

UK Offshore Energy Strategic Environmental Assessment



OESEA2 Non-Technical Summary

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

February 2011

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NON-TECHNICAL SUMMARY

Introduction

This Environmental Report has been prepared as part of the Department of Energy and Climate Change (DECC) United Kingdom Offshore Energy Strategic Environmental Assessment (OESEA) programme and is hereafter referred to as OESEA2. OESEA2 updates and extends the scope of the OESEA Environmental Report which was issued in January 2009.

The 2009 OESEA Environmental Report 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 and the territorial waters of England and Wales to a depth of 60m. The objective of the wind leasing was to achieve some 25GW of generation capacity by 2020, in addition to the 8GW already constructed or in planning. A Post Consultation Report on the UK OESEA was issued in June 2009, followed by government decisions; on the offshore wind element in the form of the policy document, "A Prevailing Wind: Advancing UK Offshore Wind Deployment"; and on the hydrocarbon licensing with the announcement of a 26th Seaward Round.

This SEA 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 offshore renewables including wind, wave, tidal stream and tidal range). This includes consideration of the implications of alternatives to the plan/programme and of the 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 OESEA2 Environmental Report, including the conclusions and recommendations.

What is the draft plan/programme?

The 2007 Energy White Paper 'Meeting the Energy Challenge' outlined two serious long-term challenges for the UK:

- Tackling climate change by reducing carbon dioxide emissions both within the UK and abroad; and
- Ensuring secure, clean and affordable energy as we become increasingly dependent on imported fuel.

The UK Government is committed to the reduction of greenhouse gas emissions by 80% on 1990 levels by 2050, with an interim target of 34% by 2020 (as implemented in the *Climate Change Act 2008* and subsequent Order revising the 2020 carbon budget). The UK also has a legally binding target to generate 15% of its energy from renewable sources by 2020, stemming from the EU Renewable Energy Directive, with offshore wind, wave and tidal energy expected to play an important role in achieving this target. To help facilitate the offshore grid required to convey electricity from offshore renewable energy devices to the UK mainland, the draft plan/programme also covers a high level strategic consideration of the

implications of major development of offshore electricity infrastructure. The development of carbon dioxide storage is another important element of the Low Carbon Transition Plan required to meet the Government targets. An Energy Security and Green Economy Bill 2010-11 was announced in the Queen's Speech in May 2010, and subsequently The Energy Bill 2010-2011 was published on 9th December 2010. The Bill has three principal objectives: tackling barriers to investment in energy efficiency, enhancing energy security, and enabling investment in low carbon energy supply.

Ensuring security of energy supply is essential to both climate change and energy policy. Fundamental to securing our energy supplies is to ensure that we are not dependant on any one supplier, country or technology. A linked factor in enhancing security of supply is the need for more gas storage capacity, since until recently seasonal fluctuations in UK gas demand were met by varying production rates from UK fields. The UK Government seeks a substantial addition to currently available facilities.

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 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. The main objectives of the current 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 – to enable future leasing in the UK Renewable Energy Zone and the territorial waters of England and Wales. The Scottish Renewable Energy Zone and Northern Irish waters within the 12 nautical mile territorial sea limit are not included in this part of the plan/programme. 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 – to enable future leasing in the UK Renewable Energy Zone and the territorial waters of England and Wales. The Scottish Renewable Energy Zone and Northern Irish waters within the 12 nautical mile territorial sea limit are not included in this part of the plan/programme. 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 – to enable future leasing in the territorial waters of England and Wales. The Severn tidal power schemes are not included as they are part of a separate DECC SEA initiative. It is considered unlikely that there will be tidal range developments outside of territorial waters.
4. Offshore wind – To enable further rounds of offshore wind farm leasing in the UK Renewable Energy Zone and the territorial waters of England and Wales with the

objective of achieving some 33GW of generation capacity by 2020. The Scottish Renewable Energy Zone and Northern Irish waters within the 12 nautical mile territorial sea limit are not included in this part of the plan/programme.

Oil and gas:

1. Exploration and production – to enable further Seaward Rounds of oil and gas licensing in UK waters.
2. Hydrocarbon gas importation and storage – to enable further licensing/leasing for unloading and underground storage of hydrocarbon gas in UK waters (territorial waters and the UK Gas Importation and Storage Zone). UK OESEA only covered gas storage in hydrocarbon reservoirs, OESEA2 will also consider hydrocarbon gas storage in other geological formations/structures including constructed salt caverns, and the offshore unloading of hydrocarbon gas.

