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

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Annex III B - Sector Analysis - Offshore oil and gas

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1. Analysis of the offshore oil and gas sector in region of the North Sea and the English Channel

1.1 Sector performance and competitive position

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[1].

The oil fields in the North Sea region are in a mature state, which naturally means that production is declining.

The first discovery of offshore gas in the North Sea took place in 1965 with the first commercial drilling for offshore oil in 1969.2 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.

Figure 1.1 Oil production output

Country	Offshore Oil Production (2012)	Offshore Gas production (2012)	Main Players
United Kingdom	567 million barrels[3]	NA	Shell, BP, Talisman, Conoco Phillips, Maersk
Norway	95 million barrels	105 million barrels	Statoil, ESS, BP
Netherlands	5.5 million barrels	119 million barrels[4]	GDF SUEZ, NAM, Vermilion, Wintershall, Northern Petroleum and DANA Petroleum[5]
Denmark	73.5 million barrels	35.2 million barrels[6]	DONG, A.P. Møller Mærsk, Nordsøfonden, Shell, Wintershall, PA Resources UK and PGNiG

1.2 Key sector 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.

[1] 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
[2] 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
[3] Oil and Gas UK (2013), latest production figures show a 14.5% decline from 2011
[4] 24% of all gas production comes from small offshore fields
[5] NL Olie- en Gasportaal (2013): Production, http://www.nlog.nl/en/production/production.html
[6] Danish Energy Agency (2013): Production of natural gas totalled 5.6 billion Nm3 in 2012, of which 4.9 billion Nm3 of gas was exported ashore as sales gas, a 13.7% decline compared to 2011.

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).[7]

Oil and gas is the largest industrial sector in **Scotland**, contributing around £22 billion to Scottish GDP and £300 billion in tax receipts to the UK in 2012.The sector employs around 200.000 people directly and indirectly in Scotland. [8] According to industry sources[9] 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. According to Eurostat in 2010 Norway had a reported 23.000 people directly employed in the sector.

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.[10] In Denmark all producing fields are located in the North Sea (199 oil and 79 gas wells). The area in the Danish sector of the North Sea west of 6° 15' eastern longitude is offered for licensing after a public invitation of applications in a so-called licensing round. Exploration licences are granted for a term of up to six years. The individual licences include a work programme describing the exploration work that the licensee is obliged to carry out. Currently there are 19 producing fields for offshore oil in Denmark with a total of 11 companies participate in production from Danish fields. Direct employment in the sector is around 2.660 according to Eurostat (2010).

According industry estimations[11] 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.

There are sporadic statistics regarding overall employment in offshore oil and gas activities for the North Sea. According to statistical figures 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. Figures for GVA were 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. Overall it is estimated that the region would have a GVA of around €104 billion per annum.

[7] Oil and Gas UK (2013): Economic Report
[8] The Scottish Government (2013): Maximising the Return from Oil and Gas in an Independent Scotland, http://www.scotland.gov.uk/Publications/2013/07/5746/3
[9] Interview conducted with a representative of the International Association of Oil and Gas Producers
[10] 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
[11] Estimations from the International Association of Oil and Gas Producers

2. The potential of offshore oil and gas to achieve Blue Growth during 2014-2020

2.1 Segments

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.

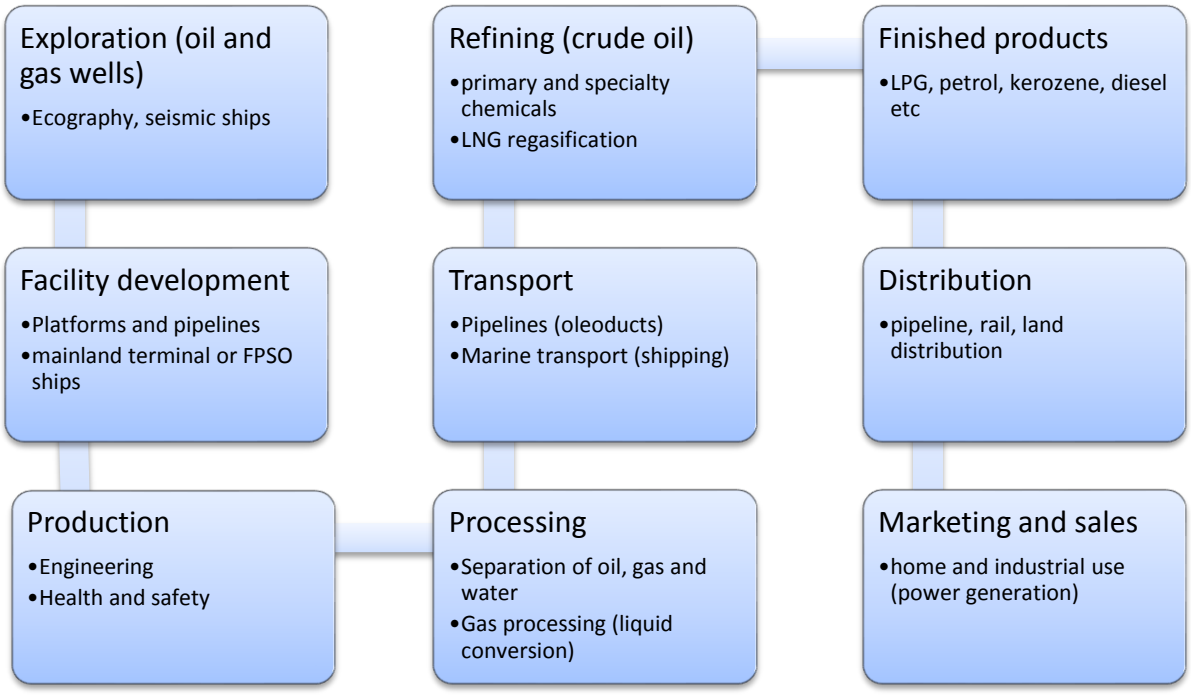
Oil and gas extracted from the North Sea region provide a stability of supply with low or no geopolitical risk as opposed to specific third country imports (e.g. Middle-East, Russia, Venezuela etc.) that could be threatened by political instability of the state of origin or country of transit.

