q1 2021 also shows a robust start to the year, with 3 transactions (in SoluBlue, Olgram and Algiknit) totalling €4m, and thus already outperforming Q1 2020. Q2 also maintains this positive outlook, with two important transactions: Oceanium, raising £2m (approximately €2,3m) and Volta Greentech raising €1,7m.

The growth in investments has also opened the door to an evolution in transactions from exclusively driven by VC capital funding in 2010 to the emergence of private equity and debt funding in 2014, with this trend continuing to grow steadily over the years. The appearance of debt and late-stage capital financing shows that the industry is already showcasing some strong business models capable of sustaining long term debt and leveraged capital structures.

Furthermore, the emergence and continual growth of grant funding (with a peak reached in 2019 of €3,8m, representing 75% of the annual investment in the industry) showcases the recognition by the public sector and philanthropies of the importance of the environmental, economic and social benefits of seaweed.

Number of deals in European seaweed companies



Note: Within the 92 investors and 138 investment tickets mapped by the Seaweed for Europe team. Considering only deals with disclosed amounts for amount invested information and considering multiple investors in the same round as different transactions. 13 investment tickets with year of investment not available. *2021 is considering the 6-month period from January to June.

B. Investments in the European seaweed industry are mostly driven by the European Commission and investors concentrated in a small number of countries

The European Commission through EASME (EU Executive Agency for SMEs) and Climate-KIC accelerator is the largest investor mapped in the European seaweed industry, totalling €10,1m invested in 10 companies through a combination of seed and grant funding.

The UK (England and Scotland combined) is the largest European investor country with €16m invested by 15 investors. The UK benefits from the support of public funding (totalling an estimated €4.1m) through the Highlands and Islands Enterprise, the Scottish Enterprise, the Scottish Investment Bank, the Coastal Communities Fund and Innovative UK.

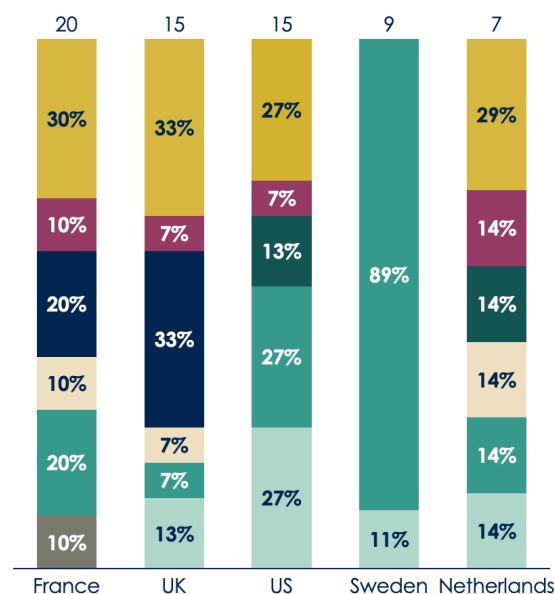
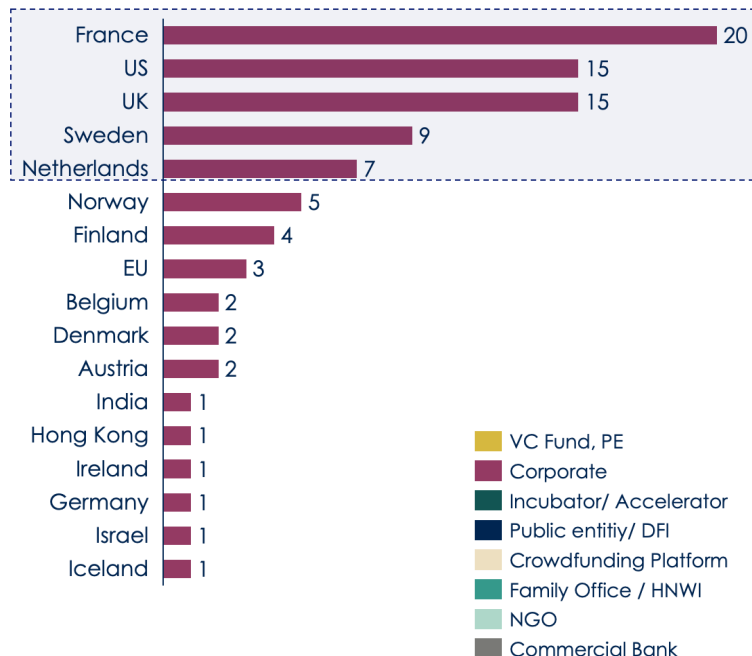
France is second with 20 investors totalling €15.2m in investment from a combination of private and public investors. Public investors are slightly less well represented than in the UK.

The French public sector is investing in seaweed through the French Environmental & Energy Management Agency (ADEME), the Aquitaine Regional Council, the Regional government of Bretagne and Bpifrance (Banque Publique d'Investissement) which all invested in seaweed (combining €2.1m in total).

Non-European countries, like the US (15 investors) and Israel (1 investor: Maarbarot) are among the countries totalling the largest amounts of investments: €11.3m out of the total €69m (16% of total investments surveyed), investing in large tickets (compared to the average tickets surveyed) in a small number of companies (Algaia received €4m from Maabarot in 2018, Notpla closed a seed round of £4m with mostly US funds, and Ocean Rainforest received \$1.5m from the WWF and a US trust fund).

Number of investors by nationality

(within the 92 distinct investors mapped)



