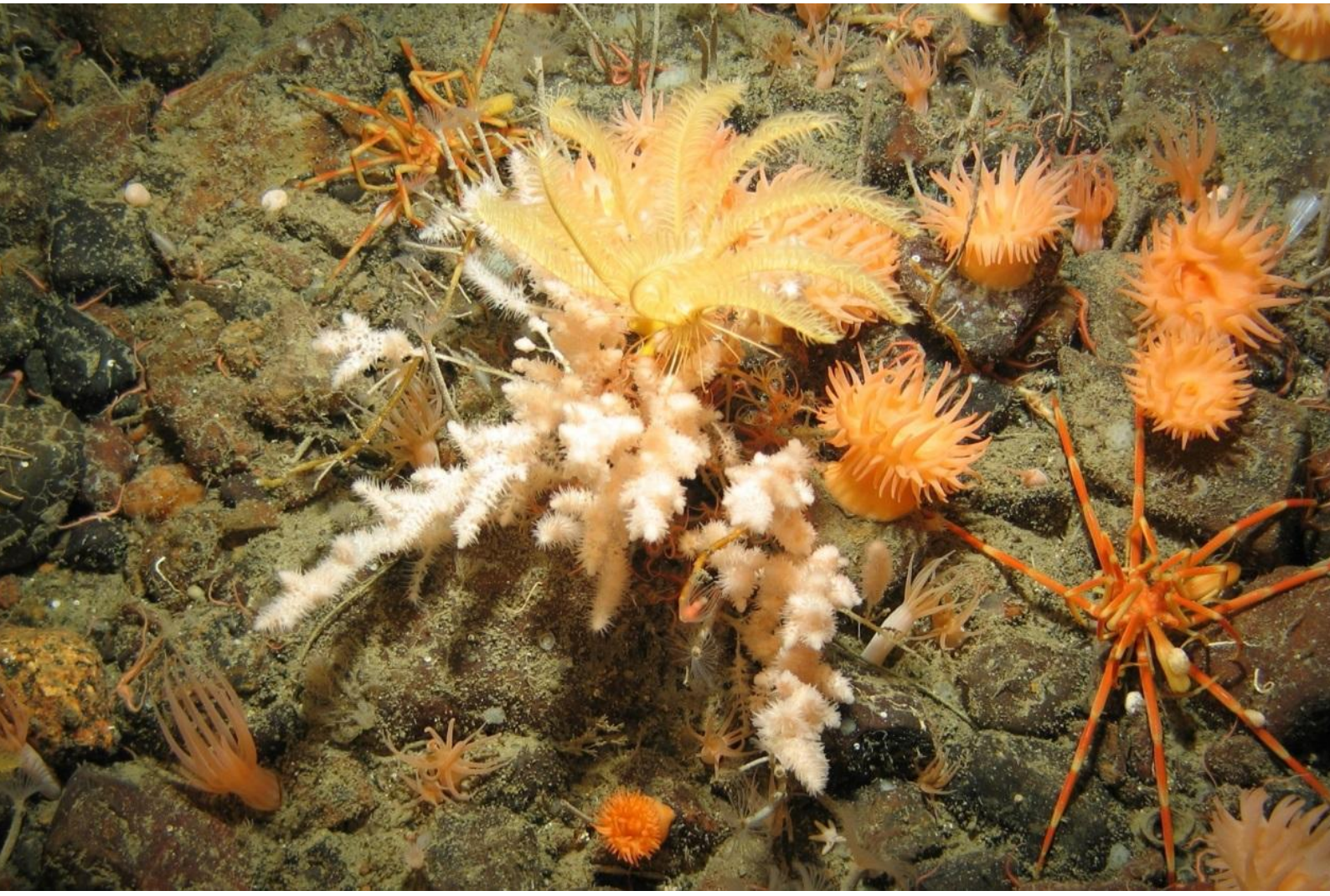
Department of Energy & Climate Change

UK Offshore Energy Strategic Environmental Assessment



OESEA3 Non-Technical summary

Future Leasing/Licensing for Offshore Renewable Energy, Offshore Oil & Gas, Hydrocarbon Gas and Carbon Dioxide Storage and Associated Infrastructure

March 2016

URN 16D/033

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Non-Technical Summary

Introduction

This Environmental Report has been prepared as part of the United Kingdom Department of Energy and Climate Change (DECC) Offshore Energy Strategic Environmental Assessment (OESEA) programme and is hereafter referred to as OESEA3. The SEA process aims to help inform licensing and leasing decisions by considering the environmental implications of the proposed plan/programme and the potential activities which could result from their implementation.

Previous SEAs undertaken as part of this programme included the OESEA in January 2009 and OESEA2 in February 2011, which built on a series of previous regional scale SEAs undertaken by DECC and its forerunner departments since 1999. OESEA considered the environmental implications of a draft plan/programme to enable: further seaward rounds of oil and gas licensing, including gas storage in UK waters; and further rounds of offshore wind farm leasing in the UK Renewable Energy Zone (now Exclusive Economic Zone)[1] and the territorial waters of England and Wales to a depth of 60m. The OESEA2 Environmental Report considered the implications of a draft plan/programme for further licensing/leasing for offshore energy including oil and gas, gas storage including carbon capture and storage (CCS) and marine renewables (wind, wave and tidal technologies).

The indicative time horizon (i.e. period of currency) for OESEA2 was 5 years from publication. During this period, as with previous SEAs, DECC has maintained an active SEA research programme; identifying information gaps (some of which were outlined in the recommendations of previous SEA Environmental Reports), commissioning new research where appropriate, and promoting its wider dissemination through a series of research seminars. This has also involved continued engagement with the SEA Steering Group (includes membership from industry, Government, statutory advisors and environmental organisations including NGOs) and review of the information base for the SEA. OESEA3 is intended to:

- Consider the environmental implications of DECC's draft plan/programme to enable further licensing/leasing for offshore energy (oil and gas, hydrocarbon gas storage, carbon dioxide storage and marine renewables including wind, wave, tidal stream and tidal range). This includes consideration of the implications of alternatives to the plan/programme and consideration of potential interactions with other users of the sea
- Inform the UK Government's decisions on the draft plan/programme
- Provide routes for public and stakeholder participation in the process

This non-technical summary provides a synopsis of the OESEA3 Environmental Report, including its conclusions and recommendations.

[1] this part of the plan/programme did not include the territorial waters of Scotland and Northern Ireland.

What is the draft plan/programme?

The draft plan/programme subject to this SEA needs to be considered in the context of overall UK energy supply policy and greenhouse gas emission reduction efforts.

Enhanced levels of atmospheric greenhouse gases (principally carbon dioxide, CO_2) derived from manmade sources (e.g. from combustion of fossil fuels in heating and energy production) have been linked to global climate change, with associated wide ranging environmental changes having been projected, including: increased atmospheric temperatures, rising sea-levels, potentially more frequent extreme weather events and ocean acidification, with associated socio-economic and environmental effects. The evidence relating to global climate change has been summarised in the latest Intergovernmental Panel on Climate Change (IPCC) assessment report. The UK Government is committed to the reduction of greenhouse gas emissions by 80% on 1990 levels by 2050, with interim targets of 34% by 2020, 50% by 2025, and 57% by 2032[2] implemented in the *Climate Change Act 2008*. Most recently, the UK was involved in the Paris Agreement, which was adopted by parties to the United Nations Framework Convention on Climate Change in December 2015 and is due to come into force in 2016/2017. The agreement aims to hold the increase in global average temperatures well below 2˚C above pre-industrial levels, and to pursue efforts to limit this to 1.5˚C. Within this context, energy production is a major source of greenhouse gases, and the UK intends to decarbonise the energy sector in the coming years to contribute to meeting legally binding UK targets and internationally agreed goals towards reducing the potential effects of climate change.

During the process of decarbonisation, which by 2050 is likely to comprise an increasing proportion of energy from renewable sources (for which the UK also has a legally binding target to generate 15% of its energy from renewable sources by 2020), plus abated (i.e. incorporating Carbon Capture and Storage, CCS) coal, biomass or gas-fired power stations and nuclear energy. Gas and oil will also continue to play a valuable role variously for heating, transport and electricity generation. In addition to decarbonising the energy supply sector, wider measures include reducing demand through greater energy efficiency in homes, businesses and in transport. The UK Government is presently reviewing its energy policy and the contribution to decarbonisation that this will make, with gas-fired power stations, new nuclear and offshore wind being indicated as the preferred means to achieve this, with continued use of coal-fired power stations only being realised through emissions abatement via CCS.

As indicated above, reliance on fossil fuel sources will continue during decarbonisation. The UK is now a net importer of both oil and gas, and a linked factor in the UK's security of energy supply is the need for more gas storage capacity. Ensuring security of energy supply is a key to UK energy policy. The UK remains the largest producer of oil and gas in the EU, and successive oil and gas licensing rounds have attracted significant interest. Reductions in the recent production and exploration of the UKCS sector led to the Wood Review in 2013, which set out a number of recommendations that were accepted by the UK Government, including maximising economic recovery, and the creation of the Oil & Gas Authority (OGA), an executive agency of DECC which was formally established in April 2015. DECC has produced a draft strategy with the principal objective of maximising the economic recovery of UK Petroleum (Maximising Economic Recovery of UK Petroleum strategy, MER UK), which sets out a central objective that relevant persons must take all steps necessary to secure that the maximum value of economically recoverable petroleum is achieved.

[2] This target for the fifth carbon budget, covering the period 2028-2032 has been recommended by the Committee on Climate Change, but is yet to be formally legislated upon.

The draft plan/programme to be covered by this SEA will help to contribute to the Government targets outlined above by enabling future rounds of renewable leasing for offshore wind, wave and tidal devices, and licensing/leasing for seaward oil and gas rounds and gas storage (including carbon dioxide storage). The main objectives of the draft plan/programme are to enhance the UK economy, contribute to the achievement of carbon emission reductions and security of energy supply, but without compromising biodiversity and ecosystem function, the interests of nature and heritage conservation, human health, or material assets and other users.

The DECC draft plan/programme under consideration is broad ranging and covers the majority of energy related activities in the UK marine environment. The elements of the draft plan/programme are:

Renewable Energy:

1. Wave – future leasing in the relevant parts of the UK Exclusive Economic Zone and the territorial waters of England and Wales. The Scottish Renewable Energy Zone and Scottish and Northern Irish waters within the 12 nautical mile territorial sea limit are not included. In view of the relatively early stage of technological development, a target generation capacity is not set in the draft plan/programme.

2. Tidal stream – future leasing in the relevant parts of the UK Exclusive Economic Zone and the territorial and internal waters of England and Wales. The Scottish Renewable Energy Zone and Scottish and Northern Irish waters within the 12 nautical mile territorial sea limit are not included. In view of the relatively early stage of technological development, a target generation capacity is not set in the draft plan/programme. Similarly, a minimum average tidal current velocity threshold is not proposed.

3. Tidal range – future leasing in the internal and territorial waters of England and Wales. It is considered unlikely that there will be tidal range developments outside of territorial waters.

4. Offshore wind – to enable further offshore wind farm leasing in the relevant parts of the UK Exclusive Economic Zone and the territorial waters of England and Wales. The technologies covered will include turbines of up to 15MW capacity and tethered (i.e. floating) turbines in waters up to 200m. The Scottish Renewable Energy Zone and the territorial waters of Scotland and Northern Ireland are not included in this part of the plan/programme.

Oil & Gas:

5. Exploration and production – further Seaward Rounds of oil and gas licensing of the UK territorial sea and UK Continental Shelf (UKCS).

6. Hydrocarbon gas importation and storage – further licensing/leasing for unloading and underground storage of hydrocarbon gas in UK waters (territorial waters and the relevant parts of the UK Exclusive Economic Zone), including hydrocarbon gas storage in other geological formations/structures such as constructed salt caverns, and the offshore unloading of hydrocarbon gas.

Carbon Dioxide:

7. Carbon dioxide (CO_2) transportation and storage – further licensing/leasing for underground storage of carbon dioxide gas in UK waters (the UK Exclusive Economic Zone and relevant territorial waters, excluding the territorial waters of Scotland). OESEA3

would include CO_2 storage in geological formations/structures including depleted reservoirs (and for enhanced oil recovery), aquifers and constructed salt caverns.

OESEA3 is expected to have a 5 year period of currency. Several of the technologies covered in the draft plan/programme remain to be deployed at a commercial scale, and are likely to undergo rapid development and change during the currency of the SEA, in order to assist in achieving medium to long-term targets in relation to UK greenhouse gas emissions. The currency of OESEA3 will be periodically reviewed by DECC (as the competent authority) in the context of new information on technologies, effects, or plan/programme status.

