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The socio-economic interactions of marine renewable energy development and the commercial fishing industry on the island of Ireland

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Contents

Declaration vi
Acknowledgements vii
Abstract viii
Thesis outputs xi
Acronyms xiii
1 Introduction 1
1.1 General Introduction 1
1.2 Rationale and motivation for research 4
1.3 Contribution of thesis 7
2 Literature review 9
2.1 Drivers for Marine Renewable Energy 9
2.1.1 Increased security of supply 11
2.1.2 Climate change mitigation 12
2.1.3 Economic impact 12
2.2 Wave Energy 13
2.2.1 Oscillating Water Column (OWC) 16
2.2.2 Oscillating bodies 17
2.2.3 Overtopping devices 18
2.3 Tidal Energy 19
2.3.1 Tidal stream/ tidal current generation 20
2.3.2 Tidal barrage 21
2.3.3 Tidal lagoon 22
2.4 Offshore Wind 22
2.4.1 Fixed structure offshore wind turbines 24
2.4.2 Floating structure offshore wind turbines 24
2.5 Policy and planning for MRE development in Ireland 25
2.5.1 Environmental Impact Assessment 27
2.6 European Union Framework 29
2.7 Commercial Fishing in Ireland 31
2.8 Attitudinal studies and stakeholder perceptions of impacts and opportunities 38
2.9 Stakeholder engagement and the consultation process 43
2.10 Community benefit schemes and compensation 49
2.10.1Financial compensation and community funds 50
2.10.2 .... Community Ownership 50
2.10.3 .... Local contracting 52
3 Methodological Approach 54
3.1 Selection of case study sites 54
3.1.1 Atlantic Marine Energy Test Site 56
3.1.2 Torr Head Tidal 59
3.1.3 Fair Head Tidal 60
3.1.4 First Flight Wind 61
3.2 Company Fisheries Liaison Officers (CFLOs) 63
3.3 Mixed methods 63
3.4 Survey design 65
3.5 Interview design 65

3.6 Pre-testing 66
3.7 Sampling 67
3.8 Consent 67
3.9 Conducting the survey and interviews 69
3.10 Analysis of data 70
3.11 Compensation model 70
3.12 Limitations 71
4 Attitudes and perceptions of fishermen on the island of Ireland towards the development of marine renewable energy projects 72
Abstract 72
4.1 Introduction 72
4.2 Materials and Methods 76
4.2.1 Case study sites 76
4.2.2 Survey design 79
4.3 Results 82
4.3.1 Fishing activity 82
4.3.2 Fishermen's attitudes towards Marine Renewable Energy 83
4.3.3 Perceived Opportunities associated with Marine Renewable Energy 85
4.3.4 Perceived Impacts associated with Marine Renewable Energy 86
4.4 Discussion 87
4.4.1 Attitudes 87
4.4.2 Opportunities 90
4.4.3 Impacts and Mitigation 93
4.5 Conclusions and Recommendations 97
5 Moving from consultation to participation: a case study of the involvement of fishermen in decisions relating to marine renewable energy projects on the island or Ireland 99
Abstract 99
5.1 Introduction 100
5.2 Background on the formal consultation process 103
5.3 Theoretical framework 105
5.4 Case study sites 107
5.4.1 Atlantic Marine Energy Test Site 108
5.4.2 Torr Head/Fair Head tidal projects 109
5.4.3 First Flight Wind 110
5.5 Data collection and analysis 111
5.5.1 Quantitative survey results 113
5.5.2 Analysis of the perception of fishermen towards the "informed" level of participation 115
5.5.3 Analysis of the perception of fishermen towards the "consulted" level of participation 116
5.5.4 Analysis of the perception of fishermen towards the "involved" level of participation 117
5.5.5 Establishing trust 119
5.6 Discussion 119
5.6.1 General discussion 119
5.6.2 Establishing trust and the role of Liaison Officers 122
5.7 Conclusion and recommendations 124
6 Exploring benefit schemes and compensation models for fishermen impacted by marine renewable energy development 126

Abstract 126
6.1 Introduction 127
6.2 Background and context 128
6.2.1 Local employment 129
6.2.2 Benefits in kind 130
6.2.3 Community and compensation funds 130
6.2.4 Ownership of projects 132
6.3 Methodology 133
6.3.1 Case study sites 134
6.3.2 Data collection and analysis 137
6.4 Results and Discussion 137
6.4.1 Local employment 137
6.4.2 Benefits in kind 140
6.4.3 Financial compensation and disruption payments 142
6.4.4 Ownership of projects 150
6.5 Conclusion and Policy Implications 151
7 Fisheries compensation model 154
7.1 Introduction 154
7.2 Background and context 155
7.2.1 Fisheries Liaison with Offshore Wind and Wet Renewables (FLOWW) best practice guidance: recommendations for liaison during negotiation of compensation 155
7.2.2 FLOWW best practice guidance: recommendations for fisheries disruption settlements and community funds 155
7.2.3 Methods for the calculation of compensation 156
7.2.4 Spatial distribution of value of fisheries 157
7.2.5 Commercial Fisheries Atlas of Ireland 159
7.3 Design of compensation model 159
7.3.1 Data requirements and availability of data 160
7.3.2 Flowchart of the model 163
7.3.3 Steps in the model 164
7.3.4 Assumptions of the model 165
7.4 Excel model 166
7.4.1 Case 1 – Vessels under 15m that provide data 166
7.4.2 Case 2 – Vessel under 15m that does not provide data 170
7.4.3 Case 3 – Vessel over 15m 173
7.5 Impact on Capital Expenditure 176
7.6 Further work 176
8 Conclusions and Recommendations 178
8.1 Recommendations for policy 179
8.1.1 Consultation 179
8.2 Recommendations for research 179
8.2.1 Data deficiencies 179
8.2.2 Ownership 180
8.3 Recommendations for MRE developers 181
8.3.1 Consultation 181
8.3.2 Provision of benefit schemes 183
8.3.3 Financial Compensation 184
8.4 Recommendations for the fishing industry 185
8.4.1 Alternative employment 185

9 References **188**
Appendix A – Survey Questionnaire **207**
Appendix B – Semi-structured Interviews **214**
Introduction and Consent Form 214
Interview questions for fishermen 216
Interview questions for CFLOs 221

Declaration

I hereby declare that this thesis is my own work and that it has not been submitted for another degree, either at University College Cork or elsewhere. Where other sources of information have been used, they have been acknowledged.

Signature:

Date:

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Abstract

The global increase in energy demand and the need to reduce carbon emissions necessitates the use of alternative sources of energy such as marine renewable energy (MRE). For the purpose of this thesis, MRE refers to offshore wind, tidal and wave energy. The island of Ireland, comprising the Republic of Ireland and Northern Ireland, has a significant marine energy resource and policies are in place to maximise the potential for MRE development. As the offshore wind sector expands and tidal and wave energy moves towards commercialisation, these will have an impact on existing sectors and traditional users of Ireland's marine resources. Commercial fishermen are arguably the stakeholder group most likely to be directly impacted by the development of MRE projects. For Ireland, fishing remains an important sector for coastal communities in terms of employment and income. The development of MRE could potentially result in loss of access to fishing grounds which would have socio-economic implications for fishermen. Spatial conflicts and the opposition of fishermen to projects, could hinder the development of the MRE sector in Ireland. The successful development of the sector will depend to a considerable extent on the ability of both sectors to co-exist and the acceptance of projects by fishermen. As such, mitigation planning is important. However, studies on the socio-economic interactions of MRE and commercial fishing are rare.

This thesis aims to address this gap and to provide recommendations to enable the development of the MRE sector in Ireland sustainability with the existing and established commercial fishing sector. This thesis consists of three case studies involving MRE projects around the island of Ireland at various stages of planning and development. A mixed methods approach, which consisted of a survey and follow-up interview, was used to gather quantitative and qualitative data on the attitudes and experiences of fishermen at the case study sites. In total, 104 complete surveys were conducted with fishermen located at ports in the vicinity of the case study sites and 14 of these fishermen were subsequently interviewed. In addition, fisheries liaison officers from MRE projects in the UK were also interviewed regarding their experiences on these projects. The research findings from the case studies are presented in three peer-reviewed journal articles reproduced in this thesis.

Firstly, in order to reduce the risk of spatial conflict and to enable decision-making based on the co-existence of the two sectors, a better understanding of the attitudes of fishermen towards the development of MRE projects in their locality was required. A survey was designed to provide quantitative information on fishermen's attitudes to MRE, perceived opportunities and impacts associated with MRE, and suggestions for mitigation. Of the fishermen surveyed, 40% agreed that it is important to develop MRE in their locality. A further 15% were neutral on this matter. It is encouraging for developers and policy makers that the majority of respondents (70%) were of the opinion that fisheries and MRE projects can co-exist. Alternative employment was the most cited opportunity. The loss of access to traditional fishing grounds, and the associated loss of income, was a concern for the majority (79%) of fishermen. The main mitigation options suggested were more effective consultation, location of developments on non-fishing grounds and financial compensation.

Effective consultation and stakeholder engagement that enables participation in decision-making is crucial to enhancing acceptance of MRE projects among fishermen. There is agreement among experts in the field that despite its importance, the consultation process is not effective and is often carried out from the top down with little opportunity for real participation. Data gathered from the survey and interviews was analysed to examine the experiences of fishermen on their level of involvement in consultations and decision-making on the case study projects. Just over half (56%) of the fishermen surveyed felt that they had been involved in consultations, while only 22% felt that they had been involved in decisions made on the projects. For many, the consultation process was seen as a "box-ticking exercise" carried out in order to advance the project. This study highlights the fact that fishermen feel that there is currently little opportunity for fishermen to participate in decision-making on MRE projects. The study found that the use of participatory mapping tools in the selection of sites for MRE development provides an opportunity for fishermen to influence decisions. Input from fishermen in the design and implementation of maritime spatial plans could also help to provide clarity and transparency over how trade-offs in the use of sea space are dealt with.

Benefit schemes and financial compensation measures for fishermen who may be impacted by the development of MRE projects were also examined as potential mitigation options. Benefit schemes refer to additional voluntary measures that are provided by a developer to local stakeholders. This part of the research was based on the interviews conducted with fishermen and fisheries liaison officers. Analysis of the interviews found that there was uncertainty among fishermen over whether they would benefit from MRE. There was agreement between fishermen and the fisheries liaison officers on the provision of an evidence base for the calculation of disruption payments. Furthermore, a formal structure for the provision of benefits schemes for fishermen would be useful.

Finally, a basic model was developed to calculate the potential compensation to be paid to fishermen who may be impacted by the development of MRE projects. The calculator can be used by developers for budgetary planning and to estimate the impact that the payment of compensation would have on expenditure.