The activities in the industry can be grouped into three main segments: **upstream**, **midstream** and **downstream**:

- Upstream comprises of exploration, development and production;
- midstream covers transportation and storage; and
- downstream includes manufacturing of products through oil refining, gas processing and petrochemical processes, as well as the selling of these products to the various consumer markets. [12]

The following figure depicts the value chain for oil and gas.

Figure 2.1 Value chain composition



According to various industry sources 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

[12] UNCTAD (2012): extractive industries: optimizing value retention in host countries, http://unctadxiii.org/en/SessionDocument/suc2012d1_en.pdf

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.

2.2 Competitive position

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%). This suggests that with adequate technology improvements the yet untapped resources can be accessed and energy diversification of European Member States can be assured on the short to medium term.

Norwegian oils and gas reserves play a crucial role in fulfilling Europe`s energy needs and supporting the diversification of resources. As a country of stable economic and political background, Norwegian supplies are reliable thus assure continuity of production and safety of economic operations in Europe consequently providing support to maintain Europe's strong competitive position on the global markets. Norwegian resources alone provide 30% of gas needs in large EU economies such as France, Germany and the UK.[13]

Recent shortages in Norwegian gas include a brief supply cut towards the UK in 2010 due to cold weather and a recent (2012) strike with energy workers which resulted in a lockout and a temporarily reduced production.

The **UK** is the second largest oil and the third largest gas producer in Europe and the sector is instrumental in maintaining the country`s competitive position in the global market. Offshore oil and gas is also a large contributor in terms of export and the UK also has a competitive advantage with regards to research and development as well as education related to oil and gas activities. Significant export markets are North America, Norway, Angola, Nigeria and the UAE.

If the current rate of investment in the sector continues, the UK has the potential to satisfy close to 50% of their internal oil and gas demand until 2020.[14] 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.

Danish investments are also adding a significant boost to sector development in the region. In 2014-2015 Dong Energy and Bayerngas are establishing the Hejre field in the North Sea. This is the single largest investment in the Danish CS of the North Sea, with new pipelines connecting the field to the installation which is located approximately 290 kilometres of Esbjerg (south-west Denmark). This investment aims to ensure the country`s energy independence (170 million barrels producible oil equivalent) for the medium term. [15]

2.3 Strength and relevance of cross-border relationships within the sector

Cross-border relationships within the sector, 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.

[13] Norsk Olje and Gass (2013): Vigorous activity and bright prospects, the oil and gas year 2012
[14] Oil and Gas UK (2013): Economic Report
[15] Penn Energy (2013): Follow the development of a future North Sea oil and gas field, http://www.pennenergy.com/articles/pennenergy/2013/08/follow-the-development-of-a-future-north-sea-oil-and-gas-field.html

The UK and Norway has a long history of cross-border action regarding offshore oil and gas starting in the 1960`s in connection with conflicting issues that surrounded cross-border petroleum deposits. This collaboration has resulted in the Delimitation Treaty of 1965 and a mineral deposit clause. This unitisation agreement serves as a point of reference for similar collaborations around the world.

Other similar national level agreements include:

- the Frigg Agreement- between the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of the Kingdom of Norway relating to the Exploitation of the Frigg Field Reservoir and the transmission of gas;
- the Framework Agreement 2005- between the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of the Kingdom of Norway concerning Cross-Boundary petroleum Cooperation.[16]

Cross-border deposits have largely been exploited and focus is now 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.