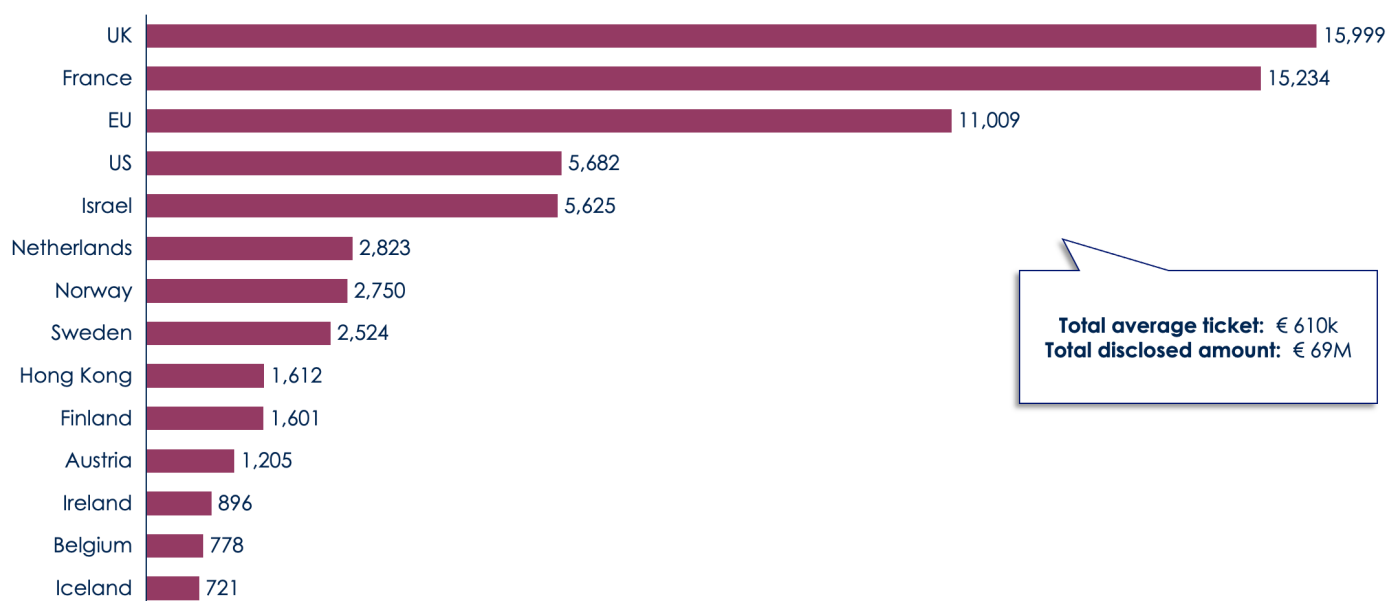
Note: Within the 92 investors and 138 investment tickets mapped by the Seaweed for Europe team. 2 of the investors could not have their nationality mapped (1 undisclosed HNWI and 1 family offices).

In the graph below, Norway is shown as a country with only a few investments mapped. This demonstrates one of the shortcomings of the analysis, as only very few Norwegian transactions have disclosed amounts.

For instance, the investment by Orkla into Arctic seaweed is not documented in terms of amounts.

Total amount invested by investors' nationality

(in '000 EUR, considering only the 67 deals with disclosed amount)



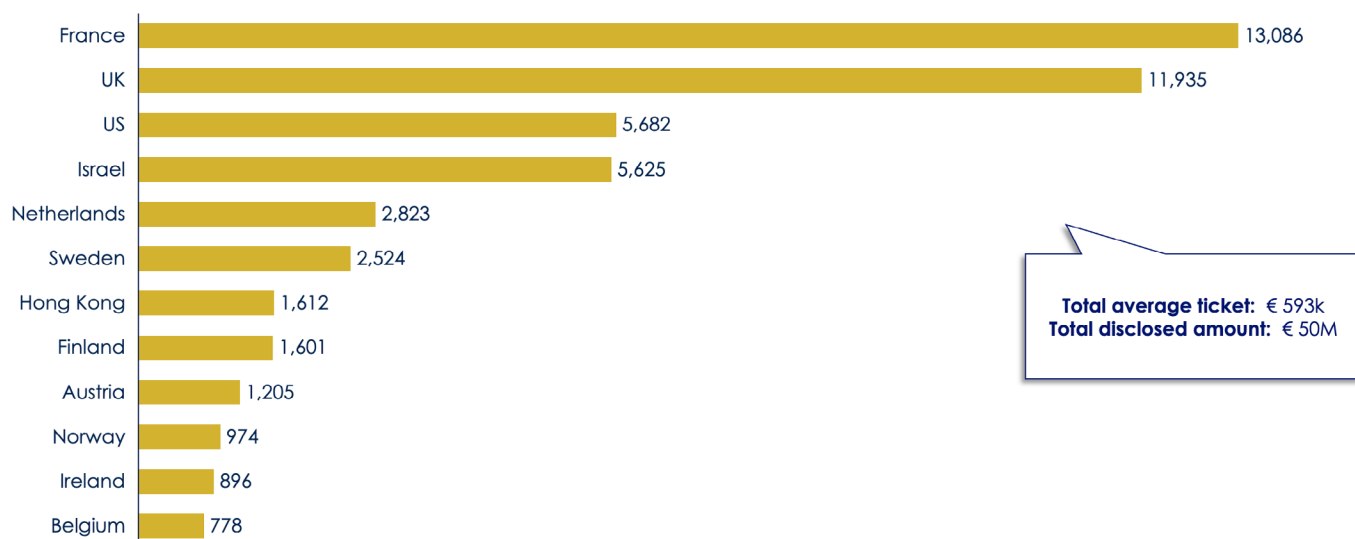
Note: Within the 92 investors and 138 investment tickets mapped by the Seaweed for Europe team. Only considered data from deals with disclosed amount of investment. Total transaction value was equally distributed among the investors except for the cases when information was explicitly disclosed for each investor.

Not including public investments, the largest investor countries are France and the UK, totalling respectively €13m with 16 investors and €11.9m investments with 10 investors respectively.

Sweden has also a large investor (9 investors) base, made up mostly of HNWI's investing smaller tickets relative to the average for the European industry.

Private capital investment by investors' nationality

(in '000 EUR, considering only the 40 deals with disclosed amount and only private capital - without DFIs/ Public entities*)



Note: Within the 92 investors and 138 investment tickets mapped by the Seaweed for Europe team. Only considered data from deals with disclosed amount of investment. Total transaction value was equally distributed among the investors except for the cases when information was explicitly disclosed for each investor.

*The DFIs/ Public entities' transactions sum €20M, representing 28% of the total amount invested.

C. Public investors and early-stage investors represent the bulk of investments

Public and development money (DFIs, public entities and NGOs) still represent the bulk of investments (€23.1m mostly in grants, equivalent to 34% of total invested amounts) demonstrating that the seaweed industry in Europe is still nascent.

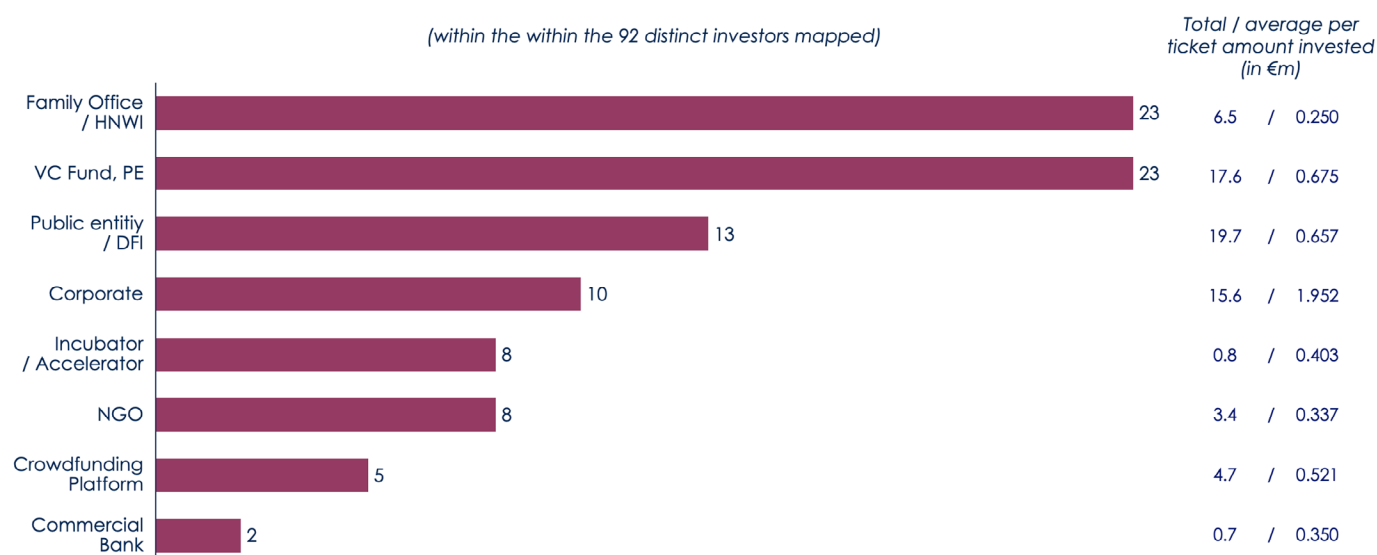
However, an ecosystem of both financial and corporate investors is growing in Europe with financial investors predominantly from retail and early-stage VC funds:

- **Early-stage investors and Private Equity:** incubators / accelerators, PE / VC funds totalling 31 investors with €18.4m invested and respective average tickets of €403k and €675k

- **Retail:** Crowdfunding platform and HNWI totalling 28 investors with €11.2m invested and respective average tickets of €521k (for the entire platform) and €250k
- **Corporates:** 10 corporates have invested in seaweed with a total of €15.6m in 7 companies and average tickets around €1.9m
- **Late-stage investors:** commercial banks totalling 2 investors with €700k in investment.

The limited presence of late-stage investors is another sign that the seaweed industry is still nascent, despite its fast growth and the growing interest of investors.

Investors' breakdown by background



Note: Within the 92 investors and 138 investment tickets mapped by the Seaweed for Europe team. Only considered data from deals with disclosed amount of investment. Total transaction value was equally distributed among the investors except for the cases when information was explicitly disclosed for each investor.

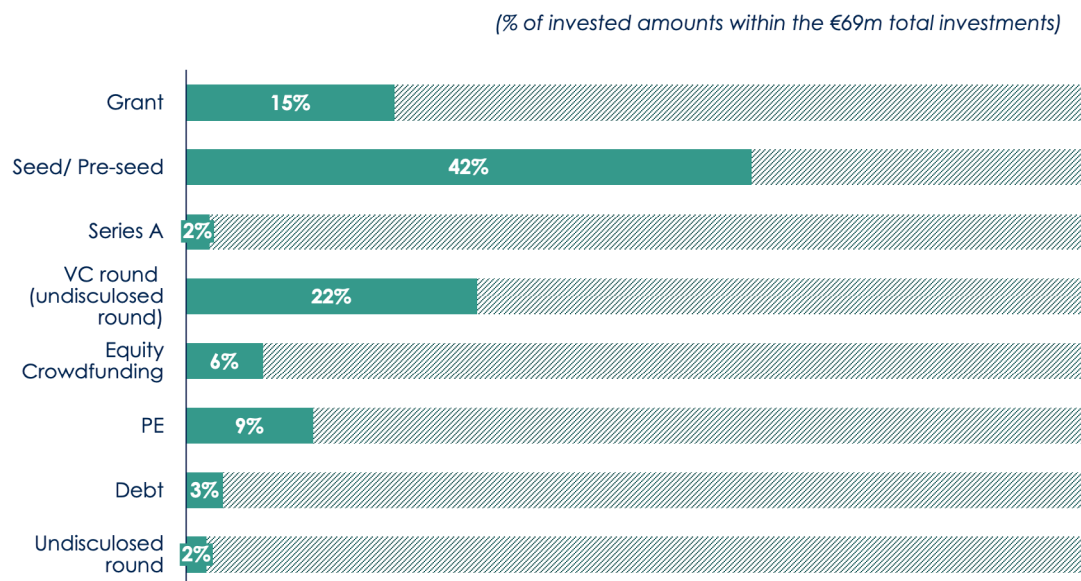
D. A universe of investment driven mostly by early-stage equity funding and grants

Given the types of investors involved and the relatively nascent nature of the industry in Europe, most of the investments are in the form of early-stage equity funding (pre-seed, seed, venture, and equity crowdfunding equal €48.8m, or 70% of total surveyed investment amounts) or grants (€10.6m, or 16% of total surveyed investment amounts) with average ticket sizes of €610k and €393k, respectively. As explained, the large and increasing portion of grant funding is also a positive sign of increased public attention in this industry. Having access to grants allows the industry to thrive and innovate quickly. However, given the methodological biases raised

earlier, it is highly likely that companies are also raising bank debt directly, which is rarely publicly disclosed and thus not covered by this analysis.

Besides, late-stage equity and debt funding are also taking an increasingly important role with €8.4m or 12.2% of total amounts invested in 10 companies (respectively 6 for PE and 4 for debt funding). Late-stage and debt funding show that some companies in the industry have proven their economic models and have thus opened the door to larger institutional investors and longer financing tenors than the existing bulk of venture and concessional capital.

Total investments' breakdown by investment maturity



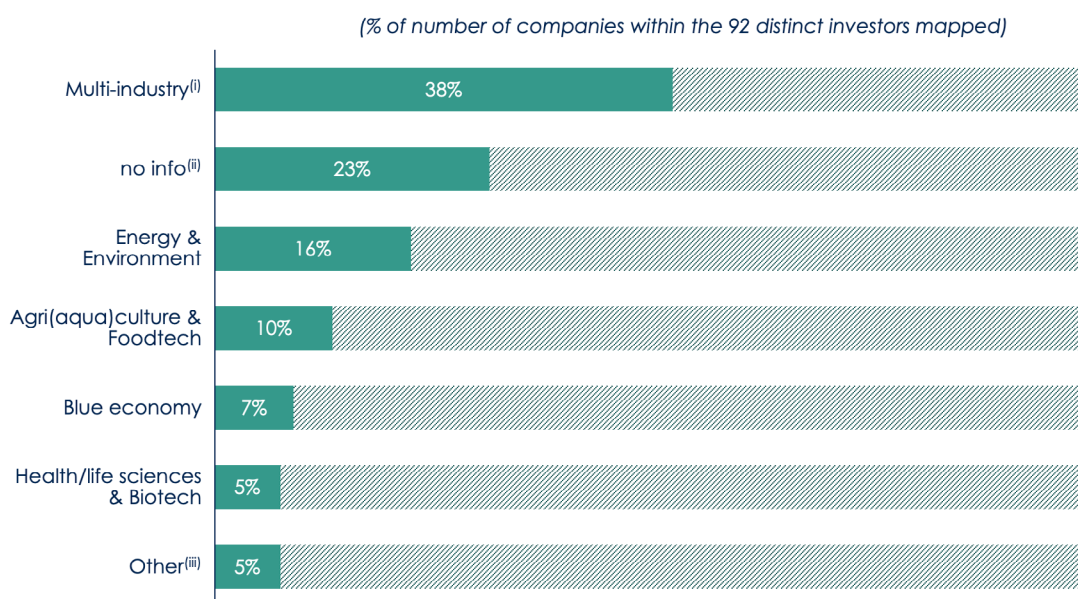
Note: Within the 92 investors and 138 investment tickets mapped by Seaweed for Europe team. Only considered data from deals with disclosed amount of investment. Total transaction value was equally distributed among the investors except for the cases when information explicitly disclosed for each investor.

