Study on Blue Growth and Maritime Policy within the EU North Sea Region and the English Channel

Final Report FWC MARE/2012/06 – SC E1/2012/01

Client: DG Maritime Affairs and Fisheries

Rotterdam/Brussels,

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List of Abbreviations

Bn	*billion*
BRIC	*Brazil, Russia, India and China*
CBS	*Centraal Bureau voor de Statistiek (Netherlands)*
CS	*Continental shelf*
CSR	*Corporate social responsibility*
DG MARE	*Directorate-General for Maritime Affairs and Fisheries*
DKK	*Danish krone*
DSS	*Deep-sea shipping*
EC	*European Commission*
EEDI	*Energy Efficiency Design Index*
EIB	*European Investment Bank*
ERDF	*European Regional Development Fund*
ESF	*European Social Fund*
EU	*European Union*
EWEA	*European Wind Energy Association*
FAO	*Food and Agriculture Organization*
GVA	*Gross Value Added*
ICT	*Information and communications technology*
IEA	*International Energy Agency*
IMO	*International Maritime Organisation*
JRC	*Joint Research Centre*
LNG	*Liquefied natural gas*
MARPOL	*International Convention for the Prevention of Pollution from Ships*
Mln	*million*
MS	*Member States*
MW	*Megawatt*
NREAP	*National Renewable Action Plan*
NUTS	*Nomenclature of Territorial Units for Statistics*
OECD	*Organisation for Economic Co-operation and Development*
OEM	*Original Equipment Manufacturers*
OPEC	*Organization of the Petroleum Exporting Countries*

OTEC	*Ocean thermal energy conversion*
RAS	*Recirculating aquaculture systems*
RDI	*Research, development and innovation*
SECA	*Sulphur Emission Control Areas*
SME	*Small and medium sized enterprises*
TEN-T	*Trans-European Transport Networks*
UK	*United Kingdom*
US	*United States*

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Executive summary

Background and Aim

This study on the Blue Growth potential in the North Sea and the English Channel is one of four sea-basin studies commissioned by DG MARE with the aim to examine in closer detail the individual development patterns of the maritime industries within the European Union. Within the framework of this present study we have evaluated the state of play and growth potential of four countries: Belgium, Germany, the Netherlands and Norway. Furthermore when zooming in on the development of particular sectors, data on the North Sea-related activities in Sweden, Denmark, the UK and France were also taken into account.

Importance of Blue Growth in the North Sea

The region of the North Sea is highly industrialised, with major port areas along the shores and increased offshore activities taking place. Some of the industries have been undergoing significant changes with both increased production (e.g. offshore wind) and stagnating or decreasing production (e.g. oil and gas). In addition to primary production, the region also serves as a home to many up- and downstream activities for its main sectors as well as hosting strong educational and research capacities.

Taken together, the North Sea coast is a crucial region for Europe's Blue Economy: its maritime economy is estimated to represent a GVA of at least € 150 billion (out of just under € 500 bn. for the EU as a whole[1]), and employs at least 850 000 people (out of 5.4 mln. people for the EU as a whole). These estimates include Belgium, Germany, Netherlands, and Norway as a whole; the UK, France, Denmark and Sweden are included in part.

Although not a Member State, **Norway** has a very important maritime economy, if only because 92 % of its population lives in maritime areas. The maritime economy of Norway constitutes an enormous GVA, estimated at € 80 bn; and employing about 150 000 in almost 14 000 enterprises. The bulk of the GVA (and less so employment) is generated by the offshore oil and gas sector, centred around Stavanger, which had a value creation of € 63 bn. in 2010. Closely connected to offshore is the shipbuilding sector. In recent years, shipyards in Norway have specialized in building and especially designing offshore supply vessels and other oil and gas related ships. Fishing and aquaculture are important activities as well, especially in terms of employment (together almost 28 000 jobs), predominantly within small enterprises. Aquaculture focuses predominantly on salmon production and has a strong research potential.

Norwegian industrial and maritime policies have a clear focus on growth and development. This has undoubtedly contributed to both increased value creation and global knowledge leadership in key sectors such as the oil and gas and the supply industry, which consists of both shipbuilding and deep sea shipping, amongst others. Improving access to finance for high risk and high potential projects, cluster support and university-enterprise cooperation are mainstays of Norwegian policy for strengthening growth.

[1] European Commission (2013): Blue Growth- Maritime Affairs, http://ec.europa.eu/maritimeaffairs/policy/blue_growth/

The North Sea coast of **Belgium** counts at least an approximate 37 000 maritime jobs, contributing to a GVA of € 4 billion per year. Both deep-sea and short-sea shipping are crucial, but so are coastal tourism and the construction of water projects (e.g. port breakwaters, coastal protection structures, dredging of access channels). While many of these activities have been long established in the country, construction of water projects and inland waterway transport demonstrate strong development potential still. Offshore wind, centred around Oostende, has been identified as the most promising activity. Short-sea shipping (Antwerp) has growth potential as well, while Zeebrugge is still growing in the area of deep-sea shipping as well as cruise shipping – mostly due to the proximity of Brugge as a major tourism attraction.

The North Sea-coast of **Germany** employs at least an estimated 170 000 people, 4 000 enterprises and a GVA of € 14 bn. This part of the coast features above all shipping and fishing. While deep-sea shipping has been negatively impacted by the economic and financial crisis, a slow recovery process has now been underway. Offshore wind is one of the most rapidly developing sectors in Germany as the extension of offshore wind energy is a main focus of the Federal Government since the country's decision to phase out nuclear power and step up climate protection targets. In March 2013, a total of 320 Megawatt (MW) were in operation (of which 50 MW in the Baltic Sea), another 1 600 MW under construction and 10 000 MW approved, most in the North Sea. The long established shipping industries are resilient and strong in terms of innovativeness, sustainability and development potential. Most activities are centred around four clusters which are rather diversified in nature: Ems-Axis, Metropolitan Region Bremen-Oldenburg, Metropolitan Region Hamburg, and Schleswig-Holstein.

The **Netherlands** has a diversified maritime economy, worth at least € 13 bn., and employing about 140 000 across 9 000 enterprises. Deep-sea and short-sea shipping are important and centred around the Rotterdam and Amsterdam ports, as well as some other harbours. Off-shore oil & gas is the second largest maritime industry, however growth prospects are bleak. Attention is shifting towards construction of water projects, which has grown steadily over the past years. Key industry players are presenting solid average annual growth year by year also through mergers and acquisitions (e.g. of Smit-Tak by Boskalis). Innovation is one of the main drivers of growth in the sector and research institutes such as TU Delft and Deltares help to strengthen the competitive position of the maritime economy in the Netherlands and its export potential. Shipbuilding remains important in the north of the country. Inland waterways and yachting count a large number of small enterprises.

In addition to the above, the North Sea economy includes four countries in part. Of the **United Kingdom's** total marine employment of about 550 000, more than 330 000 can be attributed to activities in the North Sea region, while more than € 43 billion is generated in the North Sea. For Denmark and Sweden, no sea-basin split is available. In the case of **France** one region, Nord-Pas-De-Calais has access to the North Sea and as such generates approximately €2 billion GVA from maritime economic activities, particularly inland waterway transport and passenger ferry services. In the case of **Denmark**, qualitative assessment indicates substantial shares related to the North Sea, with the region of Mid Jutland alone account for some € 2.2 bn. GVA and more than 12 000 jobs. In both the UK and Denmark, the oil & gas sector is the largest contributor to GVA while coastal tourism and short-sea shipping contribute most to employment. In **Sweden**, the Västsverige region around Gothenburg has the highest concentration of maritime activities and accounts for about € 860 mln GVA and some 12 000 jobs mainly in shipyards, ship repair and inland waterway transport.

State of play and development potential in key sectors

Following on from the findings of the country analysis, a number of key sectors with relevance and strong future development potential have been studied at the level of the North Sea as a whole, namely: offshore wind, offshore oil & gas, aquaculture, deep-sea shipping, shipbuilding, cruise tourism, and coastal protection.

In a short period, the North Sea has become the most important concentration of **offshore wind** turbines in the world. About 5 000 MW of capacity have been installed so far in the EU and North Sea countries play thereby a very strong role in the development of this technology. The UK alone as leading country concerning offshore wind has installed 2 900 MW so far and therefore obtains almost 60% of EUs offshore wind capacity. Moreover, the North Sea region also proves to remain the driving region for future growth of the sector in the EU. In 2012, 80% of the EU offshore capacity was installed in the North Sea.[2] In 2013 the installation capacity increased even more with a total of 277 wind turbines grid connections in the first half of the year, totalling 1 045 MW in seven wind farms. A further 130 turbines, totalling 484 MW, are installed but awaiting grid connection. The strong growth rates in installation in recent years led to about 30 000 jobs and € 2 bn GVA in 2012 directly linked to offshore wind. Given the data for the first half of 2013, a doubling of employment and GVA can be expected in comparison to 2012. As offshore wind is still in a development stage, most jobs (> 90%) are linked to manufacturing and installation. Over time there will be a shift towards more jobs also in maintenance of installed wind farms.

As a growing technology, offshore wind can contribute substantially to achieve Blue Growth in the upcoming years. Based on the National Renewable Energy Action Plans (NREAPs), especially the UK and Germany plan to expand offshore wind energy capacity, making it a major component of their national energy mixes. Decisive factors which can shape the future of the sector, either positively or negatively, are electricity prices, technological development, and access to finance.

Offshore wind offers significant opportunities for synergies with processes such as maritime spatial planning as well as with other energy sources e.g. wave, tidal, OTEC, osmotic sources (with wave and tidal being the more mature ones). Uncertainties in the sector on the one hand arise from a strong dependency on public financial support, which is open to political debates and hence is under constant review. Within the context of the public budget crisis, governments are increasingly reviewing their public support schemes and the tendency is to cap such public support. Even more important, the EU policy framework is currently only in place until 2020 and the uncertainty about the period afterwards already discourages new plans and initiatives right now. Another portion of uncertainty is linked to the future potential of other resources such as shale gas.

[2] EWEA (2013): The European offshore wind industry - key trends and statistics 2012, p.6

Offshore oil & gas in the North Sea region has been an important source of employment and revenue as well as an essential energy source with low or no geopolitical risk as opposed to specific third country imports that could be threatened by political instability of the state of origin or country of transit. Within the North Sea region the main oil and gas producing countries are Norway, the United Kingdom (with Scotland producing the largest quantity), the Netherlands and Denmark. Detailed figures on production size appear unreliable as data sources refer to confidentiality. According to figures from national as well as Eurostat sources, the oil & gas sector has a direct employment of around 70 000 people in the North Sea – including the UK, Netherlands, Denmark and Norway. Indirect and induced employment is however estimated to be over 600 000. Although figures for GVA are not widely available in the sector, Norway had a reported €63 billion revenue from offshore oil activities with the UK reporting €36 billion for 2010.
Reports are indicating that offshore oil & gas activities have reached their peak sometime during the mid-1990s and the industry is now in a steady decline. This however does not mean a sudden drop of employment or production and offshore oil & gas activities continue to dominate the North Sea regions of the aforementioned countries. Furthermore, there are still potential reserves to explore – especially so in Norway.

Due to many decades of experience in offshore oil & gas exploration, extraction as well as research and development, the North Sea is an important hub of knowledge and expertise which could potentially play an important role in transferring this knowledge to other parts of the world or onto other sectors within the region of the North Sea. Synergies exist with offshore wind and sea-bed and aggregates mining in terms of activities such as building and installing offshore structures, laying cables on the seabed or carrying out maintenance and safety checks. Furthermore, activities involving the supply chain actors are also transferable such as the case with underwater vehicles, robotic technology or smart buoys. The main drivers for the industry are research and innovation including collaborations (training, maintenance etc.). Policies that are of influence to the sector are various, and they can also relate to biofuels, environmental impact assessments, taxation etc.

Compared to other coastal areas, the North Sea basin is not a primary focus for **marine aquaculture** due to climate (particularly water temperature), lack of sheltered sites (coastal topography) and historical levels of pollutants in the basin. However, as environmental conditions are now improving – reduction of pollution - and so is the overall potential of the North Sea for expanding the aquaculture sector. Future development potential is also strongly linked to the ability of the sector for lowering its environmental footprint. The regulation of pollution and control of production by EU legislation has gone considerable lengths to mitigate such impacts and give assurance to the market on quality and sustainability. Atlantic salmon aquaculture in Norway is by far the most important activity, and likely to continue to increase in the future, by an expected 4% a year. In the Netherlands, aquaculture development is constrained by environmentally driven legislation and opposition on environmental grounds. In the United Kingdom, the primary opportunity for expansion of aquaculture lies with RAS (recirculating aquaculture systems) production of species such as barramundi (Pacific seabass), tilapia, African catfish etc. However, the high costs of energy, land, water, labour and equipment coupled with competition from low-cost imports mean that significant future development is unlikely.

The sector currently has a strong need to increase synergies and reduce tensions particularly in relation to environmental and health concerns. Potential for future growth can come from certification (most European salmon producers have signed up to certification to ASC standards within 7 years) and genetic modification – which could lead to increases in production. R&D is seen as the most important driver for growth. Uncertainties come from the impacts of global climate

change – as aquaculture is particularly sensitive to water temperature changes. Additionally synergies with other maritime sectors (multifunctional platforms) and improvements on water quality resulting from environmentally friendly practices could potentially increase the sector`s future potential.

Deep-sea shipping is a highly significant maritime activity for the countries bordering the North Sea basin. An important contributor to the sector`s performance is the Le Havre – Hamburg port range, which includes some of the biggest ports in Europe and the world. The ports of the North Range, located in a range of about 500 km along the south coast of the North Sea and the English Channel, serve the hinterland of Germany, the Netherlands, Belgium, France and that of other European countries, eventually comprising a market of more than 350 mln people. More than 50% of the cargo volumes handled there have an extra-EU origin while the ports of the area serve as transhipment hubs between deep-sea and short-sea services.[3]

The majority of deep-sea trade in the region goes through the Netherlands which accounts for as much as 41% of the total deep-sea cargo volumes of the sea-basin. Belgium, Germany and the United Kingdom follow with about 15 -20% each. In 2011, the ports of the countries bordering the North Sea basin handled a total of more than 648 mln. deep-sea tons. It should be noted that despite the sudden slump of international trade volumes following the 2008 crisis outbreak, deep-sea shipping has managed to bounce back to pre-crisis levels achieving even a 25% increase in freight volumes handled since 2002. Direct employment levels are at an estimated 60 000 jobs while a direct GVA of some € 11 bn. is achieved. From country-specific data we know this figure can be much higher if indirect and induced employment is taken into account. The sector has considerable potential for synergies with the rapidly growing LNG sector where LNG can be used as an alternative fuel for DSS assisting to achieve compliance with the increasingly strict environmental regulations.

An analysis of trends and prognosis suggests that deep-sea shipping in the North Sea will be faced with slowly but steadily increasing cargo flows as a result of increasing trade volumes and vessel sizes. Vessels are also calling at fewer ports, thus putting extra strain on specific port-to-hinterland bottlenecks due to increased requirements in peak capacity. This latter aspect will require ports to develop more efficient operations, assisted by the increasing use of ICT systems and specialised infrastructure. A probable scenario is that the deep-sea shipping trade will be concentrated at fewer ports in Europe. The likelihood of this scenario is reinforced by the potential impact of the Panama Canal expansion on global shipping routes. In the long run this will also affect cooperation models between deep-sea ports as well as between deep-sea and short-sea ports in the sea basin serving regional distribution. At the same time an increased inter-port integration will allow further optimisation of capacity use during peak periods, reducing the pressure on port infrastructures.

Shipbuilding is a long established sector in the region and consists of two major economic activities: the construction and maintenance of ships at yards and the supply of marine equipment which, especially in the North Sea region, are well integrated and working together in clusters. While in the North Sea as well as elsewhere in Europe, yards are facing weak demand caused by global overcapacity and fierce competition from Asian competitor yards, the competitive position of players here is considered best of Europe with renowned suppliers of high value niche segments, e.g. cruise vessels, dredgers and offshore vessels. Supplier and manufacturing clusters around leading yards such as Meyer Werft in Germany, IHC and Damen in the Netherlands or STX in

[3] Maatsch and Tasto, Hamburg-Le Havre Range topped 40 million TEU in 2011, ISL (2012)

Norway are but a few examples of these. When only looking at narrow sector data from e.g. yards, figures already amount to more than € 5 bn. GVA and over 64 000 jobs. Such figures are likely doubled if marine equipment activities are added.