Norway`s oil and gas industry also looks at cooperation with regard to the Artic and the Barents Sea. Norway's present-day Arctic strategy is focussed on cooperation[17] with other Arctic nations – and with Russia, in particular – to support UNCLOS as well as to avoid an open dispute over Svalbard.[18]

Collaborations, however, are not limited to EU Member States. There is a growing amount of investment in the North Sea region oil and gas activities arriving from far-east Asian countries such as China, Korea, India or Malaysia.[19] Information suggests that Chinese ownership now extends over around 8% of North Sea oil production activities. Following a 2010 acquisition of Dana petroleum by the Korean National Oil Corporation, the company has now a significant stake in Dutch oil production.

2.4 Access to finance

Oil and gas companies generally receive financial support from three key sources:

- Private investors
- Government incentives e.g. tax cuts
- Public donors e.g. EU

Mergers and acquisitions are common within the sector exemplified by a recent (August 2013) buyout of Statoil North Sea interest by the Austrian OMV. Via the deal OMV will acquire 19% of the Gullfaks oil and gas field, 24% of the Gudrun oil and gas field, 30% of the Rosebank oil and gas field, and 5.88 % of the Schiehallion oil field.[20]

Companies in the sector generally tend to finance their investments via their own reserves or utilising private lenders and investors. One of the obstacles identified by an industry association in

[16] Avril Lee Wong (nd): The North Sea Experience, University of Dundee
[17] Global Brief (2011): Norwegian Grand Strategy and the Arctic, http://globalbrief.ca/blog/2011/06/27/norwegian-grand-strategy-and-the-arctic/
[18] Svalbard Treaty of 1920 are given non-discriminatory access (at least onshore), and where the equal access provisions apply to the archipelago's potential economic zone.
[19] Herald Scotland (2013): Don't fear the Far East buy-in to North Sea oil and gas: it's breathing new life into the sector, says expert, http://www.heraldscotland.com/business/company-news/dont-fear-the-far-east-buy-in-to-north-sea-oil-and-gas-its-breathing-new-life-.21896650
[20] English News China (2013): OMV announces record investment in North Sea oil, gas fields, http://news.xinhuanet.com/english/world/2013-08/20/c_132644504.htm

relation to private financing is that investors are more likely to favour high-risk and high-reward exploration programmes in frontier regions, rather than programmes in mature basins such as the North Sea. Additionally, there are a rather limited number of private equity companies active in this space resulting in companies seeking out alternative sources of funding such as government bonds or short-term loans. [21]

However, government incentives also play a key role in financing new developments. In 2011 the British government increased tax relief on losses from 6pc to 10pc, costing about £50m. This incentive has led companies turning to fields with significant reserves but difficult and costly access. Statoil restarted work on its Mariner field and Centrica switched back on the UK's biggest gas field, Morecambe Bay.[22]

2.5 Research, development and innovation

In a mature sector that has been operating 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.

Beside trends in production research and innovation trajectories can also be followed via patent and education statistics.

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.[23]

Main lines for research include:

- underwater engineering,
- geology,
- geophysics,
- modelling,
- 3D visualization etc.

Handling and analysing big data is crucial for the industry in order to manage and filter through geological, engineering, production and equipment information quickly and efficiently. One of the key scientific project relates to the **MARE NOSTRUM** supercomputer, which has a calculations capacity of 1,1 Petaflops. The industry used the supercomputer to search for oil fields at greater depths up to six-times faster than currently using conventional technology.[24]

A similar project entitled **Kaleidoscope** was launched in 2007 to manage complex mathematical algorithms to create seismic images that enabling experts to see what is beneath the seabed and analyse it for hydrocarbons without drilling through the Earth's crust. [25]

[21] Oil Council (nd): North Sea - access to funding remains key, http://www.oilcouncil.com/expert_insight_articles/north-sea-access-funding-remains-key

[22] The Telegraph (2011) : North Sea oil companies get tax boost from Government, http://www.telegraph.co.uk/finance/newsbysector/energy/oilandgas/8619031/North-Sea-oil-companies-get-tax-boost-from-Government.html

[23] 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

[24] Barcelona Supercomputing Centre (2008): Repsol, Barcelona Supercomputing Center Use IBM Technology to Tap Into New Frontiers of Oil Exploration http://www.bsc.es/about-bsc/press/bsc-in-the-media/repsol-barcelona-supercomputing-center-use-ibm-technology-tap-new

[25] Repsol (nd): Kaleidoscope project, http://www.repsol.com/es_en/corporacion/conocer-repsol/canal-tecnologia/proyectos-casos-estudio/otros-proyectos/proyecto-caleidoscopio/

3. Drivers and barriers to growth for the selected sector

3.1 Drivers and barriers

There are a number of opportunities ahead of the offshore oil and gas industry in the North Sea region even as production is declining. Key drivers include the well-established knowledge and research base as well as the strong interlinking potential with renewable industries and smart grid technologies. These drivers, which are identified in the Table below, support the future development and expansion of specific activities that could be utilised to support other, complementary sectors.