E. Seaweed investors have mostly multi-industry strategies and have rarely more than one seaweed investment in portfolio

The universe of the 92 investors identified is very large and not particularly trusted by specialized / niche investors: 35 are multi-industry focused.

Only 6 are primarily focused on blue economy and 15 on sustainable investments. The rest are also investing in combination of food, animal feed and cosmetic technologies.

Investors' breakdown by primary area of interest



Note: Within the 92 investors and 138 investment tickets mapped by Seaweed for Europe team. (i)multi-industry includes company with a diverse investment portfolio, (ii)no info refers to HNWI; (iii)Other includes: Media & Technology, Textiles & Apparel, Real State, Professional Hygiene & Cleaning, Chemical Industry.

Seaweed investments are generally part of a broader portfolio and not indicative of a specific seaweed strategy: out of the 92 investors, 66 have undertaken only one investment in seaweed and 17 between 2 and 3. Only the European agency EASME has performed more than 8 investments in different companies within the seaweed space.

Given the numerous different outputs of the seaweed industry, investors are investing in companies which can serve many industries, ranging from food consumption to animal feed, cosmetics, and health care.

However, investors have also concentrated on three outputs: food consumption (23 investments in companies purely focused on food consumption), animal feed (20 investments in companies purely focused on animal feed) and bioplastics (13 investments in companies purely focused on bioplastics).

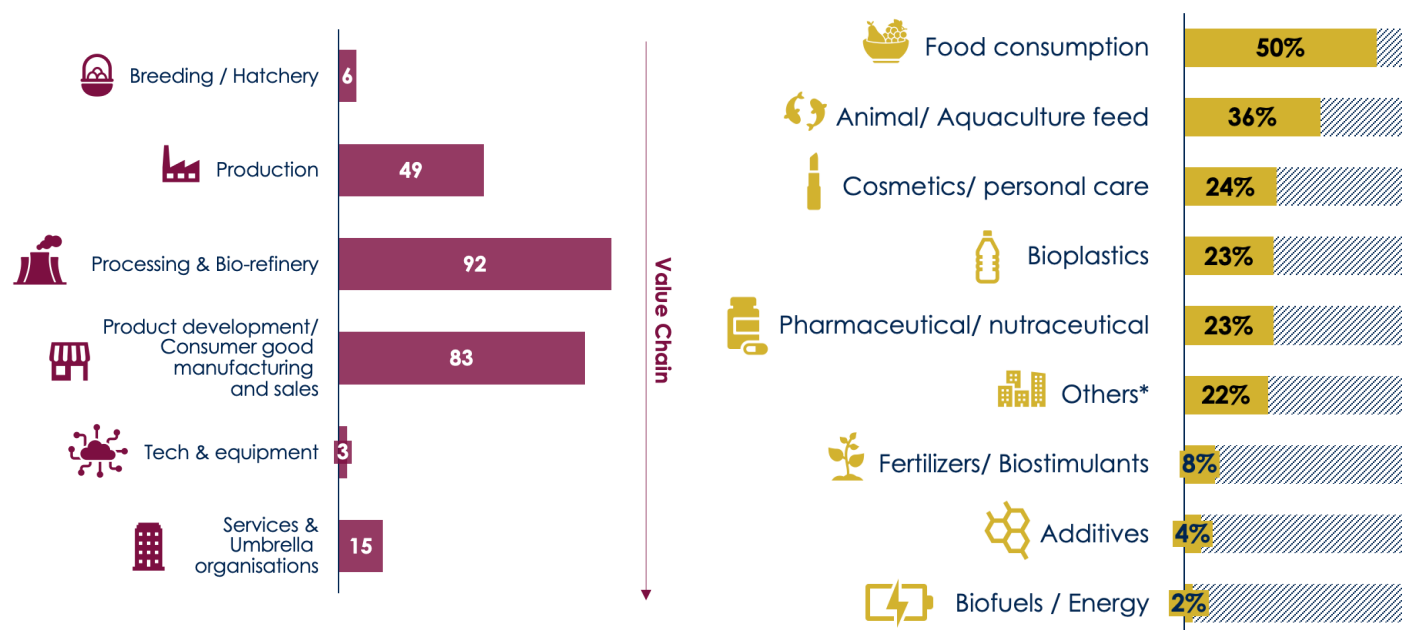
Most of the investors are focusing on product development and seaweed processing companies; out of the 92 investors, 29 have invested in companies focused solely on consumer good manufacturing and sales.

A smaller number of investors have invested in production facilities, with these investments typically pertaining to large-scale and/or industrialized seaweed producers (e.g., Algodesko, Arctic Seaweed, Ocean Rainforest).

However, many investors have also financed companies which are vertically integrated either entirely from production to consumer good manufacturing (13 out of 138 total investments), or partially, from processing to selling the transformed goods, but without producing directly (34 out of 138 total investments).

Investor's interest breakdown by stage of value chain and seaweed application

(within the 138 investors' tickets mapped)



Note: Within the 92 investors and 138 investment tickets mapped by the Seaweed for Europe team. Companies can have more than one application and/ or area of interest; *Other applications refers mostly to textile material, tourism activities and pigments, inks, dyes, and coatings.



2. Deep dive on VC and PE

A. VC and PE funds are targeting companies with high value-add products

Out of the total €17.5m invested by VC and PE funds, more than 90% are targeted at companies developing consumer goods or processing seaweed to produce high value add goods.

Most of funds are targeting high value-added products or sustainable applications of seaweed: 7 funds have invested €4m in bioplastics and 2 have invested €1.2m in pharmaceuticals. Similarly, the French fund Xange has invested €2m in 2014 as private equity round in Algologie.

Venture Capital and Private Equity funds investing in the European seaweed industry have diverse profiles. However, the UK (€2.8m invested over the period by Sky Ocean Ventures, Blue Wire Capital, Business Enterprise Fund, Green Angel Syndicate, SyndicateRoom), France (€7.3m invested over the period by Xange, Breizh Up, Super Nova Invest, Demeter Partners, Cea Investissement, Karista (former Capdecisif Management) and the US (€2.9m invested over the period by SOSV, Torch Capital and Glass Wall Syndicate, Kingfisher Capital) account for most of the VC/ PE investments.