The increased focus on fuel efficiency, reduced operating costs and ´green´ performance of ships together with a strong demand for energy efficient engines or alternative powering systems is a very positive indication for the future. In addition, suppliers in the North Sea region are well equipped to provide the equipment needed to stricter upcoming environmental rules. However, the uncertainty regarding this introduction is problematic for, especially, the smaller suppliers. After all, their current market size is limited and ship owners are not willing to invest in their expensive equipment before new rules are clearly in place. Possible synergies can be found with the offshore (oil & gas but also wind) industry. The growing demand for cruise tourism provides room for synergies as well. The greening trend is a cross-cutting synergy that shipyards and suppliers provide to all marine sectors

The **cruise sector** is an important player in the region and its overall GVA in the North Sea region is estimated to be in the range of € 800-1 000 million while the number of jobs is estimated at around 10 000. A key trend is the increase in numbers of source passengers from the region, as the cruise industry is expanding into different target groups. Another trend is that towards an increasing number of destination passengers in the region (resulting from more near home embarkations, more short trips and shorter distances between ports).The cruise market is increasingly segmented into various market segments (large scale versus small scale, affordable versus luxurious, highlights versus discovery, etc.). This offers further opportunities for cruise sector development in the North Sea. The structure of the cruise industry is rather concentrated. There are several cruise brands but these belong to just a handful of companies, mostly American. Product innovation and cooperation between ports, stakeholders and cruise companies will be key in further developing the cruise market, aiming at joint marketing of the region and its attractions, developing a cruise terminal infrastructure network and developing a variety of shore excursion offerings. The sale of shore excursions is essential to cruise companies. More cooperation between ports and stakeholders from the local tourism sector will help selling the North Sea Region cruise ports as cruise destinations. Sustainability and innovation provides one of the areas for synergies as the sector is seeking to benefit from the availability of a well-developed green technology manufacturing base.

Coastal protection is of particular importance for the region as parts of its coastal areas are highly susceptible to coastal erosion. This is especially the case for the southern part of the sea-basin - also the areas with the highest densities of population industry activity and other concentration of assets - resulting in potentially high negative impacts. Past events such as the 1953 storm have triggered the region to develop response mechanisms. The lower western parts of the Netherlands and Belgium have by now a long tradition of fighting the seas, resulting in a well-developed sector of high standing that is exporting its technologies and services to other parts of the world as well.

While the economic value of the sector in the region itself may be considered small (an estimated € 1.5 bn. GVA and some 11 000 jobs), the sector has a much wider relevance both within the sea basin through spill-overs and synergies with other sectors, and as a basis for export opportunities worldwide. Coastal protection is a growing sector globally. Several countries in the sea-basin are relatively well advanced. They have a long history of coastal protection activities, providing high skills level and top players in executing works, both within Europe and as an export product. The region can promote this as a selling point and increase its global competitive position which could

result in growth. A second growth potential already materialised is the use of technologies for a multitude of other marine sectors (port construction, access channel dredging, support to constructing offshore wind platforms, etc.). Furthermore coastal works appear to be more and more designed for multi-use (e.g. port breakwaters also contributing to coastal protection, suppletion benefiting coastal tourism, coastal barriers acting as energy plants, and protection technologies serving marine species development). The sector has strong synergies with offshore activities such as wind energy, oil & gas and sand mining as well as urban and regional development.

Conclusions: the North Sea as a knowledge hub

The development and adaptation of innovative, sustainable cross-sectoral approaches, procedures and infrastructures are found to be one of the main drivers of development in the region. Sustainability remains an essential element for emerging as well as for more traditional industries such as shipping and port activities which are increasingly focused on the development and adaptation of green technologies. Consequently there is notable employment potential in the development, adaptation and maintenance of cross-cutting sustainable infrastructures as well as procedures.

The region of the North Sea has for many decades – if not centuries - hosted maritime industries and developed clusters as well as hubs of knowledge and expertise. While there are on-going collaborations between varieties of stakeholder groups, it is essential that the research and education potential and infrastructure that exist in the region is supported in the future through public and private financing.

This wealth of knowledge and expertise provides opportunity for start-ups as well as for - established industries such as shipping or oil and gas which also require constant innovation in order to maintain competitiveness on the global market. Therefore long-term policy initiatives supporting research, innovation and the regional and local collaboration between start-ups, SMEs and multinational companies are an important contributing factor of future development.

Much scope for cross-sectoral initiatives

The study has found that long-established traditional sectors such as shipping, shipbuilding or oil & gas have arrived to a state where they efficiently distribute resources, effectively communicate with policy makers and stakeholders involved. They also make good use of and invest in research and innovation. This efficient coordination within (and sometimes also between) sectors is a result of the wealth of knowledge generated over decades on the potential resources, market demands, environmental and social impacts etc. For the majority of the maritime sectors the North Sea region is considered to be an active hub of knowledge, where innovation potential remains strong.

However, there is further scope for improvement especially taking into consideration the changing landscape which is bringing forth the importance of renewable energy generation as well as the research and innovation potential that can link together various industries. One opportunity could be the use of multifunctional systems which can further intensify relations between offshore industries such as oil & gas, wind and aquaculture. Multifunctional platforms allow for the various use of the physical infrastructure while multifunctional support vessels can aid the construction, maintenance of off- and onshore installations including port facilities as well as carry out emergency response activities linked to coastal protection or offshore oil & gas.

Further development into cross-sectoral projects can give a boost to employment as well as strengthen policy harmonisation and enhance knowledge and understanding of new applications.

Moreover, cross-sectoral initiatives coupled with research and innovation focus can further improve the competitiveness of the North Sea based maritime sectors specifically in relation to shipbuilding, coastal protection or energy.

Cross-border initiatives can be strengthened

One of the most important areas where cross-border cooperation could improve the long term strategic advantage of the region is that of education and training. One example comes from the oil & gas industry where there is a lack of skilled workforce even though there are initiatives for a better management of human resources. Therefore, it could be beneficial to have complete overview of skills needs - some of which could be transferred and utilised across borders.

Aquaculture is another sector where collaborations between private enterprises are sporadic with the exception of the salmon industry which is the most developed sub-sector in the North Sea region. Hence a comparison can be drawn between the levels of development and that of cross-border or international collaboration. The above highlighted initiatives indicate that potential for employment and sector development remain in the utilisation of cross-sectoral initiatives as well as sustainable and innovative practices.

Recommendations

The overarching review of activities concluded both on a country as well as on a sectoral level across the sea-basin confirms the crucial importance of availability and accessibility of:

- Information and information exchange platforms facilitating collaborations amongst and between industry stakeholders, local and regional authorities reaching beyond the North Sea boundaries;
- Continuous investments and development of the research and innovation potential as well as infrastructure;
- Strong focus should be maintained in sustainability of off- and on-shore facilities as well as operational activities;
- Increased support and focus on cross-sectoral initiatives such as supergrid, multi-purpose islands, energy atolls, etc.;Support to SME spin-offs and start-up companies;
- Support to marine spatial planning initiatives as a tool to facilitate cross-sectoral and cross-border dialogues in order to adapt to the changing regional maritime landscape.

1 Background and overview

1.1 Background

This study on the Blue Growth potential in the North Sea and the English Channel is one of 4 sea-basin studies commissioned by DG MARE with the aim to examine in closer detail the individual development patterns of the maritime industries within the European Union. The sea-basin studies have been carried out with a focus on countries with direct access to the North, Atlantic, Mediterranean and Black, and Baltic Seas.

In order to obtain comparability between results of the sea-basins, methodologies applied in this study have been aligned with those followed for the other sea basin studies.

Within the framework of this present study we have evaluated the state of play and growth potential of four countries, these are:

A. Belgium;
B. Germany;
C. Netherlands; and
D. Norway.

Furthermore when zooming in on the development of particular sectors at sea basin level, data on the North Sea related activities in Sweden, Denmark, the UK and France, which are addressed under the parallel studies for the Baltic Sea and the Atlantic Arc, were also taken into account.

This study has focused on the North Sea region and aimed at providing a comprehensive overview and analysis of the main marine and maritime economic activities. Additionally, it identifies the value and impact of these activities on the countries pertaining to the North Sea-basin. The study is also intended to serve as a background to the negotiations with Member States on the partnership agreements for the 2014-2020 programming periods.

Based on these aims, the research process has been following a two-folded approach which includes the analysis of the countries along the North Sea coast and the assessment of a selected set of most promising maritime economic activities on the sea-basin level. This approach allowed to cross-validate results generated through the official statistics on the countries with that of additional data arising through various other sources – including interviews – in the sector reviews.

This draft final report presents the comprehensive findings of the study including country reports for Belgium, the Netherlands, Germany and Norway and, in relation to the specific sectors studied in further detail, additional North Sea related findings for France, the UK[4], Sweden and Denmark[5].

As most maritime economic activities reach beyond their core activities – such as drilling in the case of off-shore oil & gas production – and involve many up- and down-stream activities, patterns of cross-border collaboration have been mapped and drivers and barriers highlighted.

[4] Complete report to be found in the Atlantic study
[5] Complete report to be found in the Baltic study

1.2 Main study components

1.2.1 Data gathering method for maritime activities at country level

Four different studies for four sea basins (Baltic, North Sea, Atlantic and Mediterranean + Black Sea) were commissioned by DG MARE. Two of these have been led by Cogea (Baltic and Mediterranean) and two other studies have been led by Ecorys. The two consortia developed a data methodology to align methods used, data sources and processing, as to ensure consistency and coherence.

Key elements of the methodology are:

a) The approach of marine economic activities in terms of value chains, which go beyond the narrow definition of economic sectors. As an example, the maritime economic activity of deep sea shipping includes the shipping sector, but more than 75% of employment is generated in supporting sectors found in ports and other places (think of cargo handling, pilotage, warehousing, distribution, etc.). Therefore, for each maritime economic activity, as defined in the Blue Growth study, a value chain was elaborated.

b) To allow for replication preference was shown for publicly available sources like Eurostat since these are consistent across countries and sectors and allow the build-up of time series. As a consequence, economic sectors defined by Eurostat (NACE code system) were linked to the value chains defined. Not for all maritime economic activities NACE sectors are directly available, and especially for small sized or pre-mature activities like Blue biotechnology, ocean energy or maritime security, no statistical data are available through such sources, and the researchers had to rely on alternative data. For other activities, parts of the value chain may consist of sectors that are only partially relevant to maritime activities.

c) Once data was gathered, allocation mechanisms were developed to split between maritime and non-maritime, for those sectors where applicable (example cargo handling includes handling of road and air cargo0, and to split between maritime sectors for those sectors relevant for multiple maritime activities (example cargo handling relates to deep sea but also short sea shipping).

d) Finally, for countries bordering multiple sea basins, a split was needed and for each maritime economic activity, a mechanism to allocate the economic importance was developed.

In Annex I, a detailed elaboration of the methodology can be found.

1.2.2 Country reports

For each of the four countries allocated to the North Sea, a detailed analysis was carried out using a structured template (aligned with the other sea basin studies to ensure a harmonised approach for the collection of information).

The resulting country reports present a quantitative and qualitative review on the maritime economic activities, both in terms of GVA and employment figures for the country as well as for NUTS2 level regions. Moreover, they provide and overview of the 7 largest, 7 fastest growing and 7 most promising maritime economic activities as well as an analysis of maritime strategies and policies.

As mentioned previously some of the countries under analysis have access to more than one sea basin in which case the consortia carrying out the evaluation has to provide a split within the country report identifying the economic value for the maritime sectors in the seprate sea-basins. For the Northsea study, this concerns Germany Therefore, an allocation between sea basins was made using the methodology developed for al sea basin studies (see Annex I). The overall methodology of the country reports and some aspects of the sector review have strongly built on the 2012 Blue Growth report[6].

1.2.3 Sector review

The second main study output concerns an in-depth look at a selection of six maritime economic activities in the Nort Sea Region, which are considered highly relevant and promising, or otherwise unique for this sea basin. The aim of the sector studies was to map their future development potential for the North Sea region and to draw a comprehensive picture regarding their state of play.

Based on the country reports, joinly with the European Commission the following six sectors were identified: deep-sea shipping/shipbuilding[7], cruise tourism, offshore wind, offshore oil and gas, marine aquaculture and coastal protection.

The sector studies have been developed using a structured template which had been compiled to assure consistency and allow for a comparative analysis between the industries. Key elements included in the analysis comprised of an assessment of:

- Perfomance and trends;
- Strengths and weaknesses;
- Synergies and tensions;
- Cross-border and international collaboartions;
- Research and development; and
- Future development.

Findings on the current state of the sectors were then used to devise future scenarios which would provide further support for identifying the development potential of the individual sectors in the sea basin, as well as of the synergies and tensions that might exist between them. Furthermore, the future scenarios developed contribute to outlining possible policy and financial mechanisms that might be able to provide further support to extend the growth potential and to increase the use of synergies.

1.2.4 Limitations to this study

During the course of the study it was our foremost intention to provide a robust analysis by building on valid and justifiable data and information. Therefore, we have taken great care to validate and cross check results using different sources of information and including statistics, published literature as well as interviews with relevant stakeholders.

[6] European Commission, 2012: Blue Growth – opportunities for marine and maritime sustainable growth. COM (2012) 494 final.
[7] It is noted that for analytical reasons, shipbuilding was studied separately from deep-sea shipping, and in effect 7 instead of 6 sector studies were conducted.

It is our understanding that a follow-up analysis could potentially benefit from further extending the scope of this report and bring in an additional dimension by assessing interconnectivity of activities between the European sea-basins and comparing contrasting the findings of the parallel running sea-basin studies.

1.3 Structure of this report

The following chapters of this draft final report present the findings of the study according to the following structure:

- Chapter 2: Country analysis;
- Chapter 3: State of play: most promising and relevant sectors in the sea-basin;
- Chapter 4: Future Scenarios for the most relevant and promising sectors in the sea-basin ; and
- Chapter 5: Conclusions and recommendations.

2 Country Analysis

2.1 Overview

The North Sea region is an essential area for European maritime activities. It hosts the largest and most important ports, it provides the busiest shipping routes and houses energy and electricity generation through renewable (wind turbines) and non-renewable sources (offshore oil and gas), while its coastlines are among the most intensively used in Europe.

The aim of the country analysis was to identify and analyse in detail the key maritime sectors for each of the countries and to identify patterns of development. In order to identify the largest and the fastest growing sectors a quantitative analysis has been carried out based on the added value of the sectors in terms of GVA and employment. Eurostat statistics were identified as the primary source of data with secondary sources such as industry reports and national associations providing additional information. The data were cross-checked and validated using these multiples sources and trends have been analysed to identify patterns. The most promising sectors were identified using qualitative indicators such as innovativeness, competitiveness, sustainability etc.

The region of the North Sea is highly industrialised, and serves as a home to many up- and downstream activities for its main sectors as well as hosting strong educational and research capacities. While overall the region boasts strong economic figures in terms of both GVA and employment, there are some disparities between regions in the less inhabited north versus the high density regions in the southern part of the sea basin. Such disparities can be partially explained by the limited accessibility of regions in the northern part of the sea basin. These regions also strongly depend on traditional industries such as fisheries and agriculture which have pushed out labour and where urban areas have increasingly shifted towards higher skilled jobs in IT, electronics, research and development. Moreover, as pointed out by a recent report, the overall economic performance of the North Sea region has declined during recent years compared to other OECD countries. Despite the long period of economic growth (until the 2008 financial crisis), most of the countries have faced falling productivity rates in the last 10-15 years.

The following sections provide a summary of the country profiles, additionally 2-page country reports can be found in Annex II A/D.

2.2 Belgium

Overview

Belgium counts shipping (both deep and short sea), coastal tourism and construction of water projects among its largest maritime activities. While many of these activities have been long established in the country, there are still ones such as construction of water projects and inland waterway transport with further development potential.

This development potential is reflected by the growth of these industries during the past 3 years[8], consequently these two sectors are also accounted amongst the most promising activities.

[8] Based on data availability

Short-sea shipping was listed as the largest maritime activity and is also listed as the fourth most promising one. This is explained further by the industry figures which show that from all shipping activities in 2008 the share of short-sea shipping was at 53.5% and grew to 57.5% in 2010[9].

