



## National Policy Framework for Marine Renewable Energy within the United Kingdom

### Task 4.1.1 of WP4 from the MERiFIC Project

### A report prepared as part of the MERiFIC Project "Marine Energy in Far Peripheral and Island Communities"

May 2012

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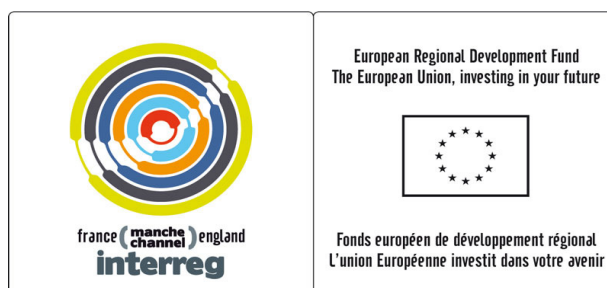
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MERiFIC was selected under the European Cross-Border Cooperation Programme INTERREG IV A France (Channel) – England, co-funded by the ERDF.

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This document is intended to provide an introduction into the international, national and regional policy and legislation framework relevant to the deployment of marine renewable energy technologies within the UK, and specifically with a focus upon the South West and the county of Cornwall and its neighbouring Isles of Scilly. Within the context and scope of this document, devices that utilize wave, tidal stream, and floating wind within the marine environment are included within the definition of 'marine renewable energy devices' however limited focus is also given to offshore fixed wind turbines as it is recognised that, (although outside of the scope and context of this document and at a much further stage of technology maturity) there are many complementarities between these technology groupings.

University of Exeter, May 2012

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## The MERiFIC Project

MERiFIC is an EU project linking Cornwall and Finistère through the ERDF INTERREG IVa France (Manche) England programme. The project seeks to advance the adoption of marine energy in Cornwall and Finistère, with particular focus on the island communities of the Parc naturel marin d'Iroise and the Isles of Scilly. Project partners include Cornwall Council, University of Exeter, University of Plymouth and Cornwall Marine Network from the UK, and Conseil général du Finistère, Pôle Mer Bretagne, Technôpole Brest-Iroise, Parc naturel marin d'Iroise, IFREMER and Bretagne Développement Innovation from France.

MERiFIC was launched on 13th September at the National Maritime Museum Cornwall and runs until June 2014. During this time, the partners aim to

- Develop and share a common understanding of existing marine energy resource assessment techniques and terminology;
- Identify significant marine energy resource 'hot spots' across the common area, focussing on the island communities of the Isles of Scilly and Parc Naturel Marin d'Iroise;
- Define infrastructure issues and requirements for the deployment of marine energy technologies between island and mainland communities;
- Identify, share and implement best practice policies to encourage and support the deployment of marine renewables;
- Identify best practice case studies and opportunities for businesses across the two regions to participate in supply chains for the marine energy sector;
- Share best practices and trial new methods of stakeholder engagement, in order to secure wider understanding and acceptance of the marine renewables agenda;
- Develop and deliver a range of case studies, tool kits and resources that will assist other regions.

To facilitate this, the project is broken down into a series of work packages:

- WP1: Project Preparation
- WP2: Project Management
- WP3: Technology Support
- WP4: Policy Issues
- WP5: Sustainable Economic Development
- WP6: Stakeholder Engagement
- WP7: Communication and Dissemination

## **National Policy Framework for Marine Renewable Energy within the United Kingdom**

### **1. Introduction**

Marine renewable energy technologies are a key element for both the decarbonising the electricity generation sector and for providing a nationally secure energy supply, less vulnerable to the volatilities of both world politics and fluctuating energy markets. Many problems remain for their wider adoption, including intermittent generation profiles, unfavourable economics and technologically and commercially immature technology. Wave, tidal and offshore wind energy technologies have been identified by the UK Government as technologies that will play an important part of the UK's long term energy mix, as well as providing jobs and export opportunities (DECC, 2010b). Although wave and tidal technology is still in an early state of maturity, the potential contribution from marine energy is vast. The UK practical wave energy resource is estimated at around 10% of current supply while tidal energy (with a far higher level of uncertainty) could practicably generate anywhere between 5% and 52% of supply<sup>1</sup> (DECC, 2011b, Committee on Climate Change, 2011). If even a small fraction of these potentials could be realised, the contribution to the UK's carbon emissions reduction would be greatly assisted and thus, there is currently a strong national policy drive to assist in its commercialisation. This document describes in further detail, many of the different facets and landscape of the national policy agenda.

The UK faces a number of pressures to increase use of renewable energy deployment, including the early stage support needed to drive innovation in less mature technologies. The UK has agreed to reduce its carbon emissions within the EU, and further has a legally binding target for carbon emission reduction within its own national legislation. European legislation is already in place to continue reducing emissions within the European Union Member States. The most significant of these is the European Emissions Trading Scheme (EU ETS) which sets legally binding limits to the emissions of 30 countries (operating over 11,000 power stations and industrial plants) to reduce overall GHG emissions to by 20% of 1990 levels by 2020 (European Parliament and the Council of the European Union, 2009a, European Commission, 2010). Specific to renewable energy, the 2009 Renewables Directive saw the UK agreed to achieve a target of 15% of all energy consumption to come from renewables by 2020, (European Parliament and the Council of the European Union, 2009b). The UK Renewable Energy Strategy document breaks this 15% target down further, suggesting 30% (or more) of all electricity will have to come from renewable energy sources of electricity (RES-E) by 2020 if the UK is to meet its overall 15% target (UK Government, 2009b). It is expected that the main technologies which will be need for the UK to meet its targets are onshore and offshore wind and biomass. However, the UK Renewable Energy Roadmap has also made it clear that wave, tidal and other technologies also have their part to play, as well as being significant beyond 2020 (DECC, 2011h).

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<sup>1</sup> Assuming DECC national supply figures of 383.791TWh for 2011 and Committee on Climate Change marine estimates of practical resource for wave (40TWh) and tidal (18-200TWh)



The generation of electricity within the UK emitted 195Mt CO<sub>2</sub>-eq in 2009, as part of a national output of 563Mt CO<sub>2</sub>-eq. Electrical generation has been the largest growth sector in GHG emissions in recent decades (IPCC, 2007, DECC, 2011g). Other key contributory sectors include the transport (122.2 Mt CO<sub>2</sub>-eq), business (85.9Mt CO<sub>2</sub>-eq), residential (78.6Mt CO<sub>2</sub>-eq) as well as agriculture sectors (49.5Mt CO<sub>2</sub>-eq) (DECC, 2011g).

In 2009, a total of 372TWh (of electricity) was generated (with a further 6.5TWh being imported) within the UK resulting in an output of 151Mt CO<sub>2</sub> (31% of the UK's total CO<sub>2</sub> emissions) (DECC, 2010a, DECC, 2010c). Breaking this generation supply into demand by sector, it can be seen in Figure 1 below that this was primarily for domestic, industrial and commercial use:

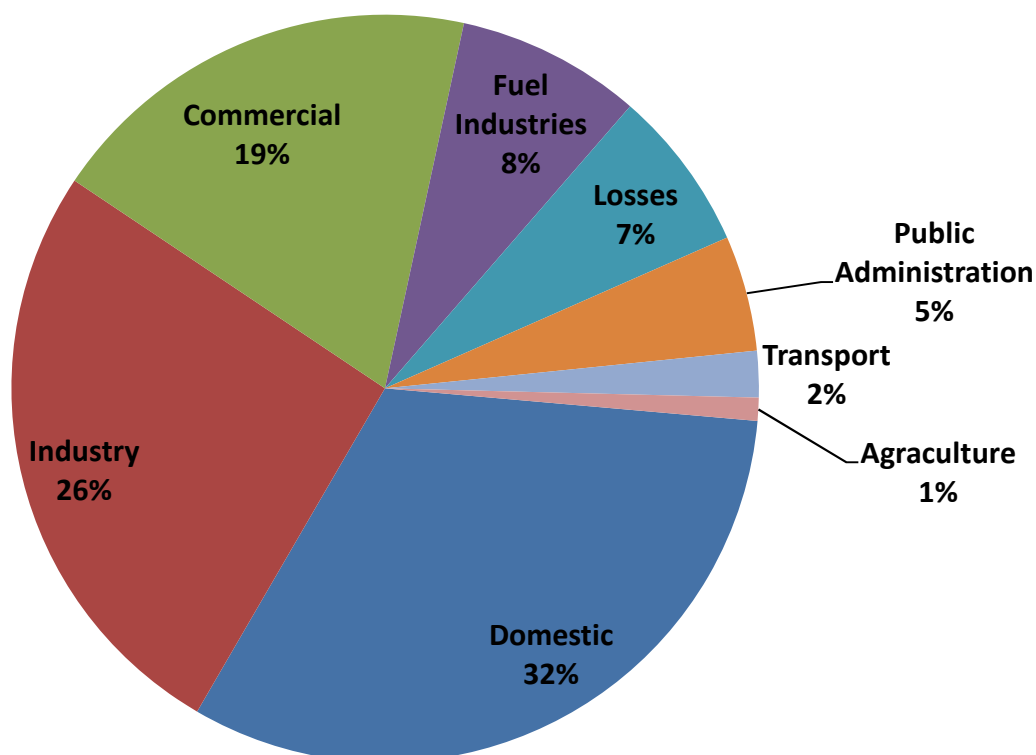


Figure 1: 2009 UK Electricity Demand by Sector (Total 378.5TWh) (DECC, 2010a)

The UK aims to support growth towards a 15% share for renewables by providing support through several policy instruments. Large scale electricity generation is supported by the market tradable certificate mechanism known as the Renewables Obligation (RO) (DECC, 2011h). This obligation works in conjunction with the EU ETS but places an onus on UK electricity supply companies to ensure a given percentage of their electricity supplied is obtained from renewable sources (or pay a fine). This percentage increases by roughly 1% annually from an initial 3% in the fiscal year 2002/2003 up to 15.4% in 2015/2016 and the UK government have stated that they currently wish to see an overall output of 108TWh/y by 2020 through this target (UK Government, 2002, UK Government, 2009a, DECC, 2011a). The Government intends to phase out this instrument and replace it with Contracts for Difference (CfD); the phase out will occur from 2013-2017 (DECC, 2011e). The CfD will operate as a form of tariff mechanism. RES-E generators are currently to have an option to opt in or out of the RO though it is not yet clear how the RO will operate following the introduction of the CfD.

National renewable electricity supply targets have recently been broken down further into technology types with highly ambitious 33-58TWh of offshore wind energy generation and a further 1TWh of marine (referring to wave and tidal stream) energy generation expected to be produced by 2020 (DECC, 2011h).

Currently there are two major planning developments occurring within the offshore renewable energy sector: The first and by far the largest is the 'Round 3' offshore wind energy leasing programme. This follows on from the first two leasing rounds announced by the UK seabed management agency, the Crown Estate. The first offshore wind leasing round was in 2000 and has led to 1GW of capacity across 12 UK wide projects (with an additional 0.2GW in construction). Round 2, announced in 2003 was for 7.2GW across 17 sites, with sites typically further from shore and employing larger turbines. Currently, 0.55GW of this is operational and a further 2.5GW is in construction. Additionally in 2010, a further 1.5GW 'extension' was provided to sites from both rounds culminating in a combined total project lease of just under 10GW for all Round 1,2 and extension sites, with 1.5GW in operation (The Crown Estate, 2011c, RenewableUK, 2012). Round 3 is a far more ambitious programme and has involved the leasing of nine large and far from shore wind zones around the UK with a potential capacity of 33GW. As this round only commenced in 2009, none of the current round 3 sites have been constructed however the scale of this project dominates the renewable energy sector as the key deliverable for the UK government's 2020 ambitions (The Crown Estate, 2011b).

The second key marine renewable energy project within the UK is the Round 1 marine energy development in the Pentland Firth. This leasing round, announced in 2008, saw successful tenders by a range of bidders and allocated potential capacity of 1GW of tidal stream devices over 5 sites and 600MW of wave energy devices over 6 project sites (The Crown Estate, 2010a). Although none of these projects have so far begun construction/deployment, this landmark leasing round is the first large scale commercial leasing announced for 'wet' renewable energy technologies in the world. The winning applicants for these leases included some of the most commercially mature wave and tidal stream technology development companies as well as several large utility companies, often in collaboration. Since the leasing announcement, several of these sites have moved into the planning stages however there is no fixed expectation for when the first actual deployment will occur. The installed capacity for wave and tidal energy around the UK coast consists of a very small number of installations generating 3.4 MW as of March 2011. Current installed capacity for wave energy is 1.31 MW while that for tidal stream is 2.05 MW (RenewableUK, 2011). The RenewableUK 2011 'State of the Industry' report also indicates that 7.4 MW of wave and tidal energy prototypes is currently being tested and that many devices are in advanced stages of planning and construction for deployment. Consent has been given for a further 11MW of wave and tidal projects and 23 MW has entered the planning system (RenewableUK, 2011).

Due to the far more advanced level of supply chain development, scale deployment and general technological maturity of fixed offshore wind energy technology within the UK, it is unfeasible within this document to fully explore the many current and diverse dimensions (such as supply chain creation and site specific requirements) that are being faced in the commercialization of this technology. An overview therefore, of the status and current issues that are being faced is supplied to provide context within the South West's overall marine energy ambitions and where this technology fits into this scheme.

## 2. The South West UK, Cornwall and the Isles of Scilly

The South West is the largest of the 9 English regions with a land area of 23,829km<sup>2</sup>. It holds 5.3 million people (making it the least densely population region of the UK), and has seen a steady rise in population of 6.7 % per year over the past decade, predominantly from other regions within the UK (ONS, 2011b).

Economically, it contributed £89b GVA to the economy in 2006, (equivalent to 7.6% of the UK wide economy roughly the same as Scotland or the west Midlands (ONS, 2011a). Within renewables, 2008 figures show £215m was added internally to the economy from the renewable energy sector as well as almost 4,000 jobs, creating an overall net GVA effect of £288m. Although this figure is relatively low in consideration of overall GVA, it is expected to rise significantly over the coming years with increase renewable capacity planned both on and offshore to around £7.5b by 2015 (DTZ, 2008).

The South West consumed 24.9TWh of electricity in 2009, roughly 8% of the GB total electricity demand. The below graphs (Figure 2 and Figure 3) show the South West's historical electricity consumption domestically and for industry (per meter) in comparison to the GB average (DECC, 2011f).

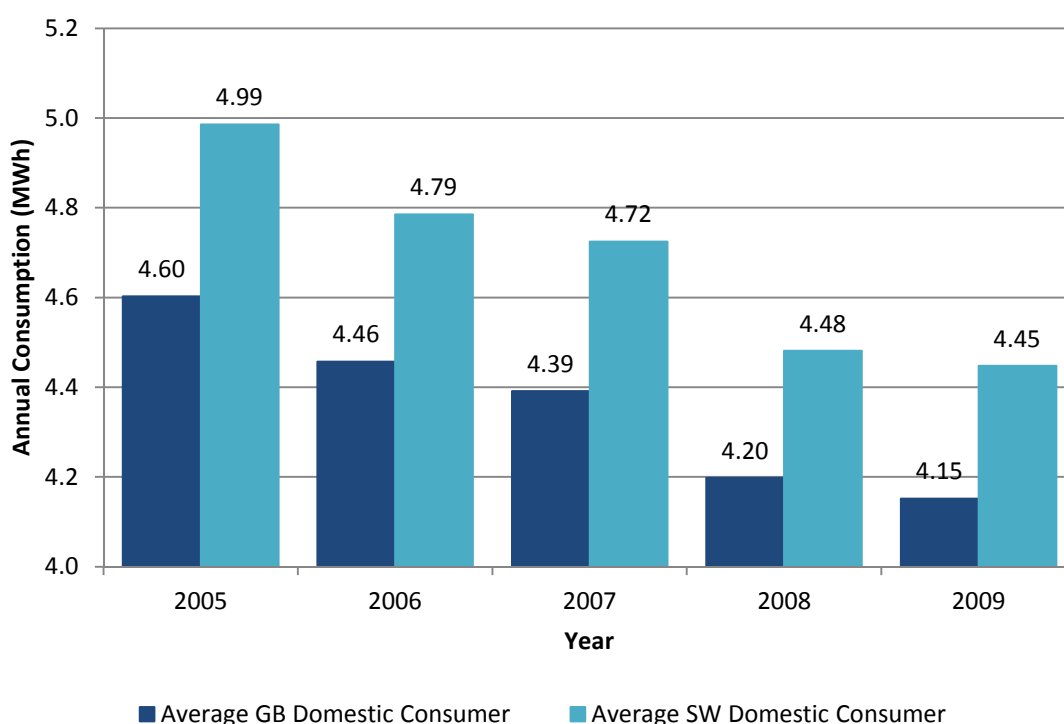


Figure 2: GB & South West Average Annual Domestic Electricity Consumption

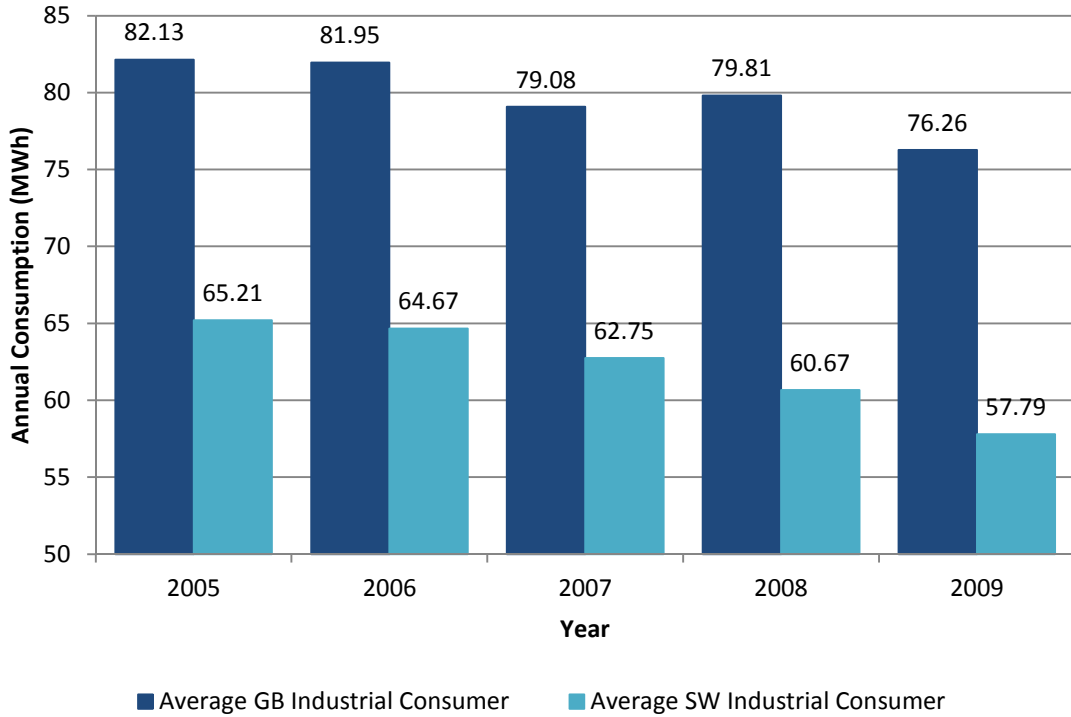


Figure 3: GB & South West Average Annual Industrial Electricity Consumption

As can be seen, the average South West domestic electricity consumption is somewhat higher than the national average. This is likely to be as a result of the higher proportion of off-gas housing (due to the rural geography of the region) and resulting increase in both electrical space/water heating and cooking load. By contrast, industrial use is on average substantially lower due to the higher quantities of (relatively) low electricity load business (such as agriculture, tourism and fishing). Regionally however it can be seen that there are clear variations with the southern end of the South West peninsular accounting for these overall national disparities as can be seen from Figure 4 and Figure 5 below (DECC, 2011c).

