MERiFIC
Marine Energy in Far Peripheral and Island Communities

Comparison of National Policy Frameworks for Marine Renewable Energy within the United Kingdom and France

Task 4.1.2 of WP4 from the MERiFIC Project

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

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Contents

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

This Report:

This report provides a comparative assessment of the wider planning, innovation and energy policy instruments relevant to marine renewable energy and applicable to the regions of Brittany in France and South West England. In addition to this, aspects of the wider institutional and political contexts in each country that have an adverse or positive effect upon policies for marine renewable energy (such as regionalisation, devolution or European legislation) are covered when considered appropriate and of value.
The intention of this document is to highlight best-practice policies and highlight opportunities and examples of where these have been put into place both nationally and regionally within the two study areas. This work will then feed on to later MERiFIC documents, (specifically within work packages 5 and 6, concerning Sustainable Economic Development and Stakeholder Engagement respectively).
The primary reference sources for this document are the two earlier MERiFIC report: National Policy Framework for Marine Renewable Energy within the United Kingdom and National Policy Framework for Marine Renewable Energy within France (Vantoch-Wood *et al.*, 2012, Kablan *et al.*, 2012).

Introduction

Marine renewable energy technologies are widely seen as a key element of current and future strategies to decarbonise the electricity generation sector and to provide nationally secure energy supplies that reduce countries' vulnerability to volatility in global energy markets. The United Kingdom (UK) and French governments have both identified wave, tidal and offshore wind energy as technologies that will play an important part in meeting European Union targets to expand renewable energy capacity and reduce greenhouse gas emissions, as well as providing jobs and export opportunities (Department of Energy and Climate Change (DECC), 2010a)[1]. Although most wave and tidal technologies are still at an early stage of technological and commercial development, the potential contribution of marine energy to meeting national energy needs is vast. The UK's practical wave energy resource is estimated at around 40TWh per year, or approximately 10% of current electricity demand, while tidal energy (with far greater uncertainty) could practicably generate between 5% and 52% of UK demand (20-200TWh per year) (Committee on Climate Change, 2011). The UK's offshore wind energy potential, however, is far greater, with a practical resource for offshore fixed wind estimated to be around 406TWh per year, (around 50TWh above current total UK electricity demand) (The Offshore Valuation Group, 2010). The theoretical potential of offshore wind energy in France is around 30 GW (or around 70TWh per year) but is still small in comparison with the country's wave and tidal energy potential. Exploitation of even a fraction of these potentials would make an important contribution to meeting the UK and French climate and energy goals and has led to strong national policy drives to assist the commercialisation of the marine energy sector.

Expansion of the French and UK marine renewable energy sectors nevertheless presents a number of challenges. These range from intermittent generation profiles to unfavourable

[1] Act No. 2009-967 dealing with the application of the *Grenelle* Environment Forum.

economics and technologically and commercially immature technologies, particularly for wave, tidal stream and floating wind devices. The National Policy Frameworks for Marine Renewable Energy for the UK and France reported on the major initiatives by the UK and French governments to provide legal and regulatory frameworks aimed at addressing these challenges (Vantoch-Wood *et al.*, 2012, Kablan *et al.*, 2012). The purpose of this report is to synthesise the findings of these reports examining current regulatory frameworks affecting the development of the marine renewable energy sectors in the UK and France.

The report has three main aims: (i) to identify strengths and weaknesses in current national regulatory frameworks affecting the development of the marine renewable energy sector in the UK and France; (ii) to provide recommendations on how these might be modified to accelerate the growth of the marine renewables sector in each country; and (iii) to examine cross-border learning opportunities that may contribute further to the growth of the marine renewable energy industry in Europe. It should be noted that differences between the legal, political, economic, social and cultural contexts (including the division of decision-making and funding powers between central, regional and local government) in France and the UK inhibit the potential for harmonising national legal and regulatory frameworks affecting marine renewable energy. Relevant international treaties (e.g. UNCLOS and OSPAR) and European Union (EU) legislation (e.g. habitats, environmental impact assessment, strategic environmental assessment, right of access to environmental information, and the forthcoming marine strategy framework directive), promote some legal-regulatory convergence, but in most cases national discretion leads to variations between France and the UK in how regulatory frameworks are applied. Primary emphasis is thus placed on analysing the strengths and weaknesses of national regulatory frameworks. Opportunities for cross-border cooperation and learning are examined whilst also stressing the need for greater research on the wider political, legal and other issues affecting cross-border cooperation and learning.

The remainder of the report is structured as follows. Section 2 provides an overview of the French and UK approaches to energy and industrial policy and the implications of these approaches for the development of the marine renewable energy sector. It also highlights more country-specific effects caused by devolution in the UK. Section 3 discusses the current state of development and issues facing the three individual technology areas examined – wave, tidal stream and floating wind – including research and policy priorities specific to individual technology groups. Section 4 provides a comparative assessment of regulatory frameworks affecting marine spatial planning, consenting processes and stakeholder consultation in the two countries; Sections 5 and 6 then review financial support mechanisms and modes and levels of investment respectively. Section 7 summarises key bottlenecks to the development of marine renewable energy in the UK and France and explores opportunities for cross-border learning and cooperation on marine renewables.

Overview of UK and French Energy Policy

French and UK energy policy has tended to follow different traditions that have influenced the two countries' approaches to renewable energy and, to a degree, regulatory frameworks affecting the development of marine renewable energy. Mitchell (2008: 1) describes the UK approach to economic and industrial policy as characterised by a regulatory state paradigm in which the government sees its role as one of providing: 'a regulatory framework that 'steers' towards a defined general direction and then leaves it to the market to select the means to reach that end, although with some regulatory limitations'. Giddens (2011) describes this paradigm as emphasising the creation of *enabling* conditions rather than *ensuring* desired outcomes are achieved, which Mitchell (2008: 21) elaborates as a method of government that steers by: 'setting the conditions for economic efficiency without old-style managerial intervention, and *certainly* *without old-style public investment*' (emphasis added). This emphasis on markets, cost-efficiency and market selection (avoiding picking winner technologies) is illustrated in the UK's reliance on market-based instruments (MBIs) for renewable energy, most notably the Renewables Obligation (RO) and the current government proposal to replace the RO with Contracts for Difference (see Section 9 Vantoch-Wood *et al.*, 2012), the UK's comparatively late adoption of a feed-in tariff system and the restriction of Feed-in Tariffs (FiTs) to date to small-scale generation (5MW or under).

The French energy policy model, in contrast, has traditionally been built on strong state intervention, the existence of two energy champions (the state-owned firms Electricité de France EDF and Gaz de France GDF), nuclear power as the dominant source of electricity generation, and the French concept of 'public service' (Meritet, 2007). The accent on state interventionism in relation to renewable energy again became apparent in the 2000 Electricity Act, in which a new 'dual system' was introduced to support wind power development, with feed-in tariffs for installations below 12 MW and a tender scheme for wind farms above 12 MW (Szarka, 2007). According to Szarka, setting prices on an interventionist basis, imposing a purchase obligation and transferring balancing costs has helped to reduce risks for developers and generators. However, the exemplar of central French government involvement in energy policy was its support for the *grand projet* of nuclear energy during the 1960s and 1970s, in which the government provided investment capital and set up operating companies to support the expansion of nuclear energy (Prévot, 2007). Examples of this approach discussed later in this report include the port infrastructural investments made by the Brittany authorities in the areas around Brest and Lorient (Section 5.9, Kablan *et al.*, 2012). The International Energy Agency notes that France and its major industrial champions have committed themselves irreversibly to a market-oriented organisation of the power sector in a European context. However, Meritet (2007) notes that significant challenges remain in reconciling the liberalisation aims of EU energy policy and French commitments to state intervention on prices, tariffs and *service public* in public utility provision.