Table 2.1 **Overview of the key maritime economic activities in Belgium[10]**

Maritime economic activity	GVA(€ million)	Employment
Other sectors		
Shipbuilding and ship repair	70	1,270
Construction of water projects[11]	460	3,520
Maritime transport		
Deep-sea shipping	547	3,306
Short-sea shipping (incl. Ro-Ro)	740	4,472
Passenger ferry services	367	2,349
Inland waterway transport	414	3,014
Food, nutrition and health		
Fisheriesfor human consumption	610	7,600
Marine aquaculture	3.4	80
Energy and sea bed materials		
Offshore wind	34.8	1,200
Aggregates mining (sand, gravel, etc.)	10	100
Leisure and tourism		
Coastal tourism	400	8,900
Cruise tourism	131	838
Coastal protection		
Coastal protection	170	1.680

Sources: Eurostat, JRC, FAO, EWEA

Aggregate mining which was identified as the fastest growing sector started in 1976. The primary recipient of sand is the construction sector and the cement industry where it is mixed with other aggregates.

Offshore wind was identified as the promising activity, and is centred around Oostende. All in all, it is estimated that 1,200 people are now employed in offshore wind, about 33% of the overall employment in in the wind energy sector.

All in all, it is estimated that 1,200 people are now employed in offshore wind, about 33% of the overall employment in in the wind energy sector in Belgium.

Regional level activities

Belgian coastal NUTS 2 regions are related to three of the Flemish provinces: West Flanders, East Flanders and Antwerp:

- In terms of GVA, 100% of the oil and gas and 75% of inland waterway transport activities were related to Antwerp[12];

[9] Ecorys estimation based on Eurostat data 2013 (see methodology annex)
[10] Please see the individual country reports for further details
[11] In the scope of this study defined as per NACE sector 42.91 of Eurostat, this class includes construction of waterways, harbour and river works, pleasure ports (marinas), locks, etc., of dams and dykes, and dredging of waterways

- West Flanders activities were concentrated on passenger ferry services, fishing, blue biotechnology, coastal tourism and yachting (all with 100% of GVA);
- East Flanders maritime activities were more scarce and related to shipping (both deep and short-sea) as well as inland water way transport (25% of GVA).

Clusters

Four maritime clusters were identified in Belgium, these are Antwerp, Oostende, Zeebrugge and Ghent. Zeebrugge is the only cluster identified as being in the "growing" stage and focused on shipping exclusively.

Antwerp is the largest of the clusters and while it can rely heavily on its strategic location its weakness is the lack of flexibility and strong attachment to established activities such as oil and gas or shipping. These can provide a hindrance in opening up towards new activities and innovative ventures.

National strategies and policies

In Belgium the Federal State has the general competency for the North Sea policy. It embraces the Blue Economy as a concept, and takes the Limassol Declaration as the overarching framework for its policies. The Master Plan for marine spatial planning system is a regulatory and legally enforceable blueprint that covers Belgium's territorial sea. The original 2005 "Master Plan" was developed by the Ministry of the North Sea; it has been revised in 2012 under the egis of the Federal Ministry of Environment

2.3 Germany

Background

Germany has direct access to two sea-basins, namely the North Sea (north-west coastline) and the Baltic Sea (north-east coastline). The entire coastline has a length of 3,204 km, representing 2.35% of the total coastline length of the EU-22 coastal Member States. Approximately 2,200 km (1.6% of the total coastline length of the EU-22 coastal Member States) is allocated to the Baltic Sea and about 1,000 km to Germany´s North Sea coastline.

Maritime economic activities

Regarding maritime economic activities, shipping and fishing are still considered to be the largest sectors in the North Sea region. While deep-sea shipping has been very negatively impacted during the last few years and freight volume declined from over 120 million tonnes in 2008 to 99 million tonnes in 2009 (-20%), a slow recovery process has now been underway. [13]

Table 2.2 **Overview of the key maritime economic activities in Germany**[14]

Maritime Economic Activity	GVA (€, million)	Employment
Other Sectors		
Shipbuilding and ship repair	540	10,840
Water projects	80	1,820
Maritime transport		

[12] Derived from Eurostat figures
[13] Derived from data analysis based on Eurostat
[14] Please see the individual country reports for further details

Maritime Economic Activity	GVA (€, million)	Employment
Deep-sea shipping	3,150	19,690
Short-sea shipping (incl. Ro-Ro)	4,020	25,100
Passenger ferry services	40	690
Inland waterway transport	1,200	8,960
Food, nutrition, health and ecosystem services		
Fish for human consumption	1,540	38,840
Marine aquatic products	3	10
Agriculture on saline soils	1	30
Energy and raw materials		
Offshore oil and gas	620	2,980
Offshore wind	1,410	15,150
Aggregates mining	20	270
Leisure, working and living		
Coastal tourism	880	41,760
Yachting and marinas	230	2,380
Cruise tourism	110	1,530
Coastal protection		
Coastal protection, protection of habitat	110	1,130

Source: Eurostat

Offshore wind is one of the most rapidly developing sectors in Germany. Due to Germany´s nuclear power phase-out and climate protection targets, the extension of offshore wind energy is a main focus of the Federal Government. In March 2013, a total of 320 Megawatt (MW) were in operation (50 MW in the Baltic Sea), another 1.600 MW under construction and 10.000 MW approved, most in the North Sea. Therefore, the rapid growth of the last years (+68% turnover and +62% employment from 2010 to 2012 annually) is anticipated to continue.[15]

It is also important to notice that the long established and traditional shipping industries also feature in the most promising list indicating innovativeness, sustainability and development potential.

Regional level activities

To define the regional breakdown of maritime activities, NUTS1 level distribution was considered for Germany. Maritime transport is still the most important activity in terms of GVA for the North Sea adjacent states with Hamburg contributing € 1.57 billion to the overall € 3 billion North Sea side value of the sector.

Other key sectors in the North Sea basin of Germany include coastal tourism with € 880 million GVA, the majority of which is distributed between Lower Saxony (€ 380 million), Schleswig-Holstein (€ 230 million) and Hamburg (€ 260 million). Hamburg also serves as the centre for the maritime activities for yachting and marinas as well as cruise tourism.

[15] Derived from data analysis based on Eurostat

Clusters

The maritime economy in Germany can be described as a cluster alliance with five integrated sub-clusters. The cluster areas accounts for almost 160 thousand employees in about 4,000 enterprises. There are four regional sub-clusters are (from west to east):

- Ems-Axis : region in the north-west of Germany along the river Ems;
- Metropolitan Region Bremen-Oldenburg;
- Metropolitan Region Hamburg: Hamburg and its hinterland;
- Schleswig-Holstein.

There is a large variety of activities concentrating in the five main clusters which contain well-established industries such as shipbuilding and shipping, up-and-coming sectors such as offshore wind and important innovation centres including marine equipment manufacturers at the forefront of green technologies. Relationships and activities between the clusters are deeply intertwined. The special quality of the maritime cluster alliance is the existence of several regional nuclei (sub-clusters) and the various collaboration relationships within and between these nuclei.

National strategies and policies

There are several national and federal level policies governing the development of the maritime industries. One of the most important policy documents is the Maritime Development Plan – a Strategy for integrated German maritime policy. It serves as a framework for a comprehensive maritime policy in Germany and its main priority is to strengthen the competitiveness of the German maritime economy and make full use of its employment potential. There are other policy papers for sustainability and biological diversity that impact on the maritime industries. Furthermore specific sectors also have their own policy papers such as port development or shipbuilding.

Additionally federal (lander) level administrations also carry out their individual programmes related to high technology, climate change or spatial planning.

2.4 Netherlands

Background

The North Sea coastline of the Netherlands is about 350 kilometres long with about 2.5 million people are living in the four maritime regions. The main economic maritime activities are geographically divided into four regions:

- Northern sea ports (Delfzijl, Harlingen, Den Helder);
- North Sea Canal (Amsterdam and surroundings);
- Rhine and Meuse (Rotterdam and surroundings); and
- Scheldt basin (Vlissingen and Terneuzen).

Maritime economic activities

The Netherlands has a diversified maritime economy, as no single activity is mentioned across all three categories (largest, fastest growing and most promising). Coastal tourism, offshore oil and gas and yachting and marinas feature among the largest maritime economic activities.

Table 2.3 **Overview of the key maritime economic activities in the Netherlands**[16]

Maritime economic activity	GVA (€, million)	Employment
Other sectors		
Shipbuilding and ship repair	609	7,700
Construction of water projects	627	5,200
Maritime transport[17]		
Deep-sea shipping	914	6,900
Short-sea shipping	963	7,300
Passenger ferry services	n/a	3,200
Inland waterway transport	677	12,800
Food, nutrition and health		
Fisheries for human consumption	276	28,400
Marine aquaculture	43	2580
Energy and seabed materials		
Offshore oil and gas	4,304	775
Offshore wind	997	2,200
Ocean renewable energy	1.5	8
Aggregates mining (sand, gravel, etc.)	115	462
Leisure and tourism		
Coastal tourism	927	41,000
Yachting and marinas	2,500	16,500
Cruise tourism	300	4,300
Maritime monitoring and surveillance		
environmental monitoring	31.6	Unknown

Sources: Eurostat, Maritime Monitor, JRC, CBS Statline

It is important to note that the offshore oil & gas sector, which is registered as the second largest maritime industry, does not feature on the list of the growing or promising activities due to its declining production figures.

Attention is shifting towards construction of water projects, which has grown steadily over the past years. Key industry players are presenting solid average annual growth year by year also through mergers and acquisitions (e.g. of Smit-Tak by Boskalis). Innovation is one of the main drivers of growth in the sector and research institutes such as TU Delft and Deltares help to strengthen the competitive position of the maritime economy in the Netherlands and its export potential. The strongly interconnected shipbuilding cluster is also participating in this process.

Regional level activities

The most important maritime regions in The Netherlands are Zuid-Holland and Noord-Holland. The two largest ports (Rotterdam and Amsterdam) are located in these regions. The presence of deep-sea shipping, short-sea shipping and inland waterway activities in these regions attract and

[16] Please see the individual country reports for further details

[17] The allocation of port services GVA and port employment to the 1.1-1.3 sectors is based on the shares of employment between these three activities, assuming an equal GVA per person between the activities

reinforce other economic activities such as ship repair, offshore activities, maritime services and marine monitoring and surveillance.

Zuid-Holland (where Rotterdam is located) is particularly strong in shipping and shipbuilding activities, while for offshore oil and gas and coincidentally coastal tourism activities are focused to the highest degree around Noord Holland.

Clusters

Three clusters have been identified in the Netherlands, two of which are located in the port regions of Rotterdam and Amsterdam and one `shipbuilding cluster' in the Northern Netherlands.

The port clusters consist of port activities, shipping and inland shipping activities maritime services and ship repair activities. Rotterdam is the largest port cluster, with over 70,000[18] persons employed directly or indirectly in the maritime economy.

Amsterdam is also a cluster of substantial size, with 40,000[19] persons employed directly or indirectly in the maritime economy. Shipbuilding is the core of the cluster in the Northern part of the Netherlands, suppliers and ship operators are included in the cluster. All three clusters have a mature status and contain similar or interlinking activities. This provides considerable concentration of expertise. At the same time, weaknesses such as access to skilled labour are also present.

National strategies and policies

The main national maritime policy in the Netherlands focuses on providing a safe, sustainable and economically strong maritime industry. The national maritime strategy for the coming 10 years aims to further develop the sectors` strong international position. The following four innovation themes have been selected:

- Deep-sea mining and sustainable energy production on sea;
- Sustainable ships (alternative fuel, fuel savings, emission reduction);
- Smart ships (reduction of staff and maintenance costs, increase functionality and use of platforms, safe ships and platforms);
- Smart harbours (improvement cargo processing, port development).

Policy for North Sea spatial planning and accommodating future activities is under development.

2.5 Norway

Background

The length of the coastline in Norway is 100,915 km, the coastal area makes up about 20% of the total coastal area of the EU-22 MS[20]. All counties in Norway except Hedmark and Oppland have access to the sea. In all, 92 per cent of the inhabitants in Norway live in "maritime areas", which can be identified as the sum of maritime NUTS 3 areas.

[18] Port of Rotterdam (nd) : Facts and Figures, http://www.portofrotterdam.com/en/Brochures/Facts-Figures-Rotterdam-Energy-Port-and-Petrochemical-Cluster-Eng.pdf

[19] Taylor and Francis Group (2002): Clustering and performance: the case of maritime clustering in The Netherlands, http://acrbw.com/files/uploads/20080707001444maritime_clusters_holland.pdf

[20] According to the Norwegian Mapping Authority (2012). This includes the islands of Svalbard and Jan Mayen.

Maritime economic activities

The main maritime economic sector in Norway is offshore oil and gas, which had a value creation of € 63 billion in 2010[21]. This sector constitutes about 80 per cent of all activity in Norway's maritime sector.

Shipbuilding is an important activity that registers amongst the largest, fastest growing and most promising sectors. The sector is closely connected the offshore oil and gas industry and is considered leading in offshore technology, with STX/Aker shipyards the main shipbuilder brand, several highly skilled equipment manufacturers as well as a number of globally operating offshore service companies. In recent years, shipyards in Norway have specialized in building offshore supply vessels and other oil and gas related ships, which are usually designed in Norway. However, since labour costs in the country are high, the hull is often built in a low labour cost country. The ship is then finished at a shipyard in Norway and fitted out with Norwegian equipment.

Table 2.4 **Overview of the key maritime economic activities in the Norway[22]**

Maritime economic activity	GVA (€, million)	Employment
Other sectors		
Shipbuilding and ship repair	2,909	26,106
Construction of water projects	14	208
Maritime transport		
Deep-sea shipping	5,065	16,454
Short-sea shipping	2,454	265
Passenger ferry services	1,105	2,514
Food, nutrition, and health		
Fisheries for human consumption	1,575	16,152
Fisheries for animal feeding	106	1,071
Marine aquaculture	2,362	10,220
Energy and sea bed materials		
Offshore oil and gas	63,754	52,800
Offshore wind	55	657
Carbon capture and storage	10	85
Leisure and tourism		
Coastal tourism	1,025	22,272
Yachting and marinas	51	276
Cruise tourism	32	290
Maritime monitoring and surveillance		
Environmental monitoring	25	260

Source: Statistics Norway, Menon Economics

Regional level activities

Overall, the western and southern parts of Norway, consisting of Agder and Rogaland and Vestlandet, have the most dominant position within the Norwegian maritime economy. These regions have a strong position in offshore oil and gas, shipping, shipbuilding as well as aquaculture.

[21] Menon, 2013

[22] Please see the individual country reports for further details

Shipbuilding is also a quite large sector with a total GVA of about € 2 billion[23]. In this segment, Vestlandet is dominating with close to half of all activities in this sector. Vestlandet is also an important region for aquaculture which is seen to be dominating to the same extent as shipbuilding both with regard to total GVA and distribution.

Clusters

Three main clusters were identified in the country all focusing on different maritime industries. The cluster of Stavanger is a centre for offshore oil and gas activities and is a global leader in terms of industry expertise in deep-sea and subsea production.

Western Norway hosts aquaculture clusters which build especially on salmon production and have strong research potential for the inclusion of new species. The sectors` continuous growth is sparked by strong demand growth in BRIC-countries. Industries linked to aquaculture however, face challenges with regard to high fluctuations in fish prices on the global market as well as diseases and other environmental issues.

The third main cluster in Norway is the shipping cluster located on the west coast of Norway, which is linked closely to the oil and gas sector and as such it is highly dependent on the willingness by oil and gas companies to continue search and production.

National strategies and policies

Norwegian industrial and maritime policies have a clear focus on growth and development. There are four main maritime policies in Norway. Separate strategies apply to the oil and gas, shipping, tourism and aquaculture industries. The national policy for oil and gas has for a long time promoted research and innovation in combination with a stable business environment. This has undoubtedly contributed to both increased value creation and global knowledge leadership in both the oil and gas sector and the supply industry, which consists of both shipbuilding and deep sea shipping, amongst others.

Improving access to finance for high risk and high potential projects, cluster support and university-enterprise cooperation are mainstays of Norwegian policy for strengthening growth among enterprises in all sectors of the Norwegian economy.

[23] Menon Business Economics,(2010)

3 State of play: most relevant and promising sectors in the sea-basin

3.1 Overview

Following on from the findings of the country analysis, a number of sectors with relevance and strong future development potential have been identified, of which six were selected for further elaboration. These are:

A. Offshore wind;
B. Offshore oil and gas;
C. Aquaculture;
D. Deep-sea shipping and shipbuilding;
E. Cruise tourism; and
F. Coastal protection.

