DEPARTMENT OF ENERGY & CLIMATE CHANGE

UK Offshore Energy Strategic Environmental Assessment

OESEA2 Environmental Report

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

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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

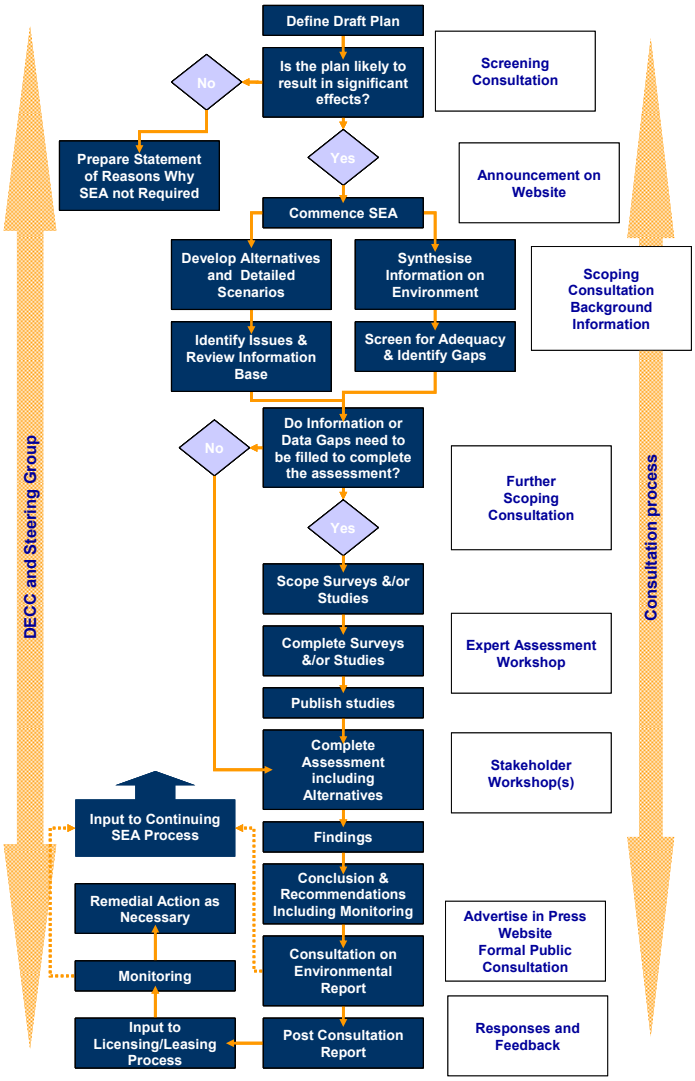
The SEA process aims to help inform licensing and leasing decisions by considering the environmental implications of the proposed plan/programme and the potential exploration, development and energy production activities which could result from its implementation.

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	19th Round	(2001)
SEA 2	The central spine of the North Sea which contains the majority of existing UK oil and gas fields	Oil & Gas	20th Round	(2002)
SEA 2 Extension	Outer Moray Firth	Oil & Gas	20th Round	(2002)
SEA 3	The remaining parts of the southern North Sea	Oil & Gas	21st Round	(2003)

	Area	Sector	Licensing/Leasing Round	
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	22nd Round	(2004)
SEA 5	Parts of the northern and central North Sea to the east of the Scottish mainland, Orkney and Shetland	Oil & Gas	23rd Round	(2005)
SEA 6	Parts of the Irish Sea	Oil & Gas	24th Round	(2006)
SEA 7	The offshore areas to the west of Scotland	Oil & Gas	25th Round	(2008)
OESEA	UK offshore waters and territorial waters of England and Wales	Oil & Gas, Offshore wind	26th 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.

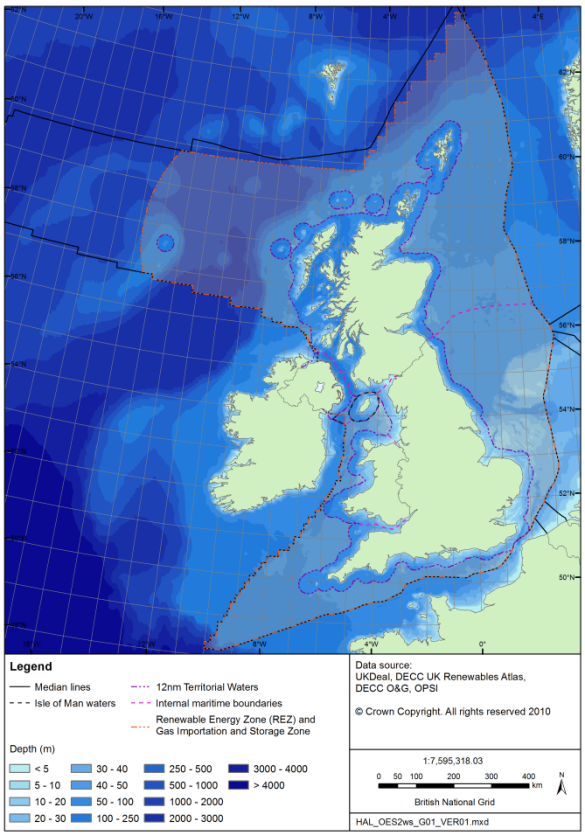
What areas are included in this SEA?

For offshore renewable energy this SEA[1] 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 exercise. For gas storage and carbon dioxide storage, the SEA[2] considers potential licensing/leasing in UK territorial waters and the UK Gas Importation and Storage Zone.

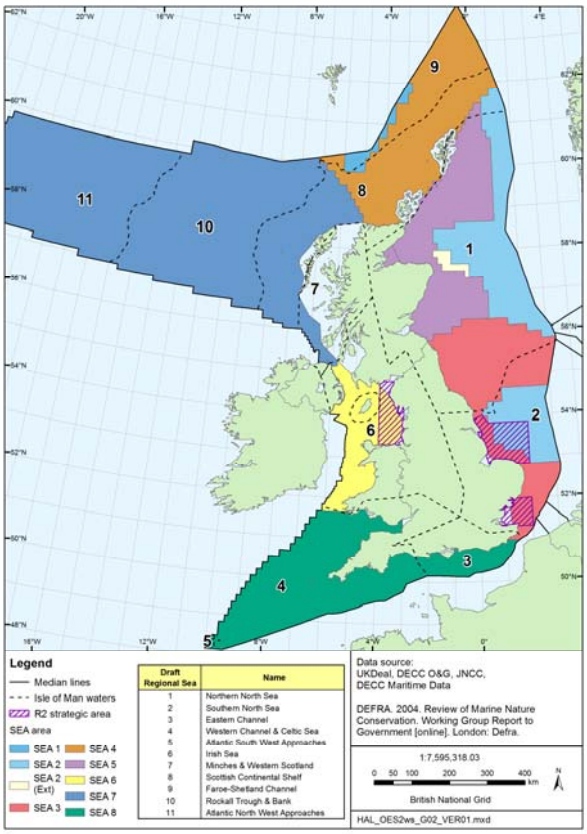
[1] In cooperation with the devolved administrations
[2] In cooperation with the devolved administrations

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 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 is 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 CO_2 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 CO_2 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 Bill[3] 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 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.

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

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 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 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 (CO_2, CO, NO_X, SO_2, CH_4, 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 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 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 routeing 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 routeing. 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 lead 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 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. 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). Comments[4] 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.

1 INTRODUCTION

1.1 This Strategic Environmental Assessment

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[5] 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"[6]; and on the hydrocarbon licensing with the announcement of a 26th Seaward Round.

OESEA2 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

1.2 The requirement for SEA

Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment (commonly called the SEA Directive) was adopted to provide a strategic complement to the Council Directives (85/337/EEC and 97/11/EC) which require Environmental Impact Assessments of specific developments and activities.

The Directive's stated objective is

> *"to provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development, by ensuring that, in accordance with this Directive, an environmental assessment is carried out of certain plans and programmes which are likely to have significant effects on the environment."*

[5] this part of the plan/programme did not include the territorial waters of Scotland and Northern Ireland
[6] DECC (2009). A Prevailing Wind: Advancing UK Offshore Wind Deployment. (http://www.berr.gov.uk/files/file51989.pdf)

A series of regulations have been established across the United Kingdom to implement the requirements of the Directive. This SEA is being conducted in accordance with the *Environmental Assessment of Plans and Programmes Regulations 2004* (the SEA Regulations), which apply to any relevant plan or programme which relates either solely to the whole or any part of England, or to England and any other part of the United Kingdom.

A required part of SEA is consultation with the consultation bodies and public, together with such neighbouring states as may be potentially significantly affected.

1.3 Previous DECC SEAs

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 Figure 1.1b overleaf.

	Area	**Sector**	**Licensing/Leasing Round**	
SEA 1	The deep water area along the UK and Faroese boundary	Oil & Gas	19th Round	(2001)
SEA 2	The central spine of the North Sea which contains the majority of existing UK oil and gas fields	Oil & Gas	20th Round	(2002)
SEA 2 Extension	Outer Moray Firth	Oil & Gas	20th Round	(2002)
SEA 3	The remaining parts of the southern North Sea	Oil & Gas	21st 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	22nd Round	(2004)
SEA 5	Parts of the northern and central North Sea to the east of the Scottish mainland, Orkney and Shetland	Oil & Gas	23rd Round	(2005)
SEA 6	Parts of the Irish Sea	Oil & Gas	24th Round	(2006)
SEA 7	The offshore areas to the west of Scotland	Oil & Gas	25th Round	(2008)
OESEA	UK offshore waters and territorial waters of England and Wales	Oil & Gas, Offshore wind	R3	(2009)
			26th Round	(2010)

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

1.4 The Environmental Report and its purpose

The purpose of this Environmental Report is to identify, describe and evaluate the likely significant effects on the environment of implementing the draft plan/programme and reasonable alternatives, taking into account the objectives and the geographical scope of the draft plan/programme. The report provides a basis of information for formal consultation with the statutory consultation bodies and authorities, and with the public, regarding the environmental implications of the draft plan/programme and its alternatives. The Environmental Report and the feedback from consultation will be taken into account during the finalisation of the plan/programme prior to its adoption.

1.4.1 Consultation bodies

Since the 2004 Regulations were made, a number of the nominated consultation bodies/authorities have been subject to organisational/name change. The following are the current consultation bodies/authorities for this SEA:

- English Heritage
- Natural England (previously English Nature and the Countryside Agency)
- Environment Agency
- Historic Scotland
- Scottish Natural Heritage
- Scottish Environment Protection Agency
- Cadw (Welsh Assembly Government's historic environment division)
- Countryside Council for Wales
- Environment Agency (Wales)
- Northern Ireland Environment Agency (previously Department of Environment (NI))

In addition, the Joint Nature Conservation Committee, Marine Management Organisation and Marine Scotland will also be included as consultation bodies for this SEA.

1.4.2 The relevant areas

For offshore renewable energy this SEA[7] 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 Figure 1.2a. 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 exercise. For gas storage and carbon dioxide storage, the SEA[8] considers potential licensing/leasing in UK territorial waters and the UK Gas Importation and Storage Zone (GISZ).

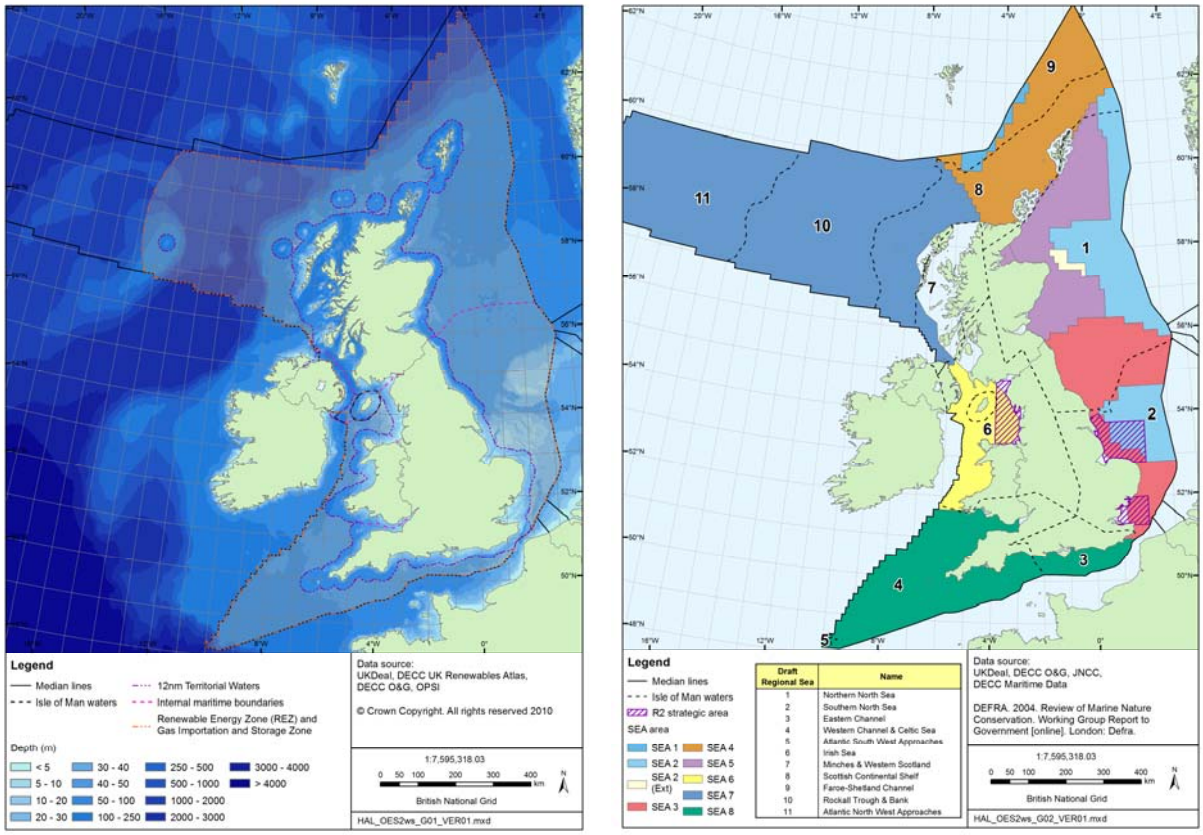
For offshore (seaward) oil and gas licensing, this SEA covers all UK waters (previous SEA 1 to 8 areas) – see Figure 1.1b[9].

[7] In cooperation with the devolved administrations
[8] In cooperation with the devolved administrations
[9] Areas that lie within bay closure lines (shown in pale blue adjacent to the UK coast on Figure 1.1B) e.g. the Minches are subject to a different oil and gas licensing regime and do not form part of this draft plan/programme. However, to allow full consideration the SEA addresses the potential of the draft plan/programme for effects on these areas.

Figure 1.1 – Relevant areas

a) OESEA2 Geographical coverage

b) Past SEA areas (coloured) also showing 2004 draft Regional Seas (numbered)



1.4.3 Contents of the Environmental Report

Schedule 2 of the Regulations sets out the information to be included in an Environmental Report of a Strategic Environmental Assessment – see Table 1.1. Regulation 12(3) specifies that….

"the report shall include such of the information referred to in Schedule 2 …. as may reasonably be required, taking account of:- (a) current knowledge and methods of assessment; (b) the contents and level of detail in the plan or programme; (c) the stage of the plan or programme in the decision-making process; and (d) the extent to which certain matters are more appropriately assessed at different levels in that process in order to avoid duplication of the assessment."

Table 1.1 – Information to be included in Environmental Reports as required by Schedule 2 of the *Environmental Assessment of Plans and Programmes Regulations 2004*

1. An outline of the contents and main objectives of the plan/programme, and of its relationship with other relevant plans/programmes.
2. The relevant aspects of the current state of the environment and the likely evolution thereof without implementation of the plan/programme.
3. The environmental characteristics of areas likely to be significantly affected.

4. Any existing environmental problems which are relevant to the plan/programme including, in particular, those relating to any areas of a particular environmental importance, such as areas designated pursuant to Council Directive 79/409/EEC on the conservation of wild birds and the Habitats Directive.

5. The environmental protection objectives, established at international, Community or Member State level, which are relevant to the plan/programme and the way those objectives and any environmental considerations have been taken into account during its preparation.

6. The likely significant effects on the environment, including short, medium and long-term effects, permanent and temporary effects, positive and negative effects, and secondary, cumulative and synergistic effects, on issues such as - (a) biodiversity; (b) population; (c) human health; (d) fauna; (e) flora; (f) soil; (g) water; (h) air; (i) climatic factors; (j) material assets; (k) cultural heritage, including architectural and archaeological heritage; (l) landscape; and (m) the inter-relationship between the issues referred to in sub-paragraphs (a) to (l).

7. The measures envisaged to prevent, reduce and as fully as possible offset any significant adverse effects on the environment of implementing the plan/programme.

8. An outline of the reasons for selecting the alternatives dealt with, and a description of how the assessment was undertaken including any difficulties (such as technical deficiencies or lack of know-how) encountered in compiling the required information.

9. A description of the measures envisaged concerning monitoring in accordance with regulation 17.

10. A non-technical summary of the information provided under paragraphs 1 to 9.

The criteria for determining the likely significance of effects are set out in Schedule 1 of the Regulations and are listed in Table 1.2.

Table 1.2 – Criteria for determining the likely significance of effects on the environment as specified in Schedule 1 of the *Environmental Assessment of Plans and Programmes Regulations 2004*

1. The characteristics of plans/programmes, having regard, in particular, to:-
   - (a.) the degree to which the plan/programme sets a framework for projects and other activities, either with regard to the location, nature, size and operating conditions or by allocating resources;
   - (b.) the degree to which the plan/programme influences other plans/programmes including those in a hierarchy;
   - (c.) the relevance of the plan/programme for the integration of environmental considerations in particular with a view to promoting sustainable development;
   - (d.) environmental problems relevant to the plan/programme; and
   - (e.) the relevance of the plan/programme for the implementation of Community legislation on the environment (for example, plans/programmes linked to waste management or water protection).

2. Characteristics of the effects and of the area likely to be affected, having regard, in particular, to:-
   - (a.) the probability, duration, frequency and reversibility of the effects;
   - (b.) the cumulative nature of the effects;
   - (c.) the transboundary nature of the effects;
   - (d.) the risks to human health or the environment (for example, due to accidents);
   - (e.) the magnitude and spatial extent of the effects (geographical area and size of the population likely to be affected);
   - (f.) the value and vulnerability of the area likely to be affected due to –
     - (i.) special natural characteristics or cultural heritage;

(ii.) exceeded environmental quality standards or limit values; or
(iii.) intensive land-use; and

(g.) the effects on areas or landscapes which have a recognised national, Community or international protection status.

1.4.4 Organisation of the Environmental Report

A large amount of information has been collated, reviewed and assessed as part of this SEA. To facilitate reader access and understanding, the following 'road-map' identifies where relevant information can be found. The body of the Environmental Report comprises 7 main sections plus a bibliography, glossary, appendices and a non-technical summary. Figures and tables are interspersed throughout the document.

Table – 1.3 – Structure of the Environmental Report

ER Section	Summary
Non-technical summary	A stand alone summary in non technical language of the SEA, its findings and conclusions.
Section 1 Introduction	Describes the background to the draft plan/programme and the regulatory context and purpose of the SEA and the ER.
Section 2 Overview of the draft plan/programme	Provides details of the background to the proposed plan/programme, the plan/programme itself, its objectives and relationships to other initiatives. Alternatives to the plan/programme are also described.
Section 3 SEA approach	Describes the scope and methodology of the SEA.
Section 4 Environmental Information	Describes the environmental characteristics of the relevant areas, identifies relevant existing environmental problems, the likely evolution of the environmental baseline and SEA objectives.
Section 5 Consideration of the potential effects of the draft plan/programme	Provides details of the assessment method, a consideration of the results of the assessment and identifies mitigation and enhancement measures to prevent, reduce or offset any significant adverse effects identified during the assessment process.
Section 6 Recommendations and monitoring	Provides an overall conclusion regarding the likely implications of the proposed licensing/leasing and alternatives, together with recommendations for mitigation and monitoring and gaps in understanding relevant to the process.
Section 7 Next steps	Describes the consultation phase for the Environmental Report and proposed plan/programme, the process underpinning the adoption of the plan/programme and the final SEA statement.
	Bibliography
	Glossary and abbreviations
Appendix 1 Key issues	Contains a matrix of key thematic issues identified to be addressed in the Environmental Report during scoping consultation, assessment and stakeholder workshops.
Appendix 2 SEA Workshops	Contains summaries of the range workshops (assessment, regional stakeholder and sector) which contributed to the SEA process and information base
Appendix 3 Environmental baseline	Underpins Section 4 and contains a series of sub-appendices (A3a to A3j) describing the key characteristics in relation to 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 and conservation of sites and species in relation to UK waters as a whole and for each of the draft regional seas. Due to the recent publication of OESEA (January 2009), and taking account of feedback received through scoping, these appendices are an update to those presented in OESEA. Electronic signposting has been used throughout to link this new information with the previous baseline.

ER Section	Summary
Appendix 4 Other initiatives	Describes other initiatives, plans and programmes of relevance to the proposed plan/programme, the implications of these for the proposed plan/programme and the implications of the proposed plan/programme on these other plans and programmes.
Appendix 5 Regulatory and other controls	Summarises the key environmental legislation and controls

1.4.5 The study team

This report was prepared by independent consultants, Hartley Anderson Limited, in conjunction with DECC. Contributions to the assessment and the public consultation document have been received from the SEA Steering Group, together with authors of the underpinning studies commissioned for the DECC SEA process and the participants in the SEA workshops.

1.5 Public consultation

The Environmental Report and draft plan/programme will be issued for formal consultation as required by the SEA Regulations.

In July 2008 the Government published a third version of the Code of Practice on Consultations which provides seven criteria for consultations – see extract below.

CODE OF PRACTICE ON CONSULTATION
THE SEVEN CONSULTATION CRITERIA

Criterion 1 When to consult
Formal consultation should take place at a stage when there is scope to influence the policy outcome.

Criterion 2 Duration of consultation exercises
Consultations should normally last for at least 12 weeks with consideration given to longer timescales where feasible and sensible.

Criterion 3 Clarity of scope and impact
Consultation documents should be clear about the consultation process, what is being proposed, the scope to influence and the expected costs and benefits of the proposals.

Criterion 4 Accessibility of consultation exercises
Consultation exercises should be designed to be accessible to, and clearly targeted at, those people the exercise is intended to reach.

Criterion 5 The burden of consultation
Keeping the burden of consultation to a minimum is essential if consultations are to be effective and if consultees' buy-in to the process is to be obtained.

Criterion 6 Responsiveness of consultation exercises
Consultation responses should be analysed carefully and clear feedback should be provided to participants following the consultation.

Criterion 7 Capacity to consult
Officials running consultations should seek guidance in how to run an effective consultation exercise and share what they have learned from the experience.

Extract from Code of Practice on Consultation issued July 2008

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2 OVERVIEW OF THE DRAFT PLAN/PROGRAMME & RELATIONSHIP TO OTHER INITIATIVES

The SEA Regulations require that the Environmental Report includes:

> *"an outline of the contents and main objectives of the plan or programme, and of its relationship with other relevant plans and programmes" and that consideration is given to the degree to which the "plan or programme influences other plans and programmes including those in a hierarchy"*
>
> *"the environmental protection objectives, established at international, Community or Member State level, which are relevant to the plan or programme and the way those objectives and any environmental considerations have been taken into account during its preparation".*

A list of the International European and UK initiatives, including plans/programmes, together with their objectives which have been analysed in terms of their implications for the draft plan/programme and vice versa is given in Appendix 4.

2.1 The draft plan/programme

2.1.1 Energy policy context

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 Low Carbon Transition Plan (2009)[10] outlines how the UK will meet the 2020 34% emission reduction. A key element in the delivery of these targets is to secure energy supplies by ensuring a supportive climate for the substantial new investment needed to bring forward low carbon infrastructure, and to maximise the economic production of offshore oil and gas to help secure the continued fossil fuel supplies required during the transition.

The UK has a legally binding target to generate 15% of its energy from renewable sources by 2020, stemming from the EU Renewable Energy Directive, and scenarios for achieving this were outlined in the UK Government Renewable Energy Strategy (2009)[11]. The strategy recognises that offshore wind, and in the longer term, wave and tidal energy will play an important role.

A number of other UK energy related initiatives and consultations are underway. A Revised Draft Overarching National Policy Statement for Energy (EN-1)[12] was presented to parliament in October 2010 and a public consultation exercise is currently underway on EN-1 and draft subsidiary policy statements. The DECC 2050 Pathways work presents a framework through which to consider some of the choices and trade-offs which the UK will have to make over the next forty years. It shows that it is possible to meet the 80% emissions reduction target in a range of ways, and allows people to explore the combinations of effort which meet the emissions target while matching energy supply and

[10] ECC (2009). The Low Carbon Transition Plan. National Strategy for Climate and Energy. (http://www.decc.gov.uk/en/content/cms/publications/lc_trans_plan/lc_trans_plan.aspx)
[11] DECC (2009). The UK Renewable Energy Strategy. (http://www.decc.gov.uk/en/content/cms/publications/lc_trans_plan/lc_trans_plan.aspx)
[12] DECC (2010) Revised Draft Overarching National Policy Statement for Energy (EN-1) (https://www.energynpsconsultation.decc.gov.uk/)

demand. The 2050 Pathways Analysis report[13] was published in July 2010 and was accompanied by a call for evidence which invited feedback by 5th October 2010.

