Agenda Item 3.2

Review of New Information on Threats to Small Cetaceans

Underwater Noise

Information Document 3.7.2.b

Marine Renewable Energy: A Global Review of the Extent of Marine Renewable Energy Developments, the Developing Technologies and Possible Conservation Implications for Cetaceans

Action Requested

- Take note

Submitted by

Whale and Dolphin Conservation (WDC)

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Marine Renewable Energy: A Global Review of the Extent of Marine Renewable Energy Developments, the Developing Technologies and Possible Conservation Implications for Cetaceans

Vicki James

Version 1. November 2013

WHALE AND
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Marine Renewable Energy: A Global Review of the Extent of Marine Renewable Energy Developments, the Developing Technologies and Possible Conservation Implications for Cetaceans

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Version 1 - Published November 2013

Cover photographs.
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A world where every whale and dolphin is safe and free

CONTENTS

EXECUTIVE SUMMARY

The global extent of marine renewable energy developments (MREDs) has been researched and considered in relation to their potential impacts on cetaceans. There is currently an unprecedented expansion of MREDs, focused on European waters, with large-scale developments covering thousands of square kilometres being planned. However, data on the likely impacts of these developments on cetaceans is lacking or, at best, significantly limited.

This research highlights the rapid expansion of MREDs, particularly in Europe, and more recently in China and off the east coast of the USA. Offshore wind farms continue to be the technology developing most swiftly; wave and tidal energy devices are mostly still in the testing phases, with the majority of operational sites being used to test the technology.

Information about the location of offshore wind farms is readily available; however information on wave and tidal sites is much more difficult to obtain, probably due to the fact that these are relatively new technologies and still being developed. It is likely that this report under-represents the actual extent of wave and tidal energy sites globally.

Around the UK many of the sites where MREDs are being built are within or adjacent to areas that are critical habitats for cetaceans; the impacts of these developments on cetaceans are not fully understood. The limited research conducted so far has shown the potential for MREDs to cause behavioural changes in harbour porpoises (*Phocoena phocoena*), which leave the area during construction and in some instances did not later return to their usual numbers. Even where areas have been recolonised, it is not clear if these are the same animals returning or new animals moving into the area. The significance of such disturbance is not understood.

Data on protected and critical areas for cetaceans outside the UK have been difficult to obtain, however, there will be other important areas for cetaceans that overlap, or are adjacent to, MREDs.

The limited available information on the impacts of MREDs on cetaceans indicates a significant risk of negative consequences, with the noise from pile driving highlighted as a major concern with the potential to cause physical harm. Marine renewables devices may impact on cetaceans in ways ranging from collisions to habitat displacement due to the effects of noise and disturbance.

Some have suggested that MREDs may have ecological benefits but these have yet to be fully assessed.

More strategically, and as an essential first step, research is required on a wider scale to identify critical habitats for cetaceans. This would enable governments and developers to avoid such areas or apply stricter protection and help ensure that the deployment of marine renewables will not threaten cetaceans.

The need for urgent and joined-up research into the impacts of MREDs on cetaceans, and the wider marine environment, is clear. Research is required to understand the short and long term impacts and should be conducted well ahead of developments to establish baselines as well as during construction, operation and decommissioning as well as years after decommissioning. To enable the impacts to be fully understood, adequate baseline data of cetacean populations is required, against which any changes can be measured. This will enable the impacts to be fully assessed, managed and mitigated.

This report highlights the fact that the impact assessment process is currently based on only very limited knowledge on both cetacean populations and the impacts of MREDS on the marine environment.

As the data are limited it is highly unlikely that conclusions on the impacts of a particular development on cetaceans, and the wider marine environment, are reliably based. As a result, developments are being consented in areas that are critical for cetaceans without giving adequate consideration to the potential wider and longer term consequences, and without appropriately focused research. With appropriate research on critical habitats for cetaceans, and the impacts of MREDs on cetaceans, these decisions will be more reliably based and allow relevant mitigation measures to be identified.

There is an urgent need for governments, developers and other stakeholders to engage in wide-ranging ecological research to help fully understand, and mitigate, the impacts of MREDs and aid good decision making. The expansion of the industry must be in step with understanding of the known and potential impacts on the marine environment.

WDC makes the following critical recommendations in order to ensure the development of this new industry, which assists with climate targets, is undertaken without impacting cetaceans and other mobile species:

- Until the impacts of MREDs can be fully assessed and mitigated, further developments within, or that may affect, areas that have already been identified as important for cetaceans must be avoided.
- Areas of critical habitat for cetaceans need to be identified in advance of leasing rounds to avoid developing potentially sensitive areas. For example, many shallow waters in northern Europe are important calving and nursing areas for harbour porpoises, which are also favourable sites for wave and tidal developments. This will also avoid costly changes in plans, unwieldy environmental constraints or delays.
- To enable any impacts of MREDs on cetaceans to be fully understood, adequate baseline data of cetacean populations, over a minimum of 2 years, and preferably more, ahead of development is required, against which any changes can be measured.
- There is clearly a requirement for further research on the impacts of MREDs on harbour porpoises and also on other cetacean species, their prey and their habitats in order to help understand and mitigate the impacts of MREDS on cetaceans. The research needs to be sufficient to detect impacts and cover all stages of the lifetime of the MREDs, pre-construction, during construction, operation and decommissioning as well as several years after to be able to evaluate their impacts on cetaceans and also consider the cumulative effects. For new devices, this needs to be conducted at the testing phase before wide scale deployment. For devices that are already operational, or have been approved for use, the impacts on cetaceans and other marine wildlife need to be studied at various sites to fully assess any impacts.
- Baseline data is also required on strandings to develop a reference point from which any increases in strandings rates due to MREDs can be understood.
- Sharing of the results of the research into both critical habitat areas for, and the impacts of MREDs on cetaceans is essential. Data needs to be made available to developers and governments to enable mitigation measures to be identified. To enable this there needs to be improved information and data-sharing facilities.
- Until mitigation measures to reduce the noise of pile driving are tested for effectiveness, the best method is to avoid pile driving altogether and use alternative foundations. Strategic investment in alternative techniques is urgently required.
- International standards for and auditing of impact assessments need to be developed, this is particularly important for an industry that is dramatically expanding in some sea areas.
- MRED designers, developers and the consenting authorities need to consider the potential impacts on cetaceans for the entire life of the development from exploration, through construction and operation to maintenance and decommissioning, during all seasons of the year.
- Cumulative impacts from all developments in a region need to be considered when a site is being considered for development, taking into account the trans-boundary nature of cetaceans.

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1. INTRODUCTION

Climate change, driven by the greenhouse effect, is a fundamental threat to whales, dolphins and porpoises (collectively known as cetaceans) (Simmonds and Elliot, 2009) as it is to other life. There is unequivocal evidence that climate change is happening and that human activities are contributing to it (IPCC, 2007).

The Intergovernmental Panel on Climate Change (IPCC) concluded that 20-30% of plant and animal species assessed so far are likely to be at increased risk of extinction if global temperatures rise by more than 1.5 - 2.5°C. The effects on the marine environment include an increase in temperature, sea level rise, changes in sea-ice cover, salinity, acidity, ocean circulation, storminess and climate patterns (IPCC, 2007).

Climate change is expected to affect cetaceans mainly through the loss of habitat (given the distinct temperature-linked ranges of most species), changes in prey availability, quality and distribution, and potentially increased competition from range expansions of other species, with resulting conservation implications (WDCS and WWF, 2007).

A number of studies have recently considered the impacts of climate change on cetaceans (Lambert *et al.*, 2011, Macleod, 2009, Simmonds and Elliot, 2009, Simmonds and Isaac, 2007, Learmonth *et al.*, 2006, MacLeod *et al.*, 2005), and highlight potential changes in abundance, distribution, timing and range of migration, prey abundance and distribution, reproductive success and ultimately survival; the major impacts on cetaceans are highlighted in figure 1.

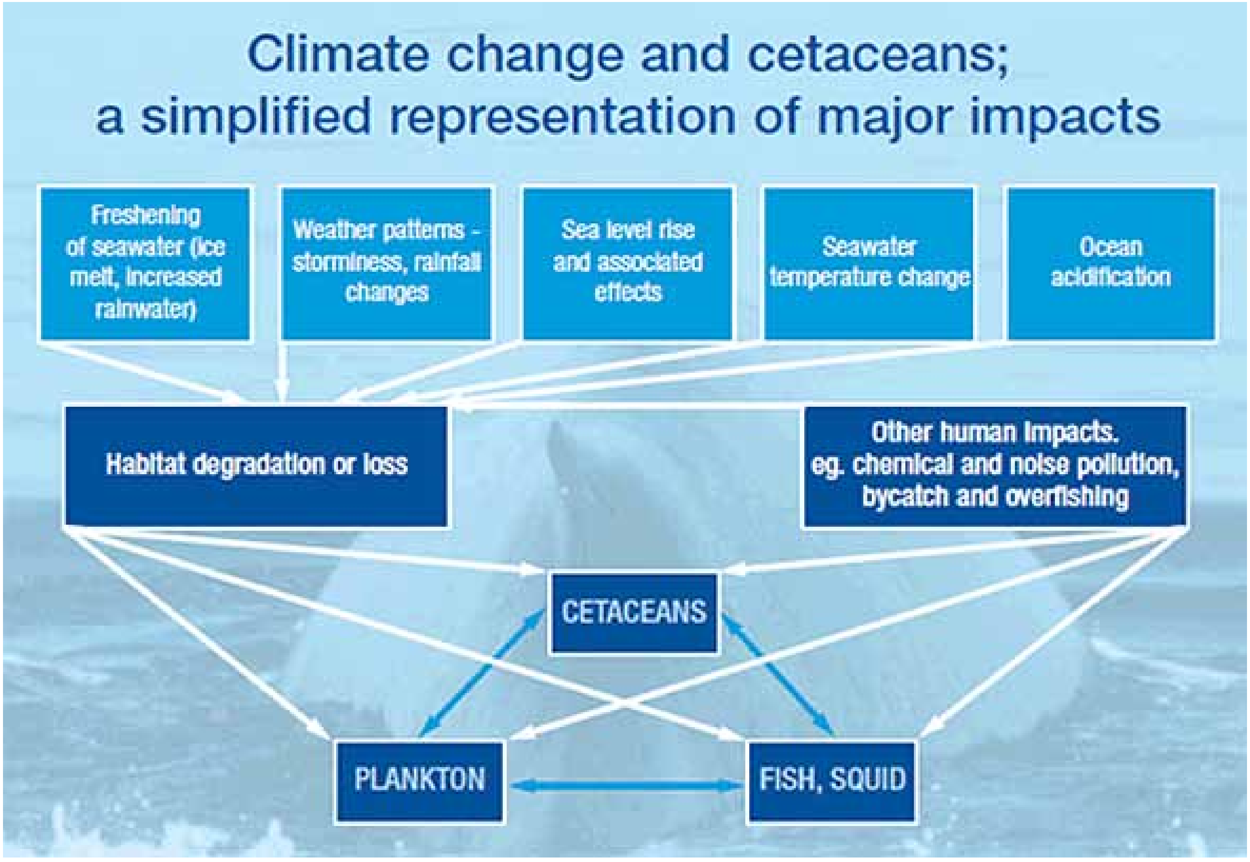


Figure 1: Climate Change and Cetaceans; a Simplified Representation of Major Impacts. From ‘Whales in Hot Water’. WDCS & WWF Report, 2007.

It is unclear to what extent cetaceans will be able to adapt to the rate of climate change predicted, in some cases such range shifts will not be possible. For example, the northern Indian Ocean is fringed by land, limiting the ability of species to move northwards into cooler habitat as waters warm (WDCS and WWF, 2007).

To try and reduce the effects of climate change and spurred on by the growing global energy crisis, concerns about energy security, and to meet requirements to reduce greenhouse gases (DECC, 2009), governments around the world are investing in new renewable energy technologies. Much of the development is going on out at sea and marine renewable energy, which is typically regarded as an abundant, inexhaustible and non-polluting resource, has the potential to contribute significantly towards the targets set by governments to produce energy from renewable sources.

Many European nations are regarded as particularly well placed to generate energy at sea, especially the more westerly nations such as Portugal and the UK, with their extensive coastlines and exposure to high winds, strong currents and powerful waves.

Due to the impacts of climate change on cetaceans, efforts aimed at reducing our dependence on fossil fuels are welcome however; ill-considered deployment of marine renewable energy developments (MREDs) may also impact marine wildlife. Several publications have highlighted potential concerns related to the deployment of MREDs (e.g. Dolman and Simmonds, 2012, Brandt *et al*., 2011, Simmonds and Brown, 2010, Dolman and Simmonds, 2010). Others have indicated that they may create local marine conservation benefits under certain conditions (Inger *et al*., 2009).

The noise from the pile driving process has the potential to cause the most harm to cetaceans, including physical injury (Carstensen *et al*., 2006). Intense noise is generated during piling of the foundations of the majority of offshore wind farms, and increasingly for wave and tidal device foundations. Thomsen *et al.* (2006) found that the noise generated by the construction of offshore wind farms was loud enough to be audible by harbour porpoises beyond 80km from the source and could mask communication at 30 – 40 km. Bottlenose dolphins (*Tursiops truncatus*), could exhibit behavioural responses at distances of up to 40 km from pile driving locations (Bailey *et al*., 2010). No studies have been conducted to understand the impacts of pile driving on other odontocetes or any baleen whales, despite their known susceptibility to noise impacts.

Provided here is an overview of the present extent of the wave, tidal and wind energy developments across the globe as of February 2013, the technology involved and the consideration of how they may affect cetaceans. Recommendations are made towards ensuring that cetaceans are adequately considered early when strategically planning these developments and offered suitable protection as a result.

2. WHAT IS MARINE RENEWABLE ENERGY?

Marine renewable energy is the power harnessed from the waves, tides and winds over the oceans, and is typically regarded as an abundant, inexhaustible and non-polluting resource. Spurred on by the growing global energy crisis and to meet requirements to reduce greenhouse gases derived from burning fossil fuels, governments around the world are investing in new renewable energy technologies and much of this development is going on out at sea.

There are a number of ways that renewable energy can be derived from the marine environment, including lesser known technologies such as ocean thermal energy - where the energy is generated from temperature differences at varying depths - and salinity gradient energy where the energy is generated from the difference in the salt concentration between seawater and river water (European Ocean Energy Association, 2012). Yet there are three main forms of renewable energy that are currently generating energy and which are being predominantly developed, these are offshore wind farms, tidal power and wave power.

Of all MREDs, offshore wind farms have been experiencing the swiftest development. Offshore wind farms generate power when the energy in the wind turns two or three propeller-like blades around a rotor. The rotor is connected to the main shaft, which spins a generator to create electricity. Instruments to measure the wind speed and direction are fitted on top of the nacelle. When the wind changes direction, motors turn the nacelle, and the blades along with it, around to face the wind (Renewable UK, 2012).

Tidal power can be subdivided into two categories:

- Tidal stream power (also called marine current energy) is produced from the horizontal movement of water in a current (kinetic energy). Useful energy can be extracted from marine currents using completely submerged turbines and hydrofoil devices called tidal energy converters. They are a relatively new technology, converting energy from sea currents. Water is 832 times denser than air, which means that a single generator can provide a significant amount of energy. The location of tidal stream systems is important and to maximise efficiency they need to be in fast currents where sea flows are compressed, such as at the entrance of a bay, around headlands, or between islands.
- Tidal range power is produced from the vertical movement of water in the rise and fall of the tide. Tidal barrages make use of the potential energy in the difference in height between high and low tides. Barrages, such as that at La Rance in France, are a type of dam spanning an estuary, providing a predictable and reliable source of energy.

Barrages suffer from very high infrastructure costs, negative environmental impacts (such as damage to adjacent estuarine ecosystems, feeding and breeding areas for wildlife (DECC, 2010)) and a worldwide shortage of sites that would be expected to produce viable amounts of electricity. For a site to be viable, the difference between high and low tides needs to be at least 5 m and there are only about 40 such sites around the world. Tidal barrages are also seemingly becoming outdated and may be superseded by recent, more efficient technologies, such as tidal fences and tidal lagoons.

A tidal fence is a continuous fence of underwater turbines stretching across an estuary or strait, with some spaces to allow the passage of ships and migrating species such as salmon.

A tidal lagoon is an adaptation of the barrage, exploiting the height between high and low tides to generate energy. It is an area of coastline enclosed by a structure typically of aggregate, rubble or rock. Turbines are set into the walls of the lagoon under the water's surface, and are driven as the sea flows in and out with the rise and fall of the tide. From a distance the lagoon resembles a breakwater or low rocky island.

As there are two tidal cycles each day one advantage of both tidal stream and tidal range energy is that their energy production capacities are predictable, frequent and regular.

Wave energy is generated from the waves that are formed by winds blowing over the sea's surface. The power of the waves depends on the speed of the wind, its duration and the distance it travels over the water (its fetch). Other determining factors are the sea depth and interacting tides. The most powerful waves are created by strong winds over a long fetch, such as those along the western coasts of Europe, South America and Australia. There are wave energy projects emerging in several countries around the world, notably in Scotland, Australia, Spain and the USA.

The main disadvantages to wave power are the variability and poor predictability of waves, making them a less reliable source of energy than tidal power. Harnessing the energy of waves evidently presents a considerable engineering challenge. The Department of Energy and Climate Change (2012) recently commented that 'the main problem with wave power is that the sea is a very harsh, unforgiving environment. An economically viable wave power machine has to generate power over a wide range of wave sizes – and be able to withstand the largest and most severe storms as well as other potential problems such as algae, barnacles and corrosion.'

Waves have two types of exploitable energy; kinetic from their horizontal motion, and potential, from the vertical difference between the wave's crest and its valley. It is not easy to harness the energy of waves, hence the development of a wide range of possible devices to attempt to do so.

3. MARINE RENEWABLE ENERGY TECHNOLOGY

This section details current and future technology, and foundations used in MREDs. However, there is also a considerable associated infrastructure development associated with these developments, which include ports, service vessels and cables (both array cables and cables for exporting electricity generated back to shore).

3.1 OFFSHORE WIND FARMS

Offshore wind turbine technology is based on the same principles as onshore technology. Foundations are constructed to hold the superstructure, of which there are a number of designs, but the most common is a driven pile (monopile). Subsea cables take the power to a transformer (which can be either offshore or onshore) which converts the electricity to a high voltage before connecting to the grid at a substation on land (BWEA, 2005).

3.1.1. CURRENT TECHNOLOGY

Initially turbines used in offshore wind farms were similar to those used in onshore wind farms, with horizontal axis turbines (HAWT), typically having three rotor blades facing into the wind 20 – 40 m long, mounted on a tubular tower, bedded into the sea floor and mounted on a tower to capture the most energy.

As there are higher wind speeds available offshore that are less turbulent, offshore wind farms can harness these winds to produce more electricity than their counterparts on land. So in recent years larger turbines have been installed to make use of the higher wind speeds available offshore. Turbines installed today are generally between 2 and 4 MW, with tower heights greater than 61 m and rotor diameters of 76 - 110 m.

3.1.2. FOUNDATIONS

The foundations currently available to offshore wind developers are listed below; and shown in figures 2a and 2b[1]:

- *Monopile* - Consists of a steel pile which is driven approximately 10 – 20 m into the seabed. This foundation is used in most offshore wind farms in shallower waters.
- *Gravity Foundation* - Currently used on many offshore wind projects in deeper water, the graity foundation consists of a large base constructed from either concrete or steel which rests on the seabed. The turbine is dependent on gravity to remain erect.
- *Tripod Foundation* - Designs tend to rely on technology used by the oil and gas industry. The piles on each end are typically driven 10 – 20 m into the seabed, depending on soil conditions. This technology is generally used at deeper depths and has not been used on many projects to date.
- *Jacket Foundation* – Currently used at Beatrice offshore wind farm in Scotland, in New Jersey and Rhode Island. This is similar to the design of power pylons, where the turbines are anchored with piles on its four feet in the sea bed. Each of these foundations has a total height of approximately 50 m and the base of the foundation has a footprint of almost 400 m^2.

1- Images are illustrative only; designs for each type may differ slightly between developers/ sites.

Figure 2a. Wind Turbine atop a Tripod Foundation at the Bard Offshore 1 Project. © BARD Group

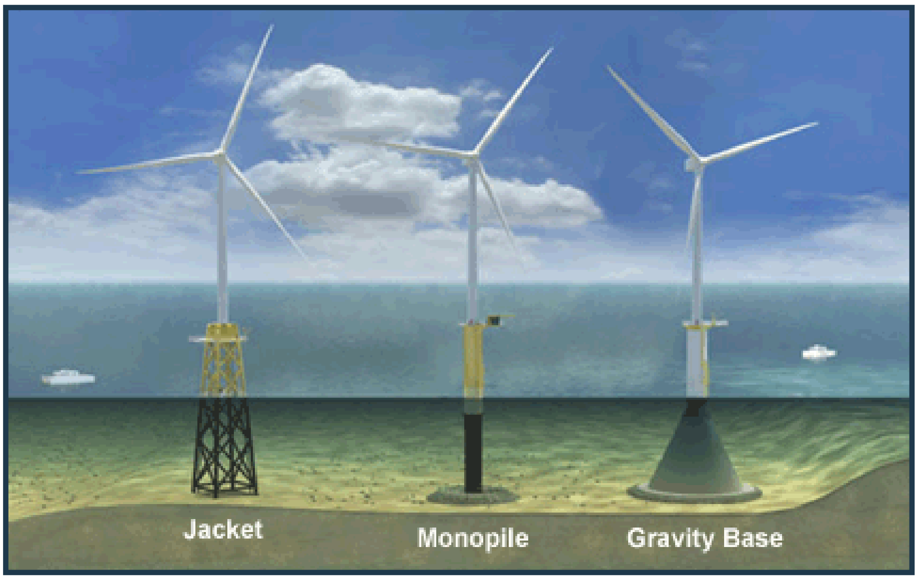


Figure 2b. Current Wind Farm Foundations © Ramboll

3.1.3 FUTURE TECHNOLOGY

Until quite recently, offshore wind farms have mainly been in near-shore waters, within approximately 5 km of the coast. Now very large developments are planned further off the coast and in deeper waters, such as the four sites being planned 197 km offshore from England, in the North Sea, covering between 1,400 - 5,160 km^2 each.

As larger turbines are developed and deployed, the diameter of the piles also increases with consequences for increased associated noise during installation (IWC, 2012).

Many of the developing technologies for offshore wind farm foundations are designs borrowed from the oil and gas industry and include floating and deep water concepts. Deep water concepts have huge potential due to stronger winds further from shore yet, the cost may be one of the biggest challenges facing deep water offshore technology.

Floating offshore wind foundation technology is still in early testing. The main concepts are listed below and shown in figure 3[2]:

- *Ballast Stabilised Sparbuoy* - the sparbuoy has a cylindrical deep-drafted hull with loose mooring lines. The flotation element stretches 100 m below the sea surface, is anchored to the seabed in three places, and can be moored in waters up to 700 m deep. The first working turbine was placed in Norway in 2009 in water 220 m deep, called Hywind.
- *Mooring Line Stabilised Tension Leg Platform* – Mooring lines are used for tension with suction pile anchors.
- *Buoyancy Stabilised Barge Platform* – The barge is a rectangular platform that rides the waves rather than passing through them. It is fixed to the sea bed with catenary mooring lines.

2- Images are illustrative only; designs for each type may differ slightly between developers/ sites.

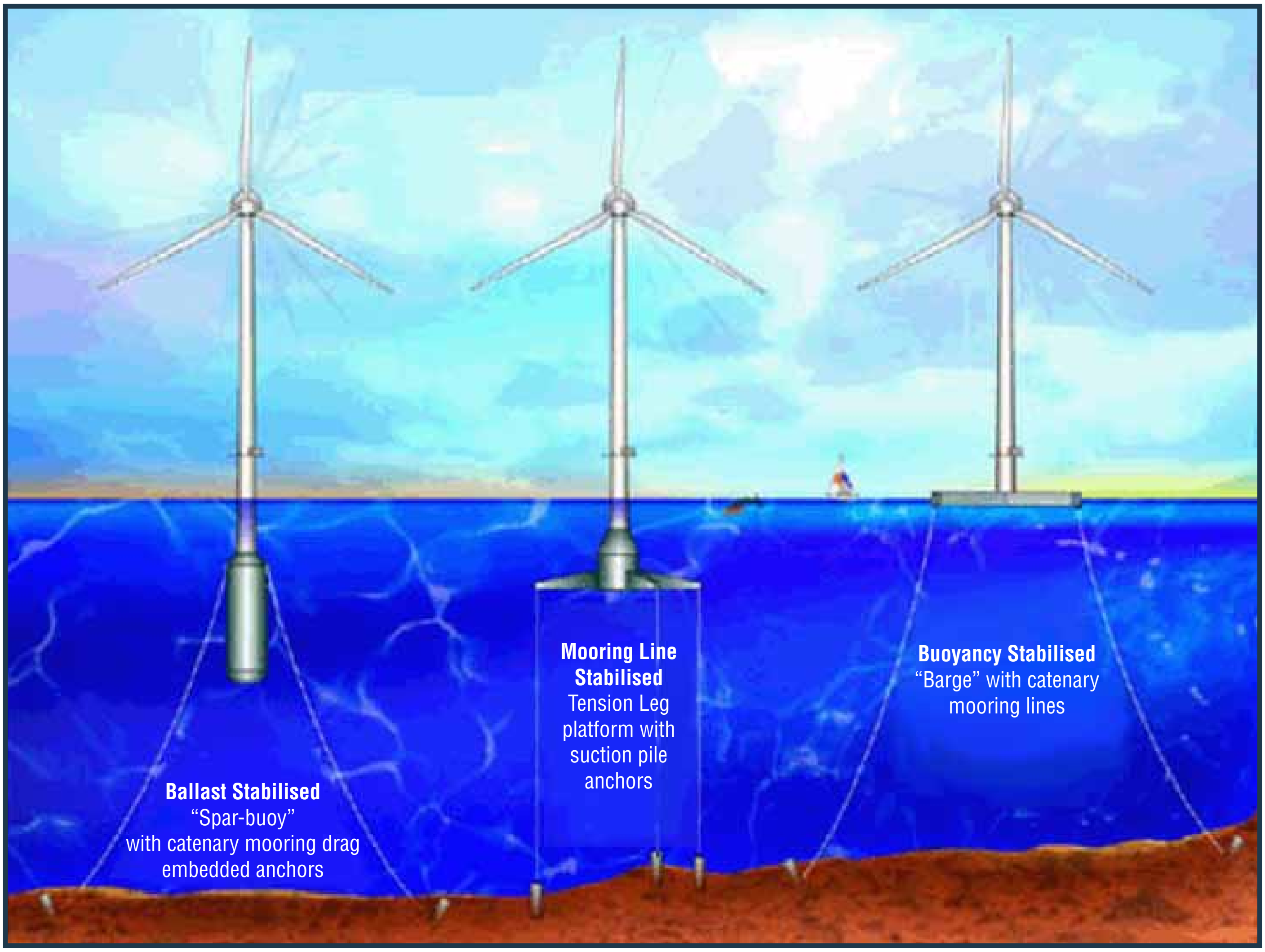


Figure 3. Floating Wind Turbine Concepts © Al Hicks, National Renewable Energy Laboratory

Other concepts in development include:

- *Titan foundation* – Offshore Wind Power Systems of Texas has designed the Mobile Self- Installing Platform (MSIP), a three legged platform able to be towed out to sea and lowered into place.
- *SWAY concept* - The SWAY concept consists of a floating spar buoy that is some 200 m tall, designed to rise and fall with wave activity. The concept is unique in that the turbine will always face downwind.
- *WindFloat* - is a semi-submersible, three-column structure, with a turbine tower, truss and "water entrapment heave plates" at each column's base, designed to reduce pitch and yaw, and make the entire structure more compact. It aims to support deployment of large capacity wind turbines (3.6 MW to 10 MW) in deep water (50 m or greater).
- *Suction caisson* - a structure resembling an upturned bucket that is lowered on to a levelled seabed. The foundation's weight combined with the hydrostatic pressure on the caisson when internal water is pumped out of it provides the force required for the bucket structure to remain in place.
- *Tripile* – instead of a single steel pile, as with current monopile foundations, this will consist of three steel piles driven into the sea bed in the same manner as a monopile.

3.2 WAVE ENERGY DEVICES

The technology for wave energy devices is still in the early stages of testing. Of the 26 operational sites around the world over half are sites for testing the devices before they are deployed commercially. There are more than 100 wave energy device concepts being developed.

The devices are either floating or moored with cables or chains which can either be taught, loose or fixed to the sea bed sometimes partially onshore. These devices can be sited in three areas:

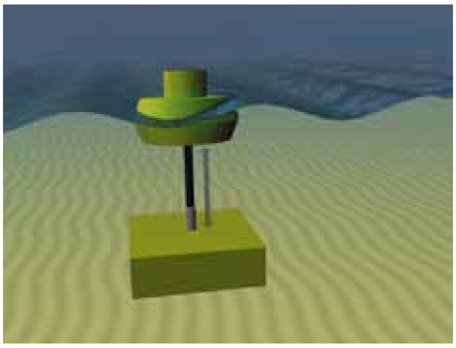
- Partially onshore where they are fixed to the or embedded in the shoreline,
- Near to shore in water depths of 20-25 m, at distances up to 500 m from the shore,
- Offshore, where more powerful waves can be exploited.

Based on discussions with developers, and available evidence, typical array sizes are likely to be on the order of several km2 for wave devices.

3.2.1. CURRENT DEVICE TECHNOLOGY

Generally the devices are categorised by the nature of the method used to harness energy. Below is a summary of well-established technology, and how each type of wave device works (description and images are illustrative only; designs for each type differ between developers):

Buoyant Moored Device/ Point Absorber
An offshore device, this type of device floats on the surface of the water or below it absorbing energy from all directions. It is moored to the seabed by a taught or loose mooring system, usually cables or chains. Electricity is generated by turbines driven by a variety of mechanisms, such as hydraulic pumps. Currently each device is c. 3 m wide tied to a 21 m long shaft.

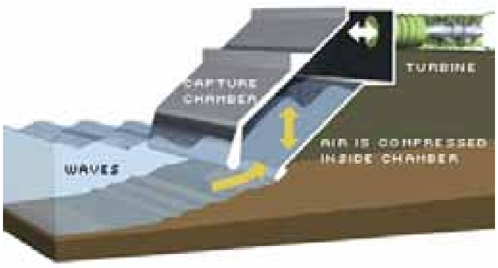


© EMEC

Hinged Contour Device/ Attenuator
An offshore device, floating on deep water moored with cables and chains. This type of device follows the motion of the waves which works parallel to the wave direction and effectively rides the waves. A segmented floating device, it creates power using the motion at the joints driving hydraulic motors. Currently each device is c.120 m long and 3.5 m in diameter.

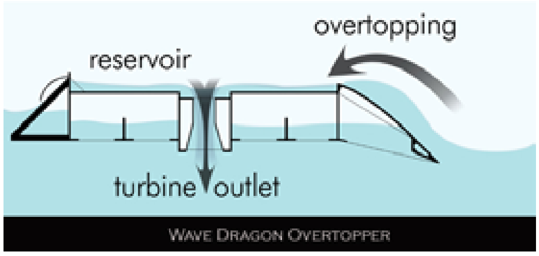
E.ON P2 Pelamis operating in Orkney July 2011.
Courtesy of Pelamis Wave Power

Oscillating Water Column (OWC)
A partially onshore device that can be fixed to the seabed or installed on shore. A hollow, partially submerged, structure which allows the rising wave in, forcing compressed air above to drive a turbine, something like a large piston. Dimensions vary, but one prototype is 20 m wide.



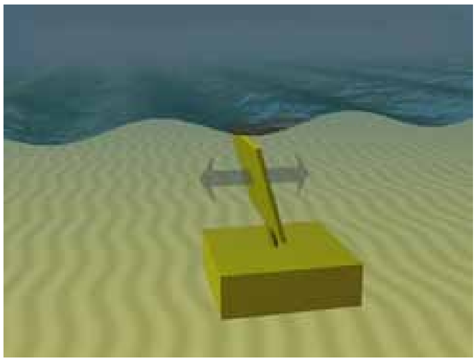
© Energy Futures, MIT Energy Initiative. 2009

Overtopping Device
A floating offshore device, loosely moored to the sea bed that can be deployed in a single unit or in arrays. This device holds 'captured' water in a reservoir above sea level before being released through low-head turbines. May be scalable as large as 170 m by 300 m.

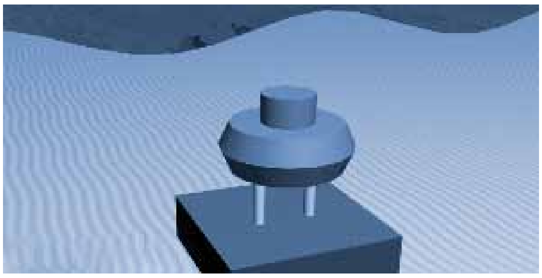


Wave Dragon Overtopping Device © Wave Dragon

Oscillating Wave Surge Converter
A near shore device, an OWS converter has an oscillating pendulum, mounted on a pivoted joint, attached to the seabed. This device extracts the energy caused by wave surges and the movement of water particles within them. Currently devices are c. 26 m wide by 11 m high.


© EMEC

Submerged Pressure Differential
These devices are typically located nearshore and attached to the seabed by chains and cables, or mounted directly, the rise and fall of the sea level above cause pressure changes in the device which drives fluid through a generating system. Currently each device is c. 12 m by 30 m.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3.2.2. FOUNDATIONS
As devices for harnessing energy from the waves are still in their infancy, there is limited information on commonly used types of foundations. The devices listed above describe how they are attached to the sea bed, and some summary information is provided below.

Onshore devices do not require deep-water moorings or lines of electrical cables; however they are attached to the shore by their massive weight. They are often embedded in large areas of concrete, often they are also fixed to the sea floor, and methods used to do this can vary greatly.

Near shore devices, such as oscillating wave surge converters, often use monopile foundations and up to four monopiles may be required per device. These are of similar size to those used in wind turbine foundations, and are driven into the sea bed in a similar fashion.

Offshore devices have the greatest variation in design as they are in deeper water and can exploit more powerful waves. Their foundations vary, many are moored by cables or chains, which may be either slack or taught depending upon the device.

3.2.3 FUTUTE TECHNOLOGY
As current devices are mainly still in the testing stage, there are limited new devices being developed, yet there are some plans for the next generation of current devices. More recent designs for offshore devices concentrate on many small modular devices deployed in arrays.

Oscillating wave surge converters are being developed with two monopile foundations rather than four; some are using sea water rather than hydraulic fluid, reducing the risk of pollution.

Some emerging devices are:

Anaconda
This is an adaptation of an attenuator device that is made mostly of rubber, and up to 200 m in length, sits just below the sea's surface. As each wave passes, the rubber is squeezed causing a pressure wave that travels its length, as the pressure reaches the end it rotates turbines that generate electricity.

Anaconda Device © Atkins

3.3 TIDAL ENERGY DEVICES

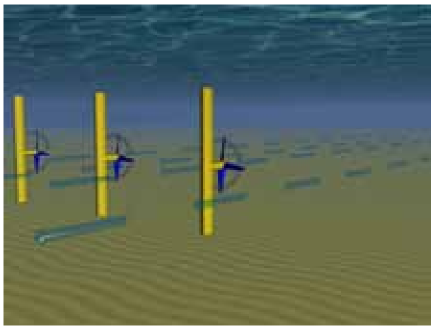
As with wave energy, the technology for tidal energy devices is still in the early stages of testing. The devices used to convert tidal range power into electricity are generally based on the technology used in traditional hydroelectric power plants. There are more than 70 tidal-stream device concepts being developed (IWC, 2012). The moving parts are entirely submerged and move of speeds up to 12 m s^{-1}, or 43 kph (Wilson *et al.*, 2007) relative to the streaming water mass.

There are a number of methods for attaching tidal current devices in place, including seabed anchoring, via a gravity base or driven piles, as well as floating or semi-floating platforms fixed to the sea-bottom via mooring lines.

3.3.1 CURRENT DEVICE TECHNOLOGY

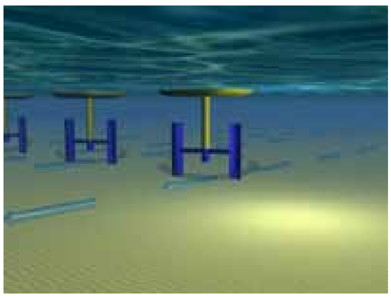
Generally the devices are categorised by the nature of the method used to harness energy. Below is a summary of well-established technology currently in use, and how each type of tidal device works (description and images are illustrative only; designs for each type differ between developers):

Horizontal Axis Turbine
This device extracts energy from moving water in much the same way as wind turbines extract energy from moving air. The kinetic energy of flowing water turns the turbine or rotor which drives a generator. Placed in estuaries, headlands, between islands, or where there are powerful, fast currents. Each turbine is c. 16 -18 m in diameter

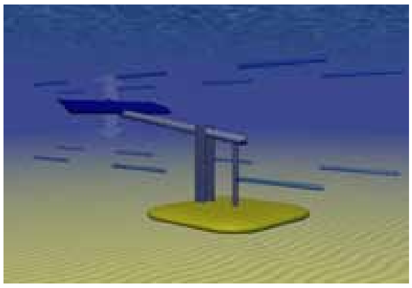


© EMEC

Vertical Axis Turbine
This device extracts energy from moving in a similar fashion to that above, however the turbine is mounted on a vertical axis. Placed in estuaries, headlands, between islands, or where there are powerful, fast currents. Each turbine is c. 16 – 18 m in diameter.



© EMEC

Duct Turbine (Venturi Effect) Housing a turbine in a duct, (or shroud), concentrates the flow of water and creates pressure, maximising the generating potential of the turbine. Placed in estuaries with powerful currents. The device is moored in the estuary stream and the turbine generates power in both the ebb and flow currents. The turbine housed in the duct is c. 5 m in diameter.	 © EMEC
Oscillating Hydrofoil A hydrofoil attaching to an arm oscillates in the current, resulting in lift, the motion of which drives fluid through a generating system. In fast currents on the seabed. Several turbines (an array), are mounted on the seabed, (gravity based). Currently c. 15 m wide hydroplane.	 © EMEC

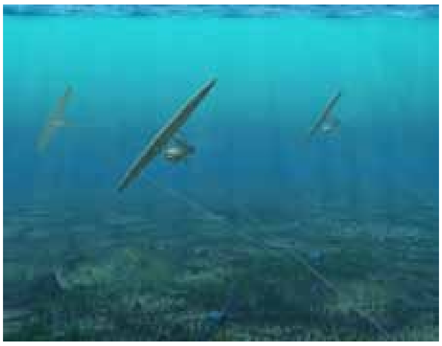
3.3.2 FOUNDATIONS

There are a number of ways that tidal energy devices are attached to the sea bed:

- *Seabed Mounted/ Gravity Base* – These are physically attached to the seabed often with large areas of concrete; in some cases the sheer weight of the device will hold it in place. In some cases there may be additional fixing to the seabed to secure the device in heavy seas.
- *Pile Mounted* - This principle is similar to that used for wind turbines, where the device is attached to a pole penetrating the ocean floor. Horizontal axis devices will often be able to rotate about this structure.
- *Floating*
    - o Flexible mooring: The device is attached via a cable or chain to the seabed, allowing considerable freedom of movement permitting the device to move as the tidal current direction changes with the tide.
    - o Rigid mooring: The device is fixed to the sea bed using a rigid mooring system.
    - o Floating structure: Allows a number of turbines to be mounted to a single platform.
- *Hydrofoil Inducing Downforce* - Using a number of hydrofoils on a frame that induce a downforce from the tidal current flow. Provided that the ratio of surface areas is such that the downforce generated exceeds the overturning moment, then the device will remain in position (EMEC, 2012).

3.3.3 FUTURE TECHNOLOGY

As with wave energy devices, tidal energy devices are mainly still in the testing stage with limited new devices being developed. Some of those that are ready for testing are:

Contra rotating Turbine This is a technique whereby parts of a mechanism rotate in opposite directions about a common axis. Usually two closely spaced contra rotating rotors, driving a contra rotating electrical generator c. 2.5 m in diameter.	 © Nautricity
Sea Kite/ Floating Turbine The kite, which at full size will have a wingspan of 8 – 14 m, carries a turbine below it. It is tethered by a cable to the sea floor and then "flies" in the tidal stream. It swoops round in a figure-of-eight shape to increase the speed of the water flowing through the turbine tenfold.	 © Minesto

4. THE EXTENT OF MARINE RENEWABLE ENERGY DEVELOPMENTS

The first operational marine renewable energy plant was La Rance Tidal Barrage, France, in 1966. In 1991 the first offshore wind farm, Vindeby in Denmark, became operational and since then, there has been a rapid expansion, in particular of offshore wind farms, around the world, but especially throughout northern Europe. Concentrations are around the UK coastline, in the North Sea, and along the Baltic Sea coasts of Germany and Denmark.

The present assessment includes information available up until February 2013. There are currently 1207 sites at various stages of development (figure 4[3]), these stages are: operational, under construction, approved, submitted, awarded, concept/ early planning, rejected or withdrawn, dormant and decommissioned[4]:

- ‘Operational’ sites are those that have been completed and are providing electricity.
- ‘Under construction’ sites are those that have been approved and construction is currently underway.
- ‘Approved’ sites are those for which the submitted plans have been consented to, but construction has not yet started.
- ‘Submitted’ sites are those where plans have been completed and reports submitted for consideration. At this stage sites can either be approved or rejected.
- ‘Awarded’ sites are those where developers have been granted exclusivity by the UK’s Crown Estate to develop an offshore wind farm. These sites are only found in UK waters.
- ‘Concept/ Early Planning’ sites are those where plans are being drawn up, here details such as number of turbines, foundation types etc. are subject to change and limited details are available.
- ‘Rejected or withdrawn’ sites are those that submitted a plan, but it was either rejected based upon the submitted plans, or withdrawn by the developer.
- ‘Dormant’ sites are those sites where plans have been drawn up but they have not been submitted for the approval process. Plans for these sites are on hold.
- ‘Decommissioned’ sites are those that have been in use and have now been shut down.

