

Marine Biotechnology RTDI in Europe Strategic Analysis

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Report on strategic analysis of marine biotechnology RTDI in Europe

Part of Task 3.3

Preliminary Analysis of the European Marine Biotechnology RTDI
Landscape

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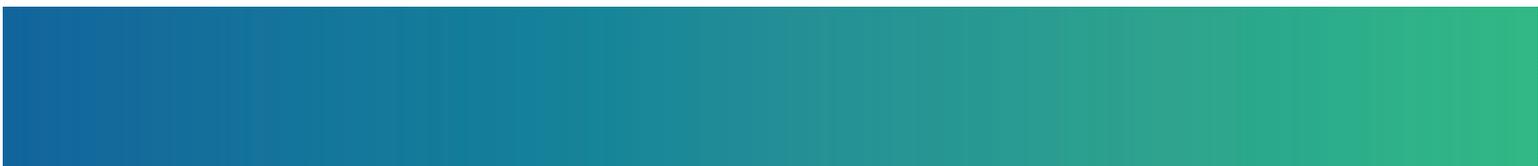


Table of Content

Introduction: about this report	3
Marine biotechnology in European countries.....	5
Science policy landscape	5
Research priorities.....	7
Infrastructures.....	7
Sub-national regional and local level collaborations	7
Conclusions and observations	8
European Regional Sea level	10
Pan-European level.....	11



1. Introduction: about this report

This report¹ provides a high-level analysis of the information collected during the CSA MarineBiotech project on the current marine biotechnology science policy landscape in Europe. The report is an output of work Package 3 of the CSA MarineBiotech (Mapping the Marine Biotechnology RTDI Landscape) and has two main objectives: (i) to provide an essential information resource to guide the funding agencies interested in developing an ERA-NET in the area of marine biotechnology research and development; and (ii) to develop a preliminary overview and analysis of the situation in Europe at national, regional and pan-European level to interested stakeholders. The first objective is important because the main aim of the CSA MarineBiotech is to prepare the foundation of a potential ERA-NET in the area of Marine Biotechnology. The second objective is important as a starting point for a long term effort to improve our understanding of the marine biotechnology landscape in Europe to inform future policies and coordination efforts at various geographic scales.

This document should be considered as a *preliminary* analysis due to the limited nature (in time and scope) of the CSA landscape profiling exercise. The baseline information about marine biotechnology science policy, funding and coordination efforts in Europe collected in the framework of the CSA is based on available online information sources and contributions from project partners and external experts and stakeholders. The CSA landscape profiling exercise did not aim to be complete or final, but should be considered as a first attempt to gain a high level overview of some of the main policies, strategies, programmes and major efforts relevant for marine biotechnology research and development. The information will be elaborated, updated and improved on the www.marinebiotech.eu portal as more information becomes available, including further inputs from experts and stakeholders.

During the outset of the CSA MarineBiotech landscape profiling exercise, it was decided to take a qualitative and descriptive approach rather than to engage in time consuming and in depth survey with questionnaires to obtain quantitative information about the level of investment in marine biotechnology research in various countries. There are a number of reasons for the choice of this approach.

First, earlier exercises (notably the Marine Board Working Group on Marine Biotechnology and the EC KBBE Collaborative Working Group on Marine Biotechnology) had revealed a wide disparity between the approach and level of support to marine biotechnology research in different European countries and regions. Some countries have developed specific programmes to fund research while the majority support marine biotechnology activities as part of the more general marine science, biotechnology or generic science programmes. Hence, in most cases there is a serious lack of quantitative information about the contribution of marine biotechnology to the bio-economy as well as the investments by governments and private sector in R&D specifically towards marine biotechnology applications.