The SEA includes high level strategic consideration of the implications of major development of offshore grid infrastructure required to convey electricity from offshore renewable energy devices to the UK mainland. National Grid Electricity Transmission as NETSO has the duty of ensuring a coordinated and efficient electricity grid both onshore and offshore. As part of this function, NETSO published an initial Offshore Development Information Statement (ODIS) for consultation in December 2009. The ODIS provides different scenarios to 2025 for offshore generation and gives NETSO's best view of how and where this generation might best connect to the onshore grid, and what onshore reinforcements would be required to accommodate the new generation. NETSO consulted in March 2010 on the scenarios it uses in the ODIS with subsequent publication of the ODIS in September 2010 following approval by the Gas and Electricity Markets Authority. The ODIS will be updated subsequently on an annual basis. In addition, a DECC consultation on implementing further refinements to the Offshore Electricity Transmission regime ended on 29th November 2010.

The development of Carbon Capture and Storage (CCS) is another important element of the Low Carbon Transition Plan. The Framework for the Development of Clean Coal (FDCC) initiates a programme of CCS demonstration with the ambition to see CCS ready for wider deployment from 2020. The UK Government has committed £1bn to help fund the demonstration of CCS on a coal or gas[14] power station selected through a competition initiated in November 2007. CCS involves capturing carbon dioxide and transporting it for permanent storage in underground geological formations, for example in depleted gas and oil fields or in saline aquifers. It has the potential to reduce emissions from power stations and other industrial installations by around 90%, but is generally considered not yet ready for large scale deployment. As part of the FDCC, the Government wishes to promote the co-location of CCS demonstrator projects, possibly yielding some cost saving benefits to the demonstrator programme through shared transportation and storage infrastructure. The UK is already considered to be a global leader in CCS and is seeking to strengthen this position and further drive the development and deployment of this technology.

The UK is presently a net importer of energy including oil and gas, with imports of gas being a particular concern. Gross natural gas production has fallen by 45 per cent since its peak in 2000. In 2009, net imports of gas accounted for a third of gas input into the transmission system (DECC, Digest of UK Energy Statistics 2010). The UK Government projects that by 2020 this will be 45%, assuming that the policies outlined in the Low Carbon Transition Plan are realised. 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.

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.

[13] DECC (2010) 2050 Pathways Analysis (http://www.decc.gov.uk/assets/decc/What%20we%20do/A%20low%20carbon%20UK/2050/216-2050-pathways-analysis-report.pdf)

[14] The CCS demonstration programme was opened to gas fired power stations in November 2010: http://www.decc.gov.uk/en/content/cms/news/PN10_117/PN10_117.aspx

2.1.2 The draft plan/programme

The draft plan/programme to be covered by this SEA will help to contribute to the Government targets outlined above by enabling future renewable leasing for offshore wind, wave and tidal devices and licensing/leasing for seaward oil and gas rounds and hydrocarbon and carbon dioxide gas 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 towards the objective of achieving an installed generation capacity of some 33GW 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 also considers 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

The indicative time horizon (i.e. period of currency) for this SEA is five years. Various legal and policy objectives and targets have long time scales (e.g. the 2008 Climate Change Act introduced legally binding 'carbon budgets', aiming to cut UK emissions on 1990 levels by 34% by 2020 and at least 80% by 2050). However, as several of the technologies covered in the draft plan/programme are likely to undergo rapid change, and various marine environmental management initiatives are underway, a five year time horizon for this SEA is considered appropriate. This indicative time horizon will be periodically reviewed by DECC (as the competent authority) in the context of new information on technologies, effects, or plan/programme status. For this SEA it is anticipated that renewable energy devices will not be deployed in water depths of more than 200m, with the majority of developments expected to be in water depths of less than 60m. No depth constraints are envisaged for hydrocarbon exploration and production, or hydrocarbon and other gas storage activities.

2.2 Marine management context

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[15]. 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

[15] DOENI (2010). A Northern Ireland Marine Bill – Policy Proposals (http://www.doeni.gov.uk/index/protect_the_environment/water.htm)

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 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.

2.3 Alternatives to the draft plan/programme

The following alternatives to the draft plan/programme 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 alternatives were considered using the hierarchy of options below (modified from ODPM 2005).

need or demand: is it necessary?
Can the need or demand be met without implementing the plan or programme at all?

↓

mode or process: how should it be done?
Are there technologies or methods that can meet the need with less environmental damage than 'obvious' or traditional methods?

↓

location: where should it go?

↓

timing and detailed implementation:
When, in what form and in what sequence should the plan be carried out?
What are the important issues? Do existing controls and measures address them? What other controls and measures are required?

The results are summarised in Table 2.2.

Table 2.2 – Consideration of hierarchy of alternatives

Is there a need or demand?	Security of supply is one of the key issues identified in a series of Energy White Papers and Reviews. As production from UK oil and gas fields declines, the UK will become more reliant on imports. In 2009, net imports of gas accounted for a third of gas input into the transmission system rising to 45%, assuming implementation of the policies outlined in the Low Carbon Transition Plan. In addition, the UK is a now net importer of oil and oil products. In the absence of the plan the UK would import additional fuel to make up the shortfall in domestic production. In December 2008 the European Parliament and Council of Ministers reached political agreement on legislation to require that by 2020, 20% of the EU's energy consumption must come from renewable sources. The UK's contribution to this will require the share of renewables in the UK's energy consumption to increase from around 1.5% in 2006 to 15% by 2020. The means by which this target is to be achieved is set out in the UK Renewable Energy Strategy. The Energy Reviews recognised that, in spite of developments in low carbon technologies and improvements in energy efficiency, fossil fuels, and particularly oil and gas, will constitute the majority of the UK energy mix for the foreseeable future and that maximising production from domestic supplies would

	further contribute to domestic employment and energy security. Exploiting the UK's energy reserves contributes to a diverse and secure UK energy mix as well as to the economy in terms of jobs, investment and national income generated by the sector.
Mode or process	Offshore wind farm technologies and oil and gas exploration, drilling and production technologies are not static and improvements are introduced to increase efficiency and reduce environmental footprint and impacts. Some aspects of the plan, such as wave, tidal stream and carbon storage are emergent industries which are unlikely to see widescale commercial deployment during the currency of this SEA, with larger arrays and commercial viability probably achieved closer to 2020. New techniques and technologies, once proven, can be expected to rapidly become accepted practice.
Location	The presence of exploitable wind, wave and tidal resources and commercial hydrocarbon resources/gas (including carbon dioxide) storage capacity is variously a function of location, geological history and existing sensitivities and uses which dictate the areas of potential interest.
Timing and detailed implementation	The plan is needed so that: • further areas can be leased for offshore wind farms in the UK REZ and in English and Welsh territorial waters • areas can be leased for wave, tidal stream and tidal range developments in the UK REZ and in English and Welsh territorial waters. • areas can be licensed for hydrocarbon exploration and production in currently unlicensed blocks/unleased areas • carbon dioxide and hydrocarbon gas storage can be licensed/leased in areas within the GISZ • • In relation to the offer of blocks covered by previous SEAs, the early implementation of the plan would allow potential synergies in terms of use of existing infrastructure (e.g. pipelines) to be taken advantage of. The extent of such synergies, including the possible use of infrastructure in the storage of

	hydrocarbon gas and carbon dioxide, will decline if the plan is delayed as infrastructure is decommissioned and removed.

2.4 Context to licensing and leasing

2.4.1 Oil and gas licensing

The exclusive rights to search and bore for and get petroleum in Great Britain, the territorial sea adjacent to the United Kingdom and on the UK Continental Shelf (UKCS) are vested in the Crown and the *Petroleum Act 1998* (as amended) gives the Secretary of State the power to grant licences to explore for and exploit these resources. The main type of offshore Licence is the Seaward Production Licence. Offshore licensing for oil and gas exploration and production commenced in 1964 and has progressed through a series of Seaward Licensing Rounds. A Seaward Production Licence may cover the whole or part of a specified Block or a group of Blocks. For hydrocarbon licensing purposes UK waters are divided into quadrants of 1° of latitude by 1° of longitude (except where the coastline, "bay closing line" or a median line intervenes). Each quadrant is further partitioned into 30 blocks each of 10 x 12 minutes. The average block size is about 250km^2.

A Licence grants exclusive rights to the holders "to search and bore for, and get, petroleum" in the area covered by the Licence. A Licence does not confer any exemption from other legal/regulatory/fiscal requirements.

There are three types of Seaward Production Licences:

- Traditional Production Licences are the standard type of Seaward Production Licences and run for three successive periods or Terms. Each Licence expires automatically at the end of each Term, unless the licensee has made enough progress to earn the chance to move into the next Term. The Initial Term lasts for four years and the Licence will only continue into a Second Term of four years if the agreed Work Programme has been completed and if 50% of the acreage has been relinquished. The Licence will only continue into a Third Term of 18 years if a development plan has been approved, and all the acreage outside that development has been relinquished.

- Frontier Production Licences are a variation of the Traditional Production Licence with longer terms. A Frontier Production Licence has a longer Initial Term (six years as opposed to four) with the objective of allowing companies to screen larger areas. After 3 years, the licensee must relinquish 75% of the licensed acreage. At the end of the Initial Term, the exploration Work Programme must have been completed and the licensee must relinquish 50% of what is left (i.e. leaving one eighth of the original licensed area).

- In the 21st Round (2002) the Department introduced Promote Licences. The general concept of the Promote Licence is that the licensee is given two years after award to attract the technical, environmental and financial capacity to complete an agreed Work Programme. In effect, DECC will defer (not waive) its financial, technical and environmental checks until the preset Check Point. Promote licensees are not allowed to carry out field operations until they have met the full competence criteria. The way this is implemented is that each Promote Licence carries a "Drill-or-Drop"

Initial Term Work Programme. The Licence will therefore expire after two years if the licensee has not made a firm commitment to DECC to complete the Work Programme (e.g. to drill a well). By the same point, it must also have satisfied DECC of its technical, environmental and financial capacity to do so.

The model clauses and terms and conditions which are attached to Licences are contained in Regulations.

It is noted that the environmental management capacity and track record of applicants is considered by DECC, through written submissions and interviews, before licences are awarded.

2.4.2 Gas storage and unloading

The *Energy Act 2008* provides for a licensing regime governing the offshore storage and unloading of gas (natural gas consisting mainly of methane). The regime applies to storage and unloading within the offshore area comprising both the UK territorial sea, and the area extending beyond the territorial sea that has been designated as a Gas Importation and Storage Zone (GISZ) under section 1(5) of that Act[16]. The Act makes it an offence to carry out any of the activities below except in accordance with a licence and with prior consent:

- use of a controlled place for the unloading of gas to an installation or pipeline
- use of a controlled place for the storage of gas
- conversion of any natural feature in a controlled place for the purpose of storing gas
- recovery of gas stored in a controlled place
- exploration of a controlled place with a view to gas storage
- establishment or maintenance in a controlled place of an installation for the purposes of activities within this subsection

The Competent Authority for the issuance and regulation of licences is DECC, and the Act makes provision for the future making of more detailed regulations in respect of this. This Act also makes provision with respect to the interaction between activities regulated under the *Petroleum Act* and gas storage activities.

The *Offshore Gas Storage and Unloading (Licensing) Regulations 2009* set out model clauses which would form part of a licence granted under the *Energy Act 2008*.

In order to explore for, drill for or use a natural gas storage site the UK's offshore area, an operator must hold:

- A Licence issued by the Secretary of State for Energy and Climate Change under Section 14 of the *Energy Act 2008*.

- A Lease from The Crown Estate for storage activities for all offshore areas, (including the territorial sea) as the right to store gas in the offshore area is vested in the Crown by virtue of Section 1 of the *Energy Act 2008*.

The leasing and licensing process will be broadly approached in parallel by DECC and The Crown Estate.

[16] Gas Storage and Importation Zone (Designation of Area) Order 2009 (SI 2009/223)

To allow for exploration/appraisal work a Licence will initially be issued for an Exploration Term which will provide the framework for regulatory consent for physical activities at the site, e.g. intrusive drilling and the subsequent Gas Storage Development Plan application. During the initial term of the Licence The Crown Estate Lease will be in the form of an Agreement for Lease for the same duration. The Licence and Lease will contain defined 2D geographical boundaries within which exploration and appraisal activities may be undertaken.

During the Exploration Term of the Licence, the operator will be required to submit an application for a Gas Storage Development Plan and will then to submit an "Option Notice" to The Crown Estate to activate a full Storage Lease. Failure to submit an application for a Gas Storage Development Plan during the Exploration Term will typically result in the termination of the Licence and Lease. The Storage Lease and Permit will define the formation within which the gas may be stored, as a three-dimensional space.

Both licensing and leasing requirements also apply to gas unloading activities although unloading gas to apparatus which is part of a submerged pipeline with no surface installation does not require a Licence.

A Lease for an unloading facility granted by The Crown Estate will define a 2D geographical boundary and for it to come into legal effect the operator will be required to apply to DECC for a Licence and the licence will refer to the lease. The licence when issued will contain a provision enabling the submission of a Gas Unloading Development Plan[17] which when approved by DECC will allow for the construction of the facility.

It is noted that the environmental management capacity and track record of applicants is considered by DECC, through written submissions and interviews, before licences are awarded.

2.4.3 Carbon dioxide storage

The *Energy Act 2008* provides for a licensing regime governing the offshore storage of carbon dioxide and makes it an offence to carry out storage activities without a licence. A Licence does not confer any exemption from other legal/regulatory/fiscal requirements. The regime applies to storage in the offshore area comprising both the UK territorial sea, and any area extending beyond the territorial sea that has been designated as a GISZ under the Act.

The Government's response to the consultation on the proposed licensing regime for offshore carbon dioxide storage was published in August 2010[18] and notes that established rights to extract petroleum would not be compromised by the storage arrangements, but the existence of petroleum rights in a particular area would not preclude the grant of storage rights over the same or overlapping areas, provided the different activities did not conflict. The consultation document indicated that it would be DECC's intention to consent to an overlapping development only where there is evidence that suitable liability and operational agreements are in place.

The *Storage of Carbon Dioxide (Licensing etc.) Regulations 2010* (SI 2010/2221) provide more detail of the licensing regime for which the Secretary of State is the licensing authority.

[17] The pipeline to the shore will be consented to separately by a Pipeline Works Authorisation.
[18] DECC (2010). Government Response to the Consultation on the Proposed Offshore Carbon Dioxide Storage Licensing Regime.

In order to explore for, drill for or use a geological feature for the long term storage of carbon dioxide in the UK offshore area, an operator must hold:

- A Licence issued by the Secretary of State for Energy and Climate Change under Section 18 of the *Energy Act 20*08, except in respect of activities in the UK territorial sea (12 miles from the baseline) adjacent to Scotland, for which Scottish Ministers are the Licensing Authority.

- A Lease from The Crown Estate for storage activities for all offshore areas, (including the territorial sea adjacent to Scotland) as the right to store gas (including carbon dioxide) in the offshore area is vested in the Crown by virtue of Section 1 of the *Energy Act 2008*.

The leasing and licensing process will be broadly approached in parallel by DECC and The Crown Estate.

To allow for exploration/appraisal work a Licence will initially be issued for a fixed Appraisal Term, will refer to the Lease, and will provide the framework for regulatory consent for physical activities at the site, e.g. intrusive drilling and the subsequent Storage Permit application. The Crown Estate will grant an Agreement for Lease for the same duration. The Licence and Lease will contain defined 2D geographical boundaries within which exploration and appraisal activities may be undertaken.

During the Appraisal Term of the Licence, the operator will be required to submit an application for a full Storage Permit and will then to submit an "Option Notice" to The Crown Estate to activate a full Storage Lease. Failure to submit an application for a Storage Permit during the Appraisal Term will typically result in the termination of the Licence and Lease. The Storage Lease and Permit will define the formation within which the carbon dioxide may be stored, as a three-dimensional space including the proposed three-dimensional extent of any intended storage site.

It is noted that the environmental management capacity and track record of applicants is considered by DECC, through written submissions and interviews, before licences are awarded.

2.4.4 Renewable energy leasing

Under *The Crown Estate Act 1961*, The Crown Estate represents the Crown as landowner of the UK seabed and areas of foreshore, as well as the holder of certain sovereign rights in respect of areas beyond the territorial sea. Such sovereign rights are vested in the Crown by the virtue of the designation of such areas as a GISZ (see above) or as a Renewable Energy Zone (REZ). The Crown Estate's permission, in the form of a site option Agreement and Lease is required for the placement of structures or cables on the seabed, this includes offshore wind farms and their ancillary cables and other marine facilities. Potential offshore wind farm developers also require statutory consents from a number of Government departments before development can take place. During Rounds 1 and 2 of UK offshore wind farm development, successful applicants were awarded an option for a Lease by The Crown Estate. When all necessary statutory consents are obtained by the developer, The Crown Estate can grant a site lease for a development.

The *Energy Act 2004*, provided for the designation of Renewable Energy Zones from 12nm (nautical miles) out to 200nm in which rights under Part V of the UN Convention on the Law of the Sea may be exercised to exploit water or wind energy.

For Round 3, The Crown Estate proposed that development would be undertaken within exclusive Zones and exclusivity agreements are in place for nine Round 3 zones. Similarly (outside of the remit of the R3 programme and this plan/programme), The Crown Estate has entered into exclusivity agreements with companies and consortia for 10 zones in Scottish territorial waters in 2009 totalling ~6.5GW.

Under the *Planning Act 2008*, the Infrastructure Planning Commission (IPC)[19] assumed responsibility for consent applications for offshore electricity generating stations with a capacity of more than 100MW. Developer applications to the IPC will be under the *Planning Act* (which replaces the provisions of the *Electricity Act 1989*).

The *Marine and Coastal Access Act 2009* provided for the creation of the Marine Management Organisation (MMO) which from 1 April 2010 took over responsibility for processing offshore renewable energy generating station applications under section 36 of the *Electricity Act 1989* (and associated safety zone applications) for developments >1MW but below 100MW in English and Welsh territorial waters and the UK Renewable Energy Zone. Defra has consulted on the new marine licensing regime which is planned for implementation in early 2011. Following its implementation, a single Marine Licence will be required for activities formerly covered by the *Coast Protection Act 1949* (CPA) and *Food and Environment Protection Act 1985* (FEPA). The process for making an application to the MMO (which will assume the former responsibilities of the Marine and Fisheries Agency) is expected to be very similar to that for developers applying for FEPA licences. In the Scottish renewable energy zone, Scottish Ministers are responsible for *Electricity Act 1989* consent decisions and FEPA licensing will still apply in their territorial waters. The Scottish Government has recently consulted on marine licensing under the *Marine (Scotland) Act 2010* and the *Marine and Coastal Access Act 2009*[20].

The leasing and consenting processes for wave and tidal current renewable energy generating developments are as described above for offshore wind, though tidal range developments consenting requirements may differ from those of offshore wind to reflect the likelihood of their being land-connected. The Crown Estate has not, to date, carried out any wave or tidal energy leasing rounds for English and Welsh waters but is currently offering leases for test devices or small arrays (up to 10MW or 20 devices). In 2009, The Crown Estate launched a wave and tidal leasing round in the Pentland Firth strategic area and ten agreements for leases were announced in March 2010. In December The Crown Estate also announced that four companies had pre-qualified to submit tenders for new wave and tidal stream energy projects (each up to 30 MW capacity), which could add to the pool of potential contenders for the Scottish Government Saltire Prize and has invited bids for three commercial demonstration projects, each up to 10 MW. A Northern Ireland SEA for its territorial waters was published in March 2010, and The Crown Estate has been discussing potential opportunities and supporting actions for offshore renewable energy deployment with the Department of Energy, Trade and Industry (DETI).

[19] The Government announced that it intends to abolish the IPC, giving its function of examining applications to a Major Infrastructure Planning Unit (MIPU) within the Planning Inspectorate. Until such time as the Planning Act 2008 is amended, the IPC will have the functions set out in the Act.

[20] Marine Scotland (2010). Consultation on Marine Licensing for Scotland under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009.

2.5 Prospectivity

2.5.1 Oil and gas

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. All licensing rounds since the 19th in 2000 have been preceded by an SEA, with all UK waters now covered by previous SEAs. 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 (see Figure 2.1) which can be utilised by new developments. Large field discoveries in shelf depth waters (<200m) have reduced in number as much of the area has been subject to exploration but further large finds cannot be ruled out. Deeper water areas are less well explored; some may not be prospective but there may be potential which has either not been drilled or cannot currently be imaged effectively.

As a context for the consideration of the likely scale of overall drilling activity which could follow future offshore licensing Figures 2.2 and 2.3 show the number of exploration and appraisal wells drilled on the offshore UKCS over the last thirteen years. The number of exploration wells shows a general decline over time although with a slight increase since 2002.