3 - MREDs are marked as points to show location and do not represent area covered).
4 - Appendix 1, 2 &3 list all MREDs at the various stages of development

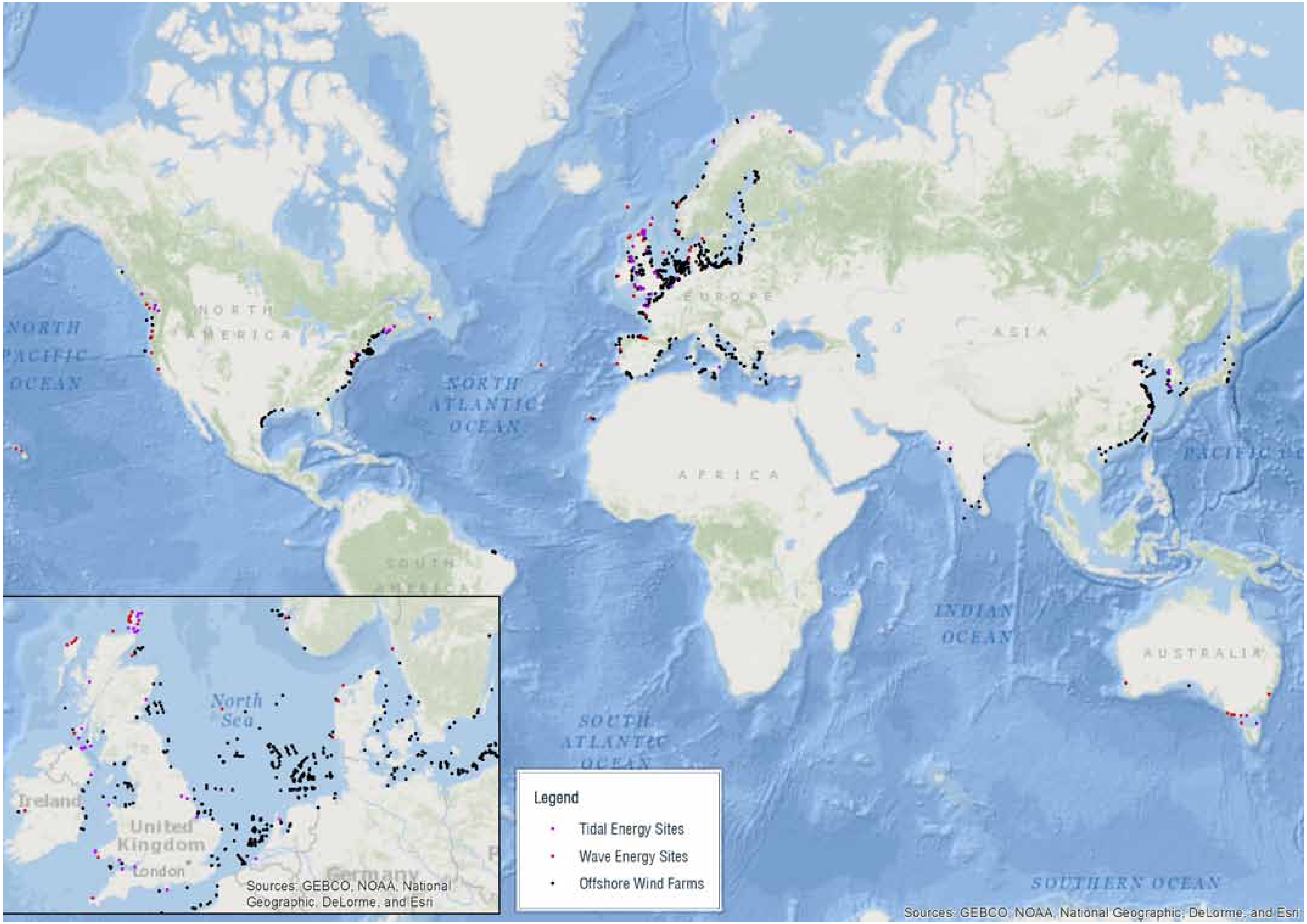


Figure 4. Global Marine Renewable Energy Developments.

4.1 OFFSHORE WIND FARMS

Of all the types of MREDs, offshore wind farms have developed the most swiftly. Their rapid expansion continues across Europe in particular . Outside of Europe, China and the USA have the highest number of offshore wind farms in various stages of development. In total there are 1085 offshore wind farms covering a total area[5] of 130,393 km^2. Appendix 1 shows the full details for each of these offshore wind farms.

Of all offshore wind farms just 72 (6.63 %) are currently generating 4,559.52 MW[5] capacity of electricity to the grid, this equates to 2,017,242 homes. The majority, 417 (38.43 %) are in the concept/ early planning stage, followed by those that have been submitted for approval with 172 sites (15.85 %). If the plans for the sites in in the concept/ early planning stage, and those that have been submitted are approved, this will result in a 2,031% increase of sites being constructed in the oceans globally than there is currently, with a further 10,556 km^2 of sea bed being developed.

Figure 5 shows the location of offshore wind farms, at all stages of development, globally.

The USA has the highest number of offshore wind farms with 150 in various stages of development. Of these none are generating power, the majority of sites are in the concept/ early planning stage of development, accounting for 84 (56 %) sites. Germany follows with 143 offshore wind farms in various stages of development. Of these only 5 (3.49 %) are generating power, the first of which became operational in 2004.

Netherlands has the third highest number of offshore wind farms with 88 sites in various stages of development, of which 4 (4.54 %) sites are operational. The majority of sites are dormant, accounting for 60 (68.18 %) sites, for unknown reasons the plans for these sites have not been submitted in the latest round for consideration apart for one site, Ijmuiden, where the draft plan was refused due to negative effects on shipping (4c Offshore, 2013).

England has the largest number of operational sites with 15 covering 350 km^2 followed by Denmark with 13 operational sites covering 113 km^2. The USA has the largest number of sites in concept/ early planning totalling 84 sites covering 29,166 km^2.

Greater Gabbard offshore wind farm is generating the largest amount of energy of all offshore wind farms at 504 MW, followed by Walney (phases 1 and 2) generating 366 MW; both these sites are off the coast of England, as are the top 4 operational offshore wind farms rated by energy generated.

Figure 6 shows the number of offshore wind farms by country broken down by the different stages of development.

5 – Figures are not available for all offshore wind farms, these figures are based on available data and under-represents the actual total.

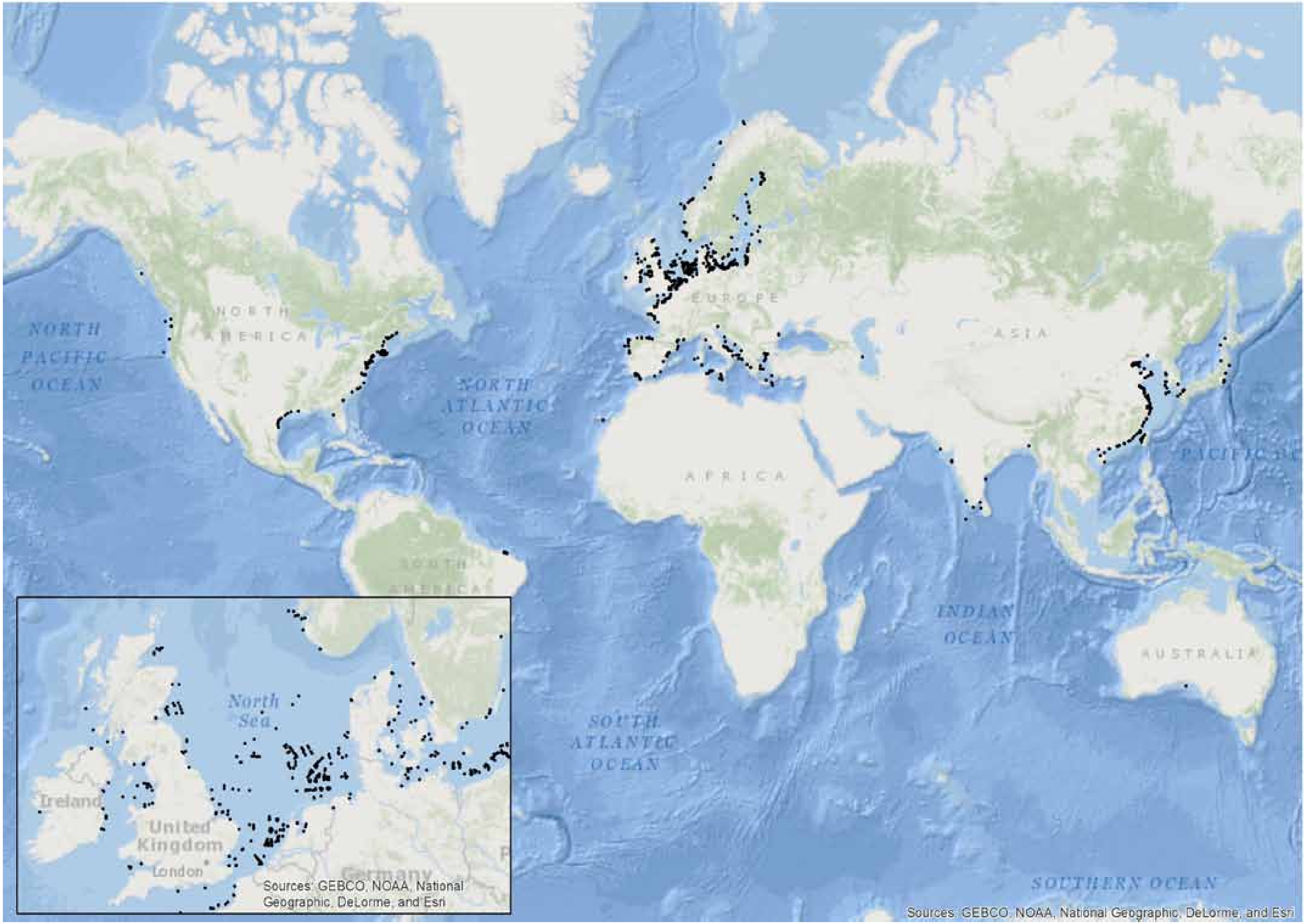


Figure 5. Global Offshore Wind Farms.

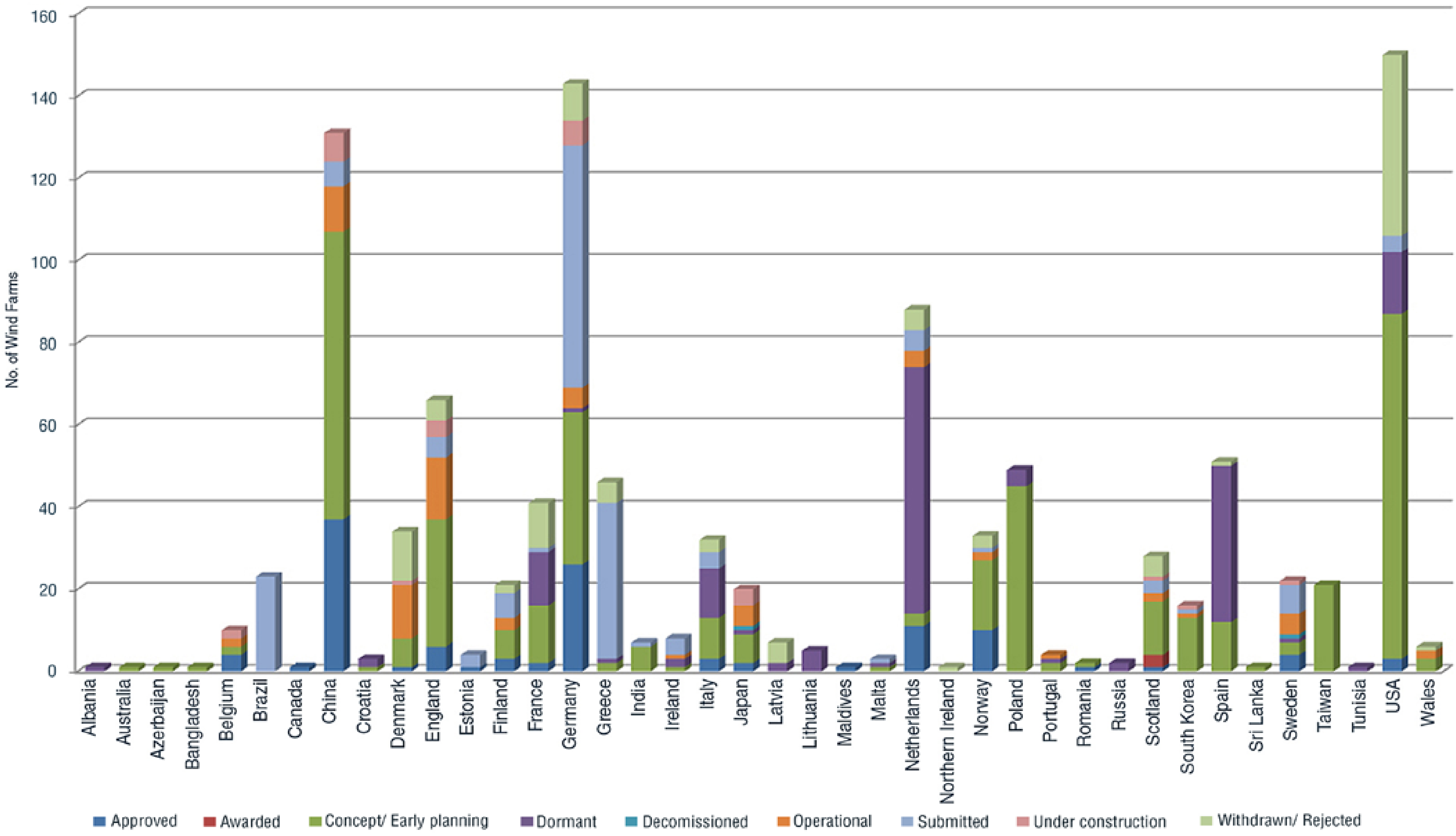


Figure 6. Offshore Wind Farms by Country

The largest offshore wind farms are in the concept/ early planning stages in the North Sea off England, 5 sites each cover 5,567 km^2, Dogger Bank Tranche C and Dogger Bank Tranche D each cover 5,162 km^2 and a further 3 each cover 4075 km^2. Dogger Bank Tranche A and Dogger Bank Tranche D are both located in the Dogger Bank Round 3 zone, in the North Sea, released by The Crown Estate[6] for offshore wind farm development. This overlaps the UK Dogger Bank Special Area of Conservation (SAC). The SAC is the largest sandbank in UK waters and the UK site adjoins Dutch and German Dogger Bank SAC sites. The UK SAC has been designated for sandbank habitat, JNCC note that 'The Dogger Bank region is an important location for the North Sea harbour porpoise population' yet it is only included as a 'Grade D' (a non-qualifying feature) in the SAC.

After Vindeby, in the Kattegat Sea, Denmark, became operational in 1991, only five other offshore wind farms became operational in the 1990s and these were all in Northern Europe. These sites were only an average of 2 km^2 in size with between 4-28 turbines. Since 2000, a further 62 sites are now operational and 347 are in the stages from planning to construction. Another 388 sites are in the stages from planning to construction but no dates are available for these sites, as these countries are relatively new in developing offshore wind farms it can be assumed that the majority of these plans have been developed since 2000.

The size of offshore wind farms has been steadily increasing. The average sizes of the earliest developments were 2 km^2 with 11 turbines. The largest site in the 1990s was Irene Vorrink in the Netherlands at 2 km^2, with 28 turbines generating 16.8 MW capacity. Today, offshore wind farms can cover thousands of km^2 of seabed, with the majority covering an area of hundreds of km^2, with hundreds of turbines generating many hundred MWs of electricity.

Of the 112 sites that are withdrawn/rejected a number have had plans withdrawn by developers, many citing the spiralling costs of developing offshore wind farms making them economically unviable. A number have been rejected due to the risk to maritime and aviation safety. 6 of the sites were rejected due to ecological concerns, mainly due to their potential negative impact on birds.

4.2 WAVE ENERGY

Wave energy sites are a more recent development than wind and remain relatively uncommon. Their development has been concentrated in Europe and especially in Scotland. Outside of Europe, the USA and Australia in particular are developing wave energy sites. There are 59 wave energy sites globally in various stages of development (test and commercial, figure 7). Appendix 2 shows the full details for each of these wave energy sites.

Of these offshore wave energy sites, 26 (44.07 %) are currently generating 27 MW capacity of electricity to the grid, this equates to 11945 homes. The majority of these operational sites are test or demonstration sites where devices are tested before being commercially deployed. There are 17 (28.81%) in the concept/ early planning stage. With the sites that are under construction, and those that have been approved, there will be an additional 6 (10.17 %) generating a further 123 MW of electricity in the next few years.

Scotland has the highest number of wave energy sites with 19 in various stages of development and accounting for 32.2 % of all wave energy sites globally. The majority of these are test sites of just one device; the first was Limpet in Scotland, which became operational in 2000.

The USA and Australia follow with 9 wave energy sites each in various stages of development, where the USA has the majority of sites in the concept/ early planning stage, Australia has 3 in the concept/early planning and decommissioned stages.

Scotland has the largest number of operational sites with 6 sites. Denmark and Spain both have 3 operational sites each. Scotland has the highest number of sites in the concept/ early planning stage numbering 10 sites in total and all of which were submitted in 2011.

6 - the body that manages the seabed in the UK

Figure 8 shows the number of wave energy sites by country, broken down by the different stages of development.

The first wave energy site, with just one device, became operational in 2000 in the Isle of Islay, Scotland. The site, Limpet 500, provides 0.5 MW of electricity to the grid. Since 2000, a further 24 sites are now operational globally (16 of which are test sites) with the latest starting operation in 2012. A further 26 sites are in the stages from planning to construction, 11 of which are being planned in Scotland.

There is currently little information available on the area of these sites; the area required will depend on the devices used, and the number deployed, at each of these sites. The area required to install a number of point absorbers, which are c. 3 m wide tied to a 21m long shaft, compared to an attenuator, which is c. 120 m long will vary greatly. Of the 10 planned sites in Scotland 4 are using c.14 attenuators each.

Data on the devices used is only available for some of the sites currently in concept/ early planning in Scotland. The devices included in these plans are oscillating wave surge converters and attenuators. The plans range from using 3 oscillating wave surge converters at the Oyster 800 project in Orkney to 14 attenuators at sites off the Isle of Lewis and Shetland Isles.

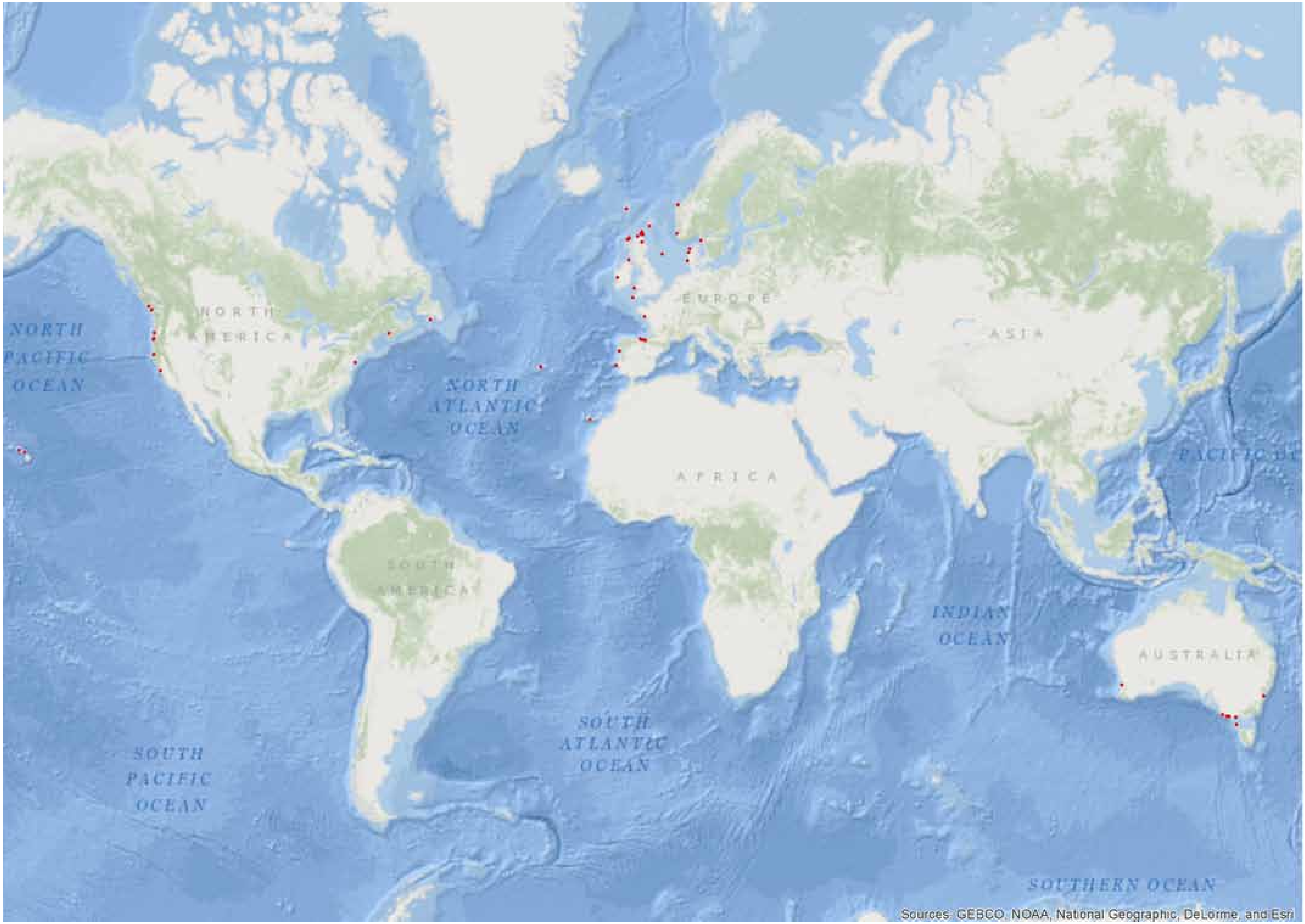


Figure 7. Global Wave Energy Sites

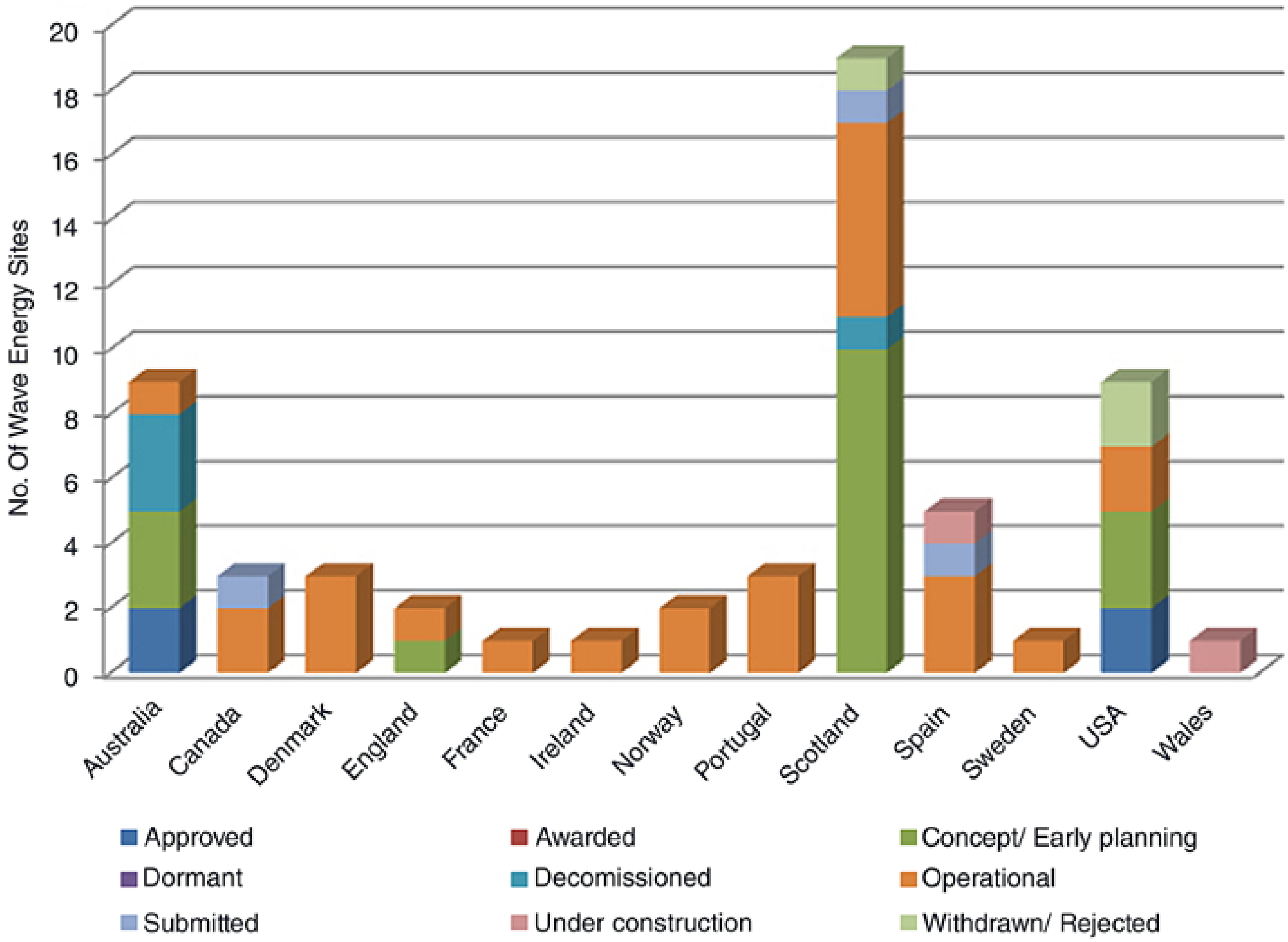


Figure 8. Wave Energy Sites by Country

4.3 TIDAL ENERGY

Tidal energy sites are still relatively uncommon. Their development has been concentrated in Europe, in Scotland in particular. Outside of Europe, the USA, Canada and South Korea in particular are developing tidal energy sites. There are 63 tidal energy sites, both test and commercial, globally in various stages of development. Appendix 3 shows the full details for each of these sites.

Of these tidal energy sites, 19 (30.16 %) are currently generating 271.35 MW capacity of electricity to the grid, which equates to 120,052 homes. The majority, 23 (36.51 %), are in the concept/ early planning stage, followed by those that are operational with 19 sites (30.16 %). The majority of these operational sites are test or demonstration sites where devices are tested before being commercially deployed.

If the plans for the sites in in the concept/ early planning stage and those that have been submitted are approved, this will result in a 66.67 % increase of sites being constructed in the oceans globally.

Figure 9 shows the location of tidal energy sites, at all stages of development, globally.

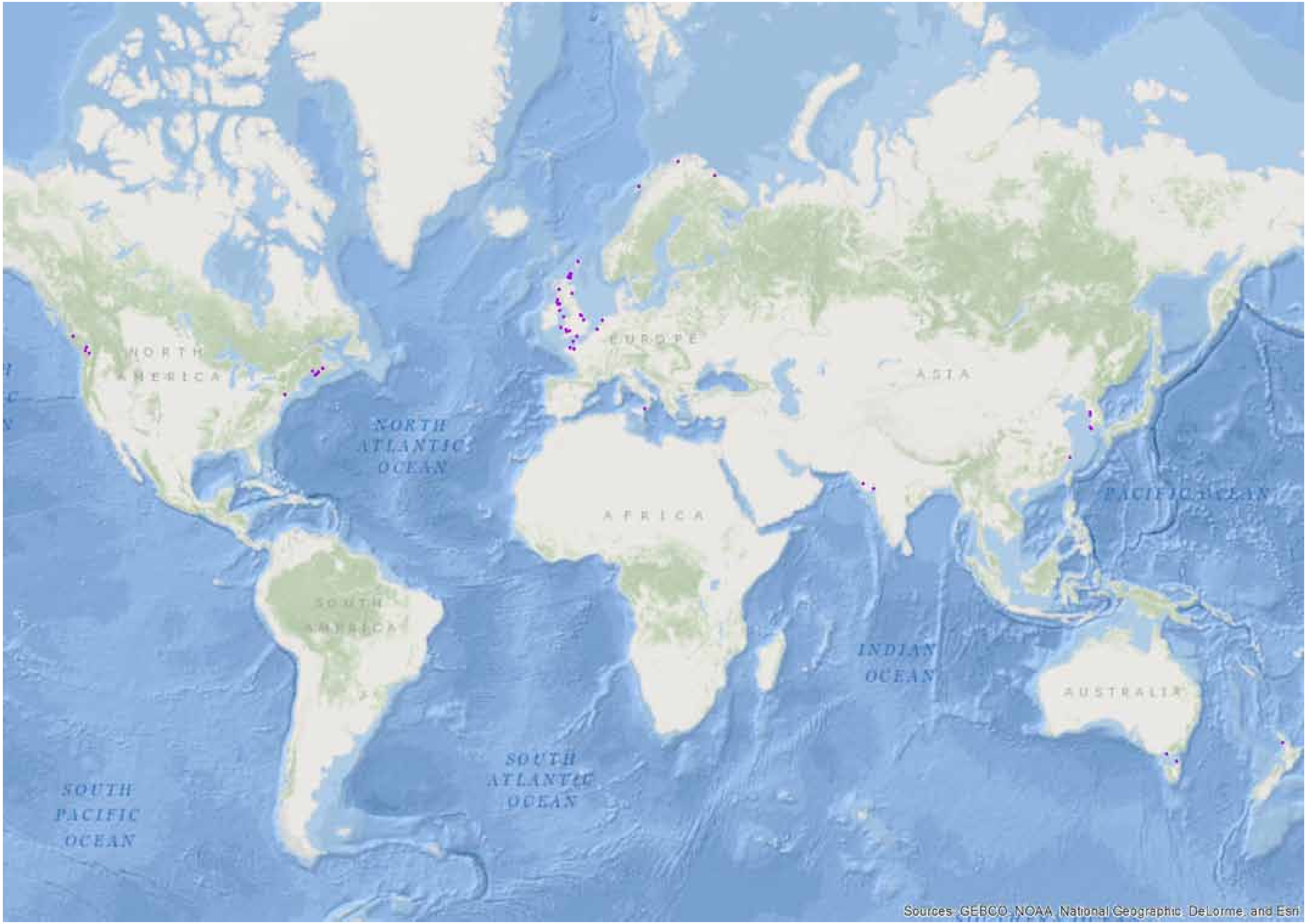


Figure 9. Global Tidal Energy Sites.

Scotland has the highest number of tidal energy sites with 15 in various stages of development accounting for 23.81 % of all tidal energy sites globally. Canada follows with 12 tidal energy sites in various stages of development, followed by England which has 7 sites. England, Norway, Scotland, Canada, Northern Ireland, and South Korea all have one operational tidal energy site each. Scotland has the highest number of sites in the concept/ early planning stage numbering 8.

Only 1site has been withdrawn, planned for the Blackney Passage off Vancouver Island, Canada; the project was rejected due to the concerns over the impact on the Northern Resident Orca population, for which the water are recognised as critically important habitat.

Original plans for the Severn Barrage across the Bristol Channel, in England, were rejected in 2010. Although there were many objections to the site including the impact on fish and the loss of mudflats and saltmarshes which are important areas for feeding birds, the reason for the rejection was given as 'overly expensive' (DECC, 2010). In 2012 Hafren Power resurrected the idea of the Severn Barrage, proposing using different technology to reduce the impact on the environment.

Figure 10 below shows the number of tidal energy sites by country, broken down by the different stages of development.

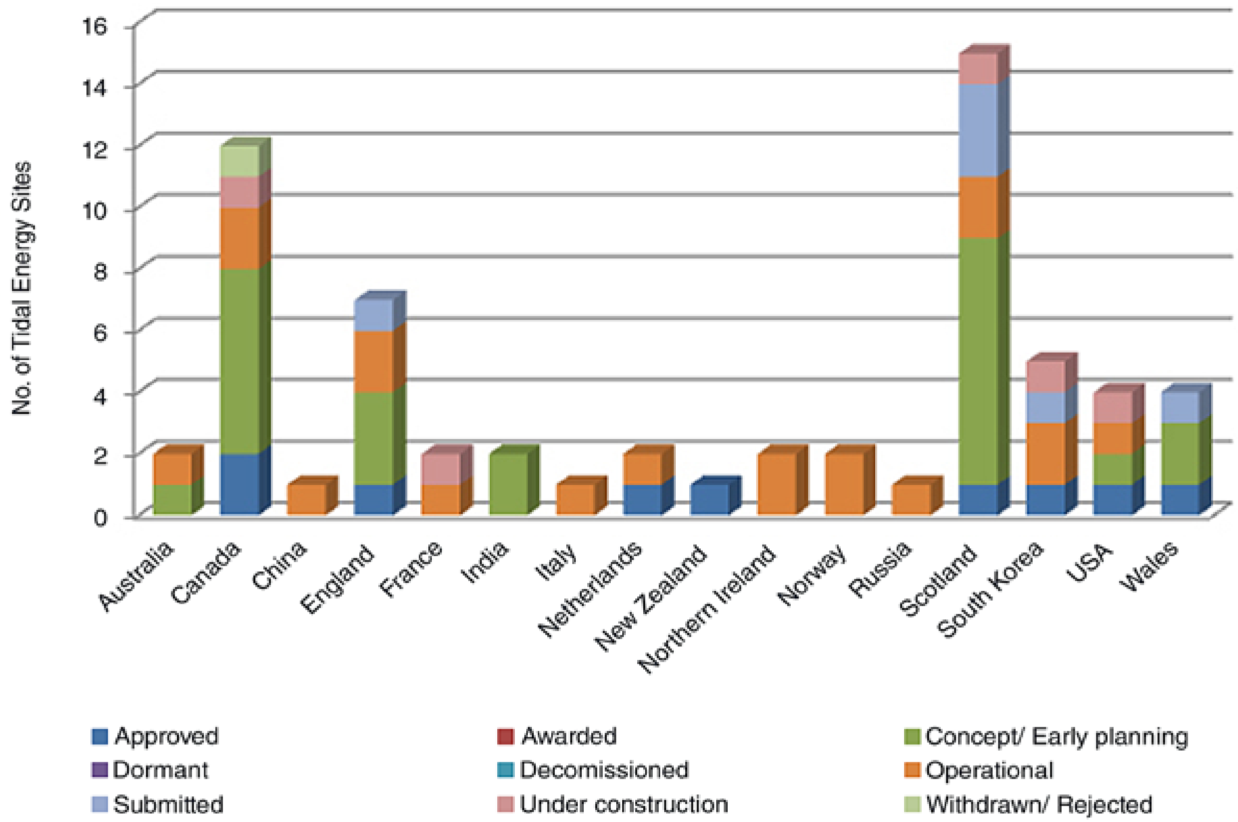


Figure 10. Tidal Energy Sites by Country

The first tidal energy site became operational in 1966 in France. The site, Rance Power Station, provides 240 MW of electricity to the grid. Since 2000, a further 16 sites are now operational, the most recent becoming operational in 2011.

There is currently very little information available on the area of these sites; the area required will depend on the devices used, and the number deployed, at each of these sites. The area required to install a number of horizontal or vertical axis turbines (flowing water turns the turbine or rotor which drives a generator) will be much less compared to a duct turbine (housing a turbine in a duct, or 'shroud', concentrating the flow of water and creating pressure).

Data on the devices used is only available for some of the sites currently in concept/ early planning in Scotland. The devices included in these plans include horizontal or vertical axis turbines, oscillating hydrofoil and contra rotating turbines. The plans range from using 66 horizontal or vertical axis turbines at the Brough Ness site in the Orkney Islands to 6 contra rotating turbines at sites in the Mull of Kintyre in the Irish Sea.

5. POTENTIAL IMPACTS OF MARINE RENEWABLE ENERGY ON CETACEANS

The potential negative impacts of the deployment of MREDs in the marine environment are likely to vary depending on the types of development, the habitat and the species found in the region. It has also been suggested that MREDs may have ecological benefits (Inger *et al*., 2009). Little is known about the negative or positive impacts of MREDS on cetaceans at present (Simmonds and Brown, 2010, Simmonds *et al*., 2010, Brown and Simmonds, 2009, Wright *et al*. 2009), despite their rapid growth, in particular of offshore wind farms where many have been in operation since the 1990s. Currently there has only been limited, small-scale research into the impacts over the last few years. Studies to date have focused on harbour porpoises and seals (Carstensen *et al*. 2006, Bailey *et al*., 2010, Brandt *et al*., 2011, Lindeboom *et al*., 2011, Nabe-Nielsen *et al*. 2011, Scheidat *et al*., 2011, Skeate *et al*., 2012, Teilmann and Carstensen, 2012).

As wave and tidal devices are new and there is limited data on the effect on cetaceans, it is difficult to know which locations would be the most sensitive to developments and which might be less affected (House of Commons Energy and Climate Change Committee, 2012).

Information on the negative environmental impacts on local ecosystems off La Rance tidal barrage, which has been in operation since the 1960s, along with the high generation costs and the long payback times, mean it is unlikely that tidal range energy will be commercially developed (European Ocean Energy Association, 2012).

The severity of any impacts on cetaceans can be expected to differ at each site based on a number of variables including the type of device used, the type of foundation, location (near shore, offshore, deep estuaries etc.), topography, nature of the sea bed, water depth and scale, as well as the species encountered, the value of the site for that species and the opportunity to move away.

A single device can be expected to have a different impact to that of an array, which in some cases may number hundreds of turbines. Neighbouring developments may have combined impacts for example, Madsen *et al*. (2006) commented that 'if the very large offshore wind farms are realised this could involve construction activities at several locations in the area [of the German Bight] simultaneously every summer for the next decade'. This has been acknowledged on the east coast of Scotland, where wind farm developers are working together to understand the impacts of simultaneous developments.

Many of the potential impacts would be site-specific and baseline data for each site would be required to understand the abundance and distribution of species and local habitat use, so that MREDs are not located in sensitive areas such as breeding and feeding grounds, or on migratory routes. For example, many shallow waters in northern Europe are important calving and nursing areas for harbour porpoises.

Despite the issues involved in identifying impacts (see section 5.1 and 5.2), defining their significance and adequately mitigating them, concerns have certainly become significant enough for Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS) to call for more action. For example, a resolution passed by the ASCOBANS Parties in 2006 called for further research to be conducted on the effects of offshore wind farms on cetaceans (ASCOBANS, 2006).

In 2009, the Parties to the same agreement highlighted concerns raised by construction noise during offshore construction in a further resolution (ASCOBANS, 2009). Among other things, this resolution called for a 'strategic approach' to siting marine renewable developments, including 'Strategic Environmental Assessments', and for the development of mitigation measures.

The rapid increase of MREDs globally, and the lack of available data on their impact on cetaceans, has also become a significant enough concern for the International Whaling Commission (IWC) to hold its first workshop to discuss the issue in 2012. The workshop highlighted the need for research to identify the threats and their potential impacts on cetaceans, via monitoring designed to assess these impacts, and to test the efficacy of any mitigation measures that are implemented (IWC, 2012).

5.1. POTENTIAL NEGATIVE IMPACTS

At all phases of the life of a project, the main potential threat to the marine environment is the disruption of natural processes (Wilson *et al.*, 2010), whether by noise, disturbance, collision or a combination of these. The potential for negative impacts to mammals from marine renewable installations is not disputed. For example, the website of 'Wind Energy – The Facts'[7] comments that 'Offshore wind farms can negatively affect marine mammals, both during construction and operational stages. The physical presence of turbines, the noise during construction, the underwater noise as well as [associated] boat and helicopter traffic can disturb mammals causing them to avoid offshore wind farms' (Wind Energy,
2012).

The House of Commons Energy and Climate Change Committee (2012) state that 'Wave and tidal energy could be damaging to marine wildlife in UK waters. For example, wildlife could collide with the devices, habitats might be lost or damaged, migration routes could be blocked and construction will result in noise and vibrations, which may have adverse consequences for wildlife. Since the technology is still very novel, there is still a great deal of uncertainty about how likely or severe these impacts will be'.

Similarly, the UK's 2009 Strategic Environmental Assessment (SEA) of Offshore Energy (which considers oil and gas exploitation as well as renewables) reported as follows: 'In general, marine mammals show the highest sensitivity to acoustic disturbance by noise generated by offshore wind farms and by hydrocarbon exploration and production activities' (DECC, 2009). There are a range of concerns related to MREDs, these are listed below:

5.1.1 SITING OF DEVICES

The impacts of an MRED are going to be strongly affected by its location. If a development is placed in, or adjacent to, sensitive areas for cetaceans, such as those used for breeding, nursing, feeding or migration, the impacts are likely to be greater than developments located away from these critical areas.

Also if there are further developments in an area, e.g. other MREDs, or oil and gas developments, the noise transmissions may combine synergistically to have a greater effect.

Developers preferred sites for tidal stream devices are usually restricted passages such as between islands and the mainland or around headlands and harbours, yet these are also areas favoured by some coastal species of marine mammals.

The limited research on the impacts of pile driving during the construction phase conducted so far, has shown the potential for MREDs to cause behavioural changes in harbour porpoises and both grey seals *(Halichoerus grypus)*, and harbour seals *(Phoca vitulina)*, which leave the area during construction and in some instances, do not return to their usual numbers later (Carstensen *et al*. 2006, Skeate *et al*., 2012).

However if MREDs are appropriately sited, away from areas critical for cetaceans, then some of the potential impacts below may be reduced or totally avoidable. This should therefore be a primary consideration in strategic decision-making surrounding development location.

7 - A project of the European Commission's Executive Agency for Competitiveness and Innovation

5.1.2 UNDERWATER AND SURFACE NOISE

Noise will be generated during construction, installation, maintenance, operation and decommissioning of MREDs. Installation is of particular concern as percussive pile driving is used for many of the foundations including oscillating wave surge convertors, tidal devices using turbines and monopile, tripod and jacket foundations for offshore wind farms which cover 15.01 % of all known offshore wind farms (where data is available).

The pile driving process for each device can last several hours (ICES WGMME, 2010), and for large wind farms at least construction could last many years, and often at sites adjacent to each other. If pile driving is conducted at more than one site at a time a 'barrier effect' might occur preventing the animals from leaving or migrating through an area. Pile driving also has the potential to cause physical harm. Reactions of harbour porpoises to the pile driving process for wind development have been recorded at distances up to 15 km from the piling site (Carstensen *et al.*, 2006).

Thomsen *et al.* (2006) found that the noise generated by the construction of offshore wind farms was loud enough to be audible by harbour porpoises beyond 80 km from the source and could mask communication at 30 – 40 km. Bottlenose dolphins could exhibit behavioural responses at distances of up to 40 km from pile driving locations (Bailey *et al.*, 2010).

Brandt *et al.* (2011) found the behavioural effect of pile driving, during the installation of monopile foundations at Horns Rev II, on harbour porpoise acoustic activity 'lasted much longer than previously reported', and that 'porpoise activity and possibly abundance were reduced over the entire 5 month construction period'.

The U.S Department of Energy (2009) stated that "it is known from experience with other marine construction activities that the noise created by pile driving creates sound pressure levels high enough to impact the hearing of harbour porpoises" and that this could lead to changes in their behaviour and increase stress levels leading to decreased foraging efficiency, displacement, decreased reproduction, increased strandings and mortality.

Currently there are no studies to demonstrate the potential impacts of pile driving on other cetacean species; however minke whales are very vulnerable to the impacts of intense noise pollution. There was a significant decrease in northern minke whale *(Balaenoptera acutorostrata)* sightings rates in western Scotland during periods of naval exercises (Parsons *et al.*, 2000). From recordings taken during pile driving in the Moray Firth, Bailey *et al.* (2010) suggested that northern minke whales, and other mid- and low-frequency hearing cetaceans, may exhibit behavioural disturbance up to 50 km away from the source.