The different approaches to energy policy will have implications for the two national approaches to stimulating marine renewable energy and potentially attendant industrial opportunities. The expectation might have been that the UK would have moved as quickly as possible to market type instruments, but the changes to tariff style mechanisms in the UK provides some acknowledgement of the growing evidence for the greater efficiency of this form of support mechanism. However, fixed wind energy is the only MRE really to be at the stage where market pull instruments are appropriate. The other MRE technologies, those still requiring a push stimulus, seem likely to be better served in a nation whose government is willing to intervene more directly. This will involve more funding, which potentially carries with it greater risk of loss of public funds, but may also offer much opportunity to meet national goals and to stimulate industries which can take advantage of both home markets and attendant export markets that might also emerge. However, the perspective and thus buy-in of different national stakeholders may influence the development of the national market framework. Levels of buy-in from utilities may have a strong influence since they may have the potential to either refuse to take part in projects or even to block deployment if they are sufficiently opposed.

Although energy policy is formally a reserved power of the UK parliament, the creation of legislative assemblies for Scotland, Wales and Northern Ireland following devolution have led to noteworthy disparities between different parts of the UK in the legal and regulatory frameworks affecting marine renewable energy. The Scottish Government has been the most active of the devolved administrations in utilising devolved powers in planning and aspects of energy policy (e.g. the Renewables Obligation Scotland) over which it has jurisdiction to develop legal, regulatory and funding frameworks that are regarded by many as providing greater incentives for the expansion of the renewable energy sector than exist in other parts of the UK. Practical examples of Scotland's support for marine renewables include: the National Renewables Infrastructure Fund (N-RIF) managed by Scottish Enterprise designated for improving port and manufacturing facilities within the country, higher-than-national rates of RO certificates for marine technologies, and planning policies that seek to provide positive support and clear criteria for applications for renewable energy developments (Scottish Executive Development Department 2007). Examples of sub-national variations relevant to the analysis are discussed in more detail later in the report.

These intra- and cross-national variations in approach to energy policy and renewable energy create some obstacles to the identification of achievable cross-border learning opportunities, although some elements of good practice and cooperation may be relatively straightforward to identify. Potentially even more significant barriers to the transfer of good practice relate to the wider political, governance, economic, social and cultural differences that exist between the UK and France, and between regions in each country. It is clear that some elements of policy may be successful in one country or region may not be easily transferable to another country or region, since they will be too embedded in the specific characteristics of the location where they originated. This will not be true for all policy elements however, and where transfer is possible then maximising the potential for international or inter-regional learning can help to reduce overall public policy costs and learning times. It is also worth noting that this is not a simple 'yes or no' issue; some policies may be successfully applied across borders provided sufficient care is taken in their adoption to fit local policy framework characteristics. It may be that when a country or region is searching for appropriate new policy elements that it makes sense to look to countries or regions with similar institutional and policy frameworks in order to find appropriate new elements, Nevertheless, there is strong evidence that some elements of policy may be effective in many different institutional environments regardless of the political or institutional environment in which they initially emerged – this is demonstrated to some extent by the slow rollout of tariff subsidies for renewable energy technologies across Europe over the last decade.

Current State of Development and Issues for individual Technology Areas

3.1 Wave Energy

The wave energy sector has undergone something of a renaissance in both the UK and France during the past decade (as part of growing overall interest in marine renewables), although a significant gap remains between high ambitions for the sector and actual deployment. This is particularly the case in France. Kablan *et al.*, 2012 notes that there are no wave-energy projects currently in operation in Brittany, although several projects are being planned (Kablan *et al.*, 2012). Elsewhere the SEM-REV platform off the coast of Le Croisic (Loire-Atlantique) headed by ECN (*École Centrale de Nantes*) allows for the testing of wave energy prototypes and has received public funding through the State-Region Project Contract between the State and the Pays de la Loire region. ECN has signed a contract for a 23 km, 8MW cable to connect four devices to the grid, completion of which is scheduled for 2012. The main wave-energy converter projects identified are SEAREV and the 'Bilboquet' project was accredited in November 2010 to construct a point absorber wave energy system. This project is currently at the development stage and has been allocated a budget of €3.85 million funded by the Single Inter-Ministry Fund, local authorities and the ERDF with the aim of full-scale demonstration project in 3 years. Several potential sites are being studied along the French Atlantic coast to host pilot sites based on more proven technologies (e.g. WaveRoller).

Currently, there is 1.31MW of wave energy capacity installed in the UK. This is comprised of Voith Hydro's shoreline 0.25MW Limpet oscillating water column device (operating since 2000), Aquamarine Power's 0.315MW Oyster 1 device (at the European Marine Energy Centre (EMEC) in Orkney since 2009) and Pelamis Wave Power's (PWP) 0.75MW P2 device installed at EMEC in 2010 (RenewableUK, 2011). Additionally, the UK government and the Crown Estate have been integral in leasing key areas of the Pentland Firth, Scotland. The ambition of this development is to oversee the installation of 600MW of leased wave energy sites by 2020, with large-scale manufacturing being preceded by a number of preliminary deployments. The UK wave sector also has a growing number of national technology developers (Table 15, Vantoch-Wood *et al.*, 2012) and a vibrant research community that includes large multinational companies such as Vattenfall, Voith Hydro, Siemens, Statoil and ABB, involvement by four of the 'big six' national utilities (E.On, EDF, RWE nPower and Scottish and Southern Energy), and several national engineering companies such as Rolls Royce, the RPS Group and Atkins. Current research projects (often combined with tidal energy research) include SUPERGEN UKCMER, PerAWaT (Performance Assessment of Wave and Tidal Array Systems), Peninsula Research Institute for Marine Renewable Energy (PRIMaRE), and MARINA (an FP7 research project of €13 million (€8.7 million contribution from the EU).

Wave energy has thus made appreciable progress in both countries but a number of obstacles remain to larger-scale testing and deployment. In particular, technology market leaders are approaching a stage where they will need to undertake larger investments to support full-scale design optimisation and the development of necessary infrastructure and facilities. The lead elements of the technology sector can be said to be entering the so-called innovation 'valley of death', a financing gap whereby scaling up of plant, labour and investment is required before significant financial returns can be realised (Knight, 2012). The main research challenges for wave energy identified are: (i) an ongoing need for information on available wave resources and the capability of different wave-device technologies and their supporting infrastructures (e.g. moorings) to operate in a variety of ocean conditions; and (ii) the provision of regulatory settings that actively support flows of investment, while dealing equitably and effectively with the environmental effects and socio-economic acceptability issues affecting wave energy (i.e. conflicts in the use of marine spaces and effects on host communities) (Knight, 2012).