Figure 3.1 Strengths and weaknesses analysis of the most promising economic activity

	Drivers for Growth		Barriers for Growth	
	SWOT analysis	**Best practice example**	**SWOT analysis**	**Best practice for mitigation**
Maritime research	Opportunity: Mitigation of environmental impacts	Opportunity to incorporate local participation, universities, companies and local communities in the solutions		-
Development and innovation	Strength: Strong development potential established infrastructure, strong university and research background	-	Threat: Handling big data	Data structuring and profiling
Access to finance	-	-	Lack of private lending opportunities for North Sea region innovations as it is considered a mature sector	-
Maritime clusters	Collaboration through industry clusters have positive impact on local and foreign industry participants	Regional development and cross-border initiatives via INTERREG and regional development funds	Economic dependency of clusters on the oil and gas industry	-
Education, needs in training and skills	Well established educational background, strong knowledge hubs	University industry collaboration	Skill shortages hinder the incorporation of local workers into the extractive industries and the development of an industrial base necessary to spread the benefits of these sectors to other	-

			areas.	
Integrated local development	Strong links between industry hubs due to long standing cooperation	Nordic Scottish cooperation	Threat: If resource trade is well managed, especially if there is a dominance of a natural resource, it may harm economic performance. Extractive industries can be a source of macroeconomic instability a.k.a as the "Dutch disease"[26]	-
Cross border collaboration	Technology spillovers and managerial know-how to gain ground in external markets	Joint industry projects	-	-

3.2 Best practice examples

The following section highlights some of the best practice examples referred to in Table 3.1 above.

Development and innovation: Data structuring and profiling services from software developers to support filtering information coming from sensors, spatial and GPS coordinates, weather services, seismic data, and various measuring devices. Other sources include data market feeds, social media, email, text, images, and multimedia.[27]

Education, training needs: Linking up to industry to betters serve skill needs and integrate new practices in the curriculum. University of Aberdeen, Robert Gordon University and University of Dundee industry partners include Shell, BP and Chevron.[28]

Integrated local development: the Nordic-Scottish cooperation placed oil and gas as one of the key regional activities into a wider context of environmental and social development. There is no recent information to suggest this activity continued beyond 2006.[29]

Cross-border collaboration: joint industry projects are plenty and include wide range of activities that can transpire into extended future activities such as Decom North Sea (DNS)[30], a project aimed at exploring the re-use market for equipment available during oil and gas platform decommissioning.

Threats

- Limited access to private lending and funding from European investors can lead to increasing influence from Asia.
- Without alternative resources and local generation of electricity substituting the loss of locally accessed oil and gas reserves, Europe will be increasingly reliant of external energy supplies.

[26] The "Dutch disease" is a description of an economic condition where increased exploitation of natural resources is coupled with a decline in the manufacturing or agricultural sectors. The expression originates from the 1960s Netherlands, when revenues generated by natural gas discovery led to an appreciation of the national currency and to a sharp decline in the competitiveness of the non-booming tradable sector.
[27] Microsoft (2013): How innovative oil and gas companies are using big data to outmaneuver the competition
[28] Scottish Development International (2013): Scotland's oil and gas industry centres of excellence, http://www.sdi.co.uk/sectors/energy/sub-sectors/oil-and-gas/centres-of-excellence.aspx
[29] Nordic-Scottish Co-operation (nd): http://www.eprc.strath.ac.uk/nordic/default.htm
[30] DECOM North Sea (2013), http://www.decomnorthsea.com/

3.3 Regulatory background

Regulatory framework conditions:

- Directive 2013/30/EU of the European Parliament and of the Council of 12 June 2013 on safety of offshore oil and gas operations and amending Directive 2004/35/EC
- Council Regulation (EU, Euratom) No 617/2011 of 24 June 2010 concerning the notification to the Commission of investment projects in energy infrastructure within the European Union and repealing Regulation (EC) No 736/96;
- Regulation (EU) No 994/2010 of 20 October 2011 concerning measures to safeguard security of gas supply;
- Council Directive 2009/119/EC of 14 September 2009 imposing an obligation on Member States to maintain minimum stocks of crude oil and/or petroleum products
- Directive 2009/73 /EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC;
- Regulation (EC) No 715/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the natural gas transmission networks;
- The Hydrocarbons Licensing Directive Regulations 1995, No. 1434;
- Directive 2004/35/EC of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage;
- Commission Decision 2003/796/EC of 11 November 2003 on establishing the European Regulators Group for Electricity and Gas
- Council Decision 1999/280/EC of 22 April 1999 regarding a Community procedure for information and consultation on crude oil supply costs and the consumer prices of petroleum products;
- Directive 94/22/EC of the European Parliament and of the Council of 30 May 1994 on the conditions for granting and using authorizations for the prospection, exploration and production of hydrocarbons

4. Overview of growth scenarios for the sector at sea-basin level

4.1 Description of the nature of the economic activity and value chain

The value chain as presented earlier under section 2 highlights the fact that the oil and gas industry has strong links to various other industries (maritime and land based as well) that can provide numerous growth opportunities for the future.