The full sector reviews are presented in Annex III A/F. Below, the key messages and strengths/weaknesses of these sectors are captured. The following Chapter 4 focuses on the future potential of each of these sectors.

3.2 Offshore wind

3.2.1 Key messages

The statement *"The North Sea has […] become home to the greatest concentration of offshore wind arrays (wind farms) in the world, mostly developed in recent years following the Renewables Directive (009/28/EC)"*[24]" demonstrates the growing importance of offshore wind for the North Sea region.

Offshore wind technology is thereby following its "older brother" onshore wind with strong growth rates in recent years. About 5 000 MW of capacity have been installed so far in the EU whereas North Sea countries play thereby a very strong role in the development of this technology. The UK alone as leading country concerning offshore wind has installed 2 900 MW so far and therefore obtains almost 60% of EUs offshore wind capacity.[25]

Moreover, the North Sea region also proves to remain the driving region for future growth of the sector in the EU. In 2012 there was 1.166 MW capacity connected to the grid in the EU, of which 80% was generated in the North Sea.[26] In 2013 the installation capacity increased even more with a total of 277 wind turbines grid connections in the first half of the year, totalling 1.045 MW in seven wind farms:

- Thornton Bank (BE),
- Gunfleet Sands 3 (UK),
- Lincs (UK), London Array (UK),
- Teesside (UK), Anholt (DK),

[24] ESPON (2013): ESaTDOR European Seas and Territorial Development, Opportunities and Risks ANNEX 7 to the Scientific Report: North Sea Regional Profile, p. 44
[25] EWEA (2013): The European offshore wind industry - key trends and statistics 2012, p.6
[26] EWEA (2013): The European offshore wind industry - key trends and statistics 2012, p.6

- BARD offshore 1 (DE).

Further 130 turbines, totalling 484 MW, are installed but awaiting grid connection.[27] The strong growth rates in installation in recent years led to about 30 000 [28] jobs in 2012 directly linked to offshore wind. As offshore wind is still in a development stage, most jobs (> 90%) are linked to manufacturing and installation. Over time there will be a shift towards more jobs also in maintenance of installed wind farms. Furthermore the offshore wind sector in the North Sea generated an estimated € 2 bn[29] of GVA. Given the data for the first half of 2013 a doubling of employment and GVA can be expected in comparison to 2012. These estimates are supported by observations from the UK where direct employment doubled between 2010 and 2013 from 3 151 to 6 830.[30]

3.2.2 *Strengths and weaknesses*

The sector characterized by several strengths and weaknesses which are in some cases of general validity for offshore wind and in some specific for the North Sea. The following table provides an overview of the main strengths and weaknesses discovered:

Table 3.1 Main strengths and weaknesses of offshore wind in the North Sea

Strengths	Weaknesses
• Already substantial capacity installed in the North Sea • Shallow waters and strong winds • Proximity to major urban centres and electricity users • Large parts of the value chain situated close to North Sea • Ports offer good infrastructure • Substantial research basis, supporting site selection and innovation • Employment offered, not only in installation but also in maintenance	• Costs of offshore wind production still high (150 Euro per MW installed) • Rough environment of the seas leads to technical challenges and high maintenance costs • Fluctuation in supply – depending on wind speed • Limited grid connectivity – and high costs related to these • Strong dependence on public financial support • Fragile equity position of certain providers

Source: Ecorys

3.3 Offshore oil and gas

3.3.1 *Key messages*

Offshore oil and gas activities are crucial and strategically important for maintaining the economic stability of the Member States and the competitive position of the European Union. Oil and gas extracted from the North Sea region provides stability of energy supply with low or no geopolitical risk as opposed to specific third country imports that could be threatened by political instability of the state of origin or country of transit.

[27] EWEA (2013): The European offshore wind industry - key trends and statistics 1st half 2013, p.2

[28] Based on multipliers from Rutovitz, J. and A. Atherton (2009): "Energy sector jobs to 2030: a global analysis." Final report. Institute for Sustainable Futures. Study conducted on behalf of Greenpeace. P.10 which 0.77 jobs/MW in maintenance, 4.8 jobs in construction/installation per MW and 24 jobs/MW in manufacturing.

[29] Estimation based on the ratio GVA/employee in Ecorys (2012): Blue Growth Scenarios and drivers for Sustainable Growth from the Oceans, Seas and Coasts, p.35

[30] http://www.offshorewind.biz/2013/09/19/uk-number-of-offshore-wind-jobs-doubles-in-the-last-3-years/

Within the North Sea region the main oil and gas producing countries are Norway, the United Kingdom (with Scotland producing the largest quantity production), the Netherlands and Denmark. These countries are not members of OPEC consequently their production capacities have been an important counterbalance in historical oil crises.[31]

The first discovery of offshore gas in the North Sea took place in 1965 with the first commercial drilling for offshore oil in 1969.[32] Reports are indicating that offshore oil and gas activities have reached their peak sometime during the mid-1990s and the industry is now in a steady decline. This however, does not mean a sudden drop of employment or production and offshore oil and gas activities continue to dominate the North Sea regions of the aforementioned countries.

3.3.2 Strengths and weaknesses

Research and innovation

One of the main strength of the industry lies in its research and innovation potential as well in its strong ties to research and education centres. In a mature sector that has been operating in the region for about four decades it is crucial to transform from a resource-based to a knowledge-based economy. This way the operating hubs or service centres can assure that their knowledge is used and adapted across geographical regions and in some cases spilling over to other technology intensive sectors.

Recent RDI initiatives include the Danish Underground Consortium (DUC) which has begun the establishment of a new Danish research centre together with its university partners. The research centre's efforts are directly aimed at improving oil and gas production from the Danish sector of the North Sea. Financing of projects are decided by DUC partners A.P. Moller - Maersk, Shell, Chevron and Nordsøfonden.[33]

The main economic impacts of the offshore oil and gas sector are similar to that of other extractive industries, such as: the macroeconomic performance of the country of extraction, government revenues, direct employment, and economic externalities and spill over effects on other sectors of the economy.

Macroeconomic impact

According to industry information, the majority of an integrated (i.e. involved in everything from exploration to marketing) oil company's net margins are in the upstream processes. The value chain as described above links very strongly to a number of other maritime industries including, shipping, port services and even to offshore wind (via technology and platform development).

Additionally the value chain relies on a number of external inputs such as research and innovation – which feeds into all the elements of the supply chain – as well as health and safety, environmental monitoring etc. These activities might be provided by external contractors not exclusively working for the oil and gas industry but to other industries as well.

[31] David W Sällh (2012) : Future North Sea oil production and its implications for Swedish oil supply regarding the transport sector -A study on energy security and sustainability of future strategic resources, http://uu.diva-portal.org/smash/get/diva2:576194/FULLTEXT01.pdf

[32] F.G. Larminie (1987): The history and future of North Sea oil and gas: an environmental perspective, Philosophical Transaction of the Royal Society of London, Volume 316, No 1181

[33] MAERSK Oil (2013): Danish research center to improve oil and gas production from the North Sea , http://www.maerskoil.com/media/newsroom/pages/danishresearchcentertoimproveoilandgasproductionfromthenorthsea.aspx

Economic impacts for the UK included a £32 billion inflow of revenue into the national economy, with an additional £20 billion coming in from supply chain industry sales In contrast total expenditure has also reached - for the first time - £20 billion (includes exploration drilling, field development, production and decommissioning).[34] According to industry sources[35] overall direct jobs in the UK oil and gas sector amount to 36.000 people only while taking into consideration indirect and induced jobs the total amount can rise up to over 430 thousand, which includes research and development as well.

Oil revenues provide 25% of revenues received by the government, while generating substantial spin-offs for Norwegian society. Norway's petroleum resources have not least laid the basis for a high-tech, internationally competitive industry which supports almost 250 000 jobs directly and indirectly.

The Netherlands is also benefiting from gas production with approximately €5 billion annually in state revenues. Denmark also receives substantial revenue from the production and trade of oil and gas which in 2012 amounted to DKK 25.2 billion a decline of over 15% from 2011.[36] Direct employment is around 8.000 according to data from CBS Statline 2010.

3.4 Aquaculture

3.4.1 Key messages

The North Sea basin is not a primary focus for marine aquaculture for a number of reasons that have an over-arching impact on the potential for future development of the activity in this region. The primary factors are climate, particularly water temperature, lack of sheltered sites (coastal topography) and historical levels of pollutants in the basin. This is not to say that no future expansion or development is likely but in comparison with other coastal areas of Europe (including the Atlantic basin) potential will be severely limited by these factors.

Historically, the North Sea has suffered from considerable inputs of pollutants largely resulting from river-borne effluents originating in the industrial revolution and leading to accumulations of heavy metals and organic contaminants[37]. Many of these pollutants are persistent and bioaccumulate in aquatic food chains, severely limiting the value of the North Sea basin for aquaculture. More recently petroleum and gas extraction, processing and transport in the North Sea basin have led to increased risks of exposure to organic pollutants, again a factor prejudicial to aquaculture development in the basin.[38]

However, conditions are now improving and, for example, projects such as the North Sea Region Programme (2007-2013)[39] have as priorities to promote transnational cooperation that:

- Increases the overall level of innovation taking place across the North Sea Region,
- Enhances the quality of the environment in the North Sea Region,
- Improves the accessibility of places in the North Sea Region,

[34] Oil and Gas UK (2013): Economic Report
[35] Interview conducted with a representative of the International Association of Oil and Gas Producers
[36] Danish Energy Agency (2013): Oil and Gas production in Denmark 2012, http://www.ens.dk/sites/ens.dk/files/dokumenter/publikationer/downloads/oliegas_rapport_uk_-_2012.pdf
[37] Salomons, W., Bayne, B.L., Duursma, E.K., Förstner, U. (1988) Pollution of the North Sea. Springer. ISBN: 978-3-642-73711-4
[38] Vella, H. (2013) North Sea data reveals extent of oil and gas pollution. offshore-technology.com, 22.10.2013
[39] www.northsearegion.eu

- Delivers sustainable and competitive communities.

There is little doubt that with respect to water quality and potential contaminants, the position in the North Sea basin is improving.

3.4.2 Strengths and weaknesses

In North Sea countries there is very little scope for increased growth in aquaculture. The one exception is Norway where the salmon industry has shown potential for increase, particularly since 2008. The fact that this was possible suggests a market which is not yet saturated but is, in fact, increasing as new consumers in the BRIC countries add to demand.

One of the main economic trends in the European aquaculture sector is innovation for added value and profitability. In terms of social trends, because of the relatively high labour costs in Europe, especially in the countries bordering the North Sea basin, the trend has been towards production efficiencies reducing the number of workers required per unit weight of aquaculture production.

The industry is rapidly moving to demonstrate long-term ecological and social sustainability. Eco-labelling of aquacultured produce (GAA, Globalgap, ASC etc.) is an important driver but it should be remembered that the industry in Europe has long recognised the benefits of adopting resilient and responsible farming practices. Indeed, in many respects European aquaculture is a world-leader in understanding and managing the complex relationships between their activities and the natural environment.

3.5 Deep-sea shipping

3.5.1 Key messages

Deep-sea Shipping (DSS) can be defined as: "the *international (freight) transport by sea with large vessels that often sail fixed routes containers, major bulk) or tramp shipping*"[40]

For the countries bordering the North Sea and English Channel basin deep-sea shipping forms a significant maritime activity. An important contributor to this is the Le Havre – Hamburg port range (located mainly in the North Sea and English Channel basin), which includes some of the biggest ports in Europe and the world. The ports of the North Range, located in a range of about 500km along the south coast of the North Sea and the English Channel, serve the hinterland of Germany, The Netherlands, Belgium, France and that of other European countries, eventually comprising a market of more than 350 mln people. More than 50% of the cargo volumes handled there have an extra-EU origin while the ports of the area serve as transhipment hubs between Deep-Sea and Short-Sea services.[41]

In 2011, the ports of the countries (United Kingdom, Belgium, Netherlands, Germany, Denmark and Norway) bordering the North Sea basin handled a total of more than 648 million deep-sea tons. It should be noted that despite the sudden slump of international trade volumes following the 2008 crisis outbreak. Deep-sea shipping has managed to bounce back to pre-crisis levels achieving even a 25% increase in freight volumes handled since 2002. Direct employment levels at an estimated 60,000 jobs while a direct GVA of some € 11 bn is achieved. From country-specific data we know

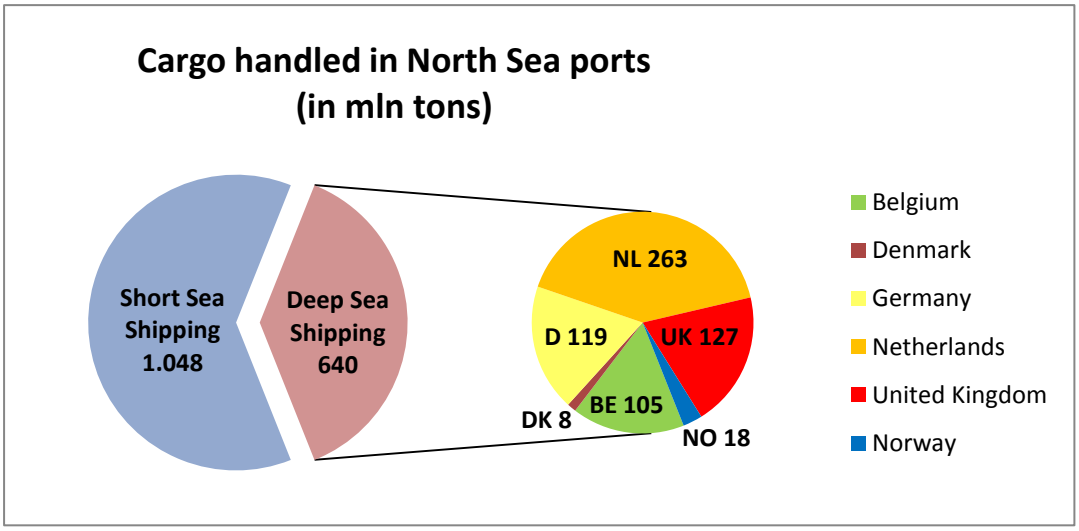
[40] Ecorys, Blue Growth, final report (2012)
[41] Maatsch and Tasto, Hamburg-Le Havre Range topped 40 million TEU in 2011, ISL (2012)

this figure can be much higher if indirect and induced employment is taken into account. These figures still exclude the UK where North Sea related deepsea shipping accounts for almost € 1 bn and employs about 9,000.

At a European level, the North Sea basin holds a 38% share of all EU maritime cargo[42] (see figure 3.1 below) but when it comes to deep-sea-going cargo in specific, North Sea ports handle as much as 57% of all deep-sea cargo arriving or departing from European ports making the North Sea effectively the main gateway for EU international trade. The increasing globalisation of trade and the specialisation of North Sea ports in receiving deep-sea going vessels have also strengthened the position of deep-sea shipping within the North Sea ports as the share of deep-sea cargo in North Sea ports raised within the last decade from 34 to 38% of all cargo handled.

Most of the deep-sea trade in the region goes through The Netherlands which accounts for as much as 41% of the total deep-sea cargo volumes of the sea basin. Belgium, Germany and the United Kingdom follow with about 15 to 20% each.

Figure 3.1 **Cargo handled in North Sea ports by service type and country (2011)[43]**



Source: Eurostat; database mar_sg_am_cw

As The Netherlands and Belgium have only a limited number of DSS vessels registered under their flags, in these countries, the DSS sector appears to be underperforming in matters of GVA and employment creation compared to countries with larger commercial fleets, such as Germany, the UK and Norway.

Table 3.1 **Overview of the economic contribution of the Deep-sea Shipping industry**

Economic relevance of deep-sea Shipping								
	Norway	**Denmark (Whole)**	**Germany (N. Sea)**	**The Netherlands**	**Belgium**	**France (N. Sea)**	**U.K. (N. Sea)**	**Total**
GVA (mln €)	5,065	100	3,150	914	547	263	1,039	**11,078**
Employment	16,454	1,040	19,690	6,900	3,306	2,635	9,543	**59,568**

Source: Country Fiches

[42] Eurostat database (mar_go_aa)
[43] Germany Denmark and United Kingdom data include also non-North Sea ports

However, the impacts of the DSS sector for the North Sea region are not limited to the simple reporting of GVA and employment creation. It is important to also take into account the type of jobs created by the DSS activities. Due to the geographical nature of transport, the jobs created, as well as the relevant GVA born, have a strong local connection. This makes the jobs less volatile and probable to move to other parts of the world as they are certainly not off-shorable, while the sector is resilient to crises of other specific sectors. Finally, it should also be mentioned that port operations create both low- and high-end jobs, spreading welfare more equally between social strata and eventually leading to a higher added value for society as a whole.