Secondly, in cases where research funders (both governmental and private) are willing to share quantitative information, the lack of a common understanding of what activities should be included and the total absence of a framework for measuring/recording relevant investments would make it very difficult to gather that data, for example by structured survey-questionnaires (standard way of obtaining information about the Gross Domestic Expenditure for Research and Development) which is coherent and inter-comparable among the different countries. This problem has been recognised by the Organisation for Economic Cooperation and Development (OECD) during its recent Global Forum on Marine Biotechnology (see <http://www.oecd.org/sti/biotechnologypolicies/marinebiotechnologyattheoecd.htm>). As a result,

¹ Deliverable 3.6: Strategic Analysis of Marine Biotechnology Research, Technological Development and Innovation (RTDI) in Europe



exploring options for metrics and indicators to measure the contribution of marine biotechnology to the bio-economy, investments in R&D and the return on these investments was identified as one of the possible areas for further OECD policy work at the global level.

Thirdly, in a range of other ERA-NETs and coordination initiatives (MARINERA, AMPERA, MARIFISH, SEAS-ERA, JPI Oceans etc.) research funders and programme managers have already been invited to participate in heavy interviews/questionnaires to gather data and information about science policies, public spending on R&D as well as the existing research priorities. This has resulted in a certain level of fatigue to participate in similar exercises if there is not a clear added value and return on invested time. This might be justifiable for project partners who have a contractual obligation to participate but it is unrealistic to expect the same effort on a voluntary basis at this stage.

For these reasons, the CSA decided to focus on realistic, achievable and meaningful exercise to work step by step and start gathering an overview of the status in different European countries and regions. Where possible this includes identifying common areas of interest, potential research priorities, gaps, needs and opportunities for Europe in this field.



2. Marine biotechnology in European countries

Science policy landscape

Only recently, a limited number of European countries have developed a dedicated marine biotechnology research and development plan, strategy or policy. Notable examples include Ireland, Norway and Denmark. In 2007, Ireland developed its “Sea Change² - A Marine Knowledge, Research & Innovation Strategy for Ireland 2007-2013” with a strong focus on research and development in areas such as marine biotechnology, marine technology, marine functional food and renewable ocean energy. In 2009, Norway published its first national strategy on marine bioprospecting entitled “Marine Bioprospecting³ - a source of new and viable wealth creation” which aims to better organize the utilization of Norwegian marine bio-resources. The strategy aims to strengthen bioprospecting research and promote among others innovation and development of Norwegian marine bioresources value chains, the use of marine resources and biobanks and international collaboration. In 2010, Denmark published its strategic document “The Ocean⁴ – a underutilised resource” with a focus on use of marine bioresources for biomass and healthy diets, bioprospecting for new biological principles and compounds and biofilm research. Given the considerable effort to design and implement focussed strategies in Norway, Ireland and Denmark, they have gained valuable experience and serve as examples which may be exported and adapted to other countries in Europe who wish to develop similar strategic plans. The strategic documents of these countries are therefore considered as important anchors for transeuropean collaborations in the future. It is highly recommendable that they are all fully translated in English for better mutual understanding.

However, most countries support marine biotechnology research and development under a wider strategic umbrella, either within an overarching science and technology strategy/plan, as part of a more general marine or biotechnology research plan/strategy or as a combination of both.

Portugal for example does not have a dedicated marine biotechnology strategy or plan, but the more generic marine strategy (National Strategy for the Sea) contains ample reference to the strategic importance of marine biotechnology research while currently, in practice, the research and development activities in this field still remain very fragmented.

In a growing number of countries there is also significant focus on support for activities that stimulate what is called the “biobased economy” echoing largely the European Commission's strategy and action plan “Innovating for Sustainable Growth: a Bioeconomy for Europe”⁵ which was adopted in early 2012. These Bioeconomy strategies are very relevant as they focus on greater and more sustainable use of renewable biological resources for secure and healthy food and feed, as well as for materials, energy, and other products, all areas where marine biotechnology can provide significant contributions.