Some elements of the value chain can function on their own independent of the oil and gas industry and provide services for other sectors. Such elements of the value chain include:

- Decommissioning which could be 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.

The North Sea oil and gas industry has the potential to become an international leader for **decommissioning** activity and expertise. According to a 2011 report on UKCS decommissioning[31] within the next 30-40 years over £30 billion will need to be spent to meet UKCS decommissioning liabilities, with £3.3bn being incurred between 2012 and 2016 as 51 installations are due to be retired. Beyond 2016, UKCS decommissioning activity is estimated to increase to £1bn per annum.

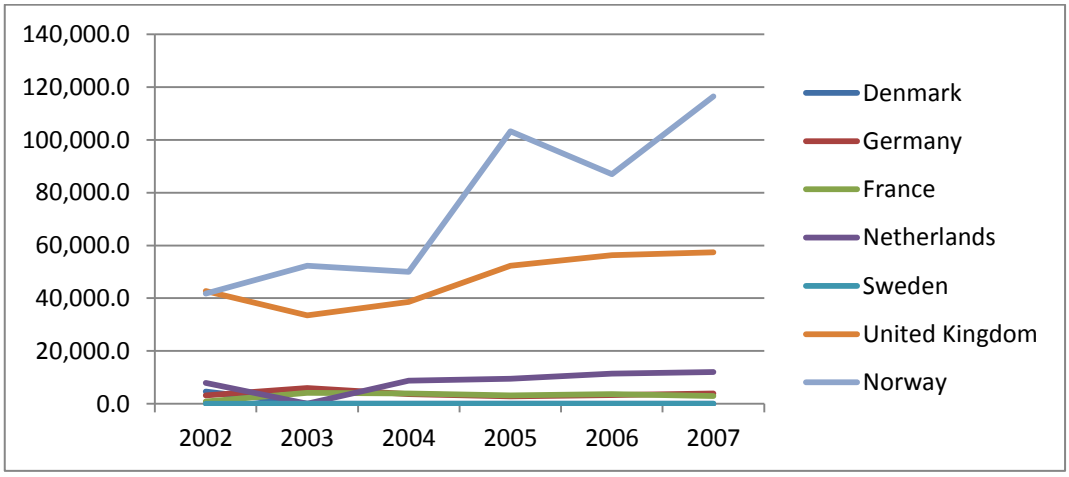
The North Sea is not the only basin that requires significant investment in decommissioning activity, with considerable expenditure required on the Gulf of Mexico, west of Africa, and the South China Sea. The skills and experience gained through decommissioning projects in the North Sea could result in a demand for the export of these services in decades to come.[32]

4.2 Potential development: Description of economic and infrastructural scenario

Data from Eurostat (Figure 4.2 below) gives an indication of recent output trends regarding oil production in the countries of the North Sea region. These figures depict national output trends as opposed to focusing on regional varieties that could be linked to the offshore sector of the North Sea.

[31] Oil and Gas UK (2012): Economic Report 2011, http://www.oilandgasuk.co.uk/economic_report/decommissioning.cfm
[32] The Scottish Government (2013): Maximising the Return from Oil and Gas in an Independent Scotland, http://www.scotland.gov.uk/Publications/2013/07/5746/5

Figure 4.1 Production value in the oil and gas sector



Source: Eurostat, extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying

A more focused result of offshore output trends can be gathered from industry associations. The following table summarises the most recent oil production output trends as well as projected outputs until 2020 in the four main oil and gas producing countries of the North Sea region.

Figure 4.2 oil production output trend

	2000	2011	2012/2013	Trend	Forecast
Norway (oil and gas combined figures)[33]	-	1.68 million barrels per day	1.52 million barrels per day	40% drop in oil production since 2001	By 2017 -26% decline in oil production compared to 2008
UK (oil and gas combined figures)[34]	-	2.6 billion barrels per year	1.54 million barrels per day	6.6% average annual decline in oil and 8.6% decline in gas production since 2000	By 2020 39 million tonnes per year oil and 28 million tonnes of gas production
Netherlands (oil)	936.4 thousand m^3	848 thousand m^3	884 thousand m^3	4.2% oil production growth from 2011/2013	By 2020- 1.5 thousand m^3 of oil and 8 million m^3 of offshore gas production from reserves [35]
Netherland (Gas)	-	18.204 mil m^3	18.891 mil m^3	3.6% gas production drop	
Denmark (oil)[36]	21 million m^3	12.84 million m^3	11.7 million m^3	8.6% decline from 2011 to 2012	By 2017: 12 million m^3 oil production
Denmark (gas)	7 billion m^3	6.53 billion m^3	5.6 billion m^3	13.7%decline from 2011 to 2012	By 2017: 5.4 billion m^3 gas produced

Based on the above figures and some of the initiatives introduced in the countries there are two underlying trends that can be identified with regard to future production and output. These two trends are summarised below.