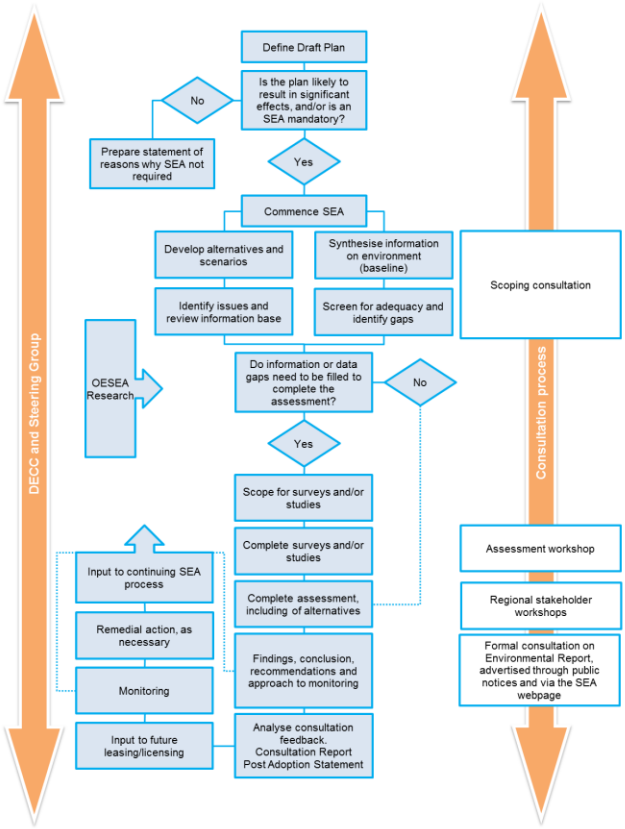
What are the alternatives to the draft plan/programme?

The following alternatives to the draft plan/programme for future offshore wind, wave and tidal leasing, oil and gas licensing and carbon dioxide and gas storage have been assessed in the SEA:

1. Not to offer any areas for leasing/licensing
2. To proceed with a leasing and licensing programme
3. To restrict the areas offered for leasing and licensing, temporally or spatially

The DECC SEA process

The SEA process aims to help inform licensing and leasing decisions by considering the environmental implications of the proposed plan/programme and the potential exploration, development and energy production activities which could result from its implementation.



The DECC offshore energy SEA process has developed over time, drawing in concepts and approaches from a variety of individuals, organisations and other SEAs as well as addressing the requirements of legislation and guidance. The process followed for this SEA and temporal sequence of events is summarised to the left, but note that certain activities such as information gathering continue throughout the process.

Initial scoping for OESEA3 with the SEA Steering Group, environmental authorities and a range of academic and conservation organisations commenced early in 2015. A formal scoping exercise with the statutory Consultation Bodies/Authorities and other stakeholders was conducted from July 2015; a report of the scoping feedback is available on the SEA webpages of the gov.uk website.

Since 1999, the Department has conducted nine SEAs of the implications of further licensing of the UK Continental Shelf (UKCS) for oil and gas exploration and production (SEAs 1-7, OESEA (incorporating SEA 8) and OESEA2), an SEA for a second round (R2) of wind leasing – see the tabulation below and Map 1 overleaf:

SEA	Area	Sectors covered	Year	Licensing/leasing round
SEA 1	The deep water area along the UK and Faroese boundary	Oil & Gas	2001	19th Round
SEA 2	The central spine of the North Sea which contains the majority of existing UK oil and gas fields	Oil & Gas	2002	20th Round
SEA 2 extension	Outer Moray Firth	Oil & Gas	2002	20th Round
SEA 3	The remaining parts of the southern North Sea	Oil & Gas	2003	21st Round
R2	Three strategic regions off the coasts of England and Wales in relation to a second round of offshore wind leasing	Offshore wind	2003	Round 2
SEA 4	The offshore areas to the north and west of Shetland and Orkney	Oil & Gas	2004	22nd Round
SEA 5	Parts of the northern and central North Sea to the east of the Scottish mainland, Orkney and Shetland	Oil & Gas	2005	23rd Round
SEA 6	Parts of the Irish Sea	Oil & Gas	2006	24th Round
SEA 7	The offshore areas to the west of Scotland	Oil & Gas	2008	25th Round
OESEA	UK offshore waters and territorial waters of England and Wales	Oil & Gas, Offshore wind	2009	26th Round/ Round 3
OESEA2	UK offshore waters and territorial waters of England and Wales	Oil & Gas, Offshore wind, wave and tidal stream, gas and carbon dioxide storage	2011	27th Round 28th Round

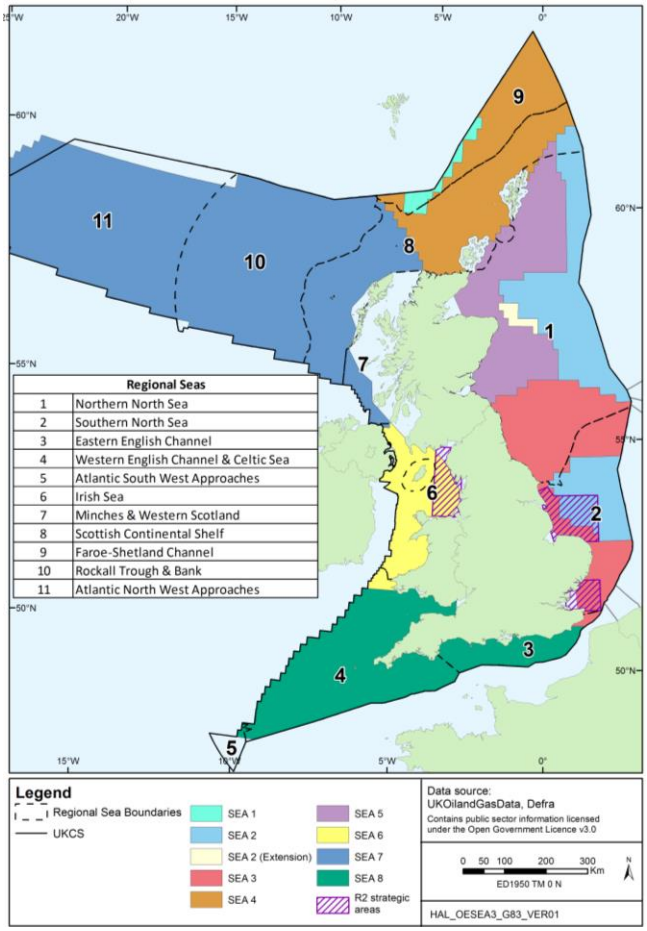
In addition, DECC SEA work was undertaken in 2010 for the potential exploitation of Severn Tidal Power (Severn Tidal Power Feasibility Study).

An Assessment Workshop involving the SEA Steering Group and SEA team was held in December 2015. The output of this workshop included the final list of SEA objectives and indicators (see Section 3 of the Environmental Report), the draft plan/programme alternatives and a list of topics to be considered in more detail in the Environmental Report.

Three regional stakeholder meetings were held in London, Bristol and Aberdeen in February 2016 at which stakeholders from a wide variety of organisations, sectors and areas participated. The stakeholder input on the information base and other issues of relevance to the SEA is summarised in Appendix 4 of the Environmental Report.

The Environmental Report and draft plan/programme are being issued for an 8 week public consultation period. The Department and the Secretary of State will consider comments received from consultation in the decision making regarding the plan/programme. A Post Consultation Report will be prepared and placed on the SEA pages of the gov.uk website collating the comments and DECC responses to them.

Map 1: Past SEA areas (coloured) and Regional Seas (numbered)



Environmental Report

The Environmental Report of OESEA3 provides relevant information for formal consultation with the statutory Consultation Bodies/Authorities and with the public regarding the implications of the draft plan/programme and its alternatives. In accordance with the SEA Regulations, the following potentially affected receptors were included within the scope of the assessment.

- Biodiversity, habitats, flora and fauna
- Geology, substrates and coastal geomorphology
- Landscape/seascape
- Water environment
- Air quality
- Climate and meteorology
- Population and human health
- Other users, material assets (infrastructure, other natural resources)
- Cultural heritage, including architectural and archaeological heritage
- Conservation of sites and species
- Interrelationships of the above

Information on the environmental baseline and its likely future evolution has been grouped into these subject areas, with the assessment sections being organised by identified sources of potentially significant effect.

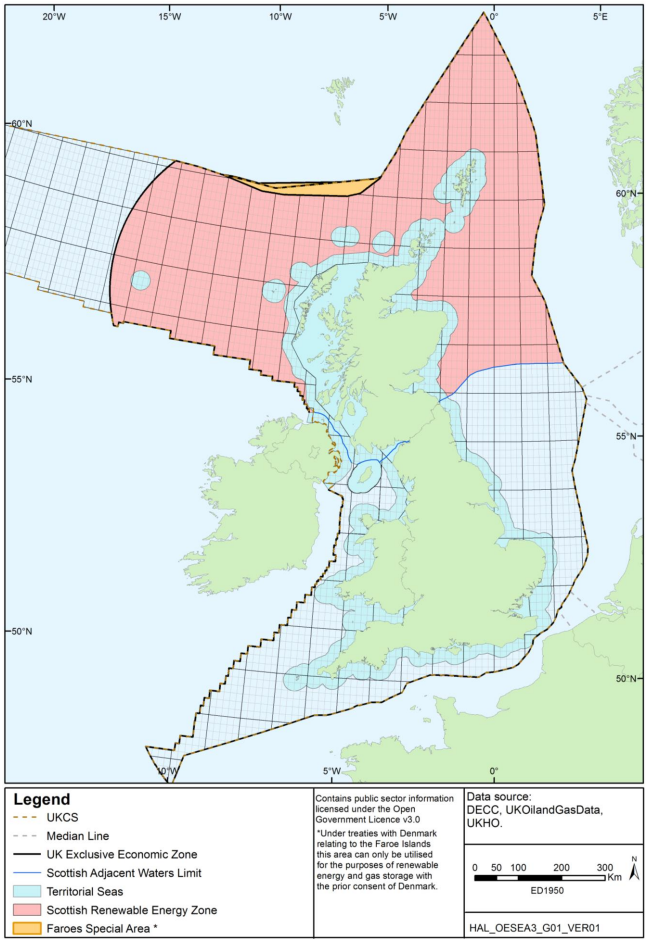
The key points and conclusions of the assessment are summarised in the sections which follow.

What areas are included in the SEA?

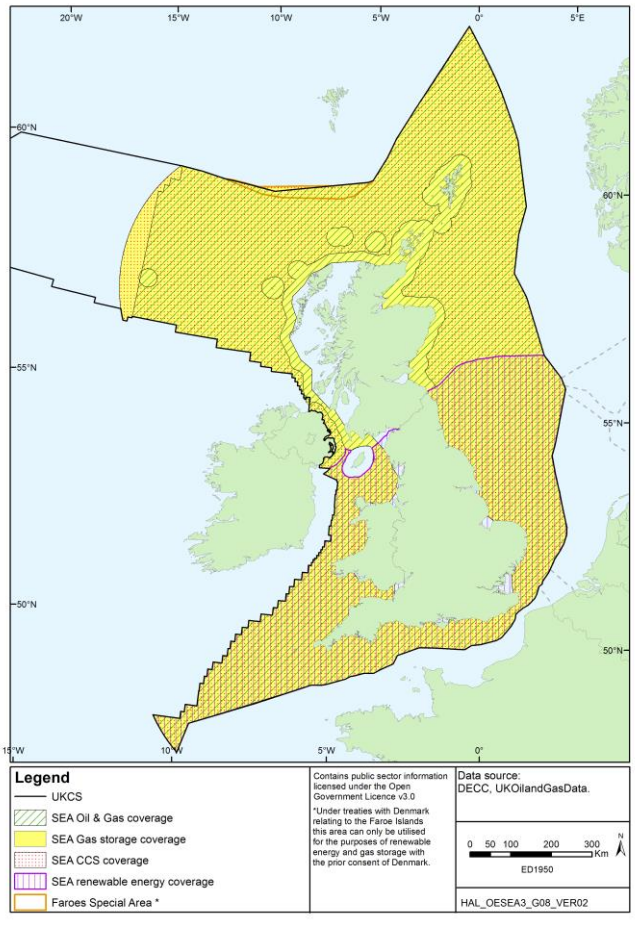
For offshore renewable energy this SEA considers potential leasing in the relevant areas of the UK Exclusive Economic Zone (EEZ), and also the territorial waters of England and Wales. The area covered by the Scottish Renewable Energy Zone and Northern Irish waters within the 12 nautical mile territorial sea limit are not covered by renewable energy aspects of the plan – see Maps 2 and 3. For gas storage and carbon dioxide storage, the SEA considers potential licensing/leasing in relevant UK territorial waters (note CCS in Scottish territorial waters is a devolved matter and so not covered in the OESEA3 draft plan/programme) and the UK EEZ. For offshore (seaward) oil and gas licensing, this SEA covers all UK waters.

Geographical coverage of the SEA

Map 2: Areas mentioned in the text



Map 3: Coverage for oil and gas, gas storage, CCS and marine renewables



Overview of the environment

The UK has a rich marine biodiversity reflecting both the range of habitats present in water depths from the shore to >2,400m, and its position where several biogeographical provinces overlap. Some species and habitats are naturally rare, whilst others are endangered by human

activities, and actions to protect and promote biodiversity are being taken at many levels including national, European and global.