Figure 2.1 – Location of existing oil and gas infrastructure

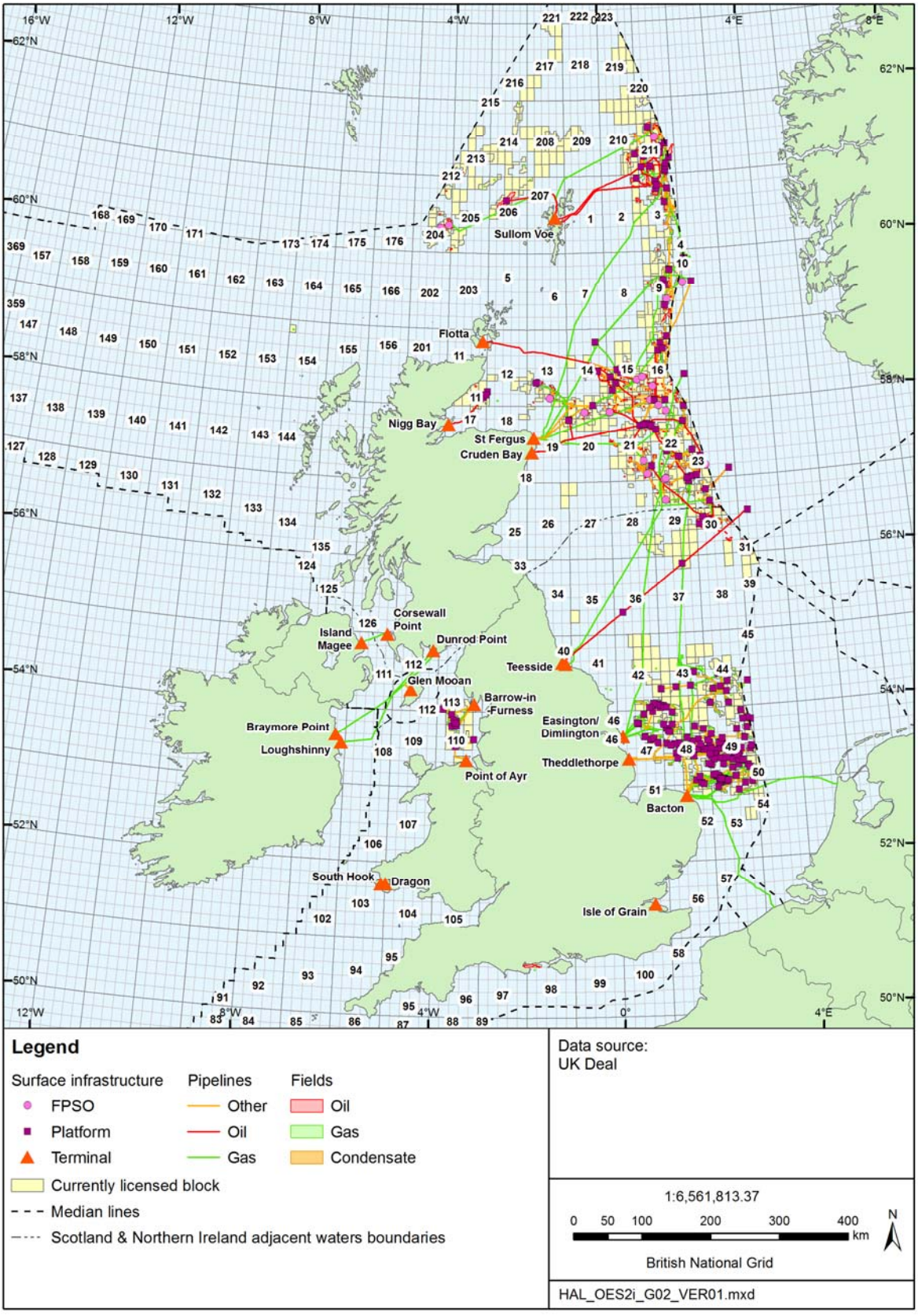


Figure 2.2 – Trends in exploration drilling on the UKCS

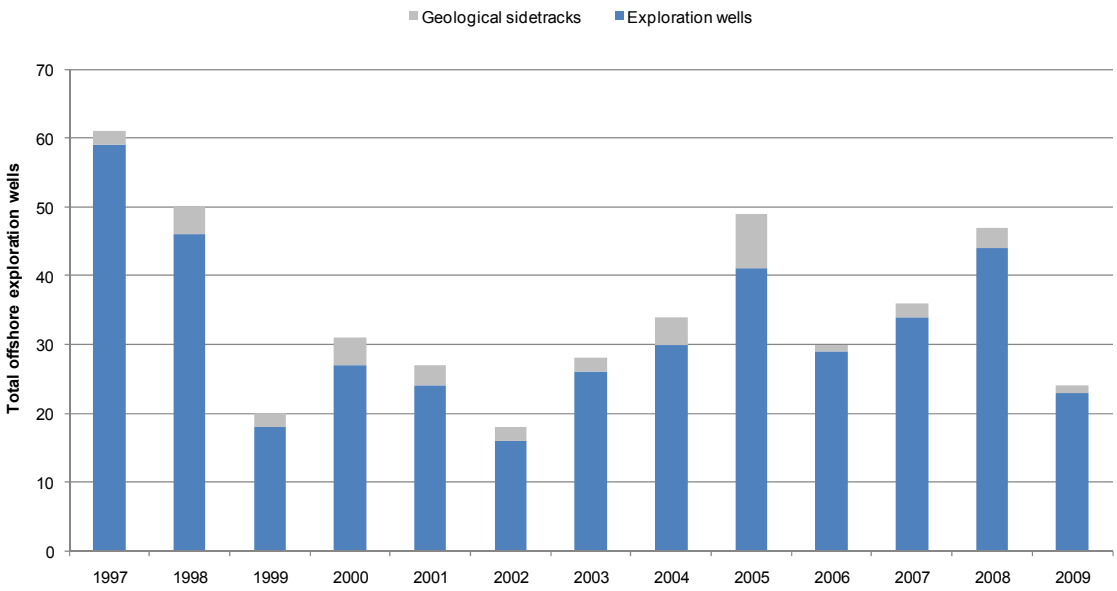
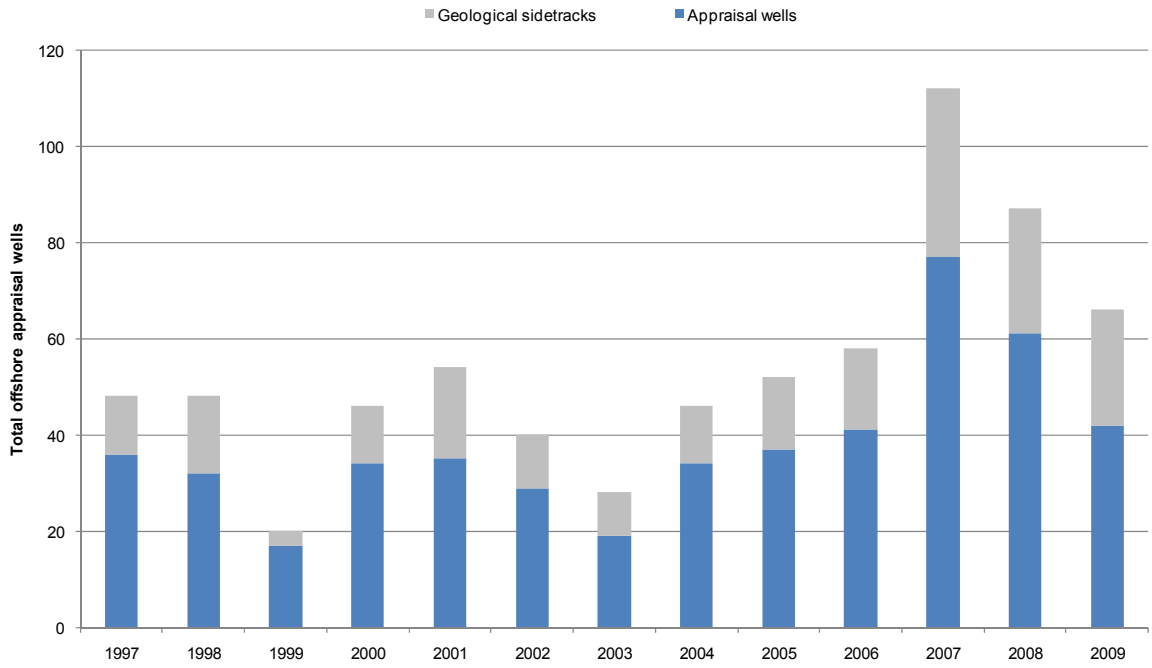


Figure 2.3 – Trends in appraisal drilling on the UKCS



2.5.2 Gas storage and unloading

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).

The most prospective area for halites with gas storage potential (Smith *et al.* 2005) is the Triassic Preesall formation in the East Irish Sea Basin (see Appendix 3b).

Smith *et al.* (2005) note that "based solely on geological criteria, large parts of the offshore Wessex Basin, Peel Basin, Solway Firth Basin, Cardigan Bay Basin and Forth Approaches Basin could also support such facilities. However, these areas currently have no infrastructure, and some have very few wells within the salt depositional area. Without knowing the economic viability of the various elements of the facility, the future competition with onshore facilities, and the total import of gas by this method, it is difficult to assess whether facilities could also be developed in such areas remote from existing infrastructure." Most other deposits in the UKCS are too thin or buried at too great a depth to be viable, though some salt diapirs that rise to shallow depths may be prospective in the Central and Southern North Seas (see Appendix 3b).

2.5.3 Carbon dioxide storage

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 (see Figure 2.5), 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 CO_2 in saline aquifers (4.6-46Gt) and depleted hydrocarbon fields (7.4-9.9Gt), though much of this capacity is presently theoretical.

Carbon capture demonstrator projects are likely to be located in areas of high carbon dioxide emissions (e.g. from power stations around the Thames Estuary, Humberside, Merseyside, the Firth of Forth, Teesside and Tyneside).

For carbon dioxide storage, this SEA considers storage in depleted hydrocarbon reservoirs and in saline aquifers. Like gas storage, the storage of carbon dioxide may be reasonably expected to take place in areas of existing oil and gas production. In addition to these, saline aquifers pose a potentially large repository for carbon dioxide. The storage capacity and suitability of such formations for carbon dioxide storage is presently not well understood, with the most prospective formation being the Lower Triassic Bunter Formation located in the Southern North Sea. Of particular interest are a number of domed structures within the sandstone which may be suited to the storage of gases such as CO_2 (see Appendix 3b). The storage capacity of this formation is estimated to be up to 14.25Gt. Within the currency of OESEA2 it may be reasonably expected that the UK Government funded demonstration programme will get underway on no more than 4 coal or gas fired power plant.

2.5.4 Marine renewable energy

The UK has extensive marine renewable energy resources including wind, wave and tidal, all of which are variable over space and time (see Figures 2.4-2.7).

Figure 2.4 – Annual mean wind power density

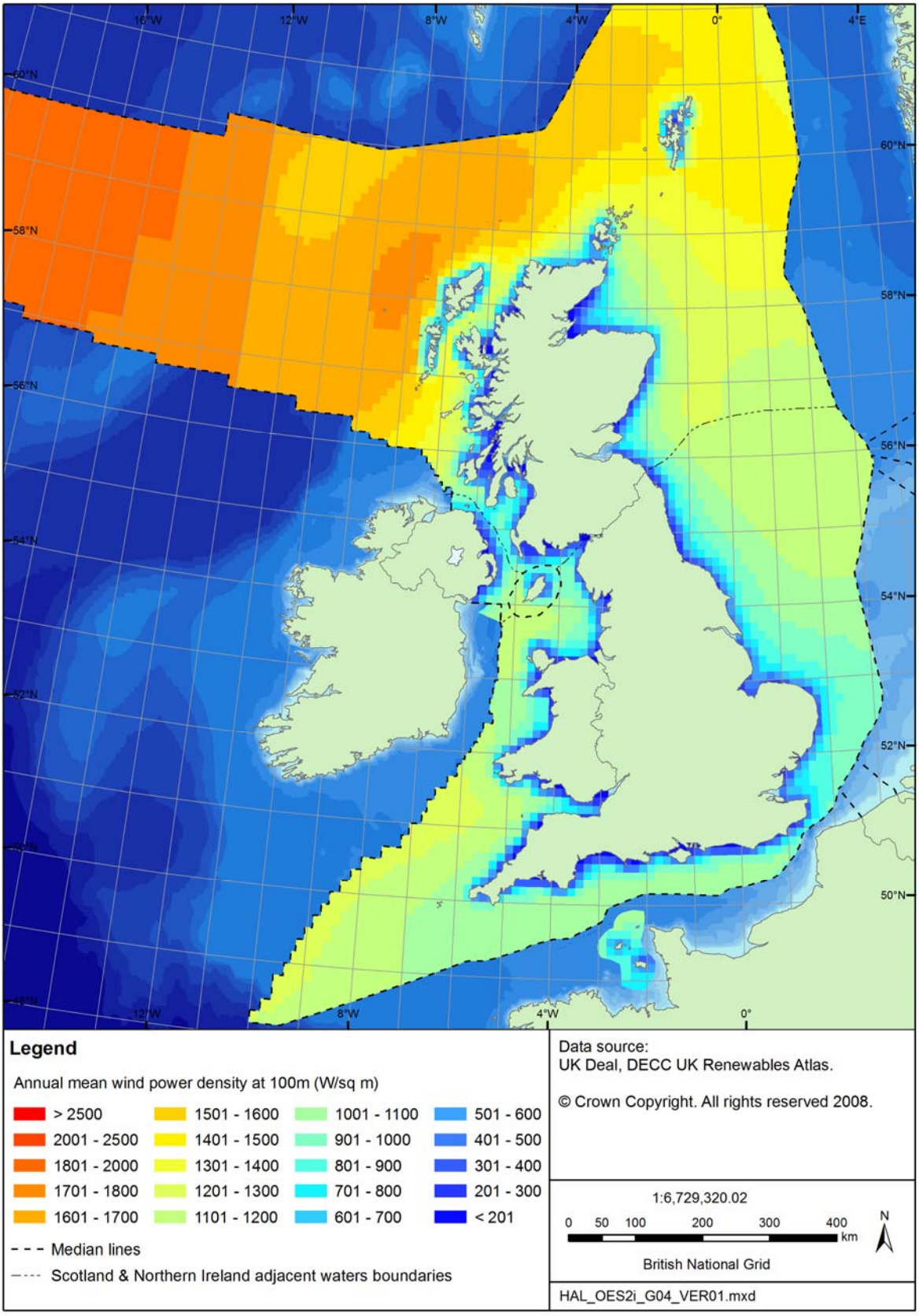


Figure 2.5 – Annual mean wave power

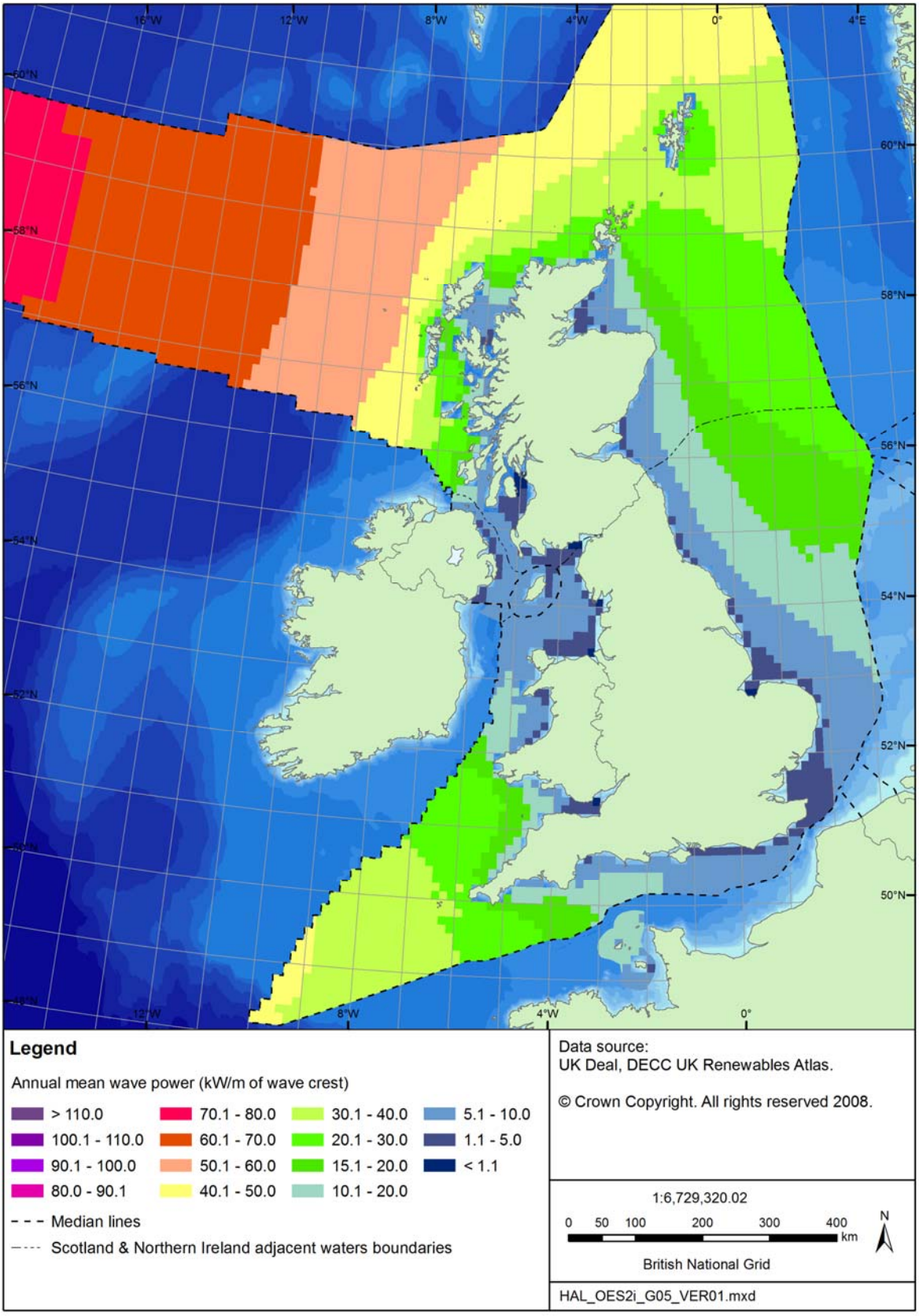


Figure 2.6 – Annual mean tidal power

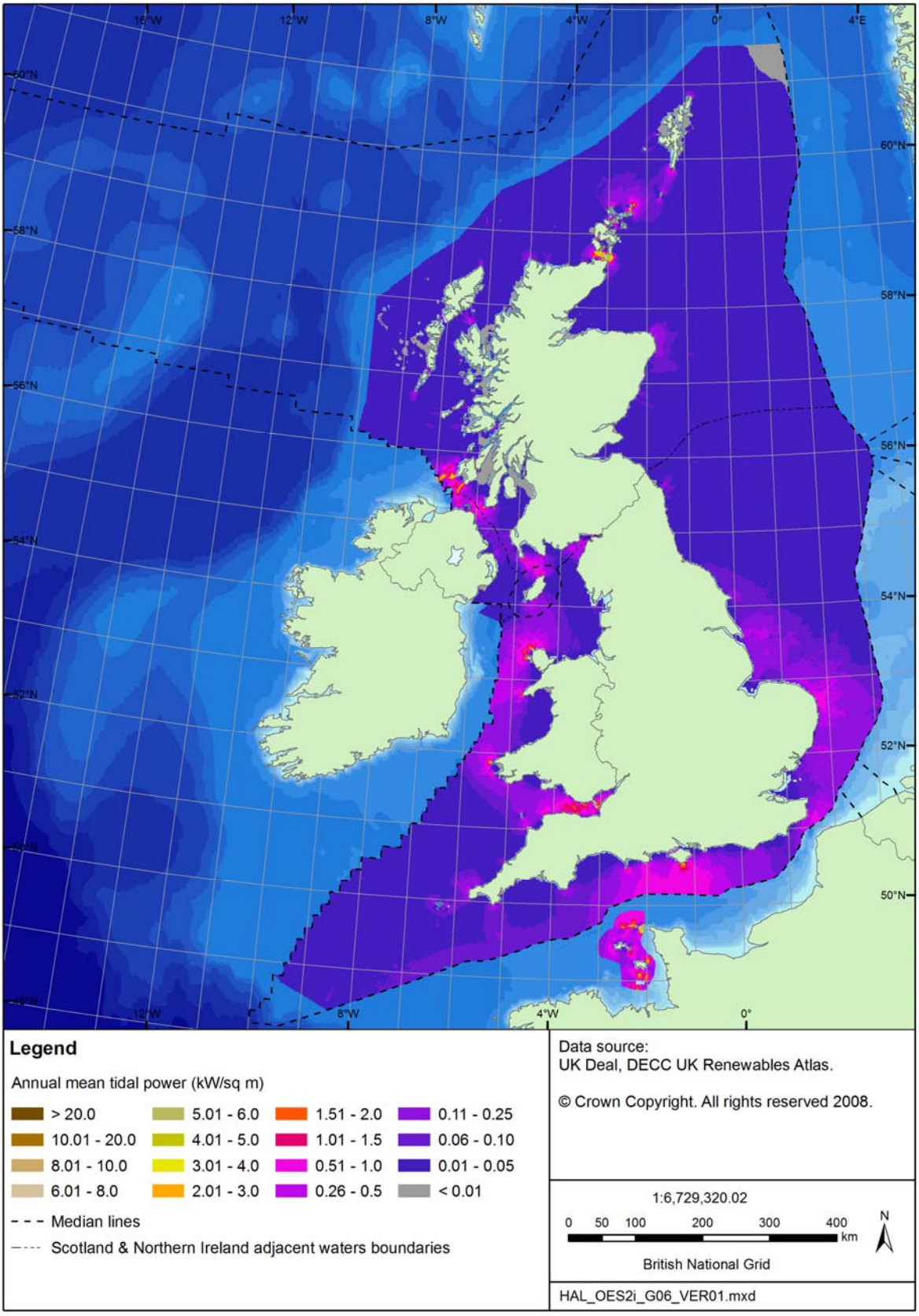
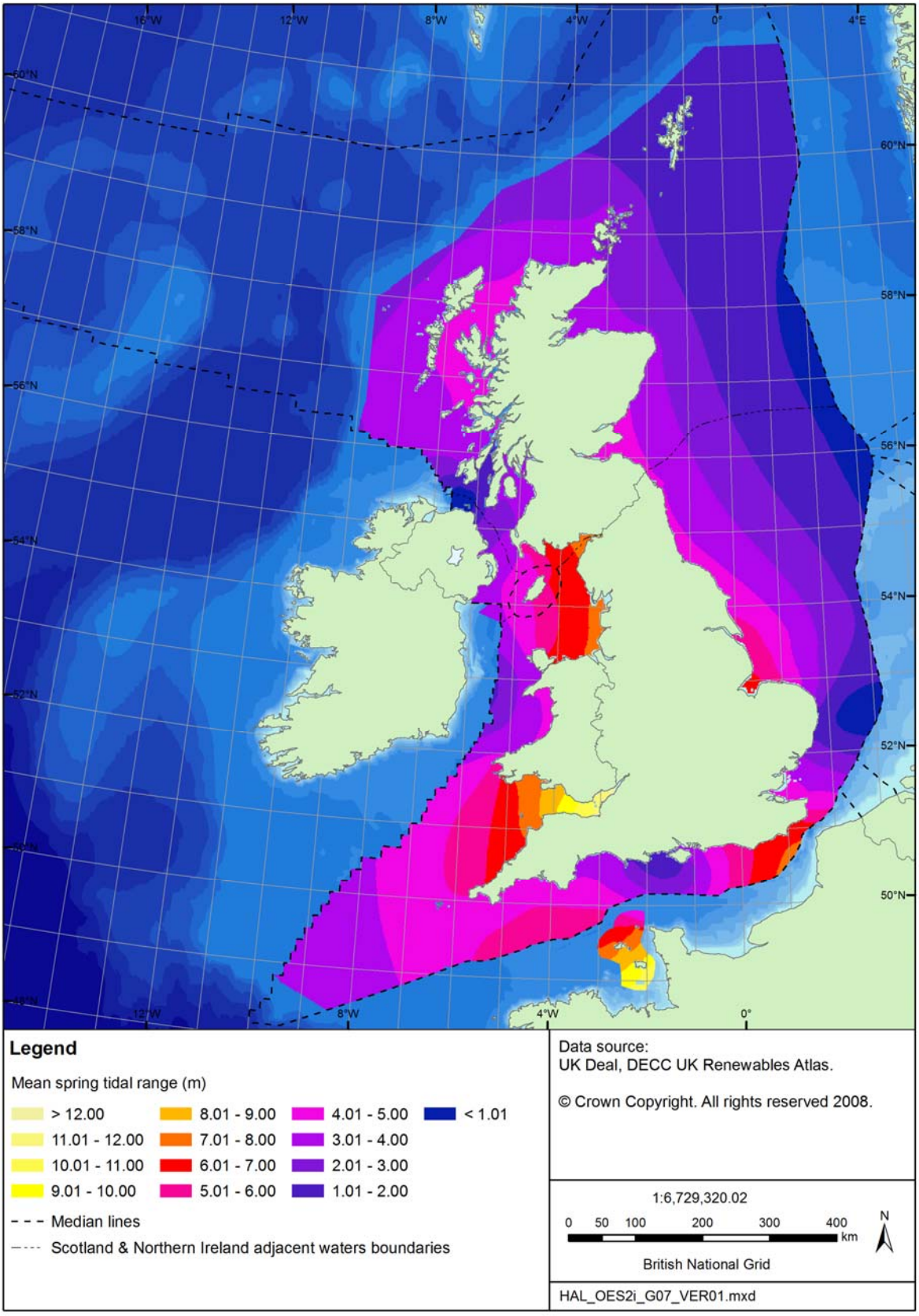


Figure 2.7 – Mean spring tidal range



In UK waters, offshore wind is the most developed of these technologies, see Figure 2.8. 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 5.5 GW with a further 2.3 GW in planning. In January 2010, The Crown Estate announced the exclusivity zone agreements for nine Round 3 offshore wind zones: Moray Firth zone (1.3 GW); Firth of Forth zone, (3.5 GW); Dogger Bank zone, (9 GW); Hornsea zone (4 GW); East Anglia (Norfolk Bank zone), (7.2 GW); Southern Array (Hastings zone), (0.6 GW); West of Isle of Wight zone, (0.9 GW); Atlantic Array (Bristol Channel zone), (1.5 GW); Irish Sea zone (4.2 GW). In May 2010 The Crown Estate awarded extension projects at a number of existing offshore windfarms, namely; Galloper Wind Farm at Greater Gabbard, Kentish Flats 2, Walney extension, Burbo Bank extension, totalling some 1.5 GW. A fifth extension project at Thanet was awarded but later withdrawn by the developer. 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.

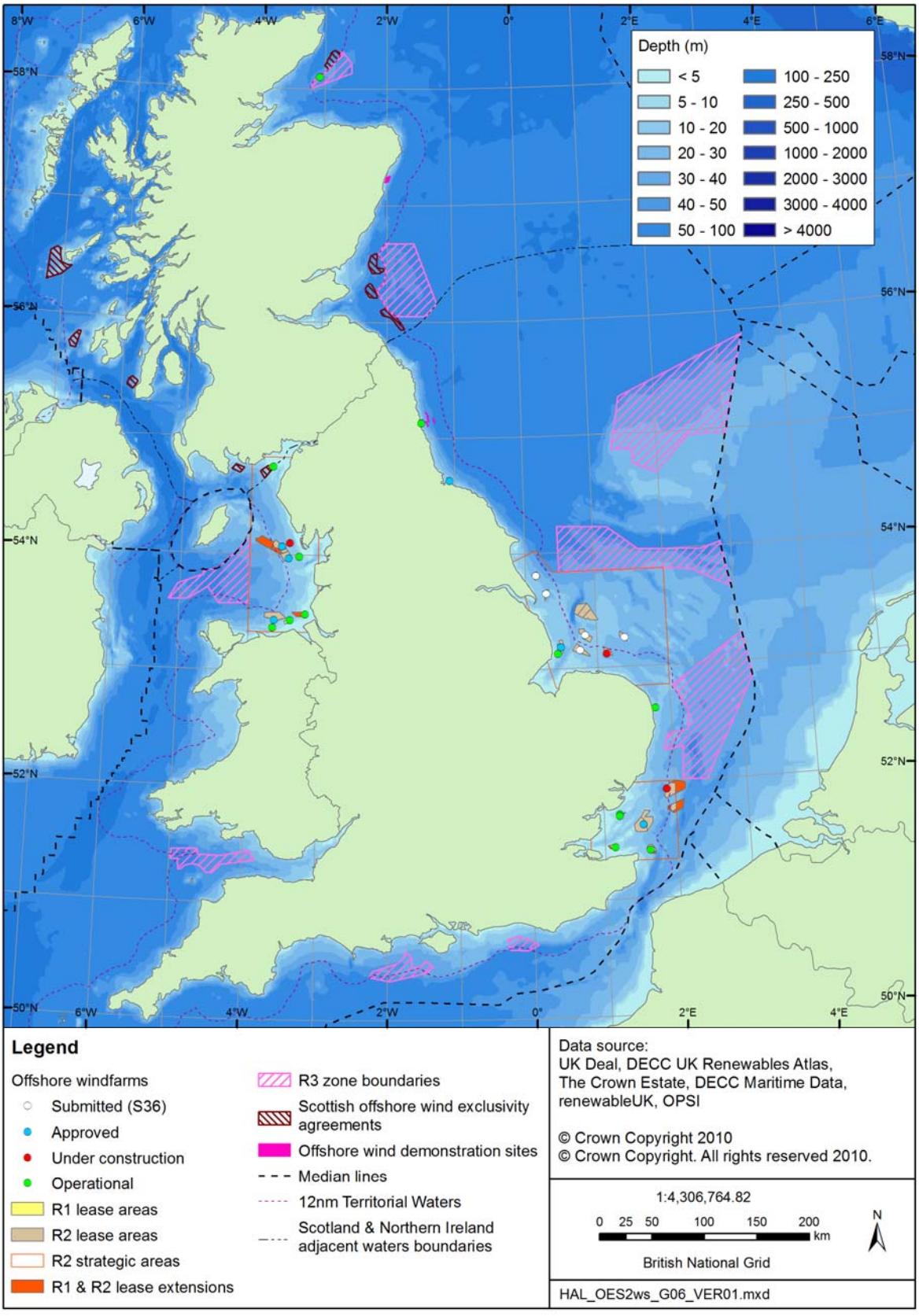
Away from the shelter of the coast, the total wind resource over a given year is relatively uniform across very large areas, although clearly the occurrence and strength of wind is dependent on a number of meteorological factors. At any point in time, while some areas of the UK may be calm, the wind 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.