A key element of regulatory support for wave energy is the provision of 'technology-push' and 'market-pull' financial support mechanisms to assist technology and project developers in bridging financing gaps, as technologies reach full testing and begin to compete more actively with 'mainstream' energy sources during the transition towards commercialisation. Finance Support Mechanisms and the development of appropriate planning, consenting and consultation procedures (covering all technologies) are discussed in subsequent sections.

The question also arises as to how far cross-national cooperation on the testing of devices and infrastructure could be utilised to promote knowledge exchange and to avoid cost duplication. The advantages of joint projects are potentially considerable, but need to be offset against two major factors. The first is the need for detailed information on: how different technologies operate in 'live' conditions; the economics of connecting to grid systems; and the likely environmental and coastal impacts of arrays of devices. The evidence to date suggests that these factors can vary considerably between locations. As such, over-reliance on joint trials may produce inexact estimations that impede the technological and financial viability of future projects, and prior evaluation is needed of the degree of compatibility between potential test and deployment sites. The second factor concerns the desire by national and local authorities to develop regional economic clusters around prospective wave-energy sites as part of the financial *quid pro quo* for underwriting the development stages of marine renewable energy projects and, thus, the potential for competition rather than cooperation to become the dominant mode of interaction between regions. This issue is discussed further in the section on floating wind devices.

3.2 Tidal Stream

The UK and France rank first and second within Europe in terms of their potential for tidal stream energy generation. Overall, the development of the sector is more advanced than that of wave energy and (even more so) floating wind devices. Although tidal energy has been a controversial issue in the UK with recent disputes over consultations on the construction of a tidal barrage across the Severn Estuary (DECC, 2010b), tidal stream technology is generally accepted to produce lower risks to navigation, shipping and wildlife.

Vantoch-Wood *et al.* (2012) report that current UK deployment of tidal stream devices stands at around 3.05 MW. This is comprised of five deployments by five different technology developers, mostly in Scotland and Northern Ireland. In addition, over 63MW of deployment is currently at varying stages in the planning and development process within the UK, while the Crown Estate has leased up to 1000MW of capacity within the Pentland Firth site in Scotland and, along with the Northern Ireland Department of Enterprise Trade and Investment, has called for tenders for a further round of tidal leasing for 300MW of tidal technology within Northern Ireland (The Crown Estate, 2010; 2011).

The flagship tidal-stream project in France at present is led by EDF and involves the installation of the first farm of OpenHydro underwater generators connected to the power grid in Paimpol Bréhat (Northern Brittany). The long-term goal is to create the world's largest underwater generator farm connected to the power grid. The EDF Arcouest is the only technology of this type installed in Brittany to date and was immersed in October 2011. The total rated capacity of the project, reported by Kablan *et al.* (2012), will be 2MW. Other French tidal stream projects reported include: ORCA (led by Alstom with testing due to commence in 2013-14); The Sabella D 10 underwater generator project; and BluStream. A scenario coordinated by IFREMER estimated 400 MW of installed capacity by 2020 on the basis of national commitments made via the *Grenelle* Environment Forum (French Ministry for Ecology, Energy, Sustainable Development and the Sea, 2009).

The main research and operational issues identified for tidal stream by Kablan *et al.* (2012) were:

- Towing and mooring of bulky devices and the installation and positioning of support structures and devices on the seabed. Priorities under this banner include innovation to reduce logistics costs and time, and the design of dedicated ships.
- Innovation to improve the economics and reliability of maintenance, particularly in respect of corrosion and bio-fouling (e.g. through the use of anti-fouling paints and removable devices).
- Improvements to sub-marine connector engineering.
- Systemic innovation to accommodate neap tides and periods of slack water, during which power generation rates reduce (e.g. through hybrid energy solutions).
- Non-technological bottlenecks include: social acceptance and conflicts with fishing areas.

Many of these issues are also relevant to the UK tidal-stream sector, as are the more overarching issues identified above for wave energy (e.g. shifts in financial support mechanisms). Vantoch-

Wood *et al.* (2012) nevertheless highlight several reasons for the relative commercial attractiveness of tidal stream technologies:

- Despite device and site specific factors and high uncertainty and variation in estimations of levelised generation costs, most estimates indicate that tidal technology will be 20-30% cheaper per MWh than current wave energy technology (Allan *et al.*, 2011; The Offshore Valuation Group, 2010).
- Tidal energy is showing stronger signs of technology convergence (mainly at present around three-blade horizontal axis turbines), an important factor for building investor and developer confidence. Convergence also aids in maximising learning curves for technology optimisation (e.g. through more focused research and development, benefitting more technology developers (subject to intellectual property and patents issues)). Additionally, methods of designing, manufacturing, deploying, maintaining and monitoring can become more standardised, creating further cost and effort reductions.
- The high level of UK practical resource, estimated by Salter and others to be 18-200TWh per annum (compared with 40TWh per annum for wave energy) (Salter, 2009; Committee on Climate Change, 2011; The Offshore Valuation Group, 2010).

These issues have resulted in the tidal energy sector seemingly moving a few years closer to commercialisation than wave energy technology, despite the higher estimated overall global practical resource for wave energy. MERiFIC 4.1.1 thus notes that arguments for diversity of supply and variability in the generation capacity of different marine energy types suggest that there remain sound environmental, economic and energy-security rationales for continued support of all technologies within the wider energy mix.

3.3 Floating Wind

Floating wind energy is still a nascent technology compared with wave and tidal technologies, although testing of turbines and support structures is underway in several locations around Europe (Vantoch-Wood *et al.*, 2012, p. 49). Floating wind development in France is also beginning to move from design and specification to the deployment of demonstration turbines to the South of Brittany (target date 2013) and near Fos-sur-Mer in Provence-Alpes-Côte d'Azur. There are currently no UK floating wind development companies, due in part to the relatively shallow coastal waters in the North Sea and Irish Sea, where fixed-base wind turbines are feasible. However, there is also a lack of specialist wind turbine manufacturers, universities have only recently started researching into floating wind turbine technologies, and there are very few research students working within this field.

The main goals of research into floating wind in the UK and France at present are concentrated towards the design, construction and deployment of test turbines. The primary UK research institute working on floating wind technology is the Energy Technology Institute (ETI), which provides financial support for technology developers. NAREC and TWI Ltd are also both currently providing research assistance on the €11 million EU HiPRwind project which aims to deploy floating turbines off the coast of Spain by 2015 (Bard, 2011). The largest UK floating wind project is the £25m offshore wind floating demonstration project coordinated by the ETI. The ETI is currently reviewing applications for the design, construction and deployment of a 5-7MW rated floating wind system by 2016 (Energy Technologies Institute, 2012a). The £3.3 million Deepwater project ran from January 2009 until mid-2010, with the goal of assessing the feasibility and cost of constructing a 5MW floating wind turbine for depths of 70-300 metres (Energy Technologies Institute, 2012b). The University of Strathclyde is involved with much of the UK research on floating and deep-sea wind projects, e.g. Helm Wind, Nova and the EU EERA Design Tools for Offshore Wind Farm Cluster, examining deep-sea wind farm wake effects. Other institutes with some focus on floating wind research include Cranfield University, Sheffield University and Imperial College London (CORDIS, 2012).