It has been suggested that Acoustic Deterrent Devices (ADDs) (powerful underwater noise-generating devices are intended to warn and deter animals) could be used to minimise injury from pile driving. Not only does this introduce additional noise, it remains unproven due to the early stage of development of these devices (Dolman and Simmonds, 2012). There is concern that the noise generated by ADDs may exclude marine mammals, especially cetaceans from significant areas of habitat (Gordon and Northridge, 2002).

In Germany, there is a consensus that temporary threshold shift (TTS, a type of potentially recoverable auditory damage) is categorised as injury in the sense of law therefore developers are required to apply noise mitigations to reduce noise levels to below 160 dB Sound Exposure Level (SEL) or 190 dB Sound Pressure Level (SPL) at distances greater than 750 m to the piling site (IWC, 2012). Even with the noise mitigation measures required by developers in Germany it can still be expected that there will be disturbance of harbour porpoises within a 10 km radius of the site (IWC, 2012).

Noise and other disturbance from MRED-associated drilling, dredging, cable laying and dramatically increased vessel activity during construction and operation could also have a negative impact. Tougaard *et al* (2008) stated that the 'operation of the offshore wind farm where turbine machinery (and service activities) creates a low-intensity, yet almost continuous, underwater noise'. The noise transmission from an operational array of offshore wind farms or other devices may combine synergistically to have a biological effect. Masking could be a particular problem as cetaceans communicate by sound (Tougaard *et al.*, 2008).

During operation, wave and tidal devices have the potential to generate noise in a number of different ways, including rotating machinery, flexing joints, structural noise, moving water, moorings, electrical noise, and noise caused by device instrumentation. These sounds can enter the marine environment by direct contact with the water or by transfer through the seabed (ICES WGMME, 2012). The noise produced from tidal devices is relatively unknown, the noise generated from wave devices is assumed to be around 140 dB at 350 Hz re: 1 μPa at 1 m (IWC, 2012).

Decommissioning of MREDs is likely to involve structure/device removal, waste and debris clearance and disposal and seabed restoration. Many of the activities involved in decommissioning are similar to those in device installation, and as a result many of the associated risks to marine mammals are similar e.g. collision with maintenance vessels, noise, seabed disturbance, and disturbance of animals. However the physical removal of foundations, such as mooring systems, and piles, may pose the greatest risk, particularly if structures such as piles need to be physically removed from the seabed.

Pile removal is likely to involve excavation or cutting of the exposed part; explosives may be used to remove the piles in certain cases (ICES WGMME, 2012). The use of explosives has the potential to cause physical harm or be lethal to cetaceans (Prior and McMath, 2007).

The U.S Department of Energy (2009) stated that 'it is known from experience with other marine construction activities that the noise created by pile driving creates sound pressure levels high enough to impact the hearing of harbour porpoises' and that this could lead to changes in their behaviour and increase stress levels leading to decreased foraging efficiency, displacement, decreased reproduction, increased strandings and mortality.

5.1.3 DISPLACEMENT

It is possible that a combination of disturbing and habitat-degrading activities, potentially including the noise generated from pile driving, cable laying, increased vessel movements for construction and maintenance purposes, could cause displacement of cetaceans from the area where devices are deployed.

Boat disturbance has been shown to affect behaviour and displace dolphins (see, for example, Lusseau, 2005). Noise has the potential to displace cetaceans, as sound is essential for communication (possibly over a wide ranging area), navigation and hunting. Harbour porpoises were shown to occur less frequently in the area around both Nysted and Horns Rev during the construction of the offshore wind farms in Denmark; a change mainly thought to be due to the noise created during construction. At Horns Rev it seems the porpoises started to return, yet two years later, at Nysted, the porpoises are still not as numerous as they were during the baseline study (Snyder and Kaiser, 2009).

Installing arrays of devices, perhaps particularly tidal arrays, may make entire local habitats inaccessible for coastal communities of certain species, including harbour porpoises.

5.1.4 ENTRAPMENT, ENTANGLEMENT OR COLLISION

The devices themselves and certain features in particular (such as rotating blades and tethering lines) may present risks of entrapment, entanglement and harmful, perhaps even lethal collisions.

Tidal barrages in particular have the potential to trap marine life. At one tidal energy site, Annapolis Royal Generating Station in the Bay of Fundy, Canada, two humpback whales (*Megaptera novaeangliae*) became trapped. The first was trapped in the upper part of the river for several days in 2004 after swimming through the sluice gates. In 2007 the body of an immature humpback whale was discovered, the post mortem suggested that the whale had followed the fish through the sluice gates and also became trapped (Nova Scotia Power, 2012).

Floating devices could present a collision hazard along with their supporting structures. Carter *et al.* (2008) have modelled the likely encounter rate of marine mammals with marine energy devices. They concluded that there was a possible risk to marine mammals noting that these devices will be big (for example, the turbines of one device have a diameter of approximately 15 to 20 m) and that the developers' preferred sites for tidal stream devices will be restricted passages, for example, between islands and the mainland, or around headlands which are also favoured by marine mammals. Wilson *et al.* (2007) conducted a modelling exercise, in Scottish waters within the Strategic Environmental Assessment (SEA) area, to investigate the collision risk for porpoises with rotating blades of underwater turbines.

Their model predicts an encounter rate of 13 individuals per year per turbine. Collision risk with the device is considered to be higher when a greater proportion of the device is below the surface, and also at times of increased turbidity and during storms. Collisions with rotating blades used in underwater turbines are likely to cause direct injury, and in some cases death.

One of the greatest hazards for some animals may be cables used to tether some types of wave and tidal devices to the seabed. Types and amounts of cable vary according to the device type, but include mooring cables, chains, guy-lines and power cables. They can be slack, taut, vibrating, horizontal, diagonal, vertical, crossed, current-carrying and so forth, and with the potential to be hazards for cetaceans and other wildlife. As many future devices and arays being developed use floating structures, there will be many more devices attached to the sea bed using various cables. Some species seem predisposed to entanglement, particularly baleen whales. In Scottish waters more than 50% of stranded minke whales showed signs of having been entangled (Northridge *et al.*, 2010).

Cetaceans may be able to avoid the devices but only if they are able to detect the objects, realise they are a threat and be able to take appropriate action i.e. swim around, evade, swerve etc. (Wilson *et al.*, 2007). This becomes more complicated for the animals if several cables are used per device and/or multiple devices are present.

The risk of collisions between boats and cetaceans is significantly increased due to the increased vessel activities during exploration, construction, maintenance and decommissioning of various MREDs. Vessels installing and maintaining tidal devices can potentially have a greater collision risk as they will be operating in full tidal flows, and to remain stationary may be moving at speed through the water (i.e. >3 m s-1) (ICES WGMME, 2011). Vessels, in particular commercial vessels (e.g. shipping and fishing), may be banned from a site reducing the risk of vessel collisions within the MRED site; however this will result in increased vessel traffic, and potential for higher collisions with cetaceans outside the site.

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5.1.5 CONTAMINATION OF THE LOCAL ENVIRONMENT

Contamination could occur via leaks or spills of hydraulic fluid used in various devices e.g. due to storm damage, corrosion, device malfunction or collision with vessels. Vessel collisions may lead to significant leaks of cargoes or fuel carried by the vessel involved (ICES WGMME, 2011).

Antifouling methods are most likely to be used on wave and tidal devices to retain functionality as their moving parts are under the water and also on the static parts of other devices. It is most likely that antifouling paints would be the primary method used to stop marine growth and such coatings are typically toxic and may increase local pollution.

5.1.6 ELECTRICAL AND ELECTROMAGNETIC DISTURBANCE

The extensive underwater electrical cables associated with MREDs may affect wildlife. This has been highlighted as a threat to elasmobranchs, but other wildlife, including cetaceans, might also be affected. The electromagnetic fields could alter feeding behaviour, migration, reproduction, or susceptibility to predation of animals near the cables and there is also risk of injuries and mortalities depending on the strength of fields (U.S Department of Energy, 2009).

5.1.7 OTHER HABITAT DEGREDATION

This might include damage to the sea bed, destruction due to artificial hard foundations (Wilson *et al.*, 2010), changes in vertical mixing and increased turbidity (particularly during installation and construction). Scouring around turbine bases causes major changes in sandbank habitats, and the engineering (such as rock placement) to stop scouring has the potential to cause major habitat changes.

Local benthic flora and fauna may be disturbed, though the affects may be short term. Disturbance of pelagic or demersal organisms, including fish, may have negative implications for their predators.

In areas where devices are placed in the currents and velocities there, is the potential for alterations of currents, waves, circulation patterns and water quality, potentially having knock-on effects for cetacean behaviour (U.S Department of Energy, 2009).

5.2.POTENTIAL POSITIVE IMPACTS

There are possible positive impacts for marine wildlife that may result from deployment of MREDs, although currently there is little direct evidence of this.

Renewable developments might exclude large fishing operations from certain waters due to boats being unable to operate amongst the structures, reducing risk of collisions, bycatch and noise generated into the marine environment. However the potential benefit of reduced fishing operations may be offset by the increased number of maintenance vessels.

Such potential benefits need to be carefully evaluated before they can be accepted.

5.2.1. ARTIFICIAL REEFS

Inger *et al*. (2009) suggest that, if appropriately managed and designed, MREDs may increase local biodiversity and potentially benefit the wider marine environment by acting as artificial reefs. Witt *et al.* (2012) note that the extent to which these ‘artificial reefs’ may be beneficial to marine life will depend on the location, size and type of device.

A wider consideration is that MREDs may help to restore areas of seabed that have been lost through commercial fishing as these areas are likely to be closed to commercial fishing during the lifetime of the site. The hard structures that are used to support, or for foundations for MREDs provide hard bottom habitats and opportunities for fish or larvae to settle (Wilson *et al.*, 2010).

5.2.2. FISH AGGREGATION DEVICES

Reefs and aggregation devices have been used previously to facilitate restoration of damaged ecosystems, which have proven successful in enhancing both biodiversity and fisheries (Inger *et al.* 2009). The extensive mooring systems used on the foundations of many MREDs may act as fish aggregating devices and attract marine mammals that feed on the concentrated prey resources (Witt *et al.*, 2012).

5.2.3. REDUCED VESSEL ACTIVITY

Owing to the potential for collision between vessels and MREDs, and the entanglement of fishing gear, it is likely that traffic within a site will be limited to vessel traffic for construction, maintenance and decommissioning of a site. Usually there is a significant exclusion zone around wind turbines, for vessel safety, this may result in large wind farms becoming more or less no-take zones. The extent of vessel activities, eg.g fishing, conducted around MREDs will depend on the spacing between devices and other safety issues.

Potentially commercial vessels will be banned along with limited recreational traffic within the site reducing the potential for collisions with these types of vessels and cetaceans within the site. However this may be offset by increased number of maintenance vessels in the site.

5.2.4 POTENTIAL PROTECTED AREAS

With potentially limited non-MRED vessel traffic, in particular commercial fishing activity, it is possible that MRED sites could to some extent form *de facto* marine-protected areas. However, the extent to which marine renewable sites may cause fisheries to be excluded (or encouraged) or, more generally, the levels of protection for species that they may create, remain unclear.

5.3. CURRENT RESEARCH

The potential impacts of MREDs on cetaceans are increasingly supported by scientific evidence and opinion, but remain relatively little studied in the field (Dolman and Simmonds, 2012). As wave and tidal power devices are relatively new, less research has been conducted into their impact on the marine environment than on wind farms. However, with similarities in the types of foundations, some conclusions can be drawn from similar research conducted into offshore wind farms and oil and gas operations.

Noise levels from construction, again in particular pile driving, and maintenance may be a significant issue, especially in areas of high marine mammal abundance. Current research shows that the construction phase of offshore wind farms, when pile driving is typically used, has the greatest potential to cause acute effects including behavioural changes such as avoidance of currently used areas. Certainly, pile driving is identified as among the most intense anthropogenic sound sources in the marine environment (Weilgart, 2007). The installation of monopile foundations has been found to have a profound negative effect on harbour porpoise acoustic activity up to 72 hours after pile driving activity (Brandt *et al.*, 2011).

Many of the turbines used for wave and tidal power have a diameter of c.15 – 20 m, and the developers preferred sites for tidal stream devices will be restricted passages where current movement is fast, such as between islands and the mainland, or around headlands, areas which are also favoured by marine mammals. Wilson *et al.* (2007) conducted a modelling exercise to investigate the collision risk for porpoises with underwater turbines. Their model predicts an encounter rate of 13 individuals per year per turbine. Scaling this for 200 turbines, such as at the approved New Zealand Kaipara Harbour site, there is the possibility of 2600 turbine blade encounters per year, some of which may have the potential to be fatal.

To date offshore wind farm studies focus on the impacts of MREDs on harbour porpoises, only recently are the impacts on bottlenose dolphins starting to be researched. Those studies that have been conducted are small in number and mainly short term studies. In the main these studies have shown a reduction in the abundance of harbour porpoises and the potential to cause behavioural reactions in bottlenose dolphins up to 40 km during the construction of the offshore wind farm during pile driving (Bailey *et al.*, 2011).

Between 1999 and 2006, monitoring was conducted at Horns Rev and Nysted offshore wind farms in Denmark. This included gathering baseline data and then studying the construction and operational phases. The only cetacean commonly encountered on this coastline is the harbour porpoise (Teilmann *et al.*, 2007).

At Horns Rev, the density of the porpoise population decreased during construction, and then recovered. At Nysted, porpoise densities decreased significantly during construction. Carstensen *et al.* (2006) reported a pronounced negative effect of construction on the reaction of porpoises to the construction of the Nysted offshore wind farm in the western Baltic by monitoring their echolocation clicks.

On the basis that clicks relate to density, they found substantial changes in habitat use, with harbour porpoises leaving the construction area, then, only after two years of operation, did the population partially recover. This indicates that harbour porpoises were displaced during the construction phase and have not used the habitat to the same extent they previously did. It has also been noted that it is unclear if it is the same animals returning, or if they are new animals moving into the area.

Given the intense sound production during construction, it is not surprising that harbour porpoise detection at Nysted and Horns Rev marine offshore wind farms in Denmark decreased over considerable ranges during pile driving for offshore wind farm construction (Teilmann *et al.*, 2007).

Thomsen *et al.* (2006) found that the noise generated by the construction of offshore wind farms was loud enough to be audible by harbour porpoises beyond 80km from the source, could mask communication at 30 – 40 km, and that there are behavioural reactions at 10 – 20 km. They concluded that the construction of offshore wind farms has "the potential to affect porpoise behaviour and physiology at considerable distances and the mitigation should focus on damping of the higher frequency part of the ramming noise".

Brandt *et al.* (2011) found the effect of pile driving during the installation of monopile foundations at Horns Rev II on harbour porpoise acoustic activity was "reduced by 100% during 1 h after pile driving and stayed below normal levels for 24 to 72 h at a distance of 2.6 km from the construction site….consequently, porpoise activity and possibly abundance were reduced over the entire 5 month construction period. The behavioural response of harbour porpoises to pile driving lasted much longer than previously reported."

In contrast to these findings, between 2007 and 2009, monitoring was conducted at Egmond ann Zee offshore wind farm studying the acoustic activity of harbour porpoises during normal operation of the offshore wind farm, and comparing this with baseline data from 2003-2004. Scheidat *et al.* (2011) found "a substantial increase in acoustic activity from baseline to operation at all stations indicating an increase in the number of porpoises occurring in the area as a whole". Unfortunately, in the case of Egmond ann Zee, no monitioring was conducted during contruction of the wind farm.

No conclusions could be drawn for the increase in numbers, but two causes have been suggested; increased food availability due to the reef effect, or the absence of vessels. Teilmann *et al.* (2007) have suggested that harbour porpoises may be more tolerant to noise and other disturbance in areas that are of greater importance for breeding or feeding, and more likely to abandon areas of less importance without major consequences to the population.

Scheidat *et al.* (2011) also state that due to differences in the ecology of Egmond aan Zee which is located in the open North Sea 'in an area dominated by hydrographical frontal systems created by the efflux from large river, most notably the Rhine', compared to other offshore wind farms such as Nysted which is located in 'near-brackish waters with a bottom substrate of bare sand overlain with mud' may attribute to the different findings. The difference in foundations may also be significant with Horns Rev using monopile foundations. Lindeboom *et al.* (2011) also studying the environmental impacts of Egmond aan Zee (but no specific research was conducted for harbour porpoises) concluded that as 'all other marine offshore wind farms are planned outside the zone of 12 nautical miles, care must be taken when extrapolating results to other areas'. The exclusion of trawl fisheries was found to lead to an increase in some mobile fish species, and a decline in others which appears to have led to a localised increase in harbour porpoise numbers.

At Beatrice offshore wind farm, in the Moray Firth, Scotland, passive acoustic monitoring was undertaken to assess whether cetaceans responded to pile driving noise during the installation of two 5 MW offshore wind turbines compared to a control site. Harbour porpoises were found to respond to disturbance from installation activities, Thompson *et al.* (2010) found that there was short-term response by harbour porpoises within 1 – 2 km of the site and noted that 'Any potential disturbance to cetaceans from the pile driving required to install the two 5 MB wind turbines in this study would have been experienced over only a few days. In contrast, the pile driving activity required to install the 1– 2GW offshore wind farms anticipated under Round 3 developments could extend over several years. This clearly demands a much higher level of understanding of likely impacts and effective mitigation measures'.

On the basis of recordings made of the piling of two deep-water turbines in the Moray Firth, Bailey *et al.* (2010) suggested that bottlenose dolphins, and northern minke whales and other mid- and low- frequency hearing cetaceans, may exhibit behavioural disturbance up to 50 km away from the source. These authors also noted that physical harm could have occurred if cetaceans had been within 100 m of the pile driving.

This illustrates the importance of considering how the physical circumstances of each development will affect the noise generated at each site. Bailey *et al*. (2010) concluded that 'as the marine renewables industry develops, our understanding of the noise produced and potential effects on marine species must be improved so that appropriate mitigation procedures can be developed'.

During 2011, Wilke *et al*. (2012) tested five different noise mitigation systems for reducing noise generated during pile driving, at the Brodten pile in Lübeck Bay, Baltic Sea. The mitigation systems included various bubble curtains, fire hose curtains and a system that uses air bubbles with fixed, firm bubbles of defined size and shape that are connected to a net. All systems resulted in a reduction of the noise generated during pile driving. In relation to marine mammals the results showed that 'in the high- frequency range up to 5,000 Hertz, which is the most sensitive range for marine mammals, the reduction reaches values of up to 25 dB'. Overall the results showed a broad-band reduction of 7-9 dB SEL (Wilke *et al.*, 2012).

5.3.1. OVERVIEW OF RESEARCH RECOMMENDATIONS

Results from the research conducted stresses the fact that results from one offshore wind farm are not necessarily transferrable to other offshore wind farms. It also highlights that robust baseline data are required to understand the abundance, distribution and densities of species and local habitat use, so that MREDs are not located in sensitive areas such as breeding, nursing and feeding grounds, or on migratory routes.

There is clearly a requirement for more research on the potential impacts of MREDs, noted in sections 5.1 and 5.2, on harbour porpoises (where there has been limited research) but also on other cetacean species including monitoring the productivity of animals (they may still be present in an area but not breeding), their prey and habitats to help mitigate the impacts of MREDs on cetaceans. The research needs to cover all stages of the lifetime of the MREDs to be able to evaluate their impacts on cetaceans and also consider the cumulative effects.

At least until the key potential impacts are fully understood and accounted for, large scale monitoring programmes are required. These monitoring programmes should run before, during and after construction, addressing the amounts and behaviour of vulnerable organisms, along with the intensity and effects of human uses other than MREDs. The IWC workshop of 2012 stated that "Monitoring needs to be designed carefully to assess impacts against pre-determined conservation objectives and to measure the efficacy of any mitigation measures that are implemented."

In 2011, the ICES Working Group on Marine Mammal Ecology reviewed the effects of tidal devices on marine mammals, and in 2012 the effects of wave energy devices on marine mammals. These reviews concluded that the recommendations made in the 2010 review on baseline and impact monitoring of offshore wind farms is relevant to all MREDs (ICES WGMME, 2011 and ICES WGMME, 2012).

These comprehensive recommendations included that multinational studies should be undertaken considering the trans-boundary nature of marine mammals. They also concluded that methods need to be developed to assess the cumulative effects of the underwater noise level caused by the simultaneous wind farm construction and operation at nearby sites.

The working group concluded that the establishment of means for efficient dissemination of results of these surveys, previous EIA reports and previously collected baseline data need to be established and available for subsequent studies and assessments (ICES WGMME, 2010).

The recent IWC workshop report (2012) provides a comprehensive set of monitoring requirements covering all stages of development and site selection. It identifies that some areas of monitoring, such as distribution and abundance have well established techniques that just need to be applied. For other monitoring needs, such as the impacts of MREDs on cetaceans, there is the need for the development of field and analytical methods, and consistency between projects.

It can be expected that as the industry develops, if monitoring is adequately conducted, impacts and their significance will become clearer. Hence, there is also a need for rapid and transparent sharing of research information and government guidance on adaptive management of the marine renewables industry. This will help to reduce the unknowns, provide more certainty for developers and ultimately develop a truly environmentally sustainable industry. In addition, if some renewable energy-generating mechanisms or some methods of installation prove to be especially benign, they might be promoted and, conversely, cetacean-unfriendly mechanisms or methods could be replaced in favour of more
environmentally benign options.

Nations need to coordinate their activities in this field, especially those with shared marine boundaries as management will have to consider all potential transient impacts across such boundaries, especially considering the mobile nature of cetaceans.

5.3.1.1 BASELINE RESEARCH

Establishing adequate baseline data, on the use of an area by cetaceans, before building developments is essential. We would be in a much better position now to assess impacts if better baseline data had been available ahead of the offshore wind farms now in operation.

WDC recommends that a site specific monitoring plan is prepared for every development. A combination of visual and acoustic surveys are the best method for obtaining robust information on cetacean distribution, abundance and density, specific for the species of interest, in preparation for an environmental impact assessment (EIA) (Dolman and Simmonds, 2010). In the US, studies on the distribution of cetaceans, on both small and large scale future development sites are starting to be undertaken to try and establish some baseline data (IWC, 2012). As part of this, strandings surveillance should be undertaken to develop a baseline from which an understanding of any increases in strandings rates due to impacts can follow (Dolman and Simmonds, 2012). Changes and anomalies in 'cause of death' should also be investigated e.g. evidence of injuries from mechanical devices.

There is an urgent need for advice from governments on the most appropriate techniques to ensure adequate baseline surveys and impact studies. Most current guidance is based on terrestrial sites and seabird survey protocols which are unsuitable for tidal and offshore developments, and particularly marine mammals. Marine mammal surveys have often been developed as an add-on to boat based bird surveys (MASTS, 2010). Inadequately designed monitoring programmes may not detect behavioural or injury effects with the potential for delivering misleading results.

5.3.1.2 CONSTRUCTION RESEARCH

The majority of the existing impact research has been conducted during the construction phase of development. Studies have been largely focused on the disturbance of harbour porpoises. The results have mainly shown a reduction in the abundance of harbour porpoises over various time periods, yet little is still known about the full impacts of construction methods on harbour porpoises, and even less is known about the impacts on other cetaceans.

Due to the potential for physical harm, disturbance and displacement during the pile driving process used in the majority of MRED foundations, and the large number and size of MREDs planned, it is urgent that the impacts of construction are adequately monitored, fully understood and a timely adaptive approach is taken to future developments based on what is learnt.

Acoustic monitoring at sites that use different foundation types, have different sea bed habitats and other factors that will affect noise transmissions is required. Preferably foundation types that are shown to cause a negative reaction in cetaceans, in particular those that require pile driving should not be used until tried and tested mitigation measures can be implemented. Some developers have stated that this may not be viable in many locations due to the cost of other types of foundations and conditions of the environment (such as the nature of the sea bed and currents). However, the noise generated from pile driving is the most immediate threat to cetacean populations in coastal waters where developments are proposed, particularly where pile driving is anticipated to be occurring around large parts of some coastlines for a number of years. It is essential that much greater effort is invested in developing alternative, quieter technologies or effective quieting mitigation measures.

Significantly more research is needed to determine the extent of chronic, cumulative and long term effects of pile driving. Particular attention should be paid to identifying the range of frequencies utilised by marine mammals and minimising the production noise within this frequency range (Inger *et al.*, 2009).

5.3.1.3 OPERATIONAL RESEARCH

The Sea Mammal research Unit (SMRU, 2010) looked in detail at methods of marine mammal monitoring at MREDs; they stated that 'The details of a monitoring strategy need to be considered on a site-by-site basis. The site-specific factors include species present, distance from shore, depth and characteristics of the devices to be used. It is also important to fully assess the extent of the existing data and how recent they are'.

Appropriate guidelines are required for survey work at potential renewable sites, along with detailed guidance on survey methods for marine mammals. Scottish Natural Heritage (SNH) suggested that up to 15 years of post-construction monitoring may be necessary to fully understand the impacts (Dolman and Simmonds, 2010).

Accurate measurements of operational noise from different designs of MREDs are required to identify the frequencies and intensities generated (MASTS, 2010). Again, particular attention should be paid to identifying the range of frequencies utilised by marine mammals and minimising the production noise within this frequency range (Inger *et al.*, 2009).

Noise and vibrations during the operational phase are generally thought likely to be less intrusive than construction noise, but significantly more research is needed to determine chronic, long term effects. The noise transmission from an operational array of offshore wind farms or other converters may combine synergistically to have an enhanced biological effect.

Understanding how cetaceans perceive, and interact with wave and tidal energy devices is important to assess the risk of collisions, entanglement and habitat displacement etc. The likely results of encounters between cetaceans and underwater turbines need to be investigated as a priority. Sites where devices are being tested offer a place to undertake this research. At test sites, alongside testing the efficiency of devices, the impact on the environment should also be recorded by obtaining suitable baseline data first and researching cetacean interaction/ response to the devices. To assess the impacts of operational MREDs on cetaceans, methods such as passive acoustic monitoring and aerial surveys will help to assess any habitat displacement (Dolman and Simmonds, 2010).

Collisions with devices are generally either fatal or lead to a serious injury that has the potential to result in fatality. Collisions measurement needs to sample continuously or at least for an extended time window to capture seasonal variation (MASTS, 2010). Focusing on sites which offer the best scope for measuring actual collisions and validating collision risk predictions would be the most cost effective approach to collecting high quality data (MASTS, 2010). Video equipment can record collisions and entanglement incidents (Dolman and Simmonds, 2010).

5.3.1.4 POST-OPERATION RESEARCH

Comprehensive monitoring to detect changes between pre-construction and post-operation stages requires a long term research programme, and large coverage to take into account natural variability.

At this stage, the decommissioning of MREDs has the greatest potential to negatively impact cetaceans through noise generated, where it is likely to involve structure/device removal, possibly through the use of explosives. Waste and debris clearance and disposal and seabed restoration have the potential to cause physical harm, or be lethal to cetaceans (Prior and McMath, 2007).

As noise is of particular concern, research is required into the noise impacts of the decommissioning process, as well as a number of years after decommissioning to see the full impacts on cetaceans.

6. MARINE RENEWABLE ENERGY AND MARINE PROTECTED AREAS

The term marine protected area, or 'MPA,' describes an area of ocean in which human activity is appropriately managed to conserve the marine environment and the wildlife that lives there. Under this umbrella term there are many different types of protected areas, including marine parks, marine reserves and in Europe, Special Areas of Conservation (SAC), Special Protection Areas (SPAs) and Marine Conservation Zones (MCZs), each with its own level of protection and different laws backing them up.

The suitability of MPAs for cetaceans has been discussed by Hoyt (2011). He noted that there are areas of a cetacean's range that are 'essential for day-to-day well-being and survival, as well as for maintaining a healthy population growth rate' and that these include 'areas that are regularly used for feeding, breeding, calving, socialising and resting, as well as, sometimes, migrating'. These areas may be called home ranges, breeding or feeding grounds. He also noted the need to protect these 'critical habitat' areas for cetaceans and to also extend this protection to critical habitat for cetacean prey species.

A limited number of MPAs, solely designated for cetaceans, exist worldwide. These range from the IWC ocean sanctuaries to small local reserves. The earliest MPA was designated in Glacier Bay, Alaska, in 1925 which offered some protection to cetacean habitat, and El Vizcaino Biosphere Reserve, Mexico, in 1972 and expanded in 1988, specifically to protect a prime grey whale mating and calving lagoon (Hoyt, 2011); one of the latest to be designated is Camden Sound marine park, Australia, in 2012 specifically designated to protect the calving ground of humpback whales.

Recently WDC has identified 12 key habitats for whales and dolphins around the world and is campaigning to have these areas designated as MPAs; some of these areas have MREDs (at various stages) located within, or adjacent, to these key habitats for cetaceans particularly around Scotland, (figure 11) but also in other parts of Europe, Australia and New Zealand.

The relationship between the siting of MREDs and associated activities, and the location of cetacean MPAs is an important one.

In UK waters, at those sites where adequate data exists to enable analysis, a number of areas of cetacean critical habitat, and areas of interest (areas where there is some evidence of importance for cetaceans, however there is limited information available) have been identified for harbour porpoises, bottlenose dolphins, white-beaked dolphins (*Lagenorhynchus albirostris*), Risso's dolphins (*Grampus griseus*), minke whales and short-beaked common dolphins (*Delphinus delphis*) (Clark *et al.* 2010). In addition Clark *et al.* (2010) they state that 'For at least harbour porpoises, white-beaked dolphins, minke whales and common dolphins, given the importance of UK waters for these species, it is highly likely that further areas of critical habitat exist [….]. For many – particularly Atlantic white-sided dolphins (*Lagenorhynchus acutus*), long-finned pilot whales (*Globicephala melas*), northern bottlenose whales (*Hyperoodon ampullatus*), Sowerby's beaked whales (*Mesoplodon bidens*), sperm whales (*Physeter macrocephalus*) and killer whales (*Orcinus orca*) – the UK's waters provide significant areas of habitat and, within this, there will be areas of critical habitat, important for critical life processes such as breeding, calving and feeding'.

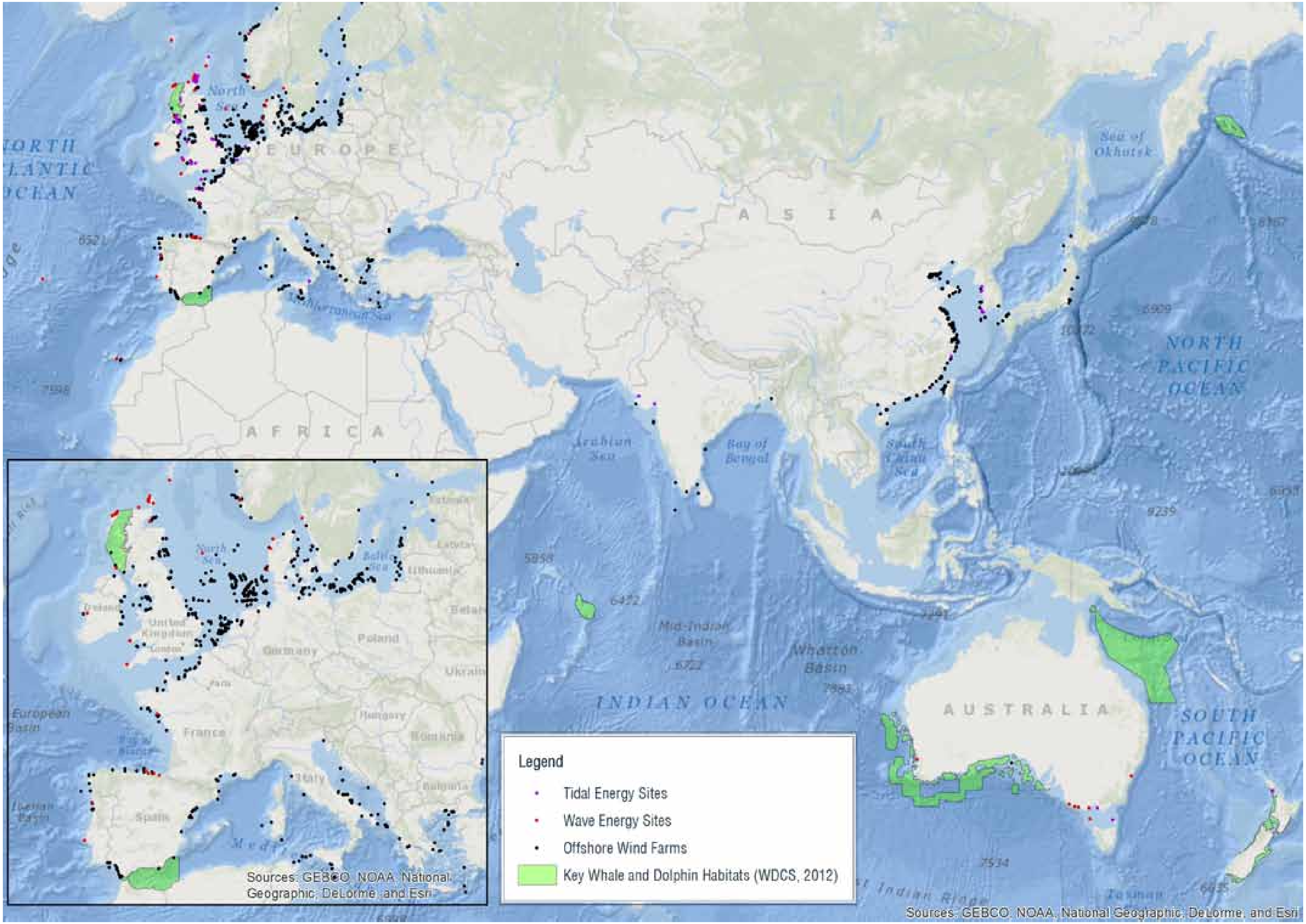

Figure 11. WDC Key Habitats for Whales and Dolphins and MREDs

Earlier in this report the potential, but still largely unknown, impacts of MREDs on cetaceans have been detailed. Given the real concerns about impacts associated with intense introduced noise, habitat displacement, disturbance and injury, WDC recommends that until the impacts of MREDs can be fully assessed and mitigated, further developments within, or that may affect, areas that have already been identified as important for cetaceans are avoided.

This will ensure that areas sensitive for cetaceans are avoided in the development process until an adaptive management and planning approach is applied and these developments have demonstrated that they are environmentally benign.

6.1 HARBOUR PORPOISE

As can be seen from figure 12 there are a number of locations around the UK where critical areas, and areas of interest, have been identified for harbour porpoises, the majority of which also include MREDs, in particular offshore wind farms, either inside these areas or adjacent to them. As these areas have been identified as containing higher densities of harbour porpoises, or are important for biological behaviours, any impacts on the harbour porpoises as a result of development activities, in particular from pile driving, collisions and increased boat traffic, may be accentuated in these areas.

Current research into impacts of wind farm construction on harbour porpoises, are covered in detail in section 5.3. The limited research conducted so far has shown the potential for wind farms to cause behavioural changes, particularly displacement in harbour porpoises, which leave the area during construction and in some instances, do not return in their usual numbers later.

An area of interest for harbour porpoises off the east coast of England overlaps with the Dogger Bank SAC, and the Round 3 Zone released by the Crown Estate. The Moray Firth Round 3 Zone is completely within an area of interest, and adjacent to critical habitat for harbour porpoises. These areas are of particular concern as the noise generated by constructing these offshore wind farms has the potential to drive the harbour porpoises out of these areas.

Overlapping the area of interest for harbour porpoises at Dogger Bank is also the UK Dogger Bank candidate (c) SAC designated for its sandbank habitat, the German Dogger Bank SAC designated for its sandbank habitat, harbour porpoises and common seals and the Dutch Dogger Bank SAC, designated for its sandbank habitat, harbour porpoise, grey seals and common seals. JNCC (2011) have noted that ‘the Dogger Bank region is an important location for the North Sea harbour porpoise population and as such they are included as a non-qualifying feature’. Overlapping both the area of interest for harbour porpoises and the cSAC is the Round 3 Zone where 8 of offshore wind farms are already being planned covering many thousand km^2 between them. The construction of these sites in particular has the potential to not only negatively impact the harbour porpoises, but also to damage the sandbank habitat which is important for prey species as well as in its own right.

In the critical habitat areas off the west coast of Scotland, and Anglesey, Pembrokeshire and the Lleyn Peninsula in Wales a number of MREDs are in various stages of development, all of which have a high potential to negatively impact harbour porpoises. A number are also being deing developed in areas of interest for harbour porpoises, such as in the Moray Firth, Scotland, where a wave power testing facility is in operation, testing devices such as buoyant moored devices; the mooring systems of chains and cables of these devices have the potential to entangle cetaceans.

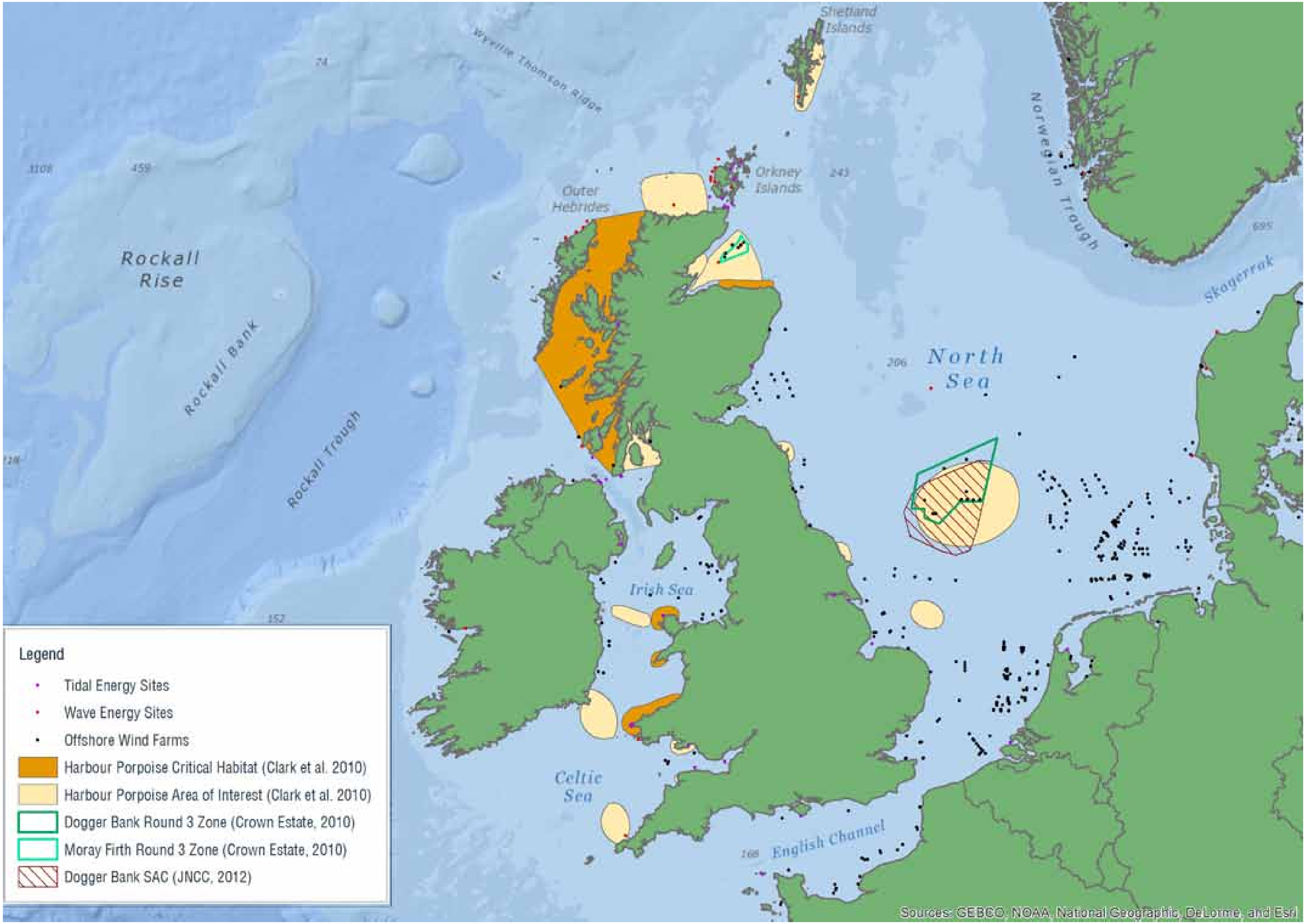

Figure 12. Location of Critical Harbour Porpoise Habitat and MREDs.

6.2 BOTTLENOSE DOLPHIN

As with harbour porpoises there are a number of MREDs that are located in areas critical for bottlenose dolphins, in particular along the west coast of Scotland where wind, wave and tidal energy projects are proposed to be based (figure 13). As this area has been identified as containing a small population of bottlenose dolphins (around 45 in total) and is important for biological behaviours, any impacts as a result of development activities, in particular from pile driving, increased boat traffic and collisions with tidal turbines, may be accentuated for this species in this region.

Information on the critical habitat areas for bottlenose dolphins has led to the designation of MPAs in the form of the Moray Firth and Cardigan Bay SACs, where bottlenose dolphins are a 'species that are a primary reason for selection of this site' (JNCC, 2012).

Of particular concern is the Moray Firth SAC in Scotland which supports the only known resident population of bottlenose dolphins in the North Sea. Although the identified critical habitat and the Moray Firth SAC covers just the inner Moray Firth, field research conducted by WDC, Aberdeen University and the Cetacean Research and Rescue Unit (CRRU) since 1997 of the outer Moray Firth show this area is also important to bottlenose dolphins as well as a number of other species including harbour porpoises. The southern Moray Firth has also been identified as a search location for minke whales as part of the Scottish MPA Project. Figure 14 shows the sightings gathered by WDC from 2005-2009 in the outer Moray Firth.

As can be seen from the data gathered, this area of the Moray Firth is of great importance to bottlenose dolphins and a number of other cetacean species. The potential impacts of individual and the cumulative impacts of all proposed marine renewable developments (such as the planned extension to the Beatrice offshore wind farm) in the Moray Firth, and along the east coast of Scotland, including the Firth of Forth, alongside the continuing oil expansion at Beatrice Oil field are of great concern, especially for the vulnerable population of bottlenose dolphins.