Additionally, the existence of a strong logistics sector, a vital part of which is the ports segment, functions as a booster for the whole of the supply chain of all relevant industries. It should be therefore noted that the further strengthening of the competitiveness of the DSS sector for the North Sea region, causes, beyond the direct job and GVA creation, also an indirect one, through the strengthening of the value chain and competitiveness of other industry sectors.

3.5.2 Strengths and weaknesses

Main strengths of the North Sea deep-sea shipping sector, including the ports and landside services associated, are the following:

- Large volume of operations providing economies of scale that have brought the region a competitive advantage vis-à-vis other parts of Europe
- Highly integrated services network both on the marine side (shortsea and feeder services to regional ports within the sea basin as well as other parts of Europe – Baltic in particular)
- Fierce competition between ports for attracting deep-sea (container) cargoes resulting in high operating efficiencies

Identified weaknesses are:

- Limited ability to expand land side infrastructure, in particular hinterland connections
- Competition between ports (countries) in the region and limited coordination beyond national borders causing overcapacity and risk of development failures (example JadeWeserPort)
- Slow decision-making processes with regards to port expansion and infrastructure development.

3.6 Shipbuilding

3.6.1 Key messages

The shipbuilding sector consists of two major economic activities: the construction and maintenance of ships at yards and the supply of marine equipment. In the North Sea as well as elsewhere in Europe, yards are facing fierce competition from Asian competitor yards. , Fortunately, the North Sea based sector has a strong position in high value niche segments which are less affected by global trading volatility and are also an area not easy to serve by non-experienced yards. Examples are e.g. cruise vessels (Meyer Werft), dredgers (IHC) and offshore vessels (STX Norway, Damen, SBM Offshore).

The North Sea based marine equipment industry is considered world leading with a strong focus on green technologies (fuel efficient engines, after treatment systems and alternative powering systems). They export worldwide and most of the larger ones (M.A.N., Wärtsilä, Rolls Royce) have subsidiaries in Asian shipbuilding countries.

The main brands mentioned above are covered by industry conglomerates active in many more sectors than just marine, and often this is only a small niche are for them (in comparison to for instance automotive or real estate). Examples are SAM electronics, Siemens and Imtech. These companies often have a liaison office in Asia and often have assigned licenses to Asian manufacturers. On the other hand manufacturers of emission reduction technology are often SMEs with only a few products. These companies work locally for regionally based clients, rather than exporting to yards outside Europe.

Although these companies have developed products that can decrease the emissions levels of vessel, it is difficult form them the sell their product, as there is often no market for these products. Depending on the state of legislation they will have a business or not. Examples are Couple Systems, Germany, Skysails, and Multronic in Belgium.

Such activities may have developed serving more traditional shipbuilding segments in the past; nowadays manufacturers based in the North Sea region benefit both from their close cooperation with high value niche segment shipbuilders nearby, which allow for higher value products as well as testing and piloting, but also from export to other parts of the world once new designs have been developed and proven. As such the North Sea region works as a kind of 'test bed' for development. Repair and maintenance activities are a separate activity in many cases provided by other yards than those focused on new buildings. Until 2008 the repair and maintenance yards in Northern Europe were quite competitive, however since the crisis competition has increased. Especially yard around the North Sea are losing their position to yards located around the Black Sea, due to lower labour costs. An intermediate category concerns the conversion yards.

3.6.2 Strengths and weaknesses

Table 3.3 Main strengths and weaknesses of Shipbuilding in the North Sea

Strengths	Weaknesses
• Specialisation in niche markets (cruise, offshore vessels, dredgers) in which regional shipyards are bearing globally recognised brands (STX/Aker, Meyer Werft, IHC, Damen) • Innovative SMEs and strong position of marine equipment industry also from a global perspective, especially with regard to green technologies (Hamburg manufacturing cluster in particular) • Strong linkages between yards and marine equipment manufacturers - in the specialised segments longstanding relationships have been built based on trust allowing for joint R&D and innovation and joint market actions. • Spill-overs between defence and commercial segments especially as a playground for innovative technologies - however vulnerable to budget cuts currently implemented in various countries.	• High labour cost levels vis-à-vis competitor regions in and outside Europe. Within Europe and even within the North Sea basin competition for skilled labour is felt with Norway being able to offer the highest salaries. • Vulnerability to raw material prices volatility • Access to skilled labour – besides the cost also an overall pressure on availability is felt with reduced interest in blue collar engineering work and competition from other technology sectors such as offshore wind. • Access to finance: due to the currently weak shipping market, clients have difficulty providing own funds while banks are reluctant. As regular payment schedules are not always aligned with production costs – especially not for equipment manufacturers – competition with Asian yards has intensified (also caused by state guarantee schemes offered).

Strengths	Weaknesses
	• Potential difficulties in knowledge protection (especially among SMEs).

Source: Ecorys

3.7 Cruise tourism

3.7.1 Key messages

The cruise sector has shown rapid growth worldwide in the last two decades. More recently, the cruise sector in the North Sea has started growing rapidly. It is now growing faster than the sector worldwide, but in terms of passenger volume the sector is still relatively small compared to the traditional cruise regions Caribbean and Mediterranean.

The North Sea region, particularly the UK and Germany, was already established as a passenger source market. It is now developing itself as a destination market too. Average annual growth of cruise industry in Northern Europe (which also includes the Baltic) from 2007-2012 was 15.4%.

Several trends cause this growth:

- The cruise industry is looking for new destination regions, as the traditional regions and in particular the marquee ports in these regions are starting to become congested. Besides this effect, the cruise industry is seeking to offer new destinations to repeat customers who already have seen most of the more traditional destinations. Norway is the most developed and largest cruise destination within the North Sea region.
- There is an increasing trend of near home embarkation on a cruise, rather than flying to a destination and boarding the cruise ship. The development of the port of Southampton as a cruise port is almost exclusively due to this effect. Other ports in the region have a high share of embarkations (as opposed to port of call passengers) too: Hamburg, Amsterdam, Rotterdam.
- The share of short break cruises (trips of a few days) is increasing in the region. The cruise industry offers short breaks as alternative to weekend breaks and as cruise tasters, hoping that short break cruisers will return on longer cruises.
- With rising fuel prices and with the additional costs of compliance with the North Sea ECA 0.1% sulphur fuel regulation coming up per 2015, cruise companies are seeking to reduce their fuel bills. Shortening the distances between two ports of call is on of the options, which can be quite positive for further cruise development in the North Sea region.

3.7.2 Strengths and weaknesses

Table 3.4 Main strengths and weaknesses of Cruise tourism in the North Sea

Strengths	Weaknesses
• The market is growing: there is a large group of relatively wealthy citizens that are increasingly discovering cruise as a holiday option. • The area is an important source market for cruise passengers, who increasingly are interested in embarking near their homes rather than flying to a port of embarkation. • The area offers a good potential as destination market for cruise companies, as there is still room for growth compared to more traditional cruise destinations as the Caribbean and Mediterranean. • The countries along the North Sea and English Channel are generally perceived as safe and politically stable destinations.	• The climate is generally perceived as cold and windy by both cruise companies and holiday makers. • The region lacks a clear identity as a cruise region and is still mostly considered as a connection between the cruise regions.

Source: Ecorys

3.8 Coastal protection

3.8.1 Key messages

Parts of the coastal areas in the North Sea region are highly susceptible to coastal erosion. Especially in the southern part of the sea basin, these are also the areas with highest densities of population, industry activity and other concentration of assets, resulting in potentially high negative impacts. Past events like the 1953 storm or historical memories like the 1421 Elizabeth flood have triggered the region to develop response mechanisms already centuries ago, with especially the low lying western parts of the Netherlands and Belgium having a long tradition of fighting the seas, resulting in a well-developed sector of high standing that is exporting its technologies and services to other parts of the world nowadays as well.

The backbone of the coastal protection sector is composed of four marine contractors (e.g. Boskalis, DEME, Jan de Nul and Van Oord) who jointly account for some 80% of the global dredging market, as well as shipbuilders (e.g. IHC) and equipment manufacturers (e.g. VostaLMG), research companies (e.g. Deltares, Hydraulic Research Wallingford and Danish Hydraulic Institute) and engineering companies.

The sector generates GVA and employment through the implementation of flood and erosion protection infrastructure. The following table shows the GVA and employment the North Sea and English Channel. Specific basin information is not available for France and the UK.

Table 3.5 Current economic size of coastal protection in North Sea countries

Country	GVA (EUR, billion)	Employment (x 1,000)
Norway	N/A	N/A
Denmark (Baltic and North Sea)	0.305	1.42
Germany (North Sea)	0.11	1.13

Country	GVA (EUR, billion)	Employment (x 1,000)
Netherlands (including construction of water projects)	0.627	5.20
Belgium	0.460	3.52
France (North Sea, Atlantic Sea and Mediterranean sea)	0.012	0.118
UK	*	*

Source: country fiches

* Data not available

Although the above figures are fairly small compared to some other marine sectors, the economic relevance of this function is still substantial since it enables other maritime economic activities or results in a higher economic value of the economic activities in the coastal area. Furthermore coastal defence can be seen as the catalyst for all kinds of marine activities such as dredging, coastal development, land reclamation, port development, offshore techniques (offshore energy, deep-sea mining).

3.8.2 Strengths and weaknesses

Table 3.6 Main strengths and weaknesses of Coastal protection

Strengths	Weaknesses
• Long history of coastal protection activities, providing high skills level and top players in executing works, both within Europe and as an export product. • Strong in design/engineering and advisory capacity. Engineering companies are working world wide. • Well experienced contractors. • Excellent education and knowledge infrastructure available (universities/knowledge institutes) • Available techniques and knowledge allow a design that takes the impacts on other functions and on eco-systems into account. In addition, the knowledge to use ecosystems' natural processes for realising protection measures (one of the eco-system services).	• Coastal protection is liable to political priorities (government budgets). • Ineffective governance of coastal zones. Long and tedious planning procedures. • High capital investments required for developing equipment. • Since the financial crisis (2008) it is more and more difficult to get long term credits for these investments . • Integrated solutions are needed in coastal areas. Knowledge is fragmented and cooperation within one cluster needs to be improved.

Source: Ecorys

4 Future scenarios for the most relevant and promising sectors in the sea-basin

This chapter points to possible future scenarios for the selected sectors by taking into consideration current trends, macro-economic conditions, global industry trends as well as a number of exogenous factors such as competition, legislative environment, environmental risks etc.

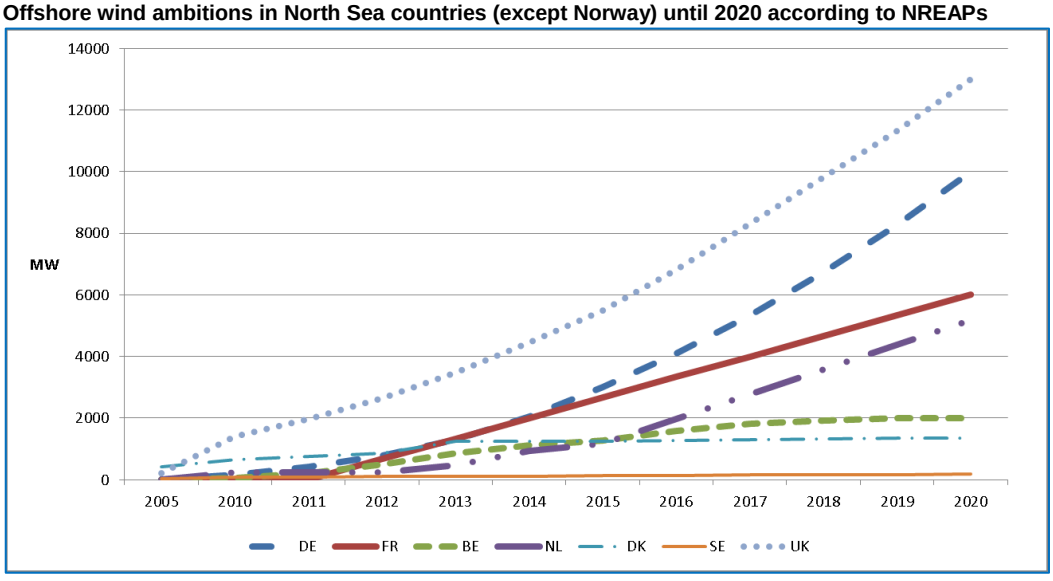
The section aims to build a picture of the potential and likely development in the period to 2020 (2030), and identifies drivers and barriers. Particular attention is paid to uncertainties, synergies, spill-over effects and tensions as well as framework conditions required to materialise these prospects.

4.1 Offshore wind

4.1.1 Potential

As a growing technology, offshore wind can contribute substantially to achieve Blue Growth in the upcoming years. Indications of this ambition are the National Renewable Action Plans (NREAPs) of all countries along the North Sea. Apart from Norway (which does not declare any offshore wind targets until 2020[44]), all countries show an ambition to invest in offshore energy's development. The following figure shows the planned development until 2020.

Figure 4.1 Offshore wind ambitions in North Sea countries (except Norway) until 2020 according to NREAPs



Source: Ecorys based on NREAPs

[44] Ministry of Petroleum and Energy (2012): National Renewable Energy Action Plan under Directive 2009/28/EC Norway, p.132-134

As visible in the figure above, especially the UK and Germany plan to expand offshore wind energy capacity, making it a major component of their national energy mixes[45]. The most ambitious country, the UK, plans investments on both coasts (Atlantic and North Sea). There are currently two offshore wind farms under construction on the west coast and two on the east coast (North Sea: one in Buckhaven and one in the east of Hull). All further (7) currently approved projects will be implemented in the North Sea (4 of them in the Bay between Hull and Norwich).[46] In Germany all major future developments are expected to happen in the North Sea[47]. The third most ambitious country according to the figure, France, has to be treated with care in this analysis as virtually none of the projects are expected to happen along the North Sea coast. Sweden's targets are low and anyhow focussed on the Baltic Sea.

4.1.2 Factors decisive for growth (drivers and barriers)

Electricity price

One driver for renewables is the development of the electricity price. Increasing prices of fossil fuels reduce the gap of competitiveness for all renewables and make therefore an investment in new technologies more attractive. However the development of such prices remains uncertain as new energy sources – notably unconventional or shale gas has a downward pressure on all non-renewable energy sources including coal.

Technological development

Installation costs are still high (€ 150-200 per MWh) and preventing competitiveness. There is a steep learning curve in installation and logistics which leads to the expectation that these costs could go down to €100 per MWh provided the large-scale projects are being realised. Furthermore the newest generation of turbines (e.g. direct drive turbines) are less sensitive to the rough seas which should lower maintenance costs. Moreover there is growing experience in dealing with manned platforms and using offshore/specific vessels.

Access to finance

The current appetite of private banks to invest in long-term investment projects such as offshore wind is limited. Public financial instiutions such as the Kreditanstalt für Wiederaufbau (KfW) and the European Investment Bank (EIB) are important actors in this field, as they have a longer term focus. However a minimum of equity capital will remain important as well, and the willingness of major electricity companies to fully join this type of investment remains crucial. The general situation could improve in 2-3 years when exploitation data become available, which are likely to point towards higher yields – up to 50% above expected yields which would be a bonus and help to get access to finance.

4.1.3 Impacts

The sector has an overall impact on the global competitive position of the sector and as such it is of high strategic importance to keep Europe's leading position in renewables and especially wind. Investments in offshore wind reduce the dependency on fossil fuels and help to raise the share of

[45] ESPON (2013): ESaTDOR European Seas and Territorial Development, Opportunities and Risks ANNEX 7 to the Scientific Report: North Sea Regional Profile, p. 44

[46] Renewable UK: http://www.renewableuk.com/en/renewable-energy/wind-energy/uk-wind-energy-database/index.cfm/map/1/status/Consented/project_type/offshore/

[47] Expert judgement

renewables in the energy mix. Hence, a successful development in the North Sea can become a prototype to sell towards other parts of the world.

4.1.4 Uncertainties

Uncertainties in the sector on the one hand arise from a strong dependency on *public financial support*, which is open to political debates and hence is under constant review. Within the context of public budget crisis, governments are increasingly reviewing their public support schemes and the tendency is to cap such public support. [48] Even more important, the EU policy framework is currently only in place until 2020 and the uncertainty about the period afterwards already discourages new plans and initiatives right now. Adding to this, the equity position of certain wind energy providers can be weak, as there is a time gap between investment costs and returns from exploitation.