For offshore wind leasing, this SEA covers those parts of the UK Renewable Energy Zone and the territorial waters of England and Wales where the water depth is around 60m or less. For reference, the current indicative Crown Estate Round 3 Development Zones are shown in Figure 2.8 along with existing Round 1 and 2 lease areas.

At present most offshore wind farms are using 3.6MW or 5MW turbines but larger turbines (up to 10MW) are in development and may be deployed in the lifetime of this draft plan/programme. Similarly, experience and understanding of the effects of the wakes from other turbines is improving, and may lead to greater separation between individual turbines in a wind farm and between wind farms.

Based on advice from BWEA (now RenewableUK) and various developers, the following example is given to allow visualisation of the potential scale of Round 3 developments. A 1GW wind farm may occupy a total area of 391.62 km^2 based on the assumptions that it comprises two groups of 98 x 5MW turbines arranged in a rectangular array of 7 rows of 14 turbines facing the prevailing wind direction with 850m between turbines within the rows and 1200m between rows giving an average array spacing of approximately 8 rotor diameters. Each wind farm is separated from its neighbours by 5km in all directions to reduce adverse wake effects. Based on this example, 25GW of generation capacity could occupy some 9800 km^2 of the shallow (<60m water depth) seabed around the UK.

Figure 2.8 – Wind energy activity and leasing areas



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.

The UK Marine Energy Action Plan (DECC 2010s) stated that industry and government envisage an installed capacity of 1-2GW by 2020 from wave and tidal stream devices. Such a capacity will probably be initially reflected in a number of demonstrator scale projects or small scale arrays, with wider deployment expected at a later date.

Scenarios for the likely scale of the wave and tidal aspects of the draft plan/programme have been generated through consultation with industry and a number of other sources which may be used to visualise the likely scale of deployment of device arrays within the currency of OESEA2, and for the purposes of assessment. Box 2.1 below summarises the range of scenarios used by other SEAs for wave and tidal stream devices in UK and Irish waters and provides context for the scenarios developed for OESEA2.

The scenarios are based on demonstrator and pre-commercial scale deployment within the lifespan of OESEA2. Given the diversity of scenarios outlined in Box 2.1, the scenarios developed for OESEA2 are broad in nature to encompass different technologies and physical settings. It is expected that individual devices will not exceed a capacity of 1MW. The scenario assumptions for OESEA2 are given below:

- Tidal stream – in current speeds of 2m/s or greater at mean spring tide. Array with installed capacity of 30MW covering 0.5-5.0km^2
- Wave – in areas of wave power of 20kW/m or greater. Array with installed capacity of 30MW covering 1-10km^2.
- Tidal range – in areas with mean spring tidal range of 6m or greater

Box 2.1 – Comparison of wave and tidal stream scenarios developed for OESEA2 and other SEAs and related studies

	Area	Tidal Stream	Wave
Resource requirement	SW England[1]	2m/s	20kW/m
	Wales[2]	2-2.5m/s flow	4-60kW/m / >1m wave height
	N. Ireland[3]	1-2m/s flow	>0.5m wave height and 5-15 second peak wave period
	Scotland[4]	2.5m/s flow	1.5m wave height
	ROI[5]	1.2m/s peak spring flow	>20kW/m of wave crest
	OESEA2[6]	**2m/s mean spring flow**	**20kW/m**
Individual device capacity	SW England	-	-
	Wales	1MW	-
	N. Ireland	1.5MW	0.5-7MW (different for different device types)
	Scotland	1–1.5MW	0.5-2MW
	ROI	1MW	0.5–5MW
	OESEA2	**1MW**	**1MW**
Expected array size	SW England	0.5km^2 for generating 30MW	4km^2 for generating 50MW, 2km x 4km for generating 20MW (from 4 devices)*
	Wales	5km^2 for an array generating 30MW	Range from 0.8–9.5km^2 for different device types for an array generating 30MW
	N. Ireland	• Small array = 0.5km^2 for 1 or 2 rows of 10 devices (generating 50-60MW/km^2) • Commercial scale array = 1.1–2.2km^2 for 50-100 devices (generating 70MW/km^2)	• Point-absorbing device = 1.5-2.4km^2 for 30-50 devices (generating 15-25MW) • Attenuator device = 1.1–2.5km^2 for 24-50 devices (generating 18-37MW) • Overtopping device = 6.5km^2 for 8 devices (generating 56MW)
	Scotland	0.5km^2 for 20-50 devices (generating 30-50MW)	4km^2 for generating 5-50MW (from 7-100 devices)
	ROI	1km^2 for generating 50MW	3km^2 for generating 30MW
	OESEA2	**0.5–5km^2 for 30MW**	**1–10km^2 for 30MW**

Notes and Sources:

1. *SW England = Southwest England (PMSS 2010);*
2. *Wales = Wales TW (RPS 2010);*
3. *Northern Ireland = Northern Ireland TW (AECOM & Metoc 2009);*
4. *Scotland = Scotland west and north coast out to 12nm (Faber Maunsell & Metoc 2007);*
5. *Republic of Ireland = All Republic of Ireland waters out to 200m water depth off the west and south coast and the Irish EEZ off the north, east and south coast (AECOM & Metoc 2010);*
6. *OESEA2 = UK REZ, England and Wales TW (exc. Scotland REZ and Northern Ireland TW)*

REZ = Renewable energy zone; TW = Territorial waters; nm = Nautical mile; EEZ = Exclusive economic zone

3 SEA APPROACH

3.1 Scoping

A key purpose of scoping is to identify key issues of concern at an early stage so that they can be considered in appropriate detail in the SEA. Scoping also aids in the identification of information sources and data gaps that may require to be filled by studies or surveys to underpin the assessment.

For the OESEA2 process scoping aimed to:

- Promote stakeholder awareness of the SEA initiative
- Ensure access to all relevant environmental information
- Identify opportunities for potential collaboration and the avoidance of duplication of effort
- Identify information gaps so these could be evaluated and filled if necessary
- Identify stakeholder issues and concerns which should be considered in the SEA

An OESEA2 scoping document was prepared and a formal scoping exercise with the statutory Consultation Bodies/Authorities for Wales, Scotland, England and Northern Ireland and other stakeholders conducted from March to April 2010. The scoping consultation was undertaken by direct mailing to the statutorily defined Consultation Bodies and Authorities. The scoping document was also placed on the DECC Offshore SEA website (www.offshore-sea.org.uk) with an alert sent to registered users. The aim of the scoping exercise was both to inform the Consultation Bodies/Authorities and other stakeholders of the draft plan/programme and associated SEA process and to request feedback.

The following consultation questions were asked:

1. Do you have any comments on the proposed approach to consultation?
2. Consultees are invited to highlight additional initiatives which they consider relevant to the draft plan/programme.
3. Consultees are invited draw attention to and provide (where possible) additional information and data sets which they consider of potential relevance to this SEA
4. Are there any objectives that you feel should be included or removed?
5. Are the indicators for each objective suitable? If not please suggest alternatives.
6. Do you have any comments on the sources of potentially significant effect for each of the activities covered by the draft plan/programme, including whether they should be scoped in or out of assessment in the Environmental Report?
7. Do you have any additional information or comments relevant to the SEA?

Responses were received from 20 organisations, listed below as well as some comments from individuals:

- Carbon Capture and Storage Association
- Countryside Council for Wales

- English Heritage
- Environment Agency (response includes views of Environment Agency Wales)
- Historic Scotland
- Joint Nature Conservation Committee
- Kintyre Development Company Limited
- Natural England
- Natural Environment Research Council
- Northern Ireland Environment Agency
- RenewableUK
- Royal Society for the Protection of Birds
- Scottish Environment Protection Agency
- Scottish Natural Heritage
- Scottish Power
- South West of England Regional Development Agency
- The Coal Authority
- The Crown Estate
- The European Marine Energy Centre
- World Wide Fund for Nature

A compilation and summary of stakeholder responses is available on the DECC Offshore SEA website (www.offshore-sea.org.uk). In addition to responses to the specific consultation questions asked, a number of additional comments were received and these were also compiled and summarised.

Responses to scoping were used to help frame the level of detail and issues addressed in the Environmental Report. Key issues are listed in Appendix 1.

3.2 The DECC SEA process

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.

Since SEA 1, the DECC Offshore Energy SEA process has evolved and the following process improvements have been implemented:

- Establishment of a SEA Steering Group with wide representation from a range of stakeholders (established in early 2001)
- A formal scoping step with relevant consultation bodies and authorities
- Integrated management of survey, consultation and assessment processes
- Facilitation of public consultation through a dedicated website
- Widespread dissemination of data and information

- Development of modular documents applicable to more than one SEA
- Syntheses of data to facilitate access
- Commissioning of expert underpinning studies
- Publication of technical reports on website, CD as well as hard copy where requested
- Involvement of authors of expert underpinning studies and other users in an assessment workshop
- Regional stakeholder workshops
- Sector meetings and workshops
- Environmental report available via website or as CD or hard copy
- Continuing development of the methods for the consideration of cumulative and synergistic effects

The process followed for this SEA and temporal sequence of events is summarised below, but note that certain activities such as information gathering and stakeholder liaison continue throughout the process.

OESEA2 builds on the work completed for the previous OESEA. Preparatory to OESEA, the Department conducted a screening exercise for potential future rounds of offshore wind leasing, to understand major constraints and issues, and whether there are any data gaps for strategic planning. A similar exercise has been undertaken for other types of marine renewable energy generation, which led to the inclusion of wave, tidal stream and tidal range in OESEA2. There has been continued engagement with initiatives of the devolved administrations and the Severn tidal power feasibility study.

An OESEA2 Assessment Workshop was held in early September 2010 and is summarised in Appendix 2. This workshop covered: the OESEA2 objectives and indicators (see Section 3.5) which were based on those of the first OESEA, amended following scoping; key assumptions in relation to the main elements of the draft plan/programme, alternatives and key issues to be considered in more detail in the Environmental Report.

In addition, 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 OESEA2 is summarised in Appendix 2 of the Environmental Report with key issues included in Appendix 1.

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.

3.3 SEA process and stages completed to date

The DECC offshore energy SEA process is underpinned by the requirements of the SEA Directive and UK implementing legislation – see Section 1.

A summary of the SEA process used for this SEA is given below and in Figure 3.1. The SEA process aims to help inform licensing and leasing decisions through consideration of the environmental implications of the proposed draft plan/programme.

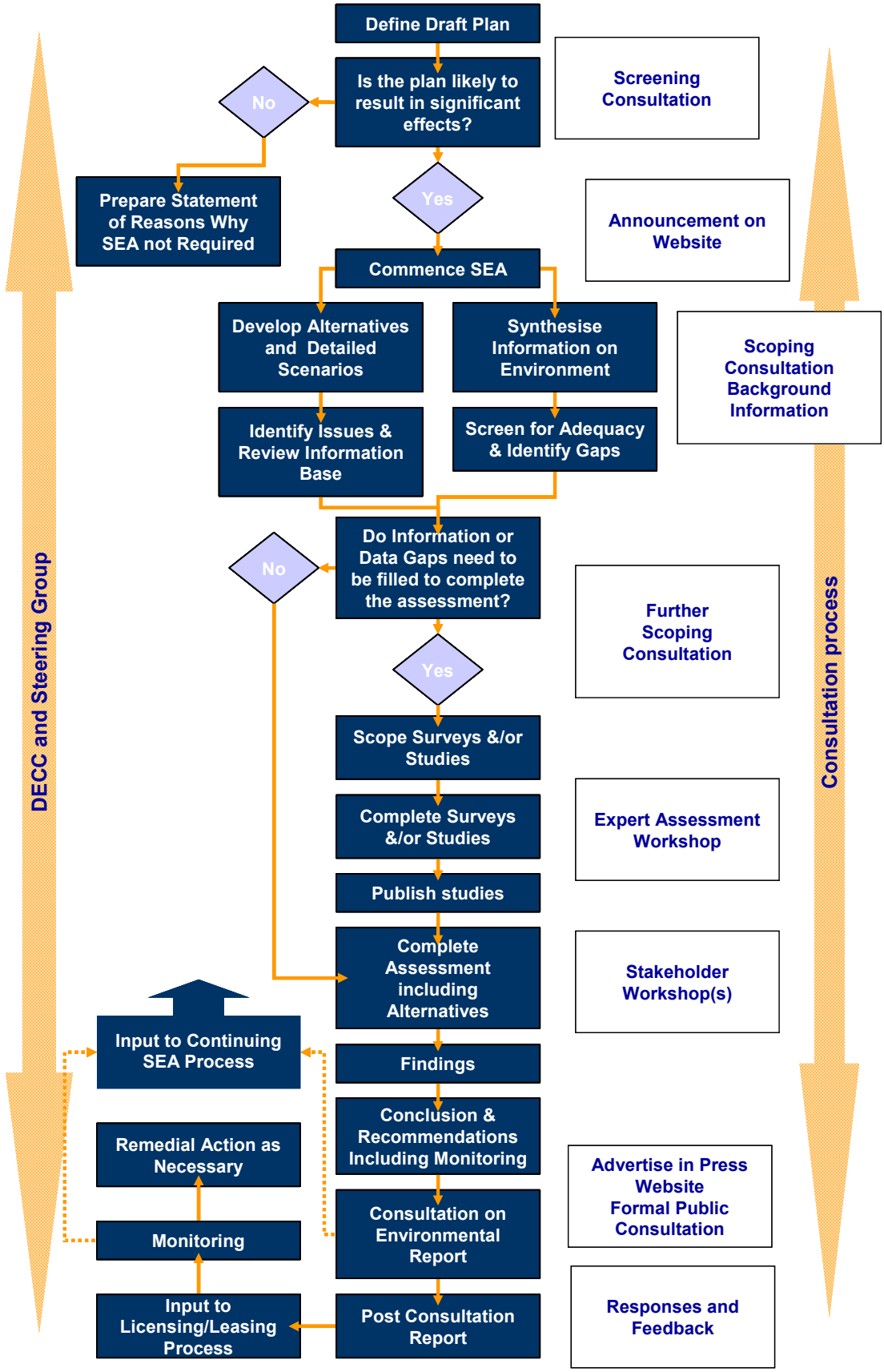
The key stages in the conduct of this SEA are:

1. Instigation of draft plan/programme and identification of alternatives and draft objectives
2. Scoping for field work / long term studies
3. Consultation with the Consultation Bodies and Authorities and other Stakeholders on the scope and level of detail of the Environmental Report
4. Information gathering and collation on:
    a. Environmental baseline
    b. Existing environmental problems
    c. Potential effects of proposed plan
    d. Other relevant initiatives, plans and programmes and their objectives
5. Assessment workshop
6. Assessment of effects including consideration of alternatives
7. Regional stakeholder workshops
8. Sector meetings and/or workshops
9. Production of Environmental Report
10. Public Consultation
11. Post consultation evaluation of feedback (post consultation report) input to decision on the plan (post adoption statement(s))
12. Monitoring plan implementation

The first nine stages of the SEA are now complete and preparatory work has been undertaken for subsequent stages.

Responsibility for the publication of the Environmental Report rests with DECC. Members of the Steering Group, as individuals and through their organisations, may comment on the proposed draft plan and the consultation materials (including this document) during the public consultation phase, and encourage others to comment.

Figure 3.1 – Overview of the SEA Process



3.4 Surveys and studies

Since 1999, many studies have been commissioned as part of the DECC SEA programme either to provide expert reviews or data syntheses in areas for which synoptic overviews were not published or readily available. These reports and new studies have been used to inform the current assessment documented in this report and are available from the DECC SEA website (www.offshore-sea.org.uk).

The programme has also over the years included range of seabed surveys and other field work based studies which have made a valuable contribution to the overall understanding of the marine environment in UK waters leading to the identification of some important conservation sites.

Data and other outputs from this work were previously archived on the UK DEAL website, but will now be available via to the British Geological Survey data portal. Biological material collected during seabed surveys (and supporting data documentation) has been archived and the majority is deposited in the collection of the National Museums of Scotland, Edinburgh to promote its long term availability for scientific study.

The data has been used as appropriate in the Environmental Baseline (Appendix 3) and the SEA assessment (Section 5). Examples of the output from the field based work are shown in Figures 3.2 – 3.12 below.

Figure 3.2 – Distribution of Darwin Mounds East as interpreted from side scan sonar and photographs taken during 1999 SEA survey

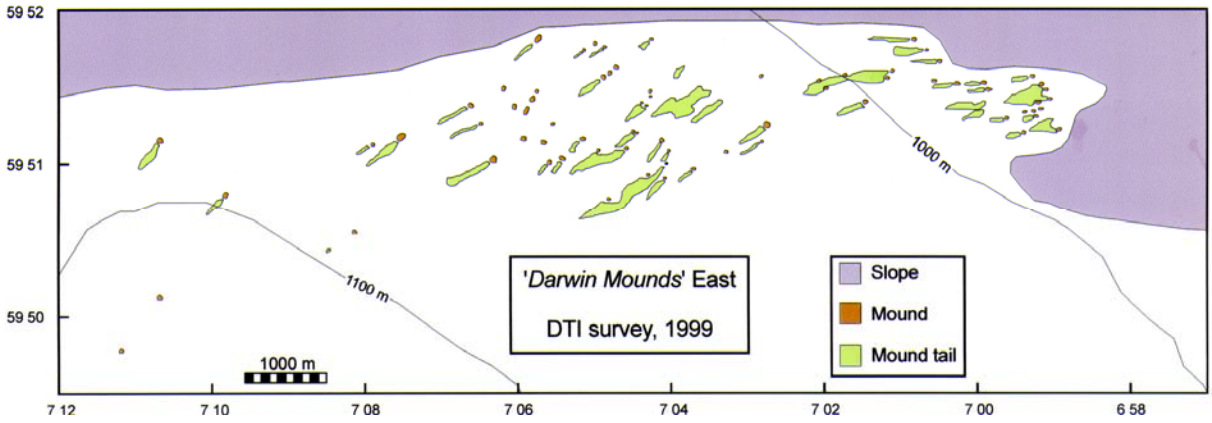
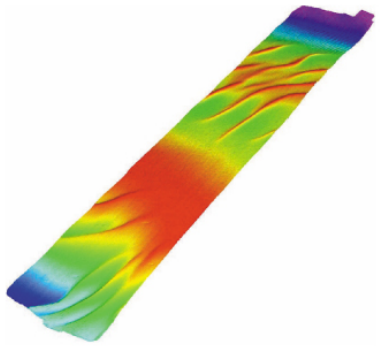
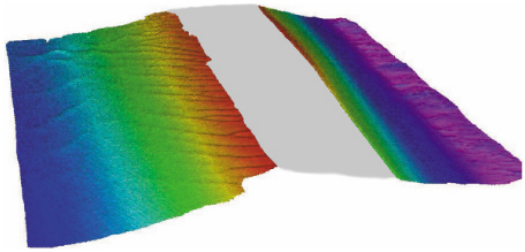


Figure 3.3 - Linear sandbank features on the Dogger Bank surveyed during the 2001 SEA survey

① Viking bank area



③ Smith's Knoll



Sandbank formation

Both active sandbanks, maintained actively by modern tidal current regime, and moribund sandbanks, formed at periods of lower sea level, are found in the SEA2 area (Belderson 1986, Collins *et al.* 1995). Models for sandbank development include spiral water circulation with convergence over the crestline; lateral migration; and stratigraphic evolution associated with submergence of coastal sand bodies. Detailed hydrography and sediment transport have been studied on Well Bank (Caston and Stride 1970, Caston 1972) and Broken Bank (Collins *et al.* 1995).

Sandbank stability

From analysis of historic bathymetric charts, Caston (1972) found that some of the more offshore Norfolk Banks had elongated towards the north west, the direction of net regional sand transport. The evidence for bank migration perpendicular to their long axis is, however, more equivocal. These offshore banks are markedly asymmetrical in cross-section with their steeper flanks oriented towards the north east suggestive of migration in that direction. The internal structure within some of the offshore banks is evidence of north eastward migration although it is uncertain whether migration still occurs at the present time.

The surfaces of many of the Norfolk Banks are covered in active sandwaves which reflect the pattern of modern sand transport around these banks. The sandwaves have their crests aligned more or less at right angles to the bank crest with their steep faces in opposing directions on either side of the sandbank reflecting the dominance of a clockwise circulation of sand around the bank (see multibeam images).

② Galleon sandwave field

Dogger Bank

The Dogger Bank is a very large shoal area with water depths less than approximately 30 metres, shallowest in the south west where water depths are only 15 metres. The 'bank' is largely composed from a 42 metre thick formation of glacio-lacustrine clays which were deposited during the last glaciation. When the ice retreated 18,000 years ago the deposits were left behind as a upstanding plateau. As sea levels rose Dogger Bank became an island and was probably not completely covered by water until approximately 7500 years ago. The presence of freshwater and saltmarsh peat beds and clays containing intertidal molluscs are evidence of former coastal environments around the margins of the Dogger Bank at this time.

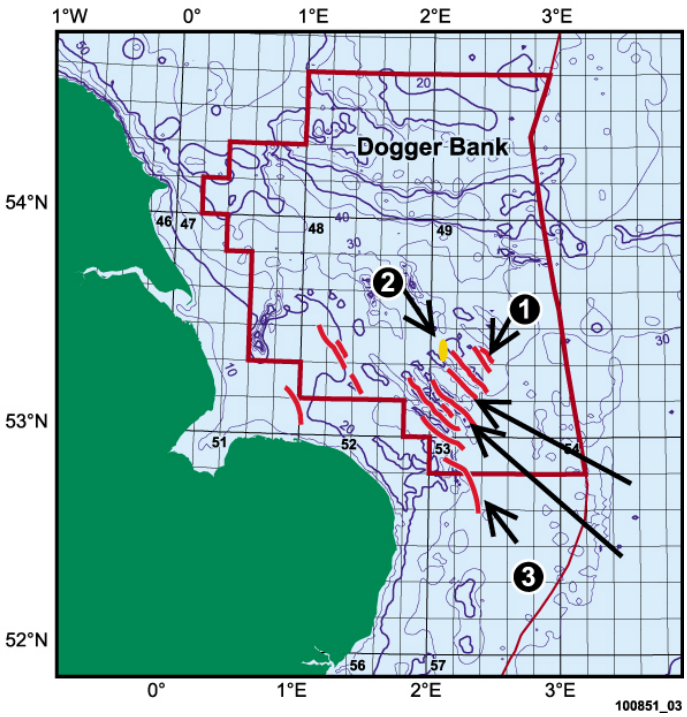


Figure 3.4 - Pockmark features in the Central North Sea surveyed during the 2001 SEA survey

Pockmark distribution and formation

Pockmarks are closed seabed depressions that are typically 2-5m deep, 50-200m wide and elongated parallel to the direction of the predominating near-bottom tidal currents. The largest modern pockmarks usually occur in the softer and finer-grained muds and they have formed following seabed excavation by processes involving fluid, gas or liquid, escape at seabed.

There is uncertainty about the precise age and duration of the processes that formed the majority of the presumed inactive (relict) pockmarks found at seabed.

The distribution and likely ages of buried pockmarks indicate that such processes have probably onset with the overall change to a warmer climate following the last glaciation (Long 1992). Giant pockmarks some 50-200m deep and 0.5 to 4km diameter have formed since the start of the early Cenozoic and are now deeply buried under parts of the modern pockmark fields in the central North Sea (Cole *et al.* 2000).

Some seabed pockmarks are sites of modern gas discharge. Fields of moribund pockmarks with densities of up to approximately 20 per km^2 at the modern seabed provide spectacular examples of historically spasmodic fluid and sediment mobility.