4.3 Scenario 1: Progressive decline in overall production

Declining production potential is a common element in the future projections of the countries, even though there are differences regarding its level.

[33] Norsk Olje & Gass, http://www.norskoljeoggass.no/
[34] Oil and Gas UK, http://www.oilandgasuk.co.uk/
[35] Nederland Olie en Gasportaal http://www.nlog.nl/en/oilGas/oilGas.html
[36] Olie Gas Danmark, http://www.oilgasdenmark.dk/dk/Om%20OGD.aspx

Based on the analysis of the national industry association DEA, **Denmark`s** oil production is expected to increase until 2016 however by around 2023 production is expected to have been halved compared to 2013. At the same time **UK** forecasts for 2020 suggests a 47% oil and 58% gas import dependency for the country.[37] A similar scenario is set to apply in the **Netherlands** where after 2030 only a small amount of natural gas liquids production is expected to continue. [38]

While this decreasing output may result in a negative change of employment for the production of oil and gas, other activities may see an increase. High numbers of jobs are expected to be created by decommissioning of operating platforms. According to the new North Sea Offshore Decommissioning Market Report the majority of decommissioning activity and related spend will occur between 2016 and 2031.[39]

Based on the reported figures of production and production forecast, it is expected that the majority of countries will continue to experience declining production and a number of new initiatives are expected to be introduced by Member States focussing on alternative energy sources such as shale gas, wind or other renewable sources as well as energy efficiency measures.

4.4 Scenario 2: Variations and fluctuations

Scenario 2 depicts a future where further reserves are accessed which allow for variations in the quantity of output and production. There are indications that the industry might follow this scenario. Forecasts for 2013 in the **UK** for example expect a significant rise of offshore oil production and output of 470 million barrels, a fivefold increase on the average over the past three years. Two million barrels of oil a day are set to come on stream by 2017, up from 1.5m in 2012. The rise in revenues are explained by new financial incentives introduced by the British Government which allowed companies to invest more in technology for the exploration of areas that have been previously considered to be commercially unviable.

Recent discoveries around the **Norwegian** Continental Shelf (NCS) including Johan Sverdrup (1.7 - 3.3bn barrels) and Skeugard/Havis (400 - 600 mmboe) are also expected to drive production on the future. However, despite these promising developments in Norway oil output has declined by almost 50% since 2000, with gas production rising substantially over the same period.

With regard to the **Netherlands** currently there are 452 proven natural gas accumulations in the Netherlands and out of these 254 are off-shore. For the majority (213) of these fields, installations are operational. Compared to January 1st 2012 the number of offshore gas accumulations has increased by seven.

Scenario 2 depicts a more optimistic outlook even though the new reserves and production increases can be seen as indications of only short term upward trends. There are no indications to suggest that new reserves would be able to substitute for the decline resulting from closed fields. However, it is expected that on-going extraction will provide an opportunity for the industry to gradually shift employment and facilities to other locations in Europe and beyond.

An additional aspect relating to take into consideration when describing a fluctuating scenario is that increasing amount of research is being carried out with the intention to access those reservoirs beneath the seabed that were previously deemed unviable and inefficient to use. This further increases the knowledge potential of the area and allows for the continuation of supply chain activities.

Furthermore, the increased research and innovation can forge close ties with sectors such as deep-sea mining or offshore wind (floating platforms etc.) as well as provide impetus into general research of tools and mechanics that benefiting a wider range of industrial and production sectors.

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[37] UK Government forecast on UKCS Oil and Gas Production Projections https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/249323/production_projections.pdf

[38] International Energy Agency (2012): Oil and gas security, the Netherlands, http://www.iea.org/publications/freepublications/publication/Oil&GasSecurityNL2012.pdf

[39] DECOM (2013): Douglas-Westwood & Deloitte Predict North Sea Oil & Gas Decommissioning Costs Could Exceed £47.5 bln - 15 Nov 2011, http://www.decomnorthsea.com/news2.cfm?news_ID=126

4.5 Uncertainties: external drivers and requirements

Uncertainties in this section are described in reference to the industry performance as a whole and not as an element to individual processes within exploration or extraction.

Uncertainties for the industry mainly originate from accurately forecasting the balance between renewables and non-renewable energy requirements for the medium to long-term and balancing the outputs efficiently. Taking into consideration the declining oil and gas output Member States will 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.[40] The occurrence of speculative funds on the financial market especially on futures market can also lead to sudden changes in the global price index.