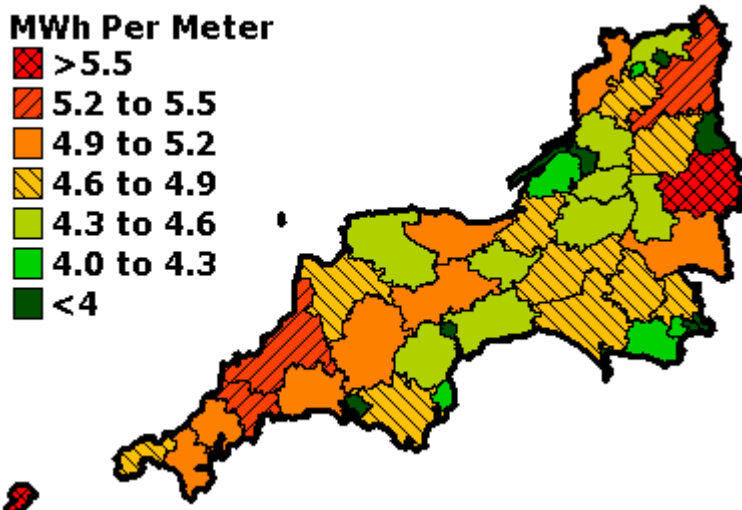


Figure 4: 2009 Average Annual Domestic Electricity Consumption per Meter

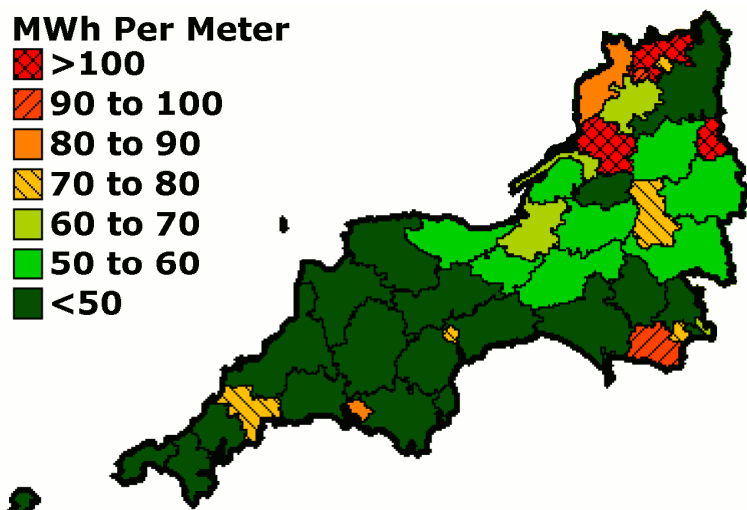


Figure 5: 2009 Average Annual Industrial Electricity Consumption per Meter

The South West has a long pedigree of involvement with both renewable energy (with Cornwall being the first county within the UK to install wind turbines at the Delabole Wind Farm in 1991), and the sea, having over 1000km of coastline and a long economic background of marine engineering, fishing, transport and leisure tourism.

## 2.1 Marine Renewable Energy Potential within the South West

Within the marine environment, a recent public sector commissioned study has suggested that there is the potential to deploy 9.2GW of mixed marine energy technologies by 2035 within 30 nautical miles (nm) of the coast around the South West (PMSS, 2010b). This capacity would generate enough for around 5% of the UK's current electricity and save over 8bn tonnes of CO<sub>2</sub> (PMSS, 2010a).

By technology, total predicted installed capacity is broken down as follows:

	South West Regional Targets					National Targets	
	Medium Wind	Deep Wind	Wave	Shallow Tidal	Deep Tidal	Offshore Wind	Wave & Tidal
2010	-	-	-	-	-	1300	3.36
2015	-	-	20	-	-	-	-
2020	3400	-	260	390	-	18000	300
2025	4400	500	460	490	-	-	-
2030	-	1500	1140	590	60	40000	-
2035	-	2500	1240	780	300	-	-

Table 1: Regional and National total Installed Renewable Energy Capacity (MW) (PMSS, 2010b, DECC, 2011h)

It should also be noted that DECC have suggested an installed wave and tidal stream capacity of 27GW by 2050 would be a reasonable and achievable level of exploitation (DECC, 2011h).

### **3. Overview of the State of Marine Renewable Energy Technologies Within the Region**

As shown in Table 1 above, the south west of England's considerable potential for marine energy generation created by its coastal areas and excellent wave, tidal and wind resources has led to the development of major and increasing research capacity within the region specifically, with respect to wave energy technology. Although there are very few device developers within the South West (notably, Marine Current Turbines (MCT) with their SeaGen device, Offshore Wave Energy Ltd with their OWEL WEC device and Dartmouth Wave Energy with their SEARASER device) the region has a strong and cohesive research community as well as good base of marine research and engineering companies built upon its historical industrial relationship with the sea. Historically much of the political (and financial) support for the regions marine renewable energy drive has come from the Regional Development Agency (RDA), the South West Regional Development Agency (SWRDA). Although due to be scrapped by March 2012, SWRDA historically were the primary funding body behind the Wave Hub Project as well as PRIMARE and the South West regional renewable support agency, RegenSW. Although one of the key regional assets for supporting marine renewable energy, Due to its national significance, Wave Hub is discussed further in section 5.3.1 below - UK National Test Facilities Centres. The regional support agency, RegenSW have themselves done a great deal of work overcoming barriers and creating opportunities for marine energy within the region such as developing skills and supply chain creation strategies and their current work on the creation of the UK's first Marine Energy Park (See section 3.2.2). From these assets as well as those detailed further below, the south west, and particularly Cornwall and Devon are hoping to attract device and project developers as well as large scale utility companies to deploy marine devices within the area.

#### **3.1 Leading Regional Research Facilities**

There are several strong research institutes and test centres within the South West, one of the most notable is the Wave Hub demonstration site, detailed within the non-financial support, test centres section above. Below is a description of the regional support provisions that complement the Wave Hub Development.

##### **3.1.1 PRIMaRE**

The two key research institutes for marine renewable energy within the region are the University of Exeter and the University of Plymouth, the key partners in the Peninsular Research Institute for Marine Renewable Energy (PRIMaRE). This virtual institute combines the expertise and equipment of the two universities to provide a joint support body for the assistive development and research requirements of businesses engaged with wave energy technology and the Wave Hub site. PRIMaRE has research vessels, state of the art monitoring and surveying tools (including wave buoy arrays and high frequency radar arrays deployed around the Wave Hub site) as well as virtual testing and modelling equipment (with supercomputing availability) and navigational simulation tools for safety assessment. PRIMaRE also owns several key physical assets that it uses to try and assist the commercialisation of the sector as follows:

### **3.1.2 SWMTF**

The South West Mooring Test Facility comprises a 2 tonne buoy with an extensive array of instruments capable of measuring environmental conditions, (wind and currently directions and speed, water quality etc.) as well as detailed positioning (through DGPS and 6 degrees motion measurement) and a spectrum of mooring load cells (tri-axial top end, in-line, mid-point and anchor point). The intent of the SWMTF is to allow any mooring system designer the opportunity to test in-situ with full feedback and analysis of operational behaviour.

### **3.1.3 DMAC**

The Dynamic Marine Component Test Facility is a 12 tonne component test rig that can provide real-world replication of stress characteristics to components based on compound wave data (from either SWMTF or other acquired data). It has an actuator capable of delivering up to 30t of force as well as +/-30° pitch and roll capability within a wet (submerged) test environment.

### **3.1.4 FabTest Site**

The FabTest site is currently seeking licensing but will be a pre-full deployed 'nursery' site close to the harbour (and thus many port facilities) of Falmouth. It is in a more benign wave regime and at a shallower water depth than the Wave Hub and will effectively be a 'pre-Wave Hub' testing ground.

### **3.1.5 Wave Basins**

Based at the University of Plymouth, the wave basins, currently due for completion in 2012 will consist of 3 different wave modelling test tanks. The first, an ocean wave basin, will be 35m x 15m and 3m deep, the second will be a coastal basin, 15m x 10m and 0.5m deep and the final one will be a 35m x 0.6m by 0.8m deep wave flume tank. The tanks are equipped with an array of features for wave and tidal device testing including the option for multi-directional wave creation while also providing variable current. The sediment tank shall also allow modelling of potential shoreline environmental impacts by devices.

Cumulatively, it is hoped that the creation of this strong R&D base of skills and facilities will attract device developers looking to commercialise their technology by lowering the cost, risk and time of full scale device development within the region.

## **3.2 Regional Infrastructural for Wave Energy:**

### **3.2.1 Grid Connectivity**

One major barrier to large scale deployment of wave energy technology within Cornwall and the South West overall is grid connectivity. Hayle Harbour where the Wave Hub site is connected to the local distribution grid has a 132kV substation and the region as a whole is a net importer of electricity having only two major power

stations (Hinkley Point B nuclear plant and Langage CCGT). The regional connection network is shown in Figure 6 below.

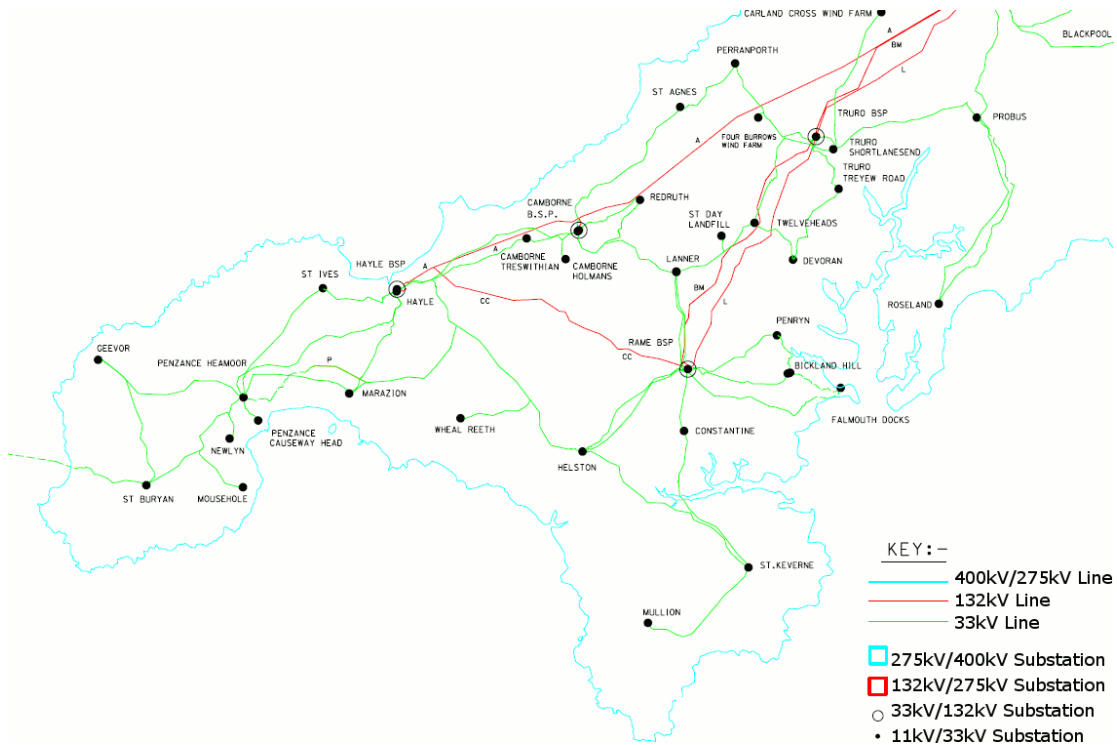


Figure 6: Cornwall Distribution Network (Western Power Distribution, 2009)

The future potential for generation connectivity within the region is thought to be low however, with Government plans to see 1,670MW of new connectivity from new nuclear capacity at Hinkley Point C. This is currently projected to come online by 2017/18 (National Grid Electricity Transmission plc, 2011), though this may be optimistic. Grid connectivity limitations and options are analysed in greater depth in the MERiFIC technical assessment documentation.

### 3.2.2 South West Marine Energy Park

One of the projects currently being driven by a consortium of stakeholders within the southwest (including RegenSW, Cornwall and Plymouth Council and the Universities of Exeter and Plymouth among others) is the creation of the South West Marine Energy Park within the South West.

The aim of this virtual establishment is to build upon; and synthesise, the industrial and academic facilities and services within the region to create both a cohesive and supportive business environment as well as a sounding board for industry within the region. This in turn it is hoped, will help to attract green investment into the region and help to accelerate the commercialisation of the sector.

## 4. Overview of the Stakeholder and Regulatory Framework Impacting on Marine Renewable Energy Within the Region - Regulatory Frameworks Regarding Consultation in Marine Renewable Energy in England



Community engagement and support for renewable energy are widely regarded as key requirements for increasing the deployment of renewable energy in the UK. Early engagement with communities is seen as especially important in facilitating planning processes for renewable energy, where community objections at the planning stage can form a significant impediment to proposals for new renewable energy developments (DTI, 2007).

The Aarhus Convention is the main international agreement establishing the right of public participation in decision-making, public access to information, and access to justice in matters regarding the environment (United Nations, 1998). The Convention came into force in October 2001 and acknowledges that sustainable development can only be achieved with the involvement of all relevant stakeholders. It thus focuses on the democratic context of the interactions between the public and public authorities on sustainability issues (United Nations Economic Commission for Europe, 2001). The European Community has ratified the Convention, making it legally binding throughout the Community. The UK is therefore legally obliged under Article 3 (1) of the Convention to introduce the necessary legislative, regulatory and other measures to establish and maintain a clear, transparent and consistent framework to implement the provisions of the Convention. These include measures to achieve compatibility with the Convention's provisions on information provision, public participation, and access-to-justice provisions, as well as to ensure their proper enforcement. As a result, national, regional and local policies related to the environment operating across the UK should reflect the provisions of the Convention, including those concerning renewable energy deployments in the UK marine environment.

Following the development trajectory set out for renewable energy developments, there is an increasing range of requirements for public engagement. The different types of consultation relevant to the marine renewable energy (MRE) sector relate in broad terms to:

Consultation on policies and plans that affect MRE development

Consultation on specific MRE development proposals

All procedures for MRE deployment must take account of the suite of policies and agreements discussed in this report. This section concentrates primarily on consultation and consenting procedures for specific MRE development proposals. Procedures for policies and plans affecting MRE development (including procedures to implement the requirements of the Strategic Environmental Assessment Directive and Sustainability Appraisal) are discussed in Section 9. The reason for this is that the UK planning system is undergoing a significant period of change as a result of the Localism Bill and the Marine and Coastal Access Act 2009. Provisions for marine plans under the Marine and Coastal Access Act and the Marine Policy Statement are particularly relevant to plans for MRE deployment. However, marine plans and their associated consultation procedures are still in their developmental phase, so are more appropriately discussed in Section 9. Additionally, this report only discusses existing and future consultation procedures for England, the area of study. Planning and consultation requirements for Scotland and other parts of the UK are outside the scope of this report.

## 4.1 Consenting and licensing procedure

This section discusses consultation requirements and procedures for marine renewable energy developments, including the different consenting regimes and consultation procedures for different sizes of marine renewable energy facility.

### 4.1.1 Regulators

**Department of Energy and Climate Change:** DECC is the government department and policy-maker on energy and climate change. DECC thus has direct input into policies on marine renewables as an energy source and as a means to mitigate climate change.

**Department of Environment, Food and Rural Affairs:** DEFRA is the UK government department, legislator and policy-maker which works with other departments and consultees to deliver policies in areas related to the natural environment, sustainable development, and environmental protection. Each of the identified areas of competency affects different aspects of marine renewable energy development.

**Marine Management Organisation:** The MMO acts both as a statutory consultee (e.g. to the Infrastructure Planning Commission and its successor body) and as the decision-maker on behalf of the Secretary of State for DECC for offshore developments generating up to 100MW and also on behalf of DEFRA for marine licences.

**Infrastructure Planning Commission:** The IPC is the decision-maker on behalf of the Secretary of State for Energy and Climate Change in relation to Nationally Significant Infrastructure Projects, under which some larger marine renewable energy project fall.

**Local Planning Authorities:** are the local authorities or councils empowered by law to exercise statutory town planning functions (e.g. granting or refusal of planning permission) in particular areas (e.g. the Town and Country Planning Act 1990 (TCPA), ss 57 and 90).

**The Crown Estate:** is empowered by the Crown Estate Act 1961 and is the landowner of around half the foreshore and almost the entire seabed in the UK's territorial seas. In the EEZ, the Crown Estate acts as landowner (see UNCLOS 1982 for state competencies in the EEZ). The Crown Estate may issue a licence or lease depending on the positioning of the site and type of renewable energy project in question, consenting to development.

**Office of Gas and Electricity Markets:** Ofgem is the regulatory body of Great Britain's gas and electricity market and is charged with protecting the interests of gas and electricity consumers, including those related to marine renewable energy developments.

#### 4.1.2 Consultees

Under English planning law, several **statutory consultees**, organisations and other bodies must by law be consulted on relevant planning applications. Among the most high profile of these are: the Environment Agency, English Heritage, Natural England, the Health and Safety Executive, the Centre for Environment, Fisheries and Aquaculture Science (an executive agency of DEFRA), and the Joint Nature Conservation Committee. Relevant planning bodies and the relevant regional development agencies (to be disbanded by April 2012) are also listed among statutory consultees. A more detailed list of statutory consultees and the circumstances under which they must be consulted, is provided in schedule 1 of the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009. Requirements for statutory consultation are covered by the Town and Country Planning Order 1996 (General Development Procedure) (SI 1995 No.419 as amended). Consultation, however, is not restricted to this list. Other legislation may require consultation with additional bodies. The Marine Management Organisation (MMO) is listed in s.42 of the Planning Act 2008 as a statutory consultee for proposed developments that relate to the activities of the MMO. The MMO is therefore a statutory consultee for marine renewable energy developments in England. If a statutory consultee objects to a development proposal, local planning authorities must treat this as a material consideration when ruling on the planning application (HM Government, 2010). In addition to lodging objections, statutory consultees have the right to recommend conditions to be attached to granting of planning permission for developments.