Thesis outputs

Journal Papers

I. Reilly, K., O'Hagan, A. M. & Dalton, G., 2015. Attitudes and perceptions of fishermen on the island of Ireland towards the development of marine renewable energy projects. *Marine Policy*, 58, 88-97. http://dx.doi.org/10.1016/j.marpol.2015.04.001

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Contribution of individual authors

I. I was responsible for the primary research activities and data collection. I analysed that data and wrote the manuscript. Anne Marie O'Hagan and Gordon Dalton provided direction and feedback on the manuscript.

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Acronyms

AMETS – Atlantic Marine Energy Test Site

ANIFPO – Anglo North-Irish Fish Producers Organisation

BIM – Bord Iascaigh Mhara

CFLO – Company Fisheries Liaison Officer

DARD – Department for Agriculture and Rural Development, now the Department of Agriculture, Environment and Rural Affairs (DAERA)

EIA – Environmental Impact Assessment

EIFA – Erris Inshore Fishermen's Association

ELCRA – Erris Lobster and Crab Re-Stocking Association

EMEC – European Marine Energy Centre

FFW – First Flight Wind

FIR – Fisheries Industry Representative

FLAG – Fisheries Local Action Group

FLO – Fisheries Liaison Officer

FLOWW – Fisheries Liaison with Offshore Wind and Wet Renewables group

ICES – International Council for the Exploration of the Sea

MMO – Marine Mammal Observer

MRE – Marine Renewable Energy

MSP – Maritime Spatial Planning

MW – Megawatts

NCLFA – North Coast Lobster Fishermen's Association

NIFPO – Northern Ireland Fish Producers Organisation

NIMBY – Not In My Back Yard

OREDP – Offshore Renewable Energy Development Plan (Ireland)

ORESAP – Offshore Renewable Energy Strategic Action Plan (Northern Ireland)

PAM – Passive Acoustic Monitoring

PDZ – Proposed Development Zone

SEA – Strategic Environmental Assessment

VMS – Vessel Monitoring System

WEC – Wave Energy Converter

1 Introduction

1.1 General Introduction

The topic under research in this thesis is the potential socio-economic interactions of marine renewable energy (MRE) development and commercial fisheries in Ireland. MRE refers to forms of renewable energy that are extracted from the marine resource. This includes offshore wind, wave energy, tidal energy, Ocean Energy Thermal Conversion (OTEC), algal biofuel and osmotic power. OTEC uses the temperature difference between cold water from the deep sea and warmer waters nearer the surface of the sea to generate electricity (Rajagopalan and Nihous, 2013). Microalgae can produce and accumulate lipids within their cell mass which is similar to those found in many vegetable oils and as such they can be used as a type of biofuel (Singh et al., 2011). Osmotic power refers to the energy created by the difference in the salt concentration between seawater and freshwater (Skilhagen et al., 2008). Offshore wind, wave and tidal energy are the most advanced of these technologies and are most applicable for the island of Ireland. As such these are the focus of this thesis and MRE herein refers to all three.

As the demand for energy increases globally, the MRE sector is also likely to expand and it is predicted that MRE will become an increasingly important part of the energy mix (International Energy Agency, 2014). The offshore wind sector is expanding throughout the world each year and there have been significant advances in wave and tidal energy technologies over the last 30 years (Falcão, 2010, O'Rourke et al., 2010). The expansion of the MRE sectors will inevitably have some effect on traditional users of the marine resource such as commercial fishermen, but as yet this expected effect is to a large extent undocumented and unknown. Commercial fishing remains an important sector in the Irish economy in terms of employment and contribution to Gross Domestic Product (GDP). Although the exact impacts of the development on MRE in Ireland are unknown there will be impacts and opportunities for fishermen. Whilst the benefits and opportunities could enhance acceptance and garner support for the development of MRE, the potential negative impacts could lead to the opposition of fishermen towards MRE projects.

The policy focus of this thesis is to assist in forming the basis for the long term co-existence of the nascent MRE and the established commercial fishing sectors in Ireland. The development of the MRE sector in Ireland with the existing commercial fishing and other established industries is a key challenge for planners, developers, policy-makers and advocates of MRE. The potential for spatial conflict and opposition by fishermen is a significant non-technical barrier to the commercialisation of wave and tidal energy and the expansion of the offshore wind sector (Alexander et al., 2013a, Alexander et al., 2013b, O'Keeffe and Haggett, 2012). The acceptance of MRE projects by fishermen will be influenced by the ability of planners, regulators and developers to minimise and mitigate the negative impacts and enhance the benefits. As MRE is still currently a relatively new sector, there are a limited number of studies focussing on the social and economic impacts of the expansion of the sector on fishermen. The majority of the research carried out to date has focussed on the technical challenges and engineering aspects of MRE development (Kerr et al., 2014). However, as wave and tidal energy sectors approach commercialisation and the offshore wind sector expands there is a requirement for studies that examine and determine the human dimensions of MRE.

The three broad areas explored in this thesis are:

(i) the current attitudes and perceptions of fishermen towards the development of specific MRE projects,
(ii) the level of involvement of fishermen in consultations on those projects and their participation in decision-making,
(iii) benefit schemes and compensation as a means of mitigating the potential negative impacts of MRE development on fisheries activities.

The main research aim of this thesis is to gather data on these three areas and address the knowledge gaps. This thesis addresses this gap by exploring the potential interactions between the development of the MRE sector and commercial fisheries. This was achieved using three separate case studies of MRE projects from the island of Ireland, which comprises the Republic of Ireland and Northern Ireland. The three MRE projects studied were the First Flight Wind (FFW) offshore wind farm, off the coast of Co. Down, Northern Ireland; the Atlantic Marine Energy Test Site (AMETS), off the coast of Belmullet, Co. Mayo, Ireland; and the Torr Head and Fair Head tidal projects, off the coast of Antrim, Northern Ireland. The three sites represent offshore wind, wave and tidal energy respectively. A mixed methods approach was used to gather quantitative and qualitative data from fishermen at each site. In addition to the case studies, the experiences of fisheries liaison officers who have been involved in MRE projects in the UK and Ireland have also been examined.

The remainder of the introductory chapter details the rationale and motivation for the research and the expected contribution. Chapter 2 provides a context for the research and includes background information on MRE and the commercial fishing sector in Ireland. This chapter also includes a review of the literature on the three mains areas covered in the thesis, which have been identified in the preceding paragraphs. Chapter 3 consists of a detailed description of the methodology used to conduct the research. This also includes additional information on the three case study projects and a justification for their selection over other potential MRE sites.

The majority of the research findings from the case studies are presented in three peer-reviewed journal articles. Chapter 4 consists of the paper titled "Attitudes and perceptions of fishermen on the island of Ireland towards the development of marine renewable energy projects", published in the journal Marine Policy. The chapter determines the current attitudes of fishermen towards MRE projects under development in their locality. It also identifies the perceptions of fishermen towards the main opportunities and negative impacts associated with MRE. In addition, it includes information on suggestions from fishermen on how these negative impacts may be mitigated.

Chapter 5 consists of a paper titled "Moving from consultation to participation: a case study of the involvement of fishermen in decisions relating to marine renewable energy projects on the island of Ireland", published in the journal Ocean and Coastal Management. This chapter explores stakeholder engagement and consultation procedures at the three case study sites. This chapter provides information on the experiences of fishermen with consultation processes and their level of involvement in decision-making on the MRE projects. This chapter identifies strengths and weaknesses of the consultation procedures used at the case study projects and recommends mechanisms that can help to enhance the meaningful participation of fishermen in decision-making.

Chapter 6 presents the paper titled “Exploring benefit schemes and compensation models for fishermen impacted by marine renewable energy development”, published in the journal Energy Policy. This chapter examines the topic of the provision of benefit schemes to fishermen affected by MRE projects based on the attitudes of fishermen towards such schemes. It also identifies schemes that have been successful at existing MRE projects in the UK based on the experiences of fisheries liaison officers. The issue of financial compensation for fishermen who may be impacted by the development of MRE projects is also discussed. This includes information on the identification of those who may be impacted and how compensation should be calculated. Following on from this, Chapter 7 outlines the methodology behind the development of a basic model to estimate the spatial distribution of the value of landings for fishing vessels. Such a model could be used to calculate compensation payments for fishermen if their fishing activity was affected due to the development of a MRE project.

The final chapter highlights the key results and findings that were identified in the previous chapters and makes a number of concluding remarks and recommendations based on these. These recommendations will assist in facilitating the development of MRE while minimising the negative impacts on commercial fishermen and maximising the benefits.

1.2 Rationale and motivation for research

A range of challenges face the commercialisation of both wave and tidal energy and the expansion of the offshore wind sectors around the globe. The challenges can be separated into technical and non-technical issues. Non-technical barriers include difficulty in securing finance at the scale needed for full size projects and fostering social acceptance of projects. Whilst considerable research is being carried out on the technical and engineering challenges the sectors face, the economic and social aspects are largely neglected. Non-technical barriers are often viewed as non-critical concerns and are treated with less importance than technical challenges and as such are left to the latter stages of developments (Kerr et al., 2014). However, the negative impacts associated with the development of MRE could potentially lead to conflict with marine stakeholders. The issue of spatial conflict in an increasingly congested marine environment is a real barrier to the expansion of MRE (Alexander et al., 2013a, Alexander et al., 2013b, O'Keeffe and Haggett, 2012) and is one that needs to be addressed. Opposition and protest from stakeholders could cause delays to projects specifically and hinder the development of the sector in general. The acceptance of projects by the main stakeholder groups will therefore have an influence on the successful development of the sector and it has been suggested that these issues should be given more importance (Kerr et al., 2014). As developers explore opportunities in MRE, these new uses of the ocean must be balanced with traditional uses such as fishing. Fishermen and other ocean community stakeholders will play a key role in shaping the future of MRE development. The co-existence of established and emerging marine industries with each other ought to be an important aim in an increasingly congested marine environment. This could help to reduce the risk of spatial conflict between the sectors and could potentially enable both sectors to achieve growth. There is currently a gap in the research of the potential interactions of commercial fisheries and the development of the MRE industry, both in Ireland and internationally. As the MRE industry is not fully commercial, studies on the potential socio-economic impacts of the development of MRE projects on fishermen are rare.

Due to the public nature of the marine environment and its many uses, there are numerous potential stakeholders who have an interest in how MRE developments may impact upon them. Stakeholders can be defined as "any group or individual who can affect or is affected by the achievement of an organisation's purpose" and more specifically as "natural resource users and managers" (Röling and Wagemakers, 1998). In the strictest sense every individual is a potential stakeholder with regard to the marine environment. However the main stakeholder groups include those involved in commercial fishing, recreational fishing, aquaculture, shipping, military, marine protected areas (MPAs), environmental group and energy production (Pomeroy and Douvere, 2008). The economic, social and environmental costs and benefits of MRE projects will be distributed across this range of stakeholders groups (Holland et al., 2010). Construction, operation and maintenance may impact on the environment which could be a cause for concern for environmental organisations (Shields et al., 2011). In some cases aesthetic impacts may have a negative non-market impact on local communities in addition to market impacts on tourism and property values (Ram, 2011). However, this may not always be an issue. A case study into the potential barriers to the development of the Firth of Forth offshore wind farm noted that public opposition to the project was not anticipated by the interviewees to be a major issue due to the fact that the wind farm would be located far offshore where it would be barely seen (O'Keeffe and Haggett, 2012). This study also noted that there would likely be a major challenge in overcoming opposition to the project from the fishing industry. Commercial fishermen are a key group of ocean users who rely on access to fishing grounds for their livelihoods and are the group most likely to suffer direct adverse social and economic impacts as a result of spatial restrictions (Yates and Schoeman, 2013). The idea that fishermen are the main stakeholder group that may potentially be impacted by the development of MRE has been claimed in a number of other studies (Alexander et al., 2013a, Alexander et al., 2013b, Gray et al., 2005, Rodmell and Johnson, 2002). The expansion of the MRE sector may directly affect the fishing industry through loss of access to fishing grounds, reduced catchability of fish species during construction and operation, loss of gear, or collisions with devices (Perry and Smith, 2012). The potential negative impacts to fishermen could lead to lead to conflict and opposition. At a more extreme scale, lack of acceptance could ultimately result in delays to projects through protests and protracted legal challenges. Fishermen are a stakeholder group who have the ability to hinder projects through litigation, as was witnessed on the Cape Wind offshore wind farm. Cape Wind is a project to develop a 468 MW offshore wind energy farm off the coast of Cape Cod in Nantucket Sound, Massachusetts, USA. The local fishermen's organisation objected to the proposed project on the grounds that it would restrict access to fishing grounds, make navigation more risky and prohibitively increase their costs (Seccombe, 2010). The organisation threatened the developer with legal action to have the wind farm moved. The federal lawsuit was dropped in 2012 after Cape Wind and the local fishermen's association agreed to work together on ways to co-exist as part of a settlement agreement. This resulted in Cape Wind ensuring fishermen that Horseshoe Shoal, the area proposed for the offshore wind farm, would remain open to fishing activities. This demonstrates that the opposition of fishermen to MRE developments may hinder MRE development and is something that ought to be addressed. In addition, it shows that the acceptance or support of fishermen is an essential component for the successful development of the MRE sector. Despite these negative impacts and the potential for conflict, MRE projects could also provide a range of benefits and opportunities for fishermen, such as alternative employment. Enhancing these benefits could help to increase acceptance of projects. It should be noted that the acceptance of projects could lead to fishermen sharing local knowledge which would be beneficial to developers and could potentially contribute to the successful development of projects.

Under a typology developed by Mitchell et al. (1997) on stakeholder identification and salience, fishermen can be considered definitive stakeholders in the marine environment (Johnson et al., 2015). This means that fishermen have the three main relationship attributes regarding the marine environment. These are legitimacy, power and urgency in the decision-making process. Despite this, commercial fishing is still considered the invisible sector (Rodmell and Johnson, 2002). It has been noted that the attitudes of the general public have tended to receive more attention in the academic literature, media and government publications (O'Keeffe and Haggett, 2012) and studies on the interactions of MRE and commercial fisheries are rare. Therefore, this is a major topic which requires research. Information on how to reduce the risk of this opposition is useful for policy makers and government departments who are responsible for ensuring that developments progress with minimal disruption to existing resource users. Similarly, MRE developers have a responsibility to ensure that MRE projects are designed and developed with cognisance of the existing environment and marine related activities, including the commercial fishing industry. The challenge for developers and policy makers is to ensure the co-existence of both sectors. This can be done by ensuring that the opportunities for fishermen are maximised while the negative impacts are limited through mitigation strategies.

1.3 Contribution of thesis

The main contribution of this thesis is to enhance the development of the MRE sector with the commercial fishing industry through policy recommendations across the three broad themes of the research. This research will help inform policy and advise policy makers on how to reduce the risk of conflict and enable the development of MRE with commercial fishing, based on case study evidence. It is expected that the recommendations made will help to overcome the non-technical barriers of social acceptance of MRE developments by reducing the risk of spatial conflict and opposition to MRE developments and enhancing acceptance. The findings from this research can help with integrated planning and enhance co-operation between the sectors. In addition, this study will gather baseline data for Ireland on the topic which does not currently exist and in this way contribute to knowledge in its own right as well as to the wider research community.

The gathering of information from the surveys and interviews is a significant research contribution from this thesis and has helped to address the knowledge gap on the topic. The baseline data on attitudes of fishermen towards the specific MRE projects on the island of Ireland can be compared with similar studies that have already been carried out. This information can also be used in future studies to examine how attitudes may change as projects develop and as the MRE sector become more established. The case studies have also gathered information on the experiences of fishermen on their level of involvement in consultations and decision-making on MRE projects. This will enable the identification of key elements necessary for the effective consultation of fishermen on MRE projects. This will help to improve the stakeholder engagement and consultation processes and identify mechanisms which could facilitate the involvement of fishermen in the making of decisions which may impact them. This research will help to identify benefit schemes that have been successful on operational MRE projects and form recommendations based on this. In addition to this, this thesis will also evaluate the issue of financial compensation as a mitigation option and provide guidance on how to identify those to be compensated, mechanisms used to provide it and the calculation of compensation figures. A further contribution of the thesis is the design of a model to estimate the potential financial impact that the development of MRE may have on fishermen.

2 Literature review

This chapter provides background information on MRE that comprises a review of the technologies involved, history of the sector and the context on the island of Ireland. This includes information on the policy drivers and the planning process for MRE in Ireland. There is also some contextual detail on commercial fishing in Ireland. This is followed by a critical review and analysis of the literature across the three key themes explored in the thesis as outlined in Chapter 1. These are the attitudes and perceptions towards the development of MRE, the engagement of stakeholder fishermen and the consultation process and community benefit and compensation schemes.

2.1 Drivers for Marine Renewable Energy

Installations which use technologies to harness energy from offshore wind, wave and tidal resources are likely to become a part of the future energy mix worldwide. A key driver for the growth of MRE and other renewable energy technologies in the European Union is the European Commission's Renewable Energy Directive (2009/28/EC). The Directive provides a legally binding framework and has set a target of a 20% share of renewable energies across the EU by 2020. In addition, interest in MRE in Ireland is based largely on the size of the resource, which is considerable (Department of Communications Energy and Natural Resources, 2014). Ireland's marine environment is around ten times the size of the terrestrial area. Figures 2.1 and 2.2 show maps of the marine renewable energy resource in the Republic of Ireland and Northern Ireland. Three major potential benefits of MRE include increased security of supply, climate change mitigation and positive economic impacts in terms of Gross Value Added (GVA) and employment.

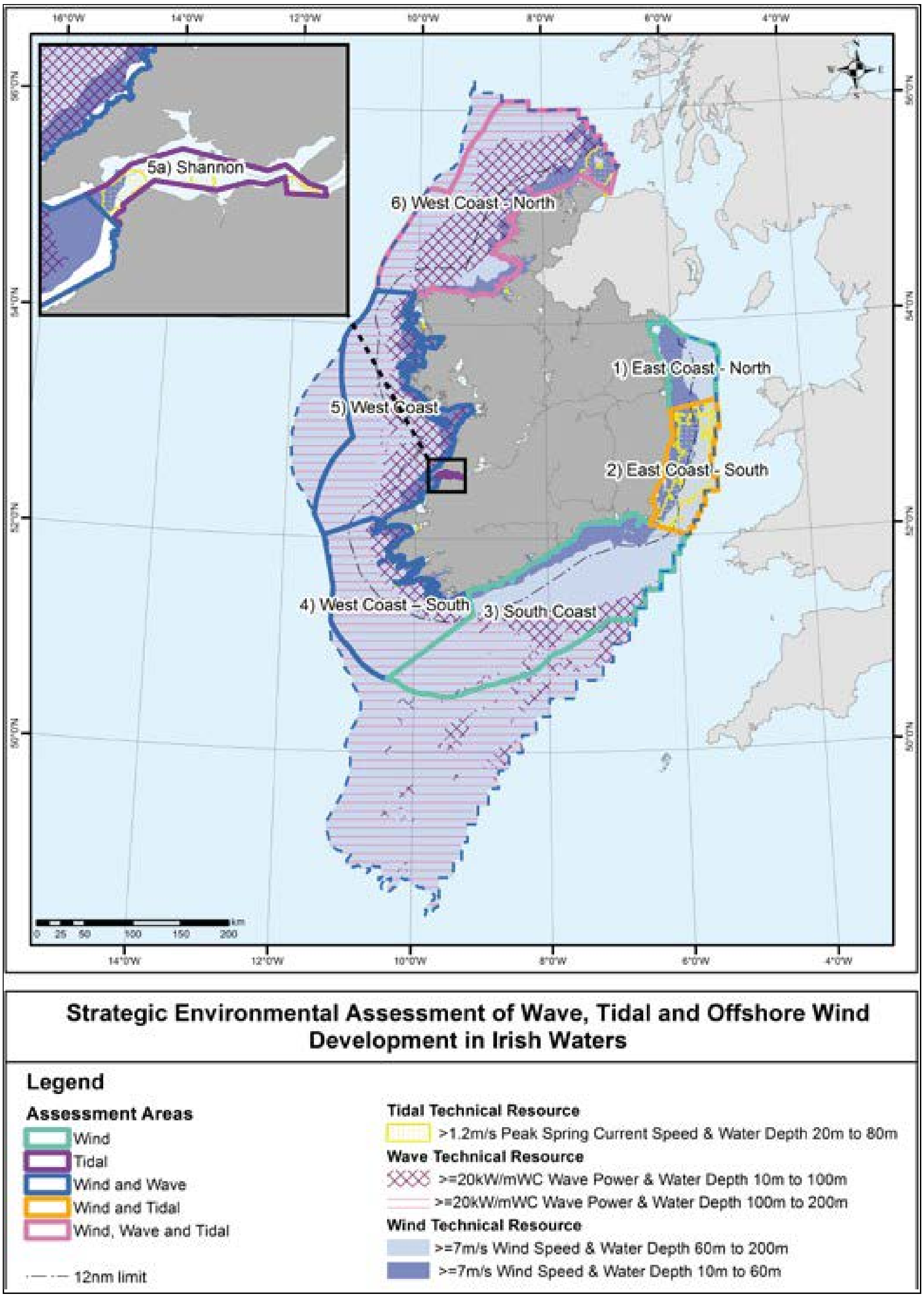

Figure 2.1 Map of SEA Assessment Areas in the Republic of Ireland (Source: Sustainable Energy Authority Ireland and AECOM, 2010)

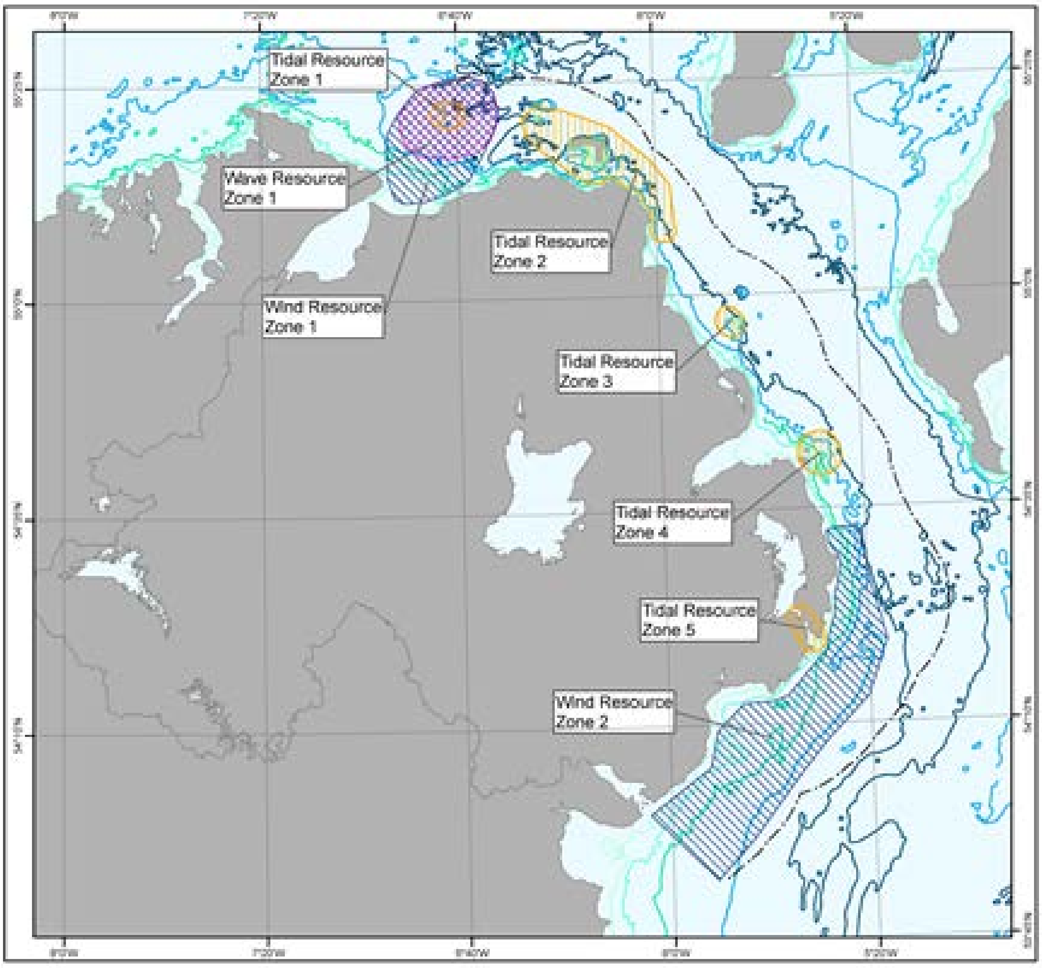

Figure 2.2. Map of SEA Assessment Areas in Northern Ireland (Source: Sustainable Energy Authority Ireland and AECOM, 2012)

2.1.1 Increased security of supply

The energy crisis of the 1970s resulted in increased support among Western governments for renewable sources of energy. Research into alternative forms of energy, such as MRE, has been on-going since then as governments worldwide are keen to avoid a repeat of the crisis. Ireland's energy supply is heavily reliant on imported fossil fuels, which accounted for 85% of all energy usage in 2014 at a cost of approximately €5.7 billion (Sustainable Energy Authority of Ireland, 2015). The current energy mix is dominated by oil (47%) and gas (29%). Gas is imported predominantly from the UK, while oil in is imported primarily from Norway (41.3% of crude oil) and the UK (89% of petroleum products). The dependence on imports to meet energy needs carries a considerable risk for Ireland and the development of a MRE sector presents an opportunity to establish a domestic supply of energy.

2.1.2 Climate change mitigation

The development of renewable energy projects is seen as major climate change mitigation option and can help to achieve targets for reduced carbon emissions. The development of MRE could potentially provide an alternative to traditional methods of electricity generation such as coal and gas which can be very damaging to the environment. Renewables are seen as the most important long-term mitigation option for power supply (Luderer et al., 2013).

2.1.3 Economic impact

The establishment of a new MRE industry could result in economic benefits for Ireland and could be an important source of sustainable employment for local communities. A study commissioned by SEAI and conducted by SQW Energy outlined the potential economic benefits of supporting the development of an ocean energy (wave and tidal energy) industry in Ireland and included a roadmap for development of the sector (SQW, 2010). The report states that the creation of new jobs could potentially increase to between 17,000 and 52,000 FTE jobs by 2030. However, it should be noted that until wave and tidal energy becomes fully established and more information on the manufacturing process is known, job creation estimates will be very uncertain and are completely indicative. A study quantifying the economic value of multi-sector marine commercial activity in Ireland found that in 2007 MRE had turnover of €6.2 million, GVA of €4.4 million, direct employment of 101 and direct and indirect GVA of €7.1 million (Morrissey et al., 2011). Following a review of studies, Dalton and Lewis (2011) found that the job creation potential of MRE is thought to be 10 jobs/MW, however, the paper acknowledges certain reservations on this metric.

A number of studies from Scotland have used regional Computable General Equilibrium (CGE) models to demonstrate that expenditures associated with MRE development can have significant impacts on the regional economy in terms of income and employment (Allan et al., 2011, Allan et al., 2014). These have demonstrated that positive impacts on employment and economic activity persist beyond the end of the expenditures themselves.

2.2 Wave Energy

The accessible wave energy resource in Ireland is estimated to be 21TWh/year (SQW, 2010). This would be sufficient to supply 75% of Ireland’s electricity consumption in 2006. Figure 2.3 shows the distribution of the wave energy resource around the coast of Ireland.

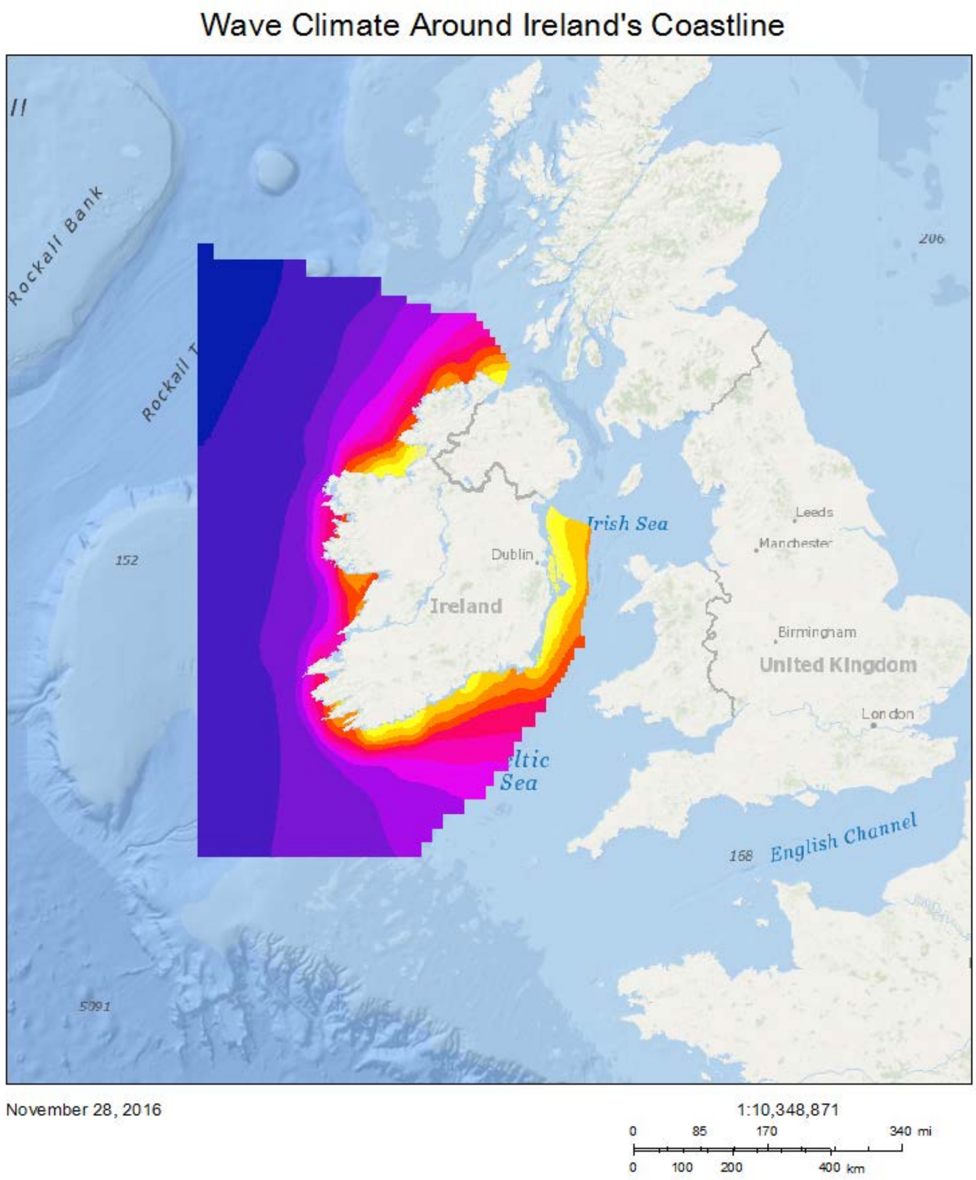

Figure 2.3. Wave Climate around Ireland's Coastline (Source: Marine Institute, 2016)

There are various ways in which energy can be extracted from ocean waves. The devices used vary depending on a number of factors such as water depth and distance from shore. The potential to gather energy from waves has received increasing interest since the 1970s and considerable research and development has been carried out in the area over the past 40 years. Over 1,000 wave energy conversion technologies have been patented in Europe, North America and Japan (Clément et al., 2002). Although there are currently no commercial wave energy farms in operation worldwide, there are a number of pilot deployments in several nations which are aiding the development of the sector. The European Marine Energy Centre (EMEC) in the Orkney Islands in Scotland claims to be the largest research centre and test site for MRE in the world (European Marine Energy Centre, 2016). Wave Hub Ltd are a UK based company that manage a wave energy test site off the coast of Cornwall, a wave energy demonstration zone in Pembrokeshire and a tidal stream test site in North Devon (Wave Hub Ltd, 2016). The company also provides support services for wave energy developers and grid connection for wave energy convertors (WEC) at the Cornwall site. In the US the Pacific Marine Energy Centre (PMEC) was established in the Pacific Northwest Region to facilitate testing for a broad range of marine renewable energy technologies (Northwest National Marine Renewable Energy Center, 2016). Testing facilities for WECs include the North Energy Test Site (NETS) and the South Energy Test Site (SETS), both of the coast of Oregon. The US Navy also have a wave energy test site in Hawaii. China is planning to build three wave energy test sites off Shandong, Zheijang and Guangdong provinces (Tidal Energy Today, 2015) and Japan is also planning to establish a marine energy centre based on EMEC.

There are currently two wave energy test sites in Ireland: one operational and one that is at an advanced stage of development. The Galway Bay Wave Energy Test Site is a one quarter scale test site located off the coast of in Spiddal, Co. Galway on Ireland’s west coast. Further north of this, the Atlantic Marine Energy Test Site (AMETS), off the coast of Belmullet, Co. Mayo is under development and is discussed in depth in section 3.1.1, as it forms one of the case studies. In addition to these test sites, Westwave is a wave energy demonstration project being developed by the Electricity Supply Board International (ESBI) off the coast of Co. Clare. The aim of that project is to deploy a number of different wave energy devices off the west coast of Ireland. The objective for all three projects is to encourage the growth of an indigenous wave energy industry in Ireland.

The technology to harness wave energy currently lags behind that of tidal and wind generation. Falcão (2010) provides a comprehensive review of the development of wave energy since the 1970s. The review classifies wave energy devices according to the working principle of the device. The classifications include oscillating water column (with air turbine); oscillating bodies and overtopping devices.

2.2.1 Oscillating Water Column (OWC)

Since the 1970s a wide variety of Oscillating Water Columns (OWC) have been proposed but only a small number have reached prototype stage, that have been tested in open water conditions. As a basic concept, the OWC consists of a chamber which is partly submerged in the water with an air turbine attached to the top of the chamber (Falcão, 2010). The waves which come into contact with the device cause the water column to rise and fall, which alternately compresses and depressurise the air column. The air flow then causes the turbine to spin and converts this energy into electricity. Wells turbines are often used in OWC devices as they spin in the same direction regardless of the air flow and as such help to increase efficiency of the energy extraction.

OWC devices can be either fixed structure or floating structure. Fixed devices are usually located on the shoreline or in the nearshore area. They generally stand on the sea bottom or are fixed to a cliff (Falcão, 2010). An example of this is the European Pilot Plant, which is a full scale fixed structure OWC prototype and was constructed on Pico Island in the Azores in 1999 (Falcão, 2000). Figure 2.4 demonstrates how this concept works.

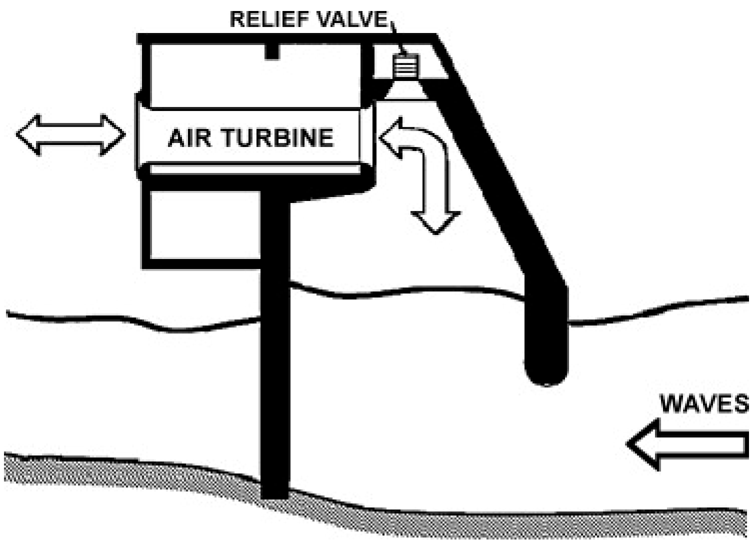

Figure 2.4. Cross-sectional view of a bottom-standing OWC (Source: Falcão, 2010)

Floating structure OWCs tend to operate in deeper water and are usually slack-moored to the seabed (Falcão, 2010). An example of a floating OWC is the Ocean Energy

(OE) buoy. The OE buoy was developed by Ocean Energy Ltd, a wave energy technology developer based in Co. Cork, Ireland. To date, a quarter scale prototype of the OE buoy has been deployed at the Galway Bay Wave Energy Test Site, and has been in operation during winter periods. At full scale the device will be rated at circa 1MW, depending on turbine technology and it will be deployed in water depths greater than 50m. The company has recently secured funding of €2.3million to build a full-scale prototype of the OE buoy that will be tested at the US Navy Wave Energy Test Site in Hawaii (Williams, 2016).

2.2.2 Oscillating bodies

Oscillating bodies are generally either floating or fully submerged offshore devices which extract energy from more powerful waves in water depths of typically more than 40m (Falcão, 2010). The simplest oscillating body system is the single-body heaving buoy which reacts with the incoming wave against the seabed or a fixed structure (Falcão, 2010). The buoy acts as a point absorber which means that the device possesses small dimensions relative to the incident wave length (Drew et al., 2009). A point absorber can capture energy from a wave front greater than the physical dimension of the absorber. It is also able to capture energy from waves arriving from any direction. Point absorbers are usually heaving systems consisting of a large buoy which is in two separate parts, one of which is stationary while the other is not. The non-stationary part moves in a heaving motion against the stationary part as the wave comes into contact with the buoy. As this happens hydraulic components are put into motion and these are used to convert the energy into electricity (Falcão, 2010). An example of two-body heaving system is the Wavebob device which was under development in Ireland between 1999 and 2013. A quarter scale prototype of Wavebob was also tested at the Galway Bay Wave Energy Test Site.

Along with these oscillating bodies that are based on heave motion, there are also those in which the energy conversion is based on the relative rotation, or pitch (Falcão, 2010). The most famous pitching device is Salter's Duck, which was initially developed at the University of Edinburgh, Scotland in the early 1970s (Salter, 1974). There are also devices that extract energy through surge motion. These devices are usually horizontal and consist of several parts which are aligned with the direction of the waves. The parts are connected by joints and start to move against each other as the wave comes into contact with the device. A prime example of this type of system is the Pelamis device, which was designed by a wave energy technology developer based in Edinburgh, Scotland. Pelamis technology is deployable in water depths greater than 50m. The Pelamis device is an attenuator and lies parallel to the predominant wave direction and “rides” the waves (Drew et al., 2009). Pelamis Wave Power had been operating full scale machines since 2004, including deployments at EMEC in Orkney. It was also responsible for the deployment of the world’s first multi-device wave energy array off the coast of Aguçadoura, northern Portugal in 2008. The project was short-lived due to technical difficulties and in 2014 the company went into administration.

Another classification of wave energy device is a bottom hinged system (Falcão, 2010). These refer to those devices which are attached to the sea bed and as a result they are typically located near to the shore in relatively shallow water. As a basic concept a buoyant flap is hinged at the seabed, and is almost entirely underwater, which pitches backwards and forwards in the nearshore waves. This type of device is best exemplified by the Oyster, which was under development by the Scottish company Aquamarine Power. The Oyster has a surface piercing flap that spans the whole water depth. The movement of the flap drives two hydraulic pistons which push high pressure water onshore via a subsea pipeline to drive a conventional hydro-electric turbine. Aquamarine Power went into administration in November 2015 due to issues securing funding for further research and development.

2.2.3 Overtopping devices

Overtopping devices collect the water of incident waves to drive one or more low head turbines (Clément et al., 2002). Waves are focussed towards a ramp and into a reservoir elevated above the sea level, where the water is stored. The gathered water is then drained from the reservoir and the energy is extracted using low head turbines (Clément et al., 2002). Overtopping devices are the least common of all devices currently under development. The Wave Dragon is one of the most advanced overtopping devices (Figure 2.5) (Tedd and Kofoed, 2009). It uses a wave reflector design to direct the wave towards a reservoir (Clément et al., 2002).

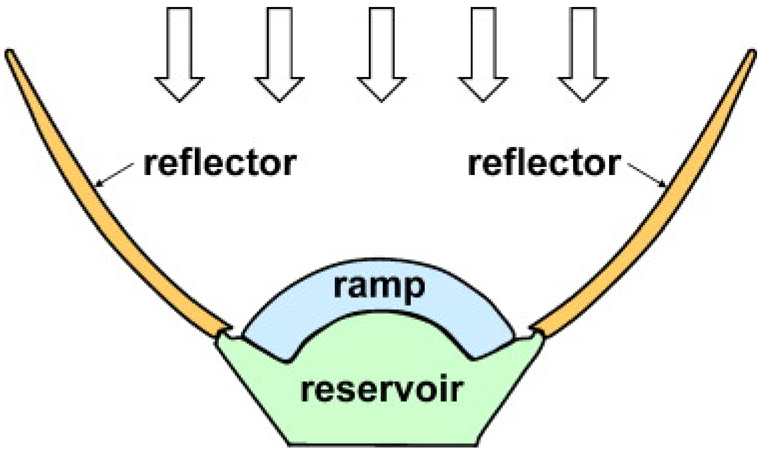

Figure 2.5. Plan view of Wave Dragon (Source: Falcão, 2010)

2.3 Tidal Energy

The viable tidal energy resource for the island of Ireland is estimated to be 0.92 TWh/year and this represents an estimated 2.18% of the electricity demand in 2010 (Sustainable Energy Authority Ireland, 2005). Figure 2.6 shows the average peak spring tidal currents for the island of Ireland. Tidal energy exploits the natural ebb and flow movements of tidal waters along the coast. As with wave energy research into the extraction of energy from tidal movement has seen an increase in interest over the last few decades. Tidal power can be classified into three generating methods. These are tidal stream/current generation, tidal barrage and tidal lagoon.

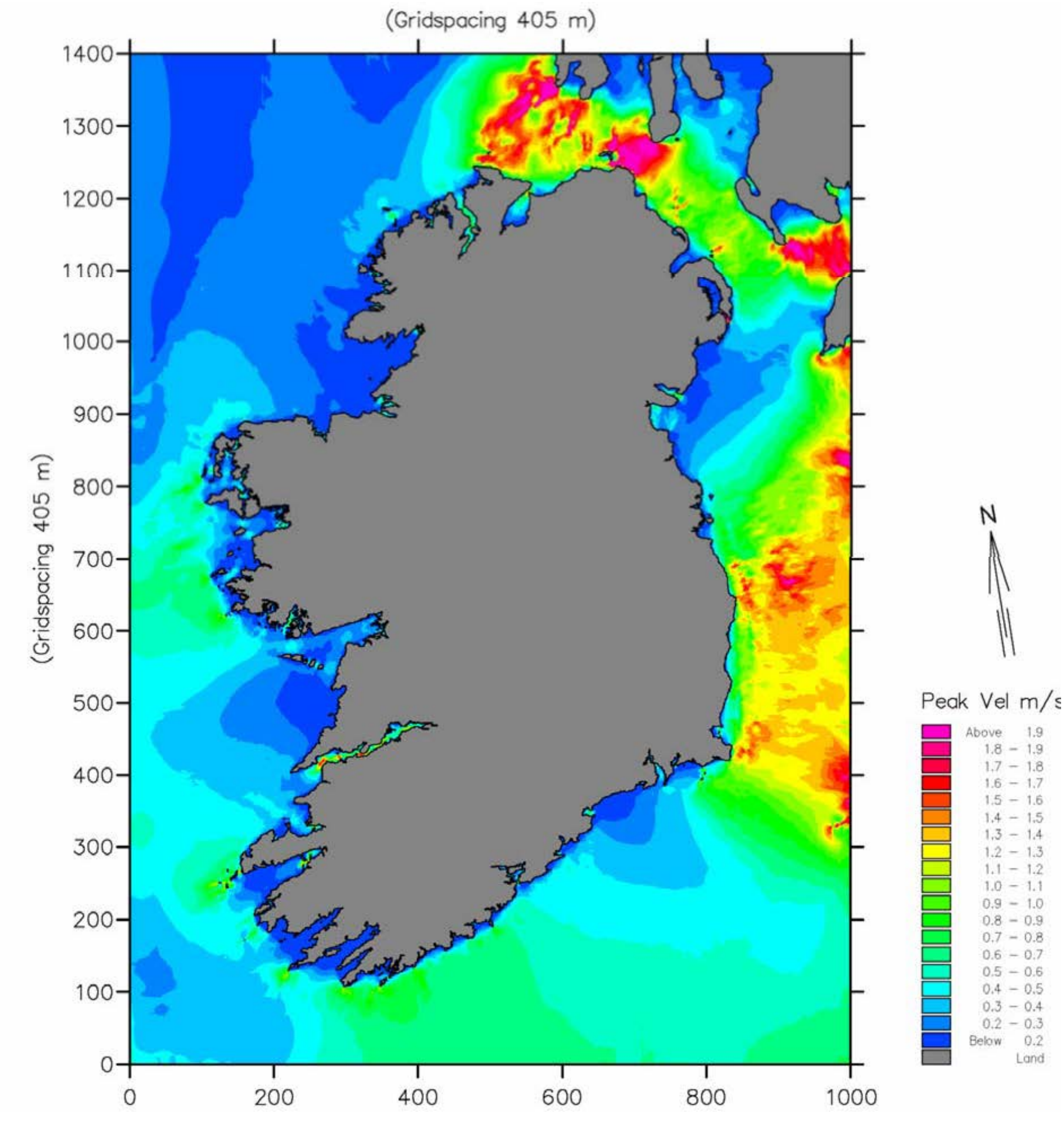

Figure 2.6. Depth average peak spring tidal currents (Source: Sustainable Energy Authority Ireland, 2005)

2.3.1 Tidal stream/ tidal current generation

Tidal current is the most common method of generating tidal power. As a basic principle of operation tidal stream technologies work by extracting some of the kinetic energy from flowing tidal currents and converting that kinetic energy to electricity (O'Rourke et al., 2009). Underwater turbines are used to generate electricity in a similar manner to standard wind turbines. These tidal turbines enable electricity to be generated during both ebb and flow tides. The two most common methods are horizontal axis tidal current turbines (where the turbine blades rotate on a horizontal axis which is parallel to the flow of water) and vertical axis tidal current turbines (where the turbine blades rotate on a vertical axis perpendicular to the flow of water) (Bryden et al., 1998).

Companies involved in the development of tidal current technology include Open Hydro which is based in Dublin and has a number of projects worldwide including Canada and France. The company is also developing a commercial project off the coast of Torr Head, Co. Antrim in Northern Ireland which will employ this technology. Further information is provided on this project in Chapter 3. Marine Current Turbines have also developed a prototype called the SeaGen which operates on the tidal current/stream principle. The device is the world’s first large scale tidal stream generator and the SeaGen technology has been tested at the narrows in Strangford Lough since 2008.

2.3.2 Tidal barrage

Tidal barrages make use of the potential energy of tides (O'Rourke et al., 2010). A tidal barrage is essentially a dam which is built across an estuary or bay that experiences a tidal range in excess of 5m. Electricity generation from tidal barrages is in principle similar to hydroelectric dams, with the exception that tidal currents flow in both directions. A typical tidal barrage consists of turbines, sluice gates, embankments and ship locks. The turbines that are used in tidal barrages are either uni-directional or bi-directional. The three methods of operation for generating electricity in a tidal barrage are ebb generation, flood generation and two-way generation. Tidal barrages can be categorised into two types; single basin and double basin tidal barrages.

The La Rance tidal power facility is the largest operating tidal barrage power plant in the world and is located at the estuary on the river Rance in Brittany, France (O'Rourke et al., 2010). For operation the facility uses a combination of two-way generation and pumped storage. There are also plans to develop a tidal barrage on the Severn Estuary, which holds the second highest tidal range in the world (Langston et al., 2007). However, proposals to develop on the Severn Estuary have been met with considerable opposition due to the potential for negative environmental impacts (Ballinger and Stojanovic, 2010).

Figure 2.7. La Rance tidal power facility

2.3.3 Tidal lagoon

Tidal lagoons generate electricity using a similar principle of operation to tidal barrages as outlined above. The Swansea Bay Tidal lagoon project plans to construct a tidal lagoon to harness the power of the Severn Estuary (Tidal Lagoon Power, 2016). The project intends to use submerged Kaplan bulb turbines with a total installed capacity of 320 MW. The Sihwa Lake Tidal Power Station is located approximately 4km from the city of Siheung in Gyeonggi Province of South Korea (Kim et al., 2012). The power station has an output capacity of 254 MW and is currently the largest tidal energy plant in the world.

2.4 Offshore Wind

Offshore wind is the most mature of the MRE technologies and is also the most standardised offshore energy device. Figure 2.8 shows the offshore wind energy resource in Ireland.

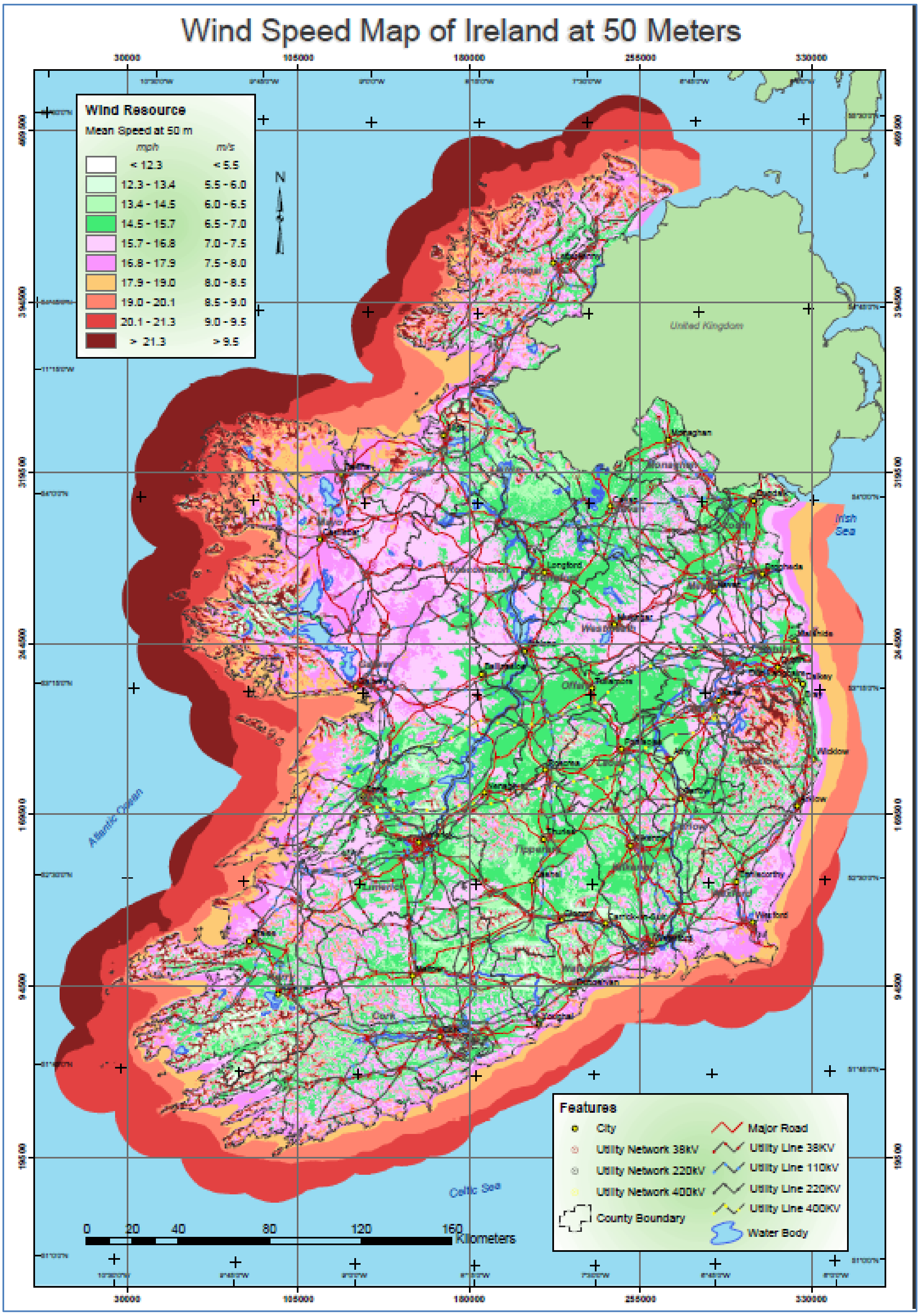

Figure 2.8. Wind Speed Map of Ireland (Source: Sustainable Energy Authority Ireland, 2003)

The world's first commercial offshore wind farm was built 2km off the coast of Vindby, Denmark in 1991. The farm consisted of eleven 450kW turbines. Europe is currently the world leader in terms of offshore wind with major projects off the coasts of the UK, Denmark, Belgium, and Germany. The world's largest operating offshore wind farm is the London Array which is located 20km from the Kent coast in the UK (London Array, 2016). The project commenced operation in 2013 and has an installed capacity of 630 MW.

The technology used is broadly similar to onshore wind turbines. In general, most modern offshore wind turbines comprise of a nacelle and three blades and the main rotor shaft is horizontally aligned. Arshad and O'Kelly (2013) provide a review of offshore wind turbine structures. The foundation concepts used for offshore wind turbines have been adopted from the oil and gas industry and can be broadly distinguished into two categories – fixed structure and floating structure.

2.4.1 Fixed structure offshore wind turbines

Fixed structure turbines are rigidly connected to the seabed through a foundation system whereas floating structure turbines have no rigid connection to the seabed (Arshad and O'Kelly, 2013). Fixed structures include gravity based structures, monopiles, tripods, jackets and braced frames. Monopiles are currently the most common substructure foundation system for offshore wind projects that are located in shallow inshore waters, usually depths of 40 metres or less. Monopiles consist of a steel tubular section which is embedded in the seabed. Braced support structures, such as tripods and jackets, are more suitable for deeper waters and heavier turbines (Arshad and O'Kelly, 2013). Tripods consist of a large-diameter central steel tubular section that is supported over its lower length by three braces which are fixed to the seabed. A range of different foundations can be used, such as gravity bases, suction buckets and piles. A jacket/braced frame structure is a lattice frame of small diameter steel struts that are anchored to the seabed using one of the foundation options.

2.4.2 Floating structure offshore wind turbines

As offshore wind projects are being developed in deeper waters, there is considerable interest in floating structure turbines. Floating systems are still in the early stages of research but once developed will be deployed in water depths of over 50 metres.

Floating systems require mooring systems to keep the device attached to the seabed. This type of structure includes tension leg platforms (TLP), spar buoys and buoys with suction anchors (Arshad and O'Kelly, 2013). Currently TLPs are considered the most economical. Spar buoys provide buoyancy to a wind turbine structure by a long cylinder that protrudes below the water line. The Hywind project is set to become the first floating offshore wind farm in the UK and the largest in the world and will have a capacity of 30 MW when completed (Energy Voice, 2016). The project will be developed by Statoil and will be located 15km from the coast in Peterhead, Scotland. Construction is due to commence in 2016 with a completion date set for 2017.

2.5 Policy and planning for MRE development in Ireland

A number of policies and plans exist which influence the development of MRE in Ireland. At a national level, the Irish government produced a White Paper on Energy for Ireland in 2015 which recognised ocean energy as one of the main research areas of focus to 2050 (Department of Communications Energy and Natural Resources, 2015). The document also outlines the actions necessary to achieve stakeholder involvement in the energy transition. This includes the establishment of a National Energy Forum to facilitate discussion on the future energy mix and transition. In the context of the marine environment, the policy document "Harnessing Our Ocean Wealth" was prepared by the Inter-Departmental Marine Co-ordination Group in 2012 (Government of Ireland, 2012). This is a roadmap of the Irish Government's vision, high-level objectives and integrated enabling actions across policy, governance and business to facilitate the realisation of Ireland's marine potential, including the expansion of commercial fisheries and MRE. The document specifies the implementation of the Offshore Renewable Energy Development Plan (OREDP). A Strategic Environmental Assessment (SEA) was carried out for the OREDP and the key findings of the SEA were used to inform the final preparation of the OREDP (AECOM et al., 2012). The OREDP was launched in 2014 to provide guidance for the future development of offshore wind, wave and tidal energy in the Republic of Ireland (Department of Communications Energy and Natural Resources, 2014). The plan outlines the key principles, policy actions and enabling actions required for the sustainable development of a MRE sector in Ireland.

The existing law and planning framework for ocean renewable energy development in Ireland has been described by O'Hagan and Lewis (2011). In Ireland there is no dedicated legislation for the development of ocean energy and as a result there is a reliance on existing foreshore, environmental and maritime jurisdiction legislation. The main legislation applicable to ocean energy development in Ireland are the Foreshore Acts, 1933-2011, the Electricity Regulation Act, 1999; the Planning and Development Acts, 2000-2010 and national legislation implementing EU instruments such as the Renewable Energy Directives, Environmental Impact Assessment (EIA) Directive, Strategic Environmental Assessment (SEA) Directive; and the Birds and Habitats Directives.

Under the Foreshore Acts, 1933-2011, the foreshore is defined as "the bed and shore, below the line of high water of ordinary or medium tides, of the sea and of every tidal river and tidal estuary and of every channel, creek and bay of the sea or of any such river or estuary". The outer limit for the foreshore area is defined as being 12 M (nautical miles). The first step for a MRE developer seeking to develop a site is to apply for a foreshore licence. Depending on the results of the site investigation works, a developer may subsequently apply for a foreshore lease. A foreshore lease is normally granted for developments that require exclusive occupation of the foreshore such as renewable energy developments. An Authorisation from the Commission for Energy Regulation (established under the Electricity Regulation Act, 1999) must be obtained by any developer constructing a new generating station prior to commencing work. An Electricity Generation Licence must also be held by a developer. The Planning and Development Acts, 2000-2010 prescribe the framework for terrestrial development works. Recent amendments to the Planning and Development Act, seek to modernise the planning system to further enable renewable energy development. The Planning & Development (Amendment) Act, 2010 provides that a county development plan shall include objectives for the provision of energy infrastructure.

Table 2.1 shows the main legal instruments regarding MRE, the responsible institution and the impact of each and is adapted from O'Hagan and Lewis (2011).

Table 2.1. Legal instruments in Ireland governing MRE development

Legal instrument	Responsible institution	Impact
Foreshore Acts, 1933-2011	Department of Housing, Planning, Community and Local Government	• Foreshore licence • Foreshore lease
Electricity Regulation Act, 1999	Commission for Energy Regulation (CER) Eirgrid ESB Networks	• Licence to generate and supply electricity • Authorisation to construct a substation • Grid connection
Planning and Development Acts, 2000-2015	Local Planning Authority or An Bord Pleanála	Planning permission for associated onshore works
EIA Directive – transposing legislation	Department of Housing, Planning, Community and Local Government	Environmental Impact Statement
SEA Directive – transposing legislation	Sustainable Energy Authority of Ireland (SEAI)	Environmental Report and SEA statement
Habitats and Birds Directives - transposing legislation	National Parks and Wildlife Service (NPWS)	Natura Impact Statement

Above the Mean High Water Mark, the Planning and Development Acts, 2000-2015 apply, primarily for the control of terrestrial planning though section 225 of the 2000 Act specifically covers adjoining foreshore.

2.5.1 Environmental Impact Assessment

The EIA Directive applies to the assessment of the environmental effects of public and private projects which are likely to have significant effects on the environment. An EIA is mandatory for wind farms with more than 5 turbines or having a total output greater than 5 MW (Planning and Development Regulations 2001, Schedule 5, Part 2, 3(i)). As a matter of policy, to date, Irish authorities have usually required the submission of an EIA for any development requiring a foreshore lease. Specific statutory instruments, i.e. the Foreshore (EIA) Regulations 1990; European Union (EIA) (Foreshore) Regulations 2012, EU (EIA and Appropriate Assessment) (Foreshore) Regulations 2014; transpose the provisions of the EIA Directive into the Foreshore Acts and associated consenting system. An EIA must also be undertaken for onshore works such as the construction of overhead electrical power lines transmitting electricity of 220kV or more and longer than 15km (Planning and Development Regulations 2001, Schedule 5, Part 1 (20)). An EIA may also be necessary where the Minister considers that the development would be likely to have significant effects on the environment.

Prior to completion of an EIA a developer is advised to consult at an early stage, with all the relevant regulators and parties likely to be affected by the project. Organisations that may need to be consulted according to section 3 of the Foreshore Regulations 2011 include Fáilte Ireland (national tourism development authority), An Taisce (the National Trust for Ireland), the National Parks and Wildlife Service, Bord Iascaigh Mhara (BIM) (Irish Sea Fisheries Board), the CER, Planning Authorities, Irish Aviation Authority, local Harbour Boards, local Chambers of Commerce, Bord Gáis Éireann as well as a number of interested Non-Governmental Organisations (NGOs). Applications for consent under the Foreshore Acts are the subject of a public notice in the local newspapers and, additionally, in the national press, for larger projects (Section 3(3)(a), EU (EIA) (Foreshore) Regulations 2012). This public notice informs the public that an application has been made and where the application documentation can be viewed. The ability of the public to participate in the consenting process is legally prescribed through EIA legislation. EIA documentation is made available at the local library. Individual applications are increasingly made available on the website of the regulatory authority, which is the Department of Housing, Planning, Community and Local Government. Larger projects often create a project specific website and undertake local outreach events. Public submissions on the application can be made, normally within four weeks of the date of publication of the public notice.

The Environmental Impact Statement (EIS) for AMETS covers impacts on commercial fishermen under the section on material assets (Electricity Supply Board International, 2011). The EIS recommends that impacts can be reduced through careful planning and continual engagement with stakeholders regarding the timing of operations. Economic losses to the fishing community could potentially be offset by the creation of new marine habitats and nursery areas as a result of the exclusion of fishing at the test sites.

2.6 European Union Framework

At the EU level there are also a number of legal instruments and policies that influence the development of MRE and the commercial fishing sector in Ireland. These include the Integrated Maritime Policy (IMP) (COM/2007/575) and associated sea basin strategies, Integrated Coastal Zone Management (ICZM), Maritime Spatial Planning (MSP) (2014/89/EU) and the Blue Growth strategy (COM/2012/494). These initiatives attempt to address increased marine activity and the resultant competition for sea space and also balance economic development and conservation of the marine environment.

The IMP seeks to provide a more coherent approach to maritime issues, with increased co-ordination. It focuses on issues that do not fall under a single sector based policy and issues that require the co-ordination of different sectors and actors. The goals and key actions set out in Harnessing Our Ocean Wealth (HOOW) are in line with the EU's IMP. One stated key action of Harnessing Our Ocean Wealth is the "development of an appropriate Maritime Spatial Planning Framework for Ireland within which the scope and objectives of an overarching national Marine Spatial Plan will be defined". MSP is a public process for planning when and where human activities take place at sea in order to ensure that these are as efficient and sustainable as possible. MSP is a means of improving decision-making and delivering an ecosystem-based approach to managing human activities in the marine environment (Ehler and Douvere, 2007). The ultimate aim of maritime spatial planning is to draw up plans to identify the utilisation of maritime space for different sea uses. Under the MSP Directive Ireland must draw up a national maritime spatial plan by 2021. A significant number of preparatory studies have been conducted on the future implementation of MSP in Ireland, both through government initiatives such as the

Enablers Task Force created as part of the implementation of HOOW and through research projects (CSP, TPEA, SIMCelt). No maritime spatial plans have yet been published for Irish waters.

ICZM is a tool for the integrated management of all policy processes affecting the coastal zone, addressing land-sea interactions of coastal activities in a co-ordinated way with a view to ensuring the sustainable development of coastal and marine areas. This is pertinent for MRE as the development of projects will have interactions with both the land and sea, for example cables coming from offshore turbines and devices to onshore substations. ICZM seeks to ensure that management or development decisions are taken coherently across sectors.

The Blue Growth strategy seeks to develop emerging marine sectors that have a high potential for job creation and growth. This includes ocean energy (wave and tidal energy), aquaculture, coastal tourism, blue biotechnology and seabed mining. It has been noted that there may be some conflict between the growth agenda and the conservation agenda in the context of MSP (Qiu and Jones, 2013). The study also notes that it is uncertain if these conflicts can be "planned away" through MSP.

In addition to the instruments mentioned above, the EU Low Carbon economy Roadmap suggests that by 2050 the EU should cut emissions to 80% below 1990 levels (COM/2011/112). The communication outlines that in order to achieve this, increasing the share of renewable energy is crucial and significant investment should be made in new low carbon technologies and renewable energy. The Strategic Energy Technology (SET) plan aims to accelerate the development and deployment of cost-effective low carbon technologies and builds on an extensive programme for research, development and demonstration of low carbon technologies (COM/2007/723).

Table 2.2 summarises the policy measures in place which are relevant for the interactions of MRE and commercial fishing.

Table 2.2. Relevant policies and responsible department

Policy	**Responsible department in Ireland**
Low Carbon Roadmap	Department of Communications, Climate Action and Environment
SET Plan	Department of Communications, Climate Action and Environment
Harnessing our Ocean Wealth	Government of Ireland with Marine Institute as secretariat
Integrated Maritime Policy	Department of Foreign Affairs, Marine Coordination Group
Integrated Coastal Zone Management	Department of Housing, Planning, Community and Local Government
Maritime Spatial Planning	Department of Housing, Planning, Community and Local Government
Blue Growth	Marine Coordination Group

2.7 Commercial Fishing in Ireland

Commercial fishing remains one of the most significant ocean uses in Irish waters and is an important contributor to the local and national economy in terms of employment, income and GVA. On average, more than 1,000 fishing vessels are active within Ireland's Exclusive Economic Zone (EEZ) each day which amounts to over 8 million fishing hours per year (Gerritsen and Lordan, 2014). Most of the seabed around Ireland is trawled at least once per year and some regions are trawled more than 10 times per year (Gerritsen et al., 2013). In 2010, the Republic of Ireland fishing fleet comprised 2,119 vessels with a total capacity of 70,800 tonnes (Scientific Technical and Economic Committee for Fisheries, 2012). Fishing in Ireland is a diverse sector with a wide range of vessel sizes using a variety of gear types. The Irish otter trawl fleet alone can be divided into 33 distinct fisheries, each using a different fishing technique or targeting different species or groups of species (Gerritsen and Lordan, 2014). Otter trawling is one of the most commonly used fishing techniques in Irish waters. It consists of a large net being dragged by a fishing vessel along the seabed or higher up in the water column behind. The extent of the impact associated with the development of MRE projects in Ireland will likely vary depending on the gear type used by the vessel. As such it is important to distinguish between gear types and a common distinction is mobile and static fishing gear. Mobile gear refers to fishing gear that is dragged through the water or on the seabed and includes trawl and dredge nets. Static gear is gear that remains stationary and includes pots and creels. It is also important to note that each of the technologies described in Sections 2.2, 2.3 and 2.4 will have different potential impacts on mobile fishing gear. Table 2.3 provides a summary of the different potential impacts of loss of access on different types of fishing activity for each technology and suggested mitigation options.

Table 2.3. Impacts of MRE technologies on fishing gear types

	Wave	**Tidal**	**Offshore wind**	**Potential Mitigation**
Static gear	Loss of access	Loss of access	Loss of access	Consultation
	Displacement	Displacement	Displacement	Compensation
Mobile gear	Loss of access	Loss of access	Loss of access	Consultation
	Displacement	Displacement	Displacement	Compensation
	Gear damage	Gear damage	Gear damage	Compensation
	Safety issues	Safety issues	Safety issues	Exclusion zone

Fishing communities are distributed around the coast of the Republic of Ireland, centred particularly on the six major fishing harbours of Killybegs, Co. Donegal, Ros a Mhil, Co. Galway, Dingle, Co. Kerry, Castletownbere, Co. Cork, Dunmore East, Co. Waterford and Howth, Co. Dublin (Gerritsen and Lordan, 2014). With over 100 kilotonnes (kt) per year, Killybegs is the busiest port in terms of the weight of fish landed by a considerable margin. Pelagic species make up the majority of landings in Killybegs but it is also the largest port for demersal species. Pelagic species refer to fish that inhabit the water column below the surface of oceans and coastal areas. Demersal fish species are found on or near the seabed. Castletownbere is the the second-largest port in terms of landings with around 19 kt per year, followed by Dingle with 10 kt per year. The majority of landings into these ports are demersal species but pelagic species also account for around one third of the landings. Ros a Mhil is the main port servicing the west of Ireland and receives a mix of pelagic, demersal and shellfish species. There are also a significant number of smaller ports along the south coast of Ireland which receive a mix of pelagic, demersal and shellfish species. The main species landed into ports on the east coast is Nephrops, or prawns. In terms of weight, landings at Irish ports are dominated by pelagic species such as horse mackerel, mackerel, boarfish, blue whiting and herring. In terms of value, mackerel, horse mackerel, Nephrops, anglerfish and hake account for the most important fish species landed into Irish ports. Although larger vessels using mobile gears account for the majority of weight and value of landings at the six major fishing harbours, there are also a significant number of smaller vessels that operate from these ports, and particularly smaller ports, that fish for crab and lobster using static gear (pots, creels, etc.) (Gerritsen and Lordan, 2014). A recent report by the Socio-Economic Marine Research Unit (SEMRU) in NUI Galway provided a profile of the contribution of the fishing industry to Ireland's ocean economy, in terms of Gross Value Added (GVA), turnover, exports and employment levels (Vega et al., 2014). Ireland had fish landings valued at €241.5 million in 2012 and the sector contributed an estimated €178.2 million in GVA to the Irish economy in 2012. Employment in sea fisheries was at 2,233 full time equivalent (FTE) jobs in 2012. The sector is in a relatively stable condition as all of the indicators mentioned have increased since 2010 (Vega et al., 2013). Challenges facing the industry include reductions in fishing quotas and limits placed on days spent at sea.

The main fish producers organisations (FPO) in the Republic of Ireland are the Killybegs Fishermen's Organisation (KFO), the Irish Fish Producers Organisation (IFPO) and the Irish South and West Fish Producers (ISWFPO). The KFO is the largest of the FPOs and was founded in 1979. It is based in Killybegs, Co. Donegal but has members from all over the Irish coast. The IFPO was formed in 1975 and represents owners of commercial fishing vessels of all sizes coast wide. The ISWFPO was established in 1995 and represents fishermen in the south and west coast of Ireland. In addition to these FPOs a number of smaller organisations exist around the coast representing local fishing vessels. The Federation of Irish Fishermen (FIF) is the umbrella organisation for these three organisations and was founded in 2006 to provide a unified input from the Irish fishing industry into policy and decision-making both nationally and internationally. The FIF currently represents over 90% of the Irish fishing fleet and participates in extensive lobbying on behalf of members. The commercial fishing industry in Ireland is supported by Bord Iascaigh Mhara (BIM), the Irish Sea Fisheries Board. BIM’s aim is to develop the Irish seafood industry and create sustainable employment. The industry is regulated by the Sea Fisheries Protection Authority (SFPA). The SFPA promotes conservation of fisheries to ensure the resource is being used sustainably.

Below are a number of maps that show the fishing effort in Ireland. This includes spatial details on the gear types used and the main fish species targeted.

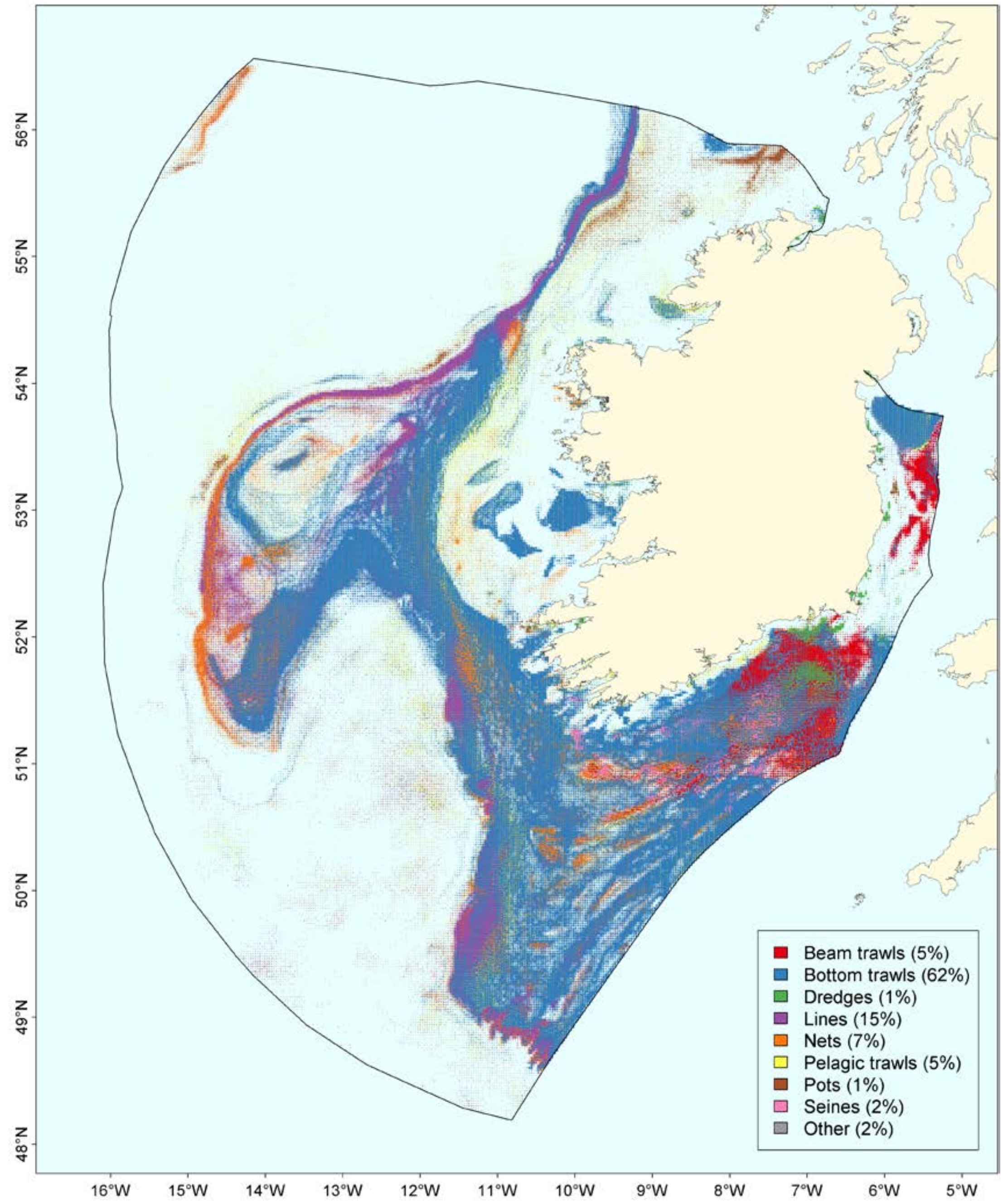

Figure 2.9. Fishing gear used by vessels 15m and over in the Irish EEZ (Source: Gerritsen and Lordan, 2014)