4.6 Synergies and tensions: potential environmental consequences and spill-over impacts to other sectors

4.6.1 Synergies

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.

Mapping out synergies between stakeholders in the sector is of key importance in order to assure stability in terms of continuing production and employment beyond the timeframe of reserves.

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. These collaborations between education institutes and production centres represent a truly multinational angle of globalisation as students come from all parts of the EU (or the world) and production companies are also headquartered in other EU Member States than the place of operation.

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.

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

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.

4.6.2 Tensions

Tensions within the sector exist generally in connection with the extent of future potential that the sector in the North Sea region might have.

As oil and gas reservoirs are becoming more difficult to access, the use of effective and cost efficient technology becomes ever more important. 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.[41]

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[42]. 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.

Environmental risks in North Sea oil and gas production have been noted by both Member State national services as well as international organisation. Environmental impacts include disturbance caused to the ecosystem e.g. sound and seismic activity brought on by exploration activity can negatively impact the fish population. Drilling also causes water pollution via the circulation of mud and other discharges from the pipes.

It is expected that a peak period of decommissioning of installations will take place until 2020, during which there are heightened environmental concerns regarding discharge of chemicals and waste management.

Figure 4.3 Key impacts of the expected trends on the sector

Type	Key questions	Extent of impact
	Economic	
Competitiveness, trade and investment flows	What is the sector`s impact on the global competitive position of the EU? Is the sector characterised by high cross-border investment flows (including relocation of economic activity- outsourcing)?	Diversification of energy resources are key to assure steady supplies.
Operating costs and conduct of business/Small and	Are there special procedural elements that burden enterprises in this sector? E.g. exploration costs	Exploration costs are usually financed by major oil companies; small and medium sized enterprises are more likely to be

[41] 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

[42] 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

Type	Key questions	Extent of impact
Medium Enterprises	Does it impact on the investment cycle?	engaged in RDI activities
Administrative burdens	Are there specific information obligations placed on businesses in the sector? What is the impact of these burdens on SMEs in particular?	Permits are required for exploration and production[43] as well as EMS, OPOL and indemnity arrangements, major spill reports etc.
Innovation and research	What the stage of innovation intensity characterises the sector? Low-innovation, medium innovation or high innovation Is there a hidden innovation potential in the sector? What is the impact of the stage of innovation on sector performance?	All innovation potential is utilised as the sector is in a mature stage and production is declining. The sector focuses on providing a stabile knowledge base and increase the spin-off potentials
	Social	
Employment and labour markets	Does the sector development trend indicate a growth in employment? Does it affect particular age groups? Does it affect the demand for labour?	The sector is lacking in skilled workforce even now as production is in a decline.
Social inclusion	Does the sector development trend indicate changes in access to the labour market? Does it affect specific groups of individuals (gender, age or ethnic group) more than others?	Social inclusion project under INTERREG IVB iAge: e-inclusion in Ageing Europe[44]
Access to educational systems	Does the sector development trend indicate a change in quality or access to educational services? Does it impact the access (including cross-border) of individuals to public/private education or vocational and continuing training?	The sector has well established and long standing relations with secondary and tertiary education institutes
	Environmental	
Impact on climate	Do the operations in the sector affect the emission of greenhouse gases and other ozone depleting substances? Do RDI innovations within the sector result in a decrease of emissions?	Offshore oil and gas production can have serious impacts on the environment including GHG emissions (gas leaks and flaring). Main substances emitted are NO2, CH4, N2O, VOCs. Sources include combustion devices (burners, flares) and ships as well as fugitive emissions. Main emission impacts however come from the final consumers of the oil and gas produces (transport, households, other industry & service sectors).
Transport and usage of energy	Do the operations in the sector affect the energy intensity of the economy? Do the operations in the sector affect the fuel mix (between coal, gas, nuclear, renewables etc.) used in energy production? Does it impact demand for transport (passenger or freight), or influence its modal split?	The sector is an energy provider, while the operations themselves use energy to extract, process and transport products to shore. Examples of energy intensive processes include: • Water injection for production aquifer pressure support • Increased gas compression due to declining reservoir pressure • Increased dependency on production lift techniques such as gas lift or electrical submersible pumps. • Increasing complexity and reduced reliability of facilities operations arising from a variety of factors such as increasing volumes of water produced with the oil

[43] Specific elements are regulated in COM 211/688 Regulation of the European Parliament and of the Council on safety of offshore oil and gas prospection, exploration and production activities

[44] INTERREG IVB: IAGE project http://www.northsearegion.eu/ivb/projects/details/&tid=147