Following discussion with the SEA Steering Group it was agreed to use the draft Regional Seas divisions used in Defra's Charting Progress 2 as a basis for considering UK waters for this SEA, albeit modified to differentiate certain areas to maintain consistency with previous OESEAs – see numbered areas on Map 1. The use of these boundaries more closely aligns with other regional divisions of UK waters, including marine plan areas and the Marine Strategy Framework Directive sub-regions. In view of the time elapsed since the publication of OESEA2 (February 2011), a new environmental baseline has been prepared for OESEA3, incorporating information from numerous new sources and updates to baseline data. A comprehensive environmental baseline is provided in Appendix 1 and selected highlights are given below.

The bird fauna of the UK is western Palaearctic; the great majority of species are found widely over western Europe and extend to western Asia and northern Africa. There are three regular patterns of species occurrence: resident, summer visitors (to breed) and winter visitors. Some of the summer visitors undertake long migrations to overwinter in southern Africa or South America. A few species are found only or predominantly in the UK. By way of example, the three Pembrokeshire islands of Skomer, Skokholm and Middleholm are estimated to hold nearly 50%, and the Isle of Rum off western Scotland between a quarter and a third, of the world's breeding population of Manx shearwaters. The largest gannet colony in the world is on Bass Rock in the Firth of Forth.

Many of the species of whales and dolphins found in UK waters have a worldwide distribution, although a number have restricted ranges, typically temperate to sub-Arctic or Arctic waters of the north Atlantic. British whales and dolphins include resident species as well as migrants (regularly moving through the area to and from feeding and breeding grounds) and vagrants (accidental visitors from the tropics or polar seas). Two species of seal breed in the UK; the grey seal has a north Atlantic distribution with the UK holding almost 40% of the world population; and the harbour seal is found along temperate, sub-Arctic and Arctic coasts of the northern hemisphere, with the UK population representing over 5% of the global total.

A wide range of biogeographic distribution patterns are shown by the fish in UK waters. The majority of continental shelf species have a north-east Atlantic/northern Atlantic distribution, although a proportion are found globally in the tropics/subtropics and others have a circumpolar pattern of occurrence. Spawning and nursery grounds have been identified for many species and widely distributed species often include local stocks with distinct breeding times and locations (e.g. herring). Deep water fish show different distribution patterns with major differences occurring north and south of the Wyville Thomson Ridge (approximately at 60°N), and a distinct species group found in the cold waters of the Faroe-Shetland Channel and Norwegian Sea. Commercially fished species are heavily exploited.

In broad biogeographical terms, the planktonic flora and fauna of UK waters is part of the North-East Atlantic Shelves Province which extends from Brittany to mid-Norway. In addition, the deeper Faroe-Shetland Channel and areas to the north are within the Atlantic sub-Arctic Province. Each province can be subdivided according to hydrography and plankton composition.

The composition of the seabed fauna of the UK reflects the intersection of four biogeographical zones:

- Boreal Province including the North and Irish Seas
- Lusitanian-Boreal Province comprising the Celtic Sea and west coasts of Ireland and Scotland
- Arctic Deep-Sea Province, a deep water zone centred on the Norwegian Sea but extending into the Faroe-Shetland and Faroe Bank Channels
- Atlantic Deep-Sea Province, a deep water zone to the west of north-east Europe

Within each Province it is possible to distinguish a series of faunal communities inhabiting specific sediment types. Often these communities extend over wide areas (e.g. the fine sands of the central North Sea and the sandy muds of the Fladen Ground in the northern North Sea). In addition, there are a number of highly localised habitats and communities, including reefs of long lived horse mussels and cold water corals, some of which are the subject of biodiversity action either at an OSPAR, EU or UK level. A large proportion of the seabed of the UK continental shelf and upper slope is physically disturbed by fishing and other activities.

The present geology and substrates of the UKCS reflect a combination of processes taking place over millions of years, most recently influenced by glacial reworking and sedimentation in successive ice ages which is now interacting with Holocene wave and tidal processes. This reworking is very slow for much of the UKCS, but more rapid at shallower depths and in proximity to the shore where wave interaction and strong tidal currents may enhance the rate of change. The speed and nature of such change is also linked to underlying geology, with softer coasts generally eroding and changing much faster, particularly those comprising poorly consolidated rock or sediments. The deep geological history of the UKCS has led to the maturation of hydrocarbons where conditions are favourable (suitable reservoirs at depth and structural traps), and other sedimentary formations such as saline aquifers provide potential opportunities for hydrocarbon gas or carbon dioxide storage.

The variability of the UK climate is largely due to its position on the edge of the Atlantic Ocean with its relatively warm waters, yet close to the continental influences of mainland Europe. Changes in topography and land use over relatively short distances, together with a long coastline and numerous islands, all add to the variety of weather. A network of coastal and marine stations and buoys around the UK monitor different meteorological parameters including air temperature, rainfall, wind speed and direction, and visibility, informing weather forecasting systems as well as the development of climate models projecting future changes to the UK climate.

Regular air quality monitoring is carried out by local authorities in coastal areas. The air quality of all local authority areas is generally within national standards set by the UK government's air quality strategy, though several Air Quality Management Areas have been declared to deal with problem areas. Most of these are in urban areas and result from traffic emissions of nitrogen dioxide or particular matter (e.g. PM_{10}). Industrialisation of the coast and inshore area adjacent to certain parts of the central North Sea has led to increased levels of pollutants in these areas which decrease further offshore, though oil and gas platforms provide numerous point sources of atmospheric emissions.

The coasts and seas of the UK are intensively used for numerous activities of local, regional and national importance including coastally located power generators and process industries, port operations, shipping, oil and gas production, fishing, aggregate extraction, military practice,

as a location for submarine cables and pipelines and for sailing, racing and other recreation. At a local scale, activities as diverse as saltmarsh, dune or machair grazing, seaweed harvesting or bait collection may be important. Population is also variable. General trends observed are lower population densities in coastal areas around much of the south-west of England, west and north Wales, the far north of England, and much of Scotland excluding the central belt. The highest population densities in coastal areas are around much of south-east England, part of north-east England, the Firths of Forth and Clyde, part of north-west England, south Wales and around the Severn Estuary. These areas are typically where conurbations are largest and most numerous.

The cultural heritage of the UK relevant to OESEA3 includes coastal sites which date to some of the earliest settlements in Britain (potentially to as early as 700-900,000 years ago), and submerged sites in shelf seas which were exposed during previous glacial periods. Later submerged heritage includes a significant shipwreck record and aircraft losses which predominantly relate to previous world wars. Designated sites are relatively few in number compared to those which are recorded, and those recorded are very few against the potential resource. With the exception of shipwreck, all designated sites to date are terrestrial.

Landscapes and seascapes, as defined by the European Landscape Convention, include natural, rural, urban and transition areas between rural and urban, land, inland water and marine areas, and includes areas that might be considered outstanding as well as everyday or degraded. The coasts and seas of the UK have a diverse character, which has or is being defined through the existing and ongoing identification of landscape and seascape character areas which account for the key characteristics of particular areas. Such characterisation and assessment may be undertaken at the regional and more local scale. The protection of areas regarded to be of particular importance in full or part for their landscape, has to date in the UK been through designation of, for example Areas of Outstanding Natural Beauty, National Scenic Areas and National Parks, however the wider recognition of landscape in the UK is now being brought about through national and regional planning policy, including marine planning.

Context to the draft plan/programme

The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) is an important mechanism through which Governments of the western coasts and catchments of Europe, together with the European Union, cooperate to protect the marine environment of the North-East Atlantic. The OSPAR Commission is in the process of establishing a network of Marine Protected Areas (MPAs), the designation of which will be informed by the OSPAR Initial List of Threatened and/or Declining Species and Habitats. It aimed to complete a joint network of well managed MPAs by 2010 that, together with European sites (the Natura 2000 network), is ecologically coherent. As part of the UK implementation of such areas, the *Marine and Coastal Access Act 2009* and the relevant marine Acts of devolved administrations provide powers to designate Marine Conservation Zones (MCZs) in England, Wales and Northern Ireland, and Marine Protected Areas (MPAs) in Scotland.

More broadly, OSPAR periodically publishes assessments in the form of Quality Status Reports (QSRs) of the North-East Atlantic and its sub-regions, with the most recent being published in 2010. QSR 2010 informed the 2010 OSPAR Ministerial Meeting in Bergen on the environmental status and future actions for the protection and conservation of the North-East Atlantic.

The EU Marine Strategy Framework Directive (MSFD) entered into force in July 2008. The *Marine Strategy Regulations 2010* transpose the Directive into UK law and require the development of the five elements of the marine strategy: (1) the assessment of marine waters;

(2) the determination of the characteristics of good environmental status for those waters (note these are qualitatively described in Annex I to the Directive); (3) the establishment of environmental targets and indicators; (4) the establishment of a monitoring programme; (5) the publication of a programme of measures.

The key objectives of the Directive are to achieve good environmental status (GES) of the EU's marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend. The Directive establishes European Marine Regions on the basis of geographical and environmental criteria. UK waters lie within the Greater North Sea and Celtic Sea sub-regions of the North-East Atlantic Ocean Region. Each Member State is required to develop strategies for their marine waters in cooperation with other Member States and non-EU countries within a Marine Region. The Marine Strategies must contain a detailed assessment of the state of the environment, a definition of good environmental status at regional level, and the establishment of clear environmental targets and monitoring programmes. To fulfil these requirements the UK has prepared documents (e.g. the Marine Strategy Parts 1, 2 and 3, and proposals for UK monitoring programmes and programmes of measures to maintain or achieve GES). The Directive requires that programmes of measures be established to achieve GES, and that these include spatial protection measures contributing to coherent and representative networks of marine protected areas, adequately covering the diversity of the constituent ecosystems. Similar to the contribution to the wider OSPAR MPA network, existing and proposed Natura 2000 and MCZ/MPA sites will be used to contribute to this measure.

The MSFD complements measures being undertaken as part of the UK implementation of the Water Framework Directive (WFD), particularly in coastal waters where geographical scope of the Directives overlap (out to 1nm in England and 3nm in Scotland), and also in transitional waters (e.g. estuaries). River Basin Management Plans (RBMPs) are one of the principal means that the WFD has been implemented in the UK, with a second phase of planning now in progress covering the period 2015-2021. Whilst the implementation of WFD and MSFD may be complementary in these areas in terms of their objectives (e.g. particularly in relation to water chemical quality and some aspects of ecological quality), for coastal waters MSFD will only cover those aspects of GES not already covered by the WFD.

The *Marine and Coastal Access Act 2009*, and Acts of devolved administrations, amongst other provisions was instrumental in formalising marine spatial planning in the UK, which at the EU level is subject to Directive 2014/89/EU which came into force in July 2014. At the highest level, the 2011 UK Marine Policy Statement (MPS) provides the overarching framework for decision making and plan making in UK waters in keeping with the high level marine objectives agreed by the Governments of England, Scotland, Wales and Northern Ireland. The first set of marine plans in English waters, the East Inshore and Offshore Marine Plans, were adopted in 2014, with plans presently being prepared for the South Inshore and Offshore Regions. Scotland's National Marine Plan was adopted in 2015, and a number of smaller Scottish marine regions will be subject to regional planning in the coming years. Other plans are presently in preparation (e.g. for Wales and Northern Ireland). Each of the regional and country marine plans should be drafted in keeping with the MPS but informed by regionally specific information, and enforcement and authorisation decisions should be taken in accordance with these regional marine policy documents, or the MPS in advance of their adoption. The MPS, adopted plans and related policies have been considered during the preparation of the SEA Environmental Report. Where policies have spatial aspects relevant to the plan, these have either be mapped or cross-referenced as appropriate.

Overarching National Policy Statements for Energy are also relevant to plan activities, and provide planning policy in relation to nationally significant energy infrastructure projects (NSIPs),

as defined in the *Planning Act 2008* – this includes almost all offshore renewable energy projects in England and Wales; however, although regulated, there is presently no planning policy for tidal lagoons.

Decision making in relation to licensing/leasing and also subsequent activities which could take place as a result of the adoption of the draft plan/programme is therefore split between a number of legislative and planning policy remits, including those of devolved administrations. A full list of other initiatives which have been analysed in terms of their implications for the draft plan/programme and vice versa is given in Appendix 2.

Prospectivity

The UK has extensive offshore energy resources, including of oil and gas and marine energy including wind, wave and tidal, all of which are variable over space and time. The UK also has a long maritime history and growing use of offshore areas from other users, and therefore not all areas of technical resource may be practically available at a given time.