**Non-statutory consultees** are organisations and bodies that should be consulted on relevant planning applications but are not defined by statute. This group includes bodies that are listed as statutory consultees, but also others that are not where they are specifically identified in relevant national planning policies. Local authorities decide which parties with a special local interest should be included in the consultation (Department for Communities and Local Government, 2009a). The guidelines and criteria for consulting these bodies are identified in the Statement of Community Involvement prepared by developers as part of the planning application process.

#### 4.1.3 Environmental Impact Assessments

The Environmental Impact Assessment (EIA) Directive (85/337/EC as amended by 97/11/EC, 2003/35/EC and 2009/31/EC) is the main European Union legislation setting out the procedural requirements for granting permissions for projects that are likely to have a significant impact on the environment. The provisions of the EIA Directive were aligned with those of the Aarhus Convention in 2004 (Directive 2003/35/EC).

Most proposals for marine renewable energy development will fall within the scope of the EIA Directive. For marine renewable energy development proposals under 100MW the MMO is the body determining whether an EIA must be completed. For Nationally Significant Infrastructure Projects (NSIP), this task currently falls to the Infrastructure Commission (IPC) (see Section 4.1.3 for more detailed description of the remit and status of the IPC). If an EIA must be conducted, the applicant is required to prepare an Environmental Statement (ES). Under current legislation (the Planning Act 2008) this process is governed by the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009. In its explanatory notes

paragraph 4.10, the regulations restate that the EIA Directive requires an EIA to be conducted before development consent is granted for projects that have significant effects on the environment (such as the major infrastructure developments). Paragraph 4.10 states that 'the EIA regulations that form part of this package [Infrastructure Planning (Environmental Impact Assessment) Regulations 2009] have transferred the EIA Directive in relation to those procedures set up for the IPC which lead to the making of orders granting development consent and to the granting of approvals in respect of requirements imposed by such orders, where these are also covered by the EIA Directive'.

Regulation 11 of the Infrastructure Planning (Environmental Impact Assessment) Regulation 2009 requires that the pre-application consultation under s.42 of the Planning Act must include consultation with the relevant consultation bodies on the preliminary environmental information of the EIA process (Department for Communities and Local Government, 2009b).

The EIA directive does not establish mandatory environmental standards. As a result, authorities must take the results of both the EIA and consultation into consideration but are not obliged to draw specific conclusions from the findings of an EIA (Commission of the European Communities, 2009). Consultation in an EIA procedure takes place during the consultation phase, at which point environmental authorities and the public must be informed and consulted. The results of these consultations must be taken into consideration by the competent authorities when taking a decision. After the decision has been made, the public will be informed and an opportunity is provided to mount legal challenges to decisions (European Commission, 2011b).

One major difficulty with assessing the environmental impacts of MRE developments is that the levels of risk and ecological significance of impacts of renewable energy developments in particular places is largely unknown, since, in particular, tidal stream and wave technologies are at a relatively early stage of development. The Marine Policy Statement calls for further research to develop a better understanding of the impacts of the technologies on potentially sensitive environmental features. In contrast, the Department for Communities and Local Government's draft National Planning Policy Framework published in July 2011 indicates that developments must be approved without delay, unless the adverse impacts of allowing development would significantly and demonstrably outweigh the benefits, when assessed against the policy objectives in the National Planning Policy Framework taken as a whole (Department for Communities and Local Government 2011a). This presumption in favour of development has since been challenged by a parliamentary committee as giving a green light to inappropriate development. The Minister for Planning has yet to respond to this criticism at the time of writing but it is clear that reconciling the presumption in favour of development with addressing knowledge deficits about the environmental impacts of the marine renewable energy industry will be a challenging task.

Onshore developments connected to marine renewable energy development, such as the construction of electrical sub-stations or above-ground (overhead) onshore cables, are likely to require consent from the relevant Secretary of State under Section 37 of the Electricity Act 1989. In applying for Section 37 consent, an application can also be made for deemed planning permission under s.90 of the Town and Country Planning Act 1990 and the Secretary of State may attach conditions to the Section 37 consent relating to the control and impact of the overhead line. There is an alternative route for consent available, wherein consent under s.36 and s.37 of the Electricity Act and under s.34 of the CPA can be

supplanted by an application under s.3 of the Transport and Works Act of 1992. Both these consenting routes have been validated through the experiences of offshore wind developers in UK waters.

#### **4.1.4 Consultation regarding Marine Renewable Energy facilities under 100MW**

Until the Marine Plans requested under the Marine and Coastal Access Act 2009 are in place (see Section 9 for further discussion), licensing decisions for marine renewable energy developments under 100MW will be made on a case-by-case basis by the Marine Management Organisation (MMO). The MMO will determine these applications under s.36 and s.36A of the Electricity Act 1989 where they relate to offshore generating stations in England and Wales or in the Exclusive Economic Zone, provided that the development is not classified as a Nationally Significant Infrastructure Project (NSIP) as determined under the Marine and Coastal Access Act 2009. Decisions should always be consistent with international law, such as the United Nations Convention on the Law of the Sea, and should also be consistent with all national statutory requirements. In addition, decisions should be aligned with current EU and UK marine policy and the UK Marine Policy Statement. The Secretary of State must provide the MMO with guidance on the kind of statements and submissions it may make during the development consent pre-application and decision making procedures under the Planning Act 2008 s.23(7).

In contrast to NSIP applications, which are considered under the Planning Act 2008, the Marine and Coastal Access Act 2009 does not include a list of specified statutory consultees that the MMO must consult before deciding on an application. The underlying reason for not having a specified list is to enable all potential consultees to be equal (Marine Management Organisation, 2011b). It also ensures that all the organisations consulted are relevant to the project. The consultation process for marine renewable energy developments under 100MW is led by the MMO.

The consenting process for MRE developments falling under the MMO's jurisdiction consists of four stages: (i) pre-application; (ii) pre-examination; (iii) application; and (iv) decision. These are now discussed in turn.

##### **4.1.4.1 Pre-application**

For marine renewable energy developments that are not classified as NSIPs, there is no legal requirement for developers to consult the MMO before applying for a marine licence. However, the applicant is expected as well as strongly advised to consult when the application is likely to need an Environmental Statement under the EIA Directive (Marine Management Organisation, 2011b). This is normally the case for MRE developments. The MMO is the responsible authority for deciding whether an EIA must be completed for marine renewable energy facilities (Department for Environment Food and Rural Affairs, 2010). The pre-application phase thus encourages and facilitates early engagement with stakeholders and consultees as well as with the MMO.

Table 2 shows the consultation process for marine renewable energy development applications under 100MW that are considered by the MMO.

##### **4.1.4.2 Application**

After publication of the application, the proposal is open to written responses and the relevant local authorities are notified of marine licence applications, as required under s.69 (1) of the Marine and Coastal Access Act 2009. Once an application has been submitted to the MMO, the applicant must publish that it has submitted an application for development by placing notices in two different local newspapers or

specialist national newspapers. The applicant must also place the application and the supporting documents somewhere where interested parties can view the application during normal office hours. If the developer fails to meet these requirements, permission to proceed with the application may be refused or the application withdrawn until the shortcomings have been corrected.

Pre-application	No legal requirement for notification of intent to submit to the MMO
	Optional pre-application service offered by the MMO: assessment whether an EIA is required and of its contents. MMO seeks relevant consultees for this process and consults its primary advisors.
	EIA Screening and Scoping Consultation under the EIA Directive and draft Environmental Statement if an EIA is required
Pre-examination	After publication of the application for development consent, this must be published in two local news papers
	Application plus supporting documents must be available for viewing
Application	Consultation: written responses from consultees
	EIA consent decision
	Analysis of responses and decision-making
	Decision notification and public register
Decision	Analysis of responses and decision-making
	Decision notification and insertion of the application and decision in the public register

Table 2: Consultation process for development applications under the MMO (Marine Management Organisation, 2011b)

During the consultation phase, the MMO manages responses from primary advisors and consultees and ensures that concerns are adequately addressed by the applicant. The MMO also provides comments to responses received during the consultation process. Where applications need an EIA and a corresponding Environmental Statement, consultees have 42 days to lodge objections and representations, beginning from the date of publication of first notice. The MMO must acknowledge acceptance of the objection or representation within 5 working days of receipt and must also consider each objection or representation in full (Department for Environment, Food and Rural Affairs 2011). To be valid, the objections must contain:

- Sufficient detail and presented in a way that facilitates proper consideration by the MMO
- Have been received within the statutory objection period of 42 days
- Must be supported by substantiating evidence submitted with the objection (Marine Management Organisation 2011: 21)

#### 4.1.4.3 Decision

All relevant objections and representations made during the consultation process will be considered by the MMO when determining whether or not to grant marine licences (Marine Management Organisation, 2011a). If an objection is valid, the applicant must make changes to the proposal in line with the objection to satisfaction of the MMO, or the applicant must demonstrate to the MMO that the objection is not relevant. It is also possible for either the application or the objection to be withdrawn. A final possibility is for the application still to be considered on the condition that an

inquiry is held. The MMO may order an inquiry related to a marine licence application to hear from all parties, as outlined under s. 70 of the Marine and Coastal Access Act 2009.

#### **4.1.5 Consultation regarding Marine Renewable Energy facilities over 100MW**

The Secretary of State for Energy and Climate Change is the relevant consenting authority for applications for offshore renewable energy generating stations over 100MW and their associated infrastructure. Energy generating stations of this size or larger are always classified as Nationally Significant Infrastructure Developments (NSIPs) and currently fall under the jurisdiction of the Infrastructure Planning Commission (IPC)<sup>2</sup>. The IPC was established in 2009 under the provisions of the Planning Act 2008 with the goal of streamlining planning decisions for NSIPs (Infrastructure Planning Commission, 2011a). Marine renewable energy facilities over 100MW are classified as NSIPs despite the fact that they are developed in the marine area. Any consent granted by the IPC will thus include the granting of a marine licence. The IPC is also the responsible authority for decisions on the completion of EIAs for marine renewable energy developments over 100MW (Department for Environment Food and Rural Affairs, 2010). Although the IPC has taken over the authority of consenting body for this category of project, the MMO is still part of the consultation procedure. s.56 of the Planning Act 2008 includes the MMO as a body that must be notified of relevant planning applications. It is also listed in s.102 of the Planning Act 2008 as an interested party. Furthermore, s.42 of the Marine and Coastal Access Act 2009 includes the MMO as a body that must be consulted in cases where developments could affect areas where the MMO operates and where the IPC also operates. The MMO will only give advice to the IPC on the marine impacts on NSIPs that have possible impacts on the marine area and its users.

During consultations for marine renewable energy developments, the MMO judges development applications for NSIPs according to the provisions of the Marine and Coastal Access Act 2009. The function of the MMO is therefore to highlight concerns that may affect decisions on the issuing of a marine licence related to marine policy statements or national planning statements.

Public commentary on development applications for NSIPs takes place at several levels. Table 3 shows the different stages that developers must complete when lodging a development application along with the prescribed formats for public consultation.

##### **4.1.5.1 Pre-application phase**

The Planning White Paper 2007 proposes that before submitting an application, developers should consult the public, and in particular, affected land owners and local communities on their proposals before sending it to the IPC. As a result, developers must engage in community consultation before lodging a development application and must demonstrate how they have acted upon the feedback. On its website, the IPC states that it will not accept applications that have inadequate quality of consultation (Infrastructure Planning Commission, 2011a).

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<sup>2</sup> The IPC will be replaced by the Major Infrastructure Planning Unit (MIPU) once the Localism Bill comes into force (this is expected to occur sometime in 2012).

Pre-application	Developers must consult the relevant local authority on the content of the developer's Statement of Community Consultation, and must incorporate the local authority's response to the consultation in the SOCC
	Make the intent to submit an application clear to the public by publishing the SOCC in a locally circulating newspaper
	Carry out consultation in accordance with the SOCC
	Consult a range of statutory consultees
	Publicise the proposed application in accordance with relevant regulations
	Have regard to relevant responses to publicity and consultation
	Notify the IPC of the proposed application; prepare and submit a consultation report to the IPC
Acceptance	IPC examines the application based on several factors, including whether public consultation is satisfactory
Pre-examination	Developer must notify relevant parties of the accepted application and publish the proposal widely
	During a minimum period of 28 days the public can register to put their case on the application
	Written views (representations) of the (registered) public will be published on the relevant project web page (what page)
	Towards the end of this stage, those who registered, commissioners, 'by-right' interested parties (such as statutory and non-statutory consultees), and the developer, come together in a procedural meeting to discuss how the case will be examined (plus identification of issues that must be investigated in more detail according to the investigator)
	Examining authority considers the representations when considering the application for development consent
Examination	Further details sought on the views of registered invitees; invitation to submit a detailed written presentation to be published on the relevant project page
	Written representations considered when decision is made
	Public hearings can be held where those registered have the opportunity to give their views in person if requested. Hearings may include: issue-specific hearings, open-floor hearings, and compulsory-acquisition hearings
	Local authority produces a Local Impact Report on which registered public can comment
Decision	Report of recommendations is made available on the relevant project page of the IPC website once a decision is reached
Post-decision	Once development consent is granted, a period for legal challenge runs from the date of publication of the order

Table 3: IPC consultation process for nationally significant infrastructure projects (Infrastructure Planning Commission, 2011c)

The Planning Act 2008 provides the main legal framework for applications for NSIPs. Section 37 (3) (c) stipulates that applications must be accompanied by a consultation report. This report must give details of the actions taken to comply with s.42, s.47 and s.48 of the Act (for proposed applications that have become formal applications) in relation to providing details on relevant consultation responses and the account taken of relevant responses. In particular, the sections describe applicants' *Duty to*



*Consult* with specified groups and individuals about proposed applications. These include: concerned local authorities, individuals with rights over affected areas, and other prescribed persons, such as statutory and non-statutory consultees. These consultees are entitled in turn to provide information on the social, economic and environmental impacts of proposals. To ensure that the input of local authorities is taken into account properly, s.60 of the Planning Act provides that local authorities be invited by the IPC to prepare a local impact report. This report gives details on the likely impact of the proposed development on the authority's area. Here, the National Policy Statement for renewable energy infrastructure (EN-3) provides guidance for local planning authorities on preparing local impact reports (Department for Energy and Climate Change 2011). EN-3 is also likely to be a material consideration in decision-making on relevant applications falling under the Town and Country Planning Act (as amended). However, this will be judged on a case-by-case basis.

S.47 of the Planning Act 2008 also specifies the duty to consult local communities by requiring applicants to prepare a statement setting out how they propose to consult about the proposed application the people living in the vicinity of the development. This statement and its content must be prepared after the applicant has consulted with the relevant local authority. This document is called the Statement of Community Consultation (SOCC) and must be produced before an application can be lodged with the IPC. In addition, regulation nine of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 indicates that the applicant must indicate in the SOCC whether the proposed development falls in the scope of the EIA Directive. If it does, the applicant must indicate how the initial information of the EIA will be publicised and consulted upon.

Once produced, the developer must stick to the procedures set out in the SOCC. The SOCC is sent to the local authority. The local authority in which the development will take place must also be consulted on the SOCC. The SOCC is therefore sent to the authority for comment and discussion with the developer to tailor the SOCC to local circumstances and communities that are likely to be affected by the proposal (Infrastructure Planning Commission 2012). According to the IPC, local authorities can ensure that local communities are properly consulted and have their views considered by advising people on how to find information about a proposal and how to be involved by contacting the developer or the IPC. Enhancing local community consultation is thus envisaged to take place through thorough and informative responses that are given to the developer's Statement of Community Consultation on the proposed application (Infrastructure Planning Commission, 2011a)

The developer must consider the comments given by the local authority, as set out in section 29 of the Planning Act; the SOCC will then be published in a local newspaper to show that the developer is intending to submit an application. If local actors have suggestions on how community consultation should be carried out, they can submit their suggestion to developer directly, or to the local authority, who will pass it on to the developer when discussing the SOCC.

In carrying out consultation in accordance with the SOCC, the developer must identify the geographical characteristics of the local community and develop an understanding of the community and different interest groups within the community. Local authorities are considered an ideal starting point for this process because of the experience in developing statements of community involvement and other consultations. They also often already have registers of local groups.

The IPC recommends that developers use a variety of consulting methods (Infrastructure Planning Commission, 2011c). In addition to written consultations, it is

suggested that other techniques that are appropriate to the community are used. These include: local exhibitions, workshops, the internet (to publicize proposals and draw attention to specific features of proposals), citizens panels and information sessions. Once this has taken place, the developer must publish the proposal (under s.48 of the Planning Act). This same section specifies that the publication encompass those requirements set out in the EIA process where this is the case. The IPC guidance for pre-application indicates that publication is an essential part of the community consultation process and states that the first of the required advertisements should more or less coincide with the start of the consultation process with communities.

More generally, the IPC recommends that consultation takes place as early as possible in the development application process. This allows consultees genuine opportunities to influence proposals. Frontloading of consultation processes is thus suggested as a way to increase both the quality of engagement and the speed of the consent process. The IPC website further indicates that that public comments on major infrastructure project proposals will play a vital role in informing the Commissioner's decision-making, and that in weighing the pros and cons of proposals, evidence provided by the public will be included in decisions or recommendations the Secretary of State (Infrastructure Planning Commission, 2011a). According to the IPC, simply carrying out public consultation before lodging an application to the IPC is not sufficient. Considering the amount of consultation that is taking place in the pre-application phase as well as the engagement that is taking place in EIAs, frontloading is taking place already in this process. Stimulating this process further could indeed streamline the consenting process.

Statutory requirements for the consultation process are described in Chapter 2 of Part 5 of the Planning Act 2008 and in the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009, and compliance with these requirements must be demonstrated in the consultation report. Developers must not only demonstrate that extensive public consultation has been undertaken before the application was made. They must also demonstrate that they have acted upon that feedback. Reasons must be given for not following up on significant relevant responses, including advice on impacts from a statutory consultee. It is recommended (but not required) that this report will be made available to consultees to ensure transparency and openness of the process. Because full consultation reports may not always be the best way to engage with the community or stakeholders for reasons of volume and detail of information, the IPC Guidance for Pre-Application (Infrastructure Planning Commission, 2011b) indicates that the applicant should consider creating a summary report detailing how local community consultation issues have been addressed. The duration of the consultation will be a minimum of 28 days as described by the Planning Act 2008. When the IPC is satisfied that the applicant has complied with all the above requirements, it will accept the application for consideration.

The IPC recognises that some consultees need different information than others. Technical consultees, for instance, require written documents containing sufficient detail on material issues to provide their assessment of the likely impacts of the development, while others will benefit from receiving more accessible material. Furthermore, project developers and consultees will not always agree on the ways in which development impacts should be mitigated. The applicant must therefore ensure that it has 'acted reasonably' and the applicant is protected in the sense that it is not expected of the IPC to conclude that the consultation itself was inadequate on the basis of non-mitigation of particular impacts to a certain degree (Infrastructure Planning Commission 2010). If a consultee feels that their views are not being taken

into account at the pre-application stage, it can inform the developer and the local authority planning department. The local authority can then comment to the IPC on the adequacy of the consultation undertaken (Infrastructure Planning Commission 2011b).