Carbon dioxide:

1. Carbon dioxide transportation and storage – to enable licensing/leasing for underground storage of carbon dioxide gas in UK waters (territorial waters and the UK Gas Importation and Storage Zone). This SEA considers carbon dioxide storage in geological formations/structures including depleted hydrocarbon reservoirs and saline aquifers, as well as the possibility of co-locating (clustering) of pipelines for storage projects

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

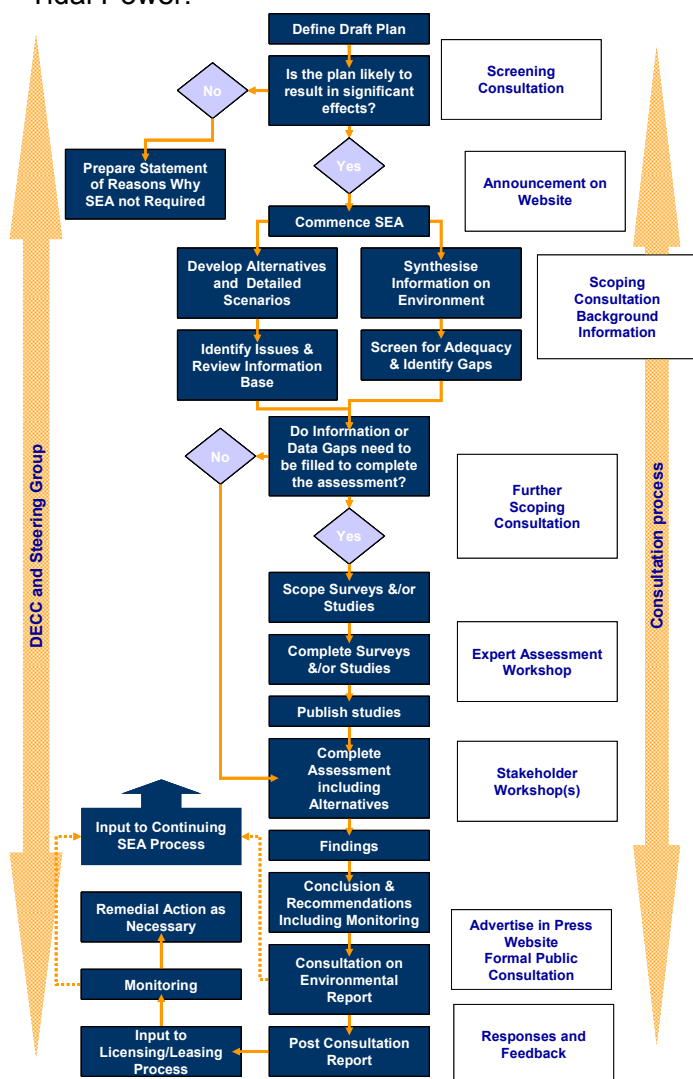
The SEA process aims to help inform licensing and leasing decisions by considering the environmental implications of the proposed plan/programme and the potential exploration, development and energy production activities which could result from its implementation.

Since 1999, the Department has conducted eight SEAs of the implications of further licensing of the UK Continental Shelf (UKCS) for oil and gas exploration and production (SEAs 1-7 and OESEA, incorporating SEA 8) and an SEA for a second round (R2) and subsequent R3 (OESEA) of wind leasing – see the list below and Map 2 overleaf.

| | Area | Sector | Licensing/Leasing Round | |
|-----------------|--|---------------|--------------------------------|--------|
| SEA 1 | The deep water area along the UK and Faroese boundary | Oil & Gas | 19 th Round | (2001) |
| SEA 2 | The central spine of the North Sea which contains the majority of existing UK oil and gas fields | Oil & Gas | 20 th Round | (2002) |
| SEA 2 Extension | Outer Moray Firth | Oil & Gas | 20 th Round | (2002) |

| | Area | Sector | Licensing/Leasing Round | |
|-------|--|--------------------------|-------------------------|--------|
| SEA 3 | The remaining parts of the southern North Sea | Oil & Gas | 21 st Round | (2003) |
| R2 | Three strategic regions off the coasts of England and Wales in relation to a second round of offshore wind leasing | Offshore wind | R2 | (2003) |
| SEA 4 | The offshore areas to the north and west of Shetland and Orkney | Oil & Gas | 22 nd Round | (2004) |
| SEA 5 | Parts of the northern and central North Sea to the east of the Scottish mainland, Orkney and Shetland | Oil & Gas | 23 rd Round | (2005) |
| SEA 6 | Parts of the Irish Sea | Oil & Gas | 24 th Round | (2006) |
| SEA 7 | The offshore areas to the west of Scotland | Oil & Gas | 25 th Round | (2008) |
| OESEA | UK offshore waters and territorial waters of England and Wales | Oil & Gas, Offshore wind | 26 th Round | (2009) |
| | | | R3 | (2009) |

In addition DECC SEA work was undertaken in 2010 for the potential exploitation of Severn Tidal Power.