Oil and gas (Map 4)

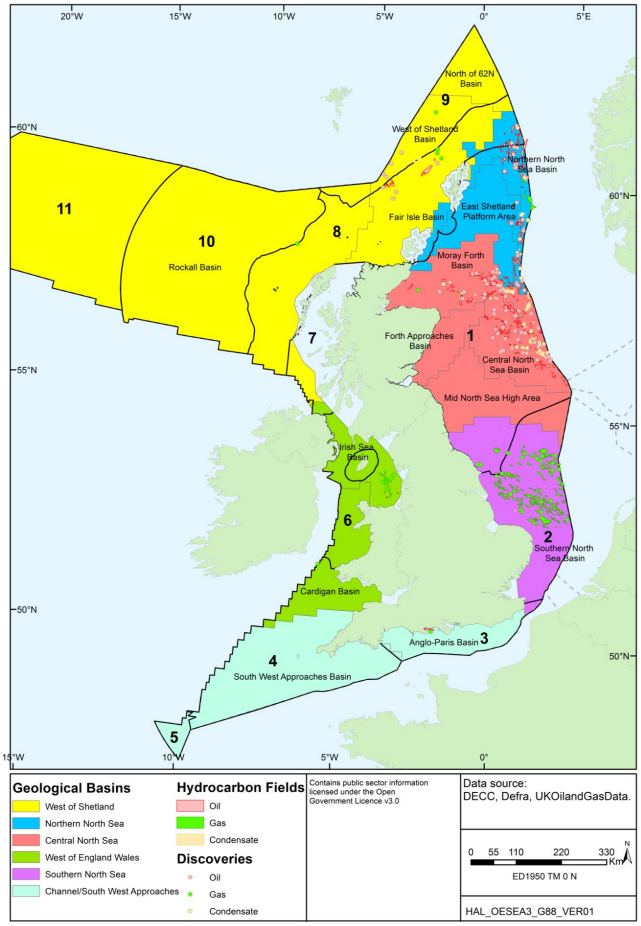
For commercial hydrocarbon resources to occur, a number of factors and features have to coincide, including:

- The presence of source rocks, with an appreciable organic matter content
- Adequate depth of burial to allow the conversion of the organic matter to oil or gas through the action of temperature and pressure
- The presence of rocks with sufficient porosity to allow the accumulation of oil or gas
- Cap or seal rocks to prevent the oil or gas from escaping from the reservoir rocks
- Migration pathways to permit oil and gas formed in the source rocks to move to reservoir formations

Such conditions typically occur in sedimentary basins and not areas of igneous rock unless these overlay sedimentary rocks, as in parts of the Faroe-Shetland Channel. Offshore areas of the UK have been offered for oil and gas licensing in a series of rounds since 1964, with the 28th Round held in 2014. Areas with hydrocarbon prospectivity have been extensively explored over this period and many fields brought into production, mainly in the North and Irish Seas, resulting in an extensive infrastructure which can be utilised by new developments. The southern North Sea and Irish Sea are largely gas provinces, with the central and northern North Sea, and West of Shetland areas being oil provinces. Whilst the major offshore hydrocarbon basins of the UK are at a mature stage of production, significant reserves remain in fields in production or development and further significant reserves are estimated to occur which are yet to be discovered.

The area of the Faroe-Shetland Channel, particularly north of 62˚N in UK waters, has been comparatively underexplored due to the presence of geology which poses barriers to seismic survey and drilling. However, new techniques are now available to improve the understanding of prospectivity in this area. Similarly, areas of the mid North Sea High and Rockall Basin are relatively underexplored and prospectivity is less well understood for these regions. The OGA undertook two regional seismic surveys in 2015 covering these areas, the results of which are expected to augment existing data and update current understanding of prospectivity to inform future licensing, in particular a 29th Frontier Round

Map 4: Major hydrocarbon basins, fields and discoveries on the UKCS



Gas storage

The inclusion in the current draft plan/programme of gas storage is part of the strategy to increase the UK's storage capacity and maintain resilience of gas supply in cold weather periods of high demand or interruptions to imported supplies. Hydrocarbon gas storage in depleted and other hydrocarbon reservoirs and other geological structures is part of the current draft plan/programme, and can be expected to take place in the same areas as existing oil and gas production, or in areas of extensive halite (rock salt) deposits. There are extensive halite deposits in the southern North Sea and eastern Irish Sea, and the most prospective area for halites with gas storage potential being in the East Irish Sea Basin.

Carbon dioxide storage

Carbon dioxide (CO_2) may be stored in a range of geological formations including depleted hydrocarbon reservoirs and saline aquifers. Hydrocarbon reservoirs have geological characteristics suited to trapping CO_2 over long timescales (e.g. a suitable porosity/permeability and impervious cap rock), and the injection of CO_2 into hydrocarbon reservoirs can also be used in enhanced oil recovery. In the longer term these reservoirs can be used exclusively for CCS. Due to the maturity of most of the UKCS hydrocarbon basins, the availability of sites for CO_2 storage is likely to increase in the coming years, and has the potential to exploit existing infrastructure. Saline aquifers can have similar characteristics to hydrocarbon reservoirs (i.e. suitably porous/permeable medium with geological constraints on migration) and may also be suited to CO_2 storage. The central North Sea, southern North Sea and East Irish Sea are presently most prospective due to the presence of suitable formations and proximity to areas of high CO_2 emissions (e.g. Thames Estuary, Humberside, Merseyside, the Firth of Forth, Teesside and Tyneside).

Offshore wind (Map 5)

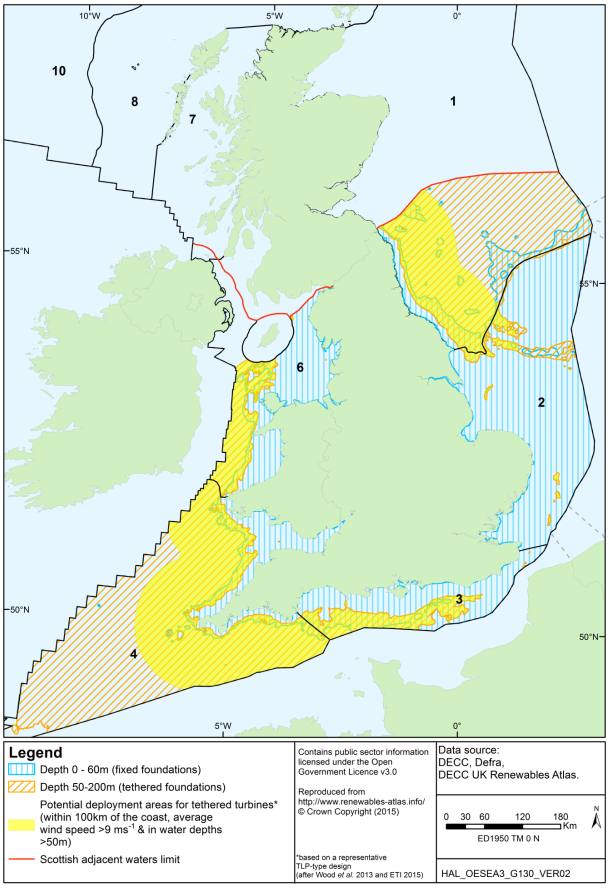
In UK waters, offshore wind is the most developed renewable energy technology. Rounds 1 and 2 of offshore wind leasing were held in 2000 and 2003 respectively, with Round 3, held in 2009, being significantly larger in terms of the areas offered for leasing. Exclusivity agreements were signed for nine of the Round 3 areas, seven of which have thus far had planning applications submitted to develop areas within each zone. UK offshore wind generation capacity can be subdivided in that presently in planning (3.25GW), consented (14.94GW) and operational (5.01GW). Though not a consideration of this SEA, included in the above figures

are areas within the territorial and offshore waters of Scotland have also been leased for offshore wind, which have 191MW of operational capacity and 4.3GW consented but not yet constructed. Away from the shelter of the coast, the total wind resource over a given year is relatively uniform across very large areas, although the occurrence and strength of wind is dependent on a number of meteorological factors. At any point in time, while some areas of the UK may be calm, the wind is likely to be blowing elsewhere.

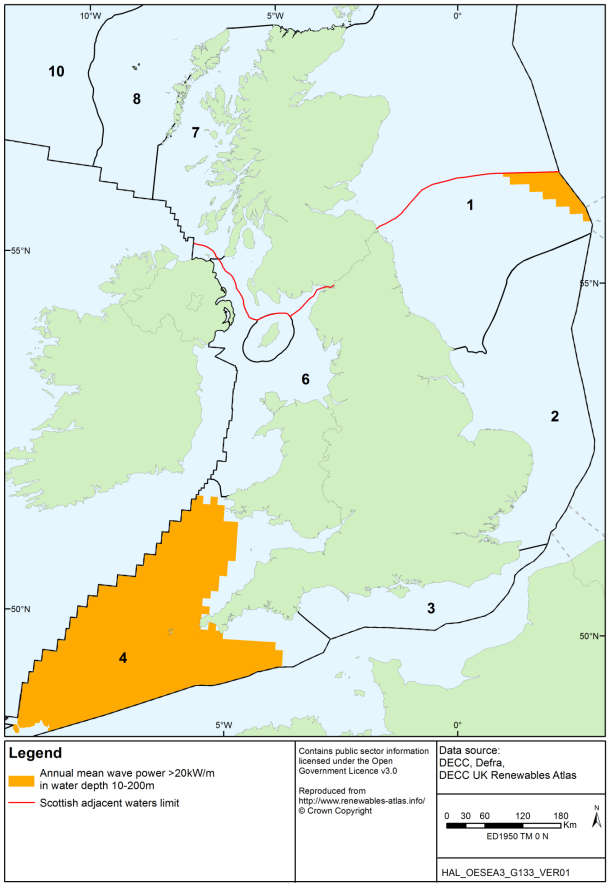
Water depth, distance from areas of high electricity demand, and the availability of connection points to the onshore transmission grid are significant factors in the preferred location of offshore wind developments. Installed or proposed wind turbine foundations have to date been dominated by fixed structures (e.g. monopiles, jackets or gravity bases), largely related to the cost of wind farm development. Such structures tend to be limited in the depth of waters they can be deployed effectively. For the purposes of OESEA3, it is considered that fixed foundations are likely to be deployed at depths of up to 60m. Floating structures similarly have a diverse range of designs (e.g. tension leg, semi-submersible, spar-buoy and a number of other concepts), with limited demonstrator deployment to date (e.g. the 2.3MW Hywind demonstrator off Norway), including proposals for demonstration in UK waters (e.g. five 6MW Hywind devices 30km off the coast of Peterhead, the Dounreay Floating Offshore Wind Development Centre (DFOWDC) being developed by Highlands and Islands Enterprise for up to five turbines of various designs, the Kincardine offshore wind farm comprising eight semi-submersible turbines located approximately 8 miles offshore from Aberdeen, and the PelaStar demonstrator to be installed at WaveHub off Cornwall). For the purposes of OESEA3, it is considered that floating foundations are likely to be deployed at depths from 50m to 200m.

Key resource areas considered in OESEA3

Map 5: Offshore wind



Map 6: Wave power



Wave (Map 6)

Exploitation of wave and tidal energy is not yet fully commercial in UK waters, although several test and demonstrator projects have been deployed or are in development. It is likely that over the coming years as devices reach commercial scale and their viability is demonstrated, larger scale deployment of wave and tidal energy generation devices will commence. Work to characterise the wave and tidal resources of UK waters has shown the key wave resource (for the purposes of OESEA3, >20kW/m wave crest) is broadly concentrated on the Atlantic facing coastline of the UK, notably the Western Isles of Scotland (not considered in this SEA) and the South West peninsula and south west Wales.

Tidal stream (Map 7)

Tidal stream resource is more geographically constrained – being localised around headlands and through straits between land masses. A number of areas in Scottish territorial waters have been leased for wave and tidal development (not considered in this SEA), with a further leasing for six new wave and tidal current demonstration zones taking place in 2014, as part of a programme to accelerate technology development. Demonstration sites include the European Marine Energy Centre (Orkney) and Wave Hub (Cornwall). Areas where commercial development may take place in the near future include the Pentland Firth and Orkney waters (Scotland), Rathlin Island and Torr Head (Northern Ireland) and Anglesey (Wales). For the purposes of OESEA3, the key resource areas are considered to be those with a current speed of >1.5m/s and a water depth of >5m.

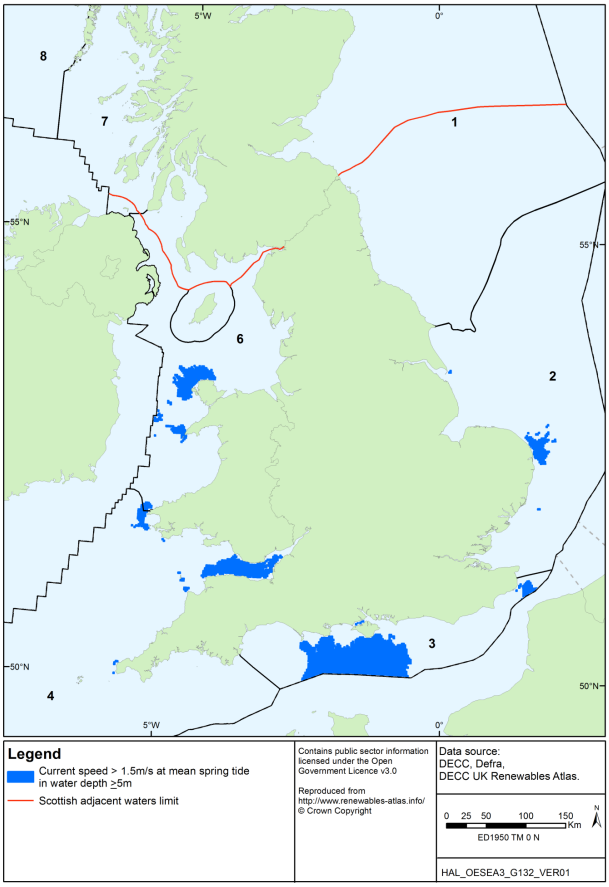
Tidal range (Map 8)

The potential future location of tidal range developments in relevant UK waters are guided by the available resource and are generally limited by other factors such as water depth (for the purposes of OESEA3, a mean tidal range of >5m and water depths ≤25m). The vast majority of the UK's tidal range resource is located in the territorial waters of England and Wales, but south-west Scotland has a large area with viable resources. As a result, any consideration of the Solway in OESEA3 has taken account of the potential for developments which could affect, or be part of, the two legislative and planning remits which meet within this estuary.