B. European case studies

- **Astanor Ventures** is a venture capital firm based out of Brussels (Belgium), focusing on entrepreneurs creating regenerative solutions in the food, blue ocean economy, and agriculture sectors. It is specialized in early and late-stage venture capital and has 16 investments in its portfolio. Together with other investors, it invested £4m in January 2020 as a seed round in Notpla, a company developing biodegradable packaging material made out of seaweed and plants.
- **Arax Capital Partners** is an Austrian biotech and high-tech early-stage investor with an exclusive focus on Austrian ventures. It has undertaken 38 investments in early-stage ventures. From 2011–2013, it invested a total of €1.2m (3 rounds) in Marinomed, a biopharmaceutical company that develops innovative products to treat respiratory and ophthalmic conditions. One of its products, Carragelose, is an antiviral polymer produced from red seaweed.

- **Blue Wire Capital (BWC)** is London-based multi-strategy investment firm, founded in 2013. It has global reach, investing in multiple asset classes, with a focus on backing early and growth stage technology companies. In March 2020, BWC invested €800k as a seed round in the Irish company Ocean Harvest Technology Limited, an Ag-Tech company developing prebiotic solutions for animals and humans using macroalgal sources.

C. Non-European case studies

- Horizon Ventures is a venture capital and private equity firm based in Hong Kong, focusing on funding disruptive and technology-focused start-ups. Currently it has 105 investments from around the world in its portfolio. In 2018, together with other investors, it invested \$2.2m (seed round) in Algiknit, an American biomaterials company developing renewable yarn from kelp⁵⁸. In March 2021, they announced another investment of \$2.4m in a new funding round, together with SOSV and Fashion for Good⁵⁹.

VCs analysed for the European case studies



VC analysed for the non-European case study



3. Deep dive on accelerators and incubators

A. Some North European accelerators and incubators are supporting seaweed entrepreneurs

Out of the 92 investors surveyed, 8 are considered as incubators or accelerators, and 2 are non-European ones (Plug and Play and Imagine H2O are based in the US), 5 are from Northern Europe (Bioinnovation Institute Foundation and Accelerace in Denmark, Fashion For Good in Netherlands, TechFounders in Germany, and Katapult Ocean in Norway) and 1 is affiliated with the European Union itself (Climate KIC Accelerator).

As per the business model of the accelerators, including providing sweat equity or having special investment clauses with their mentees, most of the transactions surveyed did not disclose amounts. Hence, there is a strong bias in our analysis given the lack of information on amounts. However, looking at the primary interest of the accelerators, most of them are targeting high added value products or sustainable applications of seaweed: all the 8 have invested in companies developing consumer goods or processing seaweed to produce high value-add goods.

B. Case studies

- **Katapult Ocean:** is a Norwegian fund with accelerator programs and impact funds that invest in the world's leading impact-tech companies within the blue economy. It has invested in 2 seaweed-related companies:
 - » **Oceanium:** Katapult invested \$150k in 2019 in Oceanium, a company developing and manufacturing food & nutrition products and marine-safe, home compostable bio-packaging materials from sustainably farmed seaweed.
 - » **Ocean Rainforest:** the Faroe island-based seaweed producer is part of Katapult Ocean's portfolio of companies. It also raised €1.5m in 2020 from WWF and the Jeremy and Hannelore Grantham Environmental Trust.
- **Accelerace:** is a Danish accelerator founded in 2008. The firm seeks to invest in fintech, edtech, cleantech, internet of things, digital health, food tech, biotech, medtech, utilities and media sectors. The Danish seaweed food processor Nordisk Tang – Nordic Seaweed Aps is one of the companies incubated by Accelerace.
- **Plug and Play:** is a seed and early-stage investor founded in 2006. Initially located in the Silicon Valley, today it has a wide European footprint today. It runs 12 industry-specific accelerator programs twice a year, that acts as platforms for major corporations and start-ups to connect and collaborate. One European seaweed company is part of its accelerator's programs:
 - » **Fermbiotics:** is a Danish human health and microbiome focused company developing natural fermented seaweed and plant products for supporting gut health. It is currently part of a Plug and Play accelerator program.

Companies analysed in the accelerators' case studies



Katapult
Ocean



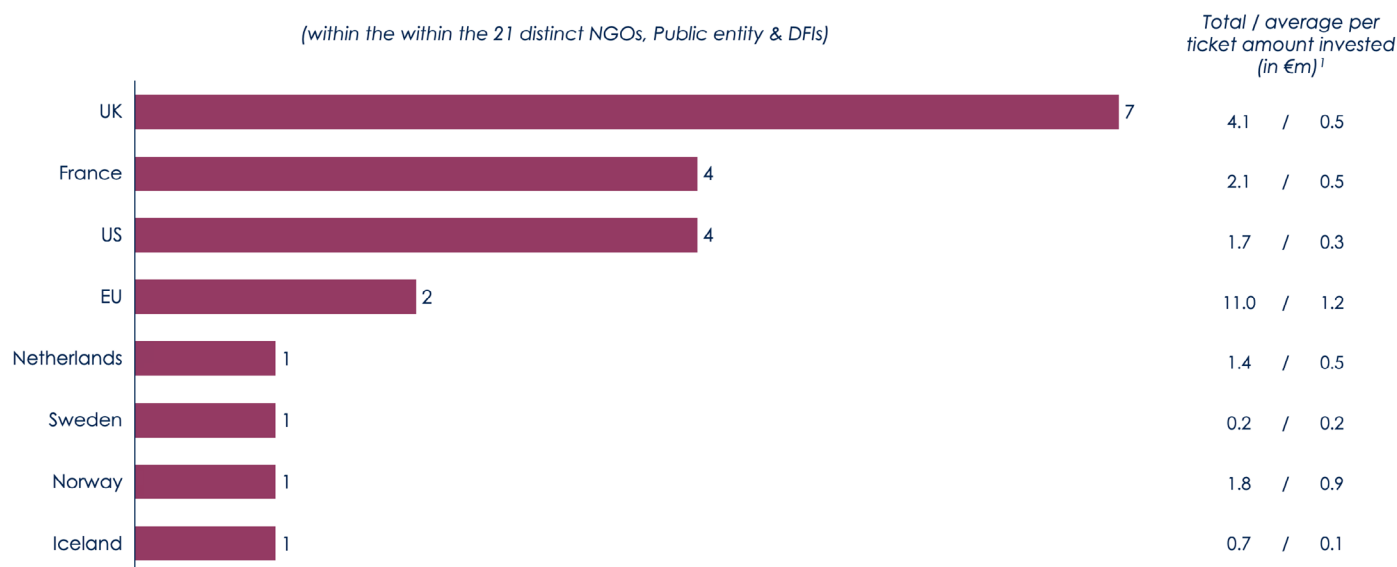
ACCELERACE

PLUGANDPLAY

4. Deep dive on catalytic capital

A. Acknowledging the benefits of the industry, philanthropies and DFIs are increasingly providing grants and equity investments to seaweed players

Catalytic capital breakdown by geography



Note: Note: Within the 92 investors and 138 investment tickets mapped by the Seaweed for Europe team. *Only considered data from deals with disclosed amount of investment. Total transaction value was equally distributed among the investors except for the cases when information was explicitly disclosed for each investor.