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 OESEA2 with the SEA Steering Group, environmental authorities and a range of academic and conservation organisations commenced early in 2010. A formal scoping exercise with the statutory Consultation Bodies/Authorities and other stakeholders was conducted from March 2010; a report of the scoping feedback can be downloaded from www.offshore-sea.org.uk.

An Assessment Workshop involving the SEA Steering Group, technical report authors and SEA team was held in September 2010 and is summarised in Appendix 2. 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 October/November 2010 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 2 of the Environmental Report.

The Environmental Report and draft plan/programme are being issued for a 12 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 website collating the comments and DECC responses to them.

Environmental Report

The Environmental Report of OESEA2 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 below.

What areas are included in this SEA?

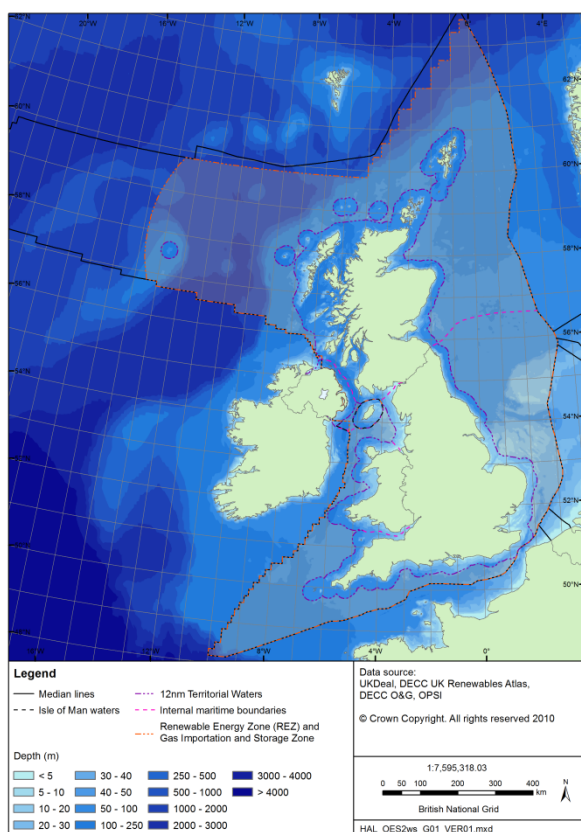
For offshore renewable energy this SEA¹ considers potential leasing in the UK Renewable Energy Zone (REZ) and the territorial waters of England and Wales but does not include the Scottish Renewable Energy Zone and Northern Irish waters within the 12 nautical mile territorial sea limit – see Map 1. It should also be noted that the SEA does not consider tidal range energy in the Severn Estuary which has been subject to a separate DECC SEA

¹ In cooperation with the devolved administrations

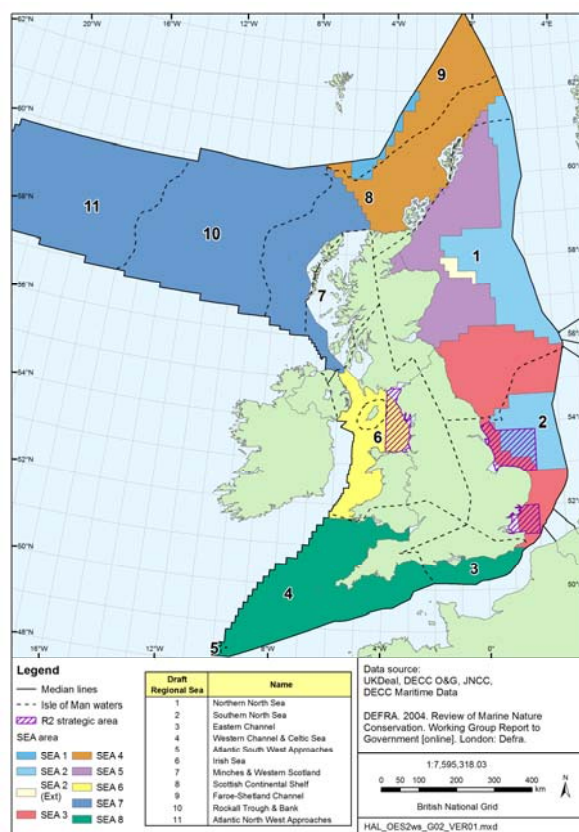
exercise. For gas storage and carbon dioxide storage, the SEA² considers potential licensing/leasing in UK territorial waters and the UK Gas Importation and Storage Zone.