#### **4.1.5.2 Pre-examination phase**

During the pre-examination phase, those interested in giving their view on the matter are invited to register for written comments or file a request to speak at an open-floor hearing. This form of consultation is open to all members of the public that want to have a say in the matter.

#### **4.1.5.3 Examination**

Once an application has been lodged it is open to written comments. The examination stage also provides the opportunity to request to speak at an open-floor hearing chaired by the Commissioner. However, this consultation is only open to those individuals who registered during the pre-examination phase. The participants are invited to give a more detailed written comment than during the previous phase or can attend the hearing. Furthermore, the examination stage allows the opportunity to comment on the local impact report prepared by the local authority during the pre-application phase of the development.

#### **4.1.5.4 Decision**

Decisions regarding marine renewable developments are currently divided into two sections. The first relates to applications falling within the remit of IPC, where a national planning statement is in place. Offshore wind, which is included in the National Policy Statement for Renewable Energy (EN-3), falls into this category, Decisions in these circumstances will be made by:

*A panel of commissioners:* the Department for Communities and Local Government appoints the Commissioners of the IPC; or

On the basis of a report and recommendation by a single commissioner

The route take depends on the scale and circumstances of the development and will be decided on a case-by-case basis.

The second category of decisions refers to cases where there is no national planning statement in place. This is currently the case for both wave and tidal energy. In these cases the Secretary of State is the decision-making authority, with decisions generally being based on reports and recommendations by IPC commissioners.

## **5. Overview of Policies and Regulatory Frameworks Impacting on Marine Renewable Energy**

Public support policies for marine renewable energy can be broadly broken down into two areas, financial support policies (relating to public financial subsidies for renewable energy technologies) and promotional support policies (which in simple terms relates to all non-financial supporting policies). Both groups of policies are key to delivering marine renewable energy deployment within the UK, the first as the primary market driver for commercializing what is otherwise a non-economic sector, and the second, as the key mechanism for cost reduction both within the innovation space and the supply chain of the product. The below section examines these two policy areas in more detail, as they specifically apply to marine renewable energy technologies within the UK.

## 5.1 Revenue Support Policy

### 5.1.1 The Renewables Obligation

The primary government driving mechanism for the promotion of renewable electricity generating technologies within the UK is the Renewables Obligation (RO). The RO came into existence in 2002 replacing the defunct renewable energy support mechanism known as the Non-Fossil Fuel Obligation (NFFO).

The RO is a tradable green certificate based system that places an onus on all electricity suppliers within England and Wales (and through the Renewables Obligation Scotland (ROS), in Scotland) to submit a certain number of Renewable Obligation Certificates (ROCs) per MWh of electricity they supply. This figure was equivalent to 3% of total supply in the fiscal year 2002-2003 and has risen annually by equivalent to 1% each year since this time<sup>3</sup> (see Figure 7 below).

The RO mechanism allows for suppliers to pay a buy-out fine for each ROCs they fail to submit (set by Ofgem) which is then re-distributed as a recycle payment (minus a nominal administrative fee) to all those who supplied ROCs on a per-ROC basis. The value of the ROC is therefore calculated based not only on the level of the buy-out fine, but also on the expected level of obligation compliance that shall then influence the overall level of the buy-out fund and in turn, the amount of refund suppliers would expect to receive. Ofgem, the public energy sector regulator and body responsible for the operation of the obligation, have set the 2011-2012 buy-out price at £38.69 per ROC while average monthly ROC prices for 2011 have been £48.37 (Ofgem, 2011b, eROC, 2011).

In 2009, in an attempt to allow for higher levels of technology selection and support for less economically viable technologies, the UK government introduced a 'banding' mechanism for the RO. This altered the ratio of ROCs to MWhs that suppliers received making the output from certain less mature and more expensive technologies (such as offshore wind, wave and tidal stream) worth more than those from cheaper, established technologies (such as co-firing or waste gas). The banding for marine energy technologies was 2 ROC/MWh for wave and tidal stream generation devices and 1.5 ROC/MWh for offshore wind (UK Government, 2009a). The Scottish government then raised the support level for wave and tidal stream technologies to 5ROC/MWh and 3ROC/MWh respectively (Scottish Government, 2009). In 2010, the UK wide level of offshore wind support was increased to 2 ROC/MWh in recognition of higher than expected deployment costs (UK Government, 2010).

As of the time of writing (November 2011) DECC is conducting another process of review in which they have proposed the level of support for offshore wind is kept at 2ROC/MWh until the 31<sup>st</sup> of March 2014 and then reduced to 1.5MWh for all new build after this. At the same time, it has been proposed that support for wave and

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<sup>3</sup> Note, the Obligation used to be a % of a suppliers generation however this link was broken in 2009 when banding of ROCs was introduced since 1 ROC was no longer equivalent to 1 MWh as was previously the case.

tidal stream technology are increased to 5ROC/MWh up to 30MW of deployment and 2ROC/MWh for everything above this level (DECC, 2011a).

Currently, the level of RES-E supported through the RO has consistently fallen short of the level of the annual obligation (it can be argued that this was intended by the design of the RO) and the 2009-2010 target obligation of 9.7% can be compared with an actual increase such that RES-E accounted for 6.8% of total electricity supply. The overall pattern of growth in renewable is shown in below.

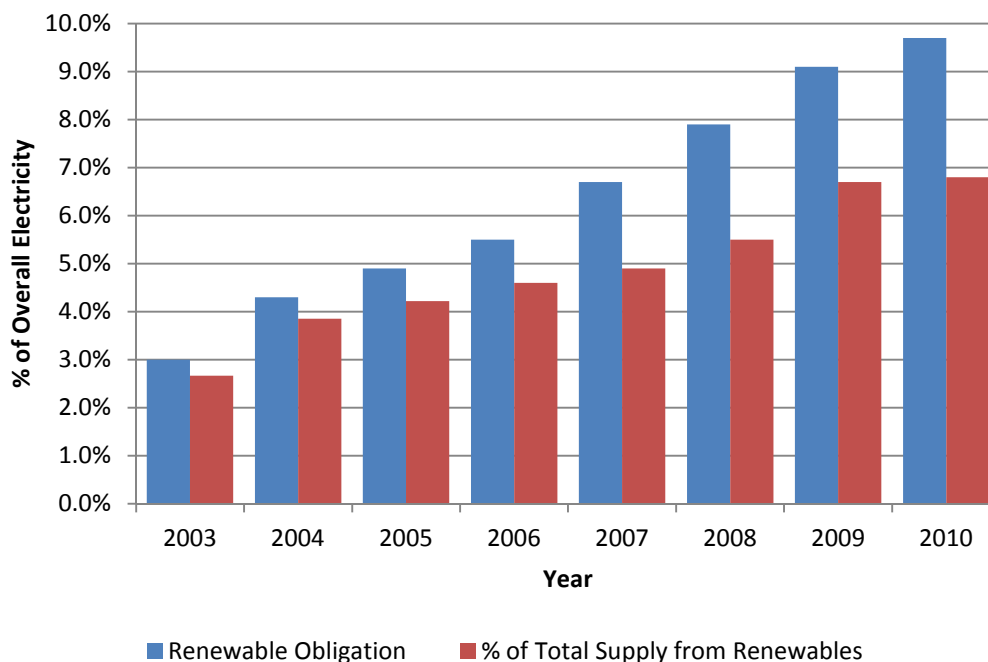


Figure 7: Renewables Electricity Obligation and Actual Supply since 2003 (DECC, 2011b, Department of Trade and Industry, 2006)

By comparison, RES-E made up 18.2% of EU electricity consumption in 2009 (the latest date for which statistics are available, with the UK coming 20<sup>th</sup> out of the 27 EU Member States (European Commission, 2011a).

In recognition that there is a need to not only accelerate renewable deployment, but also to provide investment certainty for the large capacity replacement required over the coming years (roughly 25% of capacity by 2020), the UK Government is in the process of introducing a new Contract for Difference Feed in Tariff mechanism (CfD FiT) described further in Section 9 (DECC, 2011e).

### 5.1.2 Renewable Energy Guarantees of Origin

Just prior to the introduction of the Renewable Obligation, in 2001 the EU 2001 Renewables Directive introduced the European wide tradable renewable energy 'guarantee of origin' (REGO) scheme which would be used to both provide a comparable platform of renewable energy performance among countries as well as allowing individual countries and suppliers to show their final fuel mix (European Commission, 2001).

This mechanism was adopted within the UK in 2003, initially awarding accredited generators of renewable electricity 1 REGO/kWh of electricity they produced but subsequently changing to 1 REGO/MWh from 2010 (Ofgem, 2011c). The primary

purpose (and value) of the REGO is that it is complemented by the Fuel Mix Disclosure (FMD) which was established at the same time as the REGO and obliged energy supply companies to disclose their exact energy fuel mix to the public (Ofgem, 2005). It has no intrinsic value.

### **5.1.3 Levy Exemption Certificates**

The Climate Change Levy is an energy tax on non-domestic users (i.e. commercial and industrial users) of lighting, heating and power. For electricity, this rate is currently £4.85/MWh (HM Revenue and Customs, 2011). The Climate Change Levy itself was introduced in 2001 as a result of the Finance Act 2000 (Ofgem, 2011a). Exemptions for the Climate Change Levy are provided for renewable energy generating stations which are awarded Levy Exemption Certificates (LECs) every month on a per MWh of generation basis. As with ROCs and REGOs, LECs can be traded separately from the electricity that they are generated with.

Award, retirement and overall responsibility for ROCs and REGOs are managed by the UK energy regulator, the Office of the Gas and Electricity Markets (Ofgem). LECs are also awarded through Ofgem however they are submitted to HM Revenue and Customs to show exemption of levy status. The primary trading mechanism for all of these certificates is the online auction company eROC, which is a branch of the Non-Fossil Purchasing Agency which still purchases the remaining contracted electricity from the later rounds of the NFFO as well as selling on the ROCs, REGOs and LECs from these schemes.

In the 2011 budget, the Chancellor announced that the Climate Change Levy would be extended to include suppliers of fossil fuels used to generate electricity (i.e. coal and gas) thus far except. The extra revenue bought in as a result of this is to be used to create a Carbon Price Floor support system to the EU ETS described further in section 9 (DECC, 2011e).

## **5.2 Other Financial Support Mechanisms & Bodies**

In addition to the above mentioned revenue support mechanisms that are currently available to renewable electricity generators, there is an ever-shifting landscape of 'technology-push' grant and mixed grant/revenue support initiatives that are made available from public sector stakeholders from time to time. The responsibilities for commercialisation of marine technology lie between a disaggregated mesh of bodies whose broader remit (and primary central governing bodies) include energy, climate change, business stimulation, research and development, innovation and regional economic promotion. These bodies and are shown in Figure 8 below.

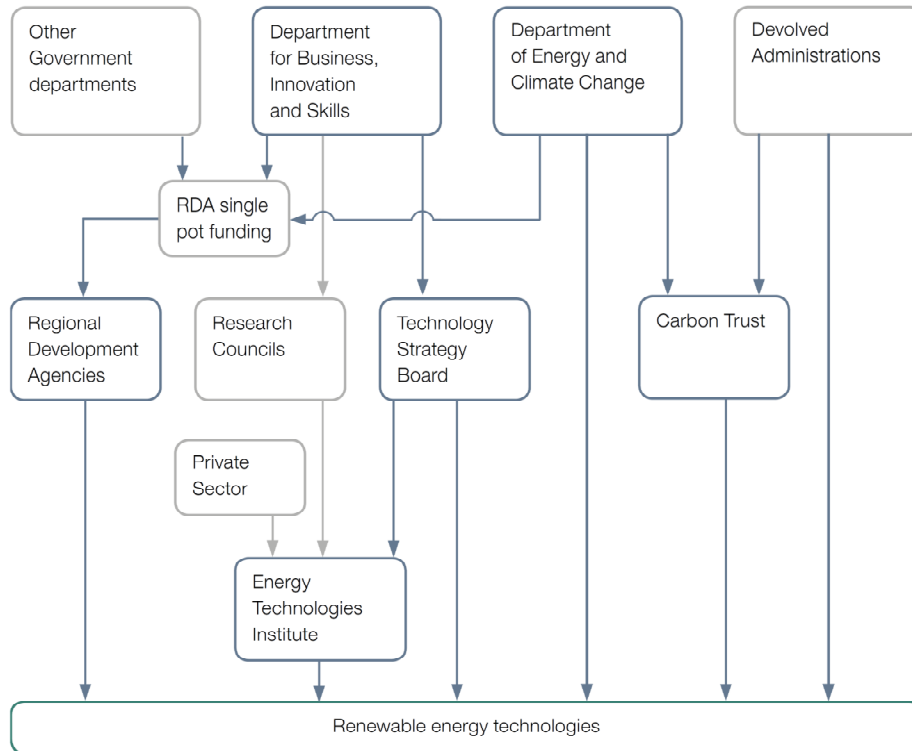


Figure 8: Key UK Funding Bodies for Offshore Renewable Technologies (National Audit Office, 2010)

All of these bodies' individual funding mechanisms are limited in time frame, budget and scope to some, there is a roughly cohesive development pathway for different stages of research and technology maturity which are supported through these different funding bodies. This is shown in Figure 9 below and the following list of UK funding bodies is therefore ordered based upon maturity of research (with support mechanisms for earliest stage listed first) rather than date or amount of subsidy.

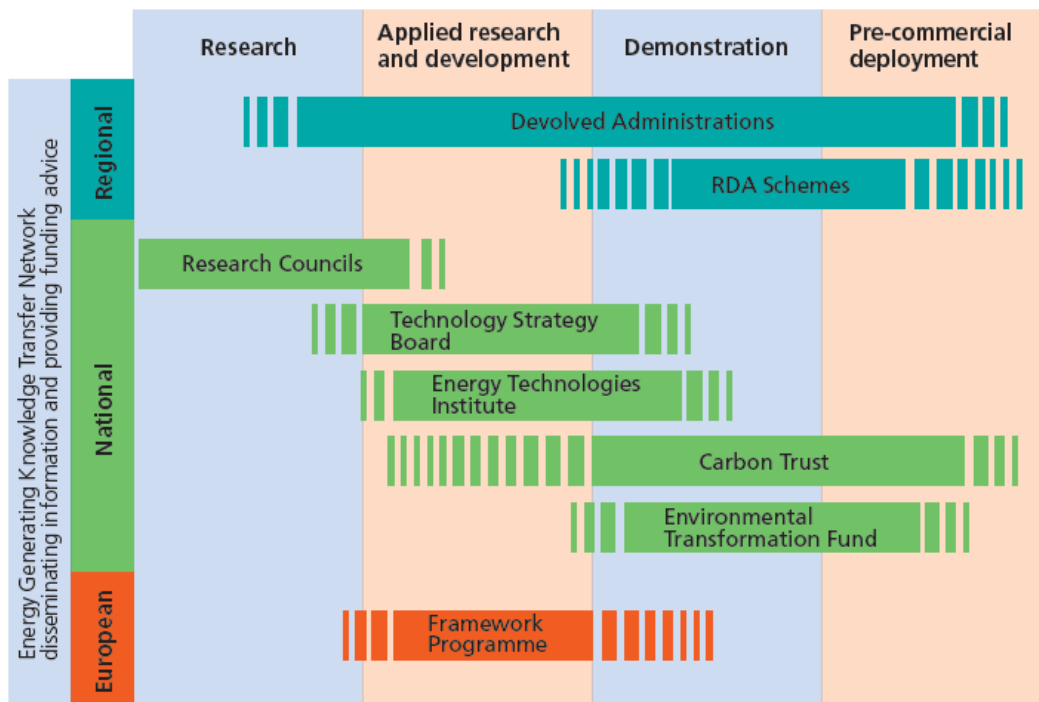


Figure 9: UK Research Funding Overview (Research Councils UK, 2010)

### 5.2.1 Research Council Funding

Most early stage research funding for marine renewable energy comes from one of the seven publicly funded research councils and their collective partnership body, Research Councils UK. These are funded through the UK Government's Department of Business, Innovation and Skills (BIS); the key UK provider of grant support for fundamental and early stage research. Their supported research is wide ranging and includes feasibility studies, instrument development, visiting researchers, capital equipment and travel grants (EPSRC, 2011). They can be international in scope and are often awarded as collaborative funding between industrial and academic or other industrial research partners. The Engineering and Physical Sciences Research Council, (EPSRC) is the key body supporting science and technological development of renewable technology, however the Economic and Social Research Council (ESRC) and the Natural Environment Research Council (NERC) marine renewable related socio-economic and environmental research programmes respectively. Additionally, certain sub-bodies to the primary research councils that have supported and researched marine renewable energy include the Energy Research Unit (ERU), the UK Energy Research Centre (UKERC) and the Research Councils UK (RCUK) Energy Programme. The last of these, the RCUK Energy Programme is a cross council partnership with a budget of £530m whose objective is to support research, training and visibility of energy related programmes to ensure government objectives are met (Research Councils UK, 2011).

Collectively, these research councils have supported hundreds of projects in wave, tidal and wind energy, to a total value of around £30m. These research grants are available year round for application and can be both interdisciplinary and covering multiple technologies. The breakdown of grants from all research councils that supported ocean energy is shown in Table 4 below (Research Councils UK, 2010):

	Invested
Marine (Wave & Tidal)	£11.8m
Wind (All)	£22.62m

Table 4: UK Research Council Spending on Offshore Renewables

Research council funding tends to support early conceptual research however this is not absolute and funding has been made before for larger developers to conduct primary research in collaboration with specialist universities.

### 5.2.2 Technology Strategy Board Funding

The Technology Strategy Board (TSB) is a non-departmental public body (NDPB) that works with businesses to support technology development and innovation that can lead to more commercially clear outcomes (i.e. has a potential commercial application). They are primarily funded through BIS but also receive support from other central government departments as well as devolved administrations and the research councils, often supporting industry as part-financed research support. As with the research councils, TSB funding support is generally more available to consortiums of industry and academic groups however, unlike the research councils, TSB funding is obtained through time specific competitions that are awarded to successful bidders and are generally 100% technology specific (rather than awarding mixed % of project funding to technologies as the Research Councils do).

To date, the key marine funded support competitions are shown below:



Technology	Programme	Invested	Status
Marine (Wave & Tidal)	Reducing Costs and Improving Performance	£9m	Active
	Underpinning Development	£3m	Active
	Low Carbon Energy Technologies Programme	£20m	Complete
Offshore Wind	Low Carbon Energy Technologies Programme	£7m	Complete
Mixed	Offshore Renewable Energy Technology and Innovation Centre	-	Announced

Table 5: Technology Strategy Board Spending on Offshore Renewables

Currently, the TSB is seeking to establish an innovation centre for offshore renewable energy which it hopes will enable reduced costs and commercialisation of all offshore technologies. The tender for this centre has closed however at the time of writing no announcement as to who won had been announced (Technology Strategy Board, 2011).