The largest French research institute on marine energy is IFREMER, which coordinates the *France Energie Marine* partnership involving over 30 companies, 20 public bodies and 70 researchers, engineers and technicians. Three main projects are noted in Kablan *et al.*, 2012:

- WINFLO, led by Nass & Wind and involving DCNS, Vergnet (designer and manufacturer of wind turbines), and two research organisations, IFREMER, and ENSTA Bretagne. After design and technical specification, the project will move to the demonstration stage in 2012 via a 1 MW Vergnet turbine and a high power turbine (5-7 MW), with testing of the first WINFLO floating wind turbine to the South of Brittany in spring 2013.
- VERTIWIND, led by the PACA Marine Competitiveness Centre aimed at developing and implementing vertical-axis offshore floating wind turbines near Fos-sur-Mer.
- DIWET (Deepwater Innovative Wind Energy Technology) project, led by Pôle Mer and involving construction of a deep-water floating wind turbine on a semi-submerged platform with taut-leg mooring. Studies linked to the project have so far been self-funded, though discussions on financial support from UK and US partners are ongoing.

Because of its technologically immature character but substantial generation potential (the practical resource potential for the UK alone is estimated to be 1.5PWh), floating wind energy appears to be a natural candidate for cross-national cooperation to achieve proof of concept and testing of devices (The Offshore Valuation Group, 2010). Both countries are currently at a very early stage of applied research and neither are 'industry leading' countries, (Statoil, the majority state owned Norwegian energy company, has been operating the 2.3MW Hywind floating turbine since 2010). As such there is a stronger rationale for the pooling of resources, (such as the newly commissioned 15MW turbine drive train test facility at NAREC) so that a joint-national competitive advantage can be achieved.

The more general problem for cooperation on this and other emergent technologies noted earlier is that support for test projects by national and regional authorities is often motivated in part by a desire to establish local competitive advantages in emergent technologies as a way of driving regional and national economic growth. The innovation benefits of cooperation may thus not always be matched by political willingness to cooperate, and technology developers may exploit this by 'trading-off' localities against each other in order to gain the most competitive contracts. There is some potential for cross-border co-operation to develop some elements of new technologies, where this avoids replication and where both policy makers and technology developers can see that this may have cost saving implications and does not put their knowledge capital at risk. The potential also exists for technology developers to gravitate towards clusters in order to gain infrastructural, economic, informational, technical and other benefits (Dahl and Pederson, 2004; European Commission, 2008a; Libaersa and Meyer, 2011). The corollary of these innovation and commercialisation benefits is that successful clusters may grow at the expense of other areas, and there are some signs of 'over-supply' in the provision of test centres for some technologies if the utilisation of facilities is used as a measure. Although floating wind is considered to be less commercially viable at present than both tidal and wave energy technology, current UK Round 3 leasing round capacities cannot be fully developed without realising advances in deep-water deployment technologies. This would imply that the commercialisation of floating wind technologies is required for the UK to meet its longer term strategic carbon-emissions targets. Since low carbon innovation funding is finite, however, it is unclear whether (despite the recent announcement of the ETI's £25m floating wind demonstration scheme) major steps to commercialise floating wind will be carried out concurrently with, or sequentially after, wave and tidal has reached a suitable level of cost competitiveness. Despite the low expected probability of resource conflict, (due to the deployment depths that floating wind turbines would require), some potential exists for competition for innovation funding between marine technologies.

These barriers to cross-national cooperation notwithstanding, considerable potential exists for knowledge sharing through the development of shared-access data management platforms (DMP). The potential for knowledge sharing is illustrated by the DMP being developed as part of the SOWFIA Project (Streamlining of Wave Farms Impact Assessment) (SOWFIA, 2012). The SOWFIA Project is funded by Intelligent Energy Europe[2] and has collected information on Environmental Impact Assessment activities being carried out at a range of wave energy test and research sites across Europe. The information has been input to the preliminary project-centred DMP (available at http://sowfia.hidromod.com/), to facilitate instantaneous access to the information collected and enable complex enquiries to be carried out. The database can be interrogated to select projects based on parameters such as distance from the coast, technologies at each site, and elements of monitoring being conducted. The extension of such DMPs to other technologies and regions provides clear opportunities for collaboration and knowledge-sharing between authorities, technology developers and project developers on issues such as the performance, impacts and financial viability of different technology types. Again, there may be limits imposed on cross-border transfer of some methodologies, but this does not necessarily rule out all possible co-operation; identification and effective delineation of areas where co-operation could be completely or partially achieved is a clear area for further work.

Comparative Assessment of Institutional Responsibilities in Marine Spatial Planning, Consenting and Stakeholder Consultation

France and the UK are both signatories to a range of international and regional agreements and related EU legislation governing the utilisation and protection of marine areas, e.g. the United Nations Convention on the Law of the Sea, the OSPAR Convention, and the Marine Strategy Framework Directive 2008/56/EC (the environmental pillar of the EU's marine strategy). As EU member states, they are also required to meet the requirements of the Environmental Impact Assessment Directive (85/337/EC, as amended in 1997, 2003 and 2009), the Strategic Environmental Assessment Directive (2001/42/EC) and relevant EU nature conservation legislation (notably the Habitats Directive (92/43/EEC) and Birds Directive)). Finally, both countries are signatories to the Aarhus Convention on the right of public participation in decision-making, public access to information, and access to justice on environmental matters, and are bound under EU law to meet the requirements of Directive 2003/4/EC on public access to environmental information.

Given these common commitments, the main areas where scope exists for differences in the regulatory frameworks affecting marine spatial planning and consenting for marine renewable energy projects relate to: (i) variations in the application of international and EU requirements

[2] Contract number : IEE/09/809/SI2.558291.

where flexibility of interpretation exists; and (ii) independently instituted national policies and political agendas, although these are still required to comply with international commitments made by the governments. Devolution has again added a further layer of variability in the regulatory frameworks affecting marine renewable energy in the UK, most notably in respect of differences in the consenting procedures operating in Scotland and other parts of the UK.

Outside Scotland, the UK currently operates a two-tier consenting process covering marine renewable energy facilities of above and below 100MW. Until the Marine Plans requested under the Marine and Coastal Access Act 2009 are fully implemented, licensing decisions for developments under 100MW will be made on a case-by-case basis by the Marine Management Organisation (MMO). The process consists of four key stages: pre-application; pre-examination; application; and decision; fuller details of the process – including details of environmental assessment requirements, consultation procedures and statutory and non-statutory consultees – can be found in Vantoch-Wood *et al.* (2012, Section 4.1.4). Developments over 100 MW (covering Nationally Significant Infrastructure Projects - NSIPs) are subject to a more centralised decision-making process, with the Secretary of State for Energy and Climate Change acting as the relevant consenting authority (see Vantoch-Wood *et al.*, 2012, Section 4.1.5).