For offshore (seaward) oil and gas licensing, this SEA covers all UK waters (previous SEA 1 to 8 areas) – see Map 2.

Map 1 – OESEA2 Geographical coverage



Map 2 – Past SEA areas (coloured) and Regional Seas (numbered)



Overview of the natural environment

Following discussion with the SEA Steering Group it was agreed to continue to use the 2004 draft Regional Seas divisions as a basis for considering UK waters for this SEA to maintain consistency with OESEA – see numbered areas on Map 2.

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. In view of the recent (January 2009) publication date of OESEA and the currency of the information presented for the Environmental Baseline therein, an addendum to this baseline data (as suggested in scoping responses) is published in OESEA2, with clear signposting (including electronic links) to the original baseline information. In addition to numerous new sources and updates to the baseline data, Defra's Charting Progress 2 (Defra 2010a, b, c, d & e) and OSPAR's Quality Status Report 2010 (OSPAR 2010a) were published during the drafting of this

² In cooperation with the devolved administrations

Environmental Report, and provide key updates at the national and regional level. Selected highlights of the baseline data are given below.

The bird fauna of the UK is western Palaearctic, that is 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 some 50%, and the Isle of Rum off western Scotland between a quarter and a third of the world's breeding population of Manx shearwaters.

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 over 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 circum-polar pattern of occurrence. 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 (ca. 60°N), and a distinct species group found in the cold waters of the Faroe-Shetland Channel and Norwegian Sea. Virtually all 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 northeast 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 activities.

Other 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 is aimed to complete a joint network of well managed MPAs by 2010 that, together with the Natura 2000 network, is ecologically coherent. As part of the UK implementation of such areas, the *Marine and Coastal Access Act 2009* (and *Marine (Scotland) Act 2010*) provide powers to designate Marine Conservation Zones (MCZs) in England and Wales, and Marine Protected Areas (MPAs) in Scotland. In April 2010, the Department of the Environment Northern Ireland (DOENI) consulted on policy proposals for a Marine Bill for Northern Ireland. The location of potential MCZs or MPAs in UK waters is currently the subject of study programmes around the UK.

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 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; (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 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. The Directive requires that programmes of measures be established to achieve good environmental status, 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. Such protected areas are to be coordinated with the Natura 2000 site network established under the Birds and Habitats Directives, for which designations in some UK marine areas are not yet completed.

The *Marine and Coastal Access Act 2009* introduced other initiatives which progress Marine Spatial Planning in UK waters. The UK Government and devolved administrations are working towards joint adoption of the Marine Policy Statement for UK waters which is based

around the UK Government High Level Marine Objectives and will create a high-level planning framework for activities taking place in the marine environment. This statement is to be used by a number of relevant authorities including the Marine Management Organisation (MMO), also created under the MCAA, to inform decisions on licensing and enforcement.

The Act also aims to streamline and modernise enforcement powers for fisheries and nature conservation, providing a civil sanctions scheme for licensing and nature conservation offences, and an administrative penalty scheme for domestic fisheries offences. Inshore fisheries management will be handled from April 2011 by the Inshore Fisheries and Conservation Authorities (IFCAs), replacing the current Sea Fisheries Committees. IFCAs will be responsible for activities out to 6nm from the coast and in estuaries where they will be responsible for sea fisheries management.

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 4.

Prospectivity

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 26th Round held in 2010. 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. There is a consensus view that the great majority of large fields in shelf depth waters (<200m) have been found, and deeper water areas are either not prospective or increasingly well explored and understood.

The inclusion in the current draft plan/programme of **gas storage** in depleted and other hydrocarbon reservoirs, and in constructed salt caverns, 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. Gas storage activities resulting from the draft plan/programme can be expected to take place in the same areas as existing oil and gas production (e.g. the Deborah gas storage project in the Southern North Sea), and in areas of extensive halite deposits (e.g. Gateway Gas Storage in the East Irish Sea).

Carbon dioxide may be stored in a range of geological formations including depleted hydrocarbon reservoirs and saline aquifers. Depleted hydrocarbon reservoirs will coincide with existing oil and gas fields, and a number of promising saline aquifers have been identified by the British Geological Survey, e.g. the Captain sandstones. DECC (2010i)

summarises the storage potential for CO₂ in saline aquifers (4.6-46Gt) and depleted hydrocarbon fields (7.4-9.9Gt), though much of this capacity is presently theoretical.