Unfortunately, in some countries, very little information was freely available on the internet and additional information could not be obtained from contacting local experts, if even possible to identify relevant experts, in the scope of the CSA mapping exercise. Also, often, strategic information is not available in English which requires substantial support from local contacts in terms of interpretation also making it difficult to make an in depth analysis.

² <http://www.marine.ie/home/SeaChange.htm>

³

http://www.regjeringen.no/upload/FKD/Vedlegg/Diverse/2009/Marin_bioprospektering_080909_lavopp1.pdf - An English summary is available at the end of the document

⁴ <http://www.fvm.dk/Default.aspx?ID=18486&PID=169609&NewsID=6112&Action=1> Only in Danish.

⁵ http://ec.europa.eu/research/bioeconomy/news-events/news/20120213_en.htm

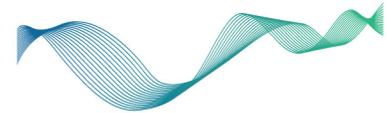


In conclusion, based on the information gathered during the landscape profiling exercise, European countries can be roughly subdivided in following four main categories:

1. Countries with a clearly identifiable marine biotechnology focus as developed in dedicated marine biotechnology RTDI plans, strategies and/or funding programmes;
2. Countries with strong marine biotechnology activities in one or more areas, but without dedicated marine biotechnology science and technology plan(s), strategies and/or programmes;
3. Countries with some interest and activities in certain marine biotechnology application areas, but without dedicated marine biotechnology science and technology plan(s), strategies and/or programmes;
4. Countries without dedicated marine biotechnology science and technology plan(s), strategies and/or programmes and where there is only limited marine biotech focus and activities.

Table 1. Overview of European countries according to the level of focus and available mechanisms to support marine biotechnology activities as identified by the CSA MarineBiotech project's preliminary landscape profiling exercise. * Based on the information that could be collected within the scope of the CSA MarineBiotech; ** Countries for which no or only limited information could be collected within the scope of the CSA MarineBiotech; * Countries with a federal structure with considerable activities in one or more specific coastal regions.**

Countries with a dedicated plan, programme or strong policy focus on marine biotech	Countries where marine biotech is supported via more wide-scope programmes and/or instruments (general science and technology plans, marine science plans and/or biotechnology plans/strategies)		
	Countries with considerable interest and/or activities in marine biotechnology research and development*	Countries with some interest and activities in marine biotechnology research and development*	Countries where there is only limited marine biotech focus and activities*
<ul style="list-style-type: none"> • Ireland • Denmark • Norway 	<ul style="list-style-type: none"> • Belgium*** • France • Germany*** • The Netherlands • Poland • Portugal • Italy** • Spain • Sweden • UK 	<ul style="list-style-type: none"> • Croatia • Greece • Finland** • Iceland • Romania • Slovenia • Turkey 	<ul style="list-style-type: none"> • Austria** • Bulgaria • Estonia** • Latvia** • Lithuania** • Malta** • Switzerland** • Ukraine**



Research priorities

The priorities identified by the mapping exercise largely confirm the relevance of the high level areas of common interest which were already defined during the EC KBBE-NET Collaborative Working Group on Marine Biotechnology. These are:

- Marine bioprospecting/biodiscovery (in particular for human health and new industrial compounds);
- Development of robust, biotechnology-based state of the art R&D tools and infrastructures tailored for marine biotechnology;
- Molecular aquaculture;
- Biomass production for bioenergy and fine chemicals.

One additional area that also seems to be re-appearing in many countries is the interest in marine environmental biotech applications and bio-sensors, among other in the context of the European Marine Strategy Framework Directive (MSFD).

In some countries (e.g. Belgium), the need for increasing communication and establishment of appropriate collaboration mechanisms to engage with stakeholders and the public have also been pointed out as key areas for improvement. This is partly based on the growing awareness of the wide range of (fragmented) markets, global value chains and application areas in the Blue Biotech arena which often make key stakeholders less obvious or less visible at the surface.