In France, developers must obtain an authorisation from the Minister for Energy to operate a site generating over 4.5 MW of electricity, under Article L311-6 of 2011 French Energy Code [*Code de l'énergie*]. This procedure appears on paper to concentrate power and be more susceptible to delays than the equivalent UK consenting procedures, although whether the latter is the case depends on the expeditiousness of each authorising body. Additionally, authorisation is automatically granted to a company that has been selected following a call for tender (Kablan *et al.*, 2012, Section 4.2). Authorisations linked to the use of the marine environment are also covered by the Maritime Public Domain Decree of 2004. Applications are addressed to the Prefect[3] and the Maritime Prefect is consulted along with other authorities such as the Head of the Tax Services (relating to financial conditions for the concession) and relevant communes concerned. The draft concession can also be submitted to the local nautical committee or the grand nautical committee for their opinion, and the project must be subjected to a common law public inquiry. Authorisation is also required under the French Water Act (Article L 214.3 of the Environmental Code), and may again involve a public enquiry for works in excess of €1.9 million.

The general view is that the piecemeal evolution of French consenting procedures for marine renewables has added excessive complexity to these processes. According to SEANERGY (2011a: 1): 'In France, there is no overarching legislation addressing the issue of integrated MSP (marine spatial planning) but a myriad of sectoral legislation and regulations dealing separately and partially with this issue.' However, steps have been taken to simplify permitting procedures as part of the Grenelle II Act, e.g. the removal of the need for building permits and the merging of exploitation authorisation and concession allowances into a single document (SEANERGY, 2011b, see also Kablan *et al.*, 2012, Section 4.2). Additionally, Grenelle II seeks to make the drafting of impact assessments more participative by allowing the assessment author to seek the advice of the environmental authority prior to formal authorisation procedures begin, and provides for the establishment of a conference of local stakeholders before impact assessments are completed.

[3] The State's representative in a *département* or region.

Vantoch-Wood *et al.* (2012) provided a commentary on current and planned provisions for consenting within the UK, as expressed in the Marine and Coastal Access Act 2009, the Localism Act and the draft National Planning Policy Framework (NPPF) (Section 9.3). It was noted that assessment and consenting procedures (including stakeholder consultation), although complex, appeared to provide appropriate 'checks-and-balances' to ensure all relevant environmental, social and economic factors were considered and taken into account during decision-making. However, some incongruous commitments appeared to exist, at the time, between ideas of local empowerment in the aforementioned acts and the government's statement in the draft NPPF that the default answer to developments was 'yes', except where these would compromise key sustainable development principles[4] (Department for Communities and Local Government, 2011). This statement proved contentious and has been removed from the final NPPF (Department for Communities and Local Government, 2012), although the general pro-development presumption is retained. More generally, this debate illustrates wider tensions between the strategic imperatives driving the marine renewables sector and local concerns about the consequences of its expansion. These comments also apply to a certain extent to France, following the strong support by central and regional government to the marine renewable energy sector reported in Kablan *et al.* (2012). The new President, François Hollande[5], has affirmed his support for growth strategies and renewable energy that may embed similar presumptions to those in the UK's NPPF (Leone, 2012), although it is too soon to predict how these commitments might affect consenting and consultation procedures.

In relation to comparisons between the UK and French approaches to marine spatial planning (MSP) and possibilities for sharing good practice and cross-national cooperation, a report by the European Wind Energy Association for the SEANERGY Project (SEANERGY, 2011b) concluded that the set-up of MSP seems always to be context specific and that the most that national legislation can do to promote international cooperation is: 'to direct decision-makers to take into consideration relevant MSP activities in neighbouring or opposing States and possibly confer the necessary powers on officials or politicians to negotiate to that end' (SEANERGY, 2011b: 40). The report continues that:

'The only way that a complete mechanism for supra-national cooperation in terms of MSP can be established is at the international level or at the European level … At this time … EU nations are typically party to a large number of international agreements which concern various different aspects of the use of maritime space on a sectoral basis. However … there is no supra-national instrument under EU or international law that is concerned with MSP in general or transboundary cooperation relating to MSP in particular' (p. 40).

The same report concludes by noting the importance of providing MSP with a legal basis and, ideally, a central organisation to coordinate inputs from different sectors. Although broadly concurring with this conclusion, previous studies of policy diffusion suggest that scope may still exist for lesson-drawing on the practical experiences of other countries (Jordan, 2005; Nilsson, 2005; Grin and Loeber, 2007).

The UK and France have both committed to the principle of integrated coastal zone management but practical moves to enact MSP are generally more advanced in the UK than in France. MSP

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[4] Where, according to the Ministerial foreword: 'Sustainable means ensuring that better lives for ourselves don't [sic] mean worse lives for future generations. Development means growth'.
[5] http://www.guardian.co.uk/world/2012/may/08/francois-hollande-germany-france.

in France is currently driven by: (i) the seaboard strategic document in Article L 219-3 of the French Environmental Code, covering integrated and joint management of activities relating to the sea and coastal areas; and (ii) the Blue Energy Plan, which encourages jointly-developed strategic planning to determine suitable sites for installing marine energy arrays (Kablan *et al.*, 2012, 4.1).

In the UK, 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 is identified as one of the English regions for which a marine plan will be developed. A key function of the Marine Policy Statement is to facilitate and support the formulation of marine plans, the goals of which are to provide clear, spatial and locally relevant expressions of policy, implementation and delivery and to ensure that the management of different and potentially competing activities takes place in ways that are consistent with the achievement of sustainable development. The key foci of plans include the promotion of compatibility between uses of marine areas and the reduction of conflicts between these uses. Fuller discussion of the processes and issues involved is provided in Vantoch-Wood *et al.* (2012).

At the time of writing, the process for creating marine plans and associated consultation procedures is still under development in the UK. Consequently, it is premature to draw firm conclusions about how these will operate or the potential for cross-national cooperation and lesson-drawing. However, the process of developing plans for different sea areas around the UK in a sequential manner encourages iterative learning from the drafting of earlier plans and the use and adaptation of these lessons to inform the development and streamlining of future marine plans. It is likely that the early focus of lesson drawing will be on intra-national learning within the UK and on understanding how the drafting of marine spatial plans need to adapt to local circumstances within one national jurisdiction. However, scope also exists for early exchange visits and information sharing between relevant authorities in the EU member states aimed at moving towards more streamlined and optimised MSP across the EU.

The roll-out of marine spatial planning across the member states would also be aided by the adoption of comprehensive primary legislation at the EU to guide, regulate, and ensure reasonable consistency in the implementation of marine spatial planning. The purpose of such legislation would be to build upon the principles contained in the Commission's 2008 communication on a roadmap for marine spatial planning (European Commission, 2008b). Although the communication notes that the implementation of marine spatial planning is the responsibility of the member states under the subsidiarity principle, it provides principles for member states to take into consideration when developing plans. These do not place an obligation on member state governments to undertake marine spatial planning, however, and so leaves the possibility of patchy and uneven governance of European marine spaces. As the SEANERGY report (SEANERGY, 2012) notes, such legislation would need to be comprehensive both in terms of the basic procedures for marine spatial planning (e.g. consultation, planning processes, enforcement, and dispute resolution) and in the coverage of activities that use maritime space within defined areas. The different physical, social, economic and political contexts in each member state (and regions within member states) means that such legislation is likely to be most feasible and appropriate if enacted in framework form in order to provide common goals and principles while enabling national and sub-national authorities discretion as to how requirements are applied. The EU Water Framework Directive's (2000/60/EC) emphasis on integrated management of geographically defined areas (the principle of river basin management based on an ecosystem approach (European Commission, 2012)) may provide a useful template methodology for the development of more holistic and coherent marine spatial plans that give greater certainty to marine renewable energy technology and project developers.