The UK has extensive **marine renewable energy** resources including wind, wave and tidal, all of which are variable over space and time. In UK waters, offshore wind is the most developed of these technologies. Rounds 1 and 2 of offshore wind leasing were held in 2000 and 2003 respectively and total generation capacity of all currently operational, in construction or consented offshore wind farms is some 5.5GW with a further 2.3GW in planning. In January 2010, The Crown Estate announced the exclusivity zone agreements for nine Round 3 offshore wind zones, totalling 32.2GW and in May 2010 announced extension projects at a number of existing offshore windfarms, totalling some 1.5GW. In August 2010, The Crown Estate also awarded agreements for lease for two demonstrator windfarms in English waters and exclusivity agreements for two demonstrator windfarms in Scottish waters. Away from the shelter of the coast, the total wind resource over a year is relatively uniform across very large areas, although clearly 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.

Full commercial scale exploitation of wave and tidal energy has not yet been realised in UK waters, although several test and demonstrator projects have been deployed or are in development. It is likely that in the coming years as devices reach commercial scale and their viability is demonstrated, larger scale deployment of wave and tidal energy will commence. Wave energy resource in the UK is broadly concentrated on the Atlantic facing coastline – notably the Western Isles of Scotland and the South West peninsula (and SW Wales). Tidal stream resource is more geographically constrained – being localised around headlands and through straits between land masses and there are a number of potential deployment sites within English and Welsh waters. Studies such as the Sustainable Development Commission's "Turning the Tide" have shown potential for extracting power from the tidal range of various estuaries and bays – such as the Severn, Mersey and Solway – for which Feasibility Studies have been undertaken or are underway.

Overview of main sources of effect and controls in place

The main stages of offshore wind farm, wave and tidal stream development are:

1. Site prospecting/selection including collection of site specific environmental data, and seabed information by geophysical and geotechnical survey
2. Development, including construction of foundations 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
3. Generation operations
4. Maintenance
5. Decommissioning, including removal of facilities

The main stages of a tidal range development are:

1. Site prospecting/selection including collection of site specific environmental data, and seabed information by geophysical and geotechnical survey

2. Development, including construction of foundations and barrage, turbine installation, cable laying, installation of gathering stations/substations and connection to the onshore national electricity transmission system
3. Generation operations
4. Maintenance

The main stages of oil and gas activity (including natural gas and carbon dioxide storage) are:

1. Exploration, including seismic survey and exploration drilling
2. 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
3. Production/operation, with routine supply, return of wastes to shore, power generation, chemical use, produced water reinjection management and reservoir monitoring
4. Maintenance
5. Decommissioning, including cleaning and 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 are:

- Noise (impulsive) from seismic survey and piling during installation and decommissioning activities
- Noise (semi-continuous or continuous) from turbines, drilling rigs, production facilities or vessels
- Physical damage (acute) to seabed features, biota and features of archaeological interest from anchoring, pipeline construction and cable laying
- Physical damage (non-acute) from particulate smothering
- Physical presence of structures, colonisation of structures by organisms, avoidance of wind farm areas e.g. by birds, animal collisions with structures and turbine blades and barriers to movement of birds, fish and marine mammals
- Physical presence of structures, interference with other users of the sea
- Physical presence of structures, visual intrusion
- Post-decommissioning (legacy) effects
- Change to sedimentation and hydrography regime
- Energy removal downstream of wet renewable devices
- Chemical contamination (routine) from drilling and other discharges, antifouling coatings etc
- Chemical contamination (accidental) from spills
- Atmospheric emissions from fuel combustion, venting
- Contribution or reduction in net greenhouse gas emissions
- Electromagnetic Fields, possible effects on electrically or magnetically sensitive species from subsea power cables
- Physical damage to submerged heritage / archaeology from infrastructure construction and impact on the setting of coastal historical sites
- Visual impacts and seascape effects including change to character

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 5).

For oil and gas, consents (with applications supported by assessments of effects) are required for seismic survey, exploration drilling, field development, pipeline installation, development drilling, field operation (including atmospheric emissions, production of hydrocarbons, use of chemicals, produced water treatment), offshore facility modification, field decommissioning etc. The major consents also include a public consultation stage which allows stakeholders to draw issues to the attention of DECC and the developers.

The *Energy Act 2008* provides for a licensing regime governing the offshore storage of carbon dioxide and the storage and unloading of gas. Both activities require a licence issued by the Secretary of State for Energy and Climate Change and a lease from The Crown Estate. The *Energy Act 2004*, the *Energy Act 2008*, the *Planning Act 2008* and the *Marine and Coastal Access Act 2009* together with the *Marine (Scotland) Act 2010* and any Northern Ireland Bill³ provide a revised framework for the consenting of offshore wind farms, wave and tidal stream devices.