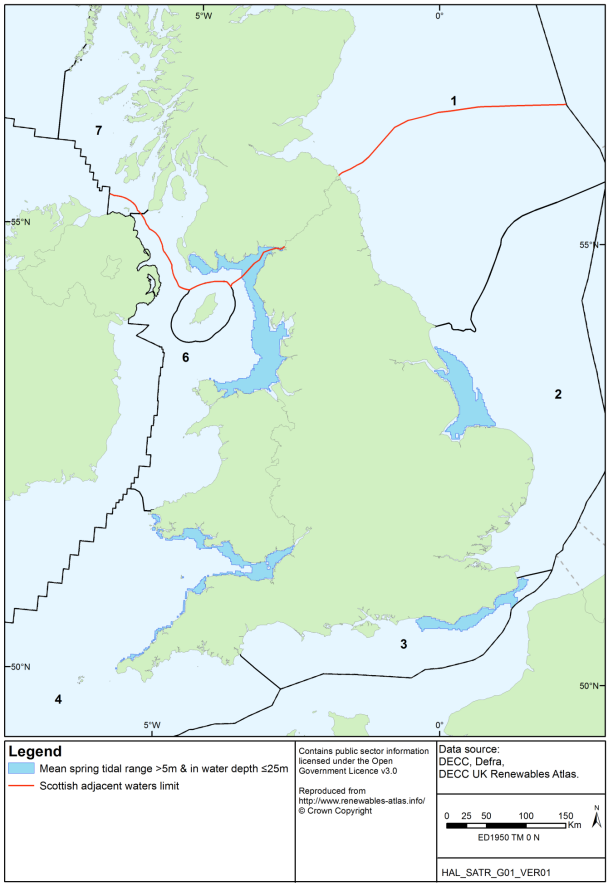
There has been much historical interest in tidal range development in the UK, particularly centred on the Severn Estuary, and a review of historical proposals revealed that they largely coincided with the prime energy resource identified above. Despite this interest, no commercial scale tidal range developments are operating in the UK. There are presently two tidal lagoon developments (Newport and Cardiff) which are in the pre-application stage of planning and one which has received consent (Swansea Bay) though this is yet to be granted a lease. The parent company behind these proposals, Tidal Lagoon Power Ltd, has plans for three other tidal lagoon developments in Bridgewater Bay, Colwyn Bay and West Cumbria.

Key resource areas considered in OESEA3

Map 7: Tidal stream



Map 8: Tidal range



Overview of main sources of effect and controls in place

The draft plan/programme includes the licensing/leasing of offshore oil and gas activities, the storage of gas and CO_2, offshore wind farms and marine renewables. An evidence-based consideration is presented in the SEA, which is summarised in the sections which follow. In addition, significant use has been made of Geographical Information System (GIS) tools to collate, process, analyse and present spatial information both in the assessment and environmental baseline presented in Appendix 1 of the SEA.

The assessment for this SEA is a staged process incorporating inputs from a variety of sources:

- Baseline understanding of the relevant receptors (including other users) grouped according to the SEA Directive, together with existing environmental problems and the likely evolution of the baseline conditions.
- The likely activities, and potential sources of effect and the existing mitigations, regulatory and other controls.
- The evolving regulatory framework.
- The evolution of technology.
- The SEA objectives.
- The evidence base regarding the relative risks and potential for significant effects from offshore wind farm, wave, tidal stream and tidal range developments, offshore oil and

gas exploration and production, carbon dioxide storage and gas storage related activities.

- Steering Group, statutory consultee and stakeholder perspectives on important issues, information sources and gaps, and potential areas to exclude from licensing derived from scoping, assessment workshop, regional stakeholder workshops, sector specific meetings, and other communications.

The main stages of those activities covered by the plan are a variation on: exploration, development, operation, maintenance and decommissioning, and may be broadly summarised for the main technologies covered by the draft plan/programme as follows:

For oil and gas activity, including gas and carbon dioxide storage:

- Exploration, including seismic survey and exploration drilling
- Development, including production facility installation, generally with construction of an export pipeline (or transport pipeline in the case of gas and CO2 storage), and the drilling of producer and injector wells
- Production/operation, with routine supply, return of wastes to shore, power generation, chemical use, produced water reinjection management and reservoir monitoring
- Maintenance
- Decommissioning, including cleaning and removal of facilities

For renewables including offshore wind, wave and tidal technologies:

- Site prospecting/selection including collection of site specific environmental data, and seabed information by geophysical and geotechnical survey
- Development, including construction of foundations, barrages or lagoon walls, and any scour protection, turbine or device installation, cable laying including shoreline crossings and armouring, installation of gathering stations/substations and connection to the onshore national electricity transmission system
- Generation operations
- Maintenance
- Decommissioning, including removal of facilities

These activities can interact with the natural and broader environment in a number of ways. The main potential sources of environmental effects from activities which could follow adoption of the draft plan/programme were informed through experience gathered from previous SEAs which included activity/effect matrices, which have sought to link human activities with effects on the marine environment. The list of potential effects and the plan activities to which they relate were subject to scoping and also discussions with the SEA Steering Group. These sources of effect include (in no particular order):

- Physical damage to biotopes from infrastructure construction, vessel/rig anchoring etc (direct effects on the physical environment)

- Sediment modification and contamination by particulate discharges from drilling etc or resuspension of contaminated sediment
- Offshore disposal of seabed dredged material
- Behavioural and physiological effects on marine mammals, birds and fish from noise (e.g. seismic or other geophysical surveys, construction, operation and decommissioning phase noise)
- The introduction and spread of non-native species
- Behavioural disturbance to fish, birds and marine mammals etc from physical presence of infrastructure and support activities
- Collision risks to birds, bats and water column megafauna (e.g. fish, marine mammals).
- Barriers to movement of birds, fish and marine mammals
- Changes/loss of habitats from major alteration of hydrography or sedimentation (indirect effects on the physical environment)
- Chemical contamination (routine) from produced or treated water, drilling and other discharges, antifouling coatings etc.
- Contamination by soluble and dispersed discharges saline discharges (aquifer water and halite dissolution in relation gas storage and CCS), and foundation construction
- Changes in seawater or estuarine salinity, turbidity and temperature from discharges and impoundment
- Electromagnetic Field (EMF) effects on electrosensitive species
- Accidental events – major oil or chemical spills, or major releases of carbon dioxide (water column, seabed and air quality related effects and socio-economic consequences)
- Physical effects of anchoring and infrastructure construction (including pipelines and cables) on seabed sediments and geomorphological features (including scour), and changes to sedimentation regime and associated physical effects
- Effects of reinjection of produced water and/or drill cuttings and carbon dioxide
- Onshore disposal of returned wastes – requirement for landfill
- Post-decommissioning (legacy) effects – cuttings piles, footings, foundations, in situ cabling etc.
- Potential effects of development on seascape including change to character (interactions between people (and their activities) and places (and the natural and cultural processes that shape them))
- Energy removal downstream of wet renewable devices
- Contributions to or reductions in net greenhouse gas emissions
- Positive socio-economic effects of reducing climate change

- Potential air quality effects including on human health resulting from atmospheric emissions associated with plan activities, or with discharges of naturally occurring radioactive material in produced water
- Interactions with fishing activities (exclusion, displacement, seismic, gear interactions, "sanctuary effects") and other users including shipping, military, potential other marine renewables and other human uses of the offshore environment
- Physical damage to submerged heritage/archaeological contexts from infrastructure construction, vessel/rig anchoring etc and impacts on the setting of coastal historic environmental assets and loss of access.

All the major stages of offshore oil and gas, offshore wind, wave and tidal installation and operation are covered by environmental regulations including the requirement for Environmental Impact Assessment at the development stage (see Appendix 3).

Assessment summary

Biodiversity, habitats, flora and fauna

In general, marine mammals show the highest sensitivity to underwater sound, particularly the intense pulses associated with seismic surveys, impact pile-driving and the use of explosives. The severity of potential effect has therefore been related principally to marine mammal species composition and abundance in an area, although effects on fish (including spawning aggregations) and other receptors have also been considered. The nature of effects range widely, from masking of biological communication and small behavioural reactions, to chronic disturbance, injury and mortality. For marine mammals and fish, effects will generally increase in severity with increasing exposure to noise; a distinction can be drawn between effects associated with physical injury and effects associated with behavioural disturbance.

Seismic surveys generate among the highest noise source levels of any non-military marine activity. The potential for significant effect in relation to oil & gas activities is therefore largely related to the anticipated type, extent and duration of seismic survey. In offshore wind farm (and other renewable energy array) construction, pile-driving of foundations can generate high noise source levels and is widely recognised as a potential concern, in particular for large developments where construction may last over several years.

There is now a reasonable body of evidence to quantify noise levels associated with both seismic survey and wind turbine foundation pile-driving, and to understand the likely propagation of such noise within the marine environment, even in more complex coastal locations. There is less clarity about the potential effects on marine mammals (and other receptors including fish), but progress is continuously being made, particularly through direct observations in the field. Further support for these studies is given in this SEA, especially to fill gaps in knowledge with respect to less well studied species and sound sources.

With respect to injury, risk from an activity can be assessed using threshold criteria based on sound levels; with respect to disturbance however, establishing broadly applicable criteria based on exposure alone has proved much more difficult, because the same sound level is likely to elicit different responses depending on the individual's behavioural context and past exposure. Consequently, recent expert assessments have used evidence from field studies within a comparable context to link measurable changes in behaviour (i.e. displacement, change in foraging rate) to sound exposure levels.

In light of the available evidence the SEA concurs with the scientific consensus judgement that underwater sound generated during seismic and pile-driving operations has the potential to cause injury within a limited range (tens to hundreds of metres in marine mammals) and to cause some level of disruption of normal behaviour in marine mammals and possibly some fish species at ranges of several kilometres. However, both planning and operational controls cover noise from relevant marine activities, including geophysical surveying and pile-driving. In addition, it is an offence to deliberately injure or disturb wild animals of a European Protected Species (EPS), particularly during the period of breeding, rearing, hibernation and migration or to cause the deterioration or destruction of their breeding sites or resting places. EPS are those species listed in Annex IV of the Habitats Directive, which includes all cetacean species. The SEA has considered the protections afforded to EPS under the Habitats Directive and the latest JNCC guidance on how to minimise the risk of injury and disturbance and has concluded that current mitigation measures are sufficient in reducing the risk of injury to negligible levels whenever carefully applied by industry for all regular species that are common on the continental shelf. More uncertainty on their effectiveness exists for deep-diving species; a particular concern identified in this SEA is for beaked whales (deep water Regional Seas 9, 10, 11 in Map 1) which are known to be highly sensitive to some underwater sounds such as military sonar.

The main challenge when assessing the likelihood of significant disturbance effects stems from the need to assess these in terms of long-term population consequences while the available evidence relates to individual responses under relatively short-term conditions. Several modelling frameworks are being developed to assess population level impacts of acoustic disturbance. All frameworks rely on assumptions and on expert judgement to cope with the gaps in the data, but so far there are considerable differences in methodologies and outcomes, all of which need to be viewed with caution. The approach used by an expert group convened under the Habitats and Wild Birds Directives Marine Evidence Group led to a report with the conclusion that planned offshore construction activity up to 2020 will result in a non-trivial level of acute disturbance, but *'this will not compromise the long-term health of the population'*. However, it also raises the possibility for population size to be negatively affected if activities were to expand significantly. The report recommends the preferential adoption of mitigation measures such as reducing noise emissions through modifications to offshore wind installation and careful planning to minimise the impact from temporal and spatial overlap between harbour porpoises and construction activity, recommendations which are accepted by this SEA through the review of this and other sources of information.

Given the spatial distribution of predicted activities resulting from both future oil & gas licensing rounds, and further rounds of offshore wind leasing, seismic activity will be likely the focus of noise risk assessments in areas to the north and west of the UK (Regional Seas 8, 9 and 10) while in Regional Seas 1, 2 and 6 (the northern, central and southern North Sea and Irish Sea) the cumulative effects of both seismic activity and piling will need to be considered. Both activities may extend throughout much of the year (although seismic surveys are normally undertaken in summer when the risk of rough seas is reduced), and be audible to marine mammals over a large proportion of their regional range.

Previous SEAs have recommended consideration of the establishment of criteria for determining limits of acceptable cumulative impact; and for subsequent regulation of cumulative impact. The SEA recognises the advances made in this respect through the establishment of the indicator on low- and mid- frequency impulsive sounds under the Marine Strategy Framework Directive. While criteria have not yet been defined, the establishment of a database to collate occurrences of 'noisy activities' (the Noise Registry) represents the necessary precursor. In addition, increased anthropogenic activities in the marine environment, including all of those under consideration in this SEA, will contribute to the continued increase in ambient

noise levels. Chronic exposure to increased levels of underwater sound has the potential to have long-term consequences for the health of marine species. At present the evidence is insufficient to be able to set targets under MSFD, but this may change in the future since an ambient noise indicator has been established.