Financial Support Mechanisms

Although a variety of government-driven support mechanisms exist for renewable energy technologies in the UK, the main financial mechanism at the time of writing remains the Renewables Obligation (RO), which came into existence in 2002, replacing the defunct Non-Fossil Fuel Obligation (NFFO). The RO is a revenue enhancing mechanism, (providing additional subsidy for renewable electricity sales through a green certificate trading scheme known as Renewable Obligation Certificates or ROCs),and requires the deployment of devices, grid connectivity and power contracts before it can be accessed by project developers. Over the past decade the RO has been criticised for its initial efforts to be 'technology blind', until 2009 it allowed all renewable technologies access to subsidy on an equal basis which effectively meant support only went to the most mature technologies. Thus, it failed to support 'technology push' of non-market ready renewable energy technologies, which included wave energy, all tidal energy technologies and floating wind (Foxon and Pearson, 2007, Allan *et al.*, 2011, Woodman and Mitchell, 2011). The introduction of banding from 2009 attempted to address this by allowing more certificates for less mature technologies, but this did little to address the problem of how to push these technologies into deployment so that they became capable of generating electricity and earning certificates.

As noted in Vantoch-Wood *et al.* (2012), recent proposals to extend technological banding to provide revenue of 5 ROC/MWh for wave and tidal stream developments up to 30MW of deployment and 2ROC/MWh for everything above this level indicates recognition of the need to provide earlier-stage technologies with greater support for them to have a realistic chance of moving towards a greater level of maturity. The Scottish Government has provided 5 ROC/MWh for wave energy generation and 3 ROC/MWh for tidal generation since 2009, although the infant status of these technologies has meant that very few technologies have accessed this finance and all have received grant subsidy support additionally (Scottish Government, 2009). UK government support systems are also currently in a state of flux as a result of a government proposal to replace the RO with the Contracts for Difference Feed-in Tariff (CfD-FiT) system (Section 9.4.1) (DECC, 2011b).

The UK Government has justified the CfD-FiT on the grounds of greater regulatory and investment certainty than existed under the RO by providing guaranteed prices to generators for low-carbon electricity generation and an effective cost ceiling for the policy by requiring generators repay surpluses to a (currently undecided) mandatorily responsible counterparty, with this counterparty acting as a conduit to "return money to consumers if electricity prices are higher than the agreed tariff"; that is, if wholesale electricity prices exceed the agreed strike price (DECC, 2011e). It also appears to provide a flexible mechanism to reduce subsidies as the cost of low-carbon power falls (Murray, 2012). Murray (2012), however, raises a number of questions about the operation of the CfD-FiT:

- Whether the government's preference for the auctioning of contracts to achieve cost-effectiveness will result in an unbalanced energy mix, where higher-cost projects, such as offshore wind, wave and tidal energy, struggle to compete despite their potential to deliver low-carbon, low-cost energy on a large scale in the long term.
- Controversies over the early review (and reduction) of the UK's solar feed-in tariffs have raised investors' concerns about the stability of strike prices and government's ability to set appropriate subsidy levels for technologies with diverse and uncertain commercial prospects and stages of development.
- How the CfD-FiT will integrate with the RO and whether the transition period may lead to complications or greater complexity than existed under the RO.

Ongoing regulatory uncertainty surrounding national policies is acting as a deterrent to business investment in marine renewables according to several industry leaders, with some companies calling for member-state renewable energy regimes to be made more coherent and consistent with the EU emissions trading scheme (MacAlistair, 2012). The UK's major energy companies have, nevertheless, generally welcomed the CfD-FiT as a means of supporting investment in renewables (Energy and Environmental Management, 2012).

The main French government incentives for renewable energy currently are a combination of: (i) guaranteed repurchase prices under the CSPE contribution [*Contribution au Service Public de l'Électricité*] paid by electricity consumers to cover expenses associated with public service missions; and (ii) competitive tendering for target quantities of 'green' electricity set by the public authorities, informed by the Multi-year Programming of Investments (*Programmations Pluriannuelles des Investissements* – PPI) established under the Electricity Act of 2000 (see Sections 5.1 and 5.5, Kablan *et al.*, 2012)[6]. This combination of measures is intended to provide certainty in both the amount of non-fossil fuel energy generated and the income and cost streams for project developers and governments. The main drawback of this system is its potential expense for electricity consumers, who usually bear the difference between the repurchase price and conventional electricity spot prices. The system's ability to mitigate this disadvantage depends predominantly on the level of competition between producers and the government's ability to establish appropriate repurchase prices via this system.

In essence, there appears little to differentiate the price mechanisms used in the UK and France to incentivise renewable energy generation, assuming the structure of the UK's CfD-FiT is not significantly altered during the consultation and legislative process. Both operate broadly on a market-pull approach, provide guaranteed purchase prices for renewable energy technologies, and aim to utilise competitive tendering to promote cost-effectiveness. Key challenges for marine energy in both countries thus centre on the management of tendering processes, in particular the establishment of guaranteed purchase prices that: (i) are high enough to persuade investors to submit bids; and (ii) differentiate appropriately between technologies according to their short- and long-term costs and potential to contribute towards a low-carbon energy mix. The second caveat applies to differentiate between more established on-shore renewables technologies (e.g. on-shore wind and solar-PV) and higher capital outlay off-shore technologies, and between different off-shore technologies. The critical question is whether the current straitened economic circumstances will tempt governments to favour less expensive but more short-term technologies, to the detriment of those with greater long-term carbon-saving and economic potential. Differences in the modes and levels of investment by the UK and French government are discussed in the next section.

The economic crisis apparent since 2008 has meant many governments have reduced the level of overall support provided for supporting the deployment of renewable energy technologies. Since European governments are committed to legally binding targets for renewable energy deployment, the focus will tend to be on technologies which are closest to market and, thus, where expenditure will result in the highest level of generation stimulated against public

[6] For 2020, the PPI plans for potential electricity generation of 6 000 MW from offshore wind energy (compared with a theoretical energy potential for offshore wind in France of around 30 000 MW), 200 MW from ocean thermal energy in French overseas territories, 400 MW from turbines, and 200 MW from wave energy.

expenditure. The danger of such policies is that they potentially mean funding is stripped away from less mature technologies. This may well include wave, tidal and floating wind because these technologies are still in the R&D phase or are only just leaving this phase. Making cuts now may reduce the chances of these technologies reaching maturity within a reasonable timeframe. This may mean less diversity of generation in the medium to long term, the loss of technologies which might eventually be economically viable, and that nations cutting support effectively abandon the potential to take the lead in a new technology market with attendant economic and social benefits such as job creation.

Modes and Levels of investment

Generally speaking, French governments have shown a greater willingness than their UK counterparts to provide direct investment in economic and industrial policy, a trend that appears to be repeated to a degree in the two governments' approaches to investment in marine renewable energy technologies. For analytical purposes, it is useful to categorise investment strategies according to whether they focus chiefly on: (i) research; (ii) technology and business development; and (iii) establishing or strengthening regional infrastructure to support marine renewable technologies.