Assessment summary

Biodiversity, habitats, flora and fauna

In general, marine mammals show the highest sensitivity to acoustic disturbance by intense noise generated primarily by piling during facility construction and by seismic survey. 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) have also been considered. For both marine mammals and fish, various effects will generally increase in severity with increasing exposure to noise; a general distinction can be drawn between effects associated with physical injury or physiological effects, 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 for turbines etc can generate high noise source levels and is widely recognised as a potential concern, in particular for large developments where many piles may be installed sequentially, or where more than one piling rig might be used simultaneously thus affecting a larger area.

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. There is less clarity about the potential effects on marine mammals (and other receptors including fish), particularly in relation to distinguishing a significant behavioural response from an insignificant, momentary alteration in behaviour. Consequently, recent expert assessments have recommended that onset of significant behavioural disturbance resulting from a single pulse is taken to occur at the lowest level of noise exposure that has a measurable transient effect on hearing. In the light of limited behavioural data the SEA also concurs with the scientific consensus judgement that seismic and pile-driving operations have the potential to cause some level of disruption of normal behaviour in marine mammals and possibly some species of fish at ranges of many 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 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

³ Northern Ireland Marine Bill Policy Proposals consultation, April 2010.

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 interpretation of the main elements of the disturbance offence.

Predicted activity levels resulting from both future oil & gas licensing rounds, and further rounds of offshore wind leasing, are concentrated in Regional Seas 1, 2 and 6; with some additional oil and gas activity likely in Regional Seas 8/9 and wind farm (OWF) activity in Regional Seas 3 and 4. It is likely that multiple sources (including simultaneous surveys and pile-driving) will occur at the same time, and that both activities may extend throughout much of the year, and be audible to marine mammals over much of the coastal Regional Seas. However, it seems improbable (given that such responses are not predicted except in the immediate vicinity of the source) that injurious or severe behavioural levels of effect will coincide. Given the lack of definition of the 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.

Regarding the effects of noise on marine mammals particularly from piling and seismic survey, 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 ongoing Marine Strategy Framework Directive (MSFD) Task Group 11 work to determine criteria for an indicator relating to high amplitude, low and mid-frequency impulsive anthropogenic sounds including those from pile driving, seismic surveys and some sonar systems. It is recommended that the findings of this Task Group are reviewed closely with respect to consenting of relevant activities which may result from the draft plan/programme, as well as other activities which generate noise in the marine environment. The establishment of noise criteria and the consenting of activities will require a coordinated approach across different industries and activities, possibly through the future marine planning system and would contribute to the achievement of Good Environmental Status (GES) as required by the MSFD.

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 and potentially on archaeological artefacts. 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. These studies have concluded that scour effects are small in scale and local in extent. 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 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 and Species Directive) and placed these in the context of natural disturbance events and current assessment (using newly available data) of the major sources of direct, physical pressure from human activities on seabed environments. The SEA concludes that physical disturbance associated with activities resulting from the proposed draft plan 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 broadscale distribution of seabed habitats is relatively well mapped, so the likely occurrence and general sensitivity of habitats in proximity of proposed activities can be assessed. Similarly, specific projects can be assessed in terms of likelihood of the presence of significant archaeological features. In both cases, however, detailed site surveys (which are routinely undertaken prior to development operations) should be evaluated with regard to environmental and archaeological sensitivities.

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 (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 or wintering locations for waterbirds), indicate a higher potential for physical presence effects. In relation to birds, these include displacement and barrier effects associated with exclusion from ecologically important (e.g. feeding, breeding) areas, disturbance of regular movements (e.g. foraging, migration), collision risk, and the disturbance effects of light. There is currently very 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. The potential fatal interactions between seals (and potentially other marine mammals such as harbour porpoises) and thrusters associated with vessels with dynamic positioning is highlighted, with a recommendation for further research on this issue. 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. However, there are some important uncertainties in relation to bird distribution, variability in migration routes and timings, the statistical power of monitoring methods, and the sensitivity of this conclusion to modelling assumptions (notably avoidance frequency in modelling of collision risk and several important factors in modelling of population dynamics). 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, the lack of modern data on waterbirds 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 spatial 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 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 inter-tidal 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.

Landscape/seascape

Major development of offshore wind farms in nearshore waters could result in significant effects on landscape/seascape. The siting of offshore wind farms at 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. Reflecting the previous OESEA and the relative sensitivity of multiple receptors in coastal waters, OESEA2 recommends that the bulk of new OWF generation capacity should be sited away from the coast, generally outside 12 nautical miles. The environmental sensitivity of coastal areas is not uniform, and in certain cases new offshore wind farm projects may be acceptable closer to the coast. Conversely, siting beyond 12nm may be justified for some areas/developments.