Different types of players are acting as catalytic capital providers in the European seaweed space. NGOs (mostly US or Swedish) are investing in seed rounds or providing grants to:

- Foster seaweed production (e.g., WWF and Jeremy and Hannelore Grantham Environmental Trust with Ocean Rainforest); or
- Nudge the development of new applications for seaweed (e.g., The Kjell and Märta Beijer Foundation with Volta Greentech – new feed supplements).

Public entities remain among the biggest investors in the European seaweed space, playing fully the role of catalytic capital. These public entities are either:

- Supra-national bodies like the European Union (mostly through the Executive Agency for SMEs and the European Maritime and Fisheries Fund) or the Postcode Lotteries Green Challenge.
- National entities like government bodies (e.g., UK coastal communities fund, Innovate UK, The Technology Development Fund in Iceland), DFIs (e.g., Highlands and Islands Enterprise, the Scottish Investment Bank, the French ADEME).
- Subnational / regional bodies like French region (e.g., conseil Regional d'Aquitaine in France).

B. International not-for-profit institutions are major contributors to the seaweed investment ecosystem

Out of the 92 investors surveyed, 8 are NGOs or philanthropies. Of these 8, the 4 largest are international or US-based ones (WWF, James Dyson Foundation, David and Lucile Packard Foundation and Jeremy and Hannelore Grantham Environmental Trust concentrate 51% of the total NGO investments mapped in European seaweed industry). These not-for profits are either private foundations (Beijer stiftelsen, Jeremy and Hannelore Grantham Environmental Trust, James Dyson Foundation), corporate-linked bodies (Stichting DOEN, Virgin StartUp) or global NGOs (WWF).

Not-for-profit institutions are major contributors to the seaweed investment ecosystem, regardless of output. However, given the small sample and the large diversity of these not-for-profit organisations, it is difficult to say that they have a common primary interest. Indeed, the 8 NGOs have invested across the value chain and in various types of outputs.

Bioplastics seems, however, to attract the focus of these NGOs, given the positive environmental impact of seaweed packaging and compostable plastics.

C. Case studies

- **Bezos/ WWF:** The Bezos Earth Fund has awarded the World Wildlife Fund (WWF) \$100m to accelerate the most promising solutions that harness the power of nature to provide for communities and stabilize the climate. Among others, it will enable WWF to develop new markets for seaweed as an alternative to fossil fuel-based products and to protect forests and other ecosystems from destruction in some of the most important landscapes in the world. Through this initiative, WWF will drive increases in seaweed demand and supply for animal feed, proteins, and biodegradable bioplastics, to significantly reduce greenhouse gas emissions. WWF's first investment through this initiative is in Ocean Rainforest: WWF contributed \$850k of the \$1.5m equity raised in 2020 by this sustainable seaweed producer in Faroe Islands. More recently, WWF has co-led a Seed II Round worth over £2m alongside Green Angel Syndicate, with the participation of other investors⁶⁰.
- **Scottish Investment Bank (SIB):** The investment arm of Scotland's main economic development agency, and Highlands and Islands Enterprise (HIE) supported a £1.7m investment round for Shore Seaweed⁶¹, a plant-based snacks and foods company based in Alness (UK), in 2020.

The SIB has taken an equity stake with undisclosed private investors and the financing was completed by a business development grant from HIE.
- **The Nature Conservancy:** As part of a fishery reform effort at the national level, The Nature Conservancy (TNC) is working with fishing communities in Belize on a pioneering sustainable seaweed aquaculture project that provides solutions to both people and nature. Seaweed farming and its restorative functions have provided an alternate and complementary source of income, new employment, recovery of local fisheries, and returned the colours of marine life to the Caribbean coast.
- **Oceans2050:** this philanthropic organisation has launched a global study assessing the role of seaweed aquaculture as a key recovery wedge for the world's oceans and the climate crisis. The 15-month study will quantify carbon sequestration by seaweed in sediment across seaweed farms on five continents. These efforts are meant to provide a scientific foundation to support the development of a new voluntary carbon protocol for seaweed aquaculture, which will allow seaweed farmers to monetize the carbon impact of their activities for the first time.

Companies sourced for the catalytical capital case studies



IV. AN INCREASINGLY ATTRACTIVE BUSINESS ENVIRONMENT TO SUPPORT THE INNOVATIVE SEAWEED BUSINESS ECOSYSTEM

1. Growing political momentum in Europe

At global level:

The High-Level Panel for a Sustainable Ocean Economy (Ocean Panel), made up of fourteen serving Heads of State and Government, has already recognised seaweed as a promising ocean-based solution to help counteract climate change and support the UN Sustainable Development Goals ("UN SDGs"). The 14 political leaders published and co-signed a document in December 2020 with priorities they have committed to work on to accelerate the sustainable ocean economy. Seaweed is well represented in this document as it prioritises: *"Scale up [of] environmentally responsible commercial farming of seaweed and algae to provide food and create alternatives for products such as fuels, aquaculture and agriculture feedstocks, biotech, and viable and sustainable plastic alternatives."*

Similarly, the Seaweed Manifesto published by the UN Global Compact in June 2020 spoke out in favour of scaling the industry.

At the European Union level:

Seaweed's climate change mitigation potential is considered by the European Commission (through the DG MARE) as a mean to support the EU Green Deal's target of a 55% reduction in greenhouse gas emissions by 2030 compared with 1990 levels⁶²:

- **The European Green Deal:** an initiative led by the European Commission to transform the EU's economy for a sustainable future by financing the transition, mobilising research and fostering innovation with the goal of achieving four main outcomes: 1) zero pollution for a toxic-free environment, 2) preserved and restored ecosystems and biodiversity, 3) a fair, healthy and environmentally friendly food system; 4) accelerating the shift to sustainable and smart mobility
- **EU Algae initiative:** the European Commission is preparing a comprehensive cross-sectoral EU algae initiative. The aim of the initiative is to increase the sustainable production, consumption and use of algae and algae-based products. Because of their small carbon and environmental footprint, raising the profile of algae will help achieve the

objectives of the European Green Deal, and support the transition to a green, circular and carbon-neutral EU. Five initial objectives have been set for the EU Algae initiative:

1. Improve governance frameworks (e.g., guidance, standardization)
2. Support functioning of the market (e.g., novel algae species, funding)
3. Improve business environments (e.g., one-stop-shop/assistance mechanism)
4. Increase social awareness and acceptance (e.g., communication, labelling)
5. Close knowledge, research and innovation gaps (e.g., developing improved systems, algae innovation, new methods, carbon sequestration, etc.)