Another portion of uncertainty is linked to the future potential of other resources such as shale gas. The example of the United States shows that significant investments into shale gas extraction have led to a strong decrease in costs for gas. According to the IEA, this has a knock-on effect on the price of other non-renewable energy sources such as coal. As global energy markets are increasingly connected, this can lead to a downward pressure on European energy prices as well – and make the cost gap with renewable energy (such as offshore wind) larger.

4.1.5 Synergies and tensions

Offshore wind technology can be combined with upcoming new renewable technologies, as well as with offshore oil and gas, following are some examples:

- Power Industry OEM's (Original Equipment Manufacturers) understands the technique and procedure necessary for the design and manufacturing of offshore equipment;
- Oil and gas contractors have experience in delivering mega offshore projects on time and budget[49].

Additionally, the offshore wind sector could potentially also benefit from closer links with processes such as maritime spatial planning which can support the enhancement of the sector via providing stability for long-term development projectst.

Furthermore, combining offshore wind with other energy sources such as: wave, tidal, OTEC, osmotic sources (with wave and tidal being the more mature ones) can potentially offer further benefits including development of a common grid as well as lower construction and maintenance costs. Even though it has to be noted that costs of planning and installation of a common grid system can levy a higher intial cost on stakeholders than that of a simple offshore wind farm.

As large offshore investments are very costly all synergies possible need to be used to support a strong growth of the offshore wind sector. Especially in the North Sea experiences with offshore oil and gas (especially driven by the Norwegian Statoil) can serve as a source for skills and knowledge to further improve the process of production and installation of offshore wind farms.

[48] For example the Belgian federal government reviewed its wind energy support policy in early November 2013. Consumers and industry contribute through a surcharge on electricity prices, amounting to € 250 mln. per year. The overall contribution of industry will now be capped to € 250,000 per company. The remaining deficit will for the moment be supplemented by the federal government.

[49] Petrofac: Synergies between Offshore Oil and Gas and Offshore Renewables, http://www.windplatform.eu/fileadmin/ewetp_docs/Events/2nd_Energy_Event/Andrew_Donaldson.pdf

4.1.6 *Framework conditions*

The regulatory framework needs to adapt to the needs of the sector to further boost its development. Currently the energy markets are a domain of national interests which hamper a European connectivity and a common development. There is a need for a single market for renewable energy sources. The current legislative framework runs out in 2020 and the EU's energy policy beyond 2020 is currently being developed. However, this creates already regulatory uncertainty in the market right now – as it prevents investors from making precise assessments of investment plans.

4.2 Offshore oil and gas

4.2.1 *Potential*

According to estimates offshore oil and gas extraction in the North Sea region has reached its peak and is now in a decline. However, there are still potential reserves to explore. With regards to Norway it is estimated that around 60% of the country`s petroleum reserves still lie beneath the seabed with a large majority already identified and discovered (75%). According to figures from national as well as Eurostat sources, the oil and gas sector has a direct employment of around 70.000 people in the area of the North Sea – including the UK, Netherlands, Denmark and Norway, whereas indirect and induced employment is estimated to be over 600 000. [50]

Figures for GVA were not widely available in the sector, Norway had a reported €63 billion[51] revenue from offshore oil activities with the UK reporting € 36 billion[52] for 2010.

Information regarding UK reserves suggests that if current rates of investment in the sector continue, the UK has the potential to satisfy close to 50% of its internal oil and gas demand until 2020.[53] Oil and Gas UK estimate that up to 24 billion barrels of oil and gas equivalent can still be recovered from the UKCS as a whole.

Due to many decades of experience in offshore oil and gas exploration, extraction as well as research and development, the North Sea is an important hub of knowledge and expertise which could potentially play an important role in transferring this knowledge to other parts of the world or onto other sectors within the region of the North Sea.

Further potential lies in maximising the benefits of the sector`s spill-over impact as well as in decommission activities:

- Decommissioning could provide services for the other energy sectors and can link to reuse, recycling and waste disposal activities
- Exploration and production operation uses technology adaptable for other industries such as robotics, sea-bed mining or space research
- Subsea engineering which links into sea-bed mining operations, environmental monitoring etc.

[50] According industry estimations 1 direct job can induce up to 7.5 other jobs. In the UK this factor is even higher and can reach a multiplier of 12, due mostly to the strong research and development capacity of the country.
[51] Statistics Norway, 2010
[52] Eurostat, 2010
[53] Oil and Gas UK (2013): Economic Report

4.2.2 *Factors decisive for growth (drivers and barriers)*

The main drivers for the industry are research and innovation that could potentially make new reserves accessible in the North Sea. Additional drivers for the industry are cross-border collaborations which can build on the following factors:

- Cross-border deposits of oil and gas;
- Research and innovation collaborations;
- Other industry wide collaborations (training, maintenance etc.).

As production is now on a decline and much more emphasis is laid on exploration of new areas – relationships, within and outside the sectoral supply chain – are reshaping as well.

Knowledge and information sharing within regional hubs is also an important factor for advancing innovation potential. Previously regional collaborations have often focused on cross-border deposits which by now have largely been exploited and attention is now shifting onto on areas near the countries` continental shelf. Therefore current collaborations are more focused on research, innovation as well as procedural elements such as decommissioning, well incidents and environmental monitoring.

4.2.3 *Impacts*

The main economic impacts of the offshore oil and gas sector are similar to that of other extractive industries, such as: the macroeconomic performance of the country of extraction, government revenues, direct employment, and economic externalities and spill over effects on other sectors of the economy.

In Norway oil revenues provide 25% of total revenues received by the government, while generating substantial spin-offs. Norway's petroleum resources have not least laid the basis for a high-tech, internationally competitive industry which supports almost 250 000 jobs directly and indirectly. The Netherlands is also benefiting from gas production with approximately €5 billion annually in state revenues. Direct employment is around 8.000 according to data from CBS Statline 2010.

Denmark also receives substantial revenue from the production and trade of oil and gas which in 2012 amounted to DKK 25.2 billion a decline of over 15% from 2011.[54] In Denmark all producing fields are located in the North Sea (199 oil and 79 gas wells).

Economic impacts for the UK included a £32 billion inflow of revenue into the national economy, with an additional £20 billion coming in from supply chain industry sales (£7 billion of which were linked to the export of goods and services). In contrast total expenditure has also reached - for the first time - £20 billion (includes exploration drilling, field development, production and decommissioning).[55]

[54] Danish Energy Agency (2013): Oil and Gas production in Denmark 2012, http://www.ens.dk/sites/ens.dk/files/dokumenter/publikationer/downloads/oliegas_rapport_uk_-_2012.pdf

[55] Oil and Gas UK (2013): Economic Report

4.2.4 *Uncertainties*

Uncertainties for the industry mainly originate from accurately forecasting the balance between renewable and non-renewable energy demand by countries for the medium to long-term and balancing the outputs efficiently. Taking into consideration the declining oil and gas output in the North Sea, Member States could be looking into national inventories of energy reserves and implementing cost-efficient strategies to replace the declining output with renewable sources or coal. Therefore, it is essential to incorporate balanced and realistic reserve estimation into industrial forecasts in order to assure stability of supply scenarios.

Estimating reservoirs and forecasting production output with internal demand and export potential can have an impact on the price of oil and gas as well as other sources of energy on the global market. Generally energy prices tend to have high volatility as a result of economic and political uncertainties of some producing countries or even sudden environmental impacts. In order for Member States to be able accurately forecasts energy costs, the price volatility of substitutes to oil and gas must also be taken into consideration. One factor to consider is how alternative energy sources impact on overall costs. The prices for coal and renewables for example could be undercut by hydrocarbon prices stemming from high production volumes of shale gas and tight oil.[56] The occurrence of speculative funds on the financial market especially on futures market can also lead to sudden changes in the global price index.

4.2.5 *Synergies and tensions*

Synergies in the sector consist of two types:

- Internal synergy between stakeholder of the oil and gas supply chain; and
- External synergies with other industries.

In terms of internal synergy between stakeholders one of the areas where activities have been successful is education and training. Universities and training centres have long traditions of collaborating with producers and other downstream players providing skilled staff as well as research and development potential to the companies.

In terms of external synergies with other sectors some oil and gas activities are close linked to offshore wind and sea-bed mining. The main activities creating synergies with the aforementioned sectors are:

- Building and installing offshore structures;
- Laying cables on the seabed;
- Carrying out maintenance and safety checks;
- Decommissioning.

Furthermore, activities involving the supply chain actors are also transferable such as the case with:

- Underwater vehicles;
- Robotic technology;
- Smart buoys;
- Anti-corrosive materials etc.

[56] Oil and Gas Journal (2013): Navigating uncertainty, http://www.ogj.com/articles/print/volume-111/issue-10b/regular-features/journally-speaking/navigating-uncertainty.html

Tensions within the sector exist generally in connection with the extent of future potential, employment and access to finances. Even with the declining rate of oil production requirements for more skilled workers persist. Both in the UK and in Norway there are initiatives to boost employment in the sector; these include the promotion of the industry among young people as well as recruitment of specialised staff e.g. ex-military.[57]

An additional source of tension within the industry is the increasing involvement and stake of far-east Asian (particularly Chinese and Korean) investors and producers[58]. On the one hand, investment and cash-flow is much needed as access to finances is limited especially from short term lenders and venture capitals as return rates are considered to be low. On the other hand these far-east Asian countries are also involved in other potential spin-off activities linking to seabed mining. New investments also create employment opportunities and boost production potential. At the same investors also access the knowledge and expertise relating to future activities which could potentially hamper EU competitiveness on the longer term.

4.2.6 Framework conditions

There are a number of policies that directly impact the production process as well as supply chain activities of offshore oils and gas producers. Additionally there are other policies that have a more indirect impact on the sector, such policies can relate to biofuels, environmental impact assessments, taxation etc.

4.3 Aquaculture

4.3.1 Potential

The potential of the North Sea for expanding the aquaculture sector is improving with respect to water quality including a reduction of contaminants in the water.

Regarding Norway the Foresight Analysis carried out in 2005 is still pertinent[59] as are the projections in the EATIP (2012)[60] vision document. Projects are expected to increase from 2010 to 2030. Atlantic salmon aquaculture will probably continue to increase in future, by 4%/year, and aquaculture of species such as Atlantic cod and Atlantic halibut may increase if market conditions allow (i.e. if wild catches increase, economically viable aquaculture becomes less likely) and, especially for halibut, if technological solutions can be found to current barriers to farming.

In Denmark given the very strict environmental regulations only one new license for a marine fish farm has been issued in the last decade (2004). Due to concerns and associated legislation it is unlikely that Denmark will achieve its stated target of an annual growth of 4% in aquaculture production.

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[57] UK Government initiative part of the 2012 oil and gas sector strategy https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/37002/12-1365-government-oil-and-gas-sector-strategy-call-for-industrys-views.pdf

[58] A reported €11 billion investment from Chinese state company CNOOC into Scottish oilfields, http://www.newsnetscotland.com/index.php/scottish-economy/5449-north-sea-oil-and-gas-sector-attracts-billions-in-foreign-investment

[59] The Research Council of Norway (2005) Aquaculture 2020, Transcending the Barriers – as long as… A Foresight Analysis. The Research Council of Norway, ISBN 82-12-02025-8, 165pp

[60] EATIP (2012) The Future of European Aquaculture. 44pp http://www.aquamedia.info/PDFFLIP/EATIPVision/files/assets/downloads/publication.pdf

In the Netherlands, aquaculture culture development is constrained by environmentally driven legislation and opposition on environmental grounds. The collection of wild mussel spat is controlled, regulated and frequently opposed and lack of seed is an issue for this industry. Traditionally spat has been collected using bottom-scraping dredges but there are moves to more efficient spat collectors in coastal waters. Offshore/off-bottom culture is also being investigated (near abandoned oil platforms or windmills) as are hatcheries for blue mussels.

With regard to the United Kingdom the primary opportunity for expansion of aquaculture lies with RAS. There has been experimental, small-scale, RAS production of species such as barramundi (Pacific seabass), tilapia, African catfish etc. in this area but the high costs of energy, land, water, labour and equipment coupled with competition from low-cost imports mean that significant future development is unlikely.

4.3.2 Factors decisive for growth (drivers and barriers)

Growth drivers for the expansion of European aquaculture production are widely understood and discussed in contexts of European food security, employment and wealth creation.[61] There are a positive as well as some negative drivers with respect to potential growth. In contrast to aquaculture globally, European aquaculture can be characterised as:

- Small - about 2% of global aquaculture by volume, 3% by value yet Europe is the largest fish market in the world;
- marine - aquaculture globally is dominated by freshwater production, but in the North Sea high value, marine, carnivorous, species, particularly Norway salmon predominate. Bivalves which are common in other EU seas amount to only around 7% of 1,455,377mt (from sector study) in the North Sea. However without Norway salmon, fin fish account for only around 56,670mt, which is about half of bivalves tonnage.;
- Whilst aquaculture production across the EU has been more or less at a plateau since 2000 in the North Sea, production has been increasing, largely due to the effect of Norway salmon, which has expanded to fill the gap left by disease outbreak in Chile, although there has been a slight drop for environmental reasons in 2013. The drivers behind improving the general unresponsiveness of EU aquaculture are ascribed to four main factors in the 2013 Communication on Aquaculture, namely:
  - reducing administrative burdens
  - improving access to space and water
  - increasing competitiveness
  - exploiting competitive advantages due to high quality, health and environmental standards. (although these may not necessarily apply in the same way to Norway salmon).
- Lacking new species - globally, a number of new species have 'taken off' including pangasius, cobia, tilapia, white shrimp etc. Since the expansion of Atlantic salmon farming (Norway, Scotland) and then seabass and sea bream (Mediterranean) over the last 30 years (to a point where markets for the latter species are largely saturated) Europe has not seen any new species of large-scale significance come into production;
- Highly regulated - EU aquaculture is regulated to a degree that is not common elsewhere, this regulation is complex and compliance is expensive. However, the limitation on the number of site locations may imply that complying with these regulations can contribute to a more sustainable production and may allow for the intensification or use of more marginal sites. The

[61] European Commission (2013) Strategic Guidelines for the Sustainable Development of EU Aquaculture. Brussels, 29.04.2013, COM (2013) 229 Final. 12pp

demands of the certification initiative of the Aquaculture Stewardship Council (ASC) for environmental compliance are even more demanding than those of the EU regulations which indicate that the EU regulations are on the right track with regard to promoting sustainable production thus becoming a competitive advantage since they can be a spring board to certification.

Other regulatory implications include:

- Certification – 70% of European salmon producers have signed up to certification to ASC standards within 7 years almost entirely due to the advantages improved environmental use will provide;
- Genetic modification – This could lead to increases in production. Its use is currently being considered by the US authorities for salmon. However, under current circumstances, use would be banned in many Member States and also under ASC certification, hence there is a regulatory issue due to major problem of escapes interbreeding with wild types;
- Genetic manipulation – this is the use of genetic quirks within a species such as triploidy (3 sites of chromosomes) or single sex culture that prevents loss of energy through reproduction. These have made considerable improvements to aquaculture, such as the use of triploidy in France's oyster culture. These do not have the disadvantages of GM above since there is no transfer of genetic material, and it is highly susceptible to R&D in which Europe excels.
- Commercial feeds - EU finfish culture is of species entirely dependent on commercially produced artificial feeds. This is in contrast to finfish culture globally where the majority depends, at least in part, on natural food present in the aquatic ecosystem. Research however, is leading to reduced requirements for fishmeal (see next section) with promise of decreased environmental impacts, lowered costs and some increase in production particularly in salmon.

Within the EU a significant driver for future increases in aquaculture production is R&D. Whilst in tonnage terms Europe's aquaculture production is relatively modest in global terms never the less it is mainly in high value species so that in 2010 it supported an EU industry worth EUR3.1 billion (COM 2013). This together with the strategic value of sea food produced by culture in filling the gap between demand and supply from capture fisheries, not to mention the dependent jobs, more than justifies the high investment made by European research to every aspect of the aquaculture industry.