Type	Key questions	Extent of impact
		production and the addition of sub-sea production facilities which feed their production back into existing production facilities.[45]
Impacts on biodiversity	Does the operation of the sector impact on biodiversity? Does it affect protected or endangered species or their habitats or ecologically sensitive areas?	Exploration and operation of sector activities impact on marine biodiversity. Furthermore oil spills and other accidents on offshore installations pose a significant threat to marine life.
Impacts on water quality and resources	Does the operation of the sector impact on the quality of waters in coastal and marine areas (e.g. through discharges of sewage, nutrients, oil, heavy metals, and other pollutants)?	Everyday operation of the offshore platforms can cause the following environmental damages: drilling muds, brine wastes, deck runoff water, flowline and pipeline leaks[46]. Accidental spills or leakage can also cause significant water pollution.
Likelihood and scale of environmental risks	Does the operation of the sector carry environmental risks?	The operation of the sector carries a high degree and potential of environmental risk (most recently seen through the Deep-water Horizon catastrophe in the Gulf of Mexico)

[45] Policy Studies Institute (2005) : Energy Use in Offshore Oil and Gas Production: Trends and Drivers for Efficiency from 1975 to 2025, http://www.psi.org.uk/pdf/Energy%20Working%20Paper%20-%20June%202005.pdf

[46] Oceana (2012): Impacts of offshore drilling, http://oceana.org/en/our-work/stop-ocean-pollution/oil-pollution/learn-act/impacts-of-offshore-drilling

5. Joint actions leading to growth and jobs

5.1 Education and training

One of the most important areas where cross-border cooperation could improve the long term strategic advantage of the sector is that of **education and training**. While the sector currently maintains databases for recruitment on the level of companies as well as in some cases for countries- it is difficult to draw an complete overview of the skills needs that could be transferred and utilised across borders.

5.2 Research and innovation

The future of the industry is to a large extent depends on its ability to **innovate**, adapt and to maintain a **sound research and development background**. The oil and gas sector carries considerable spin-off potential as it contains a wide ranging up and downstream supply chain which includes robotics and underwater vehicles etc. Knowledge generated in the sector via the involvement of the supply chain could prove to be valuable asset to retain in order to create a knowledge hub where skills are transferable across countries as well as sectors. On the short-term however research potential is also important in order to improve recovery rates of subsea fields.

Deep-water operations carried out globally by oil and gas operators that are based in or also active in the North Sea region might require specialised high-pressure, high-temperature (HPHT) subsea well systems[47] which are currently being used by the space and aeronautics sector. A costly technology which has to be adapted to fit sector specific operations and return of investment has to take into consideration the ability to further extend operation beyond the EU waters.

Collaboration and shared knowledge and infrastructure could 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.

Future areas of focus include **decommissioning activities** as well as interlinking supply chain activities with offshore wind and deep sea mining, such as installing offshore platforms, adapting new technologies such 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.

The decline of offshore oil and gas could also give way of increased shipping and fishing activities in the current exclusion zones. At the same time offshore wind platforms – or even floating platforms – could take up some of the areas. Consequently, **marine spatial planning** and **e-navigation** are all areas where joint actions by Member States and stakeholders would be beneficial to assure growth and opportunities in the future.

[47] The Telegraph (2013): We have to innovate to keep North Sea oil and gas ahead of the game, or face up to decline, http://www.telegraph.co.uk/finance/comment/10294786/We-have-to-innovate-to-keep-North-Sea-oil-and-gas-ahead-of-the-game-or-face-up-to-decline.html

6. Conclusion

6.1 Proposed new actions and priorities

Proposed **new actions and priorities** for the new financing period as well as for the further development of the offshore oil and gas industry could include:

- Support to SME spin-off activities;
- Support to cross-border training and education cooperation within North Sea countries as well as other sea-basins in Europe;
- Increased communication between stakeholders (EU-wide) on innovation potential such as the subsea power grid potential;
- Support to marine spatial planning and e-navigation projects; and
- Support to cross-sectoral communication and exchanges of ideas for offshore activities.

Potential sources of funding can include 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).

One common element of the above listed suggestions is an increased cooperation between regional stakeholders, the added value of which could be:

- Strengthening the region's position as a knowledge hub in Europe regarding offshore activities;
- Assuring skilled labour and allowing for a sea-basin wide coordination of training in line with industry requirements;
- Mitigating regional differences in technology by involving other EU stakeholders from non sea-adjacent countries;
- Improving non-renewable potential by supporting cross-sectoral exchanges and communication;
- Better planning and forecasting for long-term regional development potential.

The identified priorities shall be linked to potential sources of funding, concrete thematic objectives and investment priorities on the basis of existing and planned expenditure programming under the MFF and the ESIF 2014-2020, as well as other financial instruments.

With relation on policies and regulative measures on the national as well as the EU level, information from industry suggests that on-going changes and revisions to the current policy context are seen as a burden by the sector which could be mitigated by closer communication and stronger involvement between policy makers and industry representatives.

7. Interview

Bernard Vanheule, EU Affairs Manager- International Association of Oil and Gas Producers

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