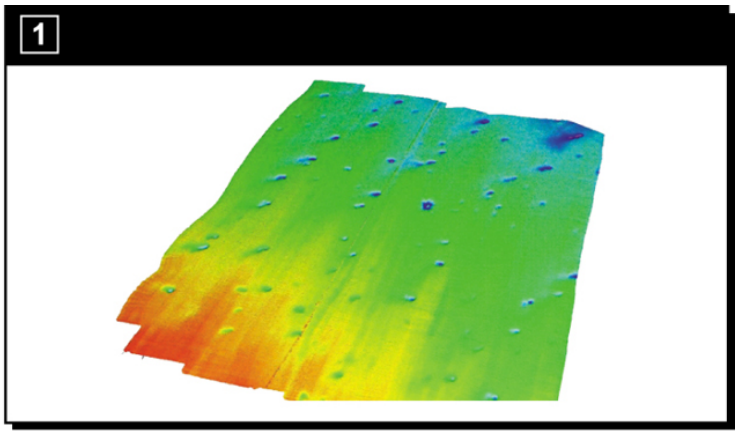
Pockmark significance

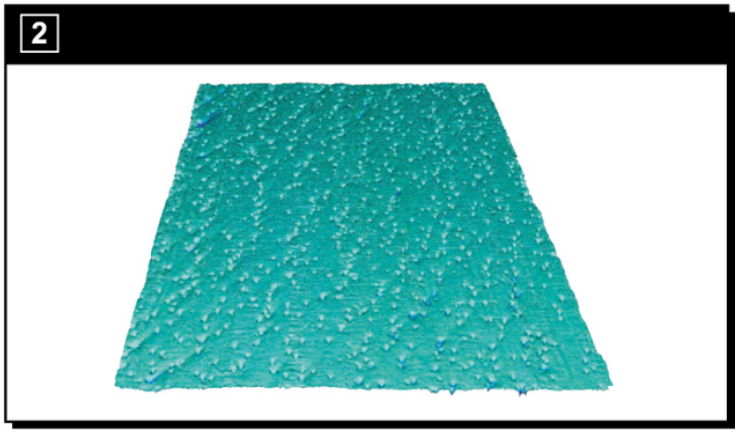
Although pockmarks observed with gas discharge at seabed occur with distinctive (local) biological assemblages, until now little research has been done on the impact of the distribution of inactive pockmarks on regional patterns of biodiversity and biological productivity.

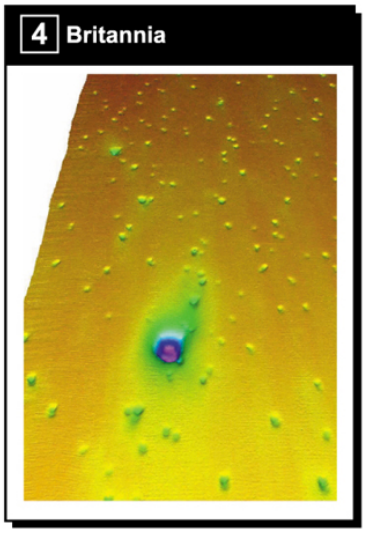
Exceptionally, carbonate cements have been reported from pockmarks. In UKCS block 15/25 they occur in a pockmark with methane gas which is actively venting at seabed (Hovland *et al.* 1987, Hovland and Judd 1988). These hardgrounds are formed during the biological oxidation of methane, provide hard substrate for epifaunal colonisation and are possible offshore sites of conservation designation.

Other hardgrounds occurring in soft muds have been reported adjacent to Shetland although there is an insecure connection with gas seepage (Hovland and Judd, 1988)

Pockmarks are regarded by industry as a possible hazard to safe operations during pipeline and other seabed development operations and they are usually avoided whenever possible. The main seabed geohazards posed by the pockmarks are perceived as foundation bridging at the relatively steep flanks of the pockmarks and the potential for loss of formation strength should sediment fluidisation occur.







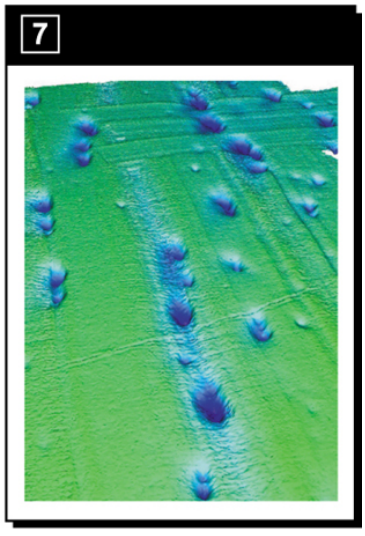


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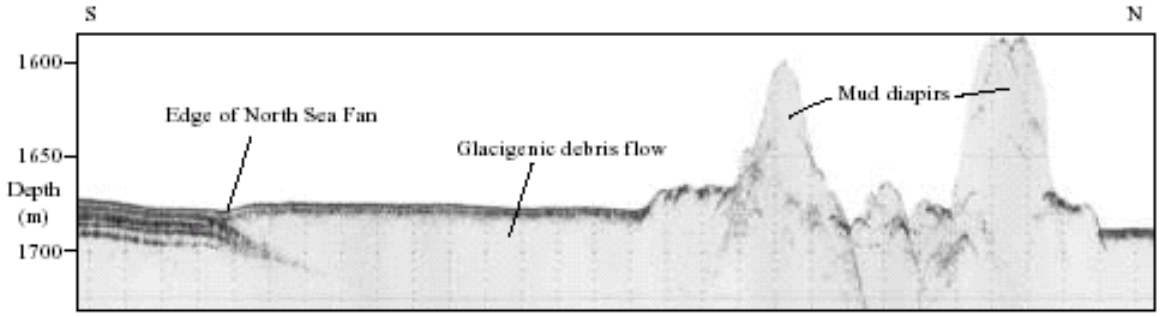
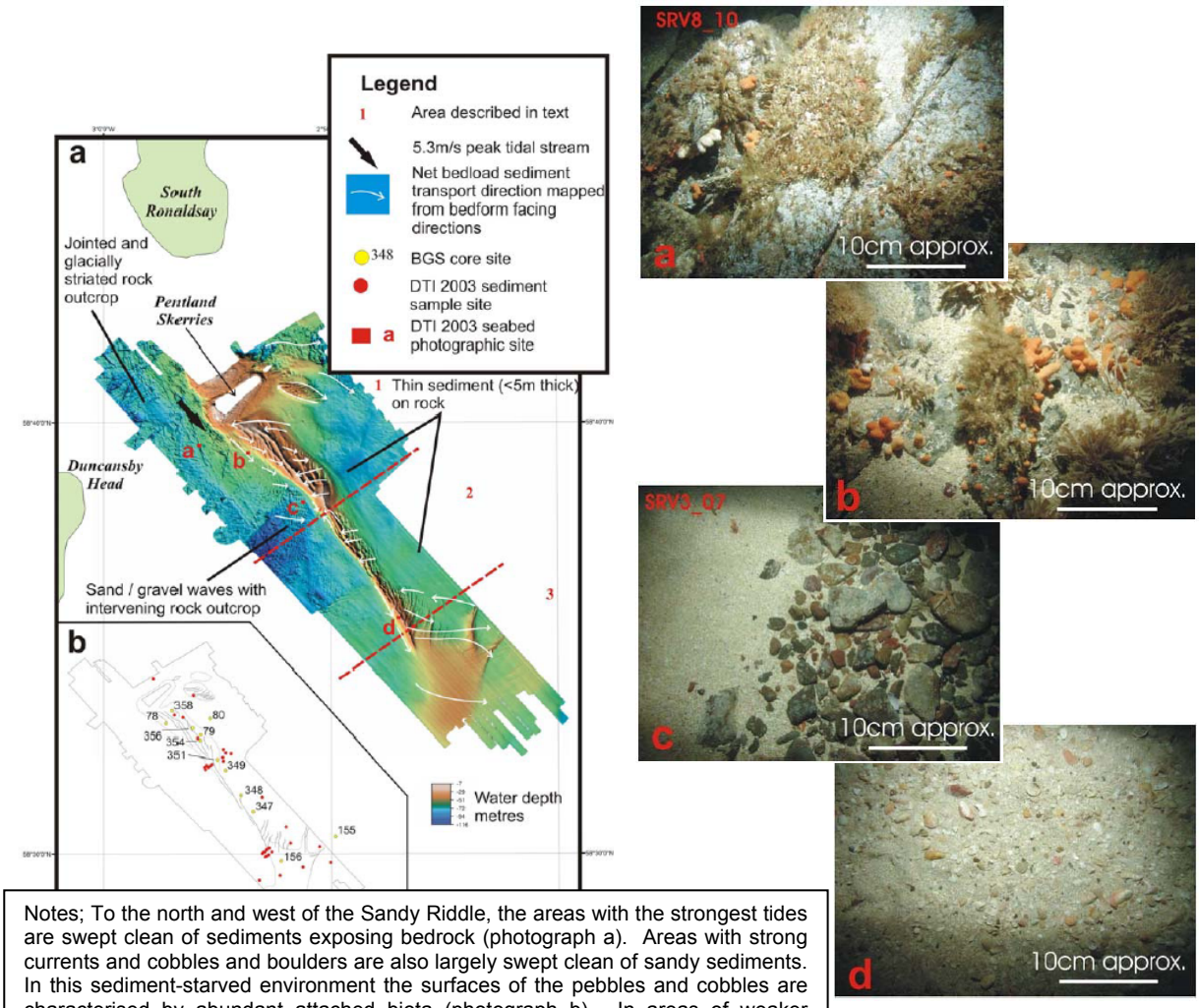
Figure 3.5 - A 3.5kHz profile from the Norwegian Basin floor showing mud diapirs (*Masson et al. 2003*).



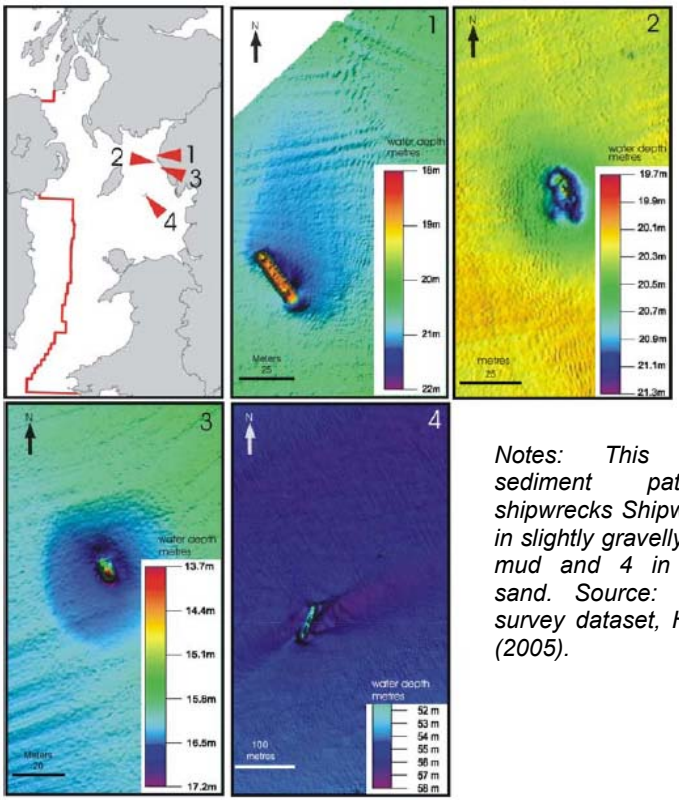
(Pilot Whale Diapirs surveyed in 2002)

Figure 3.6 - Mapping of The Sandy Riddle during 2003 SEA survey



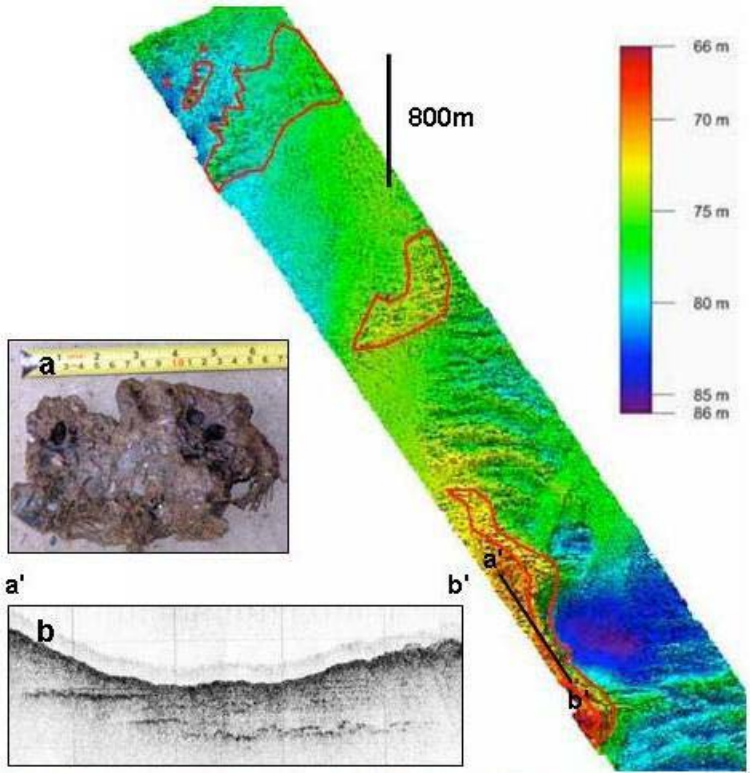
Notes; To the north and west of the Sandy Riddle, the areas with the strongest tides are swept clean of sediments exposing bedrock (photograph a). Areas with strong currents and cobbles and boulders are also largely swept clean of sandy sediments. In this sediment-starved environment the surfaces of the pebbles and cobbles are characterised by abundant attached biota (photograph b). In areas of weaker currents the seabed is characterised by mobile sands which are thick enough to migrate as sediment waves over the seabed and periodically bury an underlying pavement of cobbles and pebbles. This process appears to prevent the establishment of abundant permanently attached biota on the pebbles and cobbles (photograph c). Carbonate sand and gravel accumulate in areas of weak or convergent currents (photograph d).

Figure 3.7 – Sediment patterns around shipwrecks from 2004 SEA surveys



Notes: This image shows sediment patterns around shipwrecks Shipwreck 1 and 3 set in slightly gravelly mud, 2 in sandy mud and 4 in slightly gravelly sand. Source: DTI 2004 SEA 6 survey dataset, Holmes & Tappin (2005).

Figure 3.8 – Survey of Texel 11 from 2004 SEA surveys



Notes: Main picture – anticipated extent of methane derived authigenic carbonate (MDAC) in Texel 11 (in red), a) an MDAC samples collected by grab and b) seismic profile showing enhanced reflectors (shallow gas near the seabed at the edge of the southern seabed hollow (see main picture for seismic transect). Source: Judd (2005).

Figure 3.9 – Areas included in the 2005 and 2006 SEA surveys

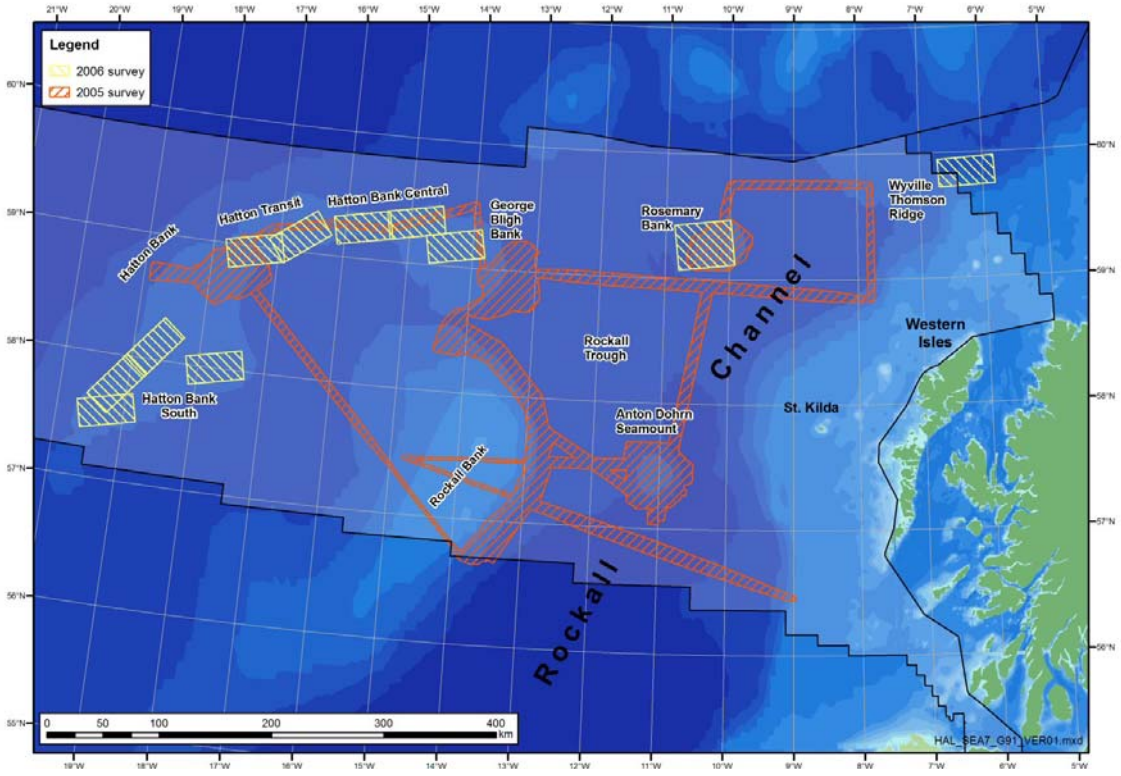


Figure 3.10 – Example seabed images from the 2005 and 2006 SEA surveys

Cold water coral on Hatton Bank

Rabbit fish at George Bligh Bank

Figure 3.11- Grey Seal satellite tag tracks from SEA funded SMRU seal tagging programme

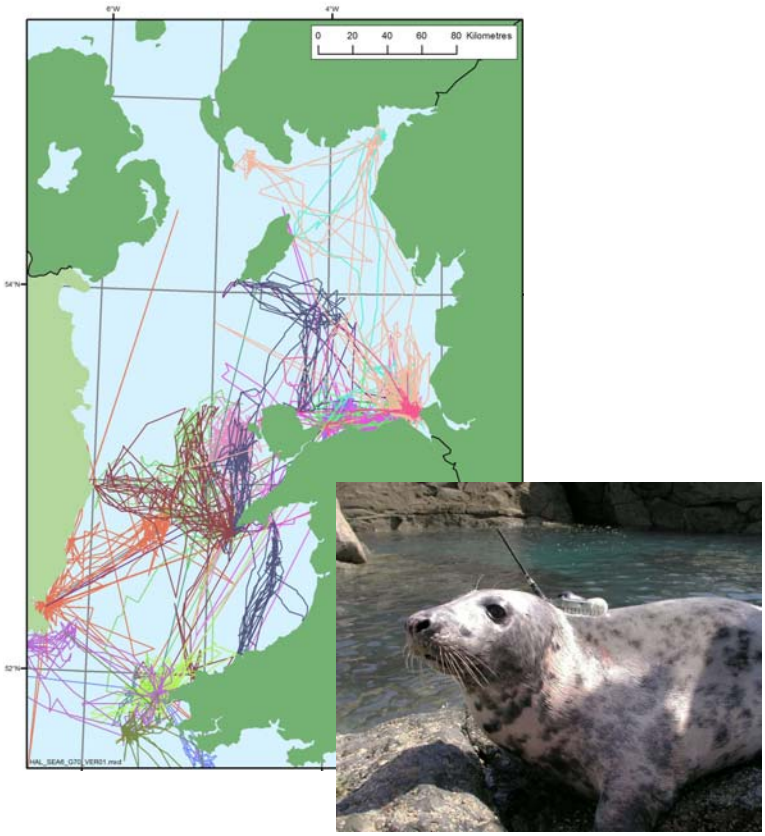
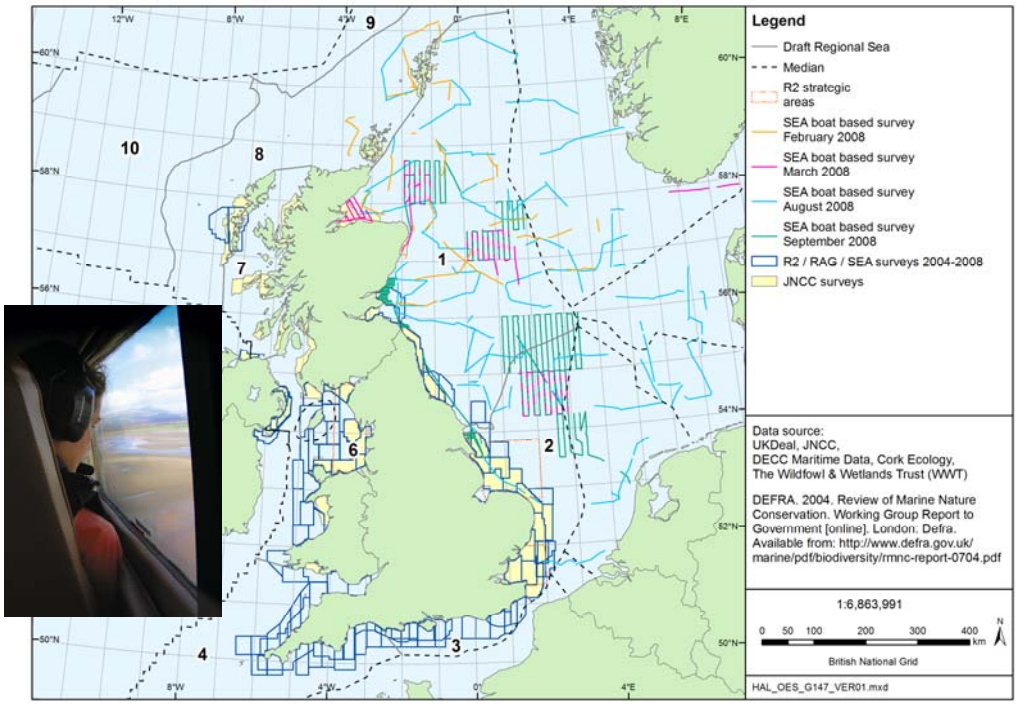


Figure 3.12 - Aerial and boat based seabird and waterbird surveys



3.5 SEA objectives

The development of SEA objectives is a recognised way in which environmental considerations can be described, analysed and compared. The OESEA2 objectives and indicators are presented in Table 3.1 below. These were based on those of the first OESEA, amended following scoping and discussed at the Assessment Workshop in 2010. The guide phrases are included to assist in interpretation.

Table 3.1 - SEA Topics, Objectives and Indicators

OESEA2 Objectives	Guide Phrases	Indicators
SEA Topic: Biodiversity, habitats, flora and fauna		
Contributes to conservation of the biodiversity and ecosystems of the United Kingdom and its seas.	*Plan activities do not lead to the loss of biological diversity, the degradation in the quality and occurrence of habitats, and the distribution and abundance of species.* *Plan activities do not lead to the introduction of non-native species at levels which adversely alter marine ecosystems.* *The plan recognises the ecosystem importance of land-sea coupling, for instance its role in species migration.* *The plan promotes the achievement of good ecological status for water bodies as outlined at a European Level.*	For selected 'valued ecosystem components' no loss of diversity or decline in population (measured as % of relevant biogeographic population) attributable to plan related marine activities and promotion of recovery wherever possible. Activities subsequent to licensing/leasing which are on, or potentially affecting, a Natura site are compliant with the requirements of the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended), the Conservation (Natural Habitats, etc.) (Northern Ireland) Regulations 1995 (as amended), the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended), and the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended). Every activity with the potential to impact upon or disturb a protected species is compliant with the requirements of the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended), the Conservation (Natural Habitats, etc.) (Northern Ireland) Regulations 1995 (as amended), the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended), and the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended).
Avoids significant impact to conservation sites, including draft, possible, candidate and designated Natura 2000 sites, along with consideration of future Marine Conservation Zones and Marine Protected Areas.		
Avoids significant impact to, or disturbance of, protected species.		
SEA Topic: Geology and soils		
Protects the quality of the seabed and its sediments, and avoids significant effects on seabed morphology and sediment transport processes	*Activities arising from the plan do not adversely affect the quality and character of the geology and geomorphology of seabed or coastal sediments.* *Plan activities avoid adverse effects on designated geological and geomorphological sites of international and national importance.*	No adverse change in quality of seabed sediments, and seabed sediment transport, at a series of regional monitoring stations. No physical damage to designated marine and coastal geological conservation sites (e.g. GCRs and MCZs).
Protects the integrity of coastal and estuarine processes.		
Avoids significant damage to geological conservation sites and protects important geological/geomorphological features.		
SEA Topic: Landscape/seascape		
To accord with, and contribute to the delivery of the aims and articles of the European Landscape Convention and minimises significant adverse impact on seascape/landscape including designated and	*Activities do not adversely affect the character of the landscape/seascape.* *The plan helps to conserve the physical and cultural visual resource associated with the land and sea.*	No significant impact on nationally-designated areas. Extent of the visual resource potentially affected by the particular developments. Number of areas of landscape sensitivity affected by proposed developments (e.g. offshore wind). Trajectory of change in coastal National Character Areas

OESEA2 Objectives	Guide Phrases	Indicators
non-designated areas.		shows no adverse effects arising from plan activities. Change in 'tranquillity' based on CPRE and CCW national mapping projects.
SEA Topic: Water Environment		
Protects estuarine and marine surface waters, and potable and other aquifer resources.	*Plan activities do not result in concentrations of contaminants at levels giving rise to pollution effects.* *Plan activities do not result in permanent alteration of hydrographical conditions which adversely affect coastal and marine ecosystems.* *Plan activities do not result in adverse effects on saline and potable aquifer resources.*	No adverse change in quality of surface water and aquifers. UKCS Exploration and Production (E&P) meets OSPAR discharge reduction targets. Number of oil and chemical spills and quantity of material spilled.
SEA Topic: Air quality		
Avoids degradation of regional air quality from plan related activities.	*The plan contributes to the achievement of air quality targets for those emissions outlined in the UK Air Quality Strategy.* *Emissions from plan activities do not contribute to, or result in, air quality issues which adversely affect human health or the wider environment.*	Monitoring of local air quality shows no adverse impact. Targets relating to airborne emissions at a regional and UK level are not exceeded.
SEA Topic: Climatic factors		
Minimises greenhouse gas emissions.	*The plan contributes to the achievement of targets relating to greenhouse gases at a national and international level.* *Plan activities contribute to mitigating climate change.*	UKCS E&P greenhouse gas emissions. 2003 Energy White Paper "Reducing Carbon Emissions Indicator" (Greenhouse gas and carbon dioxide emissions). UKCP09 projections for the expected currency of the plan/programme.
SEA Topic: Population and human health		
Has no adverse impact on human health.	*Plan activities do not result in, or contribute to the contamination of fish and other seafood for human consumption at levels which exceed those established by Community legislation or other relevant standards.* *Plan activities avoid adverse effects on physical and mental health.*	Progress in achieving OSPAR targets for continued reduction in harmfulness of offshore discharges. Consider relevant well being metrics when developed as part of Office of National Statistics project.
Avoids disruption, disturbance and nuisance to communities.	*Plan activities avoid adverse nuisance to communities, for instance through noise or vibration.* *Adverse effects on the quality or access to areas used for recreation (e.g. amenity, sailing, surfing), are*	Monitoring in relation to Noise Action Plans shows no adverse effects. Consider relevant well being metrics when developed as part of Office of National Statistics project. See also; seascape indicators.