Infrastructures

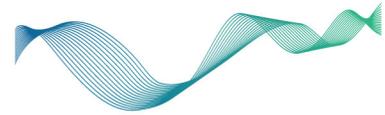
The long standing tradition in marine and biotech research in many European coastal countries is associated with world class infrastructures, including research vessels, offshore equipment, coastal and offshore stations as well as cutting edge biotechnology facilities. Unfortunately, these human capacity and infrastructure resources in marine and biotechnology research and development are not always very well connected.

Most of the aquaculture and experimental research facilities available in Europe are associated with universities and research institutes, but increasingly they are run by (or operated in collaboration with) industrial partners. These infrastructures are increasingly subject of national and European coordination efforts to pool the available infrastructure resources (e.g. screening platforms, marine stations, research vessels, large marine offshore equipments) to create the necessary economies of scale and avoid duplication (EMBRC, EURFLEETS, etc.).

Sub-national regional and local level collaborations

While overarching national, regional and Pan-European coordination is essential to provide a coherent framework, it is increasingly understood that the real progress 'on the ground' needs to happen at the sub-national regional and local level. As a result, policy makers and planners are increasing their efforts to develop more focused approaches to stimulate marine biotechnology research and development at the local level. One way this is achieved is through putting in place of regional 'bio'- and 'marine/maritime'- innovation clusters and networks (e.g. ScanBalt, CIESM) which are growing in importance, an evolution which is likely to expand even more in the future. Another consequence is that, not surprisingly, countries with a federal structure often show strong(est) support for marine biotech activities in specific regions if interest and/or of high potential.





Conclusions and observations

There is a huge disparity between the approaches, the focus and mechanisms by which various European countries support marine biotechnology research activities. Only a few have dedicated research plans and programmes focusing specifically on marine biotechnology, while the vast majority supports marine biotech research under wider biotechnology or marine science plans and programmes or both. This does not mean that countries without a specific marine biotech science plan or programme are not interested or provide less support *per se*, but it shows there are clearly very different ways in which this sector is being promoted. However, many countries lacking dedicated strategies and programmes at national level at this time seem to be considering or already developing them⁶, partly owing to the growing European and International interest and the willingness to provide a more coherent approach across countries.

While countries with a long tradition in marine activities and research are often more developed in terms of frameworks (e.g. Norway, Ireland, Denmark, Germany), there are good examples of less obvious countries that have well developed (albeit very focused) activities in the area of marine biotechnology (e.g. Austrian company sealifepharma⁷).

For countries with a federal structure, there appears to be strong engagement to support marine biotech research at the regional level (depending on the available human and infrastructure capacity or potential) because it is seen a key area for new opportunities for sustainable economic growth at local and regional levels. Installing regional bio-innovation and marine/maritime clusters is a strategy employed by several regional governments with relative good results. Clusters should be further stimulated. This means development of new clusters in other regions with region-specific focus and further support of existing ones. Under the CSA MarineBiotech and hopefully continued under an ERA-NET MarineBiotech, attempts are being made to foster collaborations between the blue biotech clusters to establish a network with the aim of share information about activities and best practices.

Given the fact that only a limited number of countries have dedicated strategies and funding programmes and most of the funding is not earmarked/ring-fenced for marine biotech, it is very difficult to make inter-country comparisons. In addition, the lack of a common understanding of what activities should be included and the total absence of a framework for measuring/recording relevant investments complicates collection of quantitative information comparable across different European countries. This has been recognized, among others by the Organisation for Economic Co-operation and Development (OECD), which will be exploring options to develop and agree metrics and indicators to measure the contribution of marine biotechnology to the bio-economy, investments in R&D and the return on these investments.

The mapping exercise revealed the general lack of information and awareness at the national level about marine biotechnology R&D activities in the private sector. Where targeted in-depth analysis where done, results revealed a substantial different picture than initially assumed, in particular in terms of industry-academic collaborations.