The French Great National Loan was launched in June 2009 in the wake of the 2008 global financial crisis and focused on two main areas: (i) enabling France to remain a major industrialised country with competitive, job-generating industries; and (ii) infrastructure projects that meet societal needs. This has since been replaced by the *Programme d'Investissements d'Avenir* (PIA), with an allocation of €35 billion that includes the "Renewable Energy innovation fund" focusing on marine renewable energy. Responsibilities for disbursing these funds are shared between the French National Research Agency (ANR) [*Agence Nationale de la Recherche*], the French Environment and Energy Management Agency (ADEME), and OSEO, a state-funded industrial and commercial establishment which oversees financing for the growth of small-medium enterprises. OSEO has become a major player in renewable energy financing in recent years, with activities centring on innovation support and funding, bank loan guarantees and financing).

UK Government-related investment in marine renewable energy appears to be relatively modest compared with France and is subdivided among a number of initiatives, including the Energy Technology Institute, the Technology Strategy Board, Research Councils UK and the Carbon Trust, each with their own resources and remits spanning the areas identified above. The now-disbanded Regional Development Agencies (RDAs) played a strong role in assisting technology development for offshore renewables. Although budgets for RDAs were more limited than those held by central government departments (e.g. the Department of Energy and Climate Change), £33.3m was spent on renewable energy across all RDAs in 2008-2009 (National Audit Office, 2010).In addition, both countries have benefitted from European funding (e.g. the Seventh Framework Programme and Intelligent Energy Europe.

The investment situation in the UK is described in Vantoch-Wood *et al.* (2012, p. 23) as:

'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.'

The UK's approach towards investment funding combined with its emphasis on market-based instruments and private-sector funding has produced a complex and arguably disjointed investment environment for technology and project developers and regional authorities. The French funding landscape appears more centrally driven and extensive, although it is difficult to make direct comparisons between the total investment available in each country as a result of the varying types of grants and loans made available, the different foci of activity (e.g. target technologies and focus on research, business development, infrastructure etc.), the timing of initiatives, and the levels of private investment leveraged as part of match-funding arrangements. However, as a rough comparison, Vantoch-Wood *et al.* (2012) reported approximately £620 million (€775 million) investment by government bodies and associated organisations (excluding European funding) across the various regions of the UK, compared with €2.85 billion (approximately £2.28 billion – again excluding European funding) available under the PIA in France reported in Kablan *et al.*, 2012). This suggests an appreciable disparity in the investment made available for marine renewable energy in the UK and France. In addition, the Brittany regional authorities have invested €134 million (£107 million) in improving port facilities and creating industrial platforms for the port of Brest, with further investment targeted for the Lorient port area. The South West Regional Development Agency has also been a major investor in the Wave Hub in Cornwall – contributing £12.5 million (€15.6 million) out of a total of £42 million (€52.5 million) investment[7] (Convergence Cornwall, 2012) – however, this forms part of the overall UK figures reported in Vantoch-Wood *et al.* (2012).

Devolution provides part of the explanation for the complexity of UK investment initiatives for marine renewable energy, while further explanations exist in the contrast between the UK's general preference for market-based approaches to energy policy and France's exercise of *colbertisme*[8] in respect of economic activities (Connor and Mitchell, 2004; Mitchell, 2008; Szarka, 2008). There is a large body of evidence that the UK's market based approach does not deliver an economic advantage in terms of cost per installed capacity or per unit of renewable energy generated, despite this being presented as the main justification for application in various territories. It is generally felt that this is linked to the additional risk inherent to market-based mechanisms such as the RO. (IEA, 2008, Mitchell *et al.*, 2006, Haas *et al.*, 2011). The adoption of feed-in tariffs for small-scale renewable electricity support and for renewable heat support suggested that the UK was moving away from market-based instruments but the announcement of the CfD-FiT (which is not a feed in tariff in the traditional sense), suggests a continued faith in market based instruments, reflecting the change in government which took place in 2010. Equally important, the UK and French approaches towards investment in marine renewables reflect deeper political and cultural preferences towards state involvement in economic activities, making them a matter of political choice rather than an issue on which firm recommendations can be made. The complexity of the UK's energy policy matrix (in relation to planning and consenting as well technology-push and market-pull incentives) has, nonetheless, been recognised in several studies as deterring private investment in renewable energy capacity (Grubb, 1995; Wood and Dow, 2011, Woodman and Mitchell, 2011). The recent House of Commons Energy and Climate Change Committee (2012) inquiry into *The Future of Marine Renewables in the UK* concluded that:

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[7] The balance of contributions coming from the UK Government (£9.5 million (€11.9 million)) and European Regional Development Fund Convergence funding (£20m (€25 million)).

[8] A policy interventionist and protectionist outlook towards economic activities developed by the Controller General of Finance of Louis XIV, Jean-Baptiste Colbert. Its general aim is to supports French industry to acquire sufficient knowledge and size to become competitive against major foreign industries.

'A key risk associated with an overly complex funding landscape is that money may be wasted. As well as the potential for duplication and overlap between schemes, there are also inefficiencies associated with projects having to apply to multiple schemes and the administrative costs associated with running multiple organisations.' (Comment 44)

The government's response was that the expansion of the Low Carbon Innovation Coordination Group's (LCICG) remit and membership, to include all key UK public-sector backed funders of low carbon innovation - including Scotland and other devolved administrations – would facilitate closer working relationships that would, in turn, ensure that support is focused on key technology areas and provides value for money. The government argued that this should avoid scheme overlap and achieve better outcomes, although it maintained that a single body would find it challenging to manage the broad remits of the existing organisations in the low-carbon innovation landscape.

Although the UK government has sought to reduce fragmentation and overlap in funding for marine renewables, the Committee also commented that funding for the sector represents a modest investment for a world leading industry with the potential to bring significant benefits to the UK (Comment 29). The government response reiterated the need to share resources equitably across policy priorities and that the current funding directed towards marine renewables 'represent[s] an appropriate level of funding to assist the sector's development towards commercialisation'.

Some concerns over the levels and timing of investment funding are also reported in Kablan *et al.* (2012). Particular attention is drawn to the *Agence Nationale de la Recherche* (ANR) first call for projects in November 2010 under the Institutes of Excellence in Carbon Free Energy (IEED) project *France Energie Marine* and *Pôle Mer Bretagne*. This funding of €142 million (£113.5 million) over ten years is seen as critical to providing dedicated financial and human resources to support study sites for the validation and testing of technologies under development. Of more general concern is the extent to which centrally directed funding can provide effective financial support in the key innovation areas of research, business development and infrastructure improvement.

Conclusions: Opportunities for Cross-border Learning and Collaboration

This report had three main aims: (i) to identify strengths and weaknesses in current national regulatory frameworks affecting the development of the marine renewable energy sector in the UK and France; (ii) to provide recommendations on how these might be modified to accelerate the growth of the marine renewables sector in each country; and (iii) to examine cross-border learning opportunities that may contribute further to the growth of the marine renewable energy industry in Europe. The first two aims were achieved by reviewing the general contexts of UK and French energy and industrial policy relevant to marine renewable energy and by examining issues facing individual technologies and the wider sector in the areas of planning, consenting and stakeholder consultation, financial support mechanisms, and modes and levels of investment. The report now concludes by re-examining the main obstacles to marine energy identified in the MERiFIC 4.1.1 UK and French reports, and by discussing opportunities for policy learning and cross-border collaboration.