OESEA2 Objectives	Guide Phrases	Indicators
	minimised or avoided.	
SEA Topic: Other users of the sea, material assets (infrastructure, and natural resources)		
Balances other United Kingdom resources and activities of economic, safety, security and amenity value including defence, shipping, fishing, aviation, aggregate extraction, dredging, tourism and recreation against the need to develop offshore energy resources.	*Plan activities integrate with the range of other existing uses of the marine environment.* *Plan activities do not result in adverse effects on marine assets and resources.*	Spatial planning capable of addressing changes in technology, policy and prioritisation of site selection Economic and social impact (both positive and negative).
Safety of Navigation.	*Plan activities avoid adverse effects on, and contribute to the maintenance of, safe navigation, including recognised shipping routes, traffic separation and existing and proposed port operations.*	Increased collision risks and restrictions on pollution-prevention methods or Search & Rescue options in the event of an emergency.
Reduces waste.	*Properties and quantities of waste and litter resulting from plan activities do not cause harm to the coastal and marine environment.*	Progress in reducing volumes of waste to landfill.
SEA Topic: Cultural heritage		
Protects the historic environment and cultural heritage of the United Kingdom, including its setting.	*Activities avoid adverse effects on the character, quality and integrity of the historic and/or cultural landscape, including those sites which are designated or registered, and areas of potential importance.*	No adverse impact upon the condition of designated sites and features (including impact on their setting) and minimal impact on all other recorded sites and features.
	Plan activities contribute to the archaeological and cultural knowledge of the marine and coastal environment.	Number of archaeological finds reported through best practice as a result of plan activities.

3.6 SEA scope

The area of study for the Offshore Energy SEA is shown in Figures 1.1.

The main stages of offshore wind and other marine renewable energy development are:

1. Site prospecting/selection including collection of site specific resource and constraint data, and seabed information by geophysical and geotechnical survey
2. Development, including construction of foundations/anchors/structures and any scour protection, 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 oil and gas activity are:

1. Exploration/appraisal including seismic survey and exploration/appraisal drilling with well evaluation and testing
2. Development, including production facility installation, generally with construction of pipeline(s), and the drilling of producer and injector wells
3. Production and export operations, with routine supply, return of wastes to shore, power generation, chemical use, flaring, produced water management/reinjection and reservoir monitoring
4. Maintenance
5. Decommissioning, including cleaning and removal of facilities

The main stages of natural gas offloading and storage are:

1. Exploration/appraisal potentially including seismic survey exploration/appraisal drilling and reservoir/geological formation evaluation
2. Development (depleted hydrocarbon reservoir), including drilling of new or workover of existing wells, installation of storage facility or modification of existing infrastructure, with new or existing import/export pipelines, and potentially offloading facilities
3. Development (salt caverns), including the drilling of wells, construction of storage caverns by dissolution, installation of storage facilities, with new import/export pipelines, and potentially offloading facilities
4. Import, storage and export operations, with routine supply, return of wastes to shore, power generation, chemical use, flaring, produced water management and reservoir/structure monitoring
5. Maintenance
6. Decommissioning, including cleaning and removal of facilities

The main stages of carbon dioxide and storage activity in depleted oil and gas reservoirs and saline aquifers are:

1. Exploration/appraisal including seismic survey and exploration/appraisal drilling and testing
2. Development, including installation of injection facilities, generally with construction of import pipelines, and the drilling of injection wells and potentially aquifer water production wells
3. Import and injection operations, with routine supply, return of wastes to shore, power generation, chemical use, venting, potentially aquifer water production/management and storage 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, semi-continuous or continuous)
- Physical damage or change to the seabed and subsurface
- Other indirect physical effects on seabed and water column
- Ecological effects of presence of structures
- Interactions with other users of the sea
- Visual intrusion
- Chemical and other inputs
- Atmospheric emissions
- Electromagnetic fields
- Waste disposal onshore
- Other effects
- Decommissioning and legacy issues
- Accidental events

All the major stages of offshore renewable energy, oil and gas, gas storage and carbon dioxide storage development, operation and decommissioning are covered by environmental regulations including the requirement for Environmental Impact Assessment at the development stage (see Appendix 5).

The SEA assessment considered the likely significant effects of the implementation of the plan including short, medium and long-term effects, permanent and temporary effects, positive and negative effects, and secondary, cumulative and synergistic effects on:

- 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
- Conservation of sites and species

and the interrelationship between the above.

3.7 Assessment methodology

The assessment is presented as evidence based discussion (Section 5) citing peer reviewed and other literature as appropriate together with spatial GIS analysis presented as output maps and graphics. The assessment considers the implications of the draft plan for relevant existing environmental problems including, especially, those relating to any areas of particular environmental importance, such as areas designated under the Habitats & Species and Birds Directives. The assessment draws on stakeholder perspectives on key issues relating to the plan/programme obtained through consultation with regulators, local authorities, operators/developers and others. The results of the assessment are summarised for each alternative in a receptor based matrix format (Section 5.17).

4 OVERVIEW OF ENVIRONMENTAL BASELINE

4.1 Introduction

The following section and associated appendices provide environmental information as required under Schedule 2 of *The Environmental Assessment of Plans and Programmes Regulations 2004* (Regulation 12(3)).

The environmental baseline for the OESEA2 is provided as Appendix 3. The OESEA baseline, issued in 2009, contains a substantial collation of information, the majority of which remains valid and forms the starting point for the OESEA2 baseline. More recent baseline information relevant to OESEA2 has been compiled for each SEA topic and is included in an addendum to Appendix 3. The addendum contains changes to/updates in knowledge and, where appropriate, the characterisation of additional components of the marine environment of relevance to new aspects of the draft plan/programme. A number of new resources, including published papers, reports and expert assessments, have been included in the update to the baseline for OESEA2.

The addendum can be found at the beginning of Appendix 3 and comprises a series of standalone sections which are linked to the original OESEA topic baseline sections through a combination of dynamic hyperlinks and, where appropriate, the retention of the same high-level headings and format (e.g. UK Context, Evolution of the Baseline and Environmental Issues).

The baseline is described under a series of headings which relate to issues identified by the SEA Regulations on which to judge the *"…likely significant effects on the environment, including short, medium and long-term effects, permanent and temporary effects, positive and negative effects, and secondary, cumulative and synergistic effects…"* These include:

- 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
- Conservation of sites and species

and the interrelationships of the above.

The environmental baseline considers all the above headings in a UK context, before providing more detailed information on key features specific to UK Regional Seas, as defined by JNCC (2004).

Within Section 4.2, a summary is provided for each baseline topic heading and Regional Sea, with further information and figures available in the addendum and series of sub-appendices to Appendix 3.

Section 4.3, Likely evolution of the baseline highlights *"…relevant aspects of the current state of the environment and the likely evolution thereof without implementation of the plan or programme."*

Finally, Section 4.4, Relevant existing environmental problems, identifies for each Regional Sea *"Any existing problems which are relevant to the plan or programme including, in particular those relating to any areas of particular environmental importance, such as areas designated pursuant to Council Directive 79/409/EEC on the conservation of wild birds and the Habitats Directive."*

Throughout Sections 4.2, 4.3 and 4.4, signposts are provided to the locations of further information in the addendum to or within the relevant sub-appendices of the original OESEA environmental baseline.

4.2 Overview of environmental baseline

4.2.1 UK context

Biodiversity, habitats, flora and fauna

The UK has a rich marine biodiversity reflecting both the range of habitats from estuaries, through coastal waters to depths of >2400m, and its position where several biogeographical provinces overlap (see for example Murray (1886), Longhurst (1998) and Spalding *et al*. (2007)). 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.

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. In general, the phytoplankton community is dominated by diatoms and dinoflagellates. Plankton blooms typically take place in spring, with a smaller bloom in late summer. The timing, composition and size of these blooms are dependent on a range of environmental factors. Some phytoplankton blooms may be toxic to marine life. The zooplankton community is dominated by copepods, including *Calanus finmarchicus* and *C. helgolandicus*. Jellyfish, krill and salps are also abundant, as are the larvae of fish, and many benthic animals (meroplankton). Further information is provided in OESEA2 Appendix 3a.2 and OESEA Appendix 3a.1.

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. Further information is provided in OESEA2 Appendix 3a.3 and OESEA Appendix 3a.2.

Most cephalopods in UK waters are long-finned squids, short-finned squids, bobtail squids, octopuses or cuttlefish. The long-finned squids (including *Loligo forbesii*) tend to have a more coastal and northerly distribution. Short-finned squids are oceanic species and are recorded particularly to the west of the UK. Bobtail squids are abundant in shallow, coastal regions, while octopuses and cuttlefish are more common in southern areas. A number of deep-sea cephalopods are present in the deep waters of the Faroe-Shetland Channel and Rockall Trough. Further information is provided in OESEA2 Appendix 3a.4 and OESEA Appendix 3a.3.

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). Widespread pelagic species include herring and mackerel, particularly around the western and northern parts of the UK. Demersal species include gadoids (e.g. cod, whiting) and flatfish (e.g. plaice, dab). Demersal communities tend to be more diverse in southern areas of the UK. Diadromous fish in UK waters include sea trout and Atlantic salmon. A number of sharks and rays are present in UK waters, including the basking shark. 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. Widespread commercial shellfish species include crustaceans (e.g. *Nephrops*, brown crab), bivalve molluscs (e.g. scallops, cockles) and gastropod molluscs (e.g. whelks). Many of these species, such as *Nephrops* and scallops, are closely tied to particular seabed sediments and so occupy distinct grounds. Many commercially fished species are heavily exploited. Further information is provided in OESEA2 Appendix 3a.5 and OESEA Appendix 3a.4.

Of the five species recorded in UK waters, the vast majority of records are of the leatherback turtle (*Dermochelys coriacea*) which is the only species considered a regular member of the UK marine fauna. While turtles have been observed along the majority of UK and Irish coasts, records are concentrated on the west and south coasts of Ireland, southwest England, south and northwest Wales, the west coast of Scotland, Orkney and Shetland. Further information is provided in OESEA2 Appendix 3a.6 and OESEA Appendix 3a.5.

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 3 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. The seabird community in the UK comprises a number of gull, auk, tern and skua species, while numerous waders, ducks, and geese make up seasonal and year-round assemblages in coastal wetlands. A few species are found only or predominantly in the UK. For 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. Further information is provided in OESEA2 Appendix 3a.7 and OESEA Appendix 3a.6.

Many of the species of cetaceans 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). The most abundant cetacean in UK waters is the harbour porpoise. 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, found along temperate, sub-Arctic and Arctic coasts of the northern hemisphere, with the UK population representing over 5% of the global total. Otters inhabit a variety of aquatic habitats, with some populations feeding in shallow, inshore marine areas. The most important otter populations utilising coastal habitats occur in western Scotland, Shetland, west Wales and the Wash and north Norfolk coast. Small numbers of the Nathusius' pipistrelle bat occur seasonally over UK waters on migrations between the UK and mainland Europe. Extensive information on the distribution, abundance and ecology of marine and other mammals in UK waters is provided in OESEA2 Appendix 3a.8 and OESEA Appendix 3a.7.

Geology substrates and coastal geomorphology

The distribution of geological strata in the UKCS is determined by past geological and geomorphological processes. The distribution of sediments and certain topographic features is a function of the underlying geology, and millennia of aeolian, fluvial and glacial activity both in the marine and terrestrial environment. The distribution of sediments and deep geological structure of the UKCS, and the North Sea in particular, is quite well known, particularly in areas of mature oil and gas production which have been extensively explored since the 1960s. Oil and gas reserves are dependent on viable source rocks and a suitable impermeable cap-rock, and these reservoirs are responsible for the distribution of much offshore activity. Certain topographic features are notable, primarily for the quality of habitat they provide, and these are bound by geology (e.g. Haig Fras) or sediment type (e.g. north Norfolk sandbanks). There are over 100 estuaries in England and Wales of relevance to the draft plan, which can be divided into a number of broad geomorphological types. Potential areas which may be suitable for gas storage/carbon dioxide storage (CCS) include hydrocarbon reservoirs, halite deposits and saline aquifers. Further information is provided in Appendix 3b of OESEA2 and OESEA.

Existing levels of contamination in the UK marine environment vary considerably on both regional and local scales, and in general have declined appreciably in recent decades. The majority of marine pollution comes from land-based activities; most pollutants enter the UK marine environment through direct discharges of effluents, land run-off (mainly via rivers) or indirectly via the atmosphere. The highest concentrations of contaminants, and hence the greatest effects, are therefore often in inshore areas. Water samples with the highest levels of chemical contamination are found at inshore estuary and coastal sites subject to high industrial usage. In offshore waters, contaminant levels (chiefly hydrocarbons) in water and sediments are generally expected to be at or near background concentrations. Levels are expected to be higher at close proximity to oil and gas infrastructure, with concentrations decreasing with increasing distance from the source. Detailed information on a variety of contaminants is provided in Appendix 3b of OESEA2 and OESEA.

Landscape/seascape

Seascape is defined by the European Landscape Convention (ELC) as “an area perceived by people, whose character is the result of the action and interaction of natural and/or human factors”, and can be separated into areas of sea, land and intervening coastline. The study of seascape is not only concerned with the physical changes in a given view but the

interaction of that view with individuals and how it affects overall visual amenity. Seascapes and coastal environments (including the sea itself) are extensively used for recreation which generates significant tourist income from which many coastal communities are dependent, and this can strongly conflict with commercial and industrial activity (Hill *et al.* 2001). The 'value' of many of the UK's seascapes is reflected in the range of designations which relate in whole or in part to the scenic character of a particular area (e.g. Area of Outstanding Natural Beauty, Heritage Coast, National Scenic Area). Further information is provided in Appendix 3c of OESEA2 and OESEA.

Water environment

The UK marine water environment is highly varied, ranging from entirely oceanic conditions to the north and west of the UK to complex estuarine systems widely distributed around the coast. It is also a dynamic environment, with a complex system of currents and varied oceanographic conditions including areas of considerable frontal activity and high-energy wave and tidal environments. Section 4.2.2 describes the general physical characteristics of the UK draft Regional Seas, while detailed information on the water masses and circulation, stratification and frontal zones, coastal tidal flows, temperature, salinity and wave climate is provided in Appendix 3d of OESEA2 and OESEA.

Air quality

Whilst air quality is not monitored routinely offshore, regular air quality monitoring is carried out by local authorities in coastal areas adjacent to each Regional Sea and by the OSPAR Comprehensive Atmospheric Monitoring Programme (CAMP) network. The air quality of all local authorities is generally within national standards set by the UK government's air quality strategy though several Air Quality Management Areas (AQMAs) have been declared to deal with problem areas. Industrialisation of the coast and certain inshore areas has led to increased levels of pollutants in these areas which decrease further offshore, though oil and gas platforms provide numerous fixed point sources of atmospheric emissions. Further information is provided in Appendix 3e of OESEA2 and OESEA.

Climate and meteorology

The UK lies within temperate latitudes and the climate is generally mild. Numerous easterly moving depressions meet the UK in the west leading to a gradient of relatively high wind speeds and precipitation in the exposed west and relatively low wind speeds and precipitation in the sheltered south and east. The upland nature of much of the west coast also contributes to this west-east gradient, with topography-induced enhanced precipitation, particularly in the north-west. The UK has a strong maritime influence, which has the effect of reducing the diurnal and annual temperature ranges; such effects are most notable at the coast and on islands (e.g. Orkney, Shetland). The North Atlantic Oscillation (NAO) has also been linked with variations in UK sea surface temperatures, wind strength, direction and rainfall. It is very likely that climatic change is influenced and/or generated by the anthropogenic production of greenhouse gases, which are likely to generate a temperature increase of 0.2°C for the next few decades as well as an increase in sea-level. More changeable and extreme weather is also a possible outcome. Further information is provided in Appendix 3f of OESEA2 and OESEA.

Population and human health

Population density in 2009 was highest in England at 398 persons per km^2, comparably lower in Wales and Northern Ireland at 145 and 132 persons per km^2 respectively, and the lowest by a considerable margin in Scotland at 67 persons per km^2. In coastal areas, there

are lower densities around much of the southwest of England, west and north Wales, the far north of England, and much of Scotland excluding the central belt. The highest coastal densities are around much of southeast England, part of northeast England, the Firths of Forth and Clyde, part of northwest England, south Wales and around the Severn Estuary. These areas are typically where conurbations are largest and most numerous, although more isolated areas of higher densities are dotted around much of the coast. Higher densities are also observed in several coastal areas of Northern Ireland.

For the UK as a whole, 9.3% of people described their health as "not good" in 2001. Values were lowest in England at 9.0%. Values for Scotland and Northern Ireland were similarly higher than the UK average at 10.2% and 10.7% respectively, with Wales the highest at 12.5%. The proportion of people with a limiting long term illness showed a similar pattern, with the lowest proportion in England and highest in Wales. Further information is provided in Appendix 3g of OESEA2 and OESEA.

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

UK waters are subject to a multitude of uses - particularly in coastal areas. The range and importance of existing and some potential uses of the sea are described in Appendix 3h, with key aspects summarised below. In advance of formal marine spatial planning, this SEA has obtained accurate and recent information on other current and likely uses of the sea in the foreseeable future.

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, with substantial numbers of vessels also transiting UK waters en route to 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 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 data allow precise tracking of individual vessels, and provide accurate information on important areas for larger vessel navigation.

Fishing in the UK has a long history and is of major economic and cultural importance. In 2009, there were just over 12,000 working fishermen in the UK, operating 6,500 vessels, many of which are smaller inshore boats. 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. Various sources of information on fishing effort show that while the majority of UK waters are fished to some extent, certain areas receive considerably more effort than others. In general, the greatest density of fishing effort takes place in coastal waters, for both static (such as pots, traps or gillnets) and mobile (such as trawls and dredges) gears. Further offshore, the density of effort was greatest to the northeast of Scotland (particularly the Fladen Ground), around the Northern Isles and to the southwest of the UK.

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 network. 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.

Military use of the coasts and seas of the UK is extensive, with all 3 Services having defined Practice and Exercise Areas, some of which are danger areas where live firing and testing may occur. Additionally, several military radars - Air Surveillance and Control Systems (ASACS) - are present around the coasts of the UK; these have been mapped along with corresponding buffers relating to potential conflict with wind farms.

Tourism and recreational use of UK coasts and coastal waters is of major importance in many areas. Annually, the British public take some 28 million days on seaside holidays in the UK, in 2009 spending £5.3 billion, split between England (£4.1 billion), Wales (£0.6 billion), Scotland (£0.4 billion) and Northern Ireland. Major recreational uses of the sea beyond beaches and coastal paths include yachting (for which the Royal Yachting Association has published charts of cruising and racing routes), surfing and sea angling, with UK anglers spending £686 million on the activity in 2009. 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 are widely recognised and protected through designations such as National Parks, Areas of Outstanding Natural Beauty, and National Scenic Areas.

Various areas of sea are used or licensed/leased for marine aggregate extraction, telecommunications and other cables, disposal of capital and other dredging wastes, Round 1 and Round 2 offshore wind farms, surface and subsea oil and gas production, hydrocarbon gas storage and export infrastructure. These have a combined turnover of some £34 billion, employing nearly 320,000 people. Potential future uses of the sea include carbon dioxide storage in geological formations or aquifers, while a number of marine renewable (wave and tidal) projects are in the demonstration phase with various test facility sites around the UK. The locations of these features, along with further information, are provided in Appendix 3h of OESEA2 and OESEA.

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, Suffolk date to as early as 700,000 years. 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 near-shore waters, has lead 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.

Further information is provided in Appendix 3i of OESEA2 and OESEA.

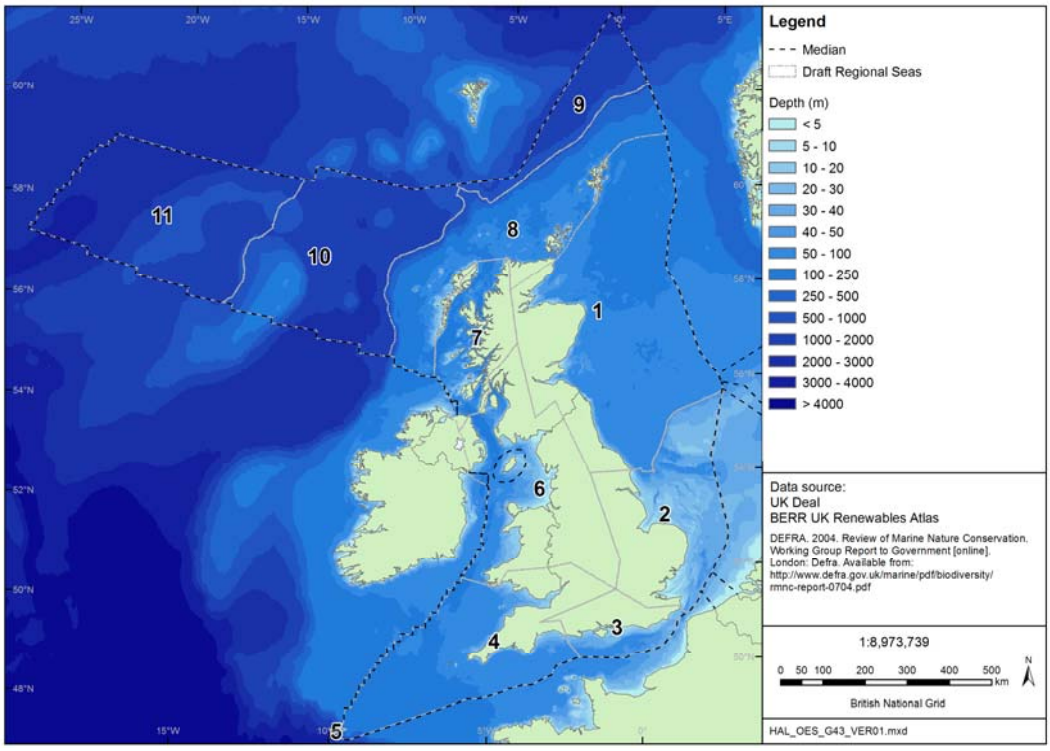
Conservation of sites and species

Designated conservation sites are widespread and abundant around the UK coast; a variety of levels of designations exist from statutory international to voluntary local, affording various levels of protection to habitats, species, and geological, cultural and landscape features. Some of the most widespread designations include the European-level Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) and the national-level Sites/Areas of Special Scientific Interest (SSSIs/ASSIs). The vast majority of currently designated coastal sites are entirely terrestrial or terrestrial with marine components; very few are exclusively marine. However, progress towards further identification of marine sites is ongoing; a number of offshore SACs are in the process of being designated, work is underway to identify new marine SPAs, and the boundaries of some coastal and marine sites are being extended. Additionally, the *Marine and Coastal Access Act 2009* introduced further requirements for identification and designation of Marine Conservation Zones (known as Marine Protected Areas in Scotland), the first of which has been established around Lundy Island. Detailed listing and descriptions of conservation sites is provided in Appendix 3j of OESEA2 and OESEA.

4.2.2 Regional Seas

The OESEA used draft Regional Sea boundaries identified by the JNCC (JNCC 2004) as an appropriate means of considering the broad scale biogeographical regions within UK waters. These boundaries are shown in Figure 4.1.