From the marine programmes the 'Reducing Costs and Improving Performance' programme is split into two strands. The aim of the first strand is to take novel scale devices towards demonstration while the second strand aims to increase reliability and reduce the costs of existing full scale demonstration device developers. The Underpinning Development programme aims to support pre-commercial full scale devices to achieve installation, maintenance, continuous operation, collection and analysis of data, supply chain development and environmental monitoring.

The TSB have also historically provided an additional £20m of support for marine technology on 19 projects and around £7m of research over 8 projects on offshore wind technology support through its Low Carbon Energy Technologies Programme (Technology Strategy Board, 2010).

In addition to the primary collaborative research grants, the TSB support two other relevant programmes: Firstly, they provide funding for Knowledge Transfer Partnerships (KTPs) which assist in deploying university and colleague affiliated researchers within industry, usually with a specific research agenda for a company. Secondly, they support knowledge exchange and diffusion through the Knowledge Transfer Networks (KTNs), which is a free web-based user network that has regular updates on news of events and industry developments as well as resource material.

### 5.2.3 Energy Technology Institute

Founded in 2007, the Energy Technology Institute (ETI) is a joint 50:50 funded collaboration between key government departments; DECC, BIS the TSB and Research Councils, and several large international companies; BP, Caterpillar, Eon, EDF, Rolls Royce and Shell. Its ambitions are purely focused on energy technology development and specifically in assisting the government to meet its various emissions reduction targets.

The ETI is currently involved with some of the largest funded programmes available including a £25m offshore wind test rig currently being constructed at the National

Renewable Energy Centre and the recently announced £25m offshore floating wind demonstration project. To date, the ETI have funded, or announced funding for the below programmes to the combined sum of £93.83m:

Technology	Program	Invested	Status
Marine (Wave & Tidal)	ReDAPT	£12.4m	Active
	PerAWaT	£8m	Active
	Wet-mate Connector	£1.1m	Active
	WEC System Demonstrator (Stage 1)	£2m	Announced
	WEC System Demonstrator (Stage 2)	-	Announced
	Tidal Modelling	£0.45m	Active
Offshore Wind	NOVA	£2.8m	Complete
	Helm Wind	£2.5m	Complete
	Condition Monitoring	£5.1m	Active
	Offshore Wind Test Rig Design	£1.53m	Active
	Offshore Wind Test Rig	£25m	Active
Floating Wind	Deep Water	£3.3m	Complete
	Offshore Wind Floating System Demonstrator	£25m	Announced
Mixed	Offshore Renewable Industrial Doctorate Centre	£5.1m	Active

Table 6: ETI Spending on Offshore Renewables

Notable elements within the ETI funding include the research programmes for offshore wind, one of which was a small demonstration floating turbine that has now been successfully completed and the other (Offshore Wind Floating System Demonstrator) which seeks to build a prototype floating offshore wind turbine with the west of the UK by 2016. The other high cost wind programme in the ETI portfolio is the construction of the Offshore Wind Test Rig. This £25m rig built at the National Renewable Energy Centre (NAREC) in Northumbria will be an indoor facility able to test the full drive train of turbines up to 15MW.

Most recently, the £6.5m doctoral training centre for offshore renewable energy will provide training to engineering graduates within the sector (and is discussed further within the skills and training support section).

The primary marine projects currently active are the ReDAPT project, aiming to construct and deploy a 1MW tidal turbine at the European Marine Energy Centre (EMEC) in Orkney, and the PerAWaT project that is led by Garrad Hassan, one of the world's largest wind energy project design companies. PerAWaT shall create analytical tools capable of wave and tidal farm site cost and power estimations.

#### 5.2.4 Carbon Trust

The Carbon Trust is a not for profit company established in 2001 by the government to assist the transition to a low carbon economy by helping businesses to reduce their overall emissions as well as enter into and innovate within the low carbon economy. Unlike the TSB and research councils, the Carbon Trust is primarily supported through DECC although it has a commercial investment branch, Carbon

Trust Investment Ltd, which it has used to provide over £160m of venture and seed capital to date for emerging low carbon businesses within the UK (Carbon Trust, 2011b).

The Carbon Trust's programmes have historically tended to look at technology cost reduction measures (rather than direct capacity building) through applied component research and integration (the clear exception to this being the Marine Renewable Proving Fund). To date the Carbon Trust has run three main projects focused on marine energy and two within wind/offshore wind as shown below:

Technology	Programme	Invested	Status
Marine (Wave & Tidal)	Applied Research Programme	£4m	Active
	Marine Energy Accelerator	£3.5m	Complete
	Marine Energy Challenge	£3m	Complete
	Marine Renewables Proving Fund	£22.5m	Active
Offshore Wind	Applied Research Programme	£1m	Active
	Offshore Wind Accelerator	£10m	Active

Table 7: Carbon Trust Spending on Offshore Renewables

Of the above programmes, the Offshore Wind Accelerator is the single largest since the CT managed contribution (provided by DECC) accounts for 1/3 of a total £30m project with the remainder coming from industry. This project aims to reduce the cost of offshore wind energy by 10% through working in collaboration with 8 key utility and turbine manufacturing partners.

The Marine Renewables Proving Fund has been provided by DECC, (which the CT are managing). It is intended to allow 6 device developers (4 tidal, 2 wave) to build and deploy full scale devices over the coming years (Carbon Trust, 2009).

### 5.2.5 The Department of Energy and Climate Change

The Department of Energy and Climate Change (DECC) is clearly one of the key stakeholders and principle funding bodies for all energy related activity. Unlike BIS, DECC directly fund large scale projects related to marine energy deployment and capacity building. Along with DECC's predecessor government bodies in charge of energy, the Department for Business, Enterprise and Regulatory Reform (2007-2009) and the Department of Trade and Industry (1983-2007), DECC have been the principle driver for the commercialisation of marine (and indeed all) renewable energy technologies. As well as governing the market pull revenue measures identified above, DECC have also funded the following programmes for marine and wind energy technology:

Technology	Program	Invested	Status
Marine (Wave & Tidal)	DTI/BERR's NRE/Technology Programme	£26m	Complete
	Low Carbon Technologies Fund	£20m	Active
	Environmental Transformation Fund (EMEC)	£8m	Complete
	NAREC	£10m	Complete
	Wave Hub	£9.5m	Complete
Offshore Wind	DTI/BERR's NRE/Technology Programme	£4m	Complete
	Offshore Wind Capital Grant Scheme	£102	Complete
	Environmental Transformation Fund Offshore Wind Demonstration (Call 1 to 3)	£28m	Complete
	OSW Components Scheme (Call 1 & 2)	£15m	Announced

Table 8: DECC Spending on Offshore Renewables (Renewables Advisory Board, 2008, DECC, 2011h, Halliday and Ruddell, 2010)

Central government legacy programmes include the Technology Programme (formerly the New and Renewable Energy Programme) which supported the development of 27 marine devices and is now part of the Technology Strategy Board's remit; it played an important part of the energy funding landscape at the early part of the last decade.

By far the largest of DECCs funded programmes was the Offshore Wind Capital Grant Scheme. This scheme provided key capital grant support (up to 40% of capital cost) for offshore wind energy farms deployment within the round 1 and 2 installations currently taking place within the UK. Second to this, the demonstration fund attempted, over 3 separate calls and 14 supported projects, to reduce the cost and deployment time for offshore wind energy deployment within multiple areas of the technology.

More recently, as well as the £15m allocated to the Offshore Wind Components Scheme which continues the earlier project to support component cost reduction, DECC have also announced a further £15m to be spent on offshore wind innovation over the next 2 years (DECC, 2011h). Within marine renewable energy, the current key funding available is the £20m Low Carbon Technologies Fund. This leverage funding is intended to support the deployment of small arrays for already tested full scale devices (such as the Pelamis and Marine Current Turbine).

Notable for its absence from the funding landscape is the Marine Renewable Deployment Fund (MRDF) which was a £50m demonstration fund that was made available to the sector in 2005. £8m of this was allocated to non-developer aspects of marine renewable energy (including a £2m environmental research programme and support for further upgrades to EMEC). The remaining £42m was for device developers but was never accessed due to the overly prohibitive requirements of access to the fund. Most notable of these was the requirement for 3 months continuous (or 12 month interrupted) operation of a full scale grid connected device (Renewables Advisory Board, 2008). As the UK Governments main funding support programme for full scale device deployment, this resulted in hindering the realisation of full scale marine devices for almost five years and can therefore be seen as an unfortunate policy failure. Although the mechanism was intended to support 'best of breed' (i.e. the most commercially mature technologies), it failed to recognise a clear

UK funding gap between the final stages of scaled system validation at which most developers were (where expected costs are estimated at £500k-£5m) and initial full scale prototyping & sea trials of devices (where costs are estimated at £10m+) (EG&S KTN, 2010, Carbon Trust, 2011a).

## 5.2.6 Devolved and Regional Administrations

### 5.2.6.1 Scotland

The Scottish Government have historically been one of the most prominent and pioneering supporters of offshore renewable energy having been integral in facilitating and funding the deployment of the first wave energy device in the UK, the 500kW Limpet in 1999. As well as this, they provided key funding for EMEC in Orkney, a separate and higher RO for marine technologies (see The Renewables Obligation section above) and completed a national marine strategic environmental assessment (SEA) in 2007, before the UK government assessed the nation as a whole (which is has still to do for wave and tidal energy technologies). Additionally, the Scottish government has provided support both for device and component development throughout the supply chain and at different stages of device maturity (in addition to that which can be accessed within the UK overall). An overview of this funding provision is shown below:

Technology	Programme	Invested	Status
Marine (Wave & Tidal)	The Saltire Prize	£10m	Active
	WATERS	£13m	Active
	WATES	£7.4m	Complete
Offshore Wind	Prototyping for Offshore Wind Energy Renewables Scotland	£35m	Active
	Beatrice Wind Farm Demonstrator Project	£3m	Complete
	National Renewables Infrastructure Fund	£70m	Active
Mixed	SMART: SCOTLAND grant awards for Marine	£1.07m	Active

Table 9: Scottish Government Spending on Offshore Renewables

Specific funding opportunities of note include the National Renewables Infrastructure Fund (N-RIF), managed by Scottish Enterprise which is a infrastructural fund designated for improving port and manufacturing facilities within the country over the coming years.

The WATES, WATERS and Beatrice fund were technology development grants specifically for technology developers to up-scale prototype testing and deploy their marine and offshore wind energy technologies respectively. The Saltire Prize however is the only competition fund project currently available within the UK and is a £10m fund available to the first wave or tidal team that can generate 100GWh of electricity within Scottish waters over a two year period<sup>4</sup> (Scottish Government, 2010b). The Scottish Government have also provided many non-financial support mechanisms to the sector, some of which are outlined in the below section.

<sup>4</sup> The timeframe for this competition is between June 2012 and July 2017 when the competition closes.

Finally, it has recently been announced that the Scottish Government are to receive £103m (half of a £200m pot created as a result of power purchase agreements under the Scottish NFFO (a previous support mechanism for renewable sources of electricity) to spend on renewable projects. The breakdown of allocation is however yet to be announced.

### 5.2.6.2 Wales

Unlike Scotland, Wales does not have either as much devolved independence, (planning and regulatory responsibilities for major energy supply are retained by the UK Government) or as much finance available for technology and innovation support. Non-the less, the Welsh Government has managed to secure EU Objective 1 funding for marine renewable energy and has a planned roadmap and policy for the deployment of offshore renewables outlined further within the specific section of this document (Renewables Advisory Board, 2008, Welsh Assembly Government, 2010).

Technology	Programme	Invested	Status
Marine (Wave & Tidal)	Welsh Gov. Objective 1 Funds	£6.5m	Active
Offshore Wind	Welsh Gov. Objective 1 Funds	£0.3m	Closed

Table 10: Welsh Government Spending on Offshore Renewables

### 5.2.6.3 Regional Development Agencies

The regional Development Agencies (RDAs) were non-departmental public bodies established at the end of the 1990s to promote economic and sustainable development as well as employment and skills within their region. RDAs were abolished (as part of an electoral promise) in April 2012 with many of their larger assets, (such as the Wave hub test site, see below) being transferred to central government while the role of economic development for the region has been taken on by regionally funded Local Enterprise Partnerships (LEPs).

Many of the 9 regional development agencies played a strong role in assisting with technology development for offshore renewables. Although budgets for RDAs were clearly more limited than central government departments, £33.3m was spent between all of the RDAs in 2008-2009 on renewable energy. Of this, £12.9m was to project developers and a further £17.6m to non-profit organisations (National Audit Office, 2010).

Statistics for RDA spend on offshore renewables specifically are hard to find and much of the influence that RDAs had on the sector was through facilitating activities (such as planning and infrastructural support for test centres etc.) as well as through application and management of European Funding streams. Some primary funders among the RDAs included the Scottish Highlands and Island Enterprise, the South West Regional Development Agency and One North East who each provided part finance for their regional marine test facilities (and ongoing operations in some cases).

### 5.2.7 European Funding

The main vehicle used by the European Commission Research and Innovation department for almost all EU research and development activities are the Research



and Technological Development Framework Programmes. The Framework Programmes focus on leading edge science and research rather than sustainability targets (such as carbon emission reduction or renewable energy generation capacity building) however enabling research that will assist in the shift towards a low carbon economy is clearly a key field of involvement. Currently, the €53.2bn 7<sup>th</sup> Framework Programme (FP7) is in operation (from 2007-2013) however much of FP7 builds on that of its predecessor the €17.5bn FP6 that ran from 2003 to 2006. As would be expected, all of the research projects underway are collaborations between different European partners (although this is not a technical requirement of EU research funding). FP7 projects with a UK offshore energy element are listed below (European Commission and CORDIS, 2011):

Technology	Programme	Invested	Status
Marine (Wave & Tidal)	MARINA PLATFORM	€8.71m	Active
	WAVEPORT	€4.59m	Active
	EQUIMAR	3.99m	Complete
	CORES	3.45m	Complete
	PULSE STREAM 1200	€8.01m	Active
Mixed	ORECCA	€1.6m	Complete
	HIPRWIND	€11.02m	Active
Offshore Wind	SAFEWIND	€3.99m	Active
	TOP WIND	€1.03m	Active
	EERA-DTOC	€2.9m	Announced
	CLUSTERDESIGN	€3.56m	Announced

Table 11: EU FP7 Spending on Offshore Renewables

In addition to the above FP7 programmes, the EU Intelligent Energy Europe (IEE) programme provides annual calls for research funding aimed at increasing energy sustainability as part of the larger Competitiveness and Innovation Framework Programme (CIP). Although the CIP has a total 2007-2013 fund of €3.6b, the IEE fund total is €730m which is split primarily between three areas: energy efficiency and the rational use of energy (SAVE), energy in transport (STEER), and, most relevant to the marine energy sector; new and renewable resources (ALTENER). ALTENER does specifically support capacity deployment as well as tackling skills and other non-technical barriers. Within IEE, the following offshore renewable energy research projects have been supported with a UK (European Commission and IEE, 2011):

Technology	Programme	Invested	Status
Marine (Wave & Tidal)	SOWFIA	€1.9m	Active
Mixed	SEANERGY 2020	€1.24m	Active
	MERiFIC	€2.5m	Active
	OFFSHOREGRID	€1.39m	Closed
Offshore Wind	GPWIND	€1.86m	Active
	WINDSPEED	€1.45m	Closed

Table 12: EU IEE Spending on Offshore Renewables

Many of the European funding streams have focussed upon collaborative research projects that enhance the knowledge base for the entire European community rather

than specific research technology development funds as is the case with much of the national level funding.

Most notable of these projects for the UK, and the South West include the EQUIMAR programme which focussed on creating standards of evaluation of marine technology devices. This programme also has 9 UK actors, (5 of which were universities). Additionally, the MERiFIC programme is a SW focussed research project seeking to advance the adoption of marine energy within Cornwall as well as its French partner site, Finistère, through identification of collaborative learning and best practice creation between the regions.

A final key development within the European Funding landscape is the New Entrance Reserve 300 Funding (NER300). The NER300 is funded through the allocation of 300m carbon emission allowances, (each equivalent to 1 tonne of carbon) which, if sold for an expected €10 each within the EU ETS, would provide €3bn of support. There are 2 rounds within the NER300; the first (and largest) has seen the UK make 5 marine renewable applications (of which a total of 3 could potentially be funded). Results will be announced in November 2012. Project selection is done in a complex fashion that will try to account for lowest cost, diversity of project types (i.e. technologies) while ensuring as many EU countries are included as possible. Successful RE applicants will receive 50% of their relevant costs over a 3 year period.

### **5.2.8 Other Public/Private Funding Support**

In addition to private commercial investment, (such as for specific project developments and the ETI programmes) and the central funding bodies outlined above, funding has also come from other public or CSR stakeholders with an interest in commercialising the marine energy sector. The Crown Estate, as manager of the UK seabed have invested over £6.3m in commercialising marine energy alone, of which £6.1m came through from their £11m Enabling Actions fund (The Crown Estate, 2011d). Other contributors include the NPower Juice Fund which has spent around £0.2m on smaller project developments (NPower, 2011). Much of the conditionality of this funding has the advantage of being less objective focussed and not requiring match-funding as most government support does due to European competition laws.

### **5.2.9 Green Investment Bank**

The Green Investment Bank (GIB) is a central government initiative which it has been announced should see the establishment and capitalisation of a £3bn investment institution whose role is to address the perceived risk and high transaction costs that the government believe early stage RE technologies hold to investors. The bank will be operational by April 2012 in an 'incubation' phase prior to EU state aid approval, after which it will become a stand-alone (at arms-length from central government) institution. As of 2015, it shall acquire borrowing powers and therefore be allowed to expand its investment portfolio. The Government has identified offshore wind energy as a key area requiring investment and this will be a priority technology for investment by the GIB (UK Government, 2011). In marine energy, the GIB perceives a 'moderate' level of investment will be required to ramp up from 2015 onwards (UK Government, 2011). Alongside offshore wind, energy efficiency, rolling stock (transport upgrades) and waste, marine RE is considered to be a sub-sector that the



government believe could benefit greatly from the GIB (UK Government, 2011). One of the problems facing early stage developers is in acquiring match funding that is required with all forms of government technology support (as a result of EU state aid and anti-competition laws) it is thought the GIB could overcome this hurdle by providing debt and equity products initially with an aim to diversify into other supporting products for low carbon technology. Concerns and uncertainty regarding the GIBs establishment include its capitalisation through the sale of government assets (such as the High Speed 1 southern rail link which shall provide £775m), the lack of GIB ISAs as a potential option for bank borrowing and providing a symbolic way of enabling individual support, its perceived proximity to government (which could delay or even prevent it from getting EU state aid approval) and its overall operating mandate which, if too prohibitively defined, will prevent it from providing the services for which it was initially designed (Environmental Audit Committee, 2011, Jowit, 2011).

