

# Maritime Clusters in Västra Götaland



In 2011 the Region Västra Götaland decided to evaluate its maritime strategy from 2008. In September 2011 a review was initiated together with Chalmers and Gothenburg University. It has had the working title "Innovation and Development of the Maritime Clusters in Västra Götaland". The review has had a steering group with Anders Carlberg, Region Västra Götaland, Kerstin Johannesson, Gothenburg University, Klas Brännström, Chalmers and Anna Jöborn, Swedish Agency for Marine and Water Management who have contributed with invaluable comments throughout the work.

During the review we have met many representatives from science, business, authorities and others who have contributed with facts and valuable remarks. We wish to thank all for this support. This report "Maritime Clusters in Västra Götaland" summarizes our findings and recommendations.

Gothenburg and Tjörnö in October 2012

Axel Wenblad	Susanne Lindegarth	Andreas Hanning
Region Västra Götaland	Gothenburg University	Chalmers Technical University

## Table of Contents

1. Background .....	4
2. Maritime development in the European Union, Sweden and Västra Götaland .....	6
2.1 European Union .....	7
2.2 Sweden .....	7
2.3 Västra Götaland .....	8
3. What are clusters? .....	9
4. The maritime cluster in Västra Götaland .....	10
4.1 Introduction .....	11
4.2 Marine management .....	13
4.3 Maritime operations and marine technology .....	13
4.4 Marine biotechnology .....	14
4.5 Marine energy .....	15
4.6 Seafood .....	16
4.7 Tourism and recreation .....	17
5. Cluster structure .....	18





## 1. Background

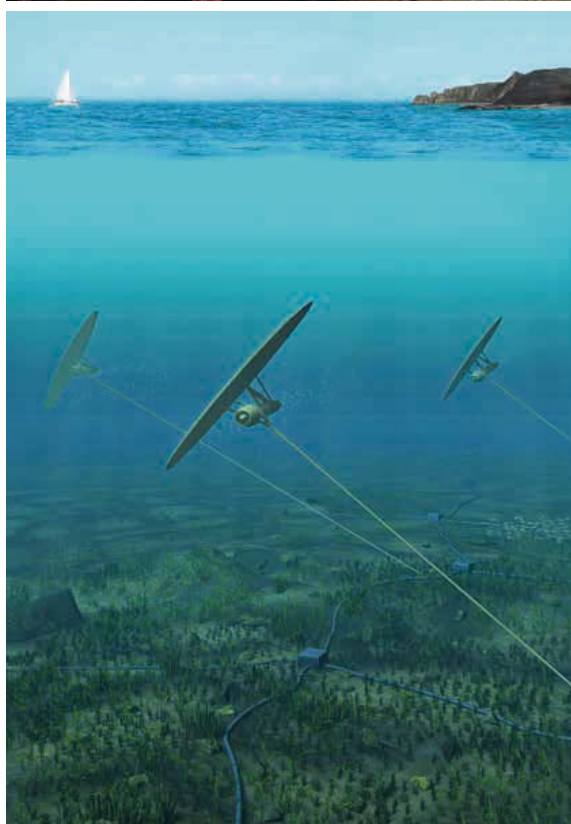
The sea has always played an important role in Sweden, which has been a seafaring nation for over a thousand years. The Swedish East India Company is an excellent example of how Sweden was carrying out extensive trading activities in distant places as early as the eighteenth century. This tradition has continued into modern times, with a large merchant navy and global trade. Even today, shipping represents nearly 90 percent of trade. Much of the maritime expertise is located in western Sweden, with Gothenburg at its hub. Gothenburg is also the logistics centre of Sweden, due to the role that it plays as the largest port in Scandinavia, which has led to considerable know-how in the area of transport.

A large part of Sweden is surrounded by water, and we have the longest coastline in the European Union (EU). We also have unique archipelagos both on the west coast and the east coast, as well as coastal areas that are sensitive to pollution and to other forms of environmental disturbances, which can be seen particularly in the Baltic Sea. It is our duty to manage these areas, and thanks to a long tradition of research, we have good expertise within the marine disciplines. Some of our research stations date back more than a hundred years.

Västra Götaland is the most distinctly maritime region in Sweden, with a range of different activities, as well as the largest lake in Western Europe – Lake Vänern – and the largest river in Sweden, the Göta älv. There is every reason to make good use of this tradition and expertise in the maritime fields, naturally to protect the environment, but also to strengthen existing activities and to develop new activities that are associated with the sea. This entails using the ecosystem services of the sea in a long-term, sustainable manner, which is also a strong trend in the EU. Within the framework of the integrated maritime policy, investments are made in the maritime fields, both to protect the environment, and also to strengthen existing activities and to develop new activities that are associated with the sea.

This report presents the results of an investigation of maritime clusters in Västra Götaland, which was carried out on the initiative of Region Västra Götaland, Chalmers University of Technology and the University of Gothenburg (GU) and presented in November 2012. The purpose of the investigation is to describe the current state of the maritime sectors, using the maritime strategy of Västra Götaland as a starting point (see section 2.3), as well as to provide an analysis of future growth areas, based on a cluster perspective. A proposal is presented for the structure and organisation of the maritime clusters. As the starting point for this, the premise was taken that development is knowledge-driven and that a crucial issue in the process is the dynamic interaction between “knowledge producers”, businesses and public sector actors.





## 2. Maritime development in the European Union, Sweden and Västra Götaland

### 2.1 EUROPEAN UNION

The EU's Blue Book for an integrated maritime policy was adopted by the Council of Ministers in 2007. This gave particular emphasis to the importance of regional clusters for the sustainable growth and development of the maritime industries. The Blue Book was in many regards the starting point for a large number of activities, both at the EU level and in the member states. An example at the regional level is the maritime strategy of Västra Götaland from 2008 (see also 2.3).

The European Commission has judged marine spatial planning to be an important tool for implementing the integrated maritime policy. This involves being able to balance the different interests that are competing for the same area of sea. It is primarily the member countries that are responsible for marine spatial planning in their respective maritime areas, up to and including the exclusive economic zone. The European Commission is working to encourage the member countries to introduce systems and legislation for marine spatial planning and it has therefore developed a "Roadmap for Marine Spatial Planning". Several projects have also been supported and conferences have been held in the area. The Commission intends to present a proposal, which i.a. is expected to state that marine spatial planning for common areas of sea by different countries needs to be coordinated.

"Blue Growth" is a long-term strategy for supporting growth in the maritime sector. By means of the EU 2020 strategy, the EU has sharpened its focus on economic recovery, and Blue Growth can be seen as a contribution to the European recovery plan. Blue Growth is based on identifying growth sectors in the maritime field and proposing measures that facilitate economic development in the areas that are judged to have the potential to grow. The role of the EU and of the member states would be to remove the obstacles to sustainable development, to invest in the infrastructure that is needed for companies to grow and to contribute to the provision of expertise. At the same time, it is strongly emphasised that growth is not to take place at the cost of the ecological sustainability of the marine environment. An example of this is that growth must be compatible with the conservation of biological diversity. Blue Growth was also the theme of the European Maritime Day, which was held in Gothenburg, 21 to 22 May 2012, hosted by the European Commission, the Swedish Government, the Region and the city of Gothenburg.

In a report from September 2012, the European Commission identified five areas in which further measures at the EU level would be able to stimulate long-term growth. For each of these areas, the European Commission will look at the options that are available and consider the different alternatives. The areas concerned are:

- Ocean renewable energy
- Aquaculture
- Maritime and coastal tourism
- Extraction of seabed minerals
- Blue biotechnology

### 2.2 SWEDEN

In recent years, the Swedish government has made considerable investments in the marine environment. The priorities include achieving the most important of the EU directives, particularly the EU marine strategy framework directive, which states that, by 2020 at the latest, we must achieve or maintain a good environmental status in the marine environment. By 2015, we must have achieved a good ecological status in lakes, rivers, groundwater and coastal waters, in accordance with the EU water framework directive.

By 2021, we must also have achieved or maintain a good environmental status in the Baltic Sea, in accordance with the HELCOM action plan (BSAP).

Consequently, there are a number of time-specified targets for a good environmental status, each of which must be achieved within a relatively short period of time.

In 2011, the Swedish Agency for Marine and Water Management was assigned by the government the task of implementing a consistent policy for our seas and water. The agency works with issues regarding the conservation, restoration and sustainable use of lakes, rivers and seas.

The Commission on Marine Spatial Planning submitted its proposals on December 2010. The Commission stated that an important pre-condition for the planning and management of marine areas is that we have basic knowledge concerning hydrography, geology, biology, and the like, which is currently lacking. Sweden has the longest coastline in the EU and 160 000 square kilometres of sea area.



The Baltic Sea Strategy is an important initiative by the Swedish government, which was adopted in 2009 by the EU Council of Ministers in connection with Sweden's presidency. The strategy includes four main targets, which in turn are divided into 15 priority areas:

- An environmentally sustainable region – the environment
- A thriving region – prosperity
- An accessible and attractive region – accessibility and attractiveness
- A safe and secure region – security

In Sweden, the Government Offices of Sweden coordinate this work, at the same time as a network has been established of the public authorities involved. In total, there are about 80 so-called flagship projects.

### 2.3 VÄSTRA GÖTALAND

In connection with the work of the EU on the Blue Book for an integrated maritime policy, Region Västra Götaland decided to develop a maritime strategy for the region. In the strategy, which was adopted in February 2008, a total of 13 different working areas were identified.

#### These are:

1. Sustainable growth by means of investment in shipping and logistics
2. Conserving marine biological diversity and the status of marine ecosystems
3. Monitoring and analysing the condition of the marine environment and initiating improvement measures
4. Recruitment of new generations of employees to the maritime sector
5. Using the environmental and security potential of maritime transports
6. Strengthening the development of the maritime engineering industry and of boatyards for leisure boats in Västra Götaland
7. A sustainable fishing industry by means of investments in quality, environmental adaptation and cooperation
8. Improved knowledge about the sea, strengthened research and the dissemination of the maritime options for sustainable growth and development
9. Implementation of the opportunities for the offshore production of renewable energy
10. Confronting climatic impacts in maritime and coastal environments
11. Development of sustainable coastal tourism and maritime adventure tourism
12. Efficiency and cooperation in the leisure boating industry
13. Conservation and development of the maritime identity of Västra Götaland

In each working area, there are a number of targets associated with different orientations. The strategy was developed within the framework of a broad partnership with representatives of businesses, research and development, municipalities and organisations that are active in fields that are connected with the sea. The working areas and the targets reflect the broad support that existed in the partnership.



## 3. What are clusters?

A cluster is a concept that is used in many different contexts and it is thus important to explain what is meant by the term in this report.

Clusters can be seen from different geographical perspectives, from national to regional, and also to international clusters. It is furthermore possible to define clusters from a purely business perspective, or to consider clusters in which organisations, institutions and public authorities are included in the analysis. In this report, we consider what can be called regional clusters, which can be defined as concentrations of companies, public authorities, organisations and research institutes that are dependent on each other, in the same or related sectors, within a regional area.

A common denominator for most clusters is that they bring together one or more sectors within a given region, and that they focus on networking and cooperation between companies and organisations, research institutes, and public sector, in so-called triple helix collaboration.

Clusters are also defined by their context and the connections between the actors in the cluster, rather than by membership in a particular organisation. Clusters also exist to stimulate cooperation between their participants, to enable the sharing of information, and to connect common issues in order to create synergy effects for the cluster as a whole, based on common challenges that the cluster faces.

Taking this description into consideration, we can state that there are several maritime sub-clusters or cluster areas in Västra Götaland. They do not necessarily have functional linkages but share the common feature of being "maritime".





## 4. The maritime cluster in Västra Götaland

### 4.1 INTRODUCTION

#### Growth opportunities:

**Maritime cluster areas should adopt a broad approach, include all relevant sectors and be open to new fields.**

**Marine management should have a key role in order to strengthen the maritime cluster areas within the framework of a sustainable development.**

**It is essential to take into consideration that some sectors are well developed, whereas others are at the beginning of their development.**

**A close and well-developed cooperation between the University of Gothenburg and Chalmers University of Technology is necessary in order for the cluster areas to be internationally competitive.**

**Meetings between research and different stakeholders have a key role in the development of the cluster areas.**

**It is important to develop cooperation with other clusters in Västra Götaland.**

**We should develop an overall vision concerning the unique position of the province of Bohuslän, both regarding its nature and its expertise about the marine environment.**

**Sweden needs a national maritime strategy so that our maritime industries can be internationally competitive.**

The following sections present the reasoning behind and the content of the six cluster areas that are proposed in the report. We have adopted a broad approach regarding clusters. This is an approach that is encouraged by the European Commission, not least within the framework of Blue Growth.

This also implies that there will not be clear functional connections between all of the cluster areas. Nevertheless, a common denominator is needed, and we have identified this as marine management/governance. This is based on the argument that the cluster areas involve different forms of the use of the goods and services of marine ecosystems, so-called ecosystem services. Some forms of use, such as shipping, have very basic requirements regarding ecosystem functions, whereas others, such as marine biotechnology, have very specific requirements. On the other hand, because of accidents, shipping can represent a very serious threat to the structure and functions of ecosystems. In order to be able to use marine ecosystems in a long-term, sustainable manner, a management approach is required that we believe needs to be developed through an investment in marine management.

The broad approach also implies that there are large differences between the cluster areas regarding how well developed they are. Shipping and tourism are mature sectors that nevertheless have considerable potential for development in meeting future challenges. These two industries also represent the largest number of persons employed in both the EU and Sweden. Sea-based wind power occupies an interesting intermediate position, and the technology for this has already been developed and is commercially available. Of interest for the future are the large investments in sea-based wind power that are being made by, among others, Germany and the United Kingdom. A consequence of these plans is that large areas of the sea will need to be claimed, in competition with its use for shipping, fishing, conservation, etc. A possible development at a later stage is towards floating wind power stations, in order to increase flexibility in the choice of location. Other sectors, such as wave power and marine biotechnology, are still at the beginning of their development, but it is thought that they could play an important role in Europe's energy supply in 20 to 30 years' time. There are few companies involved in these sectors, and those companies that do exist are small. The potential of these sectors is often difficult to assess, but it is still important to identify, give priority to and support these areas.

We are convinced that the interaction between the research community and other stakeholders plays a key role in the development of the maritime cluster. The starting point is the presumption that development is knowledge driven. Consequently, the contact and interaction of "knowledge producers" with businesses and public actors is an issue of great importance. The development of places for such contact and interaction is of decisive importance in the creation of creative environments for the exchange of knowledge, for discussions and for cooperation.

We are working with five sub clusters or cluster areas, which together with marine management constitute the proposed cluster structure. The selection is based in part on the groupings and priorities that have been made by the EU, and in part on an assessment of the areas of strength that became apparent in connection with interviews with different actors in the region and in the workshops that have been held.

- Marine management
- Maritime operations and marine technology
- Marine biotechnology
- Marine energy
- Seafood
- Tourism and recreation

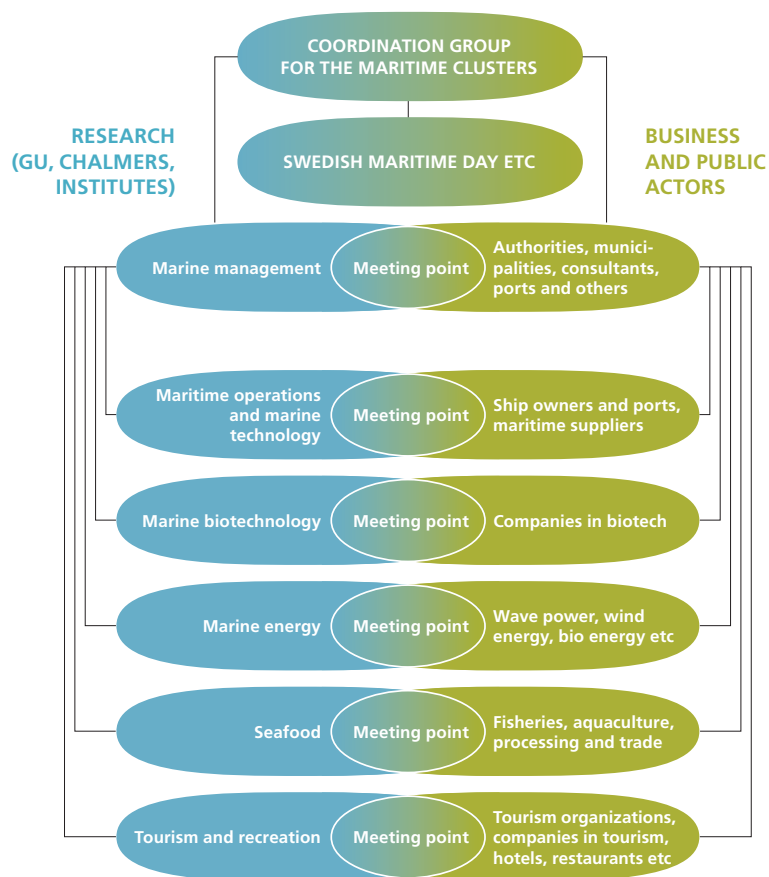
The structure of these partial clusters can be seen in the figure below. It is important to remember that these are dynamic areas of development, and so a structure that is relevant today will not necessarily be relevant tomorrow. Cluster areas may disappear, or fuse with others, and new cluster areas may evolve. The chosen structure and organisation must take this into account.

**The maritime cluster is part of a larger group of five strong clusters in Region Västra Götaland. The other areas of strength that are highlighted are:**

- Urban future
- Transport solutions
- Green chemistry and bio based products
- Life science

There are obvious functional connections between these clusters. How we manage our marine areas has importance for the “Urban future” cluster, shipping is an integrated part of “Transport solutions” and marine biotechnology has strong connections to “Green chemistry” and “Life science”. The ways in which cooperation is to take place can develop gradually. A well-developed cooperation between these areas is important.

## Maritime clusters in Västra Götaland



## 4.2 MARINE MANAGEMENT

### Growth opportunities:

**Marine management is a common denominator for the cluster areas, as functioning ecosystems are a prerequisite for the long-term sustainable development of the maritime clusters.**

**Legislation in the maritime fields is very complex and requires an investment in internationally oriented expertise of a high level.**

**Marine spatial planning is a priority area of the EU, which will require development of methodologies and a considerable development of expertise and know-how.**

**The knowledge production in the marine and maritime areas and tools for analysis are fields in which there is considerable expertise in Västra Götaland. This expertise can be further strengthened by means of cooperation between research, public authorities and companies.**

Marine management, as earlier pointed out, should be seen as a common denominator for the maritime clusters.

Looking at the development of maritime clusters in the EU, in other countries and in regions, no clear picture emerges regarding the development of a comprehensive marine management. This may be due to a tendency in the development of maritime clusters to form distinct sectors. Marine spatial planning, which has a high priority in the EU, can though be seen as an important starting point for a comprehensive marine management.

Consequently, an investment is needed in marine management, both to connect together all of the different decision processes that exist in the different sectors, and also to ensure that we have a good marine environment. Marine management can be seen as a common tool with which to implement an integrated maritime policy. The intention is that we should be able to use the ecosystem services of the sea in a long-term, sustainable manner.

One of the reasons that we need to make a concerted effort regarding marine management is the complex legislation that exists internationally, in the EU and nationally. At the international level, there is the Law of the Sea Convention (UNCLOS), which is very complex, with many areas of application. International legislations that relates to shipping are largely regulated by the International Maritime Organisation (IMO). Internationally, there are also regional conventions, such as HELCOM and OSPAR. In the EU, there are a large number of directives that either directly concerns the sea, such as the Marine Strategy Framework Directive, or which have an indirect effect, such as the

Renewable Energy Directive. In some cases, such as within fisheries, European Community legislation is directly applicable in all common marine areas. The number of regulations is increasing, they are becoming more complex, and the coordination between different directives is far from clear. Nationally, we have also quite a large number of statutes regulating activities on and in the sea.

The provision of knowledge about marine areas is an important development area. Maritime monitoring is, as earlier pointed out, a priority area in the EU. This involves building up knowledge about marine areas, and also making the knowledge that exists accessible in an efficient manner.

In Västra Götaland, there is considerable expertise at the University of Gothenburg, though Chalmers University of Technology also has important expertise in, for example, environmental systems analysis. Also located in the region is the Swedish Agency for Marine and Water Management, which has the national responsibility for the provision of knowledge about the marine environment, and the Swedish Institute for the Marine Environment, which has important analytical competence. There are also a number of companies that are at the forefront of their field.

## 4.3 MARITIME OPERATIONS AND MARINE TECHNOLOGY

### Growth opportunities:

**Västra Götaland has a strong maritime tradition and a maritime identity.**

**The region has a great number of large and small companies engaged in maritime operations and marine technology; some of these companies are world-leaders in their field, which contributes to creating a very strong cluster.**

**The region has very broad research expertise in maritime operations and marine technology, particularly at Chalmers, and through Lighthouse maritime competence centre, as well as at several other institutions in the region.**

**Gothenburg is today the largest transport and logistics hub in Scandinavia, with the Port of Gothenburg as its centre, which gives it a unique position in Sweden.**

**At the University of Gothenburg, there is research expertise in, among other fields, marine biology, oceanography and marine geology, which are of great importance for marine spatial planning and the rapidly developing field of marine surveillance technology.**

The field of maritime operations and marine technology is an extension of what was traditionally seen as shipping and shipping related areas.



Maritime technology has as its base the traditional construction of ships and other floating materials, but also includes all the technology that affects maritime operations, from ship engines to port equipment.

The region has very broad research expertise in the areas that are covered by maritime operations and marine technology. Lighthouse maritime competence centre which was started by Chalmers, the University of Gothenburg and the Swedish Ship owners' Association, covers, via six so-called "ships", a large part of the research that is carried out in the field of maritime operations and marine technology. These ships are "Business Ship", "Cargo Ship", "Eco Ship", "Ergo Ship" and "Safe Ship", as well as the newly started "Info Ship".

In addition to the research at Lighthouse, research is also carried out at the SP Technical Research Institute of Sweden, and at the company SSPA AB, whose facilities give it a unique international position and which is among the five foremost ship-testing companies in the world.

As part of the development of cooperation with public authorities, Chalmers and the Swedish Maritime Administration have, since September 2012, co-located their simulators for education and research regarding shipping at the Department of Shipping and Marine Technology, and thereby created one of the most advanced and largest continuous simulator laboratories in Europe. This new centre is at the forefront of development in Sweden and Scandinavia.

Gothenburg is today the largest transport and logistics hub in Scandinavia, with the Port of Gothenburg as its centre, which gives it a unique position in Sweden. The port has developed a so-called rail port concept, as a result of which rail transport has handled nearly the entire increase in the amount of freight since the turn of the century.

Västra Götaland has a large number of companies and organisations, considerable research and educational activities, and public actors, which creates many opportunities for effective cluster activities. Many companies contribute to different value chains, contributing to strengthen the cluster as a whole. Some of these companies are competitors, but share the same suppliers, which strengthens the functional connections between the different actors in the region.

Despite the practice of registering ships under a flag of convenience, there are several shipping companies in Västra Götaland that are leaders in their sectors, particularly Stena Line. The Gothenburg area has, by tradition, been a centre for companies that provide services for shipping, for example shipbrokers, insurance companies and finance companies, even if these have become fewer as a result of

the restructuring of the financial sector. Among the enterprises located in Gothenburg are the suppliers to shipping companies and ports, which in turn create incentives for suppliers to meet the needs of these companies. Offshore industries that are oriented towards oil and gas will continue to experience increased growth, at least for the next few years. Several companies have increased their operations in the Gothenburg area. Offshore companies can also gain a new direction, becoming involved in the increased construction of wind farms and in the supporting infrastructure for offshore wind power, such as transformers and the like.

Few maritime regions in Europe, and perhaps even the world, can show such a broad range of maritime activities within a limited territory as Västra Götaland.

A large future growth area, which results from both the increased need for knowledge about marine management and also the future construction of offshore wind power, is marine surveillance technology. Research in marine biology and oceanography is carried out at the University of Gothenburg, and there is a leading company in the region, MMT Sweden AB. There is development potential for education, and also the opportunity for new companies to make use of future market opportunities.

#### 4.4 MARINE BIOTECHNOLOGY

##### Growth opportunities:

**There is a broad range of research expertise in the region, which includes all of the five target areas for Marine Biotechnology: Food, Energy, Health, Environment and Industrial Products and Processes.**

**Special areas of strength for growth, in which there is a well-developed cooperation, are marine genomics, anti-fouling, the health effects of fish consumption and the use of microalgae for bio energy and other purposes.**

**The broad research expertise and the access to marine infrastructure, including the research stations of the University of Gothenburg, form a foundation for these efforts, and provide good conditions for innovation and growth in marine biotechnology.**

**There are only a few, small companies in Västra Götaland that specialise in research and development in the field of marine biotechnology, and for these to be successful, a long-term perspective and long-term funding are needed.**

Marine biotechnology, or Blue Bio, includes applications of biological knowledge and advanced techniques in order to develop products and services in which marine bio-resources are either the source or the target.

The EU has identified Blue Bio as a future area of growth within Blue Growth, and a proposal has been made regarding

research priorities – "Marine biotechnology: A new vision and strategy for Europe" (ESF Marine Board 2010). The report defines five target areas in which Blue Bio can contribute to the solution of important societal challenges:

*Food* – food products and ingredients that have a marine origin (algae, invertebrate animals and fish) with optimal nutritional properties for the health of humans and animals

*Energy* – robust systems for the production of bio energy, particularly from micro- and macro algae

*Health* – new medicines, treatments and health and body-care products that have a marine origin

*Environment* – biotechnology methods, mechanisms and processes for tackling important issues in the marine environment

*Industrial products and processes* – molecules and substances that have a marine origin and that can be used by industry, such as enzymes, biopolymers and biomaterials

One of the strongest driving forces for the continued development of Blue Bio is the rapid development in the Life Science field. Blue Bio thus has great potential for making a considerable contribution to knowledge-based employment and to economic growth in the coming decades and beyond. Succeeding in this requires a multidisciplinary effort and cooperation between research and businesses. Currently, the Blue Bio sector is characterised around the world by small, specialised SMEs (small and medium sized enterprises) that focus on research and development. It is also these that bear the considerable risks that are implicit in research and development. It is important that there is a general understanding that a long-term approach is needed, particularly regarding funding, in order to achieve the desired result.

Today, in 2012, there are only a few, small companies in the region within the Blue Bio field. A common feature of these is that their work involves applied research and development, and that they do not have a finished product on the market. However, there are several research groups at universities and institutes in the region that carry out research in all five of the major target areas for development. Research orientations include marine genomics, anti-fouling, marine ecotoxicology, pharmaceutical applications, marine biomaterials, fish as functional foods and microalgae as a source of bio energy. In some cases, the research groups are at the forefront of their respective field, either nationally or internationally. There is access in the region to a first-class and unique infrastructure to carry out research within the Blue Bio sector, including the University of Gothenburg's marine field stations at Kristineberg and Tjärnö, where a number of marine model organisms are cultivated. The strong research environments are mainly found at the University of Gothenburg, where research concerning the marine environ-

ment has a long tradition. However, there is also research specialising in several areas of the Blue Bio sector at Chalmers and at the SP Technical Research Institute of Sweden. In a few cases, cooperation has already today been established between the University of Gothenburg, Chalmers and SP Technical Research Institute, including in the anti-fouling area and in micro algal research.

#### 4.5 MARINE ENERGY

##### Growth opportunities:

**There are strong research environments in Västra Götaland, not least at Chalmers, which work with different aspects of marine-based energy, such as wind and wave power, transmission technology and marine bio energy.**

**There is potential for considerable synergy effects between wind power development and wave and tidal power regarding foundations, underwater anchorage, the transmission of electricity and environmental aspects.**

**Chalmers, in cooperation with the University of Gothenburg and SP Technical Research Institute of Sweden, is carrying out important research on the production of bio fuel from micro- and macro algae. The cultivation of biomass at sea for energy production may in the future be an important sector within marine energy.**

**The development of marine-based energy in the Baltic Sea and in the North Sea can offer considerable potential for service and maintenance companies, as well as companies for design and construction of offshore wind power stations.**

Marine energy is, in this report, a collective term for the renewable energy that can be obtained from the sea, or from the wind out at sea. The renewable energy that comes from the sea mostly originates from the sun, either as the "engine" that drives the wind, which both generates electricity via wind power at sea and drives the waves that wave power stations can use, or as solar energy that generates the growth of biomass in the sea that we can use for obtaining bio fuel. It is only tidal power that is not directly driven by the sun, though it is also renewable.

Opportunities for generating large amounts of electricity via wave power in Sweden are rather limited. Västra Götaland has though the expertise needed for developing new technologies, and can act as a test bed for new types of energy production. From the perspective of innovation, regional energy producers can make an important contribution in starting up new markets. As an example, Sweden's first commercial wave power farm – Sea Based – is being constructed in Bohuslän. The wave-park will contribute to the development of this technology thanks to the test bed that local conditions can provide.



The three main categories of marine energy that are highlighted in this report are wind power at sea, wave and tidal power, and bio energy from marine organisms. These three areas are relatively unconnected to each other, except for wind power and wave and tidal power, which have similar issues regarding the design of underwater structures and the transmission of electricity to land.

Research concerning wind power is assembled at a national centre, the Swedish Wind power Technology Centre (SWPTC) at the Department of Energy and Environment at Chalmers. Members of this centre include the largest Swedish suppliers to the wind power industry, SKF and ABB. The SWPTC is a centre that brings together research and businesses, and considers issues that range from the design of turbines to the design of electricity grids and transmission in order to contribute to expertise in the development of the construction and optimisation of wind power stations. At Chalmers, research is also carried out concerning how the large-scale integration of an intermittent electricity production, such as wave, wind and tidal power, can affect the electricity grid.

Research and development relating to wave and tidal power is organised at a common centre: the Ocean Energy Centre (OEC). The centre is located at the Department of Shipping and Marine Technology at Chalmers and aims to bring together companies that work with wave and tidal power, development companies and research institutes, and to connect these with research at other universities. A common feature of the companies in OEC is that they carry out fundamental research concerning the implementation of wave and tidal power.

Furthermore, marine energy has connections to marine spatial planning, as future wind and wave power farms will claim large areas of the sea. In addition to the general technological development associated with marine-based energy, it is of great importance to evaluate, at an early stage, the effects of different technologies on the environment and on society, in order to understand the challenges that these technologies face.

There has been a considerable development in the businesses that could provide a developed marine-based energy provision and the region should actively support companies that choose to engage themselves in the field. The decision made in Germany to phase out nuclear power by 2022 will contribute to increasing demand for marine-based wind power in the Baltic Sea and the North Sea.

#### 4.6 SEAFOOD

##### Growth opportunities:

**The conditions for developing the cluster for seafood are excellent, as the entire value chain from "the sea to the table" is present in Västra Götaland.**

**Scope for growth and increased profitability in the fishing sector can be created by diversifying and by quality improvement measures that increase the value of the product.**

**The processing industry and distribution sector are important actors in the cluster, with a key role in developing products that meet the demands of the modern consumer for accessible, tasty, healthy and environmentally friendly food from the sea.**

**Marine spatial planning plays an important role for the future growth of aquaculture sector.**

The global demand for seafood is growing. At the same time, wild fish stocks are already today being fully exploited, or overexploited, by fishing. The issue of depletion of fish stocks is of great concern for the future of the entire fishing industry, both globally and regionally. In order to meet the demand for seafood, the growth of aquaculture is expected to be of increasing importance. We have chosen to put the seafood products at the centre of the cluster area instead of focusing on the raw material production i.e. fisheries and aquaculture. We see great advantages of a common cluster development that includes the entire value chain. In the end, the fisheries and aquaculture sectors deliver to the same household customers, restaurants and retailers.

The fishing fleet of the west coast consists of large-scale pelagic fisheries and small-scale coastal fisheries. Pelagic fisheries include primarily the fishing of herring, sprat and mackerel, and in terms of value, this type of fishing represents the largest part of the fish that is landed. Small-scale fisheries mostly focus on five different types of fishing, of which the most economically valuable resource is the Norway lobster, which is fished by both trawl and pot.

The aquaculture of western Sweden is completely dominated by mussel farming along the coast of Bohuslän, which has good potential for further development due to the positive environmental effects of mussel farming. Also, cultivation of the domestic European flat oyster is being developed with the opening of a hatchery for oyster spat production (Ostrea Sverige AB).

The research institutions of Västra Götaland are important knowledge providers for further development of the seafood cluster. In the fisheries sector, the Institute of Marine Research at Lysekil (SLU – the Swedish University of Agricultural Sciences) is an important actor, which carries out research and exploratory fishing to make population assessments, to construct management models and to develop equipment. At the marine field stations of the University of Gothenburg, research is conducted concerning the environmental effects of fishing, as well as genetic analyses in order to describe the distribution and movement of different fish populations as a supporting material for management models. Regarding research within aquaculture, there is Aquaculture Centre West, which includes several strong research environments.

At the Food Science unit of Chalmers, internationally competitive research is being conducted on the health-promoting effects of fish consumption on cardiovascular diseases and on developing methods for making use of underutilised fish raw materials and fish by-products. At Chalmers, research is also conducted concerning re-circulating systems for land-based fish farming. The Swedish Institute for Food and Biotechnology (SIK) is an important actor with a key position regarding innovations in the area of sea-based food and regarding the development of sustainable fishing and aquaculture methods via the use of environmental life-cycle analysis and the eco-certification of aquatic food products.

There are many strengths and opportunities within the existing seafood cluster that can be used as a starting point for further work. Fish and shellfish that are caught or cultivated on the west coast have a very good reputation for being of the highest quality and it should be possible to use this to provide increased value. Fishing tourism is another area that can be further developed.

Oyster and mussel farming have the potential to expand in the near future, provided that farming licences are approved and that the production of oyster spat in hatcheries becomes successful. With the research expertise present in the region, western Sweden has the potential for becoming a pioneer in the use of new, local marine species and in developing modern farming technologies for fish aquaculture. Development of novel ingredients for fish feed are already today a regional area of strength where further innovations can be expected.

There are also very good preconditions for innovations in product development and the processing of marine fish and shellfish due to the presence of several large fish-processing facilities along the Bohuslän coast.

#### 4.7 TOURISM AND RECREATION

##### Growth opportunities:

**Inclusion of Bohuslän on the UNESCO World Heritage List should be considered which would reflect the unique values of the province.**

**A broad research focus, together with higher education that supports the development of long-term, sustainable tourism and recreation, is essential in order to take new initiatives within this cluster area.**

**Increasing the attractiveness of the region, and thereby extending the season for visitors, requires a new approach and focus on new activities, not least in the cultural field.**

The province of Bohuslän has many unique features, with respect to both nature and culture. There is an archipelago that is unique from an international perspective, with islands and fjords. The archipelago is mostly limited to the area that has been covered by inland ice and where the elevation of the land is still taking place. A special feature of the archipelagos of Bohuslän and of the Baltic Sea is that they lack a true tidal variation. Valuable and unique biological features include the deep-sea corals in the Kosterhavet National Park. The province has a long cultural history whose early stage can be seen in the area of rock carvings at Tanum, which is a World Heritage Site. There are also a number of nature reserves in Bohuslän, which represent both the natural and the cultivated landscapes of the region. The coastal communities are unique to Bohuslän, and to a large extent reflect the history of fishing, including the great herring fishery periods.

It is time to make a new, concerted effort in the field of tourism and recreation, in order to strengthen the tourism and recreation cluster. This requires long-term efforts and the range of what is offered must be successively broadened. An important aspect of this is that actors who normally do not work together must find new forms of cooperation. This should involve local initiatives by local companies and organisations – the ideas should come from below. Research is also needed to increase knowledge about future demands and also about how tourism and recreation can be made more sustainable.



## 5. Cluster structure

The different cluster areas will function differently depending on the area concerned, the actors that are participating, etc. Some clusters have a long tradition of cooperation, whereas others need more time to develop collaborative forms. Examples of cluster activities include bringing together businesses and research at meetings, workshops and conferences, carrying out strategic communication and developing and coordinating common projects on the basis of the needs of each partial cluster.

### There are however certain basic principles which should characterize all cluster areas:

- There must be one organisation that has the administrative responsibility for the cluster areas and that ensures that they are active and functioning. Existing organisations should be used, in order to avoid creating additional structures.
- The clusters areas should have a leadership that is divided between a leading representative of research and a leading representative of the users of research, which could be a company or a public authority. This is in order to create balance and mutual understanding, so that researchers, businesses and public sector actors can participate on equal terms.
- The cluster areas must develop common goals and working programmes for activities that are anchored both in academia and among the users of research.

- There must be a structure with which to record and develop any proposals that emerge, that is, some form of “innovation group” that can further develop ideas and provide feedback. The representatives of existing regional innovation systems should thus be included in the cluster.
- It is an advantage if the cluster monitors activities, have a strategic intelligence process and carry out benchmarking.
- The cluster should be open for anyone who wishes to participate, but there should be a clear working programme. It should also be understood that being a part of the cluster entails an active engagement.

The different cluster areas are held together in a common structure, without the need to introduce unnecessary bureaucracy. The arrangement can be better described as a “partnership model” than as a “membership model”. One consequence of this is that the projects in this model can be carried out outside of the cluster organisation itself. The projects can engage different partners, which make the group of project participants open and transparent.

The European Maritime Day in Gothenburg in May 2012 proved to be a very good experience. This will now be followed by an annual Swedish Maritime Day in Gothenburg, starting in April 2013.

## Timeline

2007	Adoption of the EU Integrated Maritime Policy
2008	Adoption of the Maritime Strategy of Region Västra Götaland
2011, July	Swedish Agency for Marine and Water Management is established
2011, October	Cluster project starts
2012, May	European Maritime Day, Gothenburg
2012, July	Seminar on Blue Growth, Almedalen
2012, November	Presentation of cluster project report
2013	Implementation

### FOR MORE INFORMATION

**Anders Carlberg**, Region Västra Götaland, anders.carlberg@vgregion.se

**Axel Wenblad**, Region Västra Götaland, axel.wenblad@gmail.com

**Susanne Lindegarh**, University of Gothenburg, susanne.lindegarh@bioenv.gu.se

**Andreas Hanning**, Chalmers University of Technology, andreas.hanning@chalmers.se