Finally, many countries recognise the need for stronger support for research at the demonstration stage (e.g. via pilot plants, proof of concept experiments, etc.) and for bridging the gap between the results from academic research, the initial work done by SMEs and the interest from large multinational companies able to launch a product on the market. This observation has been echoed by several stakeholders during CSA Marine Biotech activities (workshops, conference)⁸. In particular the long time and high amount of financial resources required to develop new drugs (from marine origin) and other human health applications highlights the need for market corrective measures in specific sectors and application areas which are scientifically promising and of high societal relevance but where return on investments are uncertain. A structured analysis on how state aid may be required for certain marine biotechnology sub-sectors where markets are not

⁶ Based on informal information shared by country experts and interviewees

⁷ www.sealifepharma.com

⁸ See reports of the CSA MarineBiotech workshops and conference, including the stakeholder recommendations, at www.marinebiotech.eu





promoting spontaneous investment, such as is the case for the development of new anti-biotics from marine sources, would be very useful. Such an analysis should also look at the existing mechanisms used to assess and allocate market corrective state aid, as well identifying the main sub-sectors benefiting from such aid, in other countries such as Canada, the US, China and Japan.



3. European Regional Sea level

Until recently, marine biotechnology research and development has not been subject of much attention at the European Sea Basin level. This has changed with growing recognition of the potential of marine biotechnology for macro-regional collaboration and development as reflected in the regional strategic research agendas, for example as developed under the SEAS-ERA project. As a result a range of initiatives, including landscape profiling, networking and coordination activities, are being set up in several basins.

In some regions, such as the **Baltic**, new initiatives can build on a long tradition in pursuing transnational cooperative strategies, which is a core requirement for turning Blue Biotechnology research into marketable applications. In this region, a dedicated marine biotechnology strategy is an option currently being considered within the Submariner project⁹. Submariner highlights that such a strategy would allow for turning regional disparities into advantages, using laboratories in the new Eastern Baltic Sea countries while developing close links with the big pharmaceutical industry based more in the Western Baltic Sea region. The strategy should be based on national action plans which take into account the respective strength of institutions and experts in the individual countries while also responding to most urgent market needs. Based on such a strategy a sequence of transnational priority actions could be initiated such as the establishment of a “Baltic Sea Region Blue Biotechnology Network”, a centre for bioprospecting of Baltic Sea microorganisms or a distribution network for cosmetics, health care and wellness products using a Baltic Sea Region label, the scaling up of marine genomics as a source of novel enzymes from the Baltic Sea or the advancement of innovative marine technologies stemming from the region. The ongoing success of the ScanBalt network for the last ten years has shown that the Baltic Sea Region is well placed not only to develop but also to implement such kind of strategy. As such it could position itself as a model region for marine biotech strategic coordination and support at macro-regional level.

The Mediterranean Science Commission (CIESM)¹⁰ represents the most important regional coordination and support capacity/initiative in the **Mediterranean** in relation to marine biotechnology research and development. Aspects of marine biotechnology have been covered by CIESM in its workshops since 1997, most recently looking at Mediterranean marine extremophiles¹¹. There are currently no specific research programmes in marine biotechnology but a recent report examined the role of blue biotechnology in answering a number of specific challenges in the Mediterranean marine ecosystem¹². Subjects included integration of marine biotechnology and nanotechnology for control of ship ballast water bio-pollution; marine biomolecules for chemistry, health, cosmetics, flavours and fragrances and vaccine adjuvants and stabilisers; new marine biomaterials and polymers. New efforts to map the marine biotechnology capacity and potential of Mediterranean countries are ongoing and some country profiles are already available on the CIESM website. These mapping results are likely to raise the visibility and profile of this area of research and development and promote collaborations within and beyond the Mediterranean region.