### **5.3 Non Financial Support Policies**

There are a wide range of non-financial support mechanisms that are available for technology developers to help assist them in commercialisation. Although the offshore wave, tidal and floating wind industry is very much in a nascent state at present, the large increase in deployment for offshore wind nationally that is currently occurring has allowed for 'spill-over' benefits to affect these budding sectors. For example, regulations for generation as well as licensing and management of offshore energy generation stations and offshore transmission networks have been given a wide ranging review and revision over the past decade as a result of the requirements for the offshore wind. Many of the complementary skills sets such as marine environmental assessment techniques, offshore power engineering and seabed construction are now being diversified into from the declining oil and gas industry within the North East of Scotland and universities throughout the UK. Finally, infrastructural upgrades to port facilities and the assemblage space requirements for the up to 33GW of wind turbine deployment leased under the Round 3 wind development are being invested in. Although not all of these developments will have a direct benefit to the marine renewables sector, there is no doubt that some of them will assist in the commercialisation of wave, tidal and offshore wind, if not now, then when these technologies are ready for ready to move from demonstration into a deployment phase themselves.

Some of the other non-financial support mechanisms currently available for marine renewable energy developers are listed in the below section:

#### **5.3.1 UK National Test Facilities Centres**

The UK establishment of wave and tidal energy test centres represent one of the largest government investments in marine renewable energy and are among the key national assets for assisting in the drive to commercialise marine energy technology. The UK Government have tried to develop a coherent technological trajectory for developers within the wave and tidal energy sector, (although not for floating wind). This moves from concept to commercial deployment, and is supported through the establishment and operation of the three key test centres (as well as 'nursery' sites) and the network of dedicated research universities and test tanks. This has led to the commercial testing and deployment of both UK and non-UK device developers within English waters.

This pathway to commercialisation is shown in Table 13 and a brief description of these test centres and facilities is given below.

	TRL	Development Phase	Step Location:	Cap.
R&D:	Applied & Strategic Research			
	1	Basic principles observed and reported	Office	0MW
	2	Technology concept and/or application formulated	Office	0MW
	3	Analytical and experimental critical function and/or characteristic proof-of concept	Office/Laboratory	0MW
	4	Component/subsystem validation in laboratory environment	Laboratory/Tank	0MW
	5	System/subsystem/component validation in relevant environment	Tank/Scale Facilities (NaREC)	0MW
	6	System/subsystem model or prototyping demonstration in a relevant end-to-end environment	Scale Facilities (NaREC)	0MW
Demo.:	System Validation			
	7	System prototyping demonstration in an operational environment	'Nursery' Facilities – EMEC Nursery/FabTest	~0.1MW < 1MW
	8	Actual system completed and proven through test and demonstration. Verification and Validation (V&V) completed	Full Scale Facilities – EMEC	0.5MW < 2MW
	9	Actual system proven through successful pre-commercial long term operations	Full Scale Facilities - EMEC	0.5MW < 2MW
Commercial:	Commercial Validation			
	na	Commercial deployment of small arrays in long term operations	Commercial Deploy. EMEC/Wave Hub/Saltire Prize projects	4MW < 10MW
	na	Commercial deployment of multiple arrays in long term operations	Commercial Deploy. Wave Hub/Pentland Firth	4MW <

Table 13: UK Marine Technology Pathway to Commercialisation

### 5.3.1.1 National Renewable Energy Centre (NAREC)

The National Renewable Energy Centre in Northumbria, north west England was established in 2002 by the regional development agency and now acts as the *de facto* national laboratory for research within a wide range of renewable technologies

including wave, tidal, wind, solar photovoltaic and electrical networking (specifically sub-sea cabling).

It has a wide range of test facilities available for wave and tidal stream technologies from specialists within almost all fields of device construction, (including prototyping, power engineering and control systems) to the large outdoor wave energy testing facility (with wave generator) and a 3MW turbine drive train test rig.

To date, NAREC has supported the research of a wide range of both wave and tidal energy developers including; Aquamarine Power, Trident Energy, Ecofys, Green Cat Renewables, OWEL Ltd, Ocean Wavemaster Ltd SMD Hydrovision and several confidential projects (narec, 2008). Its field of assistance has ranged from scale tank testing and sub-component system design to computer modelling and validation. NAREC has also assist in the important role of data validation for utilities and other investors to assure the credibility of perspective devices.

### **5.3.1.2 European Marine Energy Centre (EMEC)**

EMEC is one of the most advanced test centres for wave and tidal technology within the world. Based in the Orkney Islands in the north of Scotland, it has two primary types of birthing area. Firstly, the EMEC nursery which provides three (1 wave, 1 floating tidal and 1 non-floating tidal) relatively sheltered sites in 21-25m depths with pre-made gravity base anchoring points and a 'test support buoy' that includes wireless connectivity, control power back-up, load dispersal (up to 75kW) and a host of other features (EMEC, 2011b).

The main test sites consist of the Billia Croo Wave Test Site and the Fall of Warness Tidal Test Site. Both of these sites have hosted half a dozen or so device developers (both national companies and international) with full scale devices over prolonged deployment periods. The research locations include full grid connectivity (to the Orkney mainland), pre-compiled EIAs and much of the necessary licensing work, an extensive history of environmental and sea condition data for resource assessments as well as real-time feedback capabilities, fibre optic SCADA control provision to all births (as well as CCTV to Billia Croo) and a coastal 11kV control and switching station (EMEC, 2011a).

In addition to this, EMEC is the first ever accredited test centre for the performance of wave and tidal energy conversion systems (as registered with the UK Accreditation Service) having created a bespoke management system based upon OHSAS 18001, (health and safety management system) ISO 14001, (environmental management system) and ISO 17025, (competent testing and calibration certification for laboratories).

### **5.3.1.3 Wave Hub**

One of the newest test centres to be commissioned in the sector, Wave Hub only came into operation in late summer 2011 having been delayed by some years on its originally planned commencement date. Wave Hub is a (wave only) 11kV grid connected demonstration site designed for the deployment and monitoring of small arrays of devices at an 8 km<sup>2</sup> berthing location 13km of the coast of Hayle in Cornwall, SW England. It has four separately connectable berths available (each rated to take up to 4-5MW of capacity), each having an allocation of 2km<sup>2</sup> each. One advantage of the Wave Hub is that it holds a 25 year lease of the sea-bed that should simplify and shorten legal and other consenting processes for developers to enhance the speed with which marine energy generating devices can be deployed (Wave Hub, 2012). Additionally, Wave Hub provides a venue for research in key areas ranging from resource characterisation to environmental and biodiversity impacts.

Wave Hub is also supported by an array of testing and support facilities including a nursery site, (FabTest) component test facility, (DMaC) mooring test facility, (SWMTF) as well as large array of specialist support and assistive resource and environmental data. These services and activities related to the Wave Hub are discussed further within the regional overview of marine renewable energy section (3) above.

### **5.3.2 Industry Representation**

Industry representation plays an important part in assisting in an increase in both the legitimacy of marine RE technology and encouraging government support and regulatory alignment. There are a range of different industry bodies that have adopted the marine renewable industry within their remit of representation including the Renewable Energy Association (REA), the Marine Renewables Industry Association (MRIA) and Subsea UK. One of the largest of these industrial representation bodies however (and certainly the most active in terms of events coordination and other supportive activity is RenewableUK, (formerly the British Wind Energy Association (BWEA)).

RenewableUK conduct a range of supporting activities to the sector, as well as being an outlet for news and information specific to the sector, they host many supporting events such as workshops, broader H&S or legislation training courses and their flagship 'Wave and Tidal' event, (supported by the Crown Estate). They also publish industry updates, jobs and courses and networking opportunities for members and event attendees.

Other key events for the sector include the annual All Energy trade conference (organised by the Aberdeen Renewable Energy Group (AREG)) which, although designed as a full renewable energy technologically wide conference, sees the wave and tidal energy sector heavily represented. There is also the trade conference, the International Conference on Ocean Energy (ICOE) and the more academically focussed European Wave and Tidal Energy Conference (EWTEC), both of which are European in focus and hosting but play an important part in the UK industry calendar of events. All Energy, ICOE and Wave and Tidal usually comprise of a wide range of industry stakeholders including public sector representatives test centres and utilities. There is often also large representation from prospecting primary and secondary supply chain businesses ranging from consultancies, engineering firms, aggregate suppliers and specialist occupations such as divers.

In conjunction with industrial associations, there are a host of current academic/joint research groups focussing on marine renewable energy (notably; PRIMaRE, SUPERGEN, MARINA) as well as industry actor specific networks (Developers Forum for Pentland Firth, Aberdeen Renewable Energy Group, SubseaUK) and individual interest stakeholder groups (such as the TSB Knowledge Transfer Network for Wave & Tidal and the International Network on Offshore Renewable Energy).

### **5.3.3 Information Provision**

Having a clear idea of what is currently occurring within the sector, as well as a future roadmap for development is critical for allowing stakeholders to judge the level of time and money that they should commit to the sector. Almost all of the above

stakeholders mentioned within the Financial Support section produce regular updates on both funding developments and industrial activity however of most importance are central government documents which (in theory) show government ambitions for technology commercialisation to a given timeframe. DECC have produced two key documents, the Marine Energy Action Plan, which explains the governments vision for marine energy and the more recently published UK Renewable Energy Roadmap, that shows national ambitions for renewable energy deployment, (DECC, 2010b, DECC, 2011h).

Communication of the research landscape affecting marine renewable energy (as with other technologies) is provided through the UK Energy Research Centre's 'Research Atlas' and Landscape documentation (UKERC, 2011).

### **5.3.4 Skills and Employment**

Although still in its infancy, there is a clear need to examine the skills and employment requirement that would be expected as the sector matures. An obvious synergy of skill sets exists between the onshore and offshore wind energy sector and that anticipated from the commercialisation of wave and tidal as found within several studies (Adams Associates UK Ltd, 2007, Pricewaterhouse Coopers LLP, 2010). Little has been researched however on the direct transferability and expected timing of skill demand, though the Research Council Energy Programme is supporting work to identify skills shortages and provision across the marine and other renewable energy sectors.

There is a clear acknowledgement that Science, Technology, Engineering and Mathematics (STEM) skills will be crucial to the requirements of future deployment within the industry and with this in mind, the UK government, (through the ETI) have recently announced the establishment of a new £6.5m Industrial Doctorate Centre in Offshore Renewable Energy (IDCORE). Although direct figures do not yet exist for floating wind technology, current estimates suggest that the UK could directly employ up to 10,000 people in wave and tidal by 2020 and almost twice this number by 2035, again, mainly within STEM based fields (RenewableUK, 2010).

The University of Southampton have published research suggesting indirect employment from the wave sector accounts for the creation of a further 3 jobs for every 6.5 direct wave energy employees. For tidal technology, this figure is slightly higher at 6.6 direct jobs to 4 indirect jobs. The breakdown of this figure (based on a per €m spend) is shown in Figure 10 below (Bahaj and Batten, 2005).

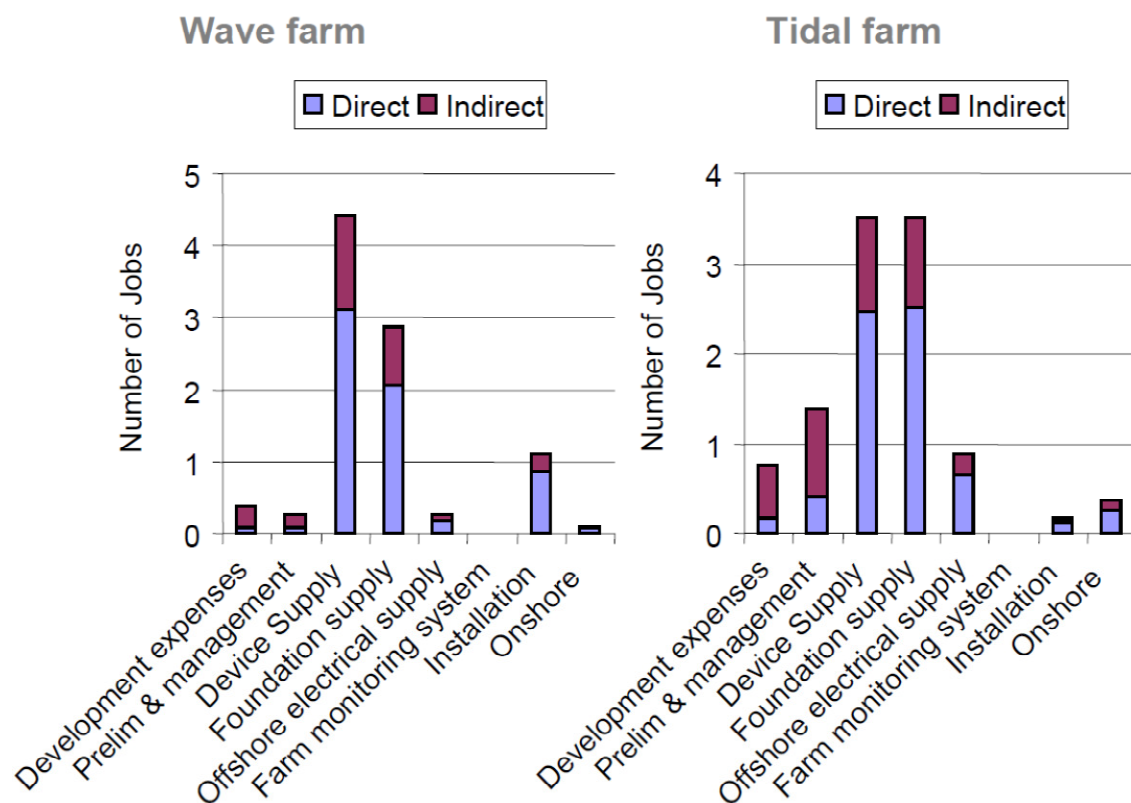


Figure 10: UK Wave and Tidal Jobs, Direct to Indirect Employment Ratio (Bahaj and Batten, 2005)<sup>5</sup>

## 6. Issues Specific to the Development of Wave Energy in the Nation and Region

### 6.1 State of the Industry

Currently, there is 1.31MW of wave energy capacity installed within the UK, comprising of Voith Hydro’s shoreline 0.25MW Limpet oscillating water column device (which has been operating since 2000), Aquamarine Power’s 0.315MW Oyster 1 device (operating at EMEC since 2009) and Pelamis Wave Power’s (PWP) 0.75MW P2 device which was installed at EMEC in 2010 (RenewableUK, 2011).

This low level of deployment does not however reflect the ambitions of the sector. The UK government which, alongside the Crown Estate, has been integral in leasing key areas of the Pentland Firth in northern Scotland. The ambition of the Pentland Firth Development, often thought of as ‘Round 1’ for wave and tidal technologies (following in the categorisation that offshore wind has taken with large leasing tranches), is to see 600MW of leased wave energy site installed upon by 2020 along with a similar capacity of tidal power. Before the large scaling up of manufacturing required to achieve this target ensues, a number of preliminary deployment are being planned (referred to as the “Saltire Round” due to eligibility for the Scottish Governments Saltire Prize explained on page 31) which are listed below:

<sup>5</sup> Figures are based on employment levels per €1m however do not take into account learning effects.

Site	Rating	Developer	Status
Bernera, Isle of Lewis	10MW	Pelamis Wave Power Ltd	In Planning
Burghead, Moray Firth	30-50MW	AWS Ocean Energy Ltd	In Planning
Galson, Isle of Lewis	10MW	Lewis Wave Power Ltd	In Planning
North West Lewis	30MW	Lewis Wave Power Ltd	In Planning
South West Shetland	10MW	Aegir Wave Power Ltd	In Development

Table 14: Planned UK Wave Energy Deployments

## 6.2 National Technology Developers

As would be expected, those technologies that have had the highest number of successful deployments to date are in most cases 'leading' the market in terms of sector landmarks. Pelamis Wave Power (PWP) was globally the first company to commercially deploy a wave energy device and array off the coast of Aguçadoura in Portugal. This project unfortunately shut down after only two months due to both technical faults and the project's owner, (Babcock and Brown) being badly affected by the advent of the global economic crisis. Nonetheless, Pelamis Wave Power gained technically from the experience, have re-designed their technology (into the Pelamis 2) and have since gained further orders and leased sites. PWP are currently working with energy utility companies E.On, Scottish Power Renewables and Swedish utility company Vattenfall, testing two devices at EMEC and developing a 10MW deployment in the Scottish Shetland Isles respectively. In addition, PWP are unique in the industry in that they are also developing 2 of their own projects (inclusive of the 50MW Pentland Firth site, Farr Point) with a combined potential capacity of 60MW.

Another clear UK technology leader is Aquamarine Power with its Oyster 2 device. Aquamarine Power are currently in the process of developing several projects, notably within the Pentland Firth they are working with SSE Renewables to develop the Borough Head wave farm, a site leased for up to 200MW. They are also developing a 40MW project off the Isle of Lewis (as an applicant for the Saltire Prize) and have several research deployments planned in Ireland, the United States and within the UK.

Despite the high historic level of market exits, (with devices such as C-Wave, Bristol Cylinder, McCabe Wave Pump, PS Frog and more now scrapped) there currently are around 20 wave technology developers within the UK (see Table 15 below). All of these developers are at an earlier stage of technology development than the market leaders (PWP and Aquamarine) however the diversity of concept designs shows that overall technology convergence is far from imminent. This indicates both that there is still a high level of uncertainty as to which form of power extraction is ultimately most efficient and indeed that there may be potential for multiple technology convergences to suit different wave, depth and geomorphic/geographic environments.

Company	WEC Device	Device Type
Ocean Navitas	Aegir Dynamo	Point Absorber
Checkmate SeaEnergy	Anaconda	Other
AWS Ocean Energy	Archimedes Waveswing	Point Absorber
Pure Marine Gen	DUO Wave Energy Converter (NI)	Point Absorber
FreeFlow 69	FreeFlow 69 Wave Pump	Point Absorber
Green Cat Renewables	Green Cat Wave Turbine	Attenuator
Voith Hydro Wavegen	Limpet500	OWC
Offshore Wave Energy Ltd	OWEL WEC	Surge Converter
Aquamarine Power	Oyster 2	Surge Converter
Pelamis Wave Power	Pelamis	Attenuator
Trident Energy	PowerPod	Point Absorber
Sea Energy Associates	SEA Clam	Surge Converter
Dartmouth Wave Energy Limited	Searaser	Point Absorber
Seatricity	Seatricity Pump	Point Absorber
AlbaTurn	SQUID	Attenuator
Embley Energy	Superboy	Point Absorber
Manchester Bobber Company	The Manchester Bobber	Point Absorber
Neptune Renewable Energy	The Neptune Triton	Surge Converter
Ocean WaveMaster	Wave Master	Other
Green Ocean Energy	Wave Treader	Attenuator
Lancaster University RE Group	Wraspa	Surge Converter

Table 15: UK Wave Energy Developers

### 6.3 Current Outstanding National Issues

Generally, it can be said that the wave energy sector, (as with all offshore renewables) has experienced a renaissance in research and funding within the UK over the last decade (IEA, 2010). This has enabled a steady increase in the number of technology developers, university research departments and relevant public sector representation both within the UK and internationally. Only in the past few years have devices started to be both manufactured and deployed at full scale (see above). This in turn has led to an expensive stage for emerging market leaders whereby full scale design optimisation needs to occur, larger overheads need to be supported and facilities for scaling of production need to be met. The lead elements of the technology sector can be said to be entering what is commonly referred to as the innovation 'Valley of Death', whereby scaling up of plant, labour and investment is required before any significant financial returns have been realised.