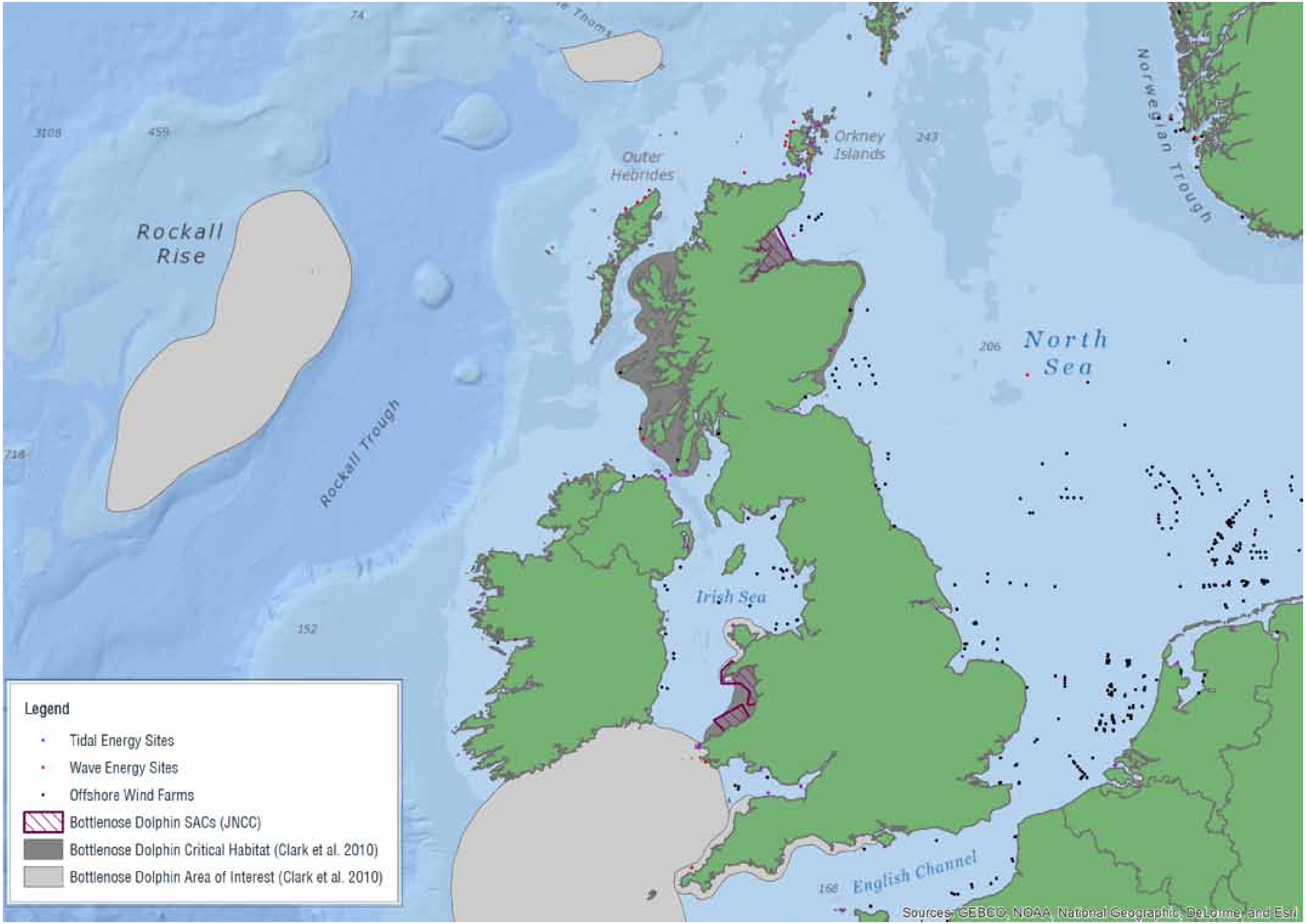

Figure 13. Location of Critical Bottlenose Dolphin Habitat and MREDs.

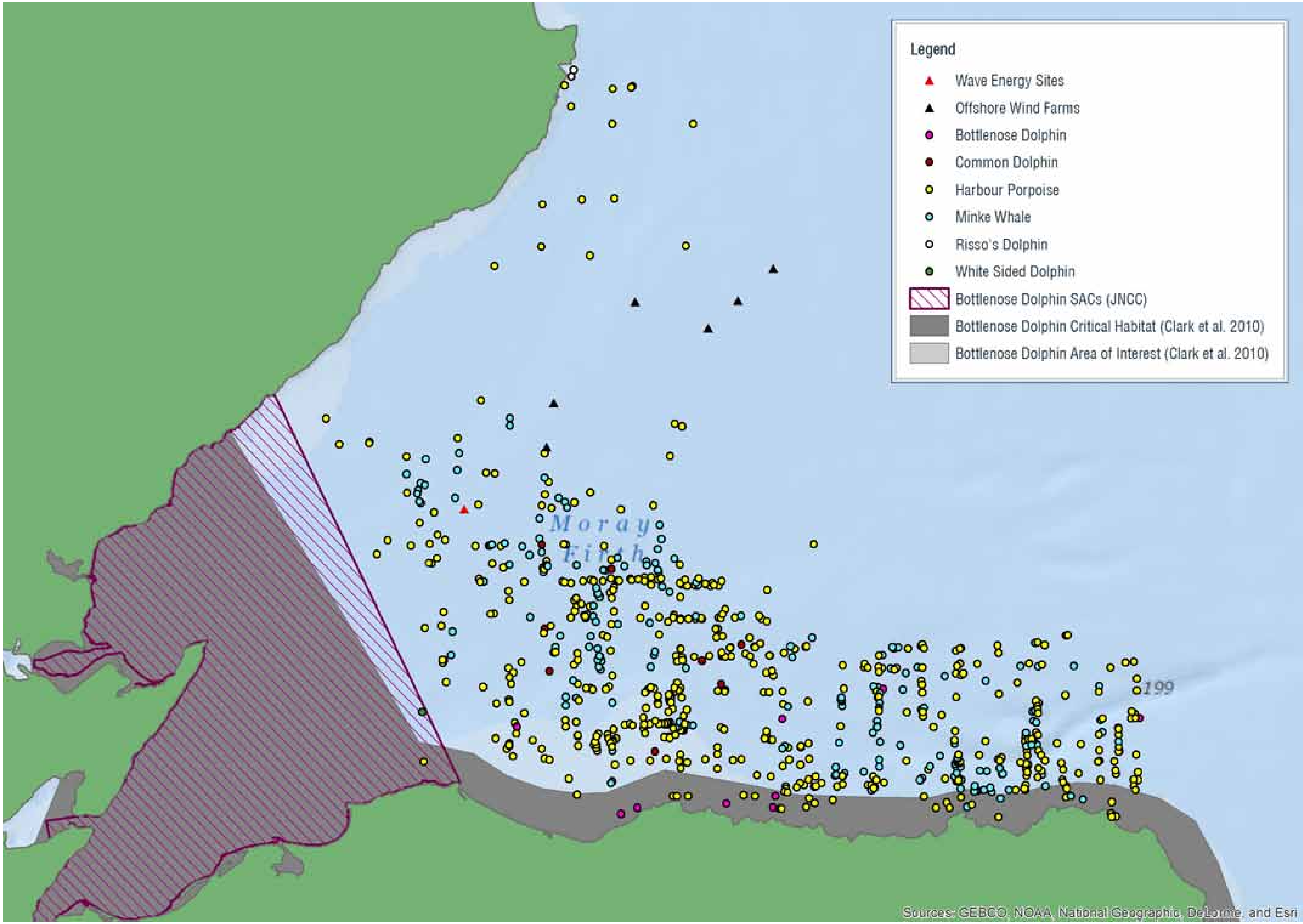

Figure 14. All sightings recorded from WDCS Moray Firth surveys 2005-2009 and MREDs

6.3 OTHER CETACEANS

The UK Round 3 zones highlighted above (Moray Firth and Dogger Bank) are those that are of immediate concern as these are areas identified as being of critical habitat. And areas of interest, for cetaceans, particularly harbour porpoises and bottlenose dolphins, which currently are the only two species given site-related protection in the EU under Annex II of the Habitats Directive, requiring that Special Areas of Conservation (SAC) be established for their protection (Green *et al*, 2012). However there are other areas around the UK where MREDs are located in critical habitat areas for other cetacean species, including white-beaked dolphin, short-beaked common dolphin, minke whale, killer whale and Risso's dolphin (figure 15).

Some areas are critical habitat for more than one species, here MREDs have a greater potential to have a significant impact on a number of species. The Dogger Bank has also been identified as a critical habitat for minke whales and white-beaked dolphin; the Moray Firth is critical habitat for minke whales and white-beaked dolphins also.

The southern Moray Firth and the west coast of Scotland have been identified as critical habitat for minke whales where large scale offshore wind projects are proposed. These areas have been identified as containing critical habitat as part of the Scottish MPA Project and are important for biological behaviours. Any impacts as a result of development activities, in particular from pile driving and increased boat traffic, may be accentuated for this species in this region.

Tidal developments are usually placed in estuaries, headlands, between islands, or where there are powerful, fast currents. Due to their coastal locations in productive areas these may coincide with critical cetacean habitat. For example Ramsay sound off the coast of Pembrokeshire in Wales is an area that has been identified as critical habitat for three species, harbour porpoise, bottlenose dolphin and Risso's dolphin. Here, a tidal stream demonstration site was approved in 2008 using horizontal axis turbines.

Information on critical and protected areas for cetaceans outside the UK has been hard to obtain. However the findings around the UK coast will be mirrored in many other countries with similar overlaps of critical habitat areas for various species of cetaceans and MREDs arising to similar concerns and warranting detailed investigation of potential for a higher level of impacts.

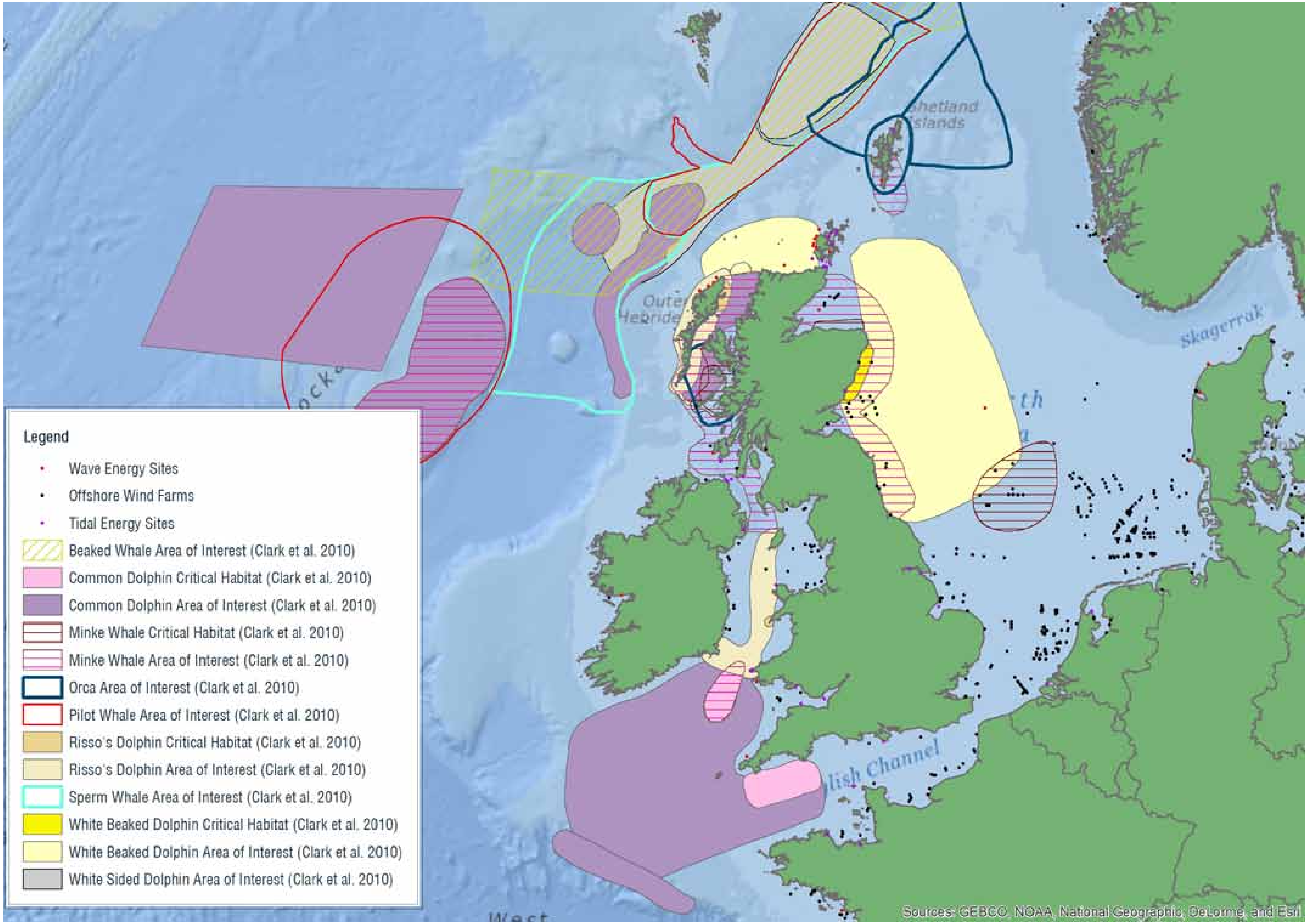

Figure 15. MREDs in the UK and Critical Habitat Areas for Cetaceans Other Than Bottlenose Dolphin and Harbour Porpoise.

7. CONSIDERATION OF CETACEANS IN ENVIRONMENTAL ASSESSMENTS

A critical element in the development stages of any MRED is the assessment of the potential impacts of the development on the marine environment. This procedure should ensure that the environmental implications of decisions are adequately taken into account before the decisions are made, and allow for any necessary management and mitigation measures to be undertaken. Wilson *et al.* (2010) state that an environmental impact assessment should consist of 'what is the effect of this activity, at this place, at this time, carried out in this way, and how do we mitigate or compensate for any effect identified'.

Within the European Union, where the vast majority of developments are being undertaken, environmental assessments must be undertaken for public plans or programmes on the basis of the Strategic Environmental Assessment (SEA) Directive 2001/42/EC; or for individual projects, such as a dam, motorway, airport or factory, on the basis of the Environmental Impact Assessment (EIA) Directive 85/337/EEC, as amended[8]. For the most part, a SEA is conducted before a corresponding EIA is undertaken (European Commission, 2012).

Marine developments for which an EIA is mandatory are listed under Annex I of the EIA Directive; while those listed under Annex II of the EIA Directive may require an EIA if it is concluded that the project 'will exceed certain limits or thresholds' (MMO, 2011). Such considerations include factors such as its size, nature and/or location.

Currently no marine renewable developments are specifically listed in Annex I of the EIA Directive, but fall under 'Industrial installations for the production of electricity, steam and hot water' in Annex II (European Commission website, 2012). For projects listed in Annex II, the national authorities have to decide whether an EIA is needed. This is done by the 'screening procedure', which determines the effects of projects on the basis of thresholds/criteria or a case by case examination. However, the national authorities must take into account the criteria laid down in Annex III of the Directive.

7.1 REGIONAL APPROACHES

In the UK, the Marine Works EIA (Amendment) Regulations 2011 (MWRs) incorporate the EIA Directive into UK law referring to Annex I and Annex II of the European Council Directive on EIA (85/337/EEC, as amended).

The Crown Estate is responsible for seabed management in the UK. In Scotland the devolved Government is responsible for marine licensing in their areas. However, under the devolution arrangements certain matters remain reserved to the UK Government (Scottish Government, 2012).

In England and Wales, the Marine Management Organisation (MMO) is the primary marine planning authority and regulator of activities. The MMO has produced guidance on the EIA, and 'ensure that applications are subject to EIA where necessary' (MMO, 2011). Exceptions to its licensing powers include 'nationally significant' infrastructure projects; this includes MREDs over 100 MW (DEFRA, 2009), which equate to a significant number of wind farms in various stages of development.

Projects over 100 MW are considered by the Planning Inspectorate which will make recommendations to the Secretary of State for Energy and Climate Change.

For the Welsh inshore region, applications for Marine Licences and wildlife licences for European Protected Species in respect of renewable energy installations are made to Natural Resources Wales (DEFRA, 2012).

Within Scotland, the Scottish Government has jurisdiction over marine planning under the Marine (Scotland) Act 2010 with responsibility for developing and implementing the new marine planning system throughout Scottish waters (Dolman and Simmonds, 2012). Marine Scotland has produced guidance for developers and undertakes licensing and consenting for MREDs.

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8 - The EIA Directive of 1985 has been amended three times, in 1997, in 2003 and in 2009 details of which can be found on the European Commission website at http://ec.europa.eu/environment/eia/eia-legalcontext.htm

In addition (in Scotland at least), renewables developers are using a 'Rochdale Approach' to progress their EIAs, where often the specific design technology and even the number of devices is not known at the time of submission for consent. This makes it particularly difficult to adequately assess environmental impacts, and subsequent required management and mitigation measures. This approach is far from satisfactory and all efforts should be made to make the approach as realistic as possible to enable stakeholders to provide meaningful responses to public consultations.

Through the EU and transposition of the EU Habitats Directive, the Habitat Regulations require that an Appropriate Assessment (AA) is carried out on any development that has the potential to affect a Natura 2000 (European) site, no matter how far away from the site(s) it is situated. These assessments focus solely on the qualifying interests of the Natura site affected and consider any impacts on the conservation objectives of the site (SNH, 2012). A development will not be approved if the AA concludes that it will adversely affect the integrity of a Natura site.

The Habitats Directive requires that in the European Union marine mammal populations are maintained at, or restored to a favourable conservation status and impacts need to be monitored to ensure they are not having a negative affect (JNCC, 2012). European Protected Species (EPS) also warrant a high level of protection from disturbance and as such, developers of marine renewable energy will need to undertake an EIA. In some cases an EPS license may be an additional requirement.

However the screening procedure, guidelines, thresholds and mitigation measures for an impact assessment differ considerably from country to country. For example, Germany always requires baseline data to be collected during the EIA, whereas most other countries will only collect new data if other relevant data is deemed not available (ICES WGMME, 2010).

As cetaceans are highly mobile species, the UK requires historical data of up to five years before a species can be assumed to use a site regularly (IEEM, 2006) and at that point further research will be conducted if required. As information on cetacean populations is limited, it would be inaccurate to assume an area is not used by cetaceans and therefore there would be no adverse effects. Also as information on critical habitats are limited and the impacts of MREDs largely unknown, it is very difficult to make an accurate assessment of habitat use in some areas, let alone impacts and appropriate mitigation measures. Yet five years of baseline monitoring has not been required of any renewable developer to inform the EIA and subsequent consenting process, despite the patchy data that exists.

Where adverse effects are identified, the potential for these to be 'significant' is considered based on available scientific evidence, guidelines or, where scientific evidence does not exist, further research may be required. All potentially significant effects from the environmental impact assessment are summarised for consideration within the Environmental Statement (ES). The ES will then assess the impacts in close detail and identify the mitigation measures that will be applied to reduce these impacts to an acceptable level.

The House of Commons Energy and Climate Change Committee (2012) have found that 'marine licensing authorities have taken different approaches to monitoring requirements in different parts in the UK. In some places a stringent 'precautionary' approach has been taken while others have set a more flexible 'deploy and monitor' type of requirement'. The favourable approach is to monitor a site and take a precautionary approach rather than the latter which may result in irreversible damage being done to the marine environment.

German legislation states that 'a permit for offshore installations, such as offshore wind farms, has to be granted unless it is demonstrated to, among other things, pose a threat to the marine environment' (IWC, 2012). Whilst in other European countries this legislation does not currently exist, governments are strongly encouraging renewable energy projects in order to meet the EU's 2020 energy target.

A two year research programme is undertaken which informs the EIA and must also consider the German Nature Conservation Act in which it is prohibited to affect species in a way that will impair the conservation status of local populations. There has been some consensus that temporary threshold shift is categorised as injury in the sense of law, and therefore, due to the known impacts of pile driving on harbour porpoises, developers are required to apply noise mitigations to reduce noise levels to below 160 dB (SEL) or 190 dB (SPL) at distances greater than 750 m to the piling site (IWC, 2012).

In Belgium each project consists of a mandatory monitoring programme to mitigate or halt any activities in case of 'extreme danger to the ecosystem' (IWC, 2012). The results of these surveys are used to inform policy management and design of offshore wind farms.

Outside of the EU, most developments are still at various stages of planning and development, therefore guidelines on the impact assessments of these developments are not as well defined. Santora *et al*. (2004) note that the legal and regulatory issues surrounding the renewable energy industry in the US are not straight-forward, the National Marine Fisheries Service (NMFS) provide information through the Bureau of Ocean Energy Management (BOEM) to assist developers in minimising and reducing conflicts in the siting process of MREDs and addressing their potential impacts on marine life (IWC, 2012).

7.2 WEAKNESSES

Assessments of the impacts of MREDs on cetaceans and the wider marine environment are currently based on very limited knowledge. The limited understanding of the effects of renewable energy devices on cetaceans and the marine environment results in a lack of information available for environmental consenting, which in turn affects the decision making process and ultimately our ability to meet legislated conservation requirements. Even with the noise mitigation measures required for MRED developments in Germany, it can still be expected that there will be disturbances of harbour porpoises with a 10 km radius of the site (IWC, 2012).

Because of this lack of data, developers may only discover that an area is environmentally sensitive late in the development process, leading to costly changes in plans, unwieldy environmental constraints or delays. Identifying potentially sensitive areas in advance of leasing rounds would avoid this risk (House of Commons Energy and Climate Change Committee, 2012).

Data on marine wildlife is not currently held centrally in one place. Therefore the developers need to contact various organisations, including those in neighbouring countries that may be affected by the development, to acquire the data to base a reliable decision upon the extent of impact on cetaceans.

As the data are limited and take time to obtain, it is highly unlikely that currently any decisions on the importance of an area for cetaceans are based on reliable information. This could result in assumptions that an area is not important for cetaceans and therefore they would not be considered during the assessment process. However, there is the possibility that further research could be undertaken to assess the effects of the proposed developments on cetaceans.

Correctly undertaken, the research should highlight any potential impacts which will not only allow appropriate and effective mitigation measures to be undertaken, but also assist with future decision making.

7.3 RECOMMENDATIONS FOR IMPROVEMENTS

Impact assessments are currently geared towards land development. Marine development is very different with wider ranging consequences (such as noise carrying over large distances) with the potential to impact a wide number of species far beyond the zone of development. As a result, cumulative assessments are a critical component of EIAs and much more effort is required to ensure that these are adequate and all associated cumulative impacts are fully explored.

For developments that are being carried out at sea, the EIA process should include effects not just in the area to be developed, but also the potential impacts outside the area, as well as fully assessing cumulative impacts. Taking this into consideration in the early stages of the planning, and at a strategic level can then be used to guide mitigation.

The recent International Whaling Commission (IWC) workshop (IWC, 2012) recommended that impact assessments should be undertaken at two levels; 1 – the local/ regional scale by the developer, 2 – on a wider national/ international scale by the Government/ State. This is particularly important given that cetaceans, and areas critical for their survival, cross borders and cross-boundary impacts need to be considered where appropriate.

7.3.1 DEVELOPERS
There is an urgent need for comprehensive baseline data from which the effects of MREDs on the marine environment can be understood and on which reliable assessments can then be made. In particular data on the noise produced and potential effects on marine species must be improved so that appropriate mitigation procedures can be developed.

Where offshore wind farms are being developed, baseline studies must be undertaken in areas that are critical for cetaceans and surrounding areas due to the distance the noise of pile driving carries. Results need to be compared with other similar sites so that cetaceans are not driven from areas that are critical to their survival. The research needs to be robust and defendable. Analyses of long-term data sets and comparisons between the impact area and reference areas are needed when interpreting the possible effects of offshore wind farms (Lindeboom, 2011).

All developers should collect their own baseline data, using scientists to ensure that the research design is adequate, to confirm that it is up-to-date and answers the appropriate questions for their development and for the region in which they are interested to develop. These surveys should take place well in advance of any proposed development, and last longer than 2 years which only gives a ‘snapshot’ of cetacean populations.

Any data collected through these surveys should be used to inform the project design, rather than a project being designed and then assessed. The data should be made available in a timely fashion to enable this to inform an adaptive approach to management.

Any impact assessment process needs to look at each stage of the process: construction, operation and decommission, rigorously. Pre-construction monitoring is required to establish robust and reliable baseline data, on which the impacts on cetaceans can be accurately assessed and appropriately mitigated. Sound baseline data is highly important to enable accurate assessments of any impacts on cetaceans and facilitate the design of impact assessments.

Monitoring across the life of each project is key to identifying the impacts, and if those predicted to occur did so and to the extent to which they were anticipated. This will increase the knowledge base on the effect of MREDs on the marine environment, and feed into future EIAs enhancing their value and accuracy (Wilson *et al.*, 2010).

7.3.2 GOVERNMENTS
The likely ecological consequences of a marine renewable energy development are going to be strongly affected by its location. For example, if it is being established in an otherwise pristine environment, or one which is regularly used by vulnerable or important wildlife populations, its impacts may be greater than at other locations. Identifying potentially sensitive areas in advance of leasing rounds would avoid this risk. This consideration, combined with the variety of devices now being developed, points to the need for a detailed case-by-case environmental impact assessment.

The SEA that was undertaken in the UK, when Round 3 offshore wind zones were selected, only looked at the Round 3 windfarm sites and did not consider tidal or waves devices, which are still being licensed on an ad hoc basis with no cumulative impact assessment. The government needs to ensure that robust SEAs are undertaken to ensure that areas important for wildlife populations are avoided and take into consideration all MREDs and the potential impacts on cetaceans.

The RSPB suggested to the House of Commons Energy and Climate Committee an approach in which particularly sensitive sites were identified “up-front” through a systematic survey of marine wildlife and were then excluded from further development (under the EU Habitats Directive, marine renewables developments should not cause long-term or irreparable damage to existing sites or species of national or international environmental importance). Then a “deploy and monitor” approach could be used for developments in other areas (House of Commons Energy and Climate Change Committee, 2012). This approach would allow for important areas for marine wildlife to be known, and allow developers to concentrate on areas that can be developed and mitigate any potential effects in these areas.

Decisions regarding MREDs should be based on appropriate populations and/or management units for the relevant marine mammal species, irrespective of national borders (ICES WGMME, 2010). All decisions should be made with a view to the broader environment and should be detailed enough to reflect the level of monitoring required.

8. CONCLUSIONS AND RECOMMENDATIONS

The number of MREDs continues to grow rapidly with a potential of 2335 % increase of sites being constructed in the oceans globally over the next few years. As governments around the world are increasingly investing in marine renewable energy technology to reduce greenhouse gas emissions, the number of sites being submitted and in early planning continues to grow as well.

Offshore wind farms continue to be the favoured method of extracting energy out at sea, accounting for nearly 90 % of all MREDs, with larger turbines being developed to harness more energy.

New wave and tidal energy devices are increasingly being developed and tested to extract energy from the oceans, with a number of testing facilities already in operation particularly around the UK, which is currently the world leader in the development of wave and tidal stream renewable energy generation (The House of Commons Energy and Climate Change Committee, 2012).

These developments have the potential to reduce the effects of climate change on cetaceans. However, currently the impacts of these developments, on both cetaceans and critical habitat for cetaceans, are not well known. As a result, adequate baseline data, extensive planning and precaution must be taken into account when determining where to site these developments, and in understanding and assessing their potential impacts on the cetacean species that may be encountered, displaced or injured.

Potential impacts on cetaceans range from collisions and entanglements to the effects of noise and disturbance, with pile driving being of particular concern due to the noise generated from the scale of development.

As there has been limited research into the impacts on cetaceans, the evidence-base for potential short and long-term impacts is currently poor, in particular for wave and tidal energy devices. As wave and tidal devices are new and there is limited data on the effect on cetaceans, it is difficult to know which locations would be the most sensitive to developments and which might be less affected (House of Commons Energy and Climate Change Committee, 2012).

The House of Commons Energy and Climate Change Committee (2012), strongly states that the development of wave and tidal energy must not happen at the expense of marine biodiversity. Because of the lack of data about marine wildlife in UK waters, it is important that developers ensure all data requirements are met to prevent discovering that an area is environmentally sensitive late in the development process, potentially leading to costly delays or other changes in plans.

MRED designers, developers and the consenting authorities need to consider the potential impacts on cetaceans for the entire life of the development from exploration, through construction and operation to maintenance and decommissioning, during all seasons of the year. The developments should be assessed on a case-by-case basis and require a staged approach with the impacts judged in combination with other renewables and activities of a similar type (oil, gas etc.) in the area to avoid simultaneous developments in an area over many years.

8.1. RECOMMENDATIONS FOR DEVELOPERS

- WDC recommends that until the impacts of MREDs can be fully assessed and found to be benign, further developments within, or that may affect, areas that have already been identified as critical, or in areas of interest for cetaceans are avoided.
- Establishing adequate baseline data, on the use of an area by cetaceans, before planning developments is essential.
- Baseline data on the use of an area by cetaceans must be collected over enough years to account for annual variation in densities of the species most likely to be encountered in the region where a development is planned. These surveys should take place well in advance of any proposed development, and last long enough to understand and assess density changes or other important questions required to monitor impacts to the animals in that area as a result of development.
- The potential impacts of developments on marine wildlife, and prey species, should be taken into account, from the point of conception. These impacts should be implicit in the design rather than further down the developmental line.

- Early and ongoing engagement with stakeholders will minimise misunderstandings and bring key concerns to the fore.
- Any desk-based studies to assess the theoretical impacts of each type of development on protected species, including cetaceans, need to be ground-truthed with real data.
- All surveys should be designed and implemented, using scientists to ensure that the research design is robust, to confirm that it is up-to-date and answers the appropriate questions for their development and for the region in which they are interested in developing.
- Surveys need to cover the distance over which impacts are likely to extend. This may be many tens of km for noise impacts.
- Current research shows that pile driving has the potential to drive harbour porpoises out of a development area, and that the population may not return. In areas known to be important for harbour porpoises, and other coastal species, pile driving should be restricted or even prohibited.
- Effective methods of reducing the noise created during pile driving, by limiting the energy radiated by noise threshold limitations (for example, the use of 'soft-starts', bubble curtains or piling sleeves) need to be developed at a strategic level.
- As pile driving is of particular concern for many cetacean species, alternative foundation types need to be developed.
- Only tested and effective mitigation measures should be relied on to protect marine species.
- There is clearly a requirement for more site specific research on the potential impacts of MREDs, noted in sections 5.1 and 5.2, on harbour porpoises (where there has been limited research) and other cetacean species, their prey and habitats to help mitigate the impacts of MREDS on cetaceans.
- Research on the impacts needs to cover all stages of the lifetime of the MRED to be able to evaluate the impacts on cetaceans, and therefore should run before, during and after construction, during operation, decommissioning as well as years after decommissioning to help assess the impacts on behaviour, intensity and effects of human uses other than offshore wind farm operation.
- Monitoring the effects of a development across the life of each project is key to identifying the impacts, and if those predicted to occur did so and to the extent to which they were anticipated.
- For new devices, extensive research into the impacts on cetaceans needs to be conducted at the testing phase before wide scale deployment. More impacts could arise with the construction of larger turbines, arrays being deployed and new devices being developed.
- For devices that are already operational, or have been approved for use, the impacts on cetaceans and other marine wildlife need to be studied and accurately assessed to allow for any mitigation measures to be identified and implemented.
- As noise is of particular concern, research is required into the noise impacts preconstruction, during construction, during operation and decommissioning as well as years after decommissioning to see the full impacts of MREDs on cetaceans. Focus should cover the effects on migrations and the success of breeding on each species.
- Significantly more research is needed to determine chronic, cumulative and long term effects of impacts, in particular on noise generated. Particular attention should be paid to identifying the range of frequencies utilised by marine mammals and minimising the production noise within this frequency range (Inger *et al.*, 2009).
- Long term effects of MREDs are not yet fully understood. Comprehensive monitoring to detect changes between pre-construction and post-operation stages requires a long term research programme and large coverage to take into account natural variability. This research has a time and effort implication but once sufficient data has been gathered and the impacts of developments are understood, it is likely the size and scope of the research could be reduced.
- Understanding how cetaceans perceive, and interact with wave and tidal energy devices is important to assess the risk of collisions, entanglement and habitat displacement etc. The likely results of encounters between cetaceans and underwater turbines need to be investigated as a priority.
- Strandings surveillance should be undertaken to develop a baseline from which an understanding of any increases or anomalies in strandings rates due to impacts can follow.
- Any data collected through surveys should be made available in a timely fashion to enable an adaptive approach to management.

- Impact assessments need to be accurate and well-informed. The process should include effects not just in the area to be developed, but also the potential impacts outside the area as well as fully assessing cumulative impacts.
- A site specific monitoring plan needs to be a key component of consenting conditions to inform an adaptive approach to management. These should be prepared for every development and informed by those with relevant expertise.

8.2. RECOMMENDATIONS FOR GOVERMENTS

- Comprehensive research needs to be conducted worldwide, to identify areas that are critical to cetaceans including information on population structure, status, distribution, migration routes, feeding and calving grounds. To obtain this data international collaboration will be essential.
- Identifying areas of interest, and critical habitat areas for cetaceans in advance of leasing rounds would avoid the risk of developing MREDs in these potentially sensitive areas, and help ensure that the deployment of marine renewables will not threaten cetaceans.
- Leasing rounds need to avoid areas that are known, or identified as, areas that are important for cetaceans.
- Until data gaps are filled, a precautionary approach is required in decision making.
- In the EU all cetaceans are subject to 'strict protection' under the Habitas Directive which must be clearly reflected in the decision making process.
- There is the need for robust SEAs that are fully informed by comprehensive data.
- Clear guidelines are required for the protection of marine mammals when MREDs are being planned.
- There needs to be early and ongoing engagement with stakeholders to minimise misunderstandings and bring key concerns to the fore.
- To ensure that all relevant stakeholders are included in the consultation process, there needs to be a central register where all interested parties are listed, who are then notified of plans for any marine renewable developments (as currently provided by Marine Scotland).
- Strategic planning is required for MRED's by governments, managers and stakeholders which need to consider the trans-boundary nature of cetaceans (IWC, 2012). Lessons from other activities at sea that impact cetaceans, such as the oil and gas industry, can assist with approaches in MRED development.
- Alternative methods to pile driving need to be developed and implemented as a matter of urgency.
- Until such a time as that alternatives to pile driving or effective quieting techniques are employed, developments should be advanced outside of areas that are important for harbour porpoises and other coastal species – especially where populations are declining.
- There is a requirement for more strategic research on the potential impacts of MREDs, noted in sections 5.1 and 5.2, on harbour porpoises (where there has been limited research) and other cetacean species, their prey and habitats to help mitigate the impacts of MREDS on cetaceans.
- Research on the impacts needs to cover all stages of the lifetime of the MREDs to be able to evaluate their impacts on cetaceans, and therefore should run before, during and after construction, during operation, decommissioning as well as years after decommissioning to help assess the impacts on behaviour, intensity and effects of human uses other than offshore wind farm operation.
- At least until the key potential impacts are fully understood and accounted for, large scale monitoring programmes are required. These monitoring programmes should run before, during and after construction, addressing the amounts and behaviour of vulnerable organisms, along with the intensity and effects of human uses other than MREDs.
- Ensure there is adequate resourcing to strategically monitor long term impacts that may result from development of the MRED industry.
- There is an urgent need for governments to ensure expert advice is undertaken to ensure adequate baseline surveys and impact studies are developed.
- Nations need to coordinate their activities in this field, especially those with shared marine boundaries.
- The sharing of the results of the research into both critical habitat areas for, and the impacts of MREDs on cetaceans, is essential between nations.

- Analyses of long-term data sets and comparisons between the impact area and reference areas are needed when interpreting the possible effects of offshore wind farms (Lindeboom, 2011). To facilitate this, consenting departments of government should implement a system to allow the input, analysis and interpretation for an adaptive approach to be taken to decision making.
- International standards for impact assessments need to be developed, this is particularly important for an industry that is dramatically expanding in some sea areas.
- Only tested and effective mitigation measures should be relied on to protect marine species.
- There is a need for rapid and transparent sharing of information and government guidlines on adaptive management of the marine renewables industry.
- A transparent government strategy is required to ensure that consenting conditions consider and reflect these urgent requirements, including well planned and effective impact monitoring. This is the only way to overcome objections during the public consultation phase, due to lack of existing knowledge.
- Consent should not be given to developments that have not taken into account the impact on marine wildlife.
- Consent should not be given to developments that have been submitted where the type of foundation has not been decided, as the full impacts on the marine environment cannot be known.
- Where management units do not currently exists, the cumulative effects of MREDs need to be considered throughout the range of each species.

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10. Appendix 1 - Offshore wind farms table

Stage of Development	Name of Wind Farm	Location	Country	Year	Developer	No. of Turbines	Energy Capacity (MW)	Foundation Type	Area km^2	Source of Information
Dormant	Durrazzo	5 miles offshore, Adriatic Sea	Albania		Blue H	154	539	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmID=al01
Concept/ Early Planning	Energy Island	Indian Ocean	Australia	2012	Marine Current Turbines	0	60	Floating - Spar		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=AU01
Concept/ Early Planning	Zira Island	South off Baku	Azerbaijan		Avrositi	0		Jacket		http://www.4coffshore.com/windfarms/zira-island-azerbaijan-az01.html
Concept/ Early Planning	Bay of Bengal	Bay of Bengal	Bangladesh			0	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BD01
Operational	Belwind Phase 1		Belgium	2010	Belwind NV	55	165	Grounded (Monopile)	13	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BE03
Approved	Belwind Phase 2		Belgium	2013	Belwind NV	55	165	Grounded (Monopile)	22	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BE08
Approved	Norther		Belgium	2011	SA Norther (Air Energy SA)	60	450		38	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BE04
Approved	Northwind		Belgium	2014	North Wind	72	216			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BE02
Concept/ Early Planning	Rentel		Belgium	2012	Otary PLC	48	288		18	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BE05
Concept/ Early Planning	Seastar - Currently suspended		Belgium	2011	Otary PLC	41	246		16	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BE06
Under Construction	Thornton Bank phase 2		Belgium	2012	C-Power nv	30	185	Grounded (Jacket)	9	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BE09
Under Construction	Thornton Bank phase 3		Belgium	2013	C-Power nv	18	111	Grounded (Jacket)	10	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BE10
Operational	Thorntonbank Phase 1	30 km from Zeebrugge	Belgium	2009	REpower	6	30	Grounded (Gravity Base)	1	http://www.4offshore.com/windfarms/windfarms.aspx?windfarmld+BE01
Approved	THV Mermaid	46km offshore, North Sea	Belgium	2012	THV Mermaid	0	450		28	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BE07
Submitted	Asa Branca 1		Brazil	2010	Asa Branca 1	96	480		179	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR01
Submitted	Asa Branca 10		Brazil	2010	Asa Branca 10	96	480		188	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR10
Submitted	Asa Branca 11		Brazil	2010	Asa Branca 11	96	480		146	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR11
Submitted	Asa Branca 12		Brazil	2010	Asa Branca 12	96	480		150	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR12
Submitted	Asa Branca 13		Brazil	2010	Asa Branca 13	96	480		115	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR13
Submitted	Asa Branca 14		Brazil	2010	Asa Branca 14	96	480		152	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR14
Submitted	Asa Branca 15		Brazil	2010	Asa Branca 15	96	480		116	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR15
Submitted	Asa Branca 16		Brazil	2010	Asa Branca 16	96	480		180	http://www.4coffshore.com/windfarms/

										windfarms.aspx?windfarmId=BR16
Submitted	Asa Branca 17		Brazil	2010	Asa Branca 17	96	480		144	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR17
Submitted	Asa Branca 18		Brazil	2010	Asa Branca 18	96	480		150	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR18
Submitted	Asa Branca 19		Brazil	2010	Asa Brana 19	96	480		142	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR19
Submitted	Asa Branca 2		Brazil	2010	Asa Branca 2	96	480		143	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR02
Submitted	Asa Branca 20		Brazil	2010	Asa Branca 20	96	480		153	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR20
Submitted	Asa Branca 21		Brazil	2010	Asa Branca 21	96	480		226	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR21
Submitted	Asa Branca 22		Brazil	2010	Asa Branca 22	96	480		131	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR22
Submitted	Asa Branca 23		Brazil	2010	Asa Branca 23	96	480		130	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR23
Submitted	Asa Branca 3		Brazil	2010	Asa Branca 3	96	480		144	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR03
Submitted	Asa Branca 4		Brazil	2010	Asa Branca 4	96	480		115	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR04
Submitted	Asa Branca 5		Brazil	2010	Asa Branca 5	96	480		151	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR05
Submitted	Asa Branca 6		Brazil	2010	Asa Branca 6	96	480		120	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR06
Submitted	Asa Branca 7		Brazil	2010	Asa Branca 7	96	480		115	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR07
Submitted	Asa Branca 8		Brazil	2010	Asa Branca 8	96	480		115	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR08
Submitted	Asa Branca 9		Brazil	2010	Asa Branca 9	96	480		137	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=BR09
Approved	NaiKun	Just off coast of Queen Charlottes Island	Canada	2008	Naikun Wind Delvelopment Inc	110	396		98	http://www.4coffshore.com/windfarms/naikun-canada-ca01.html
Approved	Beibu Gulf	Gulf of Tonkin	China		Mingyang (Guandong) WInd Power Industry Group	0	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN83
Approved	Binhai Offshore Concession Project	21km offshore, East China Sea	China	2011	CCC Third Harbor Engineering	100	300		152	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN23
Concept/ Early Planning	Cangnan #1 Offshore Wind Power Project	8km offshore, East China Sea	China	2012	China Datang Corporation	0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0U
Concept/ Early Planning	Cangzhou - Area 1	32.3km offshore, Bohai Sea	China	2012		0	300		69	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1O
Concept/ Early Planning	Cangzhou - Area 2	40.2km offshore, Bohai Sea	China	2012		0	300		75	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1P
Concept/ Early Planning	Cangzhou - Area 3	47.8km offshore, Bohai Sea	China	2012		0	300		69	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1Q
Concept/ Early Planning	Cangzhou - Area 4	24.1km offshore, Bohai Sea	China	2012		0	200		49	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1R