Given the lack of definition of actual survey and development programmes which may follow adoption of the draft plan/programme (in terms of duration and extent of acoustic sources, and the potential for temporal or spatial mitigation), it is only possible to make generic recommendations concerning mitigation. However, it is noted that environmental assessments will be required on a project-specific basis for all areas under the existing regulatory regime, including requirements for consideration of deliberate disturbance of cetaceans. In addition, Habitats Regulations Assessments will be required for activities which may affect marine mammal populations within designated SACs.

Activities associated with offshore wind farm development; exploration and production of oil and gas; carbon dioxide and gas storage; wave, tidal stream and tidal range can lead to physical disturbance of seabed habitats, with consequent effects on seabed features and habitats. In particular, scour – a localised erosion and lowering of the seabed around a fixed structure – was recognised at an early stage as a potential issue in relation to wind turbine foundations, and has been subject to considerable research and monitoring. Monitoring of Round 1 and 2 sites indicates that scour effects are generally small in scale and local in extent and are only likely to be of concern in areas characterised by large mobile bedforms, palaeochannels or sandbanks, although mitigation measures are available. The potential impacts of tidal range schemes may be significant (the scale of impact dependent on design and operation mode), with the potential loss of large areas of inter-tidal habitats and salt marshes as a result of changes in water levels and sediment transport within an estuary or river basin. The significance of potential effects of alteration or loss of intertidal habitats on birds, at a species or population level, particularly waders e.g. oystercatcher, ringed plover, sanderling is still unknown and this SEA recognises the need for further research in this area.

The SEA has considered the spatial extent of predicted disturbance effects, and the sensitivity of seabed habitats (in particular habitats listed in Annex I of the Habitats Directive) and placed these in the context of natural disturbance events and current assessment of the major sources of direct, physical pressure from human activities on seabed environments. The SEA concludes that with the currently required assessment and mitigation, physical disturbance associated with activities resulting from the proposed draft plan/programme will be negligible in scale relative to natural disturbance and the effects of demersal fishing. The potential for significant effects, in terms of regional distribution of features and habitats, or population viability and conservation status of benthic species, is considered to be remote.

The physical presence of offshore infrastructure and support activities may potentially cause behavioural responses in fish, birds and marine mammals, through a range of different mechanisms. Previous SEAs have considered the majority of such interactions with offshore oil and gas infrastructure, including for e.g. light attraction and collision (whether positive or negative) to be insignificant, because the total number of surface facilities is relatively small (low hundreds) and the majority are far offshore, in relatively deep water. This assessment is considered to remain valid for the potential consequences of future rounds of oil and gas licensing (including for carbon dioxide and gas storage). However, the large number of individual structures in offshore wind farm developments, the presence of rotating turbines, and their potential location (e.g. in relation to coastal breeding locations for seabirds and wintering locations for waterbirds), indicate a higher potential for physical presence effects. In relation to birds, these include displacement, leading to effective habitat loss, associated with exclusion from ecologically important (e.g. feeding, breeding) areas, barrier effects and disturbance of

regular movements (e.g. foraging, migration), potentially increasing flight energy demands and collision risk.

There is currently little information available on the interaction of birds, marine mammals and fish with surface and submerged wave and tidal devices and the SEA recommends that for the deployment of single devices and small arrays, appropriately focussed surveys of animal activity and behaviour should be undertaken to inform commercial scale deployment risk assessments and consenting. Other potential effects considered include fouling growth (colonisation of a structure by plants and animals), the introduction of rock in sedimentary areas, effects on natural habitats (such as localised warming around seabed cables) which could facilitate colonisation by non-indigenous species, and electromagnetic fields (EMF) as a potential source of effect resulting from marine electricity transmission, particularly on electrosensitive species (e.g. fish and seals) behaviour.

Overall, the assessment of these effects concludes that based on available evidence, displacement, barrier effects and collisions are all, unlikely to be significant to bird populations at a strategic level, while recognising that collision hazard risk could become significant if there is substantial renewable development in the North Sea. However, there are some important uncertainties in relation to bird distribution, including identifying important areas within UK waters where birds aggregate (i.e. for foraging, loafing), species-specific reactions to development sites, variability in migration routes and timings, and the statistical power of monitoring methods. There is also the issue of baselines potentially changing, and how this effects/is dealt with in determining risk, i.e. where for example climate change and prey distribution patterns impacts on bird population sizes and distribution. Therefore, recognising that a large proportion of the bird sensitivities identified are concentrated in coastal waters, it is recommended that the bulk of new OWF generation capacity should be sited away from the coast, generally outside 12 nautical miles (some 22km).

Although there has recently been significant survey effort in coastal waters and studies to improve understanding of e.g. foraging areas and migration routes, the lack of modern data on seabird and waterbird distributions in offshore areas is noted. There are some information gaps relating to EMF effects, and although not considered significant at a strategic level, it is recommended that research results are monitored to inform site specific considerations.

Geology and sediments

All UK areas include a wide range of geomorphological features resulting from the underlying solid geology, past glaciations and recent processes, with sediments ranging from muds to boulders. Various wind farm, marine renewables, gas and carbon dioxide storage and oil industry activities could result in sediment disturbance or potentially, without mitigation, destruction of small scale features. The seabed mapping undertaken in advance of operations allows the identification and hence avoidance of valued features, although currently there is poor detailed survey coverage of UK waters as a whole. Direct impacts of device footprints and cable and pipeline laying on seabed sediments and features have the greatest potential effect. However, physical disturbance associated with activities resulting from proposed oil and gas licensing and OWF, wave and tidal stream leasing will be negligible in scale relative to natural disturbance and for example the effects of demersal fishing. The potential for significant effects, in terms of regional distribution of features and habitats, or population viability and conservation status of benthic species, is considered to be low. The potential impacts of tidal range schemes however may be significant, with the potential loss of large areas of intertidal habitats and salt marshes as a result of a change in water levels and sediment transport within an estuary or river basin. The level of impact will likely be dependent on the design, siting and mode of operation (e.g. two-way operation may reduce the scale of impact).

Contamination of sediments may occur from discharges of drilling wastes and spills, or in the case of the oil industry from production wastes such as produced water. The composition of planned discharges from wind farm, wave and tidal and oil industry operations is regulated, with increasingly stringent controls applied in recent years. Monitoring results indicate that sediment contamination is not a significant issue in wind farms or recent hydrocarbon developments. The geological information derived from seabed mapping, seismic survey, geotechnical surveys and the drilling of wells is regarded as a positive contribution to the understanding of the UKCS, now being augmented by post-construction monitoring and decommissioning studies.

Landscape/seascape

The maturity and likely scale of activity of the various technologies covered by the plan indicate that offshore wind, particularly if deployed in nearshore waters and any tidal range development has the potential to generate the greatest effect. Proposed offshore wind farms have increased significantly in scale, both in terms of spatial coverage and the size of turbines. In most instances in UK waters, there has been a concurrent movement of these developments to areas further from the coast, reducing the potential for seascape effects at the coast, but also introducing a new industrial component to offshore seascapes in areas where offshore energy has already contributed to changing the seascape character (e.g. presence of offshore installations, drilling rigs, related shipping and helicopter traffic etc.).

The tidal range resource, including areas which have historically been or are presently subject to interest from commercial developers, are coastal/nearshore. Tidal lagoons are expected to be the principal technology which could be deployed during the currency of this SEA, but the possibility of barrages being proposed cannot be discounted entirely. Project proposals made in the UK to date have been shore connected and it is not expected that offshore impoundments would be proposed. Tidal range developments have the potential to generate direct changes to the character of coastal landscapes and seascapes through the imposition of lagoon walls/barrages and turbine housings, related lighting etc. resulting in, for example, foreshortening of seascape views and the introduction of industrial components. Additionally, wider indirect changes to the character of coastal landscapes and seascapes may also be realised should developments result in other effects such as: reduced sediment loads leading to a change in water clarity, reductions in intertidal areas (and/or displacement if compensatory measures are considered) and related alteration of the fauna and flora, changes in tidal regime, and alterations to the pattern of vessel movements (e.g. if requiring traffic separation through locks).

The scope for cumulative impacts between different renewables aspects of the draft plan/programme is minimised by there being little overlap in the geographical range of energy resources. Due to the expected scale of wave and tidal stream developments arising from the draft plan/programme and for the currency of this SEA, significant visual effects are not expected, particularly for completely submerged devices. Any tidal range scheme would likely result in significant effects on landscape/seascape character.

In contrast, most new hydrocarbon developments are likely to be sub-sea facilities tied back to existing infrastructure which are well offshore and beyond sight of land. The promotion of exploration in previously underexplored areas could, in the medium term, result in the addition of new fixed infrastructure depending on commercially viable resources being discovered, however these are more likely to be further offshore and isolated compared with wider scale renewables deployments. These areas include the mid North Sea High and Rockall Basin (see Map 2). Gas storage and CO_2 storage facilities are likely to be at sufficient distance from shore in most circumstances that coastal impacts are unlikely, though prospectivity in, for instance the Irish Sea and nearshore southern North Sea, and the requirement for a larger number of fixed surface infrastructure for certain project types (e.g. where salt cavern construction is required)

has the potential to generate incremental effects with other aspects of the plan and existing uses of the sea.

In all cases, temporary interaction with the coast is likely through landfall works (e.g. where pipelines or cables are taken ashore) as part of ancillary development, with more permanent changes resulting from the construction of onshore substations, or above ground installations for pipelines, and also overhead power lines or other onshore routeing to enable the offshore aspects of projects.

Major development of any aspect of the plan could result in significant effects on landscape/seascape, with the potential for effects being highly site specific and requiring individual project specific consideration, for instance due to the varying number, size and layout of potential devices, alterations to which could provide a suitable level of mitigation. Whilst National policy indicates that consent for energy development, and in particular to renewable energy, should not be refused solely on the grounds of an adverse effect on seascape, including visibility of the development from within designated sites, unless adverse effects are considered to outweigh the benefits. For example, secondary impacts on tourism and recreation, or on internationally recognised areas such as World Heritage Sites.

The siting of offshore wind farms well away from the coast is consistent with what is occurring in other European countries, and the potential use of alternative foundation types would facilitate OWF siting in deeper waters offshore. Reflecting the previous conclusions and recommendations of OESEA and OESEA2, and the relative sensitivity of multiple receptors in coastal waters, OESEA3 recommends that the bulk of new OWF generation capacity should be sited away from the coast, generally outside 12 nautical miles. The sensitivity of coastal areas is not uniform, and in certain cases new offshore wind farm projects may be acceptable closer to the coast, or be acceptable subject to changes in their layout and design. Conversely, siting beyond 12nm may be justified for some areas/developments.

In this context, the conclusions are consistent with alternative 3 of the draft plan/programme, to restrict the areas offered for leasing and licensing temporally or spatially, however in view of National policy and as the potential location and type of future developments are subject to commercial interest (with potential for limited mitigation), prescriptive restriction is difficult to make at this stage, other than providing the recommendation that wind farms be sited away from the coast. Therefore, project level assessment, including cumulative assessment with operational, consented and proposed developments, will be required to inform the potential impact on landscape and seascape character, and the suitability of future developments.

Water environment

The consequences of energy removal on natural marine systems are reasonably well understood for large tidal barrage schemes but are far less predictable and appreciated for smaller tidal range schemes (e.g. lagoons), wave and tidal stream devices. Tidal barrages may have far reaching, large scale impacts that potentially cause permanent changes to the physical nature and associated ecology of the estuary/river basin where they are located, although the exact level of impact is dependent on operation mode, design and siting. For this reason and because individual estuary/embayments are so different, the SEA recommends that detailed site specific data gathering and assessment is required before decisions can be taken on the acceptability or otherwise of a development.

Individual and small arrays of tidal stream and wave devices are thought to have localised effects that are detectable but unlikely to be highly significant at distance from the devices. However recent modelling work has suggested potentially significant, far reaching impacts, from larger arrays of these devices depending on site location and size/layout of the array. Studies

have suggested that impacts could potentially be reduced at certain sites through careful siting, although uncertainty still arises as the natural complexity of the water movements of an area are often only broadly represented in the models. Current information is still based on modelling and some small demonstrator scale monitoring studies and much more work is needed to improve both aspects.

Contamination of water may occur from discharges of drilling wastes, production wastes such as produced water (i.e. water produced along with oil and gas during the production phase), dissolution of antifouling coatings and corrosion protection anodes, accidental spills, grouting, or disturbance of previously contaminated sediments. Drilling discharges from the renewable energy and hydrocarbon industries are comprehensively regulated, with the discharge of oil-based drilling fluids effectively banned, and strict controls implemented over chemical additives used in water-based fluids. In view of the offshore locations, water depths and current regimes prevalent in areas of likely wind farm development or prospective for hydrocarbons, gas and carbon dioxide storage, significant contamination or ecological effects of drilling discharges are not expected. It is not expected that significant discharges of produced water will be made from new hydrocarbon developments, since there is a strong presumption against marine discharge and regulatory preference for reinjection to a suitable subsurface formation. Other operational discharges are subject to regulatory controls, and are not considered to have significant environmental risk. Offshore renewables are generally not thought of as a significant source of marine discharges although there is evidence for substantial use of maintenance chemicals which enter the sea. In addition, the presence of numerous offshore renewables installations may increase the risk of vessel collision and associated spill risk. However, given the likely scale of potential development and appropriate planning and siting of developments, the increase in risk is not thought to be significant. UK regional and national monitoring programme results indicate that water column contamination and associated biological effects are not significant issues.