• DG MARE initiatives:

» Awareness raising:

- ◇ #TasteTheOcean: campaign from the EU with top chefs across Europe to encourage consumers to buy and enjoy sustainable fish and seafood
- ◇ Euronews "Oceans"
- ◇ European Maritime Day with stakeholders workshops and MARE policy sessions
- ◇ Blue bioeconomy report 2020: IMTA, fish RRM, cellular mariculture
- ◇ EU4Ocean for ocean literacy

» Blue funds: Blue Invest, Annual Blue economy calls

Within European countries:

In the Netherlands: The North Sea Agreement was developed through a joint consultation of all Dutch users of the North Sea, with the aim of ensuring an integrated evolution of ocean industries. The marine spatial planning approach in this document notably proposes that the authorisation of every new offshore windfarm is contingent on combined use of the relevant area with other sustainable ocean activities. Seaweed farms are mentioned as one way to use the space between turbines. The Agreement is currently being reviewed by the Dutch parliament⁶³.

2. Corporates are investing in seaweed to secure a sustainable supply from an industry with rapidly growing demand

A. Corporates securing supply from an industry with a rapidly growing demand

Corporates investing in seaweed are mostly motivated by (1) securing a sustainable supply of a product given rapidly growing demand (e.g., Orkla with Arctic Seaweed, Maarabarot investing in Algaia); (2) developing new technologies and/or consumer products to grow revenues (e.g., Symphony environmental technologies with Eranova, Unilever and Innova Partnerships). Thus, corporates act both as off-takers and investors in the seaweed space, taking strategic equity investments (minority stakes) or majority shareholdings in production or transformation companies and / or signing long-term large volumes commercial contracts to secure a supply which (1) is traceable, (2) is likely to be critical given the rapid growth of seaweed consumption.

Out of the 92 investors surveyed, 10 are corporates, and the largest investor is from Israel (Maarabarot investing in 2018 €4m in the French company Algaia). Amounts and terms and conditions of transactions are not often disclosed, but it is clear that there is already nascent M&A activity around seaweed, and that actors are starting to merge into vertical groups encompassing the entire value chain of European seaweeds.

Corporates' primary interests are in human food consumption and in companies producing and processing seaweed (in contrast to VC funds and accelerators). Out of the €15.6m invested by corporates, €15.3m is invested in seaweed producers or processors. These investments demonstrate corporates' interest in securing the supply of a commodity which is of growing interest to European end-consumers.

Corporates also play an important role in showcasing and communicating the positive reception from end-consumers to seaweed products. For example, Waitrose is effectively

demonstrating growing demand from consumers for seaweed products, as it has experienced sales of seaweed products up 23% in 2020 when compared to 2019, and an impressive 71% increase when compared to 2018. Customers are also looking for inspiration on Waitrose.com, with searches for 'seaweed' up 141% compared to last year and searches for 'crispy seaweed' up 18%. The trends show consumer appetite for seaweed products as well as the power of large brands to push and advocate for seaweed.

Beyond the traditional investments explored in this report (i.e., grant, equity, and debt) other types of financial instruments could also be explored to enhance the European seaweed industry, for example financing trade with the support of offtake agreements, especially for seaweed farms and processors. Corporates acting as both investors and off-takers are likely to be among those most open to these financial products.

Trade finance is a form of financing that facilitates international trade and commerce, focusing on the security afforded by physical collateral and receivables, independent of the borrower's balance sheet – which may render it more accessible for SMEs. Such secured finance allows the risks of the transaction to be viewed somewhat independently of the credit of the borrower with a high level of recovery likely against the underlying secured asset in the event of default or insolvency. This type of guarantee binding the producers and/or processors of seaweed with buyers enables the development of a market for output and a long term and high-volume demand for seaweed without the requirement of external capital, such as debt or equity investments. Despite this, a large trade finance gap remains for small borrowers^{xi}.

B. Case studies of corporates interested in seaweed investments:

- **Arctic seaweed:** Nordisk Tang (Nordic Seaweed), a Danish Company, is a significant player within fine foods in Scandinavia. It has pioneered the market for gourmet food products with seaweed as a key ingredient. In 2018, A Norwegian group of investors led by the company Arctic Seaweed has invested a large, but unknown amount of money in Nordisk Tang. Arctic Seaweed is a Norwegian seaweed company cultivating, processing,

and distributing kelp with new sustainable and scalable technologies. The deal was motivated by strong synergies between both companies to develop a solid and complete value chain. With the investment, for example, Nordisk Tang had access to a fermentation process that the Norwegian investment group has largely relied on, which is extremely important for improving the food development process.

- **Orkla:** has been vocal about its commitment to embedding sustainability within its business model, and joined the UN Global Compact in 2015, placing the SDGs firmly on its agenda. In line with those principles and capitalising on its prominence in the Norwegian food market, Orkla is actively assessing the role seaweed can play in its business in the future, exploring innovative applications in packaging and its potential as a major or minor ingredient in food products. As a first step, Orkla recently set up an ocean-focused subsidiary, which has already acquired shares in a Norwegian company Arctic Seaweed⁶⁴.

- **Unilever:** and Innova Partnerships have formed an uncommon joint venture to market a seaweed-derived compound that the company claims can create self-cleaning surfaces; the applications of which are wide-ranging, from odour-proof shoes to banknotes. The product – named Lactam – rather than killing bacteria prevents microorganisms forming biofilms on surfaces by microorganisms by disrupting their communications⁶⁵.

- **Maarabarot:** In 2017, Maarabarot, a leading provider of Health and Nutrition products for the Human and Animal market co-invested into Algaia with Demeter Partners, a Venture Capital firm. In 2018, Algaia received €4m in follow on funding from Maarabarot to expand its algae product portfolio and extraction technology. The investment by Maarabarot showcases the interest of non-European corporates in the European seaweed space, motivated by European seaweed industry's R&D capabilities and potential to develop high-added value products.

- **SAPEC:** is a Portuguese multi-industrial group originally focused on phosphate fertilizers which sold its core agrobusiness in 2016, and used the sale proceeds to invest in various industries including seaweed. In 2019, it purchased 31% of Algaia (through the purchases of Demeter Partners shares)⁶⁶. Reinforcing its commitment to continue growing in the seaweed sector, as part of an overall strategy focused on healthy &

sustainable food, in February 2021, SAPEC purchased 57% of ALGApplus, a Portuguese seaweed producer⁶⁷.