In the **Atlantic** region, one of the main current science policy developments involves the development and implementation of an EU Strategy for the Atlantic Region (EUSA) and associated Action Plan. The EUSA aims to provide a strategic framework and action plan to foster better cohesion at the level of the Union by working on overall coordination of actions across a range of policy areas. Science, research and development, including management of

⁹ <http://www.submariner-project.eu/>

¹⁰ <http://www.ciesm.org>

¹¹ <http://www.ciesm.org/online/monographs/index.htm>.

¹² http://www.ciesm.org/WK_BIOTECH_REPORT_2010.pdf



research infrastructures, is clearly a policy area which will benefit from more coherent regional approaches as well as stimulating technology transfer and innovation and this will likely make a significant contribution which will also shape regional marine biotechnology activities. Several Macro-Regions are being identified throughout the European territory, covering large areas across national borders. The EU Strategies for the Baltic Sea Region and for the Danube Region have already been developed (adopted in October 2009 and starting implementation in June 2011 respectively).

4. Pan-European level

Two important documents published in 2010 and 2009 (Marine Board Position Paper 15¹³ and Scoping paper of the EC CWG on Marine Biotechnology¹⁴) have been instrumental in providing the main direction for future marine biotechnology coordination and collaboration at European scale. They not only identified the research priorities and a first set of areas of common interest among a number of European Countries, but also formulated a vision and strategy to develop marine biotechnology to its full potential by 2020. Both strategic documents have provided the groundwork for action and identified the challenges ahead but also highlighted that the time had come to move from planning to implementation if this area is to reach its full potential. Since 2010, significant progress has been made, notable at the level of:

- Increasing European research and development coordination efforts (e.g. from CSA MarineBiotech to MarineBiotech ERA-NET, Euromarine, JPI Oceans, ...);
- Development of the marine biotech portal www.marinebiotech.eu;
- Addressing identified research priorities, including but not limited to (i) cultivation challenges associated with among others marine microorganisms (e.g. FP7 project MaCumba), (ii) Legal and policy barriers (e.g. FP7 projects MicroB3, Pharmasea, Bluegenics, ...), (iii) Biodiscovery challenges (e.g. FP7 projects Pharmasea, Bluegenics, Seabiotech, ...);
- Development, coordination, networking and/or improvement of research infrastructures, including research fleets (e.g. EUROFLEETS) and access to marine model organisms and marine stations (e.g. ASSEMBLE, EMBRC)
- Increasing regional and international recognition and driving forces (e.g. OECD initiative¹⁵ and the “Blue Growth” communication from the EU-commission¹⁷).
- Establishing the identity and improving the visibility and profile of marine biotechnology as well as its understanding with a range of stakeholders.

Development of an **ERA-NET on Marine Biotechnology (MBT)** would clearly be an important factor to step up the cooperation and coordination of marine biotechnology research activities carried out at national or regional level in the Member States and Associated States. This should allow to stimulate the development of new strategies, policies and support programmes for marine biotechnology research and to better align those that exist already at the local, regional and national level. As such the ERA-NET should contribute significantly to realise the vision and strategy for Marine Biotechnology shared by the research community.

Considering the economic and social crisis in Europe, and notably the North-South gradient in the ability to fund national RTD projects, an ERA-NET is a necessary component of the future policy

¹³ Available from www.marineboard.eu/publications

¹⁴ http://ec.europa.eu/research/bioeconomy/pdf/cwg-mb_to_kbbenet_report_final.pdf

¹⁵ <http://www.oecd.org/sti/biotech/marinebiotechnologyattheoecd.htm>





but might not be sufficient to keep national policies aligned during the next decade. Additional mechanisms should be discussed and the European Commission should keep a direct support to marine biotechnology research projects, in relation with health, food, energy and environmental policies. An important instrument to provide this support is the next European Framework Programme; Horizon 2020.