Air quality

Atmospheric emissions from the potential activities likely to follow implementation of the draft plan/programme could affect local air quality. Gaseous emissions contribute to regional acid gas loads and may result in local low level ozone and smog formation. The principal routine operational emissions during offshore wind, marine renewables and oil industry exploration, construction and production operations are of combustion products (CO_2, CO, NO_X, SO_2, CH_4, and volatile organic compounds (VOCs)) from power generation and engines on rigs, production facilities, installation and support vessels, and helicopters. Fugitive emissions such as those from cement tanks (used in well operations), diesel storage and cooling/refrigeration systems can result in emissions of dust/particulates, VOCs, hydrofluorocarbon refrigerants etc. depending on the source, however regulatory controls are now in place on the use of certain refrigerants. As a proportion of UK atmospheric emissions, those directly emitted from plan related activities form a small proportion, and the distance of most point sources from shore allows for significant dispersal and so effects on coastal and terrestrial air quality are not likely to be significant.

Emissions will also be associated with the construction of marine renewables and wind farm devices to be deployed and by the choice of construction materials. The potential expansion of ports to facilitate renewable energy development may have implications for local air quality in these areas, some of which may already have air quality management areas. Operational effects of offshore renewables are expected to be negligible, and effects at the strategic level are not considered to be significant.

The likely geographic spread and timing of projected activities which may follow leasing/licensing, and the limited scale of other such sources offshore indicate that significant

effects on local and regional air quality will not occur. The implications of atmospheric emissions from offshore renewable developments, and hydrocarbon exploration, production and storage activities would be assessed through the statutory EIA and consenting processes (e.g. under the *Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013*), which would serve to identify if mitigation beyond the application of Best Available Techniques was required.

Climatic factors

Atmospheric emissions from the potential activities following implementation of the draft plan/programme will contribute to local, regional and global concentrations of CO_2 and other greenhouse gases, although in the case of offshore renewables these will be offset by the production of renewable energy. CO_2 storage can also contribute to the decarbonisation of UK energy supply.

There are growing concerns about the effects of fossil fuel combustion in terms of climate change and related effects, which in the marine and coastal environment include sea-level change, ocean acidification and potentially enhanced extreme weather events, but have wider reaching effects on terrestrial environments of the UK, Europe and elsewhere. The contribution of atmospheric emissions from hydrocarbon related activities that may result from implementation of draft plan/programme alternative 2 or 3 would represent a small fraction of existing UK, European and global emissions.

In response to climate change concerns, the UK government and European Union continue to introduce a variety of policy initiatives intended to stabilise and reduce greenhouse gas emissions, in addition to being party to international initiatives such as the Paris Agreement. All of these recognise the long term nature of the venture and that there is no one solution, with a series of contributory steps being required. These steps include reduction in energy demand through increased energy efficiency, promotion of renewable fuels and electricity generation, fuel switching to lower carbon alternatives, carbon capture and storage etc. In the short term, UK energy demand not met from indigenous sources (whether fossil or renewable) will be supplied by imported fossil fuels – with little distinction in terms of resultant atmospheric emissions, but with a change in security of supply. Thus domestic hydrocarbon production would be neutral in terms of resultant emissions, with reductions attainable in the medium term through energy sector decarbonisation by the attainment of UK climate change legislative commitments.

Population and human health

No adverse effects on population or human health are expected, based on the nature of the activities that could follow leasing and licensing; the offshore locations; the low risk (based on historic frequency and severity) of major accidental events; the regulations in place to manage occupational health risks to the workforce and others, and the controls on chemical use and discharge and on other marine discharges. Potential difficulties in effecting search and rescue operations by helicopter in offshore wind farms are noted; these can be mitigated in part by the layout of turbines within a wind farm. The potential for tidal range projects to impact coastal flooding patterns will depend on their location, nature and extent and will form an important part of the consideration of any future projects.

The adoption of the draft plan/programme is likely to contribute to maintaining investment and activity in the UK offshore oil and gas industry, and to increase investment and activity in the offshore renewable energy industry and offshore gas storage, including carbon dioxide storage. This will bring positive benefits in terms of an increased proportion of low carbon energy in the UK energy mix, greater security of energy supply and increased employment and tax revenues

Other users, material assets (infrastructure, other natural resources)

Often, views of the sea may suggest an open space with few other uses. The reality is very different, with multiple uses particularly of coastal areas. Partly in response to the scale of the area needed for major expansion of offshore renewable energy generation (100s to 1,000s of square kilometres), formal marine spatial planning through the establishment of the Marine Management Organisation (MMO), the national Marine Policy Statement and now regional scale Marine Plans is a key reform included in the *Marine and Coastal Access Act 2009*. The range and importance of existing and some potential uses of the sea are described in Appendix 1h of the Environmental Report, with key aspects summarised below. In advance of formal regional scale marine spatial planning in many areas of UK seas, the approach taken in this SEA has been to obtain accurate and recent information on other current and likely uses of the sea in the foreseeable future, to facilitate identification of sensitive areas and measures to reduce the scope and scale of significant adverse effects.

The UK is heavily reliant on shipping for the import and export of goods, and will remain so for the foreseeable future. Approximately 95% of the goods entering or leaving the UK are transported by ship, and substantial numbers of vessels transit UK waters en route to other European and more distant ports. In recognition of the vessel traffic densities and topographic constraints on various routes, the International Maritime Organisation (IMO) has established a number of traffic separation schemes and other vessel routeing measures to reduce risks of ship collision and groundings. In addition, IMO regulations have required that from 2005, an Automatic Identification System (AIS) transponder be fitted aboard all ships of >300 gross tonnage engaged on international voyages, all cargo ships of >500 gross tonnage and all passenger ships irrespective of size. AIS allows precise tracking of individual vessels, however has a limited range, and also has limited coverage of smaller vessels (e.g. small commercial and fishing vessels and recreational users). Such vessels are starting to carry AIS equipment (AIS-B) and therefore understanding of their movements is improving. New national scale data made available by the MMO for 2012 and 2013 have been analysed to provide information on important areas for larger vessel navigation. In addition to collision and grounding risk considerations, most vessels typically take direct routes from place to place and new obstructions causing large route deviations would increase transit times and fuel usage. Monitoring data of existing OWF pre- and post-construction suggest that regular users of the area are currently able to take altered routes and in busy areas the introduction of a traffic separation scheme can aid routeing, and navigation assessments and consultation informed by guidance provided by the Maritime and Coastguard Agency in the siting of new offshore wind farms can contribute to the identification of major shipping routes and the avoidance of conflict. The MPS and now regional scale marine plans recognise the strategic importance of shipping to the UK but also the potential for this to be compatible with other offshore activities, and a number of policies and policy maps have been produced to provide an indication of major routes and requirements placed on new developments to ensure safe navigation and shipping is not adversely affected. Additionally, navigation lighting requirements (including recent recommendations for lighting to fulfil both maritime and aviation requirements) and mandatory charting of new developments further reduces risks to shipping and navigation.

As wave and tidal developments are currently at demonstrator scale, the spatial extent of arrays of these and the implications for navigation are difficult to ascertain, although regulations on lighting and navigational aids mean that they are unlikely to be any more of an issue than OWF developments. The displacement of shipping and subsequent impact on the cost of shipping and port revenues is potentially significant, and should be taken into account when siting arrays of offshore renewable devices. The SEA concluded that wind farm (and other large footprint development) siting should be outside areas important for navigation (these are mapped in the Environmental Report) and that this would not preclude the attainment of the draft plan/programme objectives.

Fishing in the UK has a long history and is of major economic and cultural importance. In 2014, there were approximately 12,000 working fishermen in the UK (of which 82% were full time), operating over 6,300 vessels, 5,000 of which were smaller inshore boats (<10m). These vessels landed 756,000 tonnes of fish and shellfish in 2014, with a total value of £861 million. On top of this, fish processing provides over 19,500 jobs in the UK. The livelihoods of individual fishermen depend on their ability to exploit traditional fishing grounds and to adapt to changing circumstances to maximise profit. Consequently, they are vulnerable to competition within the UK industry and with foreign vessels, and to being displaced from primary grounds. To better understand the fishing activities of UK vessels, information from the UK Sea Fisheries Statistics (logbook submissions) was used to derive maps of fishing effort density, gear type and season. These show that the greatest density of fishing effort takes place in coastal waters, for both static (such as pots, traps or gillnets) and mobile gears (such as trawls and dredges). In addition, larger fishing vessels (>24m) in the EU have carried a Vessel Monitoring System (VMS) since 2000. From 2003, this requirement was extended to vessels >18m, from 2005 to vessels >15m, and is soon to be extended to vessels >12m. To inform the SEA, VMS data for UK vessels from 2013 was obtained and analysed to provide information on, and derive maps showing, important fishing areas for larger vessels and offshore areas.

Military use of the coasts and seas of the UK is extensive, with all three Services (army, airforce, navy) having defined Practice and Exercise Areas, some of which are danger areas where live firing and testing may occur. Such areas are well documented and have been taken account of in the SEA. In addition, in terms of national security the potential for offshore wind farms to interfere with the reception and discrimination of military radars (air traffic control and those parts of an early warning system) is a key consideration for the siting of such developments. There are a number of other defence sensitive areas which are not necessarily mapped, but need to be taken account of at the planning stages of an individual project. Developments which jeopardise national security for example through interference with radar systems or cause unacceptable impact on training areas should not be consented unless the impacts can be appropriately mitigated or are deemed acceptable.

Offshore wind farms have the potential to affect civilian aerodromes and radar systems. The UK air traffic control service for aircraft flying in UK airspace has made available mapped data indicating the likelihood of interference from offshore wind turbines on its radar reception. Similarly, the Civil Aviation Authority (CAA) produces an Aerodrome Safeguarding Map and Local Planning Authorities are required to consult on relevant Planning Applications which fall within a 15km radius. Any proposals for a wind turbine within a 30km radius of an airport also require consultation with the Airport Company. In addition, the CAA has indicated the need to consult helicopter operators and offshore installation operators for developments within 9nm of a platform to maintain the safety of helicopter approaches, and in particular missed approach procedures and navigation in poor visibility where instrument (as opposed to visual) approaches are being made. With adequate risk assessment and consultation, the siting of wind farms within 9nm of installations can be agreed. Additionally, the CAA identify a number of helicopter main routes which relate to the oil service industry and are therefore concentrated in the northern, central and southern North Sea and Morecambe Bay. Though not having a statutory basis the CAA recommends a 4nm corridor be kept clear of obstructions along these preferred routes. Comparable to consultation zones around platforms, further consultation may permit development and alteration to routes where possible (e.g. as experienced in recent Round 3 wind farm sites in the southern North Sea).

Various areas of sea are used or licensed/leased for marine aggregate extraction, telecommunications and other cables, disposal of capital and other dredging wastes, offshore wind farms, surface and subsea oil and gas production and export infrastructure. These have been mapped and considered in this SEA. Potential future uses of the sea considered in

OESEA3 include gas (natural gas and carbon dioxide) storage in geological formations, aquifers or constructed salt caverns and marine renewables such as wave, tidal stream and tidal range. Where available, information on potentially suitable locations for these has been considered in the assessment, considering likely and potential spatial constraints on these types of development.

The implementation of the draft plan/programme will result in some associated development onshore including the installation of additional equipment at existing gas terminals for gas storage, and pipelines and associated infrastructure for the transport and storage of carbon dioxide. The considerable ancillary onshore development necessary for major expansion of offshore wind generation includes reinforcements to the national electricity transmission system (as considered by National Grid as the National Electricity Transmission System Operator for Great Britain) and enhancements to the capacity of the UK's port facilities. Some ancillary offshore grid reinforcements will also be required, however the nature of any potential offshore (e.g. North Sea) grid is not the subject of this SEA. The influence of wave and tidal development within the scope of OESEA3 on port and manufacturing facilities development will likely be comparable in nature, but considerably smaller in scale than that associated with offshore wind. These will have some environmental impacts, with habitat loss/modification, noise, landscape impacts and interactions with other users among the key issues to be considered at the project planning stage, guided by National policy for ports.

Cultural heritage

The collective inventory and knowledge of maritime sites in particular is quite poor and may be subject to recording biases. Archaeology associated with human and/or proto-human activities either on the current seafloor of the southern North Sea, in the coastal zone of the British Isles and further inland, has the potential to date back at least as far as 500,000 years BP. Finds of flint artefacts in Suffolk and Happisburgh, Norfolk, tentatively push early human occupation back to a maximum age of approximately between 700 and 950,000 years BP. The current understanding of marine prehistoric archaeology is largely based on findspots recovered by fisheries and aggregates operations, now being augmented by interpretations of the palaeolandscapes of the continental shelf between the UK and Europe which would have been exposed and inhabitable during previous glacial phases.