As a result, (and led by a government acknowledgement that technology convergence needs to occur within the wave energy industry if commercially available technologies are to emerge) a focussing of public funding towards these leaders has likewise occurred. Two key examples of this include; the failed £42m MRDF fund available for singular devices being replaced by the £20m Low Carbon Deployment fund which is focussed on small array deployment (Department for



Trade and Industry, 2005, DECC, 2011d). Secondly, increasing the RO revenue mechanism from 2 to 5 ROC/MWh, which shows a move from 'technology push' grant based mechanisms to a 'market-pull' revenue system, effectively indicating that the government has chosen technology winners (DECC, 2011a). There is clear concern over the appropriability for such a decision since it could potentially result in technology 'lock-in' and the associated opportunity cost (i.e. losing the opportunity to diversify into technology types such as shore-line or overtopping devices which may provide benefits such as greater export potential) as well as ultimately 'buying-in' to a less efficient (in terms of £/MWh and CO<sub>2</sub>/£) technology itself.

Although funding is still being made available to less mature technology developers, it is both sporadic in nature and with little overarching public sector co-ordination to move developers smoothly through research steps, government funding support systems and technology scaling. As a result of this, a large number of device developers are bunched at or around the subsystem/scale model prototyping stage between TRL6 and TRL7 (See Table 13 on page 36) where funding requirements jump to around £10m for full scale prototyping (EG&S KTN, 2010).

Finally, in addition to the above trend towards convergence, the political appetite for commercialisation of offshore renewable energy within Scotland (specifically for wave and tidal) has led to higher levels of innovation funding from the devolved Scottish Government than are available elsewhere in the UK. The reason for Scotland's desire for wave and tidal sector dominance comes not only from their advantageous natural and human factor conditions (e.g. strong wave and tidal resource, EMEC and the University of Edinburgh research centres) but because it is seen as a complementary high skills employment sector for their declining oil and gas sector workers as well as a potentially lucrative international export industry (Scottish Government, 2010a, DECC, 2010b). This geographical bias to the funding landscape has seen much of the applied research within the UK occur north of the border where UK national funding has been trumped by the Scottish government policies such as higher revenue support (see ROC section 5.1.1 above), increased business support and more advanced/aligned environmental and planning legislature than the rest of Great Britain (See Section on Scotland 5.2.6.1 for more detail).

#### **6.4 National Leading Researchers**

Nationally, the UK has a world renowned research establishment within the wave energy sector. This is both as a result of historical pedigree (with institutes like the University of Edinburgh having being involved within wave energy commercialisation since the mid 70's) as well as the clearly defined route to technology commercialisation through established test centres (see Non-Fiscal Support Mechanisms section above).

This first mover advantage has resulted not only in building a vibrant research community within the UK but also in bringing foreign collaborative partnerships with overseas utilities and large multinational companies such as Vattenfall, Voith Hydro, Siemens, Statoil and ABB. In addition, 4 of the 'big 6' national utilities (E.ON, EDF, RWE NPower and Scottish and Southern Energy) as well as national engineering companies such as Rolls Royce, the RPS Group and Atkins all currently have some research or commercialisation division within the wave energy sector nationally. This increase of involvement by large industry has marked a shift in the research focus from initial, generic understandings of the basic principles and resources behind wave energy towards latter stage applied and integrated research projects such as

the heavy engineering, cost reduction and scaling required for the technology to become a commercial reality.

Below is a brief outline of some of the most prominent national and European research/collaboration projects currently being undertaken within the sector as well as a brief description of their remit.

## **6.5 Current Research Projects**

There are currently several leading research programmes on wave energy technology in operation, many of these are in collaboration with tidal technology (as marine energy projects) the most prominent of these being listed below:

### **6.5.1 SUPERGEN UKCMER**

The Supergen programmes are EPSRC's primary research delivery mechanism for sustainable energy and there are several projects covering a wide scope of projects. The Supergen Marine programme, (currently in its third round of funding and referred to as the UK Centre for Marine Energy Research) covers a multitude of research areas and produces papers as well as guidance and appraisal documentation on a host of research activities from numerical modelling and tank testing to road mapping and resource assessments. It is also the main source of direct funding for PhD doctoral training within the sector as well as hosting many annual skills workshops and training seminars for these students.

### **6.5.2 PerAWaT**

The Performance Assessment of Wave and Tidal Array Systems research project is one of the ETI's leading research projects in collaboration with several key industry actors. Its aim is to create the first software tools for estimating the energy extraction of wave and tidal arrays. GL Garrad Hassan (the lead partner), currently design and supply some of the most sophisticated modelling software for wind farms available. Working with several universities (Edinburgh, Manchester, Queens University Belfast and Oxford) as well as E.On and EDF, they aim to validate this software using real-world scale modelling as well as full scale data where available.

### **6.5.3 Wet-mate Connector**

This relatively small research project, again within the ETI's budget, has sought to cost engineer an industry standard 11kV wet-mate (i.e. sub-sea connectable/detachable) connector for marine renewable devices. Although there is clearly identified need for this connector, it is beyond the financial ability of any singular device manufacturer to develop it.

### **6.5.4 PRIMaRE**

The Peninsular Research Institute for Marine Renewable Energy is a virtual collaborative research network between the University of Exeter and the University of Plymouth. Built from a legacy of initial funding for the construction and research

requirements of the Wave Hub Project, PRIMaRE has now built improved facilities and resources in an attempt to strengthen the South West's commercially attractive positioning within the sector. These are discussed further in section 3 above.

### **6.5.5 MARINA**

This pan-European (FP7) research projects costing €13m (€8.7 from the EU and the remainder from Irish government and industry) involves multiple research partners seeking to advance the development of deep offshore renewable energy technology (including wind, wave and tidal) through cost effective technology development and modification from the oil and gas industry as well as infrastructural improvements where possible.

## **7. Issues Specific to the Development of Tidal Stream Energy in the Nation and Region**

### **7.1 State of the Industry**

Current UK deployment for tidal stream technology stands at 3.05MW. This capacity is comprised from five different deployments by five different technology developers. The longest running of these was by OpenHydro who installed their 0.25MW Open Centre Turbine at EMEC (non-commercially) in 2006. Since then Marine Current Turbines (MCT) managed to successfully deploy the first commercial tidal stream device, (in 2008) using their SeaGen 1.2MW at Strangford Lough, Northern Ireland. In 2009, Pulse Tidal followed on from this by successfully installing their 100kW Pulse Stream 100 within the Humber Estuary. Tidal Generation Ltd, (now a wholly owned subsidiary of Rolls Royce) added to EMECs capacity by installing their 0.5MW DeepGen device in the latter half of 2010 and finally Hammerfest Strom deployed the 1MW HS1000 device, again at EMEC during the very end of 2011. In addition to this current level of deployment there are several other developers with current ambitions to deploy over the coming year, these are discussed further in Section 7.2 below.

As with wave energy, the Crown Estate have leased tidal capacity within the Pentland Firth site, with an additional site re-tendering process, licenses for 1000MW of deployment have been leased to five different companies (The Crown Estate, 2010b). Of these, two have been directly leased to device developers (200MW to Tidal Development Limited and a further 100MW to SeaGeneration Ltd) while the remaining three sites have been leased to utility and project development companies (200MW to SSE Renewables Developments Ltd who are currently planning to use Open Current Turbines, 100MW to Scottish Power Renewables UK and a further 400MW within the re-tendering round to MeyGen Limited).

In addition to the Pentland Firth developments, the Crown Estate along with the Northern Ireland Department of Enterprise Trade and Investment (DETI) have also called for tenders to a further round of tidal leasing within Northern Ireland. Along with around 600MW of offshore wind, 300MW of tidal technology was opened for tender. Tender winners are expected to be announcement in early 2012 (The Crown Estate, 2011a).

In addition to the 3.05MW of current deployment, there is over 63MW of deployment currently at varying stages within the planning and development process within the UK listed in below:

Site	Rating	Developer	Status
Bellyherry Bay	0.12MW	Minesto UK Ltd	In Planning
Bluemull Sound	0.5MW	Nova Innovation Ltd	In Planning
Kyle Rhea	8MW	SeaGeneration Ltd	In Planning
Mull of Kintyre	3MW	Nautricity Ltd	In Planning
Ness of Cullivoe	0.03MW	Nova Innovation Ltd	In Planning
Ramsey Sound	1.2MW	Tidal Energy Limited	In Development
River Esk Estuary	0.5MW	GlaxoSmithKline Montrose plc	In Planning
River Humber	0.5MW	Neptune Renewable Energy Ltd	In Development
Sanda Sound	0.035MW	Oceanflow Development Ltd	In Planning
Skerries	10MW	SeaGeneration Ltd	In Planning
Sound of Islay	10MW	ScottishPower Renewables UK Ltd	In Planning
West Islay	30 MW	DP Marine Energy Ltd	In Planning

Table 16: Planned UK Tidal Energy Deployments

## 7.2 National Technology Developers

Current leading technology developers are as listed below:

Marine Current Turbines (MTC): is a UK-based company and developer of SeaGen, a commercially-operational tidal turbine (MCT, 2012). It completed the installation and commissioning of the world's first commercial scale tidal turbine, the 1.2 MW SeaGen, in Strangford Narrows, Northern Ireland, in 2008. The company is currently developing a 5MW array at Kyle Rhea, Scotland, as well as a 10MW array near Anglesey Skerries, Wales. MTC also has 100W of capacity approval for Pentland Firth, Scotland and proposes to install potentially up to 50MW of capacity by 2015, building up to 300MW or more by 2020 if the local grid can accommodate this loading (RenewableUK, 2011, BWEA, 2010)

Atlantis Resource Corporation: is an Australian company and developer of the AK-1000, Aquanator and the 150kw Nereus devices. The company has planned to commence the first commercial tidal array of Atlantis turbines in the Pentland Firth, Scotland, in summer 2012. This array is planned to have a capacity of 400MW on completion (BWEA, 2010).

Hammerfest Strøm: originally a Norway based company but now also based in Edinburgh. Hammerfest deployed a 1MW model at EMEC in 2011 and plans to continue testing with a 10MW array at Islay in 2013. The company aims for commercial deployment of its devices in 2015 (RenewableUK, 2011).

In addition to these key developers there are an extensive number of other UK based development companies working to commercialise tidal devices listed in Table 17 below:

Company	TEC Device	Device Type
Aquascientific	Aquascientific Turbine	Other Designs
Atlantis Resources Corp	AK-1000	Horizontal axis
Current2Current	Tidal Turbine	Cross-axis
Edinburgh Designs	Vertical-axis, variable pitch tidal turbine	Cross-axis
Edinburgh University	Polo	Cross-axis
Firth Tidal Energy	Sea Caisson & Turbine System	Horizontal axis
Greener Works Limited	Relentless™ Turbine	Other Designs
Greenheat Systems Ltd	Gentec Venturi	Other Designs
Hales Energy Ltd	Hales Tidal Turbine	Horizontal axis
Hydroventuri	Rochester Venturi	Enclosed Tips (Venturi)
Kepler Energy	Transverse Horizontal Axis Water Turbine (THAWT)	Cross-axis
Lunar Energy	Rotech Tidal Turbine	Horizontal axis / Enclosed Tips (Venturi)
Marine Current Turbines	Seagen, Seaflow	Horizontal axis
Nautricity Ltd	CoRMaT	Horizontal axis
Neptune Renewable Energy Ltd	Proteus	Cross-axis
Ocean Flow Energy	Evopod	Horizontal axis
Pulse Tidal	Pulse-Stream	Oscillating Hydrofoil
Robert Gordon University	Sea Snail	Horizontal axis
Rotech	Rotech Tidal Turbine (RTT)	Horizontal axis
Rugged Renewables	Savonius turbine	Other Designs
Scotrenewables	SR250	Horizontal axis
SMD Hydrovision	TiDEL	Horizontal axis
Starfish Electronics Ltd	StarTider	Horizontal axis
Sustainable Marine Technologies (SMT)	PLAT-O	Horizontal axis
Swanturbines Ltd.	Swan Turbine	Horizontal axis
The Engineering Buisness	Stingray	Oscillating Hydrofoil
Tidal Electric	Tidal Lagoons	Other Designs
Tidal Energy Ltd	Delta Stream	Horizontal axis
Tidal Generation Ltd	Deep-gen	Horizontal axis
TidalStream	TidalStream Triton Platform	Horizontal axis
University of Southampton	Southampton Integrated Tidal Generator	Horizontal axis

Table 17: UK Tidal Energy Developers

### 7.3 Current Outstanding National Issues

Many of the same issues facing the wave energy industry described in section 6.1 above are also present for tidal energy technology such as the overarching move towards a 'market pull' mechanism from 'technology push' and a higher level of overall support within Scotland. There is nonetheless a general impression that tidal technology is at a more favourable place than wave energy and in terms of its commercial attractiveness and overall viability as a technology. This is for several reasons outlined below:

Firstly, although there are a range of device and site specific factors as well as high levels of uncertainty and variation in current estimations of levelised generation cost, most research to date suggests that tidal technology is expected to be between 20-30% cheaper per MWh than current wave energy technology (Allan *et al.*, 2011, Committee on Climate Change, 2011, The Offshore Valuation Group, 2010, DECC, 2010b, Carbon Trust, 2011a).

Secondly, although there is still a degree of diversity, the tidal energy sector is showing far stronger signs of technology convergence upon three blade, horizontal axis turbines as can be seen from Table 17 above, (although there may still be convergence upon more than one technology type). This is seen as an important process for both investors and developers for several reasons. Predominantly from a public spending perspective, technology certainty ensures that learning curves of optimisation can be maximised (i.e. since diverse power extraction types are less likely to benefit from separate and incremental refinement stages than similar technologies, similar technologies, as with current wind technology can benefit from more focussed R&D processes that benefit the whole technology group). From the general public, investor and developer perspective, technology convergence provides a positive reinforcement that an optimal design solution has been found and can thus be invested into with lower risk that otherwise un-explored concepts may supersede those being researched (what is sometimes referred to as increased technology legitimacy). Finally, as convergence of concept types occurs, methods of designing, deployment, manufacturing, maintenance and monitoring can more easily be standardised which allows for further cost and effort reductions.

The last key advantage that tidal technology has over wave energy is that the UK practical resource has recently been re-assessed as argued by Salter among others and is now estimated to be between 18-200TWh per year (the wave energy resource is estimated to be around 40TWh per year) (Salter, 2009, Committee on Climate Change, 2011, The Offshore Valuation Group, 2010).

These above issues have resulted in the tidal energy sector seemingly moving a few years closer to commerciality than wave energy technology however the global practical resource for wave energy is still considered to be substantially larger than that of tidal energy, (800TWh against 8,000-80,000TWh (IEA-OES, 2006)). Additionally, arguments for diversity of supply and the lower hour-to-hour generation variation of wave energy suggest that there is still a sound environmental, economic and practical (from an energy security perspective) rationale for the support of both technologies within the wider energy mix.

## **7.4 National Leading Researchers**

As with wave energy technology, the UK has an internationally renowned pedigree of tidal energy research activity stretching back to the mid 1970s and the aftermath of the first oil crisis.

As with wave energy, there is also a high level of both engineering and environmental research activity being undertaken within the sector with institutes such as the universities of Edinburgh, Southampton, Liverpool, Strathclyde and Robert Gordon as well as University College London playing a strong active role. Additionally, there are several large multinational engineering and consulting companies (such as Rolls Royce, Garrad Hassan and Siemens) as well as the same four utility companies (EDF, Eon, SSE and Scottish Power Renewables) working within the field of tidal technology (Jay and Jeffrey, 2010).

## **7.5 Current Research Projects**

Many of the most prominent research activities being conducted within tidal energy research are categorised with wave energy support and funded under a joint umbrella term as 'marine renewable energy support' projects. Most of these are already discussed within the wave energy section above including the SUPERGEN UKMER (Section 6.5.1), the ETI's PerAWaT and Wet-mate Connector projects (Section 6.5.2 and 6.5.3 respectively) and the EU MARINEA project (Section 6.5.5). There are however a few (mainly ETI led) projects that are done separate to those wave energy ones outlined below.

### **7.5.1 Tidal Modelling**

The ETI's £450,000 tidal modelling project aims to increase our understanding of both tidal stream and tidal range technologies within the whole of the UK, looking at how deployment and power extraction at different locations across the UK could affect resource availability at other locations. This is clearly an expected result when investigating tidal range technologies (such as barges) however is also expected to become more likely when larger arrays of tidal devices are deployed. The Tidal Modelling programme also builds on prior work by the ETI's PerAWaT project (see Section 6.5.2)(Energy Technologies Institute, 2012b).

### **7.5.2 ReDAPT**

One of the largest tidal specific projects currently underway is the ETI's Reliable Data Acquisition Platform for Tidal (ReDAPT) project. This £12.4m programme is seeking to install and monitor a 1MW DeepGen tidal turbine at EMEC in Orkney. The key actors within this project are Rolls Royce, its wholly owned subsidiary company, Tidal Generation (the device developer) and EMEC along with utility companies; EDF and Eon and researchers from Garrad Hassan, Plymouth Marine Laboratories and the university of Edinburgh (Energy Technologies Institute, 2012b).

### **7.5.3 PULSE STREAM 1200**

Another commercially orientated research project currently being undertaken is the €8.01m EU Pulse Stream 1200. This programme aims at building and deploying a 1.2MW oscillating hydrofoil tidal device that could have unique application in locations not suitable (due to depth restrictions) for 'conventional' horizontal axis tidal turbines.

## **8. Issues Specific to the Development of Floating Wind Energy Devices in the Nation and Region**

### **8.1 State of the Industry**

Floating wind is a nascent technology that is further from commercial deployment than wave and tidal technology. Testing of floating wind turbines and support structures is currently underway in several locations, including Norway, Sweden, the Netherlands, Portugal and Italy. The first full scale floating wind turbine, Hywind (rated at 2.3MW), was developed by the Norwegian energy company Statoil in 2010 however has only generated around 15MWh since its completion in 2010 (Statoil, 2012, Hadley, 2012). In March of 2011, SWAY AS installed a 29m (1:5 scale) version of their integrated floating wind turbine off Bergen, Norway (Renewable Energy Focus, 2011). Most recently, Principle Power also deployed a 2MW Vestas turbine upon their WindFloat floating foundation system in Portugal at the end of last year (Principle Power, 2011).

Floating structures are among several foundation types being considered for the Atlantic Array, a major off-shore wind farm project under development by RWE Npower Renewables for location in the Bristol Channel, 13 kilometres from Lundy Island (RWE npower Renewables, 2011). RWE was among the successful bidders for the Crown Estate Round Three leasing programme for off-shore wind power and, if constructed, the facility would consist of 417 turbines and have the capacity to generate up to 1500MW of energy. However, after concerns were raised in public consultations about the visual impact of the plans and their effects on birds (see Section 4), the company has stated that it will review its plans to see whether changes can be made to reduce these impacts (BBC News Devon, 2012).