In contrast, most potential hydrocarbon developments are likely to be sub-sea facilities, well offshore and beyond sight of land. Gas storage and CO₂ 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 the requirement for a larger number of fixed surface infrastructure for certain projects has the potential to generate incremental effects with other aspects of the plan and existing uses of the sea.

The scope for cumulative impacts between different renewables aspects of the draft plan/programme is minimised by 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, 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.

Water environment

The consequences of energy removal on natural marine systems are reasonably well understood for tidal barrages but are far less predictable and appreciated for 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 involved, although the exact level of impact is dependent on design, siting and operation mode. For this reason and because individual estuaries/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. Both 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. Significant uncertainty however arises when considering commercial scale arrays of these devices as current information is based on modelling studies or demonstrator scale deployments.

Contamination of water may occur from discharges of drilling wastes, grouting, 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, 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, prospecting 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 not thought to represent a significant source of marine discharges but their presence in the water column may increase the risk of vessel collision and associated spill risk.

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 (CO₂, CO, NO_x, SO₂, CH₄, and volatile organic compounds (VOCs)) from power generation and engines on rigs, production facilities, support vessels and helicopters. Fugitive emissions such as those from cement tanks, diesel storage and cooling/refrigeration systems can result in emissions of dust/particulates, VOCs, hydrofluorocarbon refrigerants etc depending on the source. Emissions will also be associated with the construction of marine renewables and wind farm devices to be deployed and 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. 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 process, which would serve to identify if mitigation 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 CO₂ and other greenhouse gases, although in the case of offshore renewables these will be offset by the production of renewable energy. CO₂ storage will also contribute to the transition towards a low carbon energy supply. There are growing concerns about the effects of fossil fuel combustion in terms of climate change and ocean acidification. However, 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. All 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. Thus domestic hydrocarbon production would be neutral in the attainment of UK climate change response policy objectives, and potentially positive in respect of oil, since associated gas is put to beneficial use rather than mostly flared as in some other sources of potential supply. In addition, domestic hydrocarbon production has a positive contribution to the UK economy and security of supply.

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 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)

A casual look out to 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) and associated Marine Policy and Marine Spatial 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 3h of the Environmental Report, with key aspects summarised below. In advance of formal marine spatial planning, 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. Over 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 routing measures to reduce risks of ship collision and groundings. In addition, IMO regulations require 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, and for the first OESEA, AIS data covering 4 weeks in 2008 were obtained and analysed to provide accurate 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 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 routing. Recent monitoring also suggests that ship avoidance strategy is linked with local topography, for instance the greater number of vessels coming to within 1nm of Scroby Sands OWF is a function of its location relative to the Caister Road channel. As wave and tidal developments are currently at demonstrator scale, the spatial extent of arrays of these developments 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 2009, there were ~12,000 working fishermen in the UK (of which 83% were full time), operating over 6,500 vessels, 5,000 of which were smaller inshore boats (<10m). These vessels landed 581,000 tonnes of fin- and shellfish in 2009, with a total value of £674 million. On top of this, fish processing provides over 22,000 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, and from 2005 to vessels >15m. To inform the SEA, VMS data for UK vessels over three years (2005-2007) was obtained and analysed to provide information on important fishing areas for larger vessels and offshore areas.

The effect of numerous offshore renewable energy installations on fishing activities are more complex than interactions with general ship traffic; the negative effects of the exclusion from large areas and potential displacement and intensification of fishing effort to other areas may be partly countered by positive effects on fish stock numbers, potential reef effects and reduction in seabed disturbance. At a strategic level the siting of major offshore renewable energy developments (especially ones covering large areas or multiple arrays in close proximity) need to consider fisheries implications and avoid areas of significance. The SEA recommends that potential developments resulting from the implementation of the draft plan/programme which would occupy recognised important fishing grounds in coastal or offshore areas (where this would prevent or significantly impede sustainable fisheries) should not normally be consented.

Military use of the coasts and seas of the UK is extensive, with all three Services 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 maintain a 6 nautical mile obstacle-free zone around offshore oil and gas facilities to allow for the safe operation of helicopters undertaking instrument (as opposed to visual) approaches. This requirement may restrict the location of offshore wind farm developments although, with adequate risk assessment and consultation with the field operator, variations to the 6nm zone can be agreed.