Boosting marine innovation through biotechnology-related activities is specifically mentioned in **Horizon 2020** under the priority 'Better Society'. In particular under the Challenge 'Food security, sustainable agriculture, marine and maritime research and the bio-economy', marine biotechnology is to support the development of sustainable approaches to further explore and exploit the large potential offered by marine biodiversity and aquatic biomass to bring new innovative processes, products and services on the markets with potential application for example in sectors including chemical, biochemical and material industries, pharmaceuticals, fisheries and aquaculture or energy and biofuels supply. Under the priority 'Competitive Industries', key enabling technologies in marine biotechnology will be further advanced for use in multiple sectors, industries and services using a new, technology-driven approach. At the heart of Horizon 2020 objectives will also be the need to develop cross cutting marine and maritime scientific and technological knowledge with a view to unlock the blue growth potential across the marine and maritime industries. This strategic coordinated approach for marine and maritime research across all challenges and pillars of Horizon 2020 will be key to support the implementation of relevant Union policies and to help deliver blue growth objectives.

On 13 February 2012, the Commission launched a new **European Bioeconomy Strategy** entitled *Innovating for Sustainable Growth: a Bioeconomy for Europe*¹⁶ to stimulate the transition from a fossil-based economy to a sustainable bioeconomy in Europe, with research and innovation at its core. It puts forward a cross-sectoral and inter-disciplinary approach to develop the European bioeconomy aimed to generate an added value and create new jobs via increased research funding for the bioeconomy under Horizon 2020 combined with the stronger innovation drive and reinforced policy interaction. As a high potential contributor to the European bioeconomy, marine biotechnology is likely to benefit substantially from these increased resources and additional strategic actions.

At the same time, the recent impetus from the European Commission to strengthen the European Blue Economy is likely to have a positive impact on the development of the European marine biotechnology sector. In its 2012 Communication on **Blue Growth**¹⁷, the European Commission identified Marine Biotechnology as one of five areas where additional effort at EU level could stimulate long-term growth and jobs in the blue economy, in line with the objectives of the Europe 2020 strategy. In its assessments to develop the blue economy, the Commission expects the blue biotechnology sector to develop on three phases. In the very short term, the sector is expected to emerge as a niche market focused on high-value products for the health and cosmetic sectors. By 2020, it would grow as a medium-sized market producing metabolites and primary compounds (lipids, sugars) as inputs for the food and feed processing industries. In a third stage, in around 15 years' time and subject to technological breakthroughs, the biotechnology sector could become a provider of mass product markets^{18,19}. It is likely that new opportunities will arise from

¹⁶ Innovating for Sustainable Growth: a Bioeconomy for Europe – available at http://ec.europa.eu/research/bioeconomy/press/press_packages/index_en.htm

¹⁷ Blue Growth, Opportunities for marine and maritime sustainable growth – available at http://ec.europa.eu/maritimeaffairs/policy/blue_growth/documents/com_2012_494_en.pdf

¹⁸ Blue Growth: Scenarios and drivers for Sustainable Growth from the Oceans, Seas and Coasts (2012). Third Interim Report available from http://ec.europa.eu/maritimeaffairs/documentation/studies/documents/blue_growth_third_interim_report_en.pdf

¹⁹ Perspectives from the European Commission DG MARE on the role of marine biotechnology in the EC Blue Growth Strategy and the Integrated Maritime Policy (IMP). Rodríguez Sebastián, Directorate-General for Maritime Affairs and Fisheries (DG MARE) – European Commission. Marine Biotechnology in the





additional support through innovation stimulation and economic recovery packages, as well as from the development of strategies and actions to stimulate blue growth in new areas including marine biotechnology.

A number of global activities are currently taking place which may provide additional visibility, support and/or framework conditions for marine biotechnology activities to grow. In particular, the recent work at the **Organisation for Economic Co-operation and Development (OECD) Division for Science and Technology Policy** may stimulate activities in countries around the world. OECD work in this area considers the twin tensions of ocean productivity and sustainability faced by those countries seeking to realise the potential of marine biotechnology. In its activities, the OECD aims to identify the potential of the field and the support required to realise that potential. It also explores the challenges, and possible next steps for policy development, to sustainable development, recognising the unique features of the marine environment and maximising the integrity and sustainability of that ecosystem for future generations¹⁵.

However, in spite of the significant progress at various fronts, numerous challenges remain. One of the main challenges will be to keep stock of all the developments currently taking place and ensure appropriate levels of alignment, and integration where required, of the interests, strategies, programmes and activities at the local, sub-national regional, national, macro-regional (sea basin level), pan-European and international level. How to position blue biotechnology in the complicated and dynamic landscape of other biotech fields (notably industrial [white] biotech, health [red] biotech and agricultural research [green] biotech), the numerous relevant research and coordination projects (including the MarineBiotech ERA-NET and other ERA-NETs), infrastructures, the Joint Programming Initiative on Healthy Seas and Oceans etc.

Another important issue that remains unresolved is the need to find durable solutions to preserve the right to conduct research and provide opportunities for economic developments while protecting the marine environment and the genetic resources it contains. For the territorial waters and the Exclusive Economic Zones (EEZ) important progress has been made in the last decades in the framework of the Convention on Biological Diversity, in particular with the adoption of the Nagoya protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS). The Nagoya protocol is a supplementary agreement to the Convention on Biological Diversity which aims to provide a transparent legal framework for the effective implementation of one of the three objectives of the CBD: the fair and equitable sharing of benefits arising out of the utilization of genetic resources. However, in Areas Beyond National Jurisdiction the lack of legal framework to regulate access to genetic resources means that only limited countries (those who can afford it) have unlimited access the resources (freedom of the high seas).

Also very important is the need to develop mechanisms that are conducive to promote technology transfer and support industry/academic collaborative approaches to develop markets and businesses. Finally, more efforts are needed to provide appropriate multidisciplinary education and training for the next generation of scientists and entrepreneurs for this highly specialized domain.

In conclusion, some progress has been made to date to address key recommendations highlighted in strategic initiatives during the last years. Nevertheless, to reach the full potential of marine biotechnology in the coming decades, the pace will have to be significantly increased. The CSA MarineBiotech mapping exercise confirms the main shortcoming already identified in 2010, namely that the EU currently still lacks a coherent Marine Biotechnology RTD policy and needs to prepare one without delay. As it stands, individual European countries support, to varying degrees, national Marine Biotechnology initiatives, programmes, and RTD policies and/or strategies. As a result, the European Marine Biotechnology effort remains fragmented and based on national rather than common European needs and priorities. A coordinated effort is also needed at pan-European level to mobilise and optimise human resources and available infrastructures. Such efforts should address both fundamental research and advanced

European Research Area: Challenges and Opportunities for Europe. Book of Abstracts. Final CSA MarineBiotech conference. Royal Flemish Academy of Belgium for Science and the Arts, Brussels, Belgium, 11-12 March 2013. VLIZ Special Publication 64. Available from www.marinebiotech.eu/conference



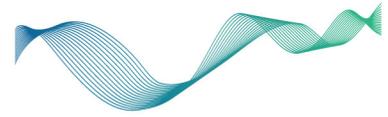


application-oriented research and take an approach which supports industry-academia collaborations for new innovations and industrial developments.

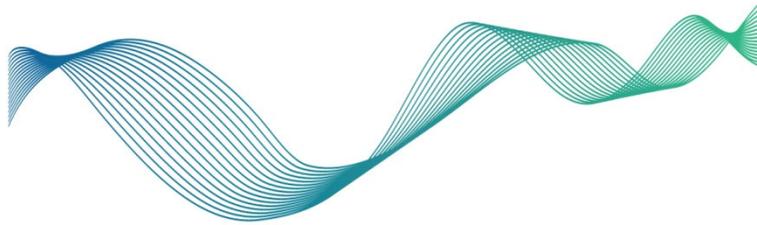


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