Concept/ Early Planning	Cangzhou - Area 5 (intertidal)	15.5km offshore, Bohai Sea	China	2012		0	300		84	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1S
Concept/ Early Planning	Cangzhou Offshore Wind Farm	Yellow Sea	China	2005	Guohua Energy Investment Co Ltd.	0	1000			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN11
Concept/ Early Planning	Caofeidian Offshore VAWT Windfarm	Yellow Sea	China		Floating Windfarms Corporation	0	450	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN15
Concept/ Early Planning	Changxing Floating Modular Foundation Demo Project	Bohai Bay	China	2012	Shandong Changxing Wind Power Technology	9	18	Floaing - Semi-submersible platform		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN97
Operational	Chenjiagang Xiangshui Project	Located in salt pans	China	2010	Yangtze New Energy Development Co. Ltd	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN50
Approved	China Guangdong Nuclear Power Daishan 4	East China Sea	China	2011	China Guangdong Nuclear Power Group	0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN18
Submitted	China Guangdong Nuclear Power East China Sea	26.5km from shore, East China Sea	China	2009	China Guangdong Nuclear Power Group	117	351		92	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN47
Concept/ Early Planning	Cixi III	East China Sea	China		New Energy Development Co., Ltd	0	95			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN17
Approved	CNOOC Weihai - phase I	Yellow Sea	China	2010	China National Offshore Oil Corp (CNOOC)	34	102			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN04
Approved	CNOOC Weihai - Roncheng - Northern Block	Yellow Sea	China	2011	China National Offshore Oil Corp (CNOOC)	0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN75
Concept/ Early Planning	CNOOC Weihai - Rushan - Southern Block	Yellow Sea	China		China National Offshore Oil Corp	0	700			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN93
Concept/ Early Planning	CNOOC Weihai - Wendeng - Eastern Block	Yellow Sea	China		China National Offshore Oil Corp	0	100			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN92
Submitted	CPI Binhai South offshore wind farm	East China Sea	China		China Power Investment Coporation	0	450			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN53
Concept/ Early Planning	CPI Binhai South offshore wind farm - Pilot	6.7km offshore, East China Sea	China	2012	China Power Investment Coporation	8	48		32	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0L
Approved	CPI Jiangsu Dafeng Demonstration (intertidal)	18.5km offshore, East China Sea	China	2012	China Power Investment Corporation	80	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN88
Submitted	Dacheng Island - Xiamen	Taiwan Strait	China			0	100			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN38
Approved	Dafeng Intertidal Concession Project	East China Sea	China	2010	Nantong Ocean Water Engineering co ltd	0	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN30
Operational	Dafeng Intertidal Demonstration Turbine	East China Sea	China	2009	China Power Internatinal New Energy Holding Ltd.	1	2			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN29
Approved	Dagang Intertidal		China	2010	China Longyuan Power Group Corporation Ltd	0	100			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN87
Submitted	Datang Laizhou Bay	Laizhou Bay	China	2011	China Datang	67	200			http://www.4coffshore.com/windfarms/

	Demonstration Project				Corporation					windfarms.aspx?windfarmId=CN95
Under Construction	Datang Laizhou Wind Farm Phase III	Laizhou Bay	China	2010	China Datang Corporation	33	49.5	Gravity base		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN84
Operational	DDHI Composite Bucket Foundation Test Project	East China Sea	China	2010	DaoDa Heavy Industry Group Co. Ltd	1	2.5	Grounded: bucket		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0J
Operational	Donghai Bridge 100 MW offshore wind power demo	East China Sea	China	2010	Shanghai Donghai Wind ower Generation Company Ltd.	34	102	Gravity base	14	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN01
Under Construction	Donghai Bridge Offshore Wind Farm Phase II	6km from shore, East China Sea	China		Shanghai East China Sea Wind Power Co., Ltd	32	117		31	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN46
Approved	Dongtai wind farm phase 3	East China Sea	China		Shenhua Group Corporation Ltd.	84	302			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN05
Concept/ Early Planning	Dongtai wind farm phase 4	East China Sea	China		Shenhua Group Corporation Ltd.	84	302			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN06
Concept/ Early Planning	Dongtou offshore wind farm	East China Sea	China		Dongtou Development and Reform Bureau	0	100			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN74
Concept/ Early Planning	Fengxian	9km from shore, Hangzho Bay	China			0	100		21	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN43
Concept/ Early Planning	Fengxian Large Scale	6.5km from shore, Hangzho Bay	China			0	300		24	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN44
Concept/ Early Planning	Fuqing Haitan Strait	Haitan Strait	China		Huadian Power International Corporation Limited	0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN40
Approved	Fuqing Haitan Strait Intertidal wind farm	Haitan Strait	China	2010	Huadian Power International Corporation Limited	0	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN39
Concept/ Early Planning	Ganyu - phase 1	8km from shore, East China Sea	China	2009	Renewable Energy Asia Group Ltd	0	400		259	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN55
Concept/ Early Planning	Ganyu - phase 2	East China Sea	China		Renewable Asia Group Ltd	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0C
Concept/ Early Planning	GC China Turbine - Dafeng Offshore Wind Power Proj	East China Sea	China		GC China Turine Corp	0	500			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN03
Concept/ Early Planning	Golden Bay	East China Sea	China			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0Y
Approved	Guangdong Yudean - Xuwen demonstration	12.3km offshore, South China Sea	China	2012	Guandong Yudean Group Co., Ltd	16	48	Monopile	34	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN26
Approved	Guangdong Yudean Zhanjiang Wailuo	South China Sea	China	2012	Guandong Yudean Group Co., Ltd	65	206			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN90
Concept/ Early Planning	Guanyun	15km offshore, East China Sea	China	2009	China Guodian Company	0	800		177	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN56
Approved	Guodian Zhoushan Putuo #6	15km offshore, East China Sea	China	2011	GD Power Development Co., Ltd	0	150			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN41
Concept/ Early Planning	Hainan Floating Wind Farm Demo	South China Sea	China		Floating Windfarms Corporation	40	20			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN16

	Project									
Approved	Hainan Lingao Offshore Pilot project	South China Sea	China	2012	China Datang Corporation	1	6			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0T
Approved	HEC	3.25m from shore, South China Sea	China	2010	The Hong Kong Electrpnic Co., Ltd	35	100		7	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=HK02
Concept/ Early Planning	Hengsha	East China Sea	China			0	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN42
Approved	Hong Kong	11.3km from shore, South China Sea	China	2010	CLP Holdings, Wind Prospect	67	201	Suction	18	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=HK01
Concept/ Early Planning	Huadian and Mingyang	East China Sea	China		Huadian Power International Corporation Limited	66	400			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN81
Concept/ Early Planning	Huadian International Shandong Jimo - Phase 1	East China Sea	China		Huadian Power International Corporation Ltd	0	100			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN89
Concept/ Early Planning	Huadian International Shandong Jimo - Phase 2/3	East China Sea	China		Huadian Power International Corporation Ltd	0	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN96
Approved	Huadian Yuhuan Offshore Wind Farm - Phase 1	East China Sea	China	2011	Huadian Power International Corporation Ltd	0	100			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN66
Concept/ Early Planning	Huadian Yuhuan Offshore Wind Farm - Phase 2	East China Sea	China		Huadian Power International Corporation Ltd	0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN08
Approved	Huaneng Dafeng Intertidal C4 Wind Power Demonstrat	55km from shore, East China Sea	China		Huaneng New Energy Industrial Holdings Ltd	100	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN35
Under Construction	Huaneng Rongcheng Power Project	Yellow Sea	China		Huaneng Renewables Corporation Ltd	3	102			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN28
Operational	Huaneng Rongcheng Power Prototype Demo Project	Yellow Sea	China		Huaneng Renewables Corporation Ltd	2	6	Multipile		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN94
Approved	Jiangsu Dongtai Intertidal Zone Concession Project	22km offshore, East China Sea	China	2010	CCCC Third Harbour Engineering	56	201		123	
Approved	Jiangsu Rudong (Intertidal) Demo - extension	East China Sea	China	2012	China Longyuan Power Group Corporation Limited	0	50			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0P
Operational	Jiangsu Rudong Demonstration Wind Farm - phase I	East China Sea	China	2012	Jiangsu Longyuan	38	99.3	Monopile		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN59
Under Construction	Jiangsu Rudong Demonstration Wind Farm - phase II	East China Sea	China	2012	Jiangsu Longyuan	21	55			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0O
Concept/ Early Planning	Jiaxing #1 Offshore Wind Power Project	Hangzhou Bay	China	2012		0	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1W

Concept/ Early Planning	Jiaxing #2 Offshore Wind Power Project	15km offshore, East China Sea	China		China WindPower	0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN13
Concept/ Early Planning	Jiaxing #3 Offshore Wind Power Project	East China Sea	China	2012	China WindPower	0	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN24
Approved	Kaomen Haitang (also known as Daishan)	East China Sea	China		Zhejiang Green Investment Co., Ltd	100	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN09
Submitted	Laoting Bodhi Island Demonstration	18km offshore, Bohai Sea	China	2010	Loating County's People Government, Hebei Province	100	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN70
Concept/ Early Planning	Laoting Intertidal	Bohai Sea	China		GD Power Co., Ltd	0	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN67
Concept/ Early Planning	Laoting Offshore Development	Bohai Sea	China		GD Power Co., Ltd	0	800			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN69
Approved	Laoting Yuetuo Island Offshore Demonstration	Bohai Sea	China	2012	GD Power Co., Ltd	60	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1X
Submitted	Lianyungang	East China Sea	China			0	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN57
Under Construction	Lingang demonstration project (phase 1)	21.5km from shore, East China Sea	China	2012	Shanghai Lingang Wind Power	17	102		56	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN45
Approved	Linhai Wind Farm	East China Sea	China		New Energy Development Co., Ltd	0	100			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN19
Approved	Long Island County - Phase I	18.7km offshore, Bohai Strait	China	2011	SANRONG	16	48	Various		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN27
Concept/ Early Planning	Long Island County - Phase II	Bohai Strait	China		SANRONG	84	252	Various		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN73
Concept/ Early Planning	Longyuan Putian Nanri Island 350MW Project	Taiwan Strait	China		China Guodian Corporation	0	350			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0W
Approved	Longyuan Putian Nanri Island 50MW Pilot project	Taiwan Strait	China	2012	China Guodian Corporation	0	50			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN99
Operational	Longyuan Rudong Intertidal Trial Wind Farm	3.5km from shore, East China Sea	China	2010	China Longyuan Power Group Corporation Limited	16	32	Piled		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN07
Concept/ Early Planning	Lufeng Lake Bay Wind Farm	East China Sea	China		Lufeng BAOLIHUA New Energy Electric Power CO.,LTD.	0	1250			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN20
Approved	Nan'ao Offshore Wind Demonstration Project	Taiwan Strait	China		GD Power Development Co., Ltd	0	48			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN33
Concept/ Early Planning	Nan'ao VAWT Offshore Wind Project	East China Sea	China	2004	Yixion Renewable Energy	0	20			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN12
Approved	Nantong Haian	East China Sea	China	2011	China WindPower	12	24			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN85
Approved	National Offshore	East China Sea	China		Fujian Mindong Electric	1000	2000			http://www.4coffshore.com/windfarms/

	Demo Ningde Xiapu A-District				Power Co					windfarms.aspx?windfarmId=CN22
Concept/ Early Planning	National Offshore Demonstration Project Ningde	East China Sea	China		China Energine	0	2000			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN22
Concept/ Early Planning	NPC Qidong 200MW offshore wind farm	40km offshore, East China Sea	China	2012	China Guangdong Nuclear Power Group	0	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1U
Concept/ Early Planning	Pingtan Offshore Wind Farm	Taiwan Strait	China			0	1500			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN21
Approved	Putian Pinghai bay demo project phase I	Taiwan Strait	China	2011	Fujian Investment and Development Group Co., Ltd.	0	50			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1Z
Concept/ Early Planning	Quangang Shanyao	South China Sea	China			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN54
Concept/ Early Planning	Quanzhou Bay	South China Sea	China			0	460			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN37
Concept/ Early Planning	Rudong Intertidal Dev Zone - Huaneng and Mingyang	East China Sea	China		China Huaneng Group	50	300		85	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN82
Approved	Rudong Zhong Guang He Demonstration Project	32km offshore, East China Sea	China	2010	China Guandong Nuclear Power Group	0	0			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN61
Under Construction	Rudong Zhongshui (intertidal) 100MW demo phase I	East China Sea	China	2012	China Hydropower Construction Energy Development	10	20			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1T
Approved	Rudong Zhongshui (intertidal) 100MW demo phase II	East China Sea	China		China hydropower construction group	40	80			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN63
Concept/ Early Planning	Shengsi #1 Offshore Wind Power Project	East China Sea	China	2012	Zhejiang Government	0	400			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0R
Concept/ Early Planning	Shengsi #5 Offshore Wind Power Project	25km offshore, East China Sea	China	2012	China Guandiong Nuclear Power Group	50	150			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN72
Concept/ Early Planning	Shengsi #7 Offshore Wind Power Project	30km offshore, East China Sea	China	2012		0	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0Q
Concept/ Early Planning	Sheyang North Area H1#	14.9km offshore, East China Sea	China			0	150		81	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0K
Concept/ Early Planning	Sheyang North Area H2#	32.3km offshore, East China Sea	China			0	300		150	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0M
Concept/ Early Planning	Sheyang North Area H3#	36.1km offshore, East China Sea	China			0			156	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0N
Approved	Sheyang Offshore Concession Project	18km offshore, East China Sea	China	2012	CCCC Third Harbor Engineering	100	300		155	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN31
Operational	Suizhong 36-1 Oil Field	70km offshore, Yellow Sea	China	2007	China National Offshore Oil Corp	1	2	Jacket		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN02
Concept/ Early Planning	Tangshan - Area 1	Bohai Sea	China			0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0Z
Concept/ Early	Tangshan - Area 2	Bohai Sea	China			0	200			http://www.4coffshore.com/windfarms/

Planning										windfarms.aspx?windfarmId=CN1A
Concept/ Early Planning	Tangshan - Area 3	Bohai Sea	China			0	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1B
Concept/ Early Planning	Tangshan - Area 4 - phase I	Bohai Sea	China			0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1C
Concept/ Early Planning	Tangshan - Area 4 - phase II	Bohai Sea	China			0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1D
Concept/ Early Planning	Tangshan - Area 5 - phase I	Bohai Sea	China			0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1E
Concept/ Early Planning	Tangshan - Area 5 - phase II	Bohai Sea	China			0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1F
Concept/ Early Planning	Tangshan - Area 5 - phase III	Bohai Sea	China			0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1G
Concept/ Early Planning	Tangshan - Area 6 - phase I	Bohai Sea	China			0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1H
Concept/ Early Planning	Tangshan - Area 6 - phase II	Bohai Sea	China			0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1I
Concept/ Early Planning	Tangshan - Area 6 - phase III	Bohai Sea	China			0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1J
Concept/ Early Planning	Tangshan - Area 6 - phase IV	Bohai Sea	China			0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1K
Concept/ Early Planning	Tangshan - Area 7(intertidal)	Bohai Sea	China			0	100			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1L
Concept/ Early Planning	Tangshan - Area 8(intertidal)	Bohai Sea	China			0	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1M
Concept/ Early Planning	Tangshan - Area 9(intertidal)	Bohai Sea	China			0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1N
Approved	Tangshan Caofeidian Eco-City Project	Bohai Sea	China			16	48			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN98
Concept/ Early Planning	Tianjin Hangu	Bohai Sea	China		Huadian Power International Corporation Limited	0	20000			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN71
Concept/ Early Planning	Tongzhou	East China Sea	China		Renewable Energy Asia Group Limited	0	100			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0I
Approved	Xiangshan Offshore Demonstration	10.5km offshore, East China Sea	China	2010	China Guodian Corporation, Xiangshan County	0	150			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN64
Operational	Xiangshui Intertidal Pilot Project - SEC2000	3.5km offshore, East China Sea	China	2010	Yangtze New Energy Development Co., Ltd	1	2			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN14
Under Construction	Xiangshui Intertidal Pilot Project - Extension	East China Sea	China	2011	Yangtze New Energy Development Co., Ltd	2	6			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0S
Operational	Xiangshui Intertidal Pilot Project - Goldwind	0.6km offshore, East China Sea	China	2010	Yangtze New Energy Development Co., Ltd	1	3			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN48
Operational	Xiangshui Intertidal Pilot Project - W2000M-93-70	East China Sea	China		Yangtze New Energy Development Co., Ltd	1	2			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN49

Approved	Xiangshui Offshore Demonstation Project	9km offshore, East China Sea	China	2012	Yangtze New Energy Development Co., Ltd	67	200		41	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN51
Concept/ Early Planning	Yangjiang Hailin Island 400MW concession project	South China Sea	China			0	49.5			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0V
Concept/ Early Planning	Zhangpu Liuao demonstration project phase 2	Taiwan Strait	China			0	150			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN0X
Approved	Zhangpu Liuao demonstration project phase 1	12km offshore, Taiwan Strait	China		Datang Zhangzhou Wind Power Co., Ltd	0	50			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN36
Concept/Early Planning	Zhejiang Daishan 2# 200MW demo project	East China Sea	China		Yangtze New Energy Development Co., Ltd	67	201			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN1V
Approved	Zhuhai Guishan Hai Demonstration Project	South China Sea	China	2012	South sea Wind Power Development Co., Ltd.	0	198			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=CN86
Concept/ Early Planning	Adriatico	Adriatic Sea	Croatia			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=HR02
Dormant	Bilice	40km offshore, Adriatic Sea	Croatia		Blue H Technologies BV	128	448	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=HR01
Dormant	Dubrovnik	26km offshore, Adriatic Sea	Croatia		Blue H Technologies BV	112	392	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=HR03
Concept/ Early Planning	Arhus Bugt	7.9km offshore, Kattegat Sea	Denmark	2010	Hawind Arhus Bugt A?S	20	60-120	Monopile or gravity	56	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK70
Under Construction	Anholt	21km offshore, Kattegat	Denmark	2010	DONG Energy/ Energinet.dk	111	400			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK13
Operational	Avedore Holme	Kattegat	Denmark	2009	DONG Energy	3	11	Gravity		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK15
Concept/ Early Planning	DanTysk DK	48km offshore, North Sea	Denmark		GEO mbh	240	1200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK16
Withdrawn/ Rejected	Djursland	20km offshore, Kattegat Sea	Denmark	2012	Danish Energy Agency	0			301	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK59
Operational	Frederikshavn	3.2km offshore, Kattegat	Denmark	2008	DONG Energy	4	10.6	Monopile, Bucket		Offshore Wind Energy www.offshorewindenergy.org
Withdrawn/ Rejected	Gedser Rev	4km offshore, Baltic Sea	Denmark	2002		0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK14
Withdrawn/ Rejected	Grenaa Havn	Kattegat	Denmark		Grenaa Havn A/S	9	18	Monopile		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK02
Withdrawn/ Rejected	Halsnµs	20km offshore, Kattegat Sea	Denmark	2012		0	31.25			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK67
Operational	Horns Rev 1	14-20km offshore from Jutland, North Sea	Denmark	2002	DONG Energy	80	160	Monopile	21	http://www.hornsrev.dk/Engelsk/default_ie.htm
Operational	Horns Rev 2	North Sea	Denmark	2009	DONG Energy	91	209	Monopile	33	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK10
Concept/ Early Planning	Horns Rev 3	20.9km offshore, North Sea	Denmark	2012	Danish Energy Agency	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK19

Withdrawn/ Rejected	Jammerbugt Nord	20km offshore, North Sea	Denmark	2012	Danish Energy Agency	0	31.25			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK57
Withdrawn/ Rejected	Koge Bugt	20km offshore, Baltic Sea	Denmark	2012	Danish Energy Agency	0	31.25		223	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK68
Concept/ Early Planning	Kriegers Flak III	Baltic Sea	Denmark		wpd Offshore GmbH	91	455			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK46
Withdrawn/ Rejected	Laeso	31km offshore, Kattegat	Denmark	2002		0			543	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK17
Withdrawn/ Rejected	Lillegrund	20km offshore, Baltic Sea	Denmark	2012	Danish Energy Agency	0	31.25		172	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK61
Operational	Middelgrunden	2km offshore from Copenhagen	Denmark	2003	DONG Energy	20				http://www.windpower.org/en/pictures/offshore.htm
Approved	NearshoreLAB	7.9km offshore. Kattegat	Denmark	2007	NearshoreLAB A/S	6	36	Various	1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK43
Withdrawn/ Rejected	Nyrup Bugt	20km offshore, Kattegat Sea	Denmark	2012	Danish Energy Agency	0	31.25		130	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK66
Operational	Nysted	10km south of Nysted on Lolland	Denmark	2003	DONG Energy	72	166	Gravity Base	26	http://uk.nystedhavmoellepark.dk/frames.asp
Withdrawn/ Rejected	Omo Stalgrunde	9km offshore, Kattegat	Denmark	2002		96			107	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK18
Operational	Poseidon	Kattegat	Denmark	2010	Foating Power Plant A/S	3	0			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK47
Operational	Rodsand 2	Baltic Sea	Denmark	2010	E.ON Sverige AB	90	207	Gravity Base	33	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK11
Concept/ Early Planning	Ronland II	1.1km offshore, Nissum Bredning	Denmark	2010	Nissum Brednings Vindm°llelaug I/S	10			5	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK44
Concept/ Early Planning	Ronland III	Nissum Bredning	Denmark			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK45
Concept/ Early Planning	Ronne Bakke	Baltic Sea	Denmark		EnergiOst	0	70			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK42
Operational	Ronland	Lim fjord	Denmark	2003		8	17.2			Offshore Wind Energy www.offshorewindenergy.org
Withdrawn/ Rejected	Samso Nord	20km offshore, Kattegat Sea	Denmark	2012	Danish Energy Agency	0	31.25		58	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK60
Operational	Samso	3.5km south of the island Samso	Denmark	2003	Locally owned	10	23			http://www.samsohavvind.dk/windfarm/
Operational	Sprogo	9.3km offshore, Kattegat	Denmark	2009	Sund & Baelt Holding A/S	7	21	Gravity Base	0	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK12
Operational	Tuno Knob	Inland Sea 6km offshore, Kattegat	Denmark	1995	DONG Energy	10	5	Gravity Base	0	Offshore Wind Energy www.offshorewindenergy.org
Withdrawn/ Rejected	Vejsnµs	20km offshore, Baltic Sea	Denmark	2012	Danish Energy Agency	0	31.25		42	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DK62
Operational	Vindeby	1.5km offshore, Kattegat	Denmark	1991	SEAS-NVE Energy Group	11	5	Gravity base	0	Offshore Wind Energy www.offshorewindenergy.org
Concept/ Early Planning	Atlantic Array Phase One	12 miles offshore Ilfracombe, Bristol Channel	England	2010	RWE Npower Renewables	139	500		417	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK42
Concept/ Early Planning	Atlantic Array Phase Three	12 miles offshore Ilfracombe, Bristol	England	2010	RWE Npower Renewables	139	500		417	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK1M

		Channel								
Concept/ Early Planning	Atlantic Array Phase Two	12 miles offshore Ilfracombe, Bristol Channel	England	2010	RWE Npower Renewables	139	500		417	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK1L
Operational	Barrow	7km Walney Island	England	2006	Barrow Offshore Wind Limited	30	90	Monopile	10	BWEA website www.bwwa.com/ukwed/operational.asp
Operational	Blyth Harbour		England	1993	AMEC Wind	2	4	Monopile		www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK45
Submitted	Blyth/ NaREC Offshore Wind Demonstration site	9.4km offshore, North Sea	England		NAREC	15	99.9	Various		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK70
Withdrawn/ Rejected	Britannia 10MW Turbine Project	North Sea	England	2011	Clipper Windpower Marine Ltd	1	10			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK83
Operational	Burbo Bank	5.2km Crosby	England	2007	DONG Energy	25	90	Monopile	10	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK02
Concept/ Early Planning	Burbo Bank Extension	11.5km offshore, Irish Sea	England		DONG Wind Energy Ltd	0	234		40	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK59
Withdrawn/ Rejected	Cirrus Array (Shell Flats)	7km Cleveleys	England	2008	Celt Power/ DONG Energy/ Shell Wind Energy	90	270		28	BWEA website www.bwea.com/ukwed/planning.asp
Withdrawn/ Rejected	Cromer	7km Cromer	England		EdF	30	108	Monopile	10	BWEA www.bwea.com/ukwed/offshore.asp
Withdrawn/ Rejected	Docking Shoal	Greater Wash	England	2012	Centrica Renewable Energy Ltd	177	540		75	BWEA website www.bwea.com/ukwed/planning.asp
Concept/ Early Planning	Dogger Bank Creyke Beck (Tranche A Project 1)	197km offshore, North Sea	England	2008	Forewind	0	1000			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK80
Concept/ Early Planning	Dogger Bank Creyke Beck (Tranche A Project 2)	North Sea	England		Forewind	333	1000		1937	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK79
Concept/ Early Planning	Dogger Bank Teesside (Tranche B Project 1)	North Sea	England	2008	Forewind	400	1200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK1F
Concept/ Early Planning	Dogger Bank Teesside (Tranche B Project 2)	North Sea	England	2008	Forewind	400	1200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK1G
Concept/ Early Planning	Dogger Bank Teesside (Tranche B Project 3)	North Sea	England	2008	Forewind	400	1200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK1H
Concept/ Early Planning	Dogger Bank Teesside (Tranche B Project 4)	North Sea	England	2008	Forewind	400	1200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK1I
Concept/ Early Planning	Dogger Bank Tranche A	197km offshore, North Sea	England	2008	Forewind	0			1937	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK79
Concept/ Early Planning	Dogger Bank Tranche B	197km offshore, North Sea	England	2011	Forewind	0			1441	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK0W
Concept/ Early Planning	Dogger Bank Tranche C	197km offshore, North Sea	England	2010	Forewind	0	1500		5162	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK0X
Concept/ Early	Dogger Bank	197km offshore,	England	2010	Forewind	0	1500		5162	http://www.4coffshore.com/windfarms/

Planning	Tranche D	North Sea								windfarms.aspx?windfarmId=UK43
Approved	Dudgeon	32 km north of Norfolk, Greater Wash	England	2012	Dudgeon Offshore Wind Ltd	168	560		35	BWEA website www.bwea.com/ukwed/offshore.asp
Concept/ Early Planning	East Anglia Five	54.4km offshore, North Sea	England		East Anglia Offshore Wind Ltd	0	1200		5567	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK68
Concept/ Early Planning	East Anglia Four	54.4km offshore, North Sea	England		East Anglia Offshore Wind Ltd	0	1200		5567	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK67
Concept/ Early Planning	East Anglia One	43.4km offshore, North Sea	England	2010	East Anglia Offshore Wind Ltd	325	1200		297	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK64
Concept/ Early Planning	East Anglia Six	54.4km offshore, North Sea	England		East Anglia Offshore Wind Ltd	0	1200		5567	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK69
Concept/ Early Planning	East Anglia Three	54.4km offshore, North Sea	England		East Anglia Offshore Wind Ltd	0	1200		5567	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK66
Concept/ Early Planning	East Anglia Two	54.4km offshore, North Sea	England	2008	East Anglia Offshore Wind Ltd	0	1200		5567	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK39
Concept/ Early Planning	Galloper Wind Farm	38.6km offshore, North Sea	England		RWE Renewables, SSE Renewables	140	504		175	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK62
Under Construction	Greater Gabbard	36km offshore, Thames	England	2010	SSE Renewables, RWE Npower Renewables	140	504	Monopile	146	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK05
Operational	Gunfleet Sands I	7km Clacton-on-Sea	England	2009	DONG Energy	30	108			BWEA website www.bwea.com/ukwed/construction.asp
Operational	Gunfleet Sands II	8.5km off Clacton-on-Sea	England	2009	DONG Energy	18	64			BWEA website www.bwea.com/ukwed/construction.asp
Under Construction	Gwynt y Mor	Liverpool Bay (13-15km offshore)	England	2012	npower renewables	200	750	Monopile	80	BWEA website www.bwea.com/ukwed/consented.asp
Concept/ Early Planning	Hornsea Heron Wind	103km offshore, North Sea	England		Heron Wind Limited	166	600			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK81
Concept/ Early Planning	Hornsea Njord	103km offshore, North Sea	England		Njord Limited	166	500		4075	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK82
Concept/ Early Planning	Hornsea Project Four	99.5km offshore, North Sea	England		SMart Wind Limited	223	1000		4075	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK1K
Concept/ Early Planning	Hornsea Project Three	99.5km offshore, North Sea	England		SMart Wind Limited	223	1000		4075	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK1J
Concept/ Early Planning	Hornsea Project Two	99.5km offshore, North Sea	England	2010	SMart Wind Limited	223	1000		540	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK37
Approved	Humber Gateway	8km offshore, Humberside	England	2011	E.ON UK Renewables	77	230		35	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK10
Operational	Inner Dowsing	5.2km Ingoldmells	England	2009	Centrica Renewable Energy Ltd	27	97	Monopile	10	BWEA website www.bwea.com/ukwed/operational.asp
Operational	Kentish Flats	8.5km offshore, North Sea	England	2005	Vattenfall	30	90	Monopile	10	http://www.bwea.com/ukwed/operational.asp
Submitted	Kentish Flats Extension	8.9km offshore, North Sea	England	2011	Vattenfall Europe Windkraft GmbH	17	51		8	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK60
Under Construction	Lincs	8km off Skegness	England	2011	Centrica Renewable Energy Ltd	75	270	Monopile	41	BWEA website www.bwea.com/ukwed/consented.asp
Under Construction	London Array Phase 1	24km off Clacton-on-Sea, North Sea	England	2011	DONG Energy/ Shell Wind Energy/ E.On Renewables	175	630	Monopile	121	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK14

Approved	London Array Phase 2	Thames, North Sea	England	2012	London Array Ltd	166	370	Monopile		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK78
Operational	Lynn	5.2km Skegness	England	2009	Centrica Renewable Energy Ltd	27	97	Monopile	10	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK15
Concept/ Early Planning	Navitus Bay Wind Park	21.4km2, English Channel	England		Eneco	240	1200	Monopile, gravity base, or hybrid	199	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK41
Concept/ Early Planning	NOVA (Novel Offshore Vertical Axis) Project	North Sea	England		Various	100	1000			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK72
Concept/ Early Planning	NOVA Project Demonstrator	North Sea	England			1	10			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK71
Operational	Ormonde	9.5km offshore, Walney Island	England	2012	Vattenfall Europe Windkraft	30	150	Jacket	10	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK17
Approved	Race Bank	27km from North Norfolk coast	England	2012	Centrica Renewable Energy Ltd	88	580		74	http://www.bwea.com/ukwed/offshore.asp
Concept/ Early Planning	Rampion	19.8km offshore, English Channel	England		E.ON Climate and Renewables UK	195	700		168	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK36
Operational	Scroby Sands	3km NE Great Yarmouth	England	2004	E.ON UK Renewables	30	60	Monopile	4	http://www.bwea.com/ukwed/offshore.asp
Under Construction	Sheringham Shoal	Sheringham, Greater Wash	England	2010	Scira Offshore Energy Ltd	88	315	Monopile	35	BWEA website www.bwea.com/ukwed/consented.asp
Under Construction	Teeside/Redcar	1.5km NE Teesmouth	England	2012	EDF Energy	27	62.1	Monopile	10	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK28
Operational	Thanet	11-13km Foreness Point, Margate	England	2010	Warwick Energy	100	300			http://www.bwea.com/ukwed/operational.asp
Withdrawn/ Rejected	Thanet 2		England	2010	Vattenfall	0	147		20	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK61
Submitted	Triton Knoll Phase One	33km off the Lincolnshire Coast	England	2009	npower renewables	111	400		134	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK30
Submitted	Triton Knoll Phase Three	33km offshore, North Sea	England		RWE NPower Renewables	118	400		134	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK1P
Submitted	Triton Knoll Phase Two	33km offshore, North Sea	England		Triton Knoll Offshore Wind Farm Ltd	111	400		134	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK1N
Concept/ Early Planning	Walney Extension	19km offshore, Irish Sea	England	2011	DONG Energy	209	750		149	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK63
Operational	Walney Phase 1	14km Walney Island, Irish Sea	England	2011	DONG Energy	51	183.6	Monopile	28	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK31
Operational	Walney Phase 2	14km offshore, Irish Sea	England	2012	Walney (UK) Offshore WInd Farms Limited	51	183.6	Monopile	45	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK32
Approved	West of Duddon Sands	N. Irish Sea	England	2008	DONG Energy/ E.ON UK/ Eurus	0	500			BWEA website www.bwea.com/ukwed/consented.asp
Approved	Westernmost Rough	8km offshore, 25 km north of Spurn Head	England	2009	DONG Energy	80	240		35	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK34
Approved	Hiiumaa	15kn offshore Baltic Sea	Estonia		Hiiumaa Offshore Tuulepark	200	700		155	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=EE01
Submitted	Kihnu South	9km offshore, Gulf of Riga	Estonia	2011	Eesti Energia AS	0	560		60	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=EE04
Submitted	Kihnu SouthWest	12km offshore,	Estonia		Eesti Energia AS	0	245		41	http://www.4coffshore.com/windfarms/

		Gulf of Riga								windfarms.aspx?windfarmId=EE05
Submitted	Neugrund	3km offshore, Gulf of Finland	Estonia	2010	OU Neugrund	38	190		13	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=EE03
Submitted	Inkoon-Raaseporin	13km offshore, Gulf of Finland	Finland	2006	Suomen merituuli OY	60	180-300		62	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI12
Operational	Kemi Ajos I	2.6km offshore, Gulf of Bothnia	Finland	2007	PV-Innopwer Oy	5	15	Gravity Base	1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI01
Operational	Kemi Ajos II	2.6km offshore, Gulf of Bothnia	Finland	2008	PV-Innopwer Oy	5	15	Gravity Base	2	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI17
Concept/ Early Planning	Kemi Ajos III	Gulf of Bothnia	Finland		PV-Innopwer Oy	34	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI14
Approved	Kemi Ajos Test Turbine	Gulf of Bothnia	Finland	2012	PVO-Innopower Oy	1	3			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI19
Concept/ Early Planning	Korsnas	1.5km offshore, Gulf of Bothnia	Finland	2008	wpd Finland OY	160	800		179	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI06
Approved	Kristinestad	2.2km offshore, Gulf of Bothnia	Finland		PVO-Innopower OY	75	365		47	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI04
Withdrawn/ Rejected	Maakrunnin	Gulf of Bothnia	Finland	2010	Fortum Oyj	130	390			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI10
Concept/ Early Planning	Ostra Skargarden	Baltic Sea	Finland		Leovind Ab	40	120			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI18
Submitted	Oulun-Haukiputaan alue 1	5km offshore, Gulf of Bothnia	Finland	2008	PV-Innopwer Oy	32	150		13	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI16
Submitted	Oulun-Haukiputaan alue 2	5km offshore, Gulf of Bothnia	Finland	2008	PVO-Innopower OY	130	650		52	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI08
Concept/ Early Planning	Oulunsalo-Hailuoto	1km offshore, Gulf of Bothnia	Finland	2008	Lumituuli OY	75	225		61	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI15
Withdrawn/ Rejected	Pitkōmatalaan	Gulf of Bothnia	Finland	2010	Fortum Oyj	300	900			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI07
Operational	Pori 1	6.6km offshore, Gulf of Bothnia	Finland	2010	Suomen Hyotutuuli Oy	1	2	Steel shell gravity	2	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI02
Submitted	Pori 2	6.1km offshore, Gulf of Bothnia	Finland		Suomen Hyotutuuli Oy	30	90		9	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI03
Concept/ Early Planning	Raahe-Maanahkiaisen	5km offshore, Gulf of Bothnia	Finland		Rajakiiri OY	100	500		145	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI09
Concept/ Early Planning	Raahe-Pertunmatala	Gulf of Bothnia	Finland		Suomen Hyotytuuli Oy	24	24			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI20
Concept/ Early Planning	Raahe-Ulkonahkiainen	20km offshore, Gulf of Bothnia	Finland		Suomen Hyotytuuli Oy	70	140 - 210			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI21
Submitted	Siipyyn	7km offshore, Gulf of Bothnia	Finland	2010	Suomen merituuli OY	80	400		53	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI11
Approved	Suurhiekka	5.9km offshore, Gulf of Bothnia	Finland	2011	Suurhiekka Offhsore OY	80	600		162	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI05
Submitted	Tornio	5km offshore, Gulf of Bothnia	Finland	2011	Rajakiiri OY	45	225		17	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FI13
Concept/ Early Planning	3B	English Channel	France	2011	Nass&Wind Offshore	42	210			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR31
Dormant	Baie de Seine	10km offshore, English Channel	France	2009	Poweo	50	300		30	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR24

Dormant	Banc de GuÚrande	12km offshore, Atlantic Ocean	France		Nass&Wind Offshore	80	400			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR19
Dormant	Bassure de Baas	15km offshore, English Channel	France		Vent d'Ouest	35	210			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR41
Dormant	Boulogne	English Channel	France		InnoVent GmbH	4				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR29
Dormant	Brianna	19km offshore, Bay of Biscay	France		Blue H France SAS	0		Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR23
Dormant	C¶tes d'Armor	English Channel	France		Vent d'Ouest	72	430			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR42
Dormant	Calvados	11km offshore, English Channel	France	2009	wpd Offshore France SAS	50	250	Gravity Base	32	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR11
Concept/ Early Planning	Cherbourg	English Channel	France		ENERTRAG France	80	400			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR28
Approved	Cote d'Albatre	6km offshore, English Channel	France	2008	ENERTRAG France	21	105		12	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR01
Concept/ Early Planning	Cote d'Albatre II	English Channel	France		ENERTRAG France	80	400			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR27
Concept/ Early Planning	Courseulles-Sur-Mer	10km offshore, English Channel	France	2012	Eolien Maritime France	75	450	Monopile	78	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR35
Concept/ Early Planning	D' Aise	Atlantic Ocean	France		Nass&Wind Offshore	20	100			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR25
Concept/ Early Planning	Des Minquiers	20km offshore, English Channel	France		Nass&Wind Offshore	40	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR26
Withdrawn/ Rejected	Deux Cotes	14km offshore, English Channel	France		GDF SUEZ	140	700	Monoplie	86	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR02
Dormant	DIWET Deepwater Innovative Wind Energy Technology	Atlantic Ocean	France	2008	Astrium SAS	1	4	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR06
Dormant	Elodie	17km offshore, Mediterranean Sea	France		Blue H France SAS	90	315	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR21
Withdrawn/ Rejected	Fecamp GDF Suez	English Channel	France		Maia EilMer	60	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR38
Dormant	Fecamp WPD	13km offshore, English Channel	France		wpd Offshore France SAS	60	500			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR12
Concept/ Early Planning	FÚcamp	13km offshore, English Channel	France	2012	Eolien Maritime France	83	498	Gravity base	88	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR34
Withdrawn/ Rejected	Grand LÚjon û Baie de Saint-Brieuc	11km offshore, English Channel	France	2012	Nass&Wind Offshore	40	500			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR09
Withdrawn/ Rejected	Gruissan Port La Nouvelle	Mediterranean Sea	France		JMB Energie	25	150			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR15
Concept/ Early Planning	Haute Normandie	10km offshore, English Channel	France		Nass&Wind Offshore	56	280			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR30
Withdrawn/ Rejected	Havre-Antifer	English Channel	France		Vent d'Ouest	12				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR39
Dormant	Helene	18km offshore, Bay of Biscay	France		Blue H France SAS	90	315	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR22
Concept/ Early Planning	INFLOW	Mediterranean	France	2012		0	2	Floating: Tension Leg Platform		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR44

Dormant	Banc de GuÚrande	12km offshore, Atlantic Ocean	France		Nass&Wind Offshore	80	400			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR19
Dormant	Bassure de Baas	15km offshore, English Channel	France		Vent d'Ouest	35	210			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR41
Dormant	Boulogne	English Channel	France		InnoVent GmbH	4				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR29
Dormant	Brianna	19km offshore, Bay of Biscay	France		Blue H France SAS	0		Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR23
Dormant	C¶tes d'Armor	English Channel	France		Vent d'Ouest	72	430			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR42
Dormant	Calvados	11km offshore, English Channel	France	2009	wpd Offshore France SAS	50	250	Gravity Base	32	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR11
Concept/ Early Planning	Cherbourg	English Channel	France		ENERTRAG France	80	400			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR28
Approved	Cote d'Albatre	6km offshore, English Channel	France	2008	ENERTRAG France	21	105		12	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR01
Concept/ Early Planning	Cote d'Albatre II	English Channel	France		ENERTRAG France	80	400			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR27
Concept/ Early Planning	Courseulles-Sur-Mer	10km offshore, English Channel	France	2012	Eolien Maritime France	75	450	Monopile	78	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR35
Concept/ Early Planning	D' Aise	Atlantic Ocean	France		Nass&Wind Offshore	20	100			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR25
Concept/ Early Planning	Des Minquiers	20km offshore, English Channel	France		Nass&Wind Offshore	40	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR26
Withdrawn/ Rejected	Deux Cotes	14km offshore, English Channel	France		GDF SUEZ	140	700	Monoplie	86	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR02
Dormant	DIWET Deepwater Innovative Wind Energy Technology	Atlantic Ocean	France	2008	Astrium SAS	1	4	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR06
Dormant	Elodie	17km offshore, Mediterranean Sea	France		Blue H France SAS	90	315	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR21
Withdrawn/ Rejected	Fecamp GDF Suez	English Channel	France		Maia EilMer	60	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR38
Dormant	Fecamp WPD	13km offshore, English Channel	France		wpd Offshore France SAS	60	500			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR12
Concept/ Early Planning	FÚcamp	13km offshore, English Channel	France	2012	Eolien Maritime France	83	498	Gravity base	88	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR34
Withdrawn/ Rejected	Grand LÚjon û Baie de Saint-Brieuc	11km offshore, English Channel	France	2012	Nass&Wind Offshore	40	500			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR09
Withdrawn/ Rejected	Gruissan Port La Nouvelle	Mediterranean Sea	France		JMB Energie	25	150			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR15
Concept/ Early Planning	Haute Normandie	10km offshore, English Channel	France		Nass&Wind Offshore	56	280			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR30
Withdrawn/ Rejected	Havre-Antifer	English Channel	France		Vent d'Ouest	12				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR39
Dormant	Helene	18km offshore, Bay of Biscay	France		Blue H France SAS	90	315	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR22
Concept/ Early Planning	INFLOW	Mediterranean	France	2012		0	2	Floating: Tension Leg Platform		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=FR44

Submitted	Arcadis Ost 1	17km offshore, Baltic Sea	Germany		Arcadis Consult GmbH	70	350		35	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE51
Submitted	AreaC I	66km offshore, North Sea	Germany		FC Wind Energy GmbH	80	400		61	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE80
Submitted	AreaC II	66km offshore, North Sea	Germany		FC Wind Energy GmbH	80	400		71	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE81
Submitted	AreaC III	66km offshore, North Sea	Germany		FC Wind Energy GmbH	80	400		73	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE82
Approved	Arkona-Becken Sudost	35km offshore, Baltic Sea	Germany	2006	AWE-Arkona-Windpark Enwicklungs	80	400		39	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE46
Concept/ Early Planning	ArkonaSee Ost	39.8km offshore, Baltic Sea	Germany		ArkonaSee Ost GmbH	0			5	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE48
Submitted	ArkonaSee Sud	26.4km offshore, Baltic Sea	Germany		ArkonaSee Sud GmbH	80			17	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE49
Concept/ Early Planning	ArkonaSee West	25.7km offshore, Baltic Sea	Germany		ArkonaSee West GmbH	0			18	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE50
Submitted	Austerngrund	128.5km offshore, North Sea	Germany		Global Wind Support GmbH	80	520	Tripile	61	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE25
Submitted	BalticEagle	30km offshore, Baltic Sea	Germany		FC Wind Energy GmbH	80	480		50	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE83
Submitted	BalticPower	33.4km offshore, Baltic Sea	Germany		FC Wind Energy GmbH	80	480		38	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE90
Under Construction	Bard Offshore 1	100 km north of the isle Borkum	Germany	2009	Bard Engineering GmbH	80	400	Tripile	59	http://www.bard-offshore.de/proj_bard_offshore_1-e
Submitted	Beltsee	9km offshore, Baltic Sea	Germany		PNE WIND AG	25	125		28	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE41
Submitted	Bernstein	90km offshore, North Sea	Germany		BARD Building Management GmbH	80	520		58	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE67
Submitted	Beta Baltic (Sky 2000)	15.8km offshore, Baltic Sea	Germany		Offshore-Windpark Beta Baltic GmbH	50	150		12	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE79
Submitted	Bight Power I	74km offshore, North Sea	Germany		FC Wind Energy GmbH	80	400		57	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE87
Submitted	Bight Power II	74km offshore, North Sea	Germany		Offshore Wind Energy GmbH	80	400		61	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE88
Under Construction	Borkum Phase 1	45km offshore, North Sea	Germany	2012	Trianel Windkraftwerk Borkum GmbH & Co KG	40	200	Tripod	23	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE27
Approved	Borkum Phase 2	45km offshore, North Sea	Germany	2008	Trianel Windkraftwerk Borkum GmbH & Co KG	40	200	Tripod	33	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0K
Approved	Borkum Riffgrund I	54km offshore, North Sea	Germany	2004	PNE2 Riff 1	77	277.2	Monopile	36	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE04
Approved	Borkum Riffgrund II	57km offshore, North Sea	Germany	2011	PNE2 Riff 2	97	349	Monopile	45	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE30
Approved	Borkum Riffgrund West	67km ofshore, North Sea	Germany	2004	Energieknotor AG	80	400	Jacket	30	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE03
Submitted	Borkum Riffgrund West II	67km offshore, North Sea	Germany		Energieknotor AG	43	215	Tripod or Jacket	35	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE32
Operational	Brietling	500m offshore,	Germany	2006	Nordex Energy AG	1	3	Gravity Base		Offshore Wind Energy