Figure 4.1 - Draft Regional Sea boundaries



Various changes to the regional sea boundaries have been proposed (e.g. Verling 2009) but as these are not yet finalised it was decided to continue using the draft version. The text below (largely drawn from JNCC 2004) describes the broad physical features of each Regional Sea, including the features upon which their boundaries are based. Detailed information on key features of each of the Regional Seas is provided by the various sub-appendices of the environmental baseline.

Regional Sea 1

The *northern North Sea* is bounded by the Flamborough front to the south, marking the transition from the shallow mixed waters of the southern North Sea to the deeper waters (50-200m) in the north which stratify thermally in summer along with a transition from sands to muddier sediments. Waters are generally of coastal origin but with a strong influx of Atlantic water in the north; turbidity is moderate. The northern boundary marks the transition from water dominated by the continental shelf current to the North Sea waters of mixed origin.

Regional Sea 1 supports an increasing diversity of cetacean species from south-north, high densities of seals (particularly around the Northern Isles), and an important population of bottlenose dolphins along the Scottish east coast. The adjacent coastline represents an important migratory pathway for many Arctic-breeding species, while the widespread and often remote cliff habitats support vast numbers of breeding seabirds; seabird densities at sea are relatively high over much of the area. The deeper waters over the mud and muddy sand of the Fladen Ground support an abundance of fish and *Nephrops* - yielding one of the most valuable fishing grounds in UK waters; additionally, inshore waters are heavily fished throughout the area. Oil and gas development is extensive, particularly in the east.

Regional Sea 2

The *southern North Sea* extends from the Flamborough front in the north to the Dover Straits in the south, with a transition from North Sea water to Atlantic water. This region is shallow (generally 0-50m), with a predominantly sandy seabed, and mixed water experiencing large seasonal temperature variations. The influences of coastal water are particularly marked in this region, the water is turbid, and it exhibits a characteristic plankton composition.

Much of Regional Sea 2 is less than 50m water depth, with many extensive sandbank features present at less than 25m depth; these include the Dogger Bank possible SAC, the North Norfolk Sandbanks candidate SAC and the Margate and Long Sands candidate SAC. The western flank of the Dogger Bank also supports high densities of seabirds. Harbour porpoise are widely distributed throughout much of the area, with apparently variable densities between 2 major surveys a decade apart. Large numbers of harbour seals breed on the coast adjacent to the Wash; these animals forage widely in adjacent waters. The region experiences high densities of shipping activity, particularly in the south, and major shipping lanes run approximately parallel to the entire length of the coast. Fishing effort is moderate overall, with vessels generally avoiding the shallowest of sandbank areas, although inshore effort is fairly high in the south with international effort high in the southeast. Gas development is extensive south of the Dogger Bank to approximately 53°N, while a number of existing, under construction and planned offshore wind farms are present in the greater Wash and Thames areas.

Regional Sea 3

The *eastern English Channel* is bounded by the Dover Straits to the east and extends to the west to a line drawn between Weymouth and Cherbourg on the north coast of France. Waters are generally shallow (0-100m) and mixed, with strong tidal streams. The seabed is

variable; a general transition can be observed from coarser sediments in the west to sand in the east, although localised rock outcrops occur throughout the English Channel basin. Water temperatures vary considerably with season. The western boundary denotes a transition in benthic fauna from the eastern English Channel (Boreal fauna) to a different community in the western English Channel (Lusitanean fauna).

The majority of Regional Sea 3 receives high to very high densities of shipping traffic, and has a water depth of less than 60m. The coastline is one of the most densely populated in the UK, and adjacent waters are used by a great number of recreational vessels. Additionally, very high levels of fishing activity occur, particularly in inshore waters, with high levels of effort by non-UK vessels also observed in this area. Many dredging licence and application areas are present in the region.

Regional Seas 4 and 5

The *western English Channel and Celtic Sea* (Regional Sea 4) is a large region west of a line drawn between Weymouth and Cherbourg and extending to approximately the 500m depth contour on the continental slope in the west. It is bounded to the northeast by the Celtic Sea front - marking the transition from oceanic water to the coastally influenced waters of the Irish Sea. Depth in the region varies from 50-200m with a general trend of increasing depth towards the west. The seabed is largely composed of sand and gravels with isolated rocky outcrops. The waters are generally subject to seasonal stratification, although mixing and seasonal temperature variation is greater in the east. The southern boundary is marked by a transition to warmer water and a community containing a greater number of Lusitanean species. The region is heavily influenced by Atlantic water, with reduced coastal influences; turbidity is moderate.

The *Atlantic south west Approaches* (Regional Sea 5) is a region bounded to the east by the shelf break and extends westwards into the northeast Atlantic. Only a very small proportion of this region lies within UK waters, and it is therefore grouped with the adjacent Regional Sea 4. The seabed is generally composed of fine material. The water is oceanic in origin, with negligible coastal influences, low turbidity and is stratified. While comparable to the other deep water Regional Seas 10 and 11, influences from the Mediterranean current are stronger in this region leading to Lusitanean species being present in the water column. The area is intersected by submarine canyons, characterised by the upwelling of nutrient-rich deep waters and with cold-water corals present.

A large area with a water depth less than 60m extends west from the Bristol Channel to approximately 5°W, and also to some distance off the coast of north Cornwall. Recent surveys have observed seasonally high densities of seabirds in coastal waters around southwest England, while densities are also seasonally high in the north of the area around southwest Wales. The Celtic Sea is an important area for cetaceans, particularly common dolphins which may be seasonally present in large numbers. A large proportion of UK's leatherback turtle sightings occur in this region. In offshore waters west of Land's End lies Haig Fras - an area of rocky reef currently designated as a Site of Community Importance. Inshore waters support four newly designated candidate SACs: Lands End and Cape Bank; Lizard Point; Lyme Bay and Torbay; and Prawle Point to Plymouth Sound. The inshore waters off the southwest coast of England receive some of the highest levels of fishing effort in UK waters. Fishing effort is also high across the majority of Regional Sea 4, while this area is also of considerable importance to recreational craft and commercial shipping. Several dredging licence and application areas are present in the inner Bristol Channel and off the south Wales coast.

Regional Sea 6

The *Irish Sea* is bounded to the south approximately by the Celtic Sea front, and extends north to a line from the Mull of Kintyre, Scotland, to Fair Head, Northern Ireland, and includes the North Channel. Movements of species suggest the North Channel to represent an area of gradual transition rather than sharp change. The seabed is variable in nature, although dominated by glacigenic deposits re-worked by tidal currents. Waters are strongly influenced by coastal processes and turbid with influxes of water from the Celtic Sea and north from the continental shelf current. Stratification occurs in deeper waters but not in the coastal margin or in the north east of the area.

UK waters within the Irish Sea are generally shallow, with the majority of the area less than 60m depth from the coast west to approximately 5°W. Seabird densities are seasonally high in the west, particularly in the far north and south Irish Sea. Concentrations of Manx shearwaters occur in the Irish Sea, with colonies on islands off Pembrokeshire and in the Inner Hebrides representing the majority of the world breeding population of this species. Bottlenose dolphins occur off the west and north Welsh coast, with sightings focussed in Cardigan Bay where the species is one of the qualifying features for a marine SAC. The newly designated Shell Flat candidate SAC lies in inshore waters near Morecambe Bay. High densities of shipping are experienced in the central St. George's Channel, off north Wales leading to the Mersey, and in the North Channel. High levels of fishing effort occur in the north, particularly to the west of the Isle of Man and off the Cumbria coast. Considerable gas infrastructure is present in the eastern Irish Sea associated with producing gas fields and there are a limited number of producing oilfields. There are also a number of existing and planned offshore wind farms.

Regional Sea 7

The *Minches and west Scotland* is bounded to the south by a line from the Mull of Kintyre to Fair Head, to the west by the Malin front, and to the north by a line from the Butt of Lewis to Cape Wrath. The region encompasses waters which are largely sheltered from Atlantic swells by Northern Ireland and the Outer Hebrides. The seabed is characterised by muddy sand and mud, although more gravel is present in the south of the region. The waters in the region largely comprise North Atlantic water as part of the continental shelf current but are modified by coastal influences. The majority of the waters in the region stratify in the summer months, and turbidity is moderate-low.

Regional Sea 7 is characterised by relatively deep waters considering its coastal nature. The complex, undulating coastline with many islands is predominantly rural with very low population density and remote from large conurbations. The region is of high environmental sensitivity for a range of features. A high diversity and abundance of marine mammals and seabirds are present, along with many coastal otter populations. This area supports some of the highest densities of harbour seals in UK waters. Fishing effort is very high throughout much of the area, and is dominated by small, inshore vessels. A very large number of designated conservation sites are present along the adjacent coast, including numerous habitat, species and landscape designations, as well as the newly designated East Mingulay draft SAC. Cold water corals occur in the area, and other reef features are present in many of the sheltered sea lochs. These lochs also support extensive mariculture activities.

Regional Sea 8

The *Scottish continental shelf* runs along the continental shelf to the north and northwest of the UK. It is bounded to the west, south of the Wyville Thomson Ridge, by the 1000m depth contour - reflecting the changes in community composition which has been observed in

various studies on shelf slope fauna. To the north of the Wyville Thomson Ridge, the boundary lies along the 600m contour where the influence of cold Norwegian Sea/Arctic Intermediate water commences. The entire continental shelf is dominated by the warm (>8ºC) North Atlantic waters of the continental shelf current until the Orkney and Shetland Isles. The boundary to the east reflects the division between Lusitanean and Boreal fauna in the channel between the Orkney and Shetland Islands, with Lusitanean fauna occurring in the Orkney Islands but not in the Shetland Islands. The seabed is characterised by sand and coarse sediment of glacigenic origin re-worked by tidal processes, and in deeper areas close to the shelf break sediments have been formed into iceberg ploughmarks - a complex matrix habitat of stony ridges and sandy troughs. Water in this region is subject to seasonal stratification, has low turbidity and there is a low level of material of terrestrial origin entering the sea.

Regional Sea 8 covers a large area and range of water depths, although waters shallower than 60m are generally restricted to those immediately west of the Outer Hebrides. The region supports a rich diversity and abundance of marine mammals, with all typical UK shelf species present in addition to many oceanic, deeper water species along the shelf edge to the north and west. Large numbers of grey seals breed on the several small remote islands present, including those around Orkney and Shetland. Seabird densities are high throughout coastal waters and to a considerable distance offshore. Of particular environmental sensitivity is the St. Kilda archipelago. Lying 66km west of the Outer Hebrides, these islands support very large populations of breeding seabirds and receive numerous conservation designations, including dual World Heritage status for both its natural and cultural significance. Large numbers of breeding seabirds also occur on the adjacent coast of the Outer Hebrides, north mainland and Northern Isles. In the far south of the region lies Stanton Banks, recently designated a Site of Community Importance for reef features. Shipping density is particularly high along the north mainland and through the Pentland Firth, while fishing effort is moderately high throughout the majority of the region. A limited amount of oil and gas activity occurs to the west of Shetland. Population density along the adjacent coast is the lowest in the UK.

Regional Sea 9

The *Faroe-Shetland Channel* is characterised by the influx of dense cold water from the Arctic and Norwegian Sea into the channel at depths below 600m. The western boundary of the region is the Wyville Thomson Ridge which prevents the majority of the flow of cold water from entering the Rockall Trough, which instead exits to the northwest via the Faroe Bank Channel. The seabed of the channel is mainly composed of silt and clay at the base with more sand and some areas of gravel and cobbles/boulders on the flanks of the continental slope, particularly in areas sculpted in the past by icebergs; glacial dropstones occur throughout the area. Water temperatures vary considerably through the water column, from approximately 0°C at the seabed but above 600m depth, where North Atlantic water flows, between 6.5-8°C. Both waters in the region are oceanic in origin and turbidity is low. The cold waters at depth result in a different characteristic benthic community to that found at shallower depths in adjacent areas or in the Rockall Trough.

Regional Sea 9 supports a diverse and abundant cetacean community, including many poorly understood oceanic and deep-diving species such as sperm whales, beaked whales and large baleen whales. Evidence suggests that this area represents a migratory route for a number of cetacean species. Along the southwest boundary of the area lies the Wyville Thomson Ridge, a large area of full salinity stony and bedrock reef currently designated as a candidate SAC.

Regional Seas 10 and 11

The *Rockall Trough and Bank* (10) and *Atlantic North West Approaches* (11) Regional Seas are deep-sea regions west of the Scottish continental shelf. Regional Sea 10 is bounded to the east by the 1000m depth contour and to the west by the 1000m depth contour on the western edge of the Rockall Bank, while Regional Sea 11 extends west of this beyond the UKCS. The seabed supports a different faunal community to that observed at depths less than 1000m, and is mainly composed of muddy sand and mud, with clay mud present in the deep waters to the west. In shallower water, on Rockall Bank and the seamounts, the fauna is likely to be similar to those found at the western edge of the Scottish continental shelf. The waters of these regions are totally oceanic in origin with negligible inputs of material of a terrestrial origin and little seasonal change in primary productivity. Turbidity is very low. Waters are cooler in Regional Sea 11 due to an influx of south flowing Arctic water.

Compared to UK shelf waters, information on the natural environmental of Regional Seas 10 and 11, particularly the latter, is sparse. Known key features include a diversity and abundance of cetaceans, including several large baleen whales species and deep diving species. Evidence suggests that this area represents a migratory route for a number of cetacean species. Several seamounts are present which are known to contain extensive reef habitat, including cold-water corals. In the far northeast of the region lies the Wyville Thomson Ridge candidate SAC, and the Darwin Mounds Site of Community Importance. In the far west of Regional Sea 10 lies the North West Rockall Bank candidate SAC. Moderate levels of fishing effort by UK vessels occur over topographical rises in the area, such as the Anton Dohrn seamount and Rockall Bank; these features are also fished extensively by non-UK vessels.

4.3 Likely evolution of the baseline

The SEA Directive (Annex I) requires that the Environmental Report provides information on the likely evolution of the relevant aspects of the current state of the environment without implementation of the plan/programme.

The information provided below was identified during preparation of the environmental baseline for the previous OESEA and the OESEA2 baseline update (see Appendix 3). The location of supporting information is signposted clearly.

Biodiversity, habitats, flora and fauna

Plankton

The Marine Strategy Framework Directive requires that the biodiversity, distribution and abundance of species be in line with prevailing physiographic, geographic and climatic conditions; this is true of the plankton around the British Isles whose biodiversity, abundance and distributions are primarily affected by hydroclimatic forcing as opposed to anthropogenic influences. Good Environmental Status also requires that ecosystems are not adversely affected by eutrophication, contamination, and non-indigenous species introduced through anthropogenic activities. The planktonic ecosystem of the British Isles meets these criteria as, though eutrophication and contamination may occur in some highly localised areas, the majority of plankton are unaffected by nutrient loading or chemical contamination and there is no evidence that non-indigenous organisms have caused negative impacts on the native plankton. Additionally, changes to marine foodwebs caused by alterations in plankton phenology (trophic mismatch) or community composition appear to be related to climatic factors and are not likely to be the direct result of anthropogenic pressures. An increase in phytoplankton biomass recorded since the mid 1980s has been positively correlated with

sea surface temperature (SST) and wind strength. North Atlantic inflows to the North Sea may affect plankton communities, and have been linked to the increase in the ratio of *Calanus helgolandicus* to *C. finmarchicus* over the last 20 years. There have been widespread changes in the zooplankton community and in the timing of phytoplankton blooms, with wider consequences throughout the ecosystem. Overall, plankton in UK seas are relatively unaffected by direct anthropogenic factors and appear to fulfill the requirements for Good Environmental Status mandated by the MSFD (Defra 2010c).

Further information: OESEA2 Appendix 3a.2, OESEA Appendix 3a.1

Benthos

Over recent geological timescales (ca. 11,000 years) seabed habitats around the UK have been subject to continuous processes of change associated with post-glacial trends in sea level, climate and sedimentation. In the shorter term, seasonal, inter-annual and decadal natural changes in benthic habitats, community structure and individual species population dynamics may result from physical environmental influences (e.g. episodic storm events; hydroclimatic variability and sustained trends) and/or ecological influences such as reproductive cycles, larval settlement, predation, parasitism and disease.

Clark and Frid (2001) reviewed long-term changes in the North Sea ecosystem, at all trophic levels, and concluded that in the northern, western and central areas of the North Sea, longterm changes are predominantly influenced by climatic fluctuations. Here, primary productivity during a particular year is related to the effect of weather on the timing of stratification and the resulting spring bloom. In the southern and eastern areas of the North Sea, the lack of stratification and the large inputs of nutrients mean that primary productivity is more strongly influenced by variations in anthropogenic nutrient inputs, and is only weakly related to climatic variation. However, the weight of evidence shows that long-term changes in the ecosystem may ultimately be related to long-term changes in either climate or nutrients, although the long-term dynamics of certain taxa and communities do show evidence of being influenced by both anthropogenic factors and/or internal factors such as competition and predation.

The Marine Climate Change Impacts Partnership Annual Report Card 2007-2008 Scientific Review - Seabed Ecology (Frid & Moore) concluded that:

- The available data show that climatic processes, both directly, e.g. winter mortality, and indirectly, via hydrographic conditions, influence the abundance and species composition of sea bed communities.
- These variations will directly affect the availability of food for bottom feeding fish such as cod and haddock, impact on shellfish populations (*Nephrops* and scallops/clams) and potentially alter patterns of biodiversity and ecological functioning.
- The alteration in the seafloor communities could alter rates and timing of processes such as nutrient cycling, larval supply to the plankton and organic waste assimilation.
- At local (although still large) spatial scales there is also evidence of effects resulting from fishing impacts and at smaller scales habitat modification e.g. wind farms, aggregate extraction and impacts from contaminants e.g. oil and gas exploration, waste dumping (see below).

Further information: OESEA2 Appendix 3a.3, OESEA Appendix 3a.2

Cephalopods

The biology and ecology of many cephalopod species remains little known and as a result, the potential effects of a changing climate on cephalopod populations are not easy to predict. However, it is known that for many species, temperature has an important influence on a number of life history processes, including recruitment (through maturation rate and the rate of embryonic development), the timing of migration and the distribution range. As well as this, food availability and predator abundance and distribution are likely to be affected by changes in the marine environment.

Further information: OESEA2 Appendix 3a.4, OESEA Appendix 3a.3

Fish and shellfish

As well as coming under severe pressure from anthropogenic factors, fish communities are likely to be affected by future climate change, which may influence the abundance, distribution, recruitment and migration of species. This could have a major effect on the community structure of the region.

Abundances of herring have been linked to cooler winters, with sardines more abundant following warmer winters. The distributions of two-thirds of North Sea fish species have shifted mean latitude in the past 25 years, with a typically northern shift in population boundaries. Species regarded as having a characteristically southerly distribution are increasing in abundance in UK waters. Cod stocks may have completely depleted in the Irish and Celtic Seas by 2100 due to temperature and hydrodynamic changes. SST is thought to influence the recruitment of cod, whiting and mackerel in the North Sea. A changing climate is also likely to affect migration routes of some species. There has been a northerly shift in the mackerel spawning grounds and a change in the timing of adult migration into these grounds. The navigation of salmon and other migratory fish back to home rivers may be severely affected as it relies on a range of environmental cues, potentially affecting recruitment success.

Shellfish populations are often tied to particular sediment types and so distributions of these species may be relatively stable. However, the settlement of many bivalve species is dependent on environmental factors and so changes in water temperature, wind strength and current direction may result in altered stock recruitment.

In general, the fish and shellfish of the British Isles may not fulfil all the criteria for Good Environmental Status put forward by the Marine Strategy Framework Directive (Defra 2010c). The MSFD requires that the biodiversity, distribution and abundance of species be in line with prevailing physiographic, geographic and climatic conditions and that all commercially exploited species are within safe biological limits; this is not true of all fish communities around the British Isles whose biodiversity, abundance and distributions are heavily affected by anthropogenic influences as well as hydroclimatic forcing. Good Environmental Status also requires that ecosystems are not affected adversely by eutrophication and contamination through anthropogenic activities, and some fish communities, particularly estuarine species are likely to be impacted by estuarine inputs and coastal development. According to OSPAR's Quality Status Report 2010 (OSPAR 2010a) there has been slow progress on the protection of species and habitats, with many problems remaining, the impact of coastal activities on marine and estuarine communities still increasing and a number of fish species in UK waters still listed as under threat and/or in decline.

Further information: OESEA2 Appendices 3a.5 and 3j, OESEA Appendix 3a.4

Marine reptiles

The low number of turtles recorded in UK waters combined with their widespread distribution makes it extremely difficult to determine any population trends. The 15°C isotherm largely determines the range of leatherback turtles, and the average summer location of this isotherm in the northeast Atlantic has moved north by several hundred kilometres over the past two decades. Additionally, the distribution of jellyfish prey species, such as *Rhizostoma*, has been linked to leatherback sightings; as ocean temperatures continue to rise it is expected that gelatinous species will move further north. Warmer temperatures and greater occurrence of gelatinous species in UK waters is likely to result in an increasing and more widespread occurrence of leatherback turtles; however, no such trend is apparent from turtle sighting and stranding records over the past 10 years. Defra (2010c) indicates that the most significant threats to marine turtles in the Atlantic occur at the breeding sites and therefore outside the UK.

Further information: OESEA2 Appendix 3a.6, OESEA Appendix 3a.5

Birds

Seabirds

Changes in breeding numbers have varied greatly between individual species: for example between 1999-2009, abundance decreased by more than 10% in seven species, increased by more than 10% in five species and changed by less than 10% in six species (Eaton *et al.* 2010). Both Charting Progress 2 (Defra 2010c) and the OSPAR QSR (OSPAR 2010a) indicate that in the northern North Sea, some seabirds have suffered a decade of breeding failure, possibly due to the combined effects of climate change and fishing on key prey species. Although breeding success was good for the first time in 2009 for some species (e.g. kittiwake and guillemots), the long-term picture is still one of serious concern.

Eaton *et al.* (2010) examined trends in abundance and breeding success of six widespread and abundant seabird species, which represent a range of foraging niches, to investigate possible common factors responsible for change across species. Kittiwakes and gannets represent the offshore surface-feeder niche; fulmars the offshore surface feeder/scavenger niche; sandwich terns the inshore surface-feeder niche; guillemots the offshore diving niche, and shags the inshore diving niche.

Kittiwakes have undergone a major population decline since 1986. They rely largely on small shoaling fish, especially sandeels, to be present at the sea surface and there is evidence that increases in sea surface temperature (SST) have reduced the abundance of sandeels and therefore the productivity (and adult survival) of kittiwakes. Gannet numbers have increased substantially over the period monitored. Unlike kittiwakes, gannets can travel great distances from the colony to find food and their diet is varied, including mackerel, herring and other large fish. These factors help gannets to maintain consistently high productivity. Fulmar breeding numbers in the UK have undergone a long term increase, which continued until the end of the 1990s, after which a decline was apparent. As fulmars gain a large proportion of their food from fishery discards, the recent decline may in part be a result of reductions in fishing activity. Indeed it is possible that fulmar populations have been bolstered by historically high fishing levels. Since many tern species nest near the tide edge on sand or shingle spits and islands, they are vulnerable to tidal inundation; this threat is likely to increase in some areas given climate change predictions of rising sea levels and increased incidence of storm events, although managed realignment of coastal defences may create new opportunities for nesting. Declines in guillemot productivity are associated with reduced sandeel availability, probably mediated by increases in SST. As with other

sandeel feeders (e.g. kittiwake), productivity of guillemots increased markedly in 2009, when sandeel abundance appeared to be high. Population change in the shag is heavily affected by the incidence of mass mortality events – or "wrecks" – which occur during prolonged periods of onshore gales, when birds such as shags find it hard to forage. Severe events, such as those in 1994 and 2005, knocked back the population considerably, and subsequent recovery has been slow. Predictions of increased storminess due to climate change suggest such mortality events may become more frequent (Eaton *et al.* 2010).

Waterbirds
Trends in overall abundance for 46 native species or populations, derived from the Wetland Bird Survey (WeBS) Core Counts and the Goose & Swan Monitoring Programme indicate that there was a steady increase in wintering waterbirds in the UK from the mid-1970s to the mid-1990s, due in part to a network of protected wetland sites. For some species, reductions in shooting pressure have also contributed to the increases. However, since the mid-1990s, the indicators suggest that average waterbird numbers have levelled off, both for wildfowl and waders, and are now indicating an overall decline, particularly for wildfowl. Results from waterbird monitoring schemes in other parts of Europe have demonstrated that this is at least partly attributable to "short stopping", whereby an increased proportion of a waterbird population is able to winter closer to its breeding area (usually further east or north) due to milder winters. However, it is crucial that the influence of short stopping on observed waterbird trends in the UK is understood so that true declines are not overlooked. Careful monitoring and research is needed, both in the UK and elsewhere on flyways, to determine whether the recent declines are the result of climate-mediated range shifts, or indicative of population-level declines (Eaton *et al.* 2010).

Further information: OESEA2 Appendices 3a.7 and 3j, OESEA Appendix 3a.6

Marine mammals

Defra (2010c) indicates that in general, cetaceans as a group are considered to be in good condition in both the northern and southern North Sea; poor condition in the Eastern Channel due to historical bycatch, and in moderate condition in the Western Channel and Celtic Sea, the Irish Sea and the Minches and Western Scottish waters. Cetacean status is unknown over the Scottish continental shelf area and offshore waters north and west of Scotland. SCANS survey data from 1994 and 2005 presented in the OESEA suggested a southerly shift in harbour porpoise distribution within the North Sea which is further supported by a monitoring study reported by Jung *et al*. (2009).