Tourism and recreational use of UK coasts and coastal waters is of major importance in many areas. Annually, the British public take over 26 million days for seaside holidays in the UK spending over £5 billion, split primarily between England (£4 billion), Wales (£0.6 billion) and Scotland (£0.4 billion). Major recreational uses of the sea beyond beaches and coastal paths include yachting, surfing and sea angling. Many visitors to the coast cite unspoilt and beautiful natural scenery as the important factors influencing their selection of location to visit. The importance of such attributes is widely recognised and protected through designations such as National Parks, Areas of Outstanding Natural Beauty, and National

Scenic Areas. The siting recommendations made above for landscape/seascape with regard to plan activities is also considered to significantly reduce the potential for adverse effects on tourism and recreation.

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 a combined turnover of some £34 billion, employing nearly 320,000 people and have all been mapped and considered in this SEA. Potential future uses of the sea considered in OESEA2 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.

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 was considered in the previous OESEA including reinforcements to the national electricity transmission system and enhancements to the capacity of the UK's port facilities. Some ancillary offshore grid reinforcements will also be required. The influence of wave and tidal development within the scope of OESEA2 on port and manufacturing facilities development will 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.

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. Relatively recent finds of flint artefacts from the Cromer Forest-bed Formation in Suffolk date to as early as 700,000 years BP. The current understanding of marine prehistoric archaeology is based on knowledge of the palaeolandscapes of the continental shelf between the UK and Europe during glacial phases and limited finds of archaeological materials, augmented with knowledge of analogous cultural and archaeological contexts from modern day terrestrial locations. 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 led to a large number of ship and aircraft wrecks in UK waters.

A number of coastal sites have been designated as World Heritage Sites, for example St Kilda, the Dorset and East Devon Coast and the Heart of Neolithic Orkney.

No strategic level controls were identified during the SEA assessment, and it is through site specific surveys that cultural heritage features would be identified and mitigation measures to be developed, in line with existing guidelines for seabed developers.

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. 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. 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 CO₂ 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. Area-wide mitigation solutions for potential radar interference may be possible but require pilot studies and trials.

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. 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. 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 towards a low carbon economy.

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 effects of multiple noise sources is an area 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 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. 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 husbanded, 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), and to the progression of other related programmes such as the Framework for the Development of Clean Coal and the Industrial Strategy for the Development of CCS in the UK. In addition, the achievement of producing 15% of energy from renewable sources by 2020 will also be significantly progressed by the expansion of offshore renewables. Achieving these goals 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 Strategy Framework Directive through the *Marine and Coastal Access Act 2009* will introduce further requirements for identification and designation of Marine Conservation Zones (or Marine Protected Areas under the *Marine (Scotland) Act 2010*). 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 or compromising good environmental status.

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 OESEA2 includes all UK waters, therefore transboundary effects are 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 – oil spills

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.

There is little 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 OESEA2), 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.

Marine spatial planning proposals are currently under development, which would give coastal regulators and communities further opportunities to have a say in the way the marine environment is managed, in addition to the existing routes for consultation as part of the development consent process.

A series of proposals are made regarding precautions, areas to be withheld, operational controls and certain data gaps.

Next steps

The Offshore Energy SEA 2 Environmental Report and supporting documents are available for review and public comment for a period of 12 weeks from the date of publication. The documents are being made available from the SEA website (www.offshore-sea.org.uk). Comments⁴ and feedback should be marked "OESEA2 Consultation" and may be made via the website or by letter or e-mail addressed to:

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The Department will consider comments received from the public consultation in their decision making regarding the draft plan/programme.

A Post Consultation Report will be prepared and placed on the website collating the comments, DECC responses to them and indicating how they and the Environmental Report have been taken account of in the implementation of the plan/programme.

⁴ Confidentiality: Your comments may be made public by DECC in relation to this consultation exercise. If you do not want your name or all or part of your response made public, please state this clearly in the response. Any confidentiality disclaimer that may be generated by your organisation's IT system or included as a general statement in your fax cover sheet will be taken to apply only to information in your response for which confidentiality has been requested. However, please also note that DECC may disclose information it holds pursuant to a statutory, legal or parliamentary obligation, including without limitation, requirements for disclosure under the Freedom of Information Act 2000 and/or the Environmental Information Regulations 2004. In considering any request for disclosure of such information under the Freedom of Information Act 2000 or the Environmental Information Regulations 2004, DECC will consider and make use of relevant exemptions or exceptions where they properly apply and, where relevant, will consider whether the public interest in withholding the information outweighs the public interest in disclosing the information. It is DECC's normal practice to consult and consider the views of third parties where necessary although decisions on disclosure are ultimately taken by DECC. However, any decision by DECC against the release of information can be appealed to the Information Commissioner and ultimately the Information Tribunal. We will handle any personal data you provide appropriately in accordance with the Data Protection Act 1998 and the Freedom of Information Act 2000.