The main *scientific and technological priorities identified for France* were: (i) the need for greater resource analyses to enhance developers' knowledge of the production capacity and profitability of different devices; and (ii) further government efforts and funding to facilitate project industrialisation, the launching of prototypes, and the development of an operational offshore study site capable of hosting full-scale demonstrators to test the capabilities and economics of technologies currently under development. Another priority was the need for innovative solutions to improve cable connections between offshore facilities and mainland grid systems[9]. The major *economic bottleneck* identified in France was the low electricity purchase price compared with other European countries, which has deterred investors from pursuing projects which may be economically viable under more favourable policy conditions. Increasing the level of purchase-price support is a general problem in the current economic climate, but arguably affects the marine sector more seriously than other renewable energy technologies as a result of the high levels of technological innovation still required and the high installation and connection costs for marine energy. Access to capital is another major economic issue. The potential for investment in low-carbon technologies is not unlimited, and investors are likely to be more attracted to proven technologies and large-scale projects with reasonable short- and medium-term returns and well-identified risk factors, than to newer, less proven technologies that will not yield profit in the near future.

Similar issues face the different branches of the UK's marine energy sector, although the UK is slightly more advanced in the development of test facilities for wave and tidal stream technologies following the establishment of NAREC in Northumbria, the European Marine Energy Centre (EMEC) in Orkney and the Wave Hub off the coast of Cornwall. However, the landscape of 'technology-push' grant and grant/revenue-support initiatives in the UK has been assessed by the Committee on Climate Change as complex, fragmented and modest in relation to the task of stimulating the development and commercialisation of marine energy technologies.

One of the potential areas for cross-border collaboration is in reducing the cost of intermediate and cross-technology components such as sub-sea cabling, mooring technologies and other shared requirements for marine energy technology. Currently both the UK, (through the ETI wet-mate connector programme) and France, (also identified by Kablan *et al.*, 2012) have acknowledged and are trying to innovate low cost, sub-sea wet-mate connector technologies. The UK has something of a lead in this area at present. As was discussed earlier, less mature technologies such as floating wind (and potentially ocean thermal and other far from commercial technologies) have an even higher potential for collaborative learning due to the larger number of unresolved technical complexities and risk.

The UK's system of financial incentives is also in a state of flux at the time of writing, following the publication of government proposal to replace the UK's main incentive mechanism for renewable energy, the Renewables Obligation (RO), with Contracts for Difference. Until the details of the new scheme and transitional arrangements are finalised, uncertainty as to the level of government support likely to be offered may act as a deterrent to investors, technology developers and project developers, particularly for technologies that are farthest from technological and commercial viability. Even once these details have been confirmed, much will depend on how markets judge the incentives given by Contracts for Difference compared with those currently offered by technological banding under the RO. The uncertainties surrounding the future of financial support mechanisms for marine renewables in the UK were further illustrated in the Committee on Climate Change's pre-legislative scrutiny of the Draft Energy Bill. The Committee noted that an apparent undertaking by the government to underwrite contracts in its original consultation on Contracts for Difference had been withdrawn from the draft bill. It further noted its view on the importance of the government as the counterparty

[9] Summary Report, Programmatic Group 5 "Marine, Hydraulic and Wind Energy", 21 May 2010 (p. 3)

underwriting contracts in order to ameliorate the risks associated with large low-carbon projects by reducing the cost of capital (Committee on Climate Change, 2012). It is not the role of this report to judge arguments for and against the government's approach aside from drawing attention to the potential effects of policy shifts on investor confidence, although the Committee's assessment is less circumspect.

Devolution has added further complexity to the UK funding and regulatory landscape, although the Scottish Executive has been highly active in utilising its decision-making powers in respect of planning and aspects of the Renewables Obligation to create favourable conditions for marine and land-based renewable energy.

The comparison of the two countries shows that there are several opportunities for cross border learning. The development of marine spatial planning offers opportunities for collaboration between France and the UK, following the framework directive. The gradual development of marine spatial planning across the member states would also be aided by the adoption of comprehensive primary legislation at the EU to guide, regulate, and ensure reasonable consistency in the implementation of marine spatial planning. This would benefit both the UK and France. Such legislation, however, should be comprehensive both in terms of basic procedures and coverage of activities in the marine space, a point emphasised by the SEANERGY report (SEANERGY, 2012). The different physical, social, economic and political contexts in France and the UK mean that such legislation is likely to be more politically acceptable and feasible to implement if it is enacted in framework form. Such an approach would provide common goals and principles for the countries involved, while enabling national and sub-national authorities to exercise discretion in how requirements are applied in each country and region.

At the time of writing, the process for marine spatial planning and its associated consultation in the UK is still under development. Much of the early focus of lesson drawing is, thus, likely to be on addressing intra-national issues rather than cross-national learning, and there appear to be sound arguments for taking a relatively cautious approach during the early stages of developing marine spatial plans. As a result, it is difficult to draw firm conclusions on their mode of operation or areas of potential collaboration. Nevertheless, there is ample scope for early exchange visits and information sharing between France and the UK aimed at achieving a more streamlined system of marine spatial planning in both countries. Opportunities for cross-border learning on the management of public and stakeholder concerns will arise from both the SOWFIA and MERiFIC projects. Work packages 4 and 6 respectively will inform these processes, as will cognate projects such as SEANERGY. Learning opportunities for creating a system of marine spatial planning will gradually emerge from these projects.

In terms of consenting procedures for marine energy, the French procedures for consenting seem (on paper) to be more susceptible to delays than are the equivalent UK consenting procedures because, at present, there is no overarching legislation addressing integrated marine spatial planning in France. The fragmentary evolution of French consenting procedures for marine renewables complicates this process. Current legislative changes to the Grenelle II Act can contribute to simplifying permitting procedures as well as making it more participative.

One potential area for collaboration is the development of shared technology clusters to gain infrastructural, economic, informational, technical and other benefits. It must be noted, however, that significant constraints exist for this type of joint-cluster approach. As a natural consequence of competition between countries and regions to establish marine renewables sectors, some clusters may grow at the expense of other areas, incentives to cooperate may be restricted, 'over-supply' of test centres may occur (if the utilisation of facilities is used as a measure), and technologies such as floating wind may become 'last resort' options that are only attractive in areas where more advanced and lower-cost technologies cannot operate. Shared technology clusters may still provide good benefits to the sector where partnership agreements can be developed between regional authorities and developers that clarify financing arrangements and information- and benefit-sharing from joint ventures.

Knowledge sharing, through development of data management platforms, has considerable potential for collaboration. Data management platforms, such as those being developed by the SOWFIA project, can facilitate access to key information on the extent of marine energy resources, the performance of technologies, environmental impacts and other factors, all of which can aid authorities, technology developers and project developers in determining the performance, impacts and financial viability of different technology types.

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