In the UK, grey seals are considerably more numerous than harbour seals. After decades of increase, total grey seal pup production appears to be levelling off and is now increasing at only a small number of colonies. Longer term pup production averages suggest that the growth of pup production in the Inner and Outer Hebrides has effectively stopped while in Orkney it has levelled off (SCOS 2009). Counts of harbour seals along the east coast of England and in the Wash have failed to demonstrate any recovery since the phocine distemper virus (PDV) epidemic. These declines are in contrast to the adjacent European colonies which have experienced rapid growth since 2002. Major declines have now been documented in harbour seal populations around Scotland with reductions of up to 50% since 2000 in Orkney, Shetland, the Moray Firth and the Firth of Tay (SCOS 2009). There has been a smaller decline in the Outer Hebrides but numbers on the west coast of Scotland have remained relatively stable. The causes of these declines are still not known and further studies are needed.

Further information: OESEA2 Appendix 3a.8, OESEA Appendix 3a.7

Geology, substrates and coastal geomorphology

The environmental baseline is likely to evolve slowly in the absence of anthropogenic influences. At present there are no anthropogenic activities which are likely to cause significant regional scale changes to geology and sediments, though trawling and dredging activities can generate localised scour and sediment plumes. Sea levels are predicted to rise by between 12-76cm over the next 100 years, outpacing the largest predictions of isostatic uplift and increasing the risk of flooding and coastal erosion. Coastal erosion is estimated to affect 17% of UK coasts.

The latest ACOPS annual survey of reported discharges from vessels and offshore oil and gas installations operating in the UK pollution control zone (Dixon 2009) indicates a reduction in the total number of accidental discharges attributed to offshore oil and gas installations during 2008, reversing the underlying upward trend in the annual totals recorded over the previous 4 years. While contamination in close proximity to some offshore platforms exists from the historical use of oil-based drilling muds, monitoring shows concentrations of organic components to be progressively reducing over time. Additionally, oil concentrations in produced water are at an all time low and are expected to continue to fall. Beach litter surveys indicate that, in general, quantities of litter on UK beaches have shown no appreciable decrease over the period 2003 to 2007.

Further information: OESEA2 Appendix 3b, OESEA Appendix 3b

Landscape/seascape

There are presently 5 offshore windfarms in planning and a further 7 which have been consented, adding to the 17 which are either operational or under construction in England and Wales. In addition to these there are now exclusivity agreements for the 9 Round 3 areas within which major windfarm developments are planned. With the exception of the Dogger Bank site, part of all of the Round 3 areas may be visible from coastal locations, and future leasing rounds for this technology are also possible. There is a likelihood of landscape effects from coastal and terrestrial wind generation projects, other marine energy developments and continued industrial, port and urban expansion.

Further information: OESEA2 Appendix 3c, OESEA Appendix 3c

Water environment

The environmental baseline is likely to be affected by large scale climatic and oceanographic processes. Variations have been observed in North Atlantic and North Sea circulation patterns in the past few decades which are likely to influence sea surface temperatures. Increased wave heights have been observed in the western and northern UK waters and wave heights in the north-east Atlantic and northern North Sea are known to respond strongly and systematically to the North Atlantic Oscillation. Around the UK, sea temperatures and seasonal stratification strengths are predicted to increase, while salinity is projected to decrease over the 21st Century.

At a local level, topography often interacts with these principal forces, focusing currents and leading to the generation of amplified current flow or eddies. At present there are no local anthropogenic activities within the UKCS area that are likely to change significantly the physical properties of the water environment, though the pH of the world's oceans has been declining due to CO_2 uptake from anthropogenic sources. It can be expected that in the wider environment, global sea-levels may rise by *c.* 1-2mm per annum. Coastal and marine

waters around the UK are generally thought to be non-problem areas with respect to eutrophication.

Further information: OESEA2 Appendix 3d, OESEA Appendix 3d

Air quality

Air quality is spatially variable, with quality generally increasing to the north of the UK where industrial development is sparser and population centres smaller and more dispersed. Air quality is likely to improve as a corollary to a push in the reduction of emissions set out in the renewed Air Quality Framework Directive (2008/50/EC) and its implementation in UK law. Increased renewable energy use and improved efficiency in conventional transport methods (e.g. diesel engines) are likely to make substantial contributions to key emissions associated with environmental and human health issues.

Further information: OESEA2 Appendix 3e, OESEA Appendix 3e

Climate and meteorology

At continental, regional, and ocean basin scales, numerous long-term changes in climate have been observed. These include changes in Arctic temperatures and ice, widespread changes in precipitation amounts, ocean salinity, wind patterns and aspects of extreme weather including droughts, heavy precipitation, heat waves and the intensity of tropical cyclones. Future trajectories are uncertain, but UK specific scenarios based on current information are presented in the most recent work by UKCIP. Overall, significant anomalies and changes have been noted in sea surface temperature (SST), thermal stratification, circulation patterns, wave climate, pH and sea level. Larger-scale trends and process changes have also been noted in the North Atlantic (e.g. in the strength of the Gulf Stream), northern hemisphere and globally.

Further information: OESEA2 Appendix 3f, OESEA Appendix 3f

Population and human health

In the UK as a whole, population is expected to increase by 4 million to 65.6 million in the years leading up to 2018, with growth being most significant in areas adjacent to Regional Seas 2 and 4, and least in Regional Sea 6. This growth will increase population density; human health in the UK is unlikely to change considerably in the near future, although the population is aging and there is an increasing trend to obesity.

Further information: OESEA2 Appendix 3g, OESEA Appendix 3g

Other users

Existing marine activities include shipping and port activities, military exercises, fishing, recreational sailing, oil and gas exploration and production, aviation and offshore wind farm construction and operation. Port activities have been continuously expanding, particularly in the last 5 years and associated with this expansion, shipping tonnage has also increased. Through-traffic in the North Sea is predicted to increase by 2020. The fishing industry is dynamic with frequent and sometimes unpredictable changes in fish abundance and distribution, climatic conditions, management regulations and fuel costs all affecting activity. Consequently the baseline is rapidly evolving. In general, the fishing industry has been in decline in recent years in terms of numbers employed, vessels at sea and catch, and in coming years technical developments, economics, changes in management strategy and

changes in target species, abundance, composition and distribution are all likely to be important. A number of demonstrator wave and tidal power electricity generation devices have been deployed which may lead to commercial scale developments in the future. Similarly there are a number of feasibility studies for the development of barrages or lagoons to harness tidal power for renewable electricity generation.

The *Marine and Coastal Access Act 2009* aims to allow a coordinated system for delivering sustainable development of the marine and coastal environment and addresses both the use and protection of marine resources.

Further information: OESEA2 Appendix 3h, OESEA Appendix 3h

Cultural heritage

There is an increasing awareness of submerged archaeological material located for example in the southern North Sea, though their distribution is speculative. These areas are vulnerable to offshore operations which disturb the seabed (drilling, piling, cabling). The development of increasingly sophisticated detection methods, mapping, and underwater excavation means that the recovery of archaeological information is increasingly likely.

Further information: OESEA2 Appendix 3i, OESEA Appendix 3i

Conservation

The *Marine and Coastal Access Act 2009* (and equivalent Acts/Bills of the devolved administrations) will aid the completion of an ecologically coherent and well-managed network of Marine Protected Areas. These sites will be known as Marine Conservation Zones (MCZs) in England and Wales and Marine Protected Areas (MPAs) in Scotland. These, together with existing and future Natura 2000, OSPAR and other conservation sites should contribute to the achievement of good environmental status in the Marine Strategy Framework Directive.

Further information: OESEA2 Appendix 3j, OESEA Appendix 3j

Onshore

The Countryside Survey 2007 (Carey *et al.* 2008) indicates general trends in the physical and ecological (flora) structure of 'broad habitats' (e.g. Broadleaved Woodland, Improved Grassland, Neutral Grassland) constituting the countryside of England, Scotland, Wales and Northern Ireland. However, coastal habitats are not specifically addressed.

Coastal habitats in the UK, which are variously influenced by physical processes including underlying geology, past and ongoing sedimentary regimes (including aeolian deposition and erosion) are important in terms of their conservation value (e.g. Annex I dune and machair sites, and priority UKBAP dune machair, coastal vegetated shingle and maritime cliffs), and the services which they provide including flood risk reduction (Rees *et al.* 2010 – see Appendix 3b). Many of these coastal habitats are not in favourable condition, being subject to past human intervention through land reclamation (for instance the use of dunes for forestry and golf course development) and the erection of hard defences. This, aligned with projections for future sea-level rise (see Appendix 3b and 3d) may lead to the further reduction of such areas, particularly where development and hard defences prevent the landward migration of certain habitats (i.e. coastal squeeze – see Appendix 3b), and also where such defences prevent erosion which is a necessary part of the coastal sedimentary system.

Rees *et al.* (2010) summarises the likely impact that climate change will have on coastal habitats including sand dunes, machair, maritime cliffs and slopes, shingle and coastal grassland and heaths. In addition to sea-level rise, certain plant communities associated with dune environments which have a northern distribution may shift their range (e.g. *Ammophila arenaria-Festuca rubra-Hypnum cupressiforme*), and though warmer and wetter conditions may be favourable in terms of dune stabilisation and development, these are likely to be offset by drought periods and storms. Low-lying machair habitats are similarly affected by sea-level rise and storm events should they increase as a result of climate change. Maritime cliffs may erode more rapidly as sea-level and storminess increase, exacerbated by an increase in rainfall which may help promote a greater number of landslips. Like other coastal habitats, land-use intensity may constrain the ability of vegetation to migrate as cliffs recede, for instance coastal grassland and heath. Rees *et al*. (2010) state that there may be a disproportionate impact on shingle beaches as these coincide with areas where projected sea-level rise is greatest (i.e. in the south and east). The migration of features may mean that present designation site boundaries will be breached, though their perpetuation is dependent upon new sediment input which is often prevented by beach defences. Shingle vegetation is sparse and is therefore susceptible to damage by storm events. In addition, a warmer climate is thought be responsible for the disappearance of the northern oyster plant in several southern shingle beaches and may help to spread invasive garden species which could displace native species.

Further information: OESEA2 Appendix 3b and 3d

4.4 Relevant existing environmental problems

The SEA Directive requires that the Environmental Report includes details of any existing environmental problems which are relevant to the plan or programme including, in particular, those relating to any areas of a particular environmental importance, such as areas designated pursuant to Directives 2009/147/EC and 92/43/EEC (the Birds and Habitats Directives).

The following environmental problems have been identified from the recent Defra Charting Progress 2 (Defra 2010a) and OSPAR QSR 2010 (OSPAR 2010a) which provided peer-reviewed assessments of the environmental status of the UK and OSPAR marine areas. Implications for the SEA are also described and the location of supporting information is signposted.

Eutrophication

The majority of UK waters do not experience significant eutrophication. However, in a limited number of coastal areas in the east, south and north-west of England inputs of nutrients of anthropogenic origin (notably nitrate and phosphate from agriculture and urban waste water sources) have resulted in nutrient enrichment in some small estuaries and bays. Where measures have been taken to reduce nutrient inputs, it may be decades before eutrophication is absent because nutrients can be released from soil and sediments.

Implications for the SEA

The SEA must consider the potential implications of the draft plan/programme on attaining good environmental status of both marine and coastal/estuarine waters as determined by the Water Framework and Marine Strategy Framework Directives. One of the descriptors for determining good environmental status under the MSFD is that human-induced

eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters.

Further information: Plankton (OESEA2 Appendix 3a.2, OESEA Appendix 3a.1) and water environment (OESEA2 Appendix 3d, OESEA Appendix 3d)

Hazardous substances

Concentrations of some metals (cadmium, mercury and lead) and persistent organic pollutants are above background in some offshore waters of the North Sea, and unacceptable in some coastal areas. In the Greater North Sea, lead levels, for example, were unacceptable at 40% of locations monitored, while PAHs and PCBs were at unacceptable levels at more than half of the monitoring sites. In the Celtic Seas, heavy metal, PAH and PCB concentrations in sediment, fish and shellfish have fallen, but are still above acceptable levels in some coastal areas, mainly around the Irish Sea. Concentrations of PAHs and PCBs are unacceptable at more than half the sites tested in the Celtic Seas.

Implications for the SEA

The SEA must consider international and national scale measures to reduce operational and accidental discharges at sea and from the terrestrial environment in relation to the possible impacts of the draft plan/programme (e.g. operational and accidental discharges from oil and gas exploration and production, and transportation and storage of CO_2). Potential activities resulting from implementation of the draft plan/programme may have the potential to affect the attainment of good environmental status under the MSFD through altering hydrographical conditions (e.g. wave, tidal stream and range devices). However, existing controls and regulation should ensure that these activities do not significantly affect the status of marine waters.

Further information: Geology, substrates and coastal geomorphology (OESEA2 Appendix 3b, OESEA Appendix 3b) and water environment (OESEA2 Appendix 3d, OESEA Appendix 3d)

Litter

Amounts of marine litter are a concern. In the Greater North Sea over 90% of fulmars have microscopic plastic particles in their stomachs and 45% to 60% have more than the Ecological Quality Objective (EcoQO) set by OSPAR. Beach litter in the southern North Sea is at OSPAR-wide average (around 700 items per 100m of beach), but levels are higher in the northern North Sea. On beaches around the Irish Sea there are unacceptable quantities of litter, reaching over 1,000 litter items per 100m of beach in some areas. This can be dangerous to seabirds, and to turtles and marine mammals when in the sea. Much of this litter probably comes from sources on land.

Implications for the SEA

The importance of tackling marine litter has been highlighted in the MSFD, which includes the descriptor that properties and quantities of marine litter do not cause harm to the coastal and marine environment. Potential activities resulting from implementation of the draft plan/programme may have the potential to affect the attainment of good environmental status under the MSFD through littering although regulatory control of waste disposal activities should ensure that no significant impact occurs.

Further information: Geology, substrates and coastal geomorphology (OESEA2 Appendix 3b)

Impacts of climate change.

The pace of warming of the sea is highest in the North Sea, with an increase in sea surface temperature of 1 to 2 °C over the past 25 years. Plankton and fish communities are already changing in response to warming. Fish like Silvery John dory, sea bass and red mullet are becoming more common further north, while North Sea cod stocks seem to be declining faster than would be expected from the impact of fishing alone.

Sea level is rising, increasing the risk of coastal erosion, flooding and loss of intertidal habitat due to 'coastal squeeze'. This is a particular concern in the southern North Sea, eastern Channel and Bristol Channel regions as the land is sinking and the coasts of south-eastern England are low lying. The coasts are generally formed of soft sediments which are susceptible to erosion. The southern North Sea coast has the highest proportion of coastal defence (32%) and flood protection schemes (33%) in the UK and further development in response to rising sea level will add to the existing pressure on intertidal sediment habitats.

Implications for the SEA

UK River Basin Management Plans and Shoreline Management Plans, have provided an ecological and morphological baseline for UK estuaries and coasts which may be influenced by plan/programme activities, for instance the imposition of tidal range technologies could negatively impact both estuarine morphology and ecology and reduce the likelihood that targets in relation to achieving good ecological status are met by 2015. More widely, and in combination with other topics including climate change, an understanding of the impacts from energy removal and sedimentary impacts of wet renewables will be necessary. It will be important that a suitable consideration of such impacts is made at a development specific level.

Activities associated with the draft plan/programme should help to make a net contribution to the reduction of UK CO_2 emissions, as set out in the UK carbon budget, albeit through carbon dioxide storage, or an increase in the proportion of UK energy generated by renewable technologies. As such, adoption of the plan/programme subject to any spatial considerations and recommendations arising from OESEA2 will also help to achieve the UK's legally binding target of producing 15% of its energy from renewable sources by 2020 – equivalent to ~30% of electricity generation. The longer term UK Government aim, of which the current draft plan/programme is one aspect, is to achieve a sufficient reduction in greenhouse gases (i.e. all of those which contribute to *global warming*, not just CO_2) to prevent those extreme climate change scenarios (e.g. as projected by IPCC or in UKCP09) and associated social, environmental and economic costs (e.g. Stern 2006).

Further information: Climate and meteorology (OESEA2 Appendix 3f, OESEA Appendix 3f), Geology, substrates and coastal geomorphology (OESEA2 Appendix 3b, OESEA Appendix 3b) and water environment (OESEA2 Appendix 3d, OESEA Appendix 3d)

Pressure on fish stocks

Some important North Sea fish stocks are still outside sustainable limits and while damaging practices have been reduced, the picture is not uniformly good. The poor status of cod is of particular concern. By-catch of rays, sharks, porpoises and dolphins in fishing nets is also of concern. While trawl effort has fallen in the Irish Sea and to the west of Scotland, fishing effort is still high. Some beam trawlers have switched to otter trawling or scallop dredging, a

fishery without quotas. Several fish stocks are harvested unsustainably. Cod and whiting are depleted to the west of Scotland and in the Irish Sea. To date, recovery plans for cod have not been effective in rebuilding the Irish Sea stock. The amount of fish caught and discarded in the Celtic Seas must be addressed and by-catch is still a problem in some areas.

Implications for the SEA

Potential activities resulting from implementation of the draft plan/programme may have the potential to improve local fish stocks through the designation of safety zones around structures.

Further information: Fish and shellfish (OESEA2 Appendices 3a.5, OESEA Appendix 3a.4)

Declines in bird numbers

In the northern North Sea, some seabirds have suffered a decade of poor breeding or failure, possibly due to the combined effects of climate change and fishing on key prey species. Although breeding success was good in 2009, the long-term picture is still one of serious concern. Similar declines in seabird breeding numbers have been observed to the west of Scotland associated with predation by introduced mammals and food supply shortages.

In the southern North Sea, some waterbird populations have declined and this has been linked to reduced food availability possibly due to pressure from shellfisheries. In the Irish Sea, the number of waterbirds, such as waders, has decreased as more birds are now wintering in east coast estuaries, potentially as a result of a changing climate.

Implications for the SEA

Given that many seabird and waterbird species may be in decline, the SEA should review areas to be licensed for oil and gas, offshore wind, marine renewable or carbon transport and storage activities and ensure awareness so that potential activities do not exacerbate the risk of surface pollution or significant disturbance to bird populations. Potential activities which may impact on coastal and marine SPAs will be subject to Appropriate Assessment.

Further information: Birds (OESEA2 Appendices 3a.7, OESEA Appendix 3a.6)

Damage to seabed habitats

Significant damage has occurred to shallow sediment habitats and reefs as a result of bottom fishing practices especially beam trawling (OSPAR 2010a). Around the UK, coastal and offshore seabed sediment habitats such as sands and muds are impacted by bottom trawling activity, which may damage ecosystem functioning (Defra 2010a).

Implications for the SEA

The SEA should review areas to be licensed for oil and gas, offshore wind, marine renewable or carbon transport and storage activities and ensure awareness of existing problems related to the benthos so that potential activities do not exacerbate problem. Safety zones around surface infrastructure will likely reduce trawling activities in these areas thereby reducing trawling pressure on benthos.

Further information: Benthos (OESEA2 Appendix 3a.3, OESEA Appendix 3a.2), Fisheries in Other users (OESEA2 Appendix 3h, OESEA Appendix 3h)

Poor knowledge of the status of marine mammals

At present, there are insufficient data on the populations of marine mammals in the OSPAR region III Celtic Seas (OSPAR 2010a). Within this region, dolphins, porpoises and grey seals are impacted through fisheries by-catch. Harbour seals are counted every five or six years, the bare minimum to assess their status, and other marine mammals have little systematic recording. Marine mammals may become entangled in ropes and nets in coastal waters to the west of Scotland and in the Minches there is concern about entanglement of minke whales, which are important to the local economy, through marine wildlife watching.

Implications for the SEA

There is the potential for disturbance of marine mammals from the activities that may result from implementation of the draft plan/programme. Activities will be spatially variable, though noise will certainly be concentrated in areas of renewable energy development utilising pile driving, and oil and gas exploration activities using seismic survey methods, principally the North Sea, Irish Sea and west of Shetland. There is also a collision risk associated with offshore structures and shipping activity.

Further information: OESEA2 Appendix 3a.8, OESEA Appendix 3a.7

Problems associated with the conservation of species and habitats

The OSPAR QSR 2010 (OSPAR 2010a) identifies a series of environmental problems in relation to the protection and conservation of biodiversity and ecosystems. These apply to the OSPAR marine area but are equally relevant to UK waters and include:

Pressures such as the removal of species (e.g. by fishing), loss of and damage to habitats, the introduction of non-indigenous species, obstacles to species migration and poor water quality are still present. Some pressures are still increasing in parts of the OSPAR area and all can act in synergy or be exacerbated by climate change. These pressures result in loss of biodiversity, including declines in the abundance and variety of species and habitats. Interruption of ecological processes, such as spawning, migration, and biological communication, may also occur.

The most sensitive features are those that are easily damaged and slow to recover. Reefs of the cold-water coral *Lophelia pertusa* and individuals of the fan mussel *Atrina fragilis* are slow-growing and delicate and can be severely damaged by bottom trawl fisheries.

Coastal waters contain feeding grounds, spawning and nursery areas, and feature on migration routes for seabirds and some fish species. These areas also host intense and varied human activities, which exert a wide range of pressures and can lead to the damage or loss of key habitats in estuaries and intertidal areas. Salt marshes and seagrass beds, which are highly productive and act as natural carbon sinks, are under pressure from relative sea-level rise and coastal development. Key areas of the shelf seas, including offshore banks and reefs, and frontal zones between different water masses, play important roles in pelagic productivity. Fishing is recognised as a key pressure on species and habitats in the shelf seas and there continues to be a need for information about ecologically important areas to guide improvements in management.

Although the general situation for most estuarine and marine fish communities seems to have improved in recent years, the status of certain vulnerable fishes has continued to deteriorate. This includes many deep-water fish species; sharks, rays and skates; and transitional/diadromous species that move between fresh and salt water (Defra 2010a). Many of these fish are listed as requiring protection under appropriate legislation and have been identified by OSPAR as being under threat and in decline (OSPAR 2010a). For example, the number of juvenile and adult European eels has fallen in many of the regions where this species occurs reflecting an Atlantic-wide downturn in the numbers of elvers returning to rivers. Causes of this decline are unclear but suggestions include changes in oceanic conditions, overexploitation, freshwater habitat destruction and contaminants (Defra 2010a).

With reference to habitats and species protected under the Habitats Directive, JNCC have assessed their conservation status. This assessment of conservation status does not only relate to that component of the habitat area or species population to be found in Special Areas of Conservation, but to the totality of the habitats and species throughout the United Kingdom. The 2007 Article 17 report (JNCC website - http://www.jncc.gov.uk/page-4096) prepared under the Habitats Directive is the second six year report.

When assessing the conservation status of habitats, four parameters were considered. These were: range, area, structure and function (referred to as habitat condition) and future prospects. For species, the parameters are: range, population, habitat (extent and condition) and future prospects. Each of these parameters was assessed as being in one of the following conditions: Favourable, Unfavourable-inadequate, Unfavourable-Bad, or Unknown. An overall assessment was determined by reference to the conclusions for the individual parameters, and, in general, reflects the least favourable of the individual parameter conclusions.

The overall UK assessments for seven Annex I marine habitats assessed included: 4 which were determined to be in ‘bad and deteriorating’ condition (sandbanks which are slightly covered by seawater all the time; estuaries; mudflats and sandflats not covered by seawater at low tide; large shallow inlets and bays); 1 in ‘inadequate’ condition (coastal lagoons), and 2 in ‘unknown’ condition (reefs; submarine structures made by leaking gases).

Of the 22 Annex II marine species assessed: 1 was considered in ‘bad’ condition (allis shad); 1 in ‘inadequate and deteriorating’ condition (maerl); 3 in ‘inadequate’ condition (twaite shad, Atlantic salmon, harbour seal); 3 in ‘inadequate but improving’ condition (sea, brook and river lampreys); 7 in ‘favourable’ condition (bottlenose dolphin; harbor porpoise; otter; grey seal; white-beaked dolphin; minke whale; fin whale), and 7 in ‘unknown’ condition (leatherback turtle, common dolphin, killer whale, long-finned pilot whale, Risso's dolphin, Atlantic white-sided dolphin, sperm whale).

Eaton *et al.* (2010) provide information on trends in abundance and breeding success of seabird and waterbird species, many of which are protected by SPA designations (see Birds section in Section 4.3 above for details).

Implications for the SEA

The SEA should consider the implications of the draft plan/programme and its alternatives on the wider marine environment, in relation to the features of conservation sites of European and national importance, and those areas for which designations are proposed. The SEA will need to draw attention to the current location of these sites and the species or habitats for which they are designated, and any sites which are currently being considered for designation, in addition to characterising the present baseline condition and issues

relating more generally to the marine environment. At this more general level, the SEA must consider the potential implications of the draft plan/programme on attaining good environmental status of both marine and coastal/estuarine waters as determined by the Water Framework and Marine Strategy Framework Directives. The creation of MCZs and MPAs under the *Marine and Coastal Access Act 2009* and *Marine (Scotland) Act 2010* respectively, represents a new type of offshore designation, the number, size and location of which are unknown at present.

Further information: OESEA2 Appendix 3j, OESEA Appendix 3j

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