		North Sea								www.offshorewindenergy.org
Approved	Butendiek	54km offshore, North Sea	Germany	2002	Butendiek Offshore Windpark Holding GmbH	80	288	Monopile	33	http://www.offshore-wind.de/page/index.php?id=4761
Submitted	Citrin	111km offshore, North Sea	Germany		BARD Service GmbH	80	520		58	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE68
Approved	Dan Tysk	70km offshore, North Sea	Germany	2005	Dank Tysk Offshore Wind GmbH	80	288		66	http://www.offshore-wind.de/page/index.php?id=4761
Approved	Delta Nordsee 1	50km offshore, North Sea	Germany	2005	Offshore Wind Park Delta Nordsee GmbH	48	240	Monopile or tripod	17	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE10
Approved	Delta Nordsee 2	51km offshore, North Sea	Germany	2009	Offshore Wind Park Delta Nordsee GmbH	32	160	Monopile or tripod	10	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE29
Approved	Demonstrationsprojekt Albatros I	North Sea	Germany	2012	Windkraft FiT GmbH	10	50	Gravity base	3	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1S
Approved	Deutsche Bucht	98km offshore, North Sea	Germany	2010	FC Windenergy GmbH	42	210	Tripile	23	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE24
Submitted	Diamant	111km offshore, North Sea	Germany		BARD Holding GmbH	160	1040		105	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE73
Operational	EnBW Baltic 1	16km offshore, Baltic Sea	Germany	2011	EnBW Baltic 1 GmbH	21	48.3	Monopile	7	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE78
Approved	EnBW Baltic 2	32km offshore, Baltic Sea	Germany		EnBW Baltic 2 GmbH	80	288	Monopile and Jacket	30	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE52
Approved	EnBW He Dreiht	97km offhshore, North Sea	Germany	2010	EnBE Nordsee Offhsore GmbH	119	595		62	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE19
Approved	EnBW Hohe See	100km ofshore, North Sea	Germany	2006	EnBE Nordsee Offhsore GmbH	80	400		42	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE11
Concept/ Early Planning	ENOVA Offshore NSWP 10	North Sea	Germany		ENOVA Energieanlagen GmbH	0			83	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0U
Concept/ Early Planning	ENOVA Offshore NSWP 11	North Sea	Germany		ENOVA Energieanlagen GmbH	0			74	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0V
Concept/ Early Planning	ENOVA Offshore NSWP 12	North Sea	Germany		ENOVA Energieanlagen GmbH	0			73	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1H
Concept/ Early Planning	ENOVA Offshore NSWP 13	North Sea	Germany		ENOVA Energieanlagen GmbH	0			74	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1I
Concept/ Early Planning	ENOVA Offshore NSWP 14	North Sea	Germany		ENOVA Energieanlagen GmbH	0			59	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0X
Concept/ Early Planning	ENOVA Offshore NSWP 15	North Sea	Germany		ENOVA Energieanlagen GmbH	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0W
Concept/ Early Planning	ENOVA Offshore NSWP 8	North Sea	Germany		ENOVA Energieanlagen GmbH	0			71	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1K
Concept/ Early Planning	ENOVA Offshore NSWP 9	North Sea	Germany		ENOVA Energieanlagen GmbH	0			68	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1J
Operational	ENOVA Offshore Project Ems-Emden	40m offshore, North Sea	Germany	2004	ENOVA Energieanlagen GmbH	1	4.5	Monopile	0	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE77
Submitted	Euklas	143km offshore, North Sea	Germany	2009	Bard Foundation GmbH	160	1040		120	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE94
Concept/ Early Planning	Fairwind	Baltic Sea	Germany			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0R
Submitted	GAIA I	84km offshore,	Germany		Northern Energy GAIA	80	400		48	http://www.4coffshore.com/windfarms/

		North Sea			1 GmbH					windfarms.aspx?windfarmId=DE75
Submitted	GAIA II	76km offshore, North Sea	Germany		Northern Energy GAIA II GmbH	40	200		19	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE57
Submitted	GAIA III	67km offshore, North Sea	Germany		STRABAG SE, Northern Energy GAIA III	80	400		61	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE58
Submitted	GAIA IV	62km offshore, North Sea	Germany		Northern Energy GAIA IV GmbH	68	340		36	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE59
Submitted	GAIA V	60km offshore, North Sea	Germany		Northern Energy GAIA V GmbH	80	400		47	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE60
Concept/ Early Planning	Gannet	86km offshore, North Sea	Germany		OWP Gannet GmbH	80	400		66	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0G
Dormant	GEOFReE	19km offshore, Baltic Sea	Germany		GEO mbh	5	25		1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE40
Concept/ Early Planning	GICON Floating Offshore Foundation (FOF) Pilot	3.6km offshore, Baltic Sea	Germany		Grossmann Ingenieur Consult (GICON) GmbH	0	2	Tension Leg Platform		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1M
Under Construction	Global Tech I	115km offshore, North Sea	Germany	2012	Global Tech I Offshore Wind GmbH	80	400	Tripod	43	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE09
Submitted	Global Tech II	70km offshore, North Sea	Germany		Northern Energy Global Tech II GmbH	76	380		35	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE64
Submitted	Global Tech III	70km offshore, North Sea	Germany		Northern Energy Global Tech III GmbH	21	105		13	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE65
Approved	Gode Wind I	40km offshore, North Sea	Germany	2006	PNE WIND AG	77	231	Monopile	42	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE13
Approved	Gode Wind II	40km offshore, North Sea	Germany	2009	PNE WIND AG	84	252	Monopile	66	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE34
Submitted	Gode Wind III	39km offshore, North Sea	Germany		DONG Energy	15	105	Tripod	12	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0H
Submitted	H2-20	290km offshore, North Sea	Germany		GEO mbh	80	400		121	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE22
Submitted	He dreiht II	46km offshore, North Sea	Germany		EOS Offshore Ltd	28	140		15	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE63
Concept/ Early Planning	Heron	84km offshore, North Sea	Germany		OWP Gannet GmbH i.G.	80	400		64	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0F
Submitted	Hochsee testfeld Helgoland	47.6km offshore, North Sea	Germany		Hochsee testfeld Helgoland GmbH	19	95	Monopile or Tripod	5	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE33
Operational	Hooksiel	0.4km offshore, North Sea	Germany	2008	BARD Engineering GmbH	1	5	Tripile		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE76
Submitted	Horizont I	125km offshore, North Sea	Germany		Mainstream Renewable Power	65	325		57	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE55
Submitted	Horizont II	121km offshore, North Sea	Germany		Mainstream Renewable Power	76	380		67	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE56
Submitted	Horizont III	131km offshore, North Sea	Germany		Mainstream Renewable Power	71	355		64	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE54
Submitted	HTOD 1	205km offshore, North Sea	Germany		Hochtief Offshore Development Eins GmbH	81	486		75	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE95
Submitted	HTOD 2	158km offshore,	Germany	2010	Hochtief Offshore	85	510		74	http://www.4coffshore.com/windfarms/

		North Sea			Development Eins GmbH					windfarms.aspx?windfarmId=DE97
Submitted	HTOD 3	190km offshore, North Sea	Germany	2010	Hochtief Offshore Development Eins GmbH	84	504		74	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE98
Submitted	HTOD 4	158km offshore, North Sea	Germany		Hochtief Offshore Development Eins GmbH	95	570		87	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE96
Concept/ Early Planning	HTOD 5	170km offshore, North Sea	Germany		Hochtief Offshore Development Vier GmbH	80	560		49	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1L
Concept/ Early Planning	HTOD 6	188km offshore, North Sea	Germany		Hochtief Offshore Development Vier GmbH	64	384		55	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1G
Approved	Innogy Nordsee 1	47.3km offshore, North Sea	Germany	2012	RWE Innogy GmbH	54	332	Jacket	33	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE28
Submitted	Innogy Nordsee 2	47.3km offshore, North Sea	Germany		RWE AG	54	332		53	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0N
Submitted	Innogy Nordsee 3	47.3km offshore, North Sea	Germany		RWE AG	54	332		46	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0O
Submitted	Jules Verne	174km offshore, North Sea	Germany	2010	PNE Wind Jules Verne GmbH	160	480		133	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0C
Submitted	Kaikas	110km offshore, North Sea	Germany		EOS Offshore Ltd	83	415		62	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE74
Submitted	KASKASI	35km offshore, North Sea	Germany		RWE Innogy GmbH	40	320	Monopile or Tripod or Jacket or Gravity Base	15	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE37
Concept/ Early Planning	Mainstream	119km offshore, North Sea	Germany		Mainstream Renewable Power	0			39	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1F
Under Construction	Meerwind Ost/ Sud	53km offshore, North Sea	Germany	2012	WindMW GmbH	80	288	Monopile	40	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE07
Submitted	Meerwind West	72km offshore, North Sea	Germany		Windland Energieerzeugungs GmbH	161	805		94	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0L
Approved	MEG Offshore I	60.6km offshore, North Sea	Germany	2009	Noordsee Offshore MEG I GmbH	80	400	Tripod	46	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE26
Concept/ Early Planning	Nautilus I	178km offshore, North Sea	Germany	2010	PNE WIND AG	80	480		56	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0B
Concept/ Early Planning	Nemo	183km offshore, North Sea	Germany		PNE WIND AG	136	680		139	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0A
Concept/ Early Planning	Neptun	105km offshore, North Sea	Germany		NEPTUN ENERGY Projektgesellschaft mbH	160	800-1120			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0T
Concept/ Early Planning	Neptun	North Sea	Germany		NEPTUN ENERGY Projektgesellschaft mbH	0			76	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1E
Concept/ Early Planning	Neptun	North Sea	Germany		NEPTUN ENERGY Projektgesellschaft mbH	0			60	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1A
Concept/ Early Planning	Neptun	North Sea	Germany		NEPTUN ENERGY Projektgesellschaft mbH	0			60	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0Y
Concept/ Early	Neptun	North Sea	Germany		NEPTUN ENERGY	0			60	http://www.4coffshore.com/windfarms/

Planning					Projektgesellschaft mbH					windfarms.aspx?windfarmId=DE1B
Approved	Nordergr³nde	16km offshore, North Sea	Germany	2008	Energiekontor AG	18	90	Monopile	6	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE20
Concept/ Early Planning	Norderland	115.9km offshore, North Sea	Germany		Norderland Projekt GmbH	0			44	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1O
Concept/ Early Planning	Norderland	114.2km offshore, North Sea	Germany		Norderland Projekt GmbH	0			39	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1N
Approved	Nordlicher Grund	84km offshore, North Sea	Germany	2005	GEO mbH, renergys GmbH	64	320	Monopile or Tripod	42	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE18
Concept/ Early Planning	NORD-OST PASSAT I	247.9km offshore, North Sea	Germany		Tiefbau GmbH Unterweser (TAGU)	0	360		42	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1P
Concept/ Early Planning	NORD-OST PASSAT II	239.4km offshore, North Sea	Germany		Tiefbau GmbH Unterweser (TAGU)	0	360		40	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1Q
Concept/ Early Planning	NORD-OST PASSAT III	241.5km offshore, North Sea	Germany		Tiefbau GmbH Unterweser (TAGU)	0	480		56	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1R
Submitted	Nordpassage	75km offshore, North Sea	Germany		Vattenfall Europe AG	80	400		90	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE53
Under Construction	Nordsee Ost	36km offshore	Germany	2012	RWE Innogy Windpower Hannover	48	295	Jacket	36	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE06
Submitted	Notos	100km offshore, North Sea	Germany		EOS Offshore Ltd	53	265		34	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE70
Submitted	Ostseeperle	25km offshore, Baltic Sea	Germany	2011	Financial Insurance GmbH	35	245		14	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1C
Submitted	Ostseeschatz	30km offshore, Baltic Sea	Germany	2011	Financial Insurance GmbH	45	315		24	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1D
Submitted	OWP West	67km offshore, North Sea	Germany		Northern Energy OWP West GmbH	80	400	Monopile or Tripod	26	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE31
Concept/ Early Planning	Petrel	78km offshore, North Sea	Germany		OWP Petrel GmbH i.G.	80	400		61	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0D
Withdrawn/ Rejected	Pommersche bucht	57.9km offshore, Baltic Sea	Germany		Winkra Energie	200	1000		24	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE92
Concept/ Early Planning	PROWIND 1	North Sea	Germany		Wind PROffshore Internatinoal GmbH	63	389		38	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0Z
Concept/ Early Planning	PROWIND 2	North Sea	Germany		Wind PROffshore Internatinoal GmbH	0	389		38	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1T
Concept/ Early Planning	PROWIND 3	181km offshore, North Sea	Germany		Wind PROffshore Internatinoal GmbH	0	389		38	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE1U
Under Construction	Riffgat	29km offshore, North Sea	Germany	2012	Offshore Windpark Riffgat GmbH & Co. KG	30	108	Monopile	6	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE21
Submitted	Sandbank 24 extension	90km offshore, North Sea	Germany		Projekt GmbH	40	200	Monopile or Tripod	37	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE35
Approved	Sandbank24	83km offshore, North Sea	Germany	2004	Projekt GmbH	96	288	Monopile	66	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE12
Concept/ Early Planning	Seagull	81km offshore, North Sea	Germany		OWP Seagull GmbH i.G.	80	400		60	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0E
Submitted	SeaStorm I	49km offshore, North Sea	Germany		Windreich AG	80	400		52	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE69
Submitted	SeaStorm II	56km offshore,	Germany		Windreich AG	38	190		37	http://www.4coffshore.com/windfarms/

		North Sea								windfarms.aspx?windfarmId=DE85
Withdrawn/ Rejected	SeaWind I	90km offshore, North Sea	Germany		STRABAG SE, Northern Energy SeaWind I GmbH	44	220		42	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE71
Withdrawn/ Rejected	SeaWind II	90km offshore, North Sea	Germany		STRABAG SE, Northern Energy SeaWind I GmbH	60	300		22	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE72
Submitted	SeaWind III	59km offshore, North Sea	Germany		Northern Energy Seawind III GmbH	57	285		50	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE86
Submitted	SeaWind IV	59km offshore, North Sea	Germany		Northern Energy Seawind IV GmbH	78	390		36	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE84
Concept/ Early Planning	Seewind	31km offshore, Baltic Sea	Germany		Iberdrola Renovables	25	150		19	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0J
Submitted	Skua	85km offshore, North Sea	Germany		OWP Skua GmbH	80	400		69	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE62
Submitted	Strom-Nord	30km offshore, Baltic Sea	Germany		Iberdrola Renovables	45	270		35	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0I
Concept/ Early Planning	Strom-Sud	Baltic Sea	Germany		Iberdrola Renovables	111	666		77	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0Q
Withdrawn/ Rejected	Uthland	70km offshore, North Sea	Germany		GEO mbh	80	400		116	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE14
Approved	Veja Mate	114.1km offshore, North Sea	Germany	2009	Cuxhaven Steel Construction GmbH	80	400	Tripile	50	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE36
Withdrawn/ Rejected	Ventotec Nord 1	137km offshore, North Sea	Germany		Ventotec GmbH	50	150		42	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE16
Withdrawn/ Rejected	Ventotec Nord 2	125km offshore, North Sea	Germany		Ventotec GmbH	50	150		42	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE17
Withdrawn/ Rejected	Weiße Bank	105km offshore, North Sea	Germany		Energiekontor AG	80	320		59	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE15
Approved	Wikinger	35km offshore, Baltic Sea	Germany	2007	Iberdrola Renovables	80	400		34	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE47
Approved	Wikinger Nord	Baltic Sea	Germany	2011		8	40		3	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0S
Withdrawn/ Rejected	Wikinger Sud	Baltic Sea	Germany	2010	Iberdrola Renovables Deutschland GmbH	18	90		6	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE44
Concept/ Early Planning	Windanker	Baltic Sea	Germany		Iberdrola Renovables	57	342		36	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE0P
Submitted	Witte Bank	120km offshore, North Sea	Germany		Projekt GmbH	118	590		76	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=DE99
Submitted	Agios Efstratios	0.5km offshore, Agean Sea	Greece		TERNA ENERGY SA	0	98		7	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR45
Withdrawn/ Rejected	Alexandroupoli Marine Park	2.5km offshore, Thracian Sea	Greece		Greek Energkikontor AU	0	76		25	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR40
Withdrawn/ Rejected	Antirion	0.4km offshore, Gulf of Patras	Greece		Greek Energkikontor AU	0	30		4	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR39
Concept/ Early Planning	Avgo	Dodekanissa	Greece		Blue H Technologies BV	0		Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR03
Submitted	Corfu	1.1km offshore, Strait of Otranto	Greece		EL.TECH WIND SA GREEK WIND	0	162		19	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR30

					TECHNODOMIKI INC					
Submitted	Diapontia Islands	1.8km offshore, Strait of Otranto	Greece		Venergia Energy SA	0	96		72	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR18
Submitted	Diapontia Wind phase Eight	1.2km offshore, Strait of Otranto	Greece		Diapontia Wind Eight	0	5		1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR28
Submitted	Diapontia Wind phase Five	0.3km offshore, Strait of Otranto	Greece		Diapontia Wind Five	0	20		3	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR23
Submitted	Diapontia Wind phase Four	2.3km offshore, Strait of Otranto	Greece		Diapontia Wind Four	0	20		4	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR26
Submitted	Diapontia Wind phase Nine	2.9km offshore, Strait of Otranto	Greece		Diapontia Wind Nine	0	30		12	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR24
Submitted	Diapontia Wind phase One	0.4km offshore, Strait of Otranto	Greece		Diapontia Wind One	0	15		1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR21
Submitted	Diapontia Wind phase Seven	3km offshore, Strait of Otranto	Greece		Diapontia Wind Seven	0	15		2	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR29
Submitted	Diapontia Wind phase Six	0.6km offshore, Strait of Otranto	Greece		Diapontia Wind Six	0	20		3	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR25
Submitted	Diapontia Wind phase Three	2km offshore, Strait of Otranto	Greece		Diapontia Wind Three	0	20		3	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR27
Submitted	Diapontia Wind phase Two	0.4km offshore, Strait of Otranto	Greece		Diapontia Wind Two	0	20		3	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR22
Submitted	Dikella Alexandroupolis	2km offshore, Thracian Sea	Greece		GEORGE E. VOULGARAKIS Ltd	0	50		6	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR46
Submitted	Golfe di Kymi	2.4km offshore, Golfe di Kymi	Greece		Canis Ltd	0	300		17	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR05
Withdrawn/ Rejected	Gulf St Nicholas	0.2km offshore, Gulf of St Nicholas	Greece		Marine Windpark 2 - K. Souridis & Co	0	24		5	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR43
Submitted	Kassos	11.7km offshore, Aegean Sea	Greece		Minoan Sea Wind Parks SA	0	350		23	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR33
Submitted	Kos	0.1km offshore, Aegean Sea	Greece		Islander Wind Inc	0	350		13	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR34
Submitted	Marathon Bay	2.5km offshore, Evian Gulf	Greece	2009	Pleiades Wind AU	90	450			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR04
Submitted	Marthakiou	0.5km offshore, Strait of Otranto	Greece		EN. TE. KA Wind Parks SA	0	30		8	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR17
Submitted	Mathraki	1.5km offshore, Strait of Otranto	Greece		Jasper Wind Greece AE & Co Kerkyra 2 EU	0	275		26	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR19
Submitted	Methones Kepoe	1.5km offshore, Aegean Sea	Greece		Terna Energy SA	0	320		94	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR35
Submitted	NorthEast South Andros	1.3k offshore, Aegean Sea	Greece		Jasper Wind Hallas SA Andros EU & Co	0	306		41	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR44
Dormant	Okeanos	Aegean Sea	Greece		Blue H Technologies BV	0		Tension Leg Platform		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR01
Submitted	Ormos Kalidhonos	0.1km offshore, Kalydona Bay	Greece		Wind Kalydonos KX II	0	141		9	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR42
Submitted	Orthoni	Strait of Otranto	Greece		Jasper Wind Greece AE & Co Kerkyra an EU	0	275		16	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR20
Submitted	Plaka	15km offshore,	Greece		City electric AE	0	500		61	http://www.4coffshore.com/windfarms/

		Aegean Sea								windfarms.aspx?windfarmId=GR08
Withdrawn/ Rejected	Plaka	3km offshore, Thracian Sea	Greece		Plaka Wind Ltd	0	12		1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR41
Submitted	Plaka Keros AG Eirini	1.2km offshore, Aegean Sea	Greece		Rokas Northern Wind Hellas SA I	0	486		73	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR36
Submitted	Porto Lagos/Thassos Park	0.1km offshore, Thracian Sea	Greece		Greek Energkikontor AU	0	156		32	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR37
Submitted	St Efstratios	0.8km offshore, Aegean Sea	Greece		Jasper Wind Hallas SA & Co. AG Efstra	0	445		35	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR32
Submitted	Steno Kafirea	Aegean Sea	Greece		Argos Aoilos A.E.	0	150		17	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR31
Withdrawn/ Rejected	Thalasio Park East Limnos	0.1km offshore, Aegean Sea	Greece		Greek Energkikontor AU	0	250		107	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR38
Submitted	Thrace Sea	3km offshore, Thracian Sea	Greece		Terna energy S.A	0	585		162	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR06
Submitted	Thrakiki Aioliki 1	1.1km offshore, Thracian Sea	Greece		Copelouzos Group	0	24		1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR09
Submitted	Thrakiki Aioliki 2	1km offshore, Thracian Sea	Greece		Copelouzos Group	0	24		1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR10
Submitted	Thrakiki Aioliki 3	1.2km offshore, Thracian Sea	Greece		Copelouzos Group	0	24		1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR11
Submitted	Thrakiki Aioliki 4	2.2km offshore, Thracian Sea	Greece		Copelouzos Group	0	24		1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR12
Submitted	Thrakiki Aioliki 5	2km offshore, Thracian Sea	Greece		Copelouzos Group	0	24		1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR13
Submitted	Thrakiki Aioliki 6	3km offshore, Thracian Sea	Greece		Copelouzos Group	0	24		1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR07
Submitted	Thrakiki Aioliki 7	1.7k offshore, Thracian Sea	Greece		Copelouzos Group	0	24		1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR14
Submitted	Thrakiki Aioliki 8	2.6km offshore, Thracian Sea	Greece		Copelouzos Group	0	24		1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR15
Submitted	Thrakiki Aioliki 9	3.6km offshore, Thracian Sea	Greece		Copelouzos Group	0	24		1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR16
Concept/ Early Planning	Zakros	Sea of Crete	Greece		Blue H Technologies BV	0		Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=GR02
Concept/ Early Planning	Bay of Bengal	Bay of Bengal	India		Astonfield Renewables Resources Ltd.	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IN01
Submitted	Gujarat	Indian Ocean	India		TATA Power	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IN05
Concept/ Early Planning	Koodankulam	Indian Ocean	India		TEDA	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IN04
Concept/ Early Planning	OGNC - Commercial Project	Indian Ocean	India		Oil and Natural Gas Corporation	0	500			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IN07
Concept/ Early Planning	OGNC - Pilot Project	Indian Ocean	India		Oil and Natural Gas Corporation	0	10			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IN06
Concept/ Early Planning	Rameshwaram	Palk Strait	India		TEDA	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IN03
Concept/ Early Planning	Southern India	Arabian Sea	India		Astonfield Renewables Resources Ltd.	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IN02

Operational	Arklow Bank Phase 1	10km offshore, Irish Sea	Ireland	2004	SSE Renewables, Acciona	7	25	Monopile		Offshore Wind Energy www.offshorewindenergy.org
Dormant	Arklow Bank Phase 2	Irish Sea	Ireland	2007	Acciona, GE Energy, SSE renewables	193	495			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IE07
Dormant	Codling Wind Park	13km offshore, Irish Sea	Ireland	2012	Codling Wind Park Ltd	220	1100		55	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IE02
Submitted	Codling Wind Park Extension	13km offshore, Irish Sea	Ireland	2010	Codling Wind Park 11 Ltd	200	1000			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IE06
Submitted	Dublin Array	3km offshore, Irish Sea	Ireland	2006	Saorgus Energy Ltd	145	364			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IE04
Concept/ Early Planning	Gaelectric Foreshore Test Sites	19.3km offshore, Irish Sea	Ireland	2011	Gaelectric Developments	0	5	Gravity-based	25	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IE08
Submitted	Oriel Wind Farm	7.8km offshore, Irish Sea	Ireland	2007	Oriel Wind Farm Ltd	55	330	Gravity Base	28	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IE03
Submitted	Sceirde (Skerd) Rocks	5.9km offshore, Atlantic Ocean	Ireland	2008	Fuinneeamh Sceirde Teorante	20	100	Monopile	4	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IE05
Dormant	Afefa	90km offshore, Mediterranean Sea	Italy		Blue H Technologies BV	200	700	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT15
Dormant	Aida	22km offshore, Mediterranean Sea	Italy		Blue H Technologies BV	88	308	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT12
Dormant	Atair	Mediterranean Sea	Italy		Blue H Technologies BV	0		Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT20
Dormant	Bari	22km offshore, Adriatic Sea	Italy		Blue H Technologies BV	126	441	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT11
Dormant	Bella	16km offshore, Mediterranean Sea	Italy		Blue H Technologies BV	80	280	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT16
Dormant	Brindisi	21.3km offshore, Adriatic Sea	Italy	2008	Sky Saver S.R.L	1		Floating	2	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT02
Dormant	Camilla	15km offshore, Mediterranean Sea	Italy		Blue H Technologies BV	80	208	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT17
Dormant	Cerano	17km offshore, Strait of Otranto	Italy		Blue H Technologies BV	126	441	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT18
Submitted	Chieuti	5km offshore, Adriatic Sea	Italy		TREVI Energy S.p.A a S.U	50	150	Monopile	22	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT05
Concept/ Early Planning	Etruria	Tyrrhenian	Italy			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT19
Concept/ Early Planning	Foce Verano	4.6km offshore, Adriatic Sea	Italy	2011	SEVA S.r.l	67	402		18	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT30
Withdrawn/ Rejected	Gargano North	7km offshore, Adriatic Sea	Italy		wpd VentItalia s.r.l	110	600		83	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT07
Submitted	Gargano Sud	10.5km offshore, Adriatic Sea	Italy	2012	PARCO EOLICO MARINO GARGANO SUD	95	342		87	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT08
Dormant	Ginevra	17km offshore, Mediterranean Sea	Italy	2012	Blue H Technologies BV	223	781	Tension Leg Platform		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT14
Dormant	Golfo di Gela	5.5km offshore, Mediterranean Sea	Italy		Moncada EnergyGroup & Enel	115	354			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT01
Submitted	Golfo di Gela	3km offshore, Mediterranean Sea	Italy		Mediterranean Offshore Wind	38	137			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT22

Withdrawn/ Rejected	Golfo di Manfredonia	10km offshore, Adriatic Sea	Italy		Gamesa Energia Italia	66	297			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT24
Submitted	Golfo di Manfredonia	8km offshore, Adriatic Sea	Italy		TREVI Energy S.p.A a S.U	100	300	Monopile	36	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT06
Concept/ Early Planning	Golfo di Trieste	24km offshore, Adriatic Sea	Italy	2009	Ansaldo sistemi industrali	0	30			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT26
Concept/ Early Planning	Is Arenas	0.6km offshore, Mediterranean Sea	Italy		Is Arenas Renewables Energies s.r.l	80	320			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT27
Concept/ Early Planning	Margherita di Savoia	5km offshore, Adriatic Sea	Italy		Daunia Wind	120	720			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT23
Concept/ Early Planning	Rodi Garganico	6.5km offshore, Adriatic Sea	Italy	2010	SEVA S.r.l	35	126		9	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT29
Dormant	Rosa	15km offshore, Mediterranean Sea	Italy		Blue H Technologies BV	91	319	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT13
Approved	San Michele	4.5km offshore, Adriatic Sea	Italy	2009	Effeventi S.r.l	54	162	Monopile	21	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT03
Concept/ Early Planning	Secche di Vada	Tyrrhenian Sea	Italy		Ravano Green Power & PRO GECO s.r.l	0	60			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT25
Approved	Talbot	51km offshore, Mediterranean Sea	Italy	2012	Four Wind s.r.l	59	354		53	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT32
Approved	Taranto	3km offshore, Gulf of Taranto	Italy	2011	Societ Energy S.p.A	10	30		1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT31
Dormant	Termoli	19km offshore, Adriatic Sea	Italy		Blue H Technologies BV	126	441	Tension Leg Platform		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT10
Withdrawn/ Rejected	Torre San Gennaro	3km offshore, Adriatic Sea	Italy	2011	TREVI Energy S.p.A a S.U	50	150	Monopile	22	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT09
Concept/ Early Planning	Tricase	20km offshore, Adriatic Sea	Italy		Sky Saver S.R.L	26	92	Floating	10	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT04
Concept/ Early Planning	Tricase - Development Phase	Adriatic Sea	Italy		Sky Saver S.R.L	1	2	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT21
Concept/ Early Planning	Tricase - Pre-Production Phase	Adriatic Sea	Italy		Sky Saver S.R.L	1		Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=IT28
Concept/ Early Planning	Chiba Prefecture IHI Marine	Pacific Ocean	Japan	2012	IHI Marine United inc., University of Tokyo	0		Tension Leg Platform		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP10
Under Construction	Choshi	3.1km offshore, Pacific Ocean	Japan	2012	TEPCO, NEDO	1	2.4	Gravity Base		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP03
Approved	Floating Demonstration Project - Kabashima	Goto-nada Sea	Japan		TODA corporation	1	2	Spar Floater	3	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP07
Under Construction	Fukushima Recovery Experimental phase 1	30km offshore, Pacific Ocean	Japan	2012	IHI Marine United inc., University of Tokyo	1	2	Semi-submersible platform	13	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP06
Concept/ Early Planning	Fukushima Recovery Experimental phase 2	30klm offshore, Pacific Ocean	Japan	2012	IHI Marine United inc., University of Tokyo	2	14	Semi-submersible platform		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP13
Concept/ Early Planning	Hitachi-Zosen Pilot	Korea Strait	Japan			0		Spar Floater		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP19
Dormant	Japan Wind Power Project	Pacific Ocean	Japan		Pavilion Energy Resources	0	250000			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP01
Operational	Kabashima Demonstration	Goto-nada Sea	Japan		Kyoto University	1	0.1	Spar Floater		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP15

	Project									
Operational	Kamisu	Kashima Nada	Japan	2010	WIND POWER Group	7	14	Monopile		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP05
Concept/ Early Planning	Kamisu - Megasite	Kashima Nada	Japan		WIND POWER Group	100	200-500		7	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP09
Under Construction	Kamisu Nearshore Wind Farm - phase 2	Kashima Nada	Japan	2012	WIND POWER Group	8	16	Monopile		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP17
Under Construction	Kitakyushu Offshore Demonstration Project	2.5km offshore, Korea Strait	Japan		NEDO, J Power	1	2	Gravity-Base		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP14
Operational	Kyushu University Wind Lens Project - phase 1	Hakata Bay	Japan		RIAMWIND Corp	0	3	Semi-submersible Platform		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP12
Approved	Kyushu University Wind Lens Project - phase 2	Korea Strait	Japan		Kyushu University	2	0.4	Semi-submersible Platform		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP08
Concept/ Early Planning	Kyushu University Wind Lens Project - phase 3	Korea Strait	Japan		Kyushu University	2	10	Semi-submersible Platform		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP11
Concept/ Early Planning	Maeda Shimonoseki	Korea Strait	Japan		Maeda Corporation	20	7.5			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP20
Operational	Sakata	Japan Sea	Japan	2004		5	10	Piled		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP04
Concept/ Early Planning	Sapporo	Sea of Japan	Japan		Green Power Investment Corporation	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP16
Decommissioned	Sasebo - 1:10 scale prototype	Sasebo Harbour	Japan		Kyoto University	1	0	Spar Floater		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP18
Operational	Setana	0.7km offshore, Sea of Japan	Japan	2004	Setana Town	1	2	Dolphin multi-pile		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=JP02
Dormant	Baltic Wind Park	17.9km offshore, Baltic Sea	Latvia	2011	Baltic Wind Park	0	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=LV07
Withdrawn/ Rejected	Development Interest Site 1	29km offshore, Baltic Sea	Latvia			0			702	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=LV01
Withdrawn/ Rejected	Development Interest Site 2	15kmoffshore, Baltic Sea	Latvia			0			274	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=LV02
Withdrawn/ Rejected	Development Interest Site 3	16km offshore, Baltic Sea	Latvia			0			155	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=LV03
Withdrawn/ Rejected	Development Interest Site 4	8km offshore, Baltic Sea	Latvia			0			332	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=LV04
Withdrawn/ Rejected	Development Interest Site 5	7km offshore, Baltic Sea	Latvia			0			916	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=LV05
Dormant	JK ENERGY Offshore Wind Park	0.5km offshore, Baltic Sea	Latvia		JK Energy Ltd	0	900		153	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=LV06
Dormant	L1	38.4km offshore, Baltic Sea	Lithuania			0			113	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=LT01
Dormant	L2	11.5km offshore, Baltic Sea	Lithuania			0			45	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=LT02
Dormant	L3	20.4km offshore, Baltic Sea	Lithuania			0			16	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=LT03

Dormant	L4	9.2km offshore, Baltic Sea	Lithuania			0			33	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=LT04
Dormant	L5	35.3km offshore, Baltic Sea	Lithuania			0			19	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=LT05
Approved	Gaafaru	Indian Ocean	Maldives			30	75	Monopile	3	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=MV01
Dormant	Barbara	20km offshore, Mediterranean Sea	Malta		Blue H Technologies BV	30	105	Tension Leg Platform		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=MT02
Submitted	Hexicon		Malta	2011	Hexicon Malta Ltd.	36	54			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=MT03
Concept/ Early Planning	Sikka l-Bajda	1.5km offshore, Mediterranean Sea	Malta	2009		19	95		11	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=MT01
Approved	Beaufort (formerly Katwijk)	24km offshore, North Sea	Netherlands	2009	Nuon (Vattenfall AB)	93	279	Monopile	42	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL04
Dormant	Breeveertien	46km offshore, North Sea	Netherlands		SSE Renewables	30	150		13	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL14
Approved	Breeveertien II	59km offshore, North Sea	Netherlands	2009	DONG Energy	97	349	Monopile	49	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL15
Approved	Brown Ridge Oost	74km offshore, North Sea	Netherlands	2009	Brown Ridge Oost B.V. i.o	94	282	Monopile	34	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL67
Dormant	Bruine Bank	63km offshore, North Sea	Netherlands		Evelop	121	550		49	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL78
Withdrawn/ Rejected	Callantsoog Noord	North Sea	Netherlands	2009	Eneco	101	303	Monopile	32	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL31
Dormant	Callantsoog Oost	37km offshore, North Sea	Netherlands		Eneco	68	245		28	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL44
Dormant	Callantsoog West	47km offshore, North Sea	Netherlands		Eneco	68	245		31	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL43
Dormant	Callantsoog Zuid	38km offshore, North Sea	Netherlands		Eneco	91	328		49	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL42
Approved	Clearcamp	66km offshore, North Sea	Netherlands	2009	Eolic Wind Power GmbH	55	275	Tripile	31	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL17
Dormant	Cornelia	116km offshore, North Sea	Netherlands		Blue H Technologies BV	125	438	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL84
Dormant	Den Haag I	28.6km offshore, North Sea	Netherlands	2006	WEOM	127	381		24	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL12
Dormant	Den Haag II	42km offshore, North Sea	Netherlands	2007	WEOM	85	255	Monopile	35	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL05
Dormant	Den Haag III	52km offshore, North Sea	Netherlands		WEOM	235	705		55	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL41
Dormant	Den Haag Noord	41.3km offshore, North Sea	Netherlands		WEOM	168	504		39	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL13
Dormant	Den Helder 1	40km offshore, North Sea	Netherlands		Raedthyus Holding BV	150	450		26	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL49
Dormant	Den Helder 2	32km offshore, North Sea	Netherlands		Raedthyus Holding BV	150	450		62	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL46
Dormant	Den Helder 3	32km offshore, North Sea	Netherlands		Raedthyus Holding BV	130	430		31	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL47
Dormant	Den Helder I	60km offshore,	Netherlands		SSE Renewables	100	500	Monopile	50	http://www.4coffshore.com/windfarms/

		North Sea								windfarms.aspx?windfarmId=NL65
Approved	Den Helder I	64km offshore, North Sea	Netherlands	2009	Den Helder Wind Farm B.V	78	468		47	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL61
Dormant	Den Helder II	60km offshore, North Sea	Netherlands		SSE Renewables	100	500		49	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL62
Dormant	Den Helder III	70km offshore, North Sea	Netherlands		SSE Renewables	100	500		51	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL63
Dormant	Den Helder IV	70km offshore, North Sea	Netherlands		SSE Renewables	100	500		50	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL64
Dormant	Den Helder Noord	33km offshore, North Sea	Netherlands		WEOM	266	798		56	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL76
Dormant	Den Helder Zuid	34km offshore, North Sea	Netherlands		WEOM	0			59	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL72
Operational	Egmond aan Zee	10km offshore from Egmond aan Zee	Netherlands	2007	NoordzeeWind (Shell/NUON)	36	108	Monopile	24	Offshore Wind Energy www.offshorewindenergy.org
Approved	Eneco Luchterduinen	23km offshore, North Sea	Netherlands	2012	Eneco	43	129	Monopile	16	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL32
Dormant	Eurogeul Noord	48km offshore, North Sea	Netherlands		Evelop	60	275		43	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL83
Dormant	Favorius	46km offshore, North Sea	Netherlands		Arcadis Nederland	43	129		14	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL45
Concept/ Early Planning	FLOW - Far Offshore Demonstration Park	75km offshore, North Sea	Netherlands		Far and Large Offshore Wind (FLOW)	6				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL89
Concept/ Early Planning	FLOW - Turbine Demonstration Facility	75km offshore, North Sea	Netherlands		Far and Large Offshore Wind (FLOW)	60	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL88
Approved	Gemini	85km offshore, North Sea	Netherlands	2012	Typhoon Offshore BV	150	600	Monopile	68	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL18
Dormant	Helder	43km offshore, North Sea	Netherlands		Evelop	51	225		34	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL77
Withdrawn/ Rejected	Helmveld	33km offshore, North Sea	Netherlands	2009	Evelop	137	493	Monopile	49	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL24
Dormant	Hoek van Holland 1	23km offshore, North Sea	Netherlands		Raedthyus Holding BV	100	300		23	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL57
Dormant	Hoek van Holland 2	40km offshore, North Sea	Netherlands		Raedthyus Holding BV	100	450		58	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL58
Dormant	Hoek van Holland 3	50km offshore, North Sea	Netherlands		Raedthyus Holding BV	150	450		46	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL59
Dormant	Hoek van Holland 4	50km offshore, North Sea	Netherlands		Raedthyus Holding BV	150	450		51	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL60
Dormant	Hopper	56km offshore, North Sea	Netherlands		Evelop	90	400		50	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL82
Dormant	HoriWind	60km offshore, North Sea	Netherlands		E-Connection Project BV	90	270		38	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL68
Dormant	Horizon	61km offshore, North Sea	Netherlands		Evelop	61	275		39	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL79
Dormant	IJmuiden	22km offshore, North Sea	Netherlands	2008	WEOM	51	153	Monopile	18	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL03

Dormant	IJmuiden 1	55km offshore, North Sea	Netherlands		Raedthuys Holding BV	150	450		41	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL50
Dormant	IJmuiden 2	55km offshore, North Sea	Netherlands		Raedthyus Holding BV	150	450		95	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL51
Operational	Irene Vorrink	20m offshore	Netherlands	1996	NUON	28	16.8	Monopile	2	Offshore Wind Energy www.offshorewindenergy.org
Dormant	Katwijk Buiten	24km offshore, North Sea	Netherlands	2006	Evelop	73	325	Monopile	40	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL06
Operational	Lely	750m offshore	Netherlands	1994	NUON	4	2			Offshore Wind Energy www.offshorewindenergy.org
Dormant	Maas West Buiten	45km offshore, North Sea	Netherlands		Evelop	38	175		27	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL80
Dormant	Noord Hinder	60km offshore, North Sea	Netherlands		Evelop	87	400		51	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL81
Dormant	Noord Hinder 1	40km offshore, North Sea	Netherlands		SSE Renewables	112	400		50	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL74
Dormant	Noord Hinder 2	50km offshore, North Sea	Netherlands		SSE Renewables	112	400		44	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL75
Submitted	Noordermeerdijk buitendijks	0.5km offshore, Ijsselmeer	Netherlands	2009	Siemens Nederland NV	10	50		5	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL86
Submitted	Okeanos	23km offshore, North Sea	Netherlands		Arcadis Nederland	44	158	Monopile	14	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL26
Dormant	Oost Friesland	23km offshore, North Sea	Netherlands		Raedthyus Holding BV	150	450		103	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL48
Dormant	Osters Bank 1	50km offshore. North Sea	Netherlands		Raedthyus Holding BV	150	450		138	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL20
Dormant	Osters Bank 2	32km offshore, North Sea	Netherlands		Raedthyus Holding BV	95	310		32	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL21
Dormant	Osters Bank 3	50km offshore, North Sea	Netherlands		Raedthyus Holding BV	150	450		95	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL22
Dormant	Osters Bank 4	50km offshore, North Sea	Netherlands		Raedthyus Holding BV	150	450		88	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL23
Submitted	P12	33km offshore, North Sea	Netherlands	2004	Eneco	47	141	Monopile	17	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL09
Dormant	P15-WP	23.1km offshore, North Sea	Netherlands		E-Connection Project BV	73	219		29	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL34
Operational	Prinses Amaliawindpark (formerly Q7-WP)	23km offshore, North Sea	Netherlands	2008		60	120	Monopile	17	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL01
Approved	Q4	26km offshore, North Sea	Netherlands	2009	Q4-WP B.V .i.o (Eneco)	26	78	Monopile	17	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL08
Dormant	Q7-West	35km offshore, North Sea	Netherlands		Eneco	68	245		32	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL40
Dormant	Riffgrond	34km offshore, North Sea	Netherlands		Evelop	120	500		148	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL33
Withdrawn/ Rejected	Rijnveld Noord	40km offshore, North Sea	Netherlands	2009	Rijnveld Noord B.V .i.o	27	81	Monopile	9	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL73
Withdrawn/ Rejected	Rijnveld Oost	35km offshore, North Sea	Netherlands	2009	Eneco	45	135	Monopile	15	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL25