The record for wreck sites is biased towards those from the post-Medieval and later periods, presumably a function of greater traffic and increased reporting associated with the introduction of marine insurance and the Lloyds of London list of shipping casualties in 1741. The strategic military importance of the sea, the importance of the North Sea as a fishing area, the importance of maritime trade routes and the treacherous nature of many nearshore waters, has lead to a large number of ship and aircraft wrecks in UK waters (e.g. the UK Hydrographic Office wrecks database contains approximately 70,000 records, and the wider wreck resource of the UKCS has been estimated to hold between 100,000 and 500,000 locations). A number of coastal sites have been designated as World Heritage Sites in full or part due to their cultural past, for example, the Cornwall and West Devon Mining Landscape and the Heart of Neolithic Orkney.

Offshore marine activities have the potential to affect cultural heritage through physical disturbance of the seabed, which can result from all the technologies covered by the plan (e.g. seabed preparation for fixed structures and foundation installation, trenching of pipeline and cable routes, including in intertidal areas). Known wrecks and other obstructions are charted, but there is an accepted disparity between the number of known and likely remains on the seabed, many of which may be settlement contexts rather than wrecks. A comprehensive set of guidelines has been drafted in recent years to promote the consideration of marine heritage in offshore development assessment, including in survey design. National scale policies

contained in the Marine Policy Statement (MPS), and now regional marine plans, emphasise the importance of non-designated sites (which can be exemplified by the contribution of knowledge to the early settlement history of Britain from the findings of work undertaken in relation to the aggregates industry), and this is now being implemented at a project level, with Development Consent Order conditions generally requiring a written scheme of archaeological investigation in consultation with relevant bodies such as Historic England, and where relevant, subsequent post-consent monitoring and material archiving.

No further strategic level controls were identified during the SEA assessment, and it is through development and site specific surveys that cultural heritage features would be identified and mitigation measures and monitoring measures developed.

Interrelationships – Cumulative effects

The effects of activities which could result from adoption of the draft plan/programme have the potential to act incrementally with those from other offshore renewables and oil and gas (including gas storage) existing facilities or new activities, or to act cumulatively with those of other human activities (e.g. fishing and shipping). Secondary effects are indirect effects which do not occur as a direct result of the proposed activities, while synergistic effects are considered to be potential effects of hydrocarbon or renewable industry activities where the joint result of two or more effects is greater than the sum of individual effects.

Cumulative effects in the sense of overlapping "footprints" of detectable contamination or biological effect were considered to be either unlikely (accidental events), or very limited (for physical damage, emissions, discharges), since monitoring data indicates that the more stringent emissions, discharge and activity controls introduced over recent years have been effective and there is no evidence for significant cumulative effects from current activities.

The SEA recognises that there is uncertainty regarding potential cumulative effects of noise disturbance, and recommendations to address this are outlined above. Displacement, barrier effects and collision risk represent potentially significant sources of cumulative effects to birds (and potentially marine mammals) at a local or regional level but are considered unlikely to be significant to bird populations at a strategic level, while recognising potential cumulative (and in-combination) impact assessments and the determination of significant effects and appropriate mitigation will be required on a project-specific basis. The SEA recommends a precautionary approach to facility siting in areas known to be of key importance to bird and marine mammal populations unless evidence indicates otherwise, and also that information on the distribution, behaviour and interactions with offshore renewable devices is in many cases limited and that additional work is required to improve current models on marine mammal and bird response/collision risk.

There is also the potential for significant adverse effects on other users of the sea (including radar coverage) and on landscape/seascape from major development of offshore wind farms, other marine renewables, and gas storage (including CO_2 storage) related infrastructure at the coast and within visible distance from the coast. However, this can be mitigated to acceptable levels by appropriate site selection, in particular avoidance of areas of prime importance to other industries/users and preferential selection of sites away from the coast where offshore structures are less visually intrusive. Progress is being made on mitigating the effects on military and civilian radar from offshore wind farms, but no universal solution is yet available, and further work is required to refine solutions at the site and development specific level.

Atmospheric emissions resulting from fossil fuel use during offshore renewables facility manufacture, construction and maintenance are more than balanced by the overall net reductions in carbon dioxide emissions as a result of electricity generation from renewable

energy, and reflects the need to reduce the carbon intensity of energy production. Atmospheric emissions from oil industry activities that may result from implementation of draft plan/programme alternative 2 or 3, and the end use of any hydrocarbons produced, will contribute to overall global emissions of greenhouse gases, but could in part be abated through CCS. However, the scale of such emissions is relatively small, and they will be included in overall UK emissions inventories and also in the longer term initiatives to shift the balance of energy demand and supply and decarbonise the energy industry.

Besides a minor contribution to climate change and ocean acidification, no secondary or synergistic effects were identified that were considered to be potentially significant, although the effect of multiple noise sources is an area which requires better understanding.

Interrelationships – Wider policy objectives

The SEA Directive requires that, in considering the likely significance of effects, the degree to which the plan or programme influences other plans and programmes should be addressed, together with the promotion of sustainable development. The implementation of marine planning in the UK has set a national scale policy framework through the MPS, which in many instances formalised a number of accepted practices which together represented *de facto* marine planning in advance of the Marine and Coastal Access Act and related initiatives. Subsequent marine planning provides a regional to local scale emphasis which, in combination with the national energy policy statements, will help to inform developers and decision makers including in relation to the activities covered by the draft plan/programme subject to this SEA. It is expected that a complete set of marine plans for UK waters will be adopted by 2021, by which time reviews of older plans will have commenced. The SEA has in the past contributed to both an understanding of potential interactions with the environment and wider range of other users for the draft plan/programme, and now is also informed by work undertaken as part of marine spatial planning.

The contribution of atmospheric emissions from oil and gas and gas storage activities that may result from implementation of draft plan/programme alternative 2 or 3, or the end use of any hydrocarbons produced, would represent a minor fraction of existing UK, European and global emissions, and be made in the context of a move to decarbonise the energy supply sector, while maximising economic recovery of resources from what are mature hydrocarbon basins. These emissions where they relate to combustion end use would be neutral in the attainment of UK climate change response policy objectives, and potentially positive in respect of oil since associated gas is used, rather than mostly flared as in some other potential sources of supply.

The expansion of offshore renewables and the transport and storage of carbon dioxide following capture, will make positive contributions to UK Government targets of reducing greenhouse gas emissions (34% reduction on 1990 levels by 2020), in addition to the achievement of producing 15% of energy from renewable sources by 2020, which will be significantly progressed by the expansion of offshore renewables. Achieving these goals (including maximising economic recovery) also promotes energy security through the maximisation of domestic supplies, and may further contribute to other national goals such as reducing dependency on gas imports, and the enhancement of gas storage infrastructure.

A number of offshore European Conservation (Natura 2000) sites are in the process of being designated under the Habitats Directive, and the boundaries of some coastal and marine sites have been or are in the process of being extended. In addition, the *Marine and Coastal Access Act 2009* introduced further requirements for identification and designation of Marine Conservation Zones (or Marine Protected Areas under the *Marine (Scotland) Act 2010*), a number of which have been identified and designated. These will require careful consideration in the selection of offshore wind farm and other marine renewables sites and oil and gas/gas

storage (including carbon dioxide storage) infrastructure to avoid adverse effects on the integrity of the sites by compromising conservation objectives. Additionally, frameworks for the wider improvements in the environmental and ecological/chemical status of UK water bodies are provided by the Marine Strategy Framework Directive and Water Framework Directive respectively. A number of targets have been set in relation to aspects of the marine and coastal environment through these initiatives and work is ongoing to achieve these. Any leasing/licensing decisions will need to be cognisant of these targets, and their integration into development consenting can be seen, for example, with the implementation of the noise registry (see above).

Closely related to the above are shoreline management plans and other initiatives (e.g. flood risk management strategies) which consider the potential implications of coastal and nearshore development, and the possible changes in the coast and flood risk from sea-level rise linked to climate change – the appropriateness of development in areas potentially affected by sea-level rise is also a consideration of the MPS and terrestrial policy such as the National Planning Policy Framework. Linked to coastal change is the potential need for future defences or else managed realignment, and the compatibility of this, particularly in estuarine areas, with maintaining the integrity of Natura 2000 sites. Activities associated with the draft plan/programme have the potential to interact with the coast and therefore the objectives of the above through landfall of pipelines and cables (though temporary) and installation of tidal range devices.

With suitable mitigation and appropriate controls on activities which could follow adoption of the draft plan/programme, major negative effects on other policies or programmes can be avoided; this includes non-environmental topics such as navigation and air traffic control. In a number of policy areas the draft plan/programme will contribute positively to the achievement of goals.

Transboundary effects

The OESEA3 covers a range of activities, some of which could take place in all UK waters, and others which are considered only for England and Wales. Transboundary effects are therefore possible with all neighbouring states whose waters abut the UK. These are France, Belgium, the Netherlands, Germany, Denmark, Norway, the Faroes and the Republic of Ireland. Since activities from this draft plan/programme may occur in UK waters and including adjacent to the majority of median lines, the sources of potentially significant environmental effects with the additional potential for transboundary effects include:

- Underwater noise
- Marine discharges
- Atmospheric emissions
- Impact mortality on migrating birds and bats
- Accidental events

All of the five aspects above may be able to be detected physically or chemically in the waters of neighbouring states. The scale and consequences of environmental effects in adjacent state territories due to activities resulting from adoption of the draft plan/programme will be less than those in UK waters and are considered unlikely to be significant.

Conclusions

The SEA considered the alternatives to the draft plan/programme and the potential environmental implications of the resultant activities in the context of: the objectives of the draft plan/programme, the SEA objectives, the existing regulatory and other control mechanisms, the wider policy and environmental protection objectives, the current state of the environment and its likely evolution over time, and existing environmental problems. The conclusion of the SEA is that alternative 3 to the draft plan/programme is the preferred option, with the area offered restricted spatially through the exclusion of certain areas together with a number of mitigation measures to prevent, reduce and offset significant adverse impacts on the environment and other users of the sea. It is considered that the objectives of the draft plan/programme can be achieved through this option.

There is limited data on the impacts of potential commercial arrays of wave and tidal stream technologies on the physical environment and habitats. Similarly, there is little information on the interaction of birds, marine mammals and fish with wave and tidal devices. The SEA recommends that for the deployment of single devices and small arrays (likely in the lifetime of OESEA3), appropriate surveys of animal activity and behaviour should be undertaken to inform commercial scale projects. The nature and uses of the range of estuaries and embayments in which tidal range developments have been and may be proposed vary widely; similarly there is a wide diversity in the type and location of installations to exploit tidal range. Consequently the SEA recommends that site specific assessments are undertaken before decisions can be taken on potential leasing and the desirability and acceptability of individual tidal range projects. Additionally, a series of proposals are made regarding precautions, areas to be withheld, operational controls and certain data gaps. The SEA has also identified a number of other data gaps for which recommendations are made to prioritise future research.

Significant steps towards formal marine spatial planning in UK waters have been taken in recent years, with national marine policy clarified at a UK level through the Marine Policy Statement. Most areas are yet to be subject to regional scale marine planning, but those undertaken to date have involved further opportunities for coastal regulators and communities to provide input to the way the marine environment in their areas is managed, which is in addition to the existing routes for consultation as part of the development consent process.

Next steps

The Offshore Energy SEA 3 Environmental Report and supporting documents are available for review and public comment for a period of 8 weeks from the date of publication. The documents are being made available from the SEA webpages of the gov.uk website and https://www.gov.uk/government/consultations/. Comments[3] and feedback should be marked "OESEA3 Consultation" and may be made via the website or by letter or e-mail addressed to:

Email: oesea3@decc.gsi.gov.uk

Postal address:

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The Department will consider comments received from the public consultation in their decision making regarding the draft plan/programme. Following public consultation a Post Consultation Report will be prepared and placed on the SEA webpages collating the comments, DECC responses to them. On adoption of the plan/programme a Statement will be published detailing:

- how environmental considerations have been integrated into the plan/programme
- how the Environmental Report has been taken into account
- how opinions expressed by the consultation bodies and public consultees on the relevant documents have been taken into account
- how the results of any consultations entered into with other Member States have been taken into account (if required)
- the reasons for choosing the plan/programme as adopted, in the light of the other reasonable alternatives dealt with; and
- the measures that are to be taken to monitor for potential significant environmental effects of the implementation of the plan/programme.

[3] **Confidentiality and data protection:** We will summarise all responses and place this summary on the OESEA3 section of the GOV.UK website. This summary will include a list of organisations that responded, but not people's personal names, addresses or other contact details. Information provided in response to this consultation, including personal information, may be subject to publication or disclosure in accordance with the access to information legislation (primarily the Freedom of Information Act 2000, the Data Protection Act 1998 and the Environmental Information Regulations 2004). If you want information that you provide to be treated as confidential please say so clearly in writing when you send your response to the consultation. It would be helpful if you could explain to us why you regard the information you have provided as confidential. If we receive a request for disclosure of the information we will take full account of your explanation, but we cannot give an assurance that confidentiality can be maintained in all circumstances. An automatic confidentiality disclaimer generated by your IT system will not, of itself, be regarded by us as a confidentiality request.

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