The largest current activities being undertaken within the UK on floating wind technology are funded through the ETI who have recently finished the Deep Water floating wind research project and, through synthesis of this and their complimentary deep water wind research projects, Nova and Helm Wind, are now seeking Request for Proposals (RfPs) for the launch of their largest £25m as yet un-named floating wind demonstrator project. These research projects however are described in more detail in Section 8.5 below.

### **8.2 National Technology Developers**

As can be surmised by the state of the industry report, there are very few UK companies working within the floating wind turbine research industry mainly due to its extremely immature state of development.



Although there are no direct technology developers with floating wind turbine technologies within the UK, several companies are working on deep-sea wind turbine concepts and technologies that could be appropriate for floating wind adaptation. Specifically for UK companies this includes; Wind Power Ltd's conceptual 10MW Aerogenerator X vertical axis turbine that was of principal investigation within the EIT's NOVA £2.8m programme. Internationally there are several as mentioned above; Statoil, Principle Power, Nautica Power and French company Nenuphar.

### **8.3 Current Outstanding National Issues**

Although the UK's offshore wind has potential to power the UK three times over, (Energy Technologies Institute, 2012a) floating wind has only recently begun to gain attention within the research community and there are no UK floating wind development companies. This may be in part due to the relatively shallow coastal waters around the UK that have, until recently afforded the use of fixed base wind turbine technology as a viable solution however since there is also a lack of complimentary wind turbine manufacturers, most technical solutions to floating wind designs may end up employing existing manufacturers turbines, (such as Vestas or Siemens) on a floatation system (spar, tension leg or semi-submersible). Additionally, universities have only recently started researching into floating wind turbine technologies and there are currently very few PhD or research students working within this field.

### **8.4 National Leading Researchers**

The primary research institute working on floating wind technology is the Energy Technology Institute (ETI) however their support is primarily financial. Technology researchers working in floating wind are secondary supply chain developers for data acquisition, consultancy services and similar. The main ETI partners are for its Dee Water project; Blue H, BAE Systems, Cefas, EDF Energy, Romax Technology, SLP and PAFA Consulting Engineers. Out of these however Blue H, (the main technology developer) and EDF Energy (the utility company) are not UK based companies. NAREC and Cambridge based consultancy company TWI Ltd are also both currently providing research assistance on the €11m EU HiPRwind project which aims to deploy MW scale floating turbine off the coast of Spain by 2015 (Bard, 2011).

### **8.5 Current Research Projects**

#### **8.5.1 Offshore wind floating system demonstration project**

The largest and most recently announced project is the £25m offshore wind floating system demonstration project. Currently in its early stages, the ETI have now closed their Request for Proposals (RfPs) period and are in the process of reviewing applications. The goal of this project shall be to design, construct and deploy an ambitious 5<7MW rated floating wind turbine system, (by far the largest currently planned within Europe) by the project completion date of 2016 (Energy Technologies Institute, 2012a). Although little more has currently been announced about the project, it is thought that the work shall integrate research findings from prior ETI; Nova, Helm Wind and the floating wind specific; Deepwater projects (Renewable Energy Focus, 2010).

### **8.5.2 Deepwater**

Deepwater is a £3.3m project that ran from January 2009 until mid 2010. Its goal was to assess the feasibility and cost of constructing (although without actual construction/deployment) a 5MW floating wind turbine for UK sites of depth between 70m and 300m (Energy Technologies Institute, 2012c).

### **8.6 Leading Research Institutes**

Nationally, the university of Strathclyde is involved with much of the research associated with floating and deep sea wind projects having been involved with the Helm Wind and Nova projects as well as the EU EERA Design Tools for Offshore Wind Farm Cluster (EERA-DTOC) which looks at deep sea wind farm wake affects. Additional institutes with some research focus on floating or deep wind include Cranfield University and the University of Sheffield as well as Imperial Collage London which currently has a relatively small £200k research project on coupled fluid-solid numerical modelling for deep-water and far-offshore floating wind turbines using an adaptive finite element method (ICFLOAT) (CORDIS, 2012).

## **9. Ongoing Legislative, Regulatory and Market Changes**

### **9.1 Changes in the consenting and consultation regime: the Big Society and the Localism Act 2011**

At the time of writing, the UK's current Coalition government is proposing major reforms to the planning system that are likely to influence the way MRE developments will be treated in policy and legislation. The general aims of these reforms are to promote the decentralisation of powers to councils and to give local communities a greater say over planning decisions affecting their areas. The broader agenda of the reforms relate to the Coalition's 'Big Society' project, which consists of three main parts: opening up public services; encouraging social action; and promoting community empowerment. The purpose of the third of these components is to give local councils and neighbourhoods more decision-making power in the development of their area. The Draft National Planning Policy sets out the general agenda of how reforms to the planning system should stimulate a bottom-up approach that gives localities 'real power' to make key decisions about their area (Cabinet Office, 2011). The Localism Act 2011 was introduced in relation to the Draft National Planning Policy Framework, which was open for consultation until 17 October 2011. Implementation of the Localism Act will eventually lead to abolishment of the IPC as part of the move from Government for planning decisions to be taken as much at local government level as possible. The Department of Communities and Local Government website states that in the place of the IPC will be 'an efficient and democratically accountable system that provides a fast-track process for major infrastructure projects' (Department for Communities and Local Government, 2011). Final decisions on nationally significant infrastructure projects will instead be made by the Secretary of State. One reason given for abolishing the IPC is that it consists of non-elected officials appointed by the Department for Communities and Local Government. The goal is to develop a quicker and more accountable system in which elected Ministers take decisions on new infrastructure projects of national

significance. Ministers will be advised on decisions by a newly-formed Major Infrastructure Planning Unit (MIPU), which will take over many of the responsibilities of the IPC and use national planning statements to examine and make recommendations to ministers on development applications for NSIPs.

## **9.2 The future of planning in the marine environment: the development of Marine Plans**

The Marine and Coastal Access Act 2009 requires the preparation of a Marine Plan by the Secretary of State for each English inshore and offshore region. The South West of England is identified as one of the English regions for which a marine plan will be developed. One of the functions of the Marine Policy Statement is to facilitate and support the formulation of *marine plans* to: 'provide a clear, spatial and locally-relevant expression of policy, implementation and delivery' (HM Government, 2011p. 10) and to ensure that management of different and potentially competing activities take place in a way that is consistent with the achievement of sustainable development. Key foci of the plans will be the promotion of compatibility between uses of marine areas and the reduction of conflicts between these uses.

In the marine plans, general policies and objectives set out by the Marine Policy Statement will be closely linked to local circumstances, as defined in s.51(7) of the Marine and Coastal Access Act 2009. To achieve this, local policy authorities must adopt the relevant marine plan, which must be published in accordance with Schedule 5 paragraph 12 of the Marine and Coastal Access Act 2009 if it has not been replaced or withdrawn either by the UK Government or the relevant local authority.

Decision-making for the marine plans will be required to take into account a number of principles. The ones relevant for stakeholder consultation and MRE development are that decisions be:

- Taken after appropriate liaison with terrestrial planning authorities and other regulators, and in consultation with statutory and other advisors when appropriate.
- Sensitive to any potential impacts on sites of particular significance including those:
  - Protected under environmental legislation or designated in relation to cultural heritage.
  - Of particular social or economic significance.

(HM Government, 2011).

The Marine Policy Statement further states that its development must be based on widespread participation and the input of information from consultees, stakeholders, regulators and relevant experts. More specifically, input for the plans should be based on a wide range of sources, including:

- Existing plans, such as terrestrial development plans and river basin management plans
- Science advisors
- Statutory and other advisors
- Industry and other marine users
- The plan area community

(HM Government, 2011).

The development of marine plans must also be consistent with the requirements of UK and EU legislation as well as any relevant obligations under international law. Among other things, marine plans should identify the areas where the deployment of different marine renewables would be most appropriate to achieve its stated goals. The Marine Policy Statement further stipulates that measures must be taken to prevent, mitigate (and when this is not possible, compensate) for potential negative impacts in line with legislative requirements such as the Directive on the conservation of wild birds (2009/147/EC) and Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora.

In order to comply with other EU and UK legal requirements, each marine plan will need to undergo a Sustainability Appraisal (as specified under the Marine and Coastal Access Act 2009), which should include consideration of the benefits and adverse effects of the proposals set out in the draft marine plan for the area. This should assess the social, economic and environmental benefits of the marine plan and must also incorporate a *Strategic Environmental Assessment* (SEA) that fulfils the requirements of the European SEA Directive (2001/42/EC). The Marine Policy Statement has already undergone a Sustainability Appraisal, as required under UK planning law to consider its impacts on the economic, social and environmental pillars of sustainable development. Since 2001, all sustainability appraisals conducted in the UK are required to meet the requirements of the SEA Directive. The SEA Directive requires that: 'during the preparation of the plan, the marine plan authority must prepare an Environmental Report on the likely significant environmental effects, consult designated environmental bodies and the public, and take the report and the results of consultation into account. Requirements for monitoring the effects of implementing the plan must also be met' (HM Government, 2011).

In England, the development of marine plans has been delegated to the Marine Management Organisation. However, the Secretary of State must still approve the versions of the marine plans prepared by the MMO.

The demands on the plan area must be reflected in the plan. Different activities planned to take place in the area must also be identified in order to assist in reducing conflicts between activities and encouraging the co-existence of multiple uses where appropriate (HM Government, 2011). The Marine Policy Statement further indicates that the involvement of stakeholders and local communities in the marine planning process should help to achieve this. The marine plans thus create a legal opportunity for stakeholders to have a say in marine renewable energy development in specific areas.

One of the tasks of the marine planning authorities is to ensure that marine planning contributes to sustainable economic growth and strong local economies in regeneration areas. The intention is therefore that plans should promote economic growth and local jobs. The Marine Policy Statement gives local infrastructure developments and optimisation of the potential of environmental resources through eco-tourism and recreation as examples of activities that meet these objectives. However, these considerations must be integrated with social considerations on equality, community cohesion, wellbeing and health, and assessment of the implications of proposals for the marine environment (HM Government, 2011). The broader aim is that marine plan authorities should seek to integrate marine plans with terrestrial planning and community engagement in order to contribute to vibrant coastal communities, particularly in remote areas, taking into account cultural

heritage, seascape and local environmental quality (HM Government, 2011). Such integration is likely to pose a significant challenge to marine plan authorities and may not always be achievable because of the characteristics and relationships between different land and marine activities. For example, trying to create a vibrant coastal community with a large 'eco-tourism' industry and recreational water use alongside a marine renewable energy facility may sometimes lead to detrimental social impacts on communities that are difficult to reconcile without removing one or more planned activity from the plan.

Both the Marine Policy Statement and the Marine and Coastal Access Act 2009 promise individuals the opportunity of a real say in marine planning, suggest that the future of the marine environment is the hands of the people most affected by it<sup>6</sup>. On the other hand, the Act promises simplification of the marine renewable energy consenting process by ensuring only one administrative process is used to consider all the marine elements of an application<sup>7</sup>. Furthermore, the Coalition Government has proposed a planning system in which 'the default answer to development application is yes', unless it compromises sustainability principles outlined in national policy planning. In a context in which developments are strongly supported by planning law, promising people that the future of the marine environments is in their hands may be optimistic and unrealistic.

### **9.3 Changes in the consenting and consultation regime after the adoption of the marine plans**

Further changes to the regulatory and policy frameworks affecting marine renewable energy concern the implementation of marine plans for areas around the English coast.

Once marine plans have been adopted, decisions on marine renewable energy developments will be taken within this framework to enable decision-makers to deliver the objectives of the Marine Policy Statement while contributing to achieving sustainable development. Licensing decisions must therefore be in accordance with marine plans and work in partnership with relevant terrestrial planning authorities. A licensing consent process will then refer to marine plans and the MMO has indicated that it will engage closely with applicants during the 'strategic assessment' and 'options appraisal' stage of plans to ensure that the applicant chooses the most sustainable option from the start.

With the development of the marine plans, the case is made for extensive public consultation in development of the plan. However, findings from research on public

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<sup>6</sup> The factsheet for individuals states that: 'It will be the first opportunity for organisations and local-coastal communities to have a real say in what happens at sea, how it affects them and what our priorities should be in the future. This will ensure that the future of the marine environment is in the hands of the people who are most affected' Defra (2009a) *Marine and Coastal Access Act 2009 - Factsheet for Individuals*, <http://archive.defra.gov.uk/environment/marine/documents/legislation/marinebill-factsheet-individuals.pdf>, 2011, 14 November..

<sup>7</sup> The industry factsheet states: 'The Act will simplify the consenting of wind, wave and tidal projects (of 100MW or less in output) by ensuring only one administrative process is used to consider all the marine elements of an application. This will help stimulate the sector, particularly the developing wave and tidal energy sector' Defra (2009b) *Marine and Coastal Access Act 2009 - Factsheet for industry*, <http://archive.defra.gov.uk/environment/marine/documents/legislation/marinebill-factsheet-industry.pdf>, 2011, 14 November..

participation in SEAs by Heiland (2005) indicate that the public tends to have low participation at the more strategic stages of plan-making where they could have greatest influence. Participation instead tends to be concentrated towards the more detailed stages of plan- and project-making, where the opportunities to influence the general direction of planning are reduced. There is some evidence that the Government may be taking action to try to change this with the Localism Act and the development of marine plans; if communities are made aware that they have a legal right to become involved, receive early notification of consultation processes (arranged at times and venues, and in ways, that encourage and enable participation), and receive clear and accessible information. Linking the development of marine renewable energy facilities to the marine planning system and more general trends in UK planning policy could, thus, lead to enhanced engagement community engagement with marine renewable energy projects than has so far tended to be the case.

On the other hand, the general approach being taken towards renewable energy remains one in which the wider context of the energy development proposal arguably takes precedence over local concerns. As the 2007 Energy White Paper, notes: 'new renewable projects may not always appear to convey any particular local benefit, but they provide crucial national benefits. Individual renewable projects are part of a growing proportion of low-carbon generation that provide benefits shared by all communities through reduced emissions and more diverse supply of energy, which helps the reliability of our supplies. This factor is a material consideration to which participants in the planning should give significant weight when considering renewables proposals' (Department of Trade and Industry 2007). If the UK government is to meet its national targets on renewable energy and meet its international and EU commitments, a large number of renewables developments must be consented and developed. It is possible that this wider context will have a significant influence on the way that local stakeholder processes operate in practice, and the genuine power that these stakeholders during consultations to influence decision-making processes. In general, the procedural elements of community and stakeholder consultation appear robust but this does not guarantee an even-handed process if a major imbalance in priorities exists. Bias in the consenting procedure towards the wider societal benefits of marine renewable energy at the cost of local stakeholder participation or views may ultimately lead to situations where coastal and peripheral areas are asked to bear the burden of marine renewables – because resources are concentrated in such regions – for wider social and economic benefits. This point is highlighted later in the Energy White Paper (2007), when it indicates that 'These wider benefits are not always immediately visible to the specific locality in which the project is sited. However, the benefits to society and the wider economy as a whole are significant and this must be reflected in the weight given to the considerations by decision makers in reaching their decisions'.

## **9.4 Changes in the Market Support Mechanism**

### **9.4.1 Introduction of the Feed in Tariff with Contracts for Difference**

One of the largest future planned changes in renewable support policy that will affect marine renewable energy is the expected transition from the RO mechanism to the CfD FiT mechanism described below: From May 2012, the UK Government shall begin legislation to change the current primary support mechanism used to assist renewable energy and expects the first feed in tariff supported contracts to be signed

by early 2014 (DECC, 2011e). CfD works through a contract between the generator and a counterparty with an agreed electricity revenue set for all of the generators electricity (the strike price). The generator then sells their electricity on the open market for whatever the most that they can get is, (presumably lower than the average market value for intermittent generation) and if this is under the agreed strike price, the counterparty tops up the value of each MWh to the strike price. If the sale of electricity provides more than the agreed strike price, the generator pays *back* the excess (per MWh) to the counterparty. This system is illustrated in Figure 11 below:

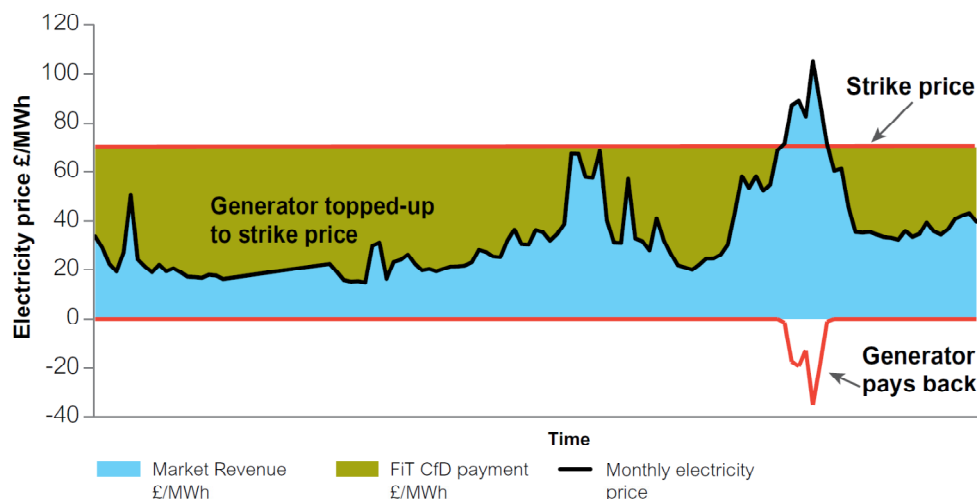


Figure 11: Example of CfD FIT for Intermittent Generation (DECC, 2011e)

The UK Government plans to run the RO until the end of fiscal year 2016/2017, however since the CfD FiT mechanism is hoped to be in place by 2014, any new generators are to allowed a one off option to enter either the RO or the CfD FiT. From the start of the fiscal year 2017/2018, all new generators will have to enter the CfD FiT mechanism however all RO projects shall be grandfathered (remain on the RO mechanism receiving the RO value at its time of cessation) ensuring that projects build is not disrupted (DECC, 2011e).

#### 9.4.2 Introduction of the Carbon Price Floor

Alongside the sweeping CfD changes to the purchasing mechanism for electricity generation, the Government plans to introduce a Carbon Price Floor (CPF) to the EU Emissions Trading Scheme currently in operation within the UK (see Introduction in Section 1) (DECC, 2011e). Under the belief that current market carbon prices are not high enough to support a low carbon transmission, the UK Government plan to provide an effective subsidy increase to the expected value of carbon in 2013 (£10.73 t/CO<sub>2</sub>) of £4.94 t/CO<sub>2</sub> resulting in a total CPF of £15.70 t/CO<sub>2</sub>. This will increase every year to reach milestones of £30 t/CO<sub>2</sub> in 2020 and £70 t/CO<sub>2</sub> by 2030 (DECC, 2011e).

The CPF is to be funded through the extension of the CCL (see Levy Exception Certificates in section 5) to include suppliers of fossil fuels to electricity generators.

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