Withdrawn/ Rejected	Rijnveld West	45km offshore, North Sea	Netherlands	2009	Rijnveld West B.V .i.o	41	123	Monopile	13	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL71
Dormant	Rijnveld Zuid	25km offshore, North Sea	Netherlands		E-Connection Project BV	50	150		23	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL66
Submitted	Rotterdam Noord-West	30km offshore, North Sea	Netherlands	2009	Evelop	50	180	Monopile	18	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL35
Dormant	Ruyter Oost	75km offshore, North Sea	Netherlands		RWE Energy Netherlands	71	256		32	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL30
Dormant	Ruyter West	75km offshore, North Sea	Netherlands		RWE Energy Netherlands	72	259		32	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL38
Dormant	Schaar	30km offshore, North Sea	Netherlands		Eneco	91	328		50	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL39
Dormant	Scheveningen 1	23km offshore, North Sea	Netherlands		Raedthyus Holding BV	150	450		29	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL52
Dormant	Scheveningen 2	35km offshore, North Sea	Netherlands		Raedthyus Holding BV	150	450		31	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL53
Dormant	Scheveningen 3	25km offshore, North Sea	Netherlands		Raedthyus Holding BV	150	450		24	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL54
Dormant	Scheveningen 4	35km offshore, North Sea	Netherlands		Raedthyus Holding BV	150	450		44	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL55
Dormant	Scheveningen 5	45km offshore, North Sea	Netherlands		Raedthyus Holding BV	150	450		30	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL56
Approved	Scheveningen Buiten	28km offshore, North Sea	Netherlands	2009	Evelop	59	212		31	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL07
Dormant	Thetys	27.4km offshore, North Sea	Netherlands		Arcadis Nederland	53	159	Monopile	16	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL11
Approved	Tromp Binnen	65km offshore, North Sea	Netherlands	2009	RWE Energy Netherlands	59	295	Gravity Base	33	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL29
Dormant	Tromp Oost	75km offshore, North Sea	Netherlands		RWE Energy Netherlands	102	367		46	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL37
Dormant	Tromp West	80km offshore, North Sea	Netherlands		RWE Energy Netherlands	107	385		48	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL36
Approved	West-Rijn	37 offshore, North Sea	Netherlands	2009	West-Rijn Wind Farm BV	72	259	Monopile	47	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL10
Concept/ Early Planning	Wieringermeerdijk	0.8km offshore, Ijsselmeer	Netherlands		Nuon	26	100			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL87
Dormant	Wijk aan Zee	24.5km offshore, North Sea	Netherlands		Evelop	60	200		18	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL19
Dormant	WindNed Noord	35km offshore, North Sea	Netherlands		E- Connection Project BV	20	60		26	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL70
Dormant	WindNed Zuid	25km offshore, North Sea	Netherlands		E- Connection Project BV	50	150		7	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL69
Submitted	Windpark Noordoostpolder	0.5km offshore, Ijsselmeer	Netherlands	2009	Siemens Nederland NV	38	190		8	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NL85
Withdrawn/ Rejected	Tunes Plateau	5km offshore, Atlantic Ocean	Northern Ireland	2011	RESs Ltd, B9 Energy Offshore Developments	85	250			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK58
Concept/ Early Planning	Aegir Havvindpark	171.2km offshore, North Sea	Norway		OceanWind AS	200	1000	Jacket	259	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO15
Withdrawn/	Fosen Offshore	3km offshore,	Norway	2006	Offshore Vindenergy AS	0	300		63	http://www.4coffshore.com/windfarms/

Rejected	Vindpark-Fase1	Norwegian Sea								windfarms.aspx?windfarmId=NO06
Concept/ Early Planning	Fosen Offshore Vindpark-Fase2	3km offshore, Norwegian Sea	Norway		Offshore Vindenergy AS	0	300		50	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO24
Concept/ Early Planning	Fosen Offshore Vindpark-Fase3	8km offshore, Norwegian Sea	Norway		Offshore Vindenergy AS	0	300		47	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO23
Concept/ Early Planning	Gims°y Offshorepark	1km offshore, Norwegian Sea	Norway		Lofotkraft Vind AS, Nordkraft Vind AS	0	250		40	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO08
Approved	Havsul I Phase 1	20.2km offshore, Norwegian Sea	Norway	2009	Vestavind Offshore VS	10	50		26	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO01
Approved	Havsul I Phase 2	19.1km offshore, Norwegian Sea	Norway		Vestavind Offshore AS	60	300		24	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO46
Withdrawn/ Rejected	Havsul II	14.6km offshore, Norwegian Sea	Norway	2009	Vestavind Kraft AS	178	800		123	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO02
Withdrawn/ Rejected	Havsul IV	8.6km offshore, Norwegian Sea	Norway	2008	HAVGUL Clean Energy AS	78	350		37	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO03
Operational	Hywind	10km offshore, North Sea	Norway	2009	Statoil ASA	1	2	Floating	2	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO04
Concept/ Early Planning	Idunn energipark	250km offshore, North Sea	Norway		Fred Olsen Renewables Ltd	200	1200		321	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO19
Approved	Karm°y Wind Turbine Demonstration Area	1km offshore, North Sea	Norway	2010	Statoil ASA, GE Energy	2	8			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO25
Approved	Kvits°y Wind Turbine Demonstration Area	1km offshore, North Sea	Norway	2010	Statoil ASA, GE Energy	2	8			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO27
Concept/ Early Planning	Lofoten Havkraftverk	2km offshore, Norwegian Sea	Norway		Lofotkraft Vind AS	0	750		85	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO09
Concept/ Early Planning	M°revind offshore vindkraftverk	22km offshore, Norwegian Sea	Norway		TronderEnergi Karft AS	240	1200		260	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO18
Approved	Rennes°y Wind Turbine Demonstration Area	1km, offshore, North Sea	Norway	2010	Statoil ASA, GE Energy	2	8		1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO26
Concept/ Early Planning	Selvµr offshore vindkraftverk	35.3km offshore, Norwegian Sea	Norway		Nord-Norsk Vindkraft AS	100	450		64	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO07
Submitted	Siragrunnen	1km offshore, North Sea	Norway	2009	Siragrunnen AS	40	200		39	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO13
Concept/ Early Planning	Sorlig Nordsjoen	150km offshore, North Sea	Norway		Lyse Energi AS	200	1000	Jacket - proposed	206	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO12
Concept/ Early Planning	Stadtvind	46km offshore, Norwegian Sea	Norway		Vestavind Kraft AS	216	1080		443	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO14
Concept/ Early Planning	Steinshamn Offshore Vindpark	4km offshore, Norwegian Sea	Norway		Offshore Vindenergy AS	0	105			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO05
Operational	SWAY 1:6 Prototype	North Sea	Norway	2012	SWAY A/S	1	0.02	Spar floater/ SWAY		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO47
Approved	SWAY 10MW test turbine	4km offshore, North Sea	Norway		SWAY Turbine AS	1	10		2	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO17
Approved	SWAY 2.6MW Test	7km offshore, North Sea	Norway	2009	SWAY AS	1	3	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO16
Approved	TestomrÕde	10.8km offshore,	Norway		Vestavind Kraft AS	2	10	Floating	11	http://www.4coffshore.com/windfarms/

	Bukketjuvane	Arctic Ocean								windfarms.aspx?windfarmId=NO30
Approved	Testposisjon Fure	2.1km offshore, Arctic Ocean	Norway		Vestavind Kraft AS	1	5	Floating	1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO28
Approved	Testposisjon Kvalheimsvika	7.6km offshore, Arctic Ocean	Norway		Vestavind Kraft AS	1	5	Floating	1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO29
Concept/ Early Planning	Utsira Phase 1	33.1km offshore, North Sea	Norway		Lysie Energie AS	5	25	Floating	2	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO10
Concept/ Early Planning	Utsira Phase 2	46.8km offshore, North Sea	Norway		Lysie Energie AS	56	280	Floating	47	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO11
Concept/ Early Planning	Vann°ya Havkraftverk I	0.2km offshore, Norwegian Sea	Norway		Troms Kraft Produksjon AS	15	75		5	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO20
Concept/ Early Planning	Vann°ya Havkraftverk II	0.2km offshore, Norwegian Sea	Norway		Troms Kraft Produksjon AS	20	100		9	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO21
Concept/ Early Planning	Vann°ya Havkraftverk III	0.2km offshore, Norwegian Sea	Norway		Troms Kraft Produksjon AS	120	600		83	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO22
Concept/ Early Planning	WindSea AS Prototype	North Sea	Norway		WindSea AS	3	10.8	Semi-submersible platform		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=NO48
Concept/ Early Planning	Licence Application No. 1 - MFW Baltyk Srodkowy I	49km offshore, Baltic Sea	Poland	2011		0			64	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL15
Concept/ Early Planning	Licence Application No. 10	Baltic Sea	Poland	2011		0			53	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL24
Concept/ Early Planning	Licence Application No. 11	35km offshore, Baltic Sea	Poland	2011		0			112	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL25
Concept/ Early Planning	Licence Application No. 12	41.9km offshore, Baltic Sea	Poland	2011		0			94	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL26
Concept/ Early Planning	Licence Application No. 13	26.6km offshore, Baltic Sea	Poland	2011		0			45	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL27
Concept/ Early Planning	Licence Application No. 14	34.6km offshore, Baltic Sea	Poland	2012		0			38	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL28
Concept/ Early Planning	Licence Application No. 15	53.4km offshore, Baltic Sea	Poland	2012		0			35	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL29
Concept/ Early Planning	Licence Application No. 16	30.7km offshore, Baltic Sea	Poland	2012		0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL30
Concept/ Early Planning	Licence Application No. 17	25.6km offshore, Baltic Sea	Poland	2012		0			35	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL31
Concept/ Early Planning	Licence Application No. 18	52.2km offshore, Baltic Sea	Poland	2012		0			31	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL32
Concept/ Early Planning	Licence Application No. 19	52.1km offshore, Baltic Sea	Poland	2012		0			32	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL33
Concept/ Early Planning	Licence Application No. 2 - MFW Baltyk P¾lnocny	88.3km offshore, Baltic Sea	Poland	2011		0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL16
Concept/ Early Planning	Licence Application No. 20	47.6km offshore, Baltic Sea	Poland	2012		0			33	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL34
Concept/ Early Planning	Licence Application No. 21	53.2km offshore, Baltic Sea	Poland	2012		0			123	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL35
Concept/ Early Planning	Licence Application No. 21a	55.9km offshore, Baltic Sea	Poland	2012		0			44	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL55

Concept/ Early Planning	Licence Application No. 22	41.9kmoffshore, Baltic Sea	Poland	2012		0			42	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL36
Concept/ Early Planning	Licence Application No. 23	87.4km offshore, Baltic Sea	Poland	2012		0			67	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL37
Concept/ Early Planning	Licence Application No. 24	35km offshore, Baltic Sea	Poland	2012		0			58	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL38
Concept/ Early Planning	Licence Application No. 25	37.8km offshore, Baltic Sea	Poland	2012		0			44	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL39
Concept/ Early Planning	Licence Application No. 26	28.1km offshore, Baltic Sea	Poland	2012		0			50	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL40
Concept/ Early Planning	Licence Application No. 27	34.1km offshore, Baltic Sea	Poland	2012		0			45	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL41
Concept/ Early Planning	Licence Application No. 27a	35.7km offshore, Baltic Sea	Poland	2012		0			21	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL56
Concept/ Early Planning	Licence Application No. 28	27.6km offshore, Baltic Sea	Poland	2012		0			38	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL42
Concept/ Early Planning	Licence Application No. 29	38.1km offshore, Baltic Sea	Poland	2012		0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL43
Concept/ Early Planning	Licence Application No. 29a	38.6km offshore, Baltic Sea	Poland	2012		0			28	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL57
Concept/ Early Planning	Licence Application No. 3 MFW Baltyk Srodkowy III	28.2km offshore, Baltic Sea	Poland	2011		0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL17
Concept/ Early Planning	Licence Application No. 30	28.4km offshore, Baltic Sea	Poland	2012		0			38	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL44
Concept/ Early Planning	Licence Application No. 31	38km offshore, Baltic Sea	Poland	2012		0			44	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL45
Concept/ Early Planning	Licence Application No. 31a	40km offshore, Baltic Sea	Poland	2012		0			25	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL58
Concept/ Early Planning	Licence Application No. 32	63km offshore, Baltic Sea	Poland	2012		0			117	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL46
Concept/ Early Planning	Licence Application No. 33	34km offshore, Baltic Sea	Poland	2012		0			127	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL47
Concept/ Early Planning	Licence Application No. 34	26.6km offshore, Baltic Sea	Poland	2012		0			85	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL48
Concept/ Early Planning	Licence Application No. 35	55.8km offshore, Baltic Sea	Poland	2012		0			67	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL49
Concept/ Early Planning	Licence Application No. 36	49.3km offshore, Baltic Sea	Poland	2012		0			62	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL50
Concept/ Early Planning	Licence Application No. 36a	51.7km offshore, Baltic Sea	Poland	2012		0			71	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL59
Concept/ Early Planning	Licence Application No. 37	83.9km offshore, Baltic Sea	Poland	2012		0			107	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL51
Concept/ Early Planning	Licence Application No. 37a	84.3km offshore, Baltic Sea	Poland	2012		0			75	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL60
Concept/ Early Planning	Licence Application No. 38	90.1km offshore, Baltic Sea	Poland	2012		0			135	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL52
Concept/ Early Planning	Licence Application No. 38a	90.2km offshore, Baltic Sea	Poland	2012		0			119	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL61

Concept/ Early Planning	Licence Application No. 39	34.1km offshore, Baltic Sea	Poland	2012		0			29	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL53
Concept/ Early Planning	Licence Application No. 4	26.4km offshore, Baltic Sea	Poland	2012		0			116	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL18
Concept/ Early Planning	Licence Application No. 40	36.7km offshore, Baltic Sea	Poland	2012		0			37	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL54
Concept/ Early Planning	Licence Application No. 41	46.2km offshore, Baltic Sea	Poland	2012		0			110	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL62
Concept/ Early Planning	Licence Application No. 8 - MFW Baltyk Srodkowy II	47.3km offshore, Baltcic Sea	Poland	2012		0			130	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL22
Concept/ Early Planning	Licence Application No. 9	29.3km offshore, Baltic Sea	Poland	2012		0			140	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL23
Dormant	P1	54.1km offshore, Baltic Sea	Poland			0			173	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL01
Dormant	P2	46.7km offshore, Baltic Sea	Poland			0			160	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL02
Dormant	P3	14.6km offshore, Baltic Sea	Poland			0			176	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL03
Dormant	P4	11.8km offshore, Baltic Sea	Poland			0			116	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PL04
Dormant	Branca	17km offshore, Atlantic Ocean	Portugal		Blue H Technologes BV	86	301	Floating: Tension Leg Platform		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PT02
Operational	WindFloat - Phase 1/ Agucadoura	5km offshore, Atlantic Ocean	Portugal	2012	WindPlus S.A	1	2	Floating: Semi-Submersible Platform		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PT01
Concept/ Early Planning	WindFloat - Phase 2	Atlantic Ocean	Portugal		Energias de Portugal	5	25	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PT03
Concept/ Early Planning	WindFloat - Phase 3	Atlantic Ocean	Portugal		Energias de Portugal	30	150	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=PT04
Approved	Blackstone	6km offshore, Black Sea	Romania		The Blackstone Group	100	500			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=RO02
Concept/ Early Planning	Unknown	Black Sea	Romania		EDP Renovaveis	0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=RO01
Dormant	R1	8.1km offshore, Baltic Sea	Russia			0			27	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=RU01
Dormant	R2	9.9km offshore, Baltic Sea	Russia			0			23	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=RU02
Awarded	Argyll Array	3m offshore of Tiree	Scotland	2009	Scottish Power	180	1800		360	http://www.argyllarray.com/
Submitted	Beatrice	Beatrice oilfield, Moray Firth	Scotland	2012	Beatrice Offshore Wind Farm Limited	277	1000		125	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK53
Operational	Beatrice Demonstration	Beatrice Oilfield, Moray Firth	Scotland	2007	Scottish and Southern	2	10	Jacket	1	BWEA website www.bwea.com/ukwed/operational.asp
Withdrawn/ Rejected	Bell Rock Lighthouse	10km offshore	Scotland	2009	Airtricity	140	700			www.scottish-southern.co.uk/
Submitted	European Offshore Wind Deployment Centre	Aberdeen	Scotland	2011	Aberdeen Renewable Energy Group (AREG)	11	84		7	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK47

Concept/ Early Planning	Fife Energy Park	North Sea	Scotland		Samsung Heavy Industries	1	7			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK1E
Concept/ Early Planning	Firth of Forth Phase 1 Alpha	43km offshore, North Sea	Scotland	2008	SeaGreen Wind Energy Ltd	109	545		178	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK44
Concept/ Early Planning	Firth of Forth Phase 1 Bravo	43km offshore, North Sea	Scotland	2008	SeaGreen Wind Energy Limited	106	530		210	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK1A
Concept/ Early Planning	Firth of Forth Phase 2 Charlie	77km offshore, North Sea	Scotland	2008	SeaGreen Wind Energy Ltd	122	610		191	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK74
Concept/ Early Planning	Firth of Forth Phase 2 Delta	77km offshore, North Sea	Scotland		SeaGreen Wind Energy Ltd	121	605		183	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK1B
Concept/ Early Planning	Firth of Forth Phase 2 Echo	77km offshore, North Sea	Scotland		SeaGreen Wind Energy Ltd	121	605		194	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK1C
Concept/ Early Planning	Firth of Forth Phase 3 Foxtrot	38km offshore, North Sea	Scotland		SeaGreen Wind Energy Ltd	113	565		146	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK75
Under Construction	Firth of Forth Phase 3 Golf	38km offshore, North Sea	Scotland		SeaGreen Wind Energy Ltd	45	255		127klm 2	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK1D
Withdrawn/ Rejected	Forth Array	21.2km offshore, North Sea	Scotland	2009	Fred Olsen Renewables	90	415		111	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK57
Approved	Hunterston Test Site	Atlantic Ocean	Scotland	2012	Scottish and Southern Energy	3	24			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK86
Concept/ Early Planning	Hywind Demonstration (UK/USA/Norway)	Atlantic Ocean	Scotland		Statoil ASA	5		Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK76
Concept/ Early Planning	Inch Cape	15km offshore in outer Tay estuary	Scotland	2010	npower/ SeaEnergy	180	905	Jacket	151	www.npower-renewables.com
Awarded	Islay	13km offshore, Atlantic Sea	Scotland	2009	Scottish and Southern Energy	138	690		95	www.scottish-southern.co.uk
Withdrawn/ Rejected	Kintyre	3km due west of Macrihanish	Scotland	2009	Scottish and Southern Energy	105	378		69	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK50
Submitted	Methil Offshore Wind Farm	1.2km offshore, North Sea	Scotland	2010	2-B Energy	2	12			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK65
Concept/ Early Planning	Moray Firth Eastern Develop Area Robert Stevenson	27.5km offshore, Moray Firth	Scotland		Moray Offshore Renewables Ltd	76	380			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK40
Concept/ Early Planning	Moray Firth Eastern Develop Area Thomas T elford	27.5km offshore, Moray Firth	Scotland		Moray Offshore Renewables Ltd	76	500			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK85
Concept/ Early Planning	Moray Firth Eastern Development Area Edward Macoll	27.5km offshore, Moray Firth	Scotland		Moray Offshore Renewables Ltd	76	380			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK84
Concept/ Early Planning	Moray Firth Western Development Area	27.5km offshore, Moray Firth	Scotland	2012	Moray Offshore Renewables Ltd	0	360		228	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK77
Awarded	Neart na Gaoithe	15km offshore, Outer Forth estuary	Scotland	2009	Mainstream Renewable Power	125	420	Jacket	105	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK56
Operational	Robin Rigg	Solway Firth	Scotland	2006	E.ON UK Renewables	60	180	Monopile	18	BWEA website www.bwea.com/ukwed/construction.asp
Withdrawn/ Rejected	Solway Firth	11.3km offshore, Irish Sea	Scotland	2011	E.On Climate & Renewables UK	100	100		59	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK48
Withdrawn/	Wigtown Bay	6.2km offshore,	Scotland	2009	DONG Energy	56	280		52	www.dongenergy.co.uk/Wind_energy/,

Rejected		Irish Sea								www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK49
Concept/ Early Planning	Busan	Korea Strait	South Korea		Hyosung Corporation	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=KR10
Concept/ Early Planning	Daejeong - Phase 1	Korea Strait	South Korea		Daejeong Offshore Wind Power	12	84			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=KR09
Concept/ Early Planning	Daejeong - Phase 2	Korea Strait	South Korea		Korea Southern Power Co. Ltd	0	116			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=KR16
Operational	Demonstrative offshore windpark of Jeju island	3.2km offshore, Korea Strait	South Korea	2012	KIER - Korea Institute of Energy Research	2	5	Grounded: High-rise Pile Cap		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=KR04
Concept/ Early Planning	Dongyang	Yellow Sea	South Korea		Dongyang Engineering and Construction Corp	0	27			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=KR15
Concept/ Early Planning	Haengwon-ri	Korea Strait	South Korea		Korea South East Power Co., Ltd	30	6			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=KR05
Concept/ Early Planning	Halla E&COffshore wind Project - phase 1	Korea Strait	South Korea		Halla Engineering & Construction Corp.	0	100			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=KR17
Concept/ Early Planning	Incheon Offshore Wind Farm	20km offshore, West Korean Peninsular	South Korea	2008	Hanhwa E&C Corporation	39	97.5			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=KR14
Concept/ Early Planning	Limjado	20km offshore, East China Sea	South Korea		POSCO E&C, KOSEP	20	100			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=KR07
Concept/ Early Planning	Shinan	East China Sea	South Korea		Dongkuk S&C	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=KR08
Concept/ Early Planning	Southwest Offshore Wind Project - Phase 1	15km offshore, Yellow Sea	South Korea		Korea Electric Power Corporation	20	100			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=KR11
Concept/ Early Planning	Southwest Offshore Wind Project - Phase 2	19.6km offshore, Yellow Sea	South Korea		Korea Electric Power Corporation	0	400			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=KR12
Concept/ Early Planning	Southwest Offshore Wind Project - Phase 3	41.5km offshore, Yellow Sea	South Korea		Korea Electric Power Corporation	0	2000			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=KR13
Submitted	Taean phase I	East China Sea	South Korea		Taean Offshore Wind Co, Ltd	27	97			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=KR01
Concept/ Early Planning	Taean phase II	East China Sea	South Korea		Taean Offshore Wind Co, Ltd	0	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=KR02
Under Construction	Tamra Offshore Wind Farm Project	0.2km offshore, Korea Strait	South Korea	2011	Tamra Offshore Wind Power Co. Ltd	10	30			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=KR03
Dormant	A Mari±a	Atlantic Ocean	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES17
Dormant	Al Andalus	Atlantic Ocean	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES34
Dormant	Bajo Ximiela	Atlantic Ocean	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES15
Dormant	Banco de Trafalgar (Cßdiz)	Gulf of Cadiz	Spain		Iberdrola Renovables	83	498			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES06
Dormant	Barbate	Gulf of Cadiz	Spain			0	982			http://www.4coffshore.com/windfarms/

										windfarms.aspx?windfarmId=ES11
Dormant	Belita	Atlantic Ocean	Spain		Blue H Technologies BV	0		Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES40
Dormant	Cabo de Trafalgar	Gulf of Cadiz	Spain		Consorcio Eolico Marino Cabo de Trafalgar	0	250			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES10
Dormant	Cadiz I y IV	Gulf of Cadiz	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES30
Dormant	Cap Term	Balearic Sea	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES24
Dormant	Chipiona I y II	Gulf of Cadiz	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES29
Dormant	Costa de Azahar (Castell¾n)	Balearic Sea	Spain		Iberdrola Renewables	83	498			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES04
Dormant	Costa de la Luz (Cßdiz)	Gulf of Cadiz	Spain		Iberdrola Renewables	83	498			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES05
Dormant	Costa de la Luz (Huelva province)	Atlantic Ocean	Spain		Iberdrola Renewables	83	498			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES01
Dormant	Cßrtago	Mediterranean Sea	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES23
Dormant	Delta del Ebro	Balearic Sea	Spain		Capital Energy	144	432			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES08
Dormant	El Arrecife	Gulf of Cadiz	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES31
Concept/ Early Planning	Galicia	Atlantic Ocean	Spain		Capital Energy	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES36
Concept/ Early Planning	Gamesa 5MW Test Turbine	Atlantic Ocean	Spain		Gamesa	1	5			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES50
Concept/ Early Planning	HiPRWind	Bay of Biscay	Spain		Fraunhofer IWES	1	2	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES43
Dormant	Huelva I al VII	Atlantic Ocean	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES21
Dormant	Huelva-Cadiz	Gulf of Cadiz	Spain		Capital Energy	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES35
Dormant	Isla Cristina	Atlantic Ocean	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES19
Dormant	Isla Cristina y Lepe	Atlantic Ocean	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES20
Withdrawn/ Rejected	Las Cruces del Mar	Atlantic Ocean	Spain	2010	Energie Las Cruces del Mar S.L.	132	396			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES12
Dormant	Mar de Alborßn	Mediterranean Sea	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES22
Dormant	Mar de la Janda	Atlantic Ocean	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES33
Dormant	Mar de Trafalgar	Gulf of Cadiz	Spain		Acciona	278	1001			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES09
Dormant	Minarzo	Atlantic Ocean	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES18
Dormant	Palamos	22km offshore,	Spain		Blue H technologies BV	160	560	Floating		http://www.4coffshore.com/windfarms/

		Mediterranean Sea								windfarms.aspx?windfarmId=ES37
Dormant	Piedra La Tomasa	Atlantic Ocean	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES16
Concept/ Early Planning	Proyecto EMERGE	Bay of Biscay	Spain		Iberdrola Renewables	0		Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES49
Concept/ Early Planning	Proyecto Idermar Phase 1	4.8km offshore, Cantabrian Sea	Spain		Idermar	0		Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES44
Concept/ Early Planning	Proyecto Idermar Phase 2	16km offshore, Cantabrian Sea	Spain		Idermar	0		Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES45
Concept/ Early Planning	Proyecto Idermar Phase 3	20km offshore, Cantabrian Sea	Spain		Idermar	0		Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES46
Dormant	Puerto de Bilbao	Bay of Biscay	Spain			0	250			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES07
Dormant	Punta Aliaga	Balearic Sea	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES25
Dormant	Punta de las Olas	Atlantic Ocean	Spain		Punta de las Olas Eolica Marina	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES14
Dormant	Punta de las Salinas (Castell¾n)	Balearic Sea	Spain		Iberdrola Renovables	83	498			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES03
Dormant	Punta de Lens	Atlantic Ocean	Spain		Punta de Lens Eolica Marina SL	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES13
Dormant	Punta del Gato (Huelva)	Atlantic Ocean	Spain		Iberdrola Renovables	83	498			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES02
Dormant	Roses	26 km offshore, Mediterranean Sea	Spain		Blue H technologies BV	160	560	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES38
Dormant	San Ciprian	9km offshore, Bay of Biscay	Spain		Blue H technologies BV	171	599	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES39
Concept/ Early Planning	SeAsturLab Phase 2	2km offshore, Bay of Biscay	Spain		University of Oviedo	5	10	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES47
Concept/ Early Planning	SeAsturLab Phase 3	20km offshore, Bay of Biscay	Spain		University of Oveido	0		Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES48
Dormant	Tarragona I al IX	Balearic Sea	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES26
Dormant	Tarragona IV al IX phase 2	Balearic Sea	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES27
Dormant	Tarragona-Castellon		Spain		Capital Energy	128	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES28
Dormant	Trafalgar I y IV	Gulf of Cadiz	Spain			0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES32
Concept/ Early Planning	TROPOS Project	Atlantic Ocean	Spain		PLOCAN	0		Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES51
Concept/ Early Planning	Zefir Phase 1	3.5km offshore, Mediterranean Sea	Spain		Catalonia Institute for Energy Research	4	20	Monopile		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES41
Concept/ Early Planning	Zefir Phase 2	30km offshore, Mediterranean Sea	Spain		Catalonia Institute for Energy Research	8	50	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=ES42
Concept/ Early Planning	300MW North Western Coast	Palk Strait/ Gulf of Mannar	Sri Lanka		Tiefbau GmbH Unterweser (TAGU)	0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=LK01
Submitted	Blekinge Offshore AB	12km offshore, Baltic Sea	Sweden	2010	Blekinge Offshore AB	500	2500		215	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE16

Operational	Bockstigen	4km offshore, Baltic Sea	Sweden	1998	OM O2	5	3	Monopile		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE02
Submitted	Finngrunden	33.2km offshore, Gulf of Bothnia	Sweden	2009	wpd Offshore Finngrunden AB	300	1500		237	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE07
Submitted	Kattegat Offshore	8.9km offshore, Kattegat Sea	Sweden	2012	Favonius AB (AGRIVIND AB)	47	282		22	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE23
Dormant	Klasarden	1.6km offshore, Baltic Sea	Sweden		OM O2	16	48	Gravity base		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE09
Concept/ Early Planning	Klocktōrnan	17km offshore, Gulf of Bothnia	Sweden		Klocktōrnan Offshore AB	132	660		87	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE15
Under Construction	KŌrehamn	3.8km offshore, Baltic Sea	Sweden		E.ON Vind Sverige AB	21	50		2	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE08
Approved	Kriegers Flak II	32.7km offshore, Baltic Sea	Sweden	2006	Sweden Offshore Wind AB	128	640		63	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE01
Operational	Lillgrund	9.3km offshore, Oresund Sea	Sweden	2007	Vattenfall	48	110	Gravity base	6	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE05
Concept/ Early Planning	Marviken	1.4km offshore, Baltic Sea	Sweden	2011	Rewind Offshore	12	60		11	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE25
Concept/ Early Planning	Petlandsskōr	Gulf of Bothnia	Sweden		Petlandsskōr Vind AB	30	90			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE19
Operational	Risholmen - Arendal	Skagarrek	Sweden	2012	GE Energy	1	4	Monopile		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE20
Submitted	Sodra Midsjobanken	96.4km offshore, Baltic Sea	Sweden		E.on Vind Sverige AB	300	1000		1060	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE11
Decommissioned	SeaTwirl Prototype III	Kattegat Sea	Sweden	2011	Ehrnburg Solutions AB	1		Spar Floater		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE24
Submitted	Skottarevsprojektet	9.5km offshore, Kattegat	Sweden		Favonius AB	30	150			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE10
Approved	Stora Middelgrund	25km offshore, North Sea	Sweden	2009	Universal Wind AB	108	540		64	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE18
Approved	Storgrundet	13km offshore, Gulf of Bothina	Sweden	2010	Storgrundet Offshore AB	53	265		67	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE14
Submitted	Taggen Vindpark	19km offshore, Baltic Sea	Sweden		Taggen Vindpark AB	60	300		50	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE17
Submitted	Trolleboda	2.3km offshore, Baltic Sea	Sweden	2009	Vattenfall Europe Windkraft GmbH	30	150		22	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE12
Operational	Utgrunden I	4.2km offshore, Baltic Sea	Sweden	2000		7	11	Monopile		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE03
Approved	Utgrunden II	5.9km offshore, Baltic Sea	Sweden	2005	E.ON Vind Sverige AB	24	86		10	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE13
Operational	Yttre Stengrund	2km offshore, Baltic Sea	Sweden	2001		5	10	Monopile		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=SE04
Concept/ Early Planning	Changhua - Stage I - Taipower	4km offshore, Taiwan Strait	Taiwan		Taipower (Taiwan Power Company)	36	129.6		15	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW13
Concept/ Early Planning	Changhua - Stage II - Taipower	4.6km offshore, Taiwan Strait	Taiwan		Taipower (Taiwan Power Company)	48	172.8		24	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW06
Concept/ Early Planning	Changhua - Stage III - Taipower	6.7km offshore, Taiwan Strait	Taiwan		Taipower (Taiwan Power Company)	0	216		20	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW15
Concept/ Early	Changhua - Stage IV	4.8km offshore,	Taiwan		Taipower (Taiwan	55	198		23	http://www.4coffshore.com/windfarms/

Planning	- Taipower	Taiwan Strait			Power Company)					windfarms.aspx?windfarmId=TW17
Concept/ Early Planning	Changhua - Stage V - Taipower	5.1km offshore, Taiwan Strait	Taiwan		Taipower (Taiwan Power Company)	54	194.4		21	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW18
Concept/ Early Planning	Changhua - Stage VI - Taipower	5.8km offshore, Taiwan Strait	Taiwan		Taipower (Taiwan Power Company)	47	169.2		19	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW19
Concept/ Early Planning	Changhua Offshore Pilot Project (COPP) - TGC	7.7km offshore, Taiwan Strait	Taiwan		Taiwan Generations Corporation	2	7.2	Jacket		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW11
Concept/ Early Planning	Chiayi - Star Energy	Taiwan Strait	Taiwan		Star Energy	43				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW20
Concept/ Early Planning	Fuhai	8km offshore, Taiwan Strait	Taiwan	2011	Taiwan Generations Corporation	28	100.8		14	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW01
Concept/ Early Planning	Fuhai Test Zone - TGC	11km offshore, Taiwan Strait	Taiwan		Taiwan Generations Corporation	22	100		11	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW12
Concept/ Early Planning	Hanbao - TGC	Taiwan Strait	Taiwan		Taiwan Generations Corporation	24	120			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW04
Concept/ Early Planning	Miaoli - Hai-Ding	Taiwan Strait	Taiwan		Hai-Ding	60	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW16
Concept/ Early Planning	Offshore Wind Demonstration Penghu Island	Formosa Strait	Taiwan		Taiwanese Government	1	8			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW07
Concept/ Early Planning	Penghu - Taipower	14.8km offshore, Formosa Strait	Taiwan		Taipower (Taiwan Power Company)	40	120		10	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW14
Concept/ Early Planning	Penghu - TGC	Formosa Strait	Taiwan		Taiwan Generations Corporation	122				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW09
Concept/ Early Planning	Tainan - Star Energy	Taiwan Strait	Taiwan		Star Energy	123				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW21
Concept/ Early Planning	Xidao	Taiwan Strait	Taiwan		Taiwan Generations Corporation	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW02
Concept/ Early Planning	Yunlin - Star Energy	Taiwan Strait	Taiwan		Star Energy	93	93			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW08
Concept/ Early Planning	Yunlin - Taipower	Taiwan Strait	Taiwan		Taipower (Taiwan Power Company)	70	252			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW10
Concept/ Early Planning	Yunlin - TGC	Taiwan Strait	Taiwan		Taiwan Generations Corporation	61				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW05
Concept/ Early Planning	Zhangfang	Taiwan Strait	Taiwan		Taiwan Generations Corporation	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TW03
Dormant	Aicha	Mediterranean Sea	Tunisia		Sky Saver S.R.L	0		Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=TN01
Concept/ Early Planning	Apex Offshore Wind North Carolina Phase 1	32.2km offshore, Atlantic Ocean	USA	2010	Apex Offshore Wind	165	200		280	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US99
Concept/ Early Planning	Apex Offshore Wind North Carolina Phase 2	57.3km offshore, Atlantic Ocean	USA	2010	Maersk Line, limited	360	1300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US0R
Withdrawn/ Rejected	Apex Offshore Wind Virginia	12 miles off Virginia Beach	USA	2010	Apex Wind Energy	0	1500			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US72
Concept/ Early Planning	Apex Virginia Offshore Wind	51.8km offshore, Atlantic Ocean	USA		Apex Virginia Offshore Wind, LLC	0			430	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US3E

Concept/ Early Planning	Aqua Ventus I (University of Maine)	Atlantic Ocean	USA	2012	University of Maine	2	12			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US3Z
Concept/ Early Planning	Arcadia (Virginia Call Response)	51.7km offshore, Atlantic Ocean	USA	2012	Arcadia Offshore, LLC	0			457	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US3F
Concept/ Early Planning	Arcadia Offshore (Maryland Call Response)	24.4km offshore, Atlantic Ocean	USA	2012	Arcadia Offshore, LLC	0			322	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US3S
Concept/ Early Planning	Arcadia Offshore Massachusetts	53.3km offshore, Atlantic Ocean	USA	2012	Arcadia Offshore, LLC	0			1844	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US3M
Dormant	Belinda Commercial Project	37km offshore, Atlantic Ocean	USA	2008	Blue H USA	120	420	Floating: Semi-submersible platform		http://www.4coffshore.com/windfarms/belinda-commercial-project-united-states-us76.html
Dormant	Belinda Project	44km offshore, Atlantic Ocean	USA	2008	Blue H USA	1		Floating: Tension Leg Platform		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US04
Submitted	Block Island Wind Farm	3 miles South East of Block Island	USA	2012	Deepwater Wind LLC	5	30	Jacket	5	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US12
Concept/ Early Planning	Bluewater Wind (New Jersey Call Response)	25.9km offshore, Atlantic Ocean	USA	2011	Bluewater Wind New Jersey LLC	0			974	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2C
Concept/ Early Planning	Bluewater Wind Delawere	12 miles off coast of Rehoboth Beach	USA		NRG Bluewater Wind	150				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US19
Concept/ Early Planning	Bluewater Wind Interim Policy Lease	31km offshore, Atlantic Ocean	USA	2011	NRG Bluewater Wind	116	348		23	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US16
Withdrawn/ Rejected	Bluewater Wind Maryland	19km offshore, Atlantic Ocean	USA	2012	NRG Bluewater Wind	200	600		708	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US20
Submitted	Bluewater Wind Rhode Island	Atlantic Ocean	USA	2012	NRG Bluewater Wind	5	450			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US47
Concept/ Early Planning	Boon Island	10 miles off Kittery Point	USA	2009	Maine State-Department of Conservation	0				http://www.4coffshore.com/windfarms/boon-island-united-states-us29.html
Withdrawn/ Rejected	Brazoria Offshore	Brazoria County, Gulf of Mexico	USA	2007	Wind Energy Systems Technology	0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US07
Concept/ Early Planning	Brigantine OffshoreMW Phase 1	23km offshore, Atlantic Ocean	USA	2010	OffshoreMW	0	350			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US0E
Withdrawn/ Rejected	Brigantine OffshoreMW Phase 2	23km offshore, Atlantic Ocean	USA	2010	OffshoreMW	0	350		208	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US0F
Withdrawn/ Rejected	Brownsville Offshore	13.2km offshore, Gulf of Mexico	USA	2007		0	500		79	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US09
Withdrawn/ Rejected	Cape Lookout Energy Preserve	Atlantic Ocean	USA		Outer Banks Ocean Energy Corporation	50	200			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US36
Approved	Cape Wind	Horseshoe Shoal, Nantucket Sound	USA	2009	Cape Wind Associates	130	468			http://www.4coffshore.com/windfarms/cape-wind-united-states-us03.html
Withdrawn/ Rejected	Center for Ocean Renewable Energy	Atlantic Ocean	USA		University of New Hampshire	1	0.01	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US0S
Withdrawn/ Rejected	Chesapeake Bay Test Site	5km offshore, Atlantic Ocean	USA	2012	Newport News Energy	1	5	Monopile		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US1O

Concept/ Early Planning	Cirrus (Virginia Call Response)	44.2km offshore, Atlantic Ocean	USA		Cirrus Wind Energy Inc.	0			69	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US3G
Concept/ Early Planning	Condor Wind Energy Mass Call Response	52.6km offshore, Atlantic Ocean	USA	2012	Condor Wind Energy LLC	208	1040		216	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US1P
Concept/ Early Planning	Coos Bay Principle Power	Pacific Ocean	USA	2012	Principle Power Inc	5	30			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US4A
Withdrawn/ Rejected	Corpus Christi Offshore	8km offshore, Gulf of Mexico	USA	2007	Wind Energy Systems Technology	0	500		74	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US08
Concept/ Early Planning	Damariscove Island	Gulf of Maine	USA	2010	Maine state- department of conservation	0				http://www.4coffshore.com/windfarms/damariscove-island-united-states-us30.html
Concept/ Early Planning	Deepwater Wind (RI and MA Call Response)	39.4km offshore, Atlantic Ocean	USA	2012	Deepwater Wind New England	200	1000	Jacket and gravity	634	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2S
Withdrawn/ Rejected	Deepwater Wind Delawere	Atlantic Ocean	USA		Deepwater Wind LLC	0		Jacket		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US71
Withdrawn/ Rejected	Deepwater Wind Energy Center Phase 1	35km offshore, Atlantic Ocean	USA		Deepwater Wind Rhode Island LLC	50	250	Jacket	104	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US75
Withdrawn/ Rejected	Deepwater Wind Energy Center Phase 2	43.6km offshore, Atlantic Ocean	USA		Deepwater Wind Rhode Island LLC	50	250	Jacket	98	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US0M
Withdrawn/ Rejected	Deepwater Wind Energy Center Phase 3	31.7km offshore, Atlantic Ocean	USA		Deepwater Wind Rhode Island LLC	50	250	Jacket	98	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US0N
Withdrawn/ Rejected	Deepwater Wind Energy Center Phase 4	48.8km offshore, Atlantic Ocean	USA		Deepwater Wind Rhode Island LLC	50	250	Jacket	113	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US0P
Concept/ Early Planning	Deepwater Wind Interim Policy Lease	30.4km offshore, Atlantic Ocean	USA	2010	Garden State Offshore Energy	96	346	Jacket	23	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US15
Dormant	Deepwater Wind Maine	Gulf of Maine	USA	2010	Deepwater Wind LLC	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US81
Withdrawn/ Rejected	Deepwater Wind Maryland	Atlantic Ocean	USA		Deepwater Wind LLC	0	350	Jacket		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US21
Withdrawn/ Rejected	Deepwater Wind Massachusetts	Atlantic Ocean	USA	2010	Deepwater Wind LLC	0		Jacket		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US0B
Concept/ Early Planning	Deepwater Wind New England	42.2km offshore, Atlantic Ocean	USA	2012		0			831	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US3N
Concept/ Early Planning	Delaware Demo Site	Atlantic Ocean	USA	2012	University of Delaware	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US3U
Concept/ Early Planning	Dominion (Virginia Call Response)	51.7km offshore, Atlantic Ocean	USA	2012	Dominion Resources	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US3H
Concept/ Early Planning	Dominion Twisted Jacket Demonstrator	35km offshore, Atlantic Ocean	USA	2012	Dominion Resources	2	12	Jacket		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US4B
Concept/ Early Planning	Energy Management (Massachusetts Call Response)	36.5km offshore, Atlantic Ocean	USA	2012	Energy Management Inc	0			570	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US1Q
Concept/ Early Planning	Energy Management (RI and MA Call	33.4km offshore, Atlantic Ocean	USA	2012	Energy Management Inc	0			337	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2T