- **Symphony Environmental Technologies:** is a producer of a wide range of polymer masterbatches and additives for the bioplastics sector, has signed a collaboration agreement and commitment to a strategic investment with French biotechnology start up, Eranova. The latter has developed a technology which extracts starch from green algae stranded on beaches in Brittany. This starch is then used, for example, to produce a range of compostable and biodegradable bioplastics.

Although Eranova's focus is not on seaweed but rather on the use of microalgae, the offtake and equity partnership remains instructive: as under the agreement, Symphony will subscribe €500k for an 8.0% holding in Eranova when the latter will be fully funded to start its pre-industrial development, with an option to increase its stake to 51% in one or more tranches at any time within three years of the initial investment. In addition, Symphony will have the right to buy 75% of Eranova's compounds made in the Middle East and North Africa, for sale as compounds or manufactured finished products within the Middle East region exclusively, and on a non-exclusive basis globally, except thirteen (mainly European) countries for which Eranova will have exclusivity⁶⁸.

- **DuPont's Nutrition & Biosciences division:** is a world leader of innovative and sustainable solutions across the food, health, pharma, and biotech industries. In collaboration with the Anderson Cabot Center for Ocean Life at the New England Aquarium, they have established the Sustainable Seaweed Program, starting in Haugesund, Norway, to develop more sustainable seaweed harvesting and cultivating practices. As Nutrition & Biosciences is one of the world's largest buyers of seaweed for hydrocolloids, this seaweed initiative is a part of a strategy to develop and implement sustainable sourcing for 90% of all bio-based raw materials⁶⁹.

Companies sourced for corporates interested in seaweed investments case studies



C. Case study of trade finance facilities applied to the seaweed industry

- **Meloy Fund:** is an impact investment fund focused on sustainable fisheries in Indonesia and the Philippines. During the pandemic, the Meloy Fund offered a pre-production purchase order financing through its new Rapid Response Loan Program (RRLP) to two seaweed trading and processing companies in the Philippines. The purpose of this short-term funding was to enable the companies to resume business operations, ensure ongoing employment for their staff, and continue sourcing from over 1,000 small scale seaweed farmers – providing stable incomes and allowing much-needed food products to flow through global supply chains.

Building on the RRLP, the Meloy Fund is in the process of expanding its sustainable trade finance facility to support companies working in the seafood and aquaculture sectors in the U.S. and Europe to grow responsible supplier networks, particularly in its target markets and in the production and delivery of sustainable, high-quality marine products including seaweed^{xii}.

The Meloy Fund has two trade financing products which could be replicated for intra-European or inter-regional/global trade transactions (the duration of these financing schemes is normally 30–60 days):

- » **RRLP Program (pre-production purchase order financing):** \$500K–1m limit approved per seaweed supplier to draw pre-production funds as necessary to procure raw goods required to fulfil the PO. The seaweed trader/processor is the borrower as it is pre-production financing. Off-takers can be distributors or transformation companies further up the value chain.
- » **Export Finance Program (post-production purchase order financing):** \$200K–500K per clip per approved supplier, total customer approved line of \$2m. The importer/distributor is the borrower. Off-takers can be distributor, transformation companies or national level retailers.



V. CALL TO ACTION

The time is right to invest in a sustainable and booming European seaweed industry, particularly because:

- 1. The seaweed industry is facing a very favourable economical and political environment**, as it benefits from a growing political support at global, national, and local levels as well as an increasing interest from large corporates.
- 2. There is a solid and diversified range of seaweed companies that are ready for investment**, and which are seeking capital to develop within a fast growing market. For instance, 85% of the out of the 223 companies in scope have a TRL above or equal to 8.
- 3. Companies are still valued low compared to their peers.** For example, the businesses sourced for this study which are creating innovative seaweed products have similar valuation to sales ratios as for plant-based food companies, even with lower level of revenues, which highlights the great potential of this seaweed industry niche.

To get more information about the seaweed industry:

- Contact the Secretariat of the Seaweed for Europe Coalition (seaweedeurope@systemiq.earth)
- Learn more about seaweed applications and economics, watching the selected videos available in Annex I.

Follow Seaweed for Europe:

- [LinkedIn](#)
- [Twitter](#)
- [Website](#)



“Sustainable seaweed is Europe’s next hidden champion. We are only starting to understand the value of seaweed as a climate-friendly source of food, feed or biomaterial. It allows us to use the European seas and create income whilst storing CO2 and restoring coastal economies. Asian countries have started to recognize the promise of seaweed. Now it’s Europe’s turn.”

Martin R. Stuchtey, Co-Founder of SYSTEMIQ & former Director of the McKinsey Centre for Business and Environment

ANNEX I: LIST OF VIDEOS TO LEARN MORE ABOUT SEAWEED

- **The Importance of Seaweed | Ocean Vet | S01 E10 | Free Documentary Nature**

<https://www.youtube.com/watch?v=m9A36BDDv3c>

- **Why demand for seaweed is about to boom**

<https://www.cnn.com/video/2020/09/19/why-demand-for-seaweed-is-about-to-boom.html>

- **Seaweed: sustainable crop of the future? | FT Food Revolution**

<https://www.youtube.com/watch?v=Y3zllorFC8g>

- **Seaweed farming: an economic and sustainable opportunity for Europe**

<https://www.youtube.com/watch?v=kmmjbGRIReA>

- **This seaweed can fight climate change**

<https://www.youtube.com/watch?v=RtG24Vmwyzw>

- **Can seaweed help curb global warming? | Tim Flannery**

<https://www.youtube.com/watch?v=tuvxXnQrRv8> Farming The Ocean To Feed The World |

- **Scott Lindell | TEDxCambridgeSalon**

<https://www.youtube.com/watch?v=fVMOjSB5cuE>

- **The Seaweed Project**

<https://www.youtube.com/watch?v=w68Tdm7TwVU>

- **Is algae the food of the future? | Mission Ahead CNN Business**

<https://www.youtube.com/watch?v=tAdrNQNP8ew>



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NOTES

- i. Considering only the 221 European established companies and start-ups
- ii. AlgiKnit, an US-based company, which received an important amount of funding in March 2021
- iii. Of which 9 names were not disclosed in the deal
- iv. Considering multiple investors in the same round as different transactions
- v. At an average annual exchange rate of €0.8475 to USD 1
- vi. At an average annual exchange rate of €0.8475 to US\$1
- vii. For wild harvesting to be part of a sustainable European industry in 2030, the process must in any event be carefully managed to protect ecosystem health. This calls for the avoidance of harmful practices, including the over-exploitation of seaweed resources, harvesting that depletes specific species, and excessive removal of holdfast material (similar to roots).
- viii. World Widelife Fund: leading organization in wildlife conservation and endangered species.
- ix. At an exchange rate of €0.8422 to US\$1 on 5 August 2020 – the day of the news announcement.
- x. Ibid
- xi. Interview with Meloy Fund representative
- xii. Interview with Meloy Fund representative