4.3.3 Impacts

The environmental impacts of aquaculture in the sea, particularly for fin fish, can be considerable including environmental degradation through pollution and genetic contamination of wild stocks. However, the regulation of pollution and control of production by EU legislation has gone considerable lengths to mitigate such impacts and give assurance to the market on quality and sustainability. In the North Sea, being a semi-enclosed sea, it is doubtful whether any meaningful culture could have been possible to conduct safely without such regulation. These regulative measures have moved in the same direction as the new requirements for the ASC certification initiative to promote sustainable production making EU farms (and also Norway which has a similar regulatory approach) far more likely to meet the requirements easily.

Given that aquaculture production in the North Sea basin is dominated by Atlantic salmon culture in Norway, it is worth pointing out that fish health impacts are also a major issue. An example for the Atlantic salmon is the impact of the salmon louse, an external parasite that is difficult to control and which is easily transferred between farmed fish and wild fish in the vicinity of the sea cages. It is estimated that salmon lice cost the Atlantic salmon farming industry globally more than €300m a

year, about 2/3rds of this cost is in Norway. Significant R&D in salmon louse control has led to improved strategies for use of in-feed and bath treatments (but lice are becoming resistant to these chemicals) for the condition and more recently the use of 'cleaner' fish (mostly wrasse) as a biological control.[62]

Marine aquaculture can have a number of impacts on the marine environment; the main impacts are nutrient release, chemicals applied for 'medicinal' purposes, farmed sites acting as a source of disease and escaped farmed animals compromising the gene pool of wild populations.[63]

4.3.4 *Uncertainties*

As with many industries, there remains considerable uncertainty over the impacts of global climate change (especially warming) on aquaculture. Aquaculture is particularly sensitive to water temperature changes because as temperatures go up the amount of oxygen dissolved in water goes down and this limits the potential for growth, or even survival, of aquatic animals.

It would require the salmon industry to improve practices and reduce impacts to allow practice to intensify. Main driver is ASC certification and need to expand the market appear to be increasing.

4.3.5 *Synergies and tensions*

In order to increase synergies and reduce the tensions existing currently with regard to environmental and health concerns there is a need to improve volume and quality of effluents, minimise use of anti-biotics and parasiticides and reduce wild fish content of feeds.

4.3.6 *Framework conditions*

Relatively few policies refer specifically to aquaculture itself. The industry is governed to a larger extent by planning regulations, health and safety and drug use laws.

4.4 Deep-sea shipping

4.4.1 *Potential*

According to the identified trends, the DSS in the North Sea will be faced in the future with slowly but steadily increasing cargo flows as a result of increasing trade volumes and vessel sizes calling at less ports thus putting extra strain on specific port-to-hinterland bottlenecks due to increased requirements in peak capacity. The latter will require ports to develop more efficient operations, assisted by the increasing use of ICT systems and specialised infrastructure. A probable scenario is that the DSS trade will be concentrated to fewer ports in Europe also as a consequence of the potential impact the Panama Canal expansion will have on global shipping routes. Moreover, as the space for efficiency gains within each section of the value chain grows narrow, there is a driver for cooperation across the various sections which we will be probably experiencing more and more often, with co-operation of port terminals between terminal operators and shipping liners being a first example. Further integration of the value chain is expected as the opportunities for collaboration are further explored, with emphasis being in the integration of hinterland connections.

[62] Whelan, K (2010) A review of the impacts of the salmon louse, *Lepeophtheirus salmonis* (Krøyer, 1837) on wild salmonids. Atlantic Salmon Trust. atlanticsalmontrust.org

[63] Bloomfield H.J., Allcock Z., Bos O., Paramor O.A.L., Allen K.A., Aanesen M., Armstrong C., Hegland T., Le Quesne W., Piet G.J., Raakær J., Rogers S., van Hal R., van Hoof L.J.W., van Overzee H.M.J. and C.L.J. Frid (2011). MEFEPO North Sea Atlas, 2nd Edition - August 2011. University of Liverpool. ISBN 978-0-906370-67-4.

Finally, in the face of the increased infrastructural requirements for ports operations, the existing clash with cities over land for their respective functions is probably going to be intensified, with ports continuing their out-of-the-city relocation of activities. The clash with other non-maritime activities is already pushing for the sector "greening" which will continue in the future with the further application of stricter environmental regulations.

4.4.2 Factors decisive for growth (drivers/barriers)

The external drivers that will define the DSS sector in the coming years can be summarised as follows:

- the further globalisation of production and trade with increasing trade volumes in existing important shipping routes but also with smaller expanding trade routes; the evolution of this trend will be the single most important factor to define future development of the DSS sector, the port sector will need to step up to be able to handle increasing cargo volumes;
- The capacity of hinterland transport in the North Sea to cope with increasing cargo volumes and clear bottlenecks will be, to a large extent, a constraining factor to the development of the sector. Smooth cooperation between ports and hinterland transport is a prerequisite;
- Shipping companies are currently challenged to overcome the bad financial circumstances that currently affect them, their capacity to adopt more cost effective solutions (i.e. larger vessels) and to find innovative funding schemes to overcome the negative financial environment will define the future of the sector;
- Infrastructure developments elsewhere, notably the completion of the Panama Canal extension in 2014, may lead to a reshaping of global shipping routes which could effect also the competitive position of the North Sea DSS sector, and drive a need to provide upgraded services to keep its important position in the global shipping network;
- Stricter environmental regulations, in the North Sea, but also globally, will be another driver for the evolution of the sector, with more elaborate marine equipment used and also the pursuit of alternative, more environmental friendly fuel;
- Finally, the possibility to find and exploit synergies, with other marine sectors (like the LNG sector), as well as the capacity to alleviate tensions generated by the competition for resources and space in particular (especially for areas crowded with maritime activities such as the North Sea) will define the growth potential of the DSS sector.

4.4.3 Impacts

While deep-sea shipping itself is fairly labour extensive (a large ship like Emma Maersk sailing with as little as 22 crew members[64]), while the majority of employment is based on ports and associated services (up to 80% according to the BG study[65]). It is expected that growing volumes will not result in growth of employment, as more and more port handling processes are being automated. This is reflected in figures like those presented by the Port of Rotterdam annually where an increase of tonnage is combined with a fairly stable Value Added and a decline in employment.

High fuel prices as well as regulatory drivers will result in a slow but gradual improvement of the environmental performance of the sector.

[64] http://www.worldslargestship.com/about/faq/

[65] Ecorys, 2012, Blue Growth, scenarios and drivers for growth of the oceans, seas and coasts.

Another impact is the relation between deep-sea (large) ports and short sea (smaller) ports. In the past we have seen cooperation models where smaller ports were used as satellites at times of high demand. In a future trend of further concentration and larger ships to be served, this need may be increased. At the same time ports are looking at integrating communication systems both within but more and more across ports as well. As an example the system of Rotterdam is now more or less integrated with that of Amsterdam. Integration across borders is being explored (e.g. Antwerp).

4.4.4 *Uncertainties*

For deep-sea shipping key uncertainties relate to:

- Global shipping markets – which depending on the segment (containers, dry bulk, liquid bulk, agri) are highly volatile, with freight rates affecting service frequencies, sailing speeds and even routes/port calls on the short term;
- European industry ability to maintain manufacturing activities on the continent;
- Implementation of environmental regulations.

4.4.5 *Synergies and tensions*

The DSS sector is currently working towards reducing the external costs it produces for society mainly by implementing stricter environmental regulations on emissions and ballast water discharges. Currently there are tensions generated with other (maritime or not) activities which regard especially spatial resources. On the water-side, there is competition for anchorage areas and vessel corridors in busy coastal areas against areas allocated to fisheries, off-shore wind and oil platforms and other activities. On the land-side the DSS sector is competing with the city activities for spatial resources, as cities attempt to expand towards and around port areas. A consequence of this is the increasing friction between the two activities caused by the disturbance of city by port activities.

On the other hand there are considerable synergies to explore with other maritime (and non-maritime sectors), the existence of a strong port cluster in the North Sea provides a good basis for further development of the maritime cluster. Especially synergies with the rapidly growing LNG sector should be explored as LNG can be used as an alternative fuel for DSS that can assist in achieving compliance with the increasingly strict environmental regulations.

4.4.6 *Framework conditions*

European and International regulations are of increasing importance in setting the framework conditions for the development of the DSS sector. The recent Communication of the Commission on the port policy labelled *Ports: an engine for growth* identifies the main challenges that the port sector (and to a large extent also the DSS sector) is facing and draws a proposed strategy to overcome them, including emphasis on increasing efficiency, environmental performance, hinterland connections, innovation, modernisation of infrastructure and labour conditions.

The issue of increasing the sectors environmental performance is further influenced by the IMO Conventions on emissions (MARPOL) and the Ballast Water Convention, as described later in the shipbuilding section. The TEN-T planning instrument has identified, via the TEN-T guidelines, the multimodal core and comprehensive network for the EU. Specific targets are set for the infrastructure connecting all ports belonging to the TEN-T core network by 2030.

4.5 Shipbuilding

4.5.1 Potential

While overcapacity in main shipping segments slows down the potential for ship yards, large growth potential is especially seen for the marine equipment sector. The increased focus on fuel efficiency, reduced operating costs and ´green´ performance of ships, the demand for energy efficient engines or alternative powering systems is very positive. In addition, suppliers in the North Sea region are well equipped to provide the equipment needed to stricter upcoming environmental rules. However the uncertainty regarding this introduction is problematic for, especially, the smaller suppliers, as their current market size is limited and ship owners are not willing to invest in their expensive equipment before new rules are clearly in place. These companies might be bankrupt before the introductions of the new regulations.

Apart from these, North Sea based shipyards building for growing specialised niche sectors (offshore wind in particular) will be able to grow along with these sectors. Their highly developed organisational skills (in terms of assembling highly complex vessels and working with 100s of different specialist suppliers) give these yards a strong place for serving upcoming marine markets.

4.5.2 Factors decisive for growth (drivers/barriers)

For the three core segments that North Sea based shipyards are serving, key drivers are:

- Offshore: the oil & gas sector moving towards exploration and production in deeper waters and more harsh marine conditions (e.g. Arctic). The offshore wind sector booming (see section 3.2) and requiring offshore technology and services especially in the construction phase;
- Dredging: continued need for coastal protection (see section 3.8), combined with the expansion to other world regions where North Sea expertise is called upon, along with the requirement for this sector to serve other markets (again offshore wind but also ports development, tourism and eventually deep-sea mining);
- Cruise: seeing a double-digit growth in past years and an ambition to raise the importance of the North Sea region (see section 3.7), continued demand for cruise ship capacity is expected, although facing non-EU competitors challenging Europe's lead position.

In addition, key drivers potentially benefiting North Sea based equipment manufacturers relate to main greening trends observed, in particular:

- Global demand for more fuel efficient ships, driven both by market factors (high fuel prices) and regulatory trends (EEDI);
- Specific emission regulations in place for European waters (North Sea and Baltic in particular), resulting in a demand for LNG propulsion as well as after treatment technologies, area in which North Sea based manufacturers have a leading position.

4.5.3 Impacts

The global market potential for the above drivers was assessed quantitatively by Ecorys and results are given in the table below.

Table 4.4.1: Global market potential related to greening trends

Market trends			Regulatory trends				Other trends	
Trend	Fuel	Environmental	NO_x	SO_x	CO2	Ballast	Offshore	Arctic

	Market trends			Regulatory trends			Other trends	
	efficiency	Awareness and CSR				Water	wind	dimension
Key driver	Fuel price	Image	Regulation	Regulation	Regulation	Regulation	Energy policy	Climate change
Market potential*	Large	Limited	2-3	2-4	3	2.5	2	0.9
Relevant markets:								
Newbuild	√	√	√	√	√	√	√	√
Retrofit	√	√		√		√	Limited	Limited

Source: Ecorys (2012), Green growth opportunities in the EU shipbuilding sector
* Estimated market potential in bn EUR per year for the period until 2020

To what extent North Sea based shipyards and equipment manufacturers will be able to capture a share of this depends on uncertainties addressed below.

4.5.4 *Uncertainties*

The main uncertainties are related to:

- Market development: the shipping market is highly volatile and historically shipbuilding has seen a 'pig cycle' with a lag time causing overcapacity to have risen even after the global crisis started;
- Regulatory uncertainty: ship owners tend to wait responding to regulations until very high levels of certainty are in place, resulting in very low demand for green technologies even now less than 14 months to implementation of the North Sea SECA is in place. Furthermore the perceived risks by ship-owners of new technologies that are not yet proven prevents the quick uptake of newly developed technologies.

4.5.5 *Synergies and tensions*

Possible synergies can be found with the offshore (oil and gas but also wind) industry. Especially the rapid growth of the wind sector has provided positive spin-off for regional suppliers and yards, who could offer their oil & gas expertise to this sector. Also the growing demand for cruise tourism provides synergies. The greening trend is a cross-cutting synergy that shipyards and suppliers provide to all marine sectors.

4.5.6 *Framework conditions*

Most influencing regulations are the IMO Conventions: MARPOL (on emissions) and the Ballast Water Convention. Based on the MARPOL Convention the North Sea and English Channel are appointed as a SECA zone by 2015. To comply with these rules vessels need new marine equipment and the suppliers in the North Sea Basin have developed the equipment needed.

From a financing perspective rules regarding State Aid for shipbuilding are important. The rules related to regional aid, innovation aid and export credits will no longer be part of a dedicated state aid framework for shipping, but of general regulations. Under the current State Aid Framework several countries, e.g. The Netherlands, Germany and France, have introduced national guarantee schemes, which ensure loans to shipyards in order to construct new vessels in the pre- delivery phase.

4.6 Cruise tourism

4.6.1 Potential

The overall GVA of the cruise sector in the North Sea region is estimated to be in the range of 800-1,000 million Euro and number of jobs is estimated at around 10,000. The main trends are:

- Increasing numbers of source passengers from the region, as the cruise industry is expanding into different target groups (no longer elderly only, but also younger couples and families).
- Increasing number of destination passengers in the region (resulting from more near home embarkations, more short break trips, shorter distances between ports).

The cruise market is increasingly segmented into various market segments (large scale versus small scale, affordable versus luxurious, highlights versus discovery, etc.). This offers further opportunities for cruise sector development in the North Sea.

The cruise industry is a very concentrated market. There are several cruise brands but these belong to just a handful of companies, mostly American. By contrast, the cruise port sector is very fragmented. There are some forms of such cooperation, mostly per sea basin. Many North Sea ports are part of Cruise Europe (together with European Atlantic and Baltic ports), and several ports have cooperated in the INTERREG North Sea region IVB project Cruise Gateway North Sea, which has just organised its final conference . The cruise shipbuilding market is very concentrated. A handful of European yards, including a German yard, produce nearly all cruise ships ordered worldwide. Asian yards are beginning/preparing to enter the market.

4.6.2 Factors decisive for growth (drivers/barriers)

Product innovation and cooperation between ports, stakeholders and cruise companies will be key in further developing the cruise market, aiming at joint marketing of the region and its attractions, developing a cruise terminal infrastructure network and developing a variety of shore excursion offerings.

The sales of shore excursions are essential to cruise companies. They are not just looking for terminals to berth their ships, they are looking for attractive destinations where they can offer tours to their passengers. More cooperation between ports and stakeholders from the local tourism sector will help selling the North Sea Region cruise ports as cruise destinations. Such cooperation already takes place (good examples found around the region), but could be increased particularly for small and upcoming ports.

Cooperation across the region to market the region as a cruise destination could help overcome the main negative perceptions about the region, which are a lack of clear identity and the idea that climate is generally wet and cold. A good example of such regional cooperation is the INTERREG funded Cruise Gateway North Sea project.

4.6.3 Impacts

Economic – It is clear that cruise tourism is contributing to local economies. Maybe less so than claimed by the reports that are commissioned by the cruise industry, but the contribution is significant.

Social – the discussion on social impacts is mostly limited to the economic spin off of cruising, centering around the question of jobs and value added created in cruise ports.

Environmental – meeting the emission requirements of the North Sea SECA zone will contribute to improved environmental performance, while respecting ballast water and waste management rules should ensure minimal impacts on water quality. A growing number of visitors will however affect landside environment as well.

4.6.4 Uncertainties

Uncertain factors in regard of future growth of the cruise sector worldwide from the demand side mainly relate to global economic (welfare) growth, and from the supply side in the North Sea region regulatory uncertainties as regards emission limits. The region is much less vulnerable to uncertainties affecting other markets such as health risks or political turmoil.

4.6.5 Synergies and tensions

The SOx emission regulations in the North Sea ECA will be a major issue for the cruise sector in the North Sea region as cruise ships will have to comply. How the sector will comply is not yet clear. Abatement technologies such as scrubbers, for which a number of manufacturers are present in the region, are tested in the cruise sector but are not near commercial implementation. Low sulphur fuel availability may be an issue. However these issues are not unique for the cruise sector. The answer of the cruise sector is most likely to reduce the average distances between ports in order to save costs (creating shorter itineraries with ports closer to one another). This may have a positive effect on the growth of the sector in the North Sea. It is not likely that the sector will shrink in the region and send ships elsewhere, as the demand will still exist in the North Sea region and as other regions (Baltic, US part of the Caribbean) will have similar emission restrictions. Furthermore the region should be able to benefit from the availability of a well developed green technology manufacturing base present.

Waste generation is an issue too, but to a lesser extent than the emission regulations. Not all ports yet offer sufficient waste reception facilities at cruise terminals. A key issue here is handling relatively large amounts in a short period (the few hours that a cruise call lasts), without disturbance/nuisance to passengers. In particular smaller terminals receiving one or a few calls per week will have difficulties to offer cost-effective waste reception facilities.

4.6.6 Framework conditions

Further cooperation may be instrumental to developing the region as a cruise destination. This cooperation should be at two levels:

- At a local level: cruise ports/terminals and the local tourism sector should jointly develop a package of terminal and tours and present themselves as a destination. The better developed this cooperation, the better the local economy will be able to profit from economic spin-off. The region could benefit from lessons learnt in the Mediterranean Sea basin in this regard[66];
- At a regional level: port/destination combinations could join forces and jointly present themselves to cruise companies, as is done in the Cruise Gateway project. [67] It is worthwhile to investigate if this type of cooperation can be taken one step further: could a few ports join hands and present themselves as an itinerary to a cruise company, rather than leaving the

[66] See Ecorys (2013), study on Coastal and Maritime tourism
[67] www.cruisegateway.eu

formation of itineraries up to the cruise companies? Or at least develop itineraries jointly with cruise companies? There are various themes which could be developed in the cruise market: the maritime history of the region, the Hanseatic cities, scenic beauty at the Wadden Islands (UNESCO heritage site) along the Dutch, German and Danish coastline.

4.7 Coastal protection

4.7.1 Potential

Coastal protection is a worldwide growing issue. Several countries in the North Sea and English Channel basin are relatively well advanced. They have a long history of coastal protection activities, providing high skills level and top players in executing works, both within Europe and as an export product. The region can promote this as a selling point and increases its' global competitive position which could result in growth. Massive efforts in research and technological development are made to improve sustainable and safe coastal regions, which also contribute to coastal protection works and services as an EU export product. Examples of coastal protections outside Europe are the support after Katrina and Sandy in the US and involvement in coastal master planning in delta countries like Bangladesh, Indonesia and Vietnam.

A second growth potential already materialised is the use of technologies for a multitude of other marine sectors (ports construction, access channel dredging, support to constructing offshore wind platforms, etc.). Furthermore coastal works appear to be more and more designed for multi-use (e.g. port breakwaters also contributing to coastal protection, suppletion benefiting coastal tourism, coastal barriers acting as energy plants, protection technologies serving marine species development).

However, a threat for the global competitive position of European marine contractors is an increasing competition from companies outside Europe who offer lower prices. Since public tenders more and more focus on price instead of quality, European contractors (who focus on value for money) have difficulties to match the financial offers from competitors especially for contracts elsewhere in the world.

4.7.2 Factors decisive for growth (drivers/barriers)

The core driver of growth of the coastal protection sector has always been the actual flood risk/erosion risk in coastal areas. Whether or not this will lead to growth in the sector depends on the amount of urgency given to the issue of coastal protection (perceived risk). The actual risk and perceived risk are driven by numerous factors.

The actual risk depends on climate change, economic growth, (the flood resilience / erosion vulnerability of) land use and contingency planning. The perceived risk depends on historic flood/erosion events, government budgets, monitoring efforts and flood protection legislation. Further drivers for the sector are international competition, oil prices, numerous innovations and scarcity of (qualified) personnel, land and other resources. Another driver is the pressure to develop eco-friendly approaches to coastal protection, resulting in an increased application of soft structures as opposed to the historic use of hard structures.

The sector is expectedly able to adequately respond to increases in demand. Currently, innovations are being developed within the coastal protection sector in order to adequately cope with the mentioned drivers.

4.7.3 Impacts

Overall, the North Sea based coastal protection sector is expected to grow in terms of jobs and turnover worldwide based on its strong current position and on innovations taking place in terms of environmentally sound techniques, the design and testing of multi-functional coastal infrastructure and generally the strong position of the research and engineering institutes from the region. The increasing completion from contractors in Asia is expected to curb the growth of the sector to some extent.

In terms of economic size (jobs and GVA), the specific need for coastal protection works will persist and as a consequence its GVA and employment relevance is expected to remain stable or slightly grow. More substantial growth however is expected from spin-off activities of the sector towards other marine economic activities (ports development, offshore energy, tourism), as well as the export of services to other parts of the world. The latter will likely contribute to GVA growth for North Sea based enterprises but employment impacts would largely materialise in other parts of the world (local sourcing).

In terms of environmental impacts, recent innovative practices aim to apply protection techniques that make use of natural processes ("working with nature") and/or that provide positive impacts on marine environments (e.g. creating attractive coastal habitats). However marine works, especially disturbing the sea bed, will remain having an at least temporary negative impact. Research is being undertaken to reduce these.

4.7.4 Uncertainties

The two main uncertainties are the availability of stable government funds to continue protection works – affecting the sector's performance on the short term, and the implications of climate change on weather conditions, water levels and erosion/flooding risks – an uncertainty in the longer term.

4.7.5 Synergies and tensions

Developments in the coastal protection sector can spill-over to other marine sectors. Because coastal protection is a driver behind scientific research for coastal processes, these spill-overs are numerous. They can be categorized as follows:

- Increased insight in (marine) natural processes, for example meteorological, tidal and sediment patterns. This insight is beneficial for numerous offshore activities like wind energy, oil and gas and sand mining. Furthermore, onshore climate adaptation with respect to water management also benefits from these insights;
- Related to these insights, the availability of (marine) data and processing methods. An example is mapping of oceanic sediment, which can be useful for offshore construction as well as sand production;
- Urban / regional development. Coastal protection as an integral challenge can strengthen urban / regional development.

Tensions resulting from coastal protection primarily result from resource requirements:

- Land use required for flood protection provides limited possibilities for other functions;
- Physical resource requirements, competing with (offshore) construction;
- Labour requirements, competing with all sectors requiring technical personnel.

4.7.6 Framework conditions

Although coastal protection is important on a European wide scale and in many cases has a transboundary character there is no European legal requirement concerning coastal protection. Three different EU policies indirectly affecting the sector can be distinguished:

- Policy asking member states to reduce coastal flooding risk by taking adequate measures (Flood Directive);
- Framework for maritime spatial planning and integrated coastal management; and
- Directives aiming at a better coastal environment like Natura 2000, Marine Strategy Framework Directive and Water Framework Directive.

Coastal protection policies differ between the North Sea basin countries. In the Netherlands, safety standards for all flood defences have been established by law and coastal erosion management has been translated into an on-going coastal nourishment policy. The opposite exists in Belgium, Denmark and Norway. To date, Belgium has no law or directive regulating the protection of the coast against flooding by the sea and is applying one safety level for the whole coast. The general tendency in the coastal protection policy of Denmark can be summarised as “wait and see”.

The Danish tradition of rather strict spatial planning regulations limits the impact of flooding along the coastline and in case of flooding in uninhabited areas, land is given back to the sea. The Norwegian coast is a fjordic coast, and much less sensitive to erosion than the coasts of most other North Sea countries. Especially the UK North Sea coast is facing severe erosion. In France, UK and Germany, coastal protection policies are decentralised.

Although limited EU policy is available and can be considered as conditions for coastal protection management and implementation of measures, there is no need for additional EU policy. The sector is able to work within the existing framework conditions.

Attention could however be paid to cooperation within the sector since it is an important condition for growth. Cross border cooperation on knowledge sharing between national and regional authorities already takes place. Cooperation within the value chain in an early stage is expected to result in more cost-effective solutions, which is needed to remain competitive on the long term and consequently leading to growth and jobs.

5 Conclusions and recommendations

5.1 Conclusions

The sectors identified as being the most relevant and most promising sectors were found to be functioning in a naturally evolving symbiotic environment where the utilisation of resources - natural as well as human resources - are yet to be optimised.

As industries develop and change with some growing while others reducing their activities, the extent and focus of impacts shift as well. Development patterns of the selected maritime industries can impact on the macroeconomic performance of the Member States directly in the form of revenues and taxes as well as through indirect means including changes in the levels of employment, training, education and research potential and can interfere with human health and environmental standards.

The development and adaptation of innovative, sustainable cross sectoral approaches, procedures and infrastructures were found to be one of the main drivers of development in the region. Sustainability remains an essential element for emerging as well as for more traditional industries such as shipping and port activities which are increasingly focused on the development and adaptation of green technologies. Consequently there is notable employment potential in the development, adaptation and maintenance of cross-cutting sustainable infrastructures as well as procedures.

5.1.1 Industrial symbiosis

Both the country reports as well as the sector reviews confirmed that long-established traditional sectors such as shipping, shipbuilding or oil and gas have arrived to a state where they:

- efficiently distribute resources;
- effectively communicate with policy makers and stakeholders involved; and
- utilise and invest into research and innovation.

This efficient coordination between the sectors is a result of the wealth of knowledge generated over decades on the potential resources, market demands, environmental and social impacts etc. For the majority of the maritime sectors the North Sea region is considered to be an active hub of knowledge, where innovation and implementation are both present.

However, the industrial landscape of the North Sea region has been changing rapidly over the last 10 years. Production output of oil and gas companies of the region has been reducing while offshore wind farms are increasing in number supported by strong technology development. Additionally, shipping industries are also evolving as their focus falls on reducing negative environmental impacts – GHG emission, waste generation and water pollution - alongside which port services are similarly directing their attention towards more environmentally friendly practices e.g. waste management.

Due to the size and structure, some of the more traditional sectors are often delayed in their reaction to these changes. Consequently, collaboration and effective involvement of the emerging sectors in a symbiotic industrial environment cannot be completed. A result of this discord is an

uneven and at times inefficient resource use and less than optimal contribution to the development of local economies.

The term and implementation of industrial symbiosis originates from the region of the North Sea, more precisely from Kalundborg in Denmark[68], where key industry stakeholders set up a closely integrated system of resource sharing and communication. The Kalundborg system is a closed-loop industrial ecosystem, where the residual product of one enterprise can be used as a resource by another enterprise. On a larger scale (i.e. regional, cross-border or on sea basin level) such symbiotic environment and the sharing of resources might not be possible to replicate. However, there are opportunities for a closer integration of sectoral activities including:

- training, re-training, employment;
- increased collaboration on research and innovation;
- use of residual products;
- common future planning of resource use etc.

The following sections indicate the potential lines of development of the selected maritime sectors, their impact on the economy and employment and highlight any possible policy measure that could be introduced to support future growth.

5.1.2 North Sea Region as a knowledge hub

The region of the North Sea has for many decades – in some cases for centuries - hosted maritime industries and developed clusters as well as hubs of knowledge and expertise. These centres of knowledge house research, innovation, training and education centres as well as private enterprises – SMEs and multinational companies alike. While there are on-going collaborations between universities, research centres and maritime industry stakeholders, it is essential that the research and education potential and infrastructure that exists in the region is supported in the future through public and private financing.

This wealth of knowledge and expertise provides opportunity for start-up companies which can either be spin-offs of academic research or independent business ventures. Additionally well-established industries such as shipping or oil and gas also require constant research and innovation in order to maintain their competitiveness on the global market. Therefore long-term policy initiatives supporting research, innovation and the regional and local collaboration between start-ups, SMEs and multinational companies are an important contributing factor of future development.

5.1.3 Cross sectoral initiatives

Cross sectoral initiatives are essential to facilitate understanding of growing demands that might impact upon local development, resource use or macro-economic factors. Further development into cross-sectoral projects can address capacity needs in terms of available skilled employment, strengthen policy harmonisation and reduce costs of operations as well as enhancing knowledge and understanding of new applications. Moreover, cross sectoral initiatives coupled with research and innovation focus can further improve the competitiveness of the European maritime sector specifically in relation to shipbuilding, coastal protection or energy.

[68] http://www.symbiosis.dk/en

One particular example for cross sectoral initiatives is cruise tourism where joint action with port authorities and other regional and local stakeholders could help further develop the North Sea Region as a cruise destination. A recent review held by Cruise Gateway North Sea amongst cruise liners revealed that the region lacks a clear identity, is generally perceived as having a rainy and windy climate, and that cruise companies are not always treated as clients by cruise ports or terminals[69].

With regard to the oil and gas sector, future areas of focus include decommissioning as well as interlinking supply chain activities with offshore wind and deep-sea mining, such as installing offshore platforms, adapting new technologies such as smart buoys and underwater vehicles as well as more indirectly related research activities e.g. non corrosive paint, underwater cables etc. Research and development into monitoring environmental impacts especially biodiversity following decommissioning activities might be another area of future investment, which could directly support blue biotechnology and aquaculture.

Multifunctional systems are one initiative that can further intensify relations between offshore industries such as oil and gas, wind and aquaculture. Multifunctional platforms allow for the various use of the physical infrastructure while multifunctional support vessels can aid the construction, maintenance of off- and onshore installations including port facilities as well as carry out emergency response activities linked to coastal protection or offshore oil and gas.

Collaboration, shared knowledge and infrastructure could also play a key role in maintaining European competitive advantage in the area of subsea power grids. This technology could also be used further on for offshore wind as well as in deep-sea mining operations.

The increasing number of offshore wind farms, the declining number of offshore oil and gas platforms and the ever present shipping industry could all benefit from an increased focus of marine spatial planning and e-navigation. In both areas joint actions by Member States and stakeholders would be favourable to assure growth and opportunities in the future.

5.1.4 Cross-border collaboration

With regard to cross-border collaboration vertically integrated companies e.g. in the area of coastal protection are less likely to form alliances for the benefit of local development as they are likely to be competitors to one another. However, there are examples showing that the large contractors from different countries work together especially in markets outside Europe.

One of the most important areas where cross-border cooperation could improve the long term strategic advantage of the region is that of education and training. One example comes from the oil and gas industry which forces a lack of skilled workforce even though there are initiatives on the level of companies as well as in some cases of countries for a better management of human resources. It would be beneficial to have a complete overview of skills needs, some of which could be transferred and utilised across borders.

[69] See: Cruise Gateway North Sea (2013), Sustainable cruise tourism in the North Sea region, a best practices guide.

Aquaculture is another sector where collaborations between private enterprises are sporadic with the exception of the salmon industry which is the most developed sub-sector in the North Sea region. Hence a comparison can be drawn between the levels of development and that of cross-border or international collaboration.

5.2 Recommendations

The overarching review of activities concluded both on a country as well as on a sectoral level across the sea-basin confirms the crucial importance of availability and accessibility of:

- Information and information exchange platforms facilitating collaborations amongst and between industry stakeholders, local and regional authorities reaching beyond the North Sea boundaries;
- Continuous investments and development of the research and innovation potential as well as infrastructure;
- Strong focus should be maintained on sustainability of off- and on-shore facilities as well as operational activities;
- Increased support and focus on cross-sectoral initiatives such as supergrid, multi-purpose islands, energy atoll, etc.);
- Support to SME spin-offs and start-up companies;
- Support to marine spatial planning initiatives as a tool to facilitate cross-sectoral and cross-border dialogues in order to adapt to the changing regional maritime landscape.

There are a number of funding opportunities including EU wide programmes such as Horizon 2020 as well as more geographically focused funding alternatives as the INTERREG programmes and the regional development programmes (ERDF and ESF). A continuation of current projects such as the North Sea Region Programme under INTERREG IVB also provides a platform for extending support.

However prior to project evaluations and financial support one of the most important elements of future support to the region is providing a joint platform to:

- exchange innovative ideas;
- encourage collaboration in less mature industries;
- allow for better planning and coordination of resources; and
- involve interested stakeholders beyond the North Sea region.

A combination of these activities would allow for the strengthening of the region`s maritime potential by integrating new and innovative ideas and reaffirming and extending on-going collaborations.

Annexes

(Under separate cover)

Annex I. Methodology for data gathering and processing for the North Sea and Atlantic Arc
Annex II A/D. 2-page country summaries
Annex III A/F. Sector reviews

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