	Response)									
Concept/ Early Planning	Energy Management Maryland	24.4km offshore, Atlantic Ocean	USA	2012	Energy Management Inc	0			322	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US1D
Concept/ Early Planning	enXco (RI and MA Call Response)	32.4km offshore, Atlantic Ocean	USA	2012	enXco Development Corporation	0			571	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2U
Concept/ Early Planning	enXco (Virginia Call Response)	51.7km offshore, Atlantic Ocean	USA	2012	enXco Development Corporation	0			454	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US3I
Concept/ Early Planning	enXco Development Corporation	24.4km offshore, Atlantic Ocean	USA	2012	enXco Development Corporation	0			322	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US3R
Concept/ Early Planning	enXco Development Corporation (Massachusetts)	42.8km offshore, Atlantic Ocean	USA	2012	enXco Development Corporation	0			1129	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US3P
Concept/ Early Planning	enXco Development Corporation (New Jersey)	26.5km offshore, Atlantic Ocean	USA	2011	enXco Development Corporation	0			1036	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2H
Dormant	Eureka Coastal Wind Power Project	Pacific Ocean	USA		Pavillion Energy Resources	0	10000			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US46
Concept/ Early Planning	First State Marine Wind	Breakwater Harbour, Delawere Bay	USA		First State Marine Wind LLC	0				http://www.4coffshore.com/windfarms/first-state-marine-wind-united-states-us39.html
Concept/ Early Planning	Fisherman's Energy (Virginia Call Response)	51.7km offshore, Atlantic Ocean	USA	2012	Fishermen's Energy	0			430	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US3J
Concept/ Early Planning	Fishermen's Atlantic City Wind Farm Phase II	12km offshore, Atlantic Ocean	USA		Fishermen's Energy	66	330		88	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US17
Concept/ Early Planning	Fishermen's Atlantic City Windfarm Phase I	Atlantic Ocean	USA		Fishermen's Energy	6	25	Monopile	2	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US69
Concept/ Early Planning	Fishermen's Energy (Maryland Call Response)	24.4km offshore, Atlantic Ocean	USA	2012	Fishermen's Energy	0			322	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US0Y
Concept/ Early Planning	Fishermen's Energy (Massachusetts Call Response)	55.3km offshore, Atlantic Ocean	USA	2012	Fishermen's Energy	0			3342	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US1R
Concept/ Early Planning	Fishermen's Energy (New Jersey Call Response)	25.3km offshore, Atlantic Ocean	USA		Fishermen's Energy	0			1279	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2L
Concept/ Early Planning	Fishermen's Energy (RI and MA Call Response)	32.3km offshore, Atlantic Ocean	USA		Fishermen's Energy	0			470	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2V
Dormant	Fishermen's Energy (RI) Energy Independence 1		USA		Fishermen's Energy	80	400			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2Q
Withdrawn/ Rejected	Fishermen's Energy Nomination 2	40.8km offshore, Atlantic Ocean	USA	2012	Fishermen's Energy	0			75	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US0Z
Concept/ Early Planning	Fishermen's Interim Policy Lease	18.9km offshore, Atlantic Ocean	USA		Fishermen's Energy	6			9	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US1H
Withdrawn/	Free Flow Power	34.5km offshore,	USA	2012	Free Flow Power	0			484	http://www.4coffshore.com/windfarms/

Rejected	Corporation	Atlantic Ocean			Corporation					windfarms.aspx?windfarmId=US1S
Concept/ Early Planning	Galveston Offshore Wind Phase 1	11.9km offshore, Galveston, Gulf of Mexico	USA	2005	Galveston-Offshore Wind LLC	75	150	Jacket (tripod)	23	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US05
Concept/ Early Planning	Galveston Offshore Wind Phase 2	11km offshore, Galveston, Gulf of Mexico	USA	2005	Coastal Point Energy LLC	75	150	Jacket (tripod)	23	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US86
Approved	Galveston Test	Gulf of Mexico	USA	2008	Galveston-Offshore Wind LLC	1	.75			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US0I
Concept/ Early Planning	Georgia Lease 1	Coast of Georgia	USA		Southern Company	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US25
Concept/ Early Planning	Georgia Lease 2	Coast of Georgia	USA		Southern Company	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US26
Concept/ Early Planning	Georgia Lease 3	Coast of Georgia	USA		Southern Company	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US27
Dormant	Grays Harbor Demonstration Project	2 miles of Coast state of Washington	USA	2010	Grays Harbor Ocean Energy Company LLC	1	10			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US0C
Concept/ Early Planning	Gulf Offshore Wind	10.2km offshore, Gulf of Mexico	USA	2012	Baryonyx Corporation	3	18	Jacket	1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US95
Concept/ Early Planning	Hampton Roads Demonstration Project	1.7km offshore, Cheapsake Bay	USA		Virginia State Government	3	15		6	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US0Q
Concept/ Early Planning	Hudson Canyon	56km offshore, Atlantic Ocean	USA		Deepwater Wind, LLC	200	1000			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2P
Withdrawn/ Rejected	Hull Offshore Wind Project	2 miles off east coast of Hull, Nantucket Beach	USA	2007	Hull Municipal Light Plant	4	20			http://www.4coffshore.com/windfarms/hull-offshore-wind-energy-project-united-states-us01.html
Concept/ Early Planning	Hywind 2 Demonstration (Maine)	20km offshore, Atlantic Ocean	USA	2012	Statoil North America	4	12	Spar Floater	58	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US3B
Concept/ Early Planning	Iberdrola (Virginia Call Response)	51.7km offshore, Atlantic Ocean	USA		Iberdrola Renewables, Inc	0			457	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US3K
Concept/ Early Planning	Iberdrola Renewables (Massachusetts Call Response)	45.9km offshore, Atlantic Ocean	USA		Iberdrola Renewables, Inc	0			1392	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US1V
Concept/ Early Planning	Iberdrola Renewables (New Jersey Call Response)	28km offshore, Atlantic Ocean	USA		Iberdrola Renewables, Inc	0			1013	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2K
Concept/ Early Planning	Iberdrola Renewables (RI and MA Call Response)	30.9km offshore, Atlantic Ocean	USA		Iberdrola Renewables, Inc	0			564	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2W
Withdrawn/ Rejected	Iberdrola Renewables(Maryland RFI Response)	23.5km offshore, Atlantic Ocean	USA	2012	Iberdrola Renewables, Inc	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US1B
Withdrawn/ Rejected	Jefferson Offshore	13km offshore, Gulf of Mexico	USA	2007		0	300			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US06

Withdrawn/ Rejected	Jones Beach	19km offshore, Atlantic Ocean	USA		Deepwater Wind LLC	260	940	Jacket		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US77
Withdrawn/ Rejected	Long Island 1	24km offshore, Atlantic Ocean	USA		Deepwater Wind LLC	167	600			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US78
Withdrawn/ Rejected	Long Island 2	19km offshore, Atlantic Ocean	USA		Deepwater Wind LLC	86	300	Jacket		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US13
Concept/ Early Planning	Long Island New York City Offshore Wind Phase 1	13 miles off Rockaway Peninsula, New York	USA	2008	Long Island- New York City Offshore Collaborative	0	350			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US14
Concept/ Early Planning	Long Island New York City Phase 2	48.4km offshore, Atlantic Ocean	USA		Long Island - NY City Offshore Wind Collaborative	97	350	Monopile, jacket or gravity based	117	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US97
Withdrawn/ Rejected	Long Island Offshore Wind Project	6 miles offshore Long Island	USA		Long Island Power Authority	0	144			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US68
Concept/ Early Planning	Maine Commercial Scale Wind Farm	Atlantic Ocean	USA			0	1000	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US1N
Concept/ Early Planning	Maine Pilot	Gulf of Maine, 2 miles from shore	USA	2010	Currently awaiting proposals	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmID=us85
Concept/ Early Planning	Mainstream Renewable Power	34.4km offshore, Atlantic Ocean	USA	2012	Mainstream Renewable Power	0			453	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2X
Withdrawn/ Rejected	Maryland Offshore (Maryland RFI Response)	31km offshore, Atlantic Ocean	USA		Maryland Offshore LLC	0			708	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US1E
Concept/ Early Planning	Monhegan Island- Maine Uni DeepCWind Test Site	Gulf of Maine	USA	2010	DeepCWind Consortium	0				http://www.4coffshore.com/windfarms/monhegan-island-united-states-us31.html
Concept/ Early Planning	Mustang Alternate Lease Area	13.7km offshore, Gulf of Mexico	USA		Baryonyx Corporation	50	1200		185	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US3T
Concept/ Early Planning	Mustang Island Phase 2	Corpus Christi, Gulf of Mexico	USA	2009	Baryonyx Corporation	57	342			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US89
Concept/ Early Planning	Mustang Island Phase 3	Corpus Christi, Gulf of Mexico	USA	2009	Baryonyx Corporation	57	342			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US90
Concept/ Early Planning	Mustang Island Phase 4	Corpus Christi, Gulf of Mexico	USA	2009	Baryonyx Corporation	57	342			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US66
Concept/ Early Planning	Mustang Island Phase 5	Corpus Christi, Gulf of Mexico	USA	2009	Baryonyx Corporation	57	342			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US91
Withdrawn/ Rejected	NC Coastal Wind Demonstration Project	Pamlico Sound, North Carolina	USA	2009	Duke Energy	3	11		2	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US38
Concept/ Early Planning	Neptune Wind (New Jersey Call Response)	29.4km offshore, Atlantic Ocean	USA	2011	Neptune Wind	0			259	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2B
Concept/ Early Planning	Neptune Wind (RI and MA Call Response)	28.4km offshore, Atlantic Ocean	USA		Neptune Wind	0			256	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2Y
Withdrawn/ Rejected	Neptune Wind Expression 1	50.4km offshore, Atlantic Ocean	USA	2012	Neptune Wind	0			1175	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US1T

Concept/ Early Planning	Neptune Wind Expression 2	61.7km offshore, Atlantic Ocean	USA	2012	Neptune Wind	0			812	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US1U
Dormant	Neptune Wind Maine	Gulf of Maine 2 miles offshore	USA	2010	Neptune Wind	0	500			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US79
Concept/ Early Planning	New Jersey Offshore Wind	Atlantic Ocean	USA	2011	New Jersey Offshore Wind LLC	0			1412	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2J
Dormant	Newport Nearshore Windpark	6.8km offshore, Delawere Bay	USA	2011	Delsea Energy LLC	106	382		111	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US18
Withdrawn/ Rejected	No Fossil Fuel	30.4km offshore, Atlantic Ocean	USA	2012	No Fossil Fuel, LLC	0			138	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US1W
Withdrawn/ Rejected	Nomans Wind	Atlantic Ocean	USA	2011	Neptune Wind	0	500			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US80
Withdrawn/ Rejected	NRG Bluewater Wind	52.8km offshore, Atlantic Ocean	USA	2012	NRG Bluewater Wind Massachusetts LLC	0			2005	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US1X
Withdrawn/ Rejected	Occidental Development Delawere	12 miles off coast of Rehoboth Beach	USA	2010	Occidental Development & Equities LLC	0				http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US88
Withdrawn/ Rejected	Ocean Energy Test Area D	Gulf of Maine 15 miles offshore	USA	2010	Maine State-Department of Conservation	0				http://www.4coffshore.com/windfarms/ocean-energy-test-area-d-united-states-us32.html
Withdrawn/ Rejected	Ocean Energy Test Area E	Gulf of Maine	USA	2010	Maine State-Department of Conservation	0				http://www.4coffshore.com/windfarms/ocean-energy-test-area-e-united-states-us33.html
Withdrawn/ Rejected	Ocean Energy Test Area F	Gulf of Maine	USA	2010	Maine State-Department of Conservation	0				http://www.4coffshore.com/windfarms/ocean-energy-test-area-f-united-states-us34.html
Withdrawn/ Rejected	Ocean Energy Test Area G	Gulf of Maine	USA	2010	Maine State-Department of Conservation	0				http://www.4coffshore.com/windfarms/ocean-energy-test-area-g-united-states-us35.html
Dormant	OEI Maine	20km offshore, Atlantic Ocean	USA	2010	Ocean Energy Institute	1000	5000	Floating		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US10
Concept/ Early Planning	Offshore MW Massachusett Phase 1	38.7kmoffshore, Atlantic Ocean	USA	2010	Martha's Vineyard Offshore Wind Alliance	0	1000		662	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US0G
Concept/ Early Planning	OffshoreMW (New Jersey Call Response)	28.4km offshore, Atlantic Ocean	USA	2011	OffshoreMW	0			477	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2A
Concept/ Early Planning	Orisol Energy (Virginia Call Response)	52km offshore, Atlantic Ocean	USA	2012	Orisol Energy Inc	0			392	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US3L
Concept/ Early Planning	Orisol Energy Maryland	21.78km offshore, Atlantic Ocean	USA	2010	Orisol Energy Inc	0			213	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US1C
Withdrawn/ Rejected	Padre Island	7.3km offshore, Gulf of Mexico	USA		Babcock and Brown	170	500		215	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US87
Concept/ Early Planning	Palmetto Wind REsearch Project	12km offshore, Atlantic Ocean	USA	2009	South Carolina Energy Office	0	80			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US43
Withdrawn/ Rejected	Plum Island	0.2km offshore, Atlantic Ocean	USA	2009	Deepwater Wind LLC	3	10.8	Monopile, Tripod	1	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US11
Withdrawn/	Proposed Lease Area	10 miles offshore	USA	2009	NRG Bluewater Wind	0				http://www.4coffshore.com/windfarms/b

Planning	Renewable Power Site C	Atlantic Ocean			Renewable Power Inc					windfarms.aspx?windfarmId=US2G
Withdrawn/ Rejected	US Wind (Massachusetts RFI Response)	44.8km offshore, Atlantic Ocean	USA	2012	US Wind Inc.	0			278	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US0H
Concept/ Early Planning	US Wind (RI and MA Call Response)	31.4km offshore, Atlantic Ocean	USA		US Wind Inc.	0			194	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2Z
Concept/ Early Planning	US Wind Inc (New Jersey Call Response)	26.2km offshore, Atlantic Ocean	USA		US Wind Inc.	0			625	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US2I
Concept/ Early Planning	Vermilion Bay	1km offshore, Gulf of Mexico	USA		Coastal Point Energy LLC	18	36	Monopile		http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US84
Withdrawn/ Rejected	Vineyard Power	Atlantic Ocean	USA	2010	Vineyard Power	17	43			http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=US0D
Concept/ Early Planning	Irish Sea North East Potential Development Area	15km offshore, Irish Sea	Wales		Centrica Renewable Energy Limited	0	1400		360	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK38
Concept/ Early Planning	Irish Sea South East Potential Development Area	15km offshore, Irish Sea	Wales		Centrica Renewable Energy Limited, DONG	0	1400		621	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK1Q
Concept/ Early Planning	Irish Sea South West Potential Development Area	15km offshore, Irish Sea	Wales		Centrica Renewable Energy Limited, DONG	0	1400		269	http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK1R
Operational	North Hoyle	7.5km offshore, Rhyl	Wales	2004	NWP Offshore Ltd	30	60	Monopile	10	BWEA website www.bwea.com/ukwed/operational.asp
Operational	Rhyl Flats	8km Abergele, Irish Sea	Wales	2009	npower renewables	25	90	Monopile	10	http://www.bwea.com/ukwed/operational.asp
Withdrawn/ Rejected	Scarweather Sands	5.5km Sker Point (nrPorthcawl)	Wales	2004	DONG Energy/ E.ON UK	30	108	Monopile	10	http://www.bwea.com/ukwed/offshore.asp

11. Appendix 2 - Wave energy sites table

Stage of Development	Name of Wave Energy Site	Location	Country	Year	Developer	Device Category	Energy Capacity (MW)	Source of Information
Concept/ Early Planning	King Island	Offhshore, King Island	Australia		BioWave	Oscillating Wave Surge Converter		http://www.biopowersystems.com/projects.html
Operational	Lorne Pier Demonstration Unit	Lorne Pier	Australia	2010	AquaGen Technologies	Buoyant Moored Device/ Point Absorber		http://www.aquagen.com.au/projects/lorne-pier-demonstration
Approved	Perth Wave Energy Project	Offshore, Garden Island	Australia	2011	Carnegie	Buoyant Moored Device/ Point Absorber		http://www.carnegiewave.com/index.php?url=/projects/perthproject
Approved	Port Fairy	Port Fairy	Australia	2013	BioPower Systems	Oscillating Wave Surge Converter		http://www.biopowersystems.com/port-fairy.html
Decommissioned	Port Kembla. Mk1	Port Kembla	Australia	2009	Oceanlinx Limited	Oscillating Water Column	0.5	http://www.oceanlinx.com/projects/past-projects/mk1-2005
Decommissioned	Port Kembla. Mk2 - test turbine	Port Kembla	Australia	2009	Oceanlinx Limited	Oscillating Water Column		http://www.oceanlinx.com/projects/past-projects/mk2-2007
Decommissioned	Port Kembla. Mk3 - pre-commercial demonstration	Port Kembla	Australia	2010	Oceanlinx Limited	Oscillating Water Column	2.5	http://www.oceanlinx.com/projects/past-projects/mk3-2010
Concept/ Early Planning	Port Macdonnell		Australia	2007	Oceanlinx Limited	Oscillating Water Column		http://www.oceanlinx.com/projects/south-australia
Concept/ Early Planning	Western Australia Wave Power Station	Portland	Australia		Ocean Power Technologies	Buoyant Moored Device/ Point Absorber	19	http://www.oceanpowertechnologies.com/portland.html
Operational	Lord's Cove - Test Site	Lord's Cove	Canada	2011	College of the North Atlantic	Buoyant Moored Device/ Point Absorber		http://www.cna.nl.ca/news/default.asp?MessageID=789
Submitted	Ucluelet Wave Energy Project	Amphitrite Point	Canada		Carnegie			http://www.carnegiewave.com/index.php?url=/projects/Canada%20project
Operational	WET Sandy Cove - Test Site	Sandy Cove	Canada	2007	Wave Energy Technologies	Buoyant Moored Device/ Point Absorber	0.04	http://www.waveenergytech.com/project_partners.aspx
Operational	DanWEC - Test Site	Hanstholm	Denmark	2009	Wave Star, Dexawave	Point Absorber, Attenuator		http://www.danwec.com/en/home.htm
Operational	Horn's Rev	14km offshore	Denmark	2012	Wave Star Energy		0.5	http://wavestarenergy.com/
Operational	Nissum Bredning	Nissum Bredning Fijord	Denmark	2006	Wave Star Energy			www.wavestarenergy.com/
Concept/ Early Planning	Wave Hub - OPT	Wave Hub Test Site	England		Ocean Power Technologies	Buoyant Moored Device/ Point Absorber	5	http://www.oceanpowertechnologies.com/cornwall.html
Operational	Wave Hub - Test Site	16km offshore from Hayle	England	2007	South West Regional Development Agancy			http://www.wavehub.co.uk/about/location-of-wave-hub/
Operational	REV wave energy test site		France	2010				http://www.semrev.fr/en/en-presentation
Operational	Galway Bay Wave Energy Test Site	N side Galway Bay, 1 mile East of An Spideal	Ireland	2006	Marine Institute and Sustainable Energy Ireland			www.marine.ie/
Operational	Kvitsoy Pilot Project	Kvitsoy	Norway	2007	Wave Energy		0.2	www.wavessg.com/WAVESSGProject.htm
Operational	Storwave	Runde Enviroenmental Centre	Norway	2006	Runde Environmental Centre	Oscillating Water Column	0.03	http://www.rundecentre.no/english/projects/projects-wave-power.htm
Operational	Aguþadoura - Test Site	5km offshore from	Portugal	2006	Energias de Portugal		22.5	www.power-

		Agucaduora						technology.com/projects/pelamis/
Operational	Pico	Pico Harbour	Portugal	1999	WavEC	Oscillating Water Column		http://www.pico-owc.net/
Operational	WaveRoller - Test site	Peniche	Portugal	2007	WaveRoller	Oscillating Wave Surge Converter		http://www.aw-energy.com/index.html
Concept/ Early Planning	Aegir	1-10km offshore, Shetland Islands	Scotland	2011	Pelamis Wave Power, Vattenfall	Attenuator	10	http://www.pelamiswave.com/our-projects/aegir-shetland
Concept/ Early Planning	Aquamarine lease (part of North West Lewis)	Area between BÓgh Dhail Beag and TrÓigh Shanndaigh	Scotland	2011	Aquamarine Power	Oscillating Wave Surge Converter	30	http://www.aquamarinepower.com/projects/north-west-lewis/
Concept/ Early Planning	Bernera Wave Farm	Great Bernera, Isle of Lewis	Scotland	2011	Pelamis Wave Power	Attenuator	10	http://www.pelamiswave.com/our-projects/bernera-wave
Operational	Billia Croo Test Site	2km offshore from Billia Croo	Scotland	2003	European Marine Energy Centre (EMEC)			www.emec.org.uk/wave_site.asp
Concept/ Early Planning	Brough Head	Orkney	Scotland	2011	Aquamarine Power, SSE Renewables Holdings (UK) Ltd	Oscillating Wave Surge Converter	200	http://www.aquamarinepower.com
Concept/ Early Planning	Costa Head	Orkney	Scotland	2011	SSE Renewables Holdings (UK) Ltd		200	www.sse.com/CostaHead/
Submitted	Faroes		Scotland	2007	Wavegen	Oscillating water column		www.wavegen.co.uk/what_we_offer_limpet_faroes.htm
Concept/ Early Planning	Farr Point Wave Farm	3-12km offshore from Bettyhill	Scotland	2011	Pelamis Wave Power	Attenuator	50	www.pelamiswave.com/our-projects/farr-point-wave-farm
Concept/ Early Planning	Galson site (part of North West Lewis)	Isle of Lewis	Scotland	2011	Aquamarine Power	Oscillating Wave Surge Converter	10	http://www.aquamarinepower.com/projects/north-west-lewis/
Operational	Limpet 500	Portnahaven	Scotland	2000	Wavegen	Oscillating Water Column		www.wavegen.co.uk/what_we_offer_limpet_islay.htm
Concept/ Early Planning	Marwick Head	Orkney	Scotland	2011	Scottish Power Renewables		50	Crown Estate, www.scottishpowerrenewables.com/pages/marwick_head.asp
Operational	Moray Firth Test Site	33nm from Invergordon	Scotland	2011	Ocean Power Technologies	Buoyant Moored Device/ Point Absorber	0.15	http://www.oceanpowertechnologies.com
Decommissioned	Oyster 1	Billa Croo Test Site, Orkney	Scotland	2011	Aquamarine Power	Oscillating Wave Surge Converter	0.315	www.aquamarinepower.com/projects/oyster-1-orkney/
Operational	Oyster 800 project - Test site	Billa Croo Test Site, Orkney	Scotland	2012	Aquamarine Power	Oscillating Wave Surge Converter	2.4	http://www.aquamarinepower.com/projects/oyster-800-project-orkney/
Operational	Scapa Flow, Wave Scale Test Site	St MaryÆs Bay	Scotland		Euopean Marine Energy Centre			http://www.emec.org.uk/scale_sites.asp
Operational	Scotland	33nm from Invergordon, North Sea	Scotland	2011	Ocean Power Technologies	Buoyant Moored Device/ Point Absorber	0.15	http://www.oceanpowertechnologies.com/scotland.html
Withdrawn/ Rejected	Siadar Wave Energy Project	350m offshore in Siadar Bay	Scotland	2009	npower/ Wavegen	Oscillating Water Column	4	http://www.wavegen.co.uk/
Concept/ Early Planning	West Orkney Middle South	Orkney	Scotland	2011	E.ON Climate & Renewables UK Limited		50	Crown Estate, www.eon-uk.com/generation/westorkneymiddlesouth.aspx
Concept/ Early Planning	West Orkney South	Orkney	Scotland	2011	E.ON Climate & Renewables UK Limited	Attenuator	50	Crown Estate, www.eon-uk.com/generation/westorkneymiddlesouth.aspx
Under Construction	Biscay Marine Energy Platform - Test Site	1km offshore, Lemoiz	Spain	2009	Ente Vasco de la Energia (EVE)			http://www.fp7-marinet.eu/EVE-biscay-marine-energy-platform-bimep.html
Operational	Canary Islands Oceanic	Gran Canaria	Spain	2011	Plocan	Point Absorber	0.15	http://www.plocan.eu/index.php/en/ho

	Platform - Test Site							me-en
Submitted	Cantabria	Offshore from Cantabria	Spain		BioPower Systems	Oscillating Wave Surge Converter		http://www.biopowersystems.com/projects.html
Operational	Mutriku	Mutriku Harbour	Spain	2011	Wavegen, Voith Hydro	Oscillating Water Column	0.30	http://voith.com/en/products-services/hydro-power/ocean-energies/wave-power-plants-590.html
Operational	Santo±a	4km offshore from Santona	Spain	2008	Iberdrola S.A, Ocean Power Technologies	Buoyant Moored Device/ Point Absorber	1.39	http://www.oceanpowertechnologies.com/spain.html
Operational	Lysekil	2 km offshore of the Islandsberg peninsula	Sweden	2009	Uppsala University	Point Absorber	0.01	http://www.el.angstrom.uu.se/forskningsprojekt/WavePower/Lysekilsprojektet_E.html
Concept/ Early Planning	Coos Bay	2.7 miles off the coast of Oregon	USA		Ocean Power Technologies	Buoyant Moored Device/ Point Absorber	100	http://www.oceanpowertechnologies.com/coos.html
Withdrawn/ Rejected	Humboldt County Offshore Wave Energy Power Plant	2.5miles off coast from Humboldt County	USA	2010	Pacific Gas and Electric		2	http://www.renewableenergyworld.com/rea/news/article/2010/11/pg-e-no-longer-pursuing-humboldt-waveconnect-ocean-energy-project
Operational	Kaneohe Site - Test Site	Kaneohe Marine Corps Base, Kaneohe Bay	USA	2004	Ocean Power Technologies	Buoyant Moored Device/ Point Absorber	0.04	http://hinmrec.hnei.hawaii.edu/nmrec-test-sites/wave-energy-project-at-mcbh/
Operational	LEAP Autonomous PowerBuoy	Atlantic City	USA	2011	Ocean Power Technologies	Buoyant Moored Device/ Point Absorber	0.04	http://www.oceanpowertechnologies.com/leap.html
Withdrawn/ Rejected	Makah Bay	Makah Bay	USA	2008	Finavera		1	http://www.hydroworld.com/articles/2009/04/finavera-surrenders.html
Approved	Maui	1km north of Pauwela Point	USA	2009	Oceanlinx Limited	Oscillating Water Column	2.7	http://www.oceanlinx.com/news/news-2009/108-oceanlinx-signs-memorandum-of-understanding-with-renewable-hawaii-inc
Concept/ Early Planning	Ocean Test Berth - Test Site	Northwest National Marine Renewable Energy Center	USA		Oregon State University			http://nnmrec.oregonstate.edu/node/85
Approved	Reedsport	2.5 miles offshore near Reedsport	USA	2012	Ocean Power Technologies	Buoyant Moored Device/ Point Absorber	50	http://www.oceanpowertechnologies.com/reedsport.html
Concept/ Early Planning	San Francisco	Offshore, San Francisco	Australia		BioPower Systems	Oscillating Wave Surge Converter		http://www.biopowersystems.com/projects.html
Under Construction	Wave Dragon Pembrokeshire	5km offshore from St. Anne's Head	Wales	2008	Wave Dragon	Overtopping Device	70	www.wavedragon.net/

12. Appendix 3 - Tidal energy sites table

Status	Name	Location	Country	Year	Developer	Device Category	Foundation Type	Energy Capacity (MW)	Area km^2	Source of Information
Concept/ Early Planning	Flinders Island	Offshore, Flinders Island	Australia		BioPower Systems					http://www.biopowersystems.com/projects.html
Operational	San Remo	San Remo	Australia	2008	Atlantis Resources Corporation	Vertical Axis Turbine				http://www.atlantisresourcescorporation.com/projects/san-remo.html
Concept/ Early Planning	Active Pass	Between Galiano and Mayne islands	Canada	2013	Western Tidal Holdings Ltd.					http://www.westerntidal.com/
Approved	Alstom/ Clean Current - Test Site	FORCE Test Centre. Minas Passage, Bay of Fundy	Canada	2009	Alstom	Vertical Axis Turbine		1		http://fundyforce.ca/technology/alstom/
Operational	Annapolis Tidal Station	Annapolis River, Bay of Fundy	Canada	1984	Nova Scotia Power	Tidal Barrage		20		http://www.nspower.ca/en/home/aboutnspower/makingelectricity/renewable/annapolis.aspx
Approved	Atlantis Resources Corporation - Test Site	FORCE Test Centre. Minas Passage, Bay of Fundy	Canada	2009	Atlantis Resources Corporation	Vertical Axis Turbine				http://fundyforce.ca/technology/atlantis/, http://www.atlantisresourcescorporation.com/projects/nova-scotia-canada.html
Withdrawn/ Rejected	Blackney Passage	Hanson Island	Canada	2012	SRM Projects Ltd					http://srmprojects.ca/wp-content/uploads/2012/11/Joint-SRM-OL-press-release-19Nov2012-final.pdf
Concept/ Early Planning	Digby Gut		Canada		Fundy TIdal					http://www.fundytidal.com/index.php?option=com_content&view=category&layout=blog&id=26&Itemid=42
Concept/ Early Planning	Grand Passage	Between Brier Island and Long Island	Canada		Fundy TIdal					http://www.fundytidal.com/index.php?option=com_content&view=category&layout=blog&id=17&Itemid=40
Under Construction	Minas Basin Tidal Power - Test site	FORCE Test Centre. Minas Passage, Bay of Fundy	Canada	2008	Minas Basin Pulp and Power Company Ltd.			5		http://minastidalpower.ca/about/oceanresearch-centre/
Concept/ Early Planning	Navy Channel	Between Mayne and North Pender islands	Canada	2013	Western Tidal Holdings Ltd.					http://www.westerntidal.com/
Operational	OpenHydro - Test Site	FORCE Test Centre. Minas Passage, Bay of Fundy	Canada	2009	OpenHydro/ Nova Scotia Power	Vertical Axis Turbine				http://fundyforce.ca/technology/openhydro-nova-scotia-power/
Concept/ Early Planning	Petit Passage	Between Long Island and Digby Neck	Canada		Fundy TIdal					http://www.fundytidal.com/index.php?option=com_content&view=category&layout=blog&id=18&Itemid=41
Concept/ Early Planning	Race Rocks	1.5 km off Southern tip of Vancouver Island	Canada	2013	Western Tidal Holdings Ltd.					http://www.westerntidal.com/

Operational	Jiangxia Pilot Tidal Power Plant	North end of Yueqing bay, East China Sea	China	1985	China Guodian Corporation	Tidal Barrage		3.2		http://mhk.pnnl.gov/wiki/index.php/Jiangxia_Pilot_Tidal_Power_Plant
Concept/ Early Planning	Alderney	3 locations around Alderney	England	2007	Alderney Energy Renewable Ltd	Vertical Axis Turbine		3000		http://www.are.gb.com/
Approved	Humber Estuary	Upper Burcom near Stallingborough	England	2008	Pulse Tidal Ltd			0.15		www.pulsetidal.com
Operational	Humber St Andrews	North Ferriby	England		Neptune Renewable Energy	Vertical Axis Turbine		2		http://www.neptunerenewableenergy.com/
Operational	Sea Flow	2km offshore Foreland Point, Lynmouth	England	2003	Marine Current Turbines Ltd					http://www.seageneration.co.uk/
Concept/ Early Planning	Solent Ocean Energy Centre - Test site	St Catherine's Point, Isle of Wight	England	2009	Solent Ocean Energy Centre					http://social.tidaltoday.com/
Submitted	The Wash Tidal Barrier	The Wash	England	2008	The Wash Tidal Barrier Corporation	Tidal Lagoon		1000		http://www.washbarrier.org/
Concept/ Early Planning	Severn Barrage	Bristol Channel	England/Wales	2012	Hafren Power	Tidal Barrage				http://www.hafrenpower.com/severn-barrage/index.html
Under Construction	Paimpol-Brehat	Offshore from Paimpol	France	2011	EDF	Horizontal Axis Turbine		4		http://press.edf.com/
Operational	Rance Power Station	Rance River	France	1966	EDF			240		www.edfenergy.com
Concept/ Early Planning	Gulf of Khambhat	Gulf of Khambhat	India	2012	Atlantis Resources Corporation	Vertical Axis Turbine				http://www.atlantisresourcescorporation.com/projects/india.html
Concept/ Early Planning	Gulf of Kutch	Gulf of Kutch	India	2012	Atlantis Resources Corporation	Vertical Axis Turbine				http://www.atlantisresourcescorporation.com/projects/india.html
Operational	Enermar	Straits of Messina	Italy	2001	Ponte di Archimede					http://www.pontediarchimede.com
Operational	Den Oever Inshore Project	Den Oever Tidal Testing Centre	Netherlands	2008	Tocardo BV International	Vertical Axis Turbine		0.035		http://www.tocardo.com/digi_cms/44/den-oever-inshore-project.html
Approved	Oosterschelde Inshore Project	Oosterschelde storm barrage	Netherlands	2010	Tocardo BV International	Horizontal Axis Turbine		1		http://www.tocardo.com/digi_cms/47/oosterschelde-inshore-project.html
Approved	Kaipara Harbour	Entrance to Kaipara Harbour	New Zealand	2011	Crest Energy	Horizontal or Vertical Axis Turbine				http://www.crest-energy.com/#
Operational	Sea Gen Test Site	Stangford Lough	Northern Ireland	2008	Marine Current Turbines Ltd					http://www.seageneration.co.uk/
Operational	Strangford Loch Test site		Northern Ireland	2011	Minesto	Sea Kite	Floating - Flexible mooring			Crown Estate, www.minesto.com
Operational	Kvalsund Sound	Kvalsundet	Norway	2003	Hammerfest Stroem					http://www.hammerfeststrom.com/research-and-development/testing/kvalsund/
Operational	Morild II	Gims°ystraumen in Lofoten	Norway	2010	Hydra Tidal	Horizontal Axis Turbine	Floating	1.5		http://www.hydratidal.info/#!technology
Operational	Kislogubskaya		Russia	2005	Kolenergo	Tidal Barrage		1.5		http://www.industcards.com/hydro-wave-tidal.htm
Under Construction	Bluemull Sound	Shetland Islands	Scotland	2011	Nova Innovation	Vertical Axis Turbine		0.5		Crown Estate, http://novainnovation.co.uk/index.php/media-menu?start=4
Concept/ Early Planning	Brough Ness	Orkney Islands, South Ronaldsay	Scotland	2010	Marine Current Turbines Limited	Horizontal or Vertical Axis Turbine		100	4.3km2	Crown Estate, http://www.marineturbines.com

Concept/ Early Planning	Cantick Head	Pentland Firth	Scotland	2010	SSE Renewables, OpenHydro Group Ltd	Oscillating Hydrofoil		200		Crown Estate, http://www.sse.com/CantickHead/ProjectInformation/
Operational	Fall of Warness Test Site	Eday	Scotland		European Marine Energy Centre					www.emec.org.uk/tidal_site.asp
Concept/ Early Planning	Inner Sound	Pentland Firth	Scotland	2011	MeyGen	Horizontal or Vertical Axis Turbine		398	3.5km2	Crown Estate, www.meygen.com
Concept/ Early Planning	Islay Tidal Energy Project	8km off the south western tip of Islay	Scotland	2007	DP Energy	Horizontal or Vertical Axis Turbine	Pile Mounted		8km2	http://www.dpenergy.com/tidal/islay.html#
Concept/ Early Planning	Kyle Rhea	North of ferry crossing, Isle of SKye	Scotland	2010	Marine Current Turbines	Horizontal or Vertical Axis Turbine		8		http://www.seagenkylerhea.co.uk/index.php
Submitted	Montrose Tidal Array	River South Esk Estuary	Scotland	2012	GlaxoSmithKline	Tidal stream array	Gravity based	0.7		Non technical summary of the Environmental Statement
Concept/ Early Planning	Mull of Kintyre	Irish Sea	Scotland	2011	Nautricity Ltd	Contra rotating Turbine	Floating structure	3		http://www.nautricity.com/news/mull-of-kintrye-tidal-array/
Concept/ Early Planning	Ness of Duncansby	Pentland Firth	Scotland	2010	ScottishPower Renewables			100		Crown Estate, www.scottishpowerrenewables.com/pages/ness_of_duncansby.asp
Submitted	Pentland Firth Tidal Energy Park	Caithness/Orkney Islands	Scotland	2007	Tocardo			10		http://www.tocardo.com/nieuwsartikel/7/master-plan-p-firth.html
Concept/ Early Planning	Sanda Sound		Scotland	2011	Oceanflow Energy	Horizontal or Vertical Axis Turbine	Floating - Flexible mooring			Crown Estate, www.oceanflowenergy.com/news16.html
Operational	Shapinsay Sound, Tidal Scale Test Site	Head of Holland	Scotland		European Marine Energy Centre					http://www.emec.org.uk/scale_sites.asp
Approved	Sound of Islay	Islay Sound	Scotland	2011	Scottish Power Renewables	Vertical Axis Turbine		10		http://www.scottishpowerrenewables.com/pages/sound_of_islay.asp
Submitted	Westray South	Orkney	Scotland	2011	SSE Renewables	Horizontal Axis Turbine		200		Crown Estate, www.sse.com/WestraySouth/
Submitted	Garorim Bay	Garorim Bay	South Korea	2008	Korean Western Power Company	Tidal Barrage		520		http://www.westernpower.co.kr/new/english/index.asp
Under Construction	Incheon	Incheon Bay	South Korea	2011	Korea Hydro & Nuclear Power	Tidal Barrage		132		http://www.koreatimes.co.kr/www/news/biz/2010/01/123_59412.html
Operational	Sea Turtle Tidal Park		South Korea	2011	Voith Hydro	Vertical Axis Turbine	Monopile	0.11		http://voith.com/en/markets-industries/industries/hydro-power/ocean-energies-539.html
Operational	Uldolmok Tidal Power Station	Uldolmok Strait	South Korea	2009	South Korea Ministry of Land, Transport, Maritime	Tidal Barrage		1.5		http://mhk.pnnl.gov/wiki/index.php/Uldolmok_Tidal_Power_Station
Approved	Wando Hoenggan waterway	Wando Hoenggan waterway	South Korea	2008	Lunar Energy/ Korean Midland Power Company	Duct Turbine		300		http://www.lunarenergy.co.uk/newsDetail.php?id=14
Approved	Admiralty Inlet	35 miles northwest of Seattle	USA	2011	Pacific Northwest National Laboratory	Horizontal or Vertical Axis Turbine		1		http://www.offshorewind.biz/2011/07/28/turbines-to-harness-tidal-energy-in-admiralty-inlet-usa/
Under Construction	Cobscook Bay	North Lubec	USA	2012	Ocean Power Renewable Company			5		http://www.orpc.co/content.aspx?p=h3jCHHn6gcg%3d

Concept/ Early Planning	Half Moon Cove	Cobsook Bay	USA	2010	Tidewalker Associates	Tidal Barrage		9		http://www.mainetidalpower.com
Operational	Roosevelt Island Tidal Energy (RITE) Project	East River between Queens and Roosevelt Island	USA	2006	Verdant Power			0.		http://verdantpower.com/what-initiative/
Submitted	Anglesey Skerries Tidal Stream Array	The Skerries	Wales	2011	Marine Current Turbines and npower renewables	Vertical Axis Turbine		10		http://seagenwales.co.uk/
Approved	DeltaStream Demonstration	Ramsey Sound	Wales	2008	Tidal Energy Limited	Horizontal Axis Turbine	Gravity based			www.tidalenergyltd.com
Concept/ Early Planning	St DavidÆs Head	St DavidÆs Head	Wales	2012	Tidal Energy Ltd	Horizontal Axis Turbine	Gravity based			http://www.tidalenergyltd.com/?p=1112
Concept/ Early Planning	Swansea Bay	I mile off coast from Swansea	Wales	2012	TidalLagoon Swansea Bay	Tidal Lagoon		250		http://www.tidallagoonswanseabay.com/default.aspx

13. APPENDIX 4 – MAIN RECOMMENDATIONS FROM THE INTERNATIONAL WHALING COMMISSION RENEWABLES WORKSHOP 2012

1. STRATEGY TO MINIMISE RISK

Risks from both lethal and sub-lethal effects can be minimised via a series of actions: the collection, collation and analysis of appropriate baseline cetacean data and appropriate industrial data will allow the identification and quantification of threats and their potential implications for conservation objectives. All stakeholders need to be involved from the outset such that impacts from all factors are considered, ensuring that appropriate mitigation measures and associated monitoring programmes are developed. Suitable scientific evaluation and compliance mechanisms are needed to ensure that mitigation and monitoring are adequate.

2. BROAD MANAGEMENT

Governments, managers and other stakeholders need to co-operate in strategic planning for MREDs taking into account the trans-boundary nature of cetaceans. Uncertainties over the level of impacts require a staged approach to developments taking into account lessons learned from other developments and other human activities that affect cetaceans, in order to be adequately precautionary.

3. "FUNDAMENTAL" RESEARCH

International collaboration will be required to determine population structure, status, distribution and procedures for assessing impacts. The Committee can assist with design and evaluation of population and impact assessments. While there are established methods for assessing lethal takes, data on the effects of (sub-lethal) stressors on cetaceans are also needed.

4. EVALUATION OF THREATS

All lethal and non-lethal impacts of human activities should be considered in an integrated manner, e.g. using modelling approaches that take into account the cumulative impacts from all threats when evaluating whether conservation objectives are likely to be met. The Committee has considerable expertise in developing management frameworks and testing their performance against specified objectives.

5. MONITORING

Monitoring should be designed carefully, to assess impacts against pre-determined conservation objectives and to measure the efficacy of any mitigation measures that are implemented.

6. DATA SHARING AND THE FUTURE ROLE OF THE IWC SCIENTIFIC COMMITTEE IN THE CONSIDERATION OF MREDS

Improved information and data-sharing were identified as key, and the workshop encouraged the Committee to continue to act as a forum to review the development of MREDs and their implications for cetaceans, including promoting the sharing of data. Countries were encouraged to help in this by providing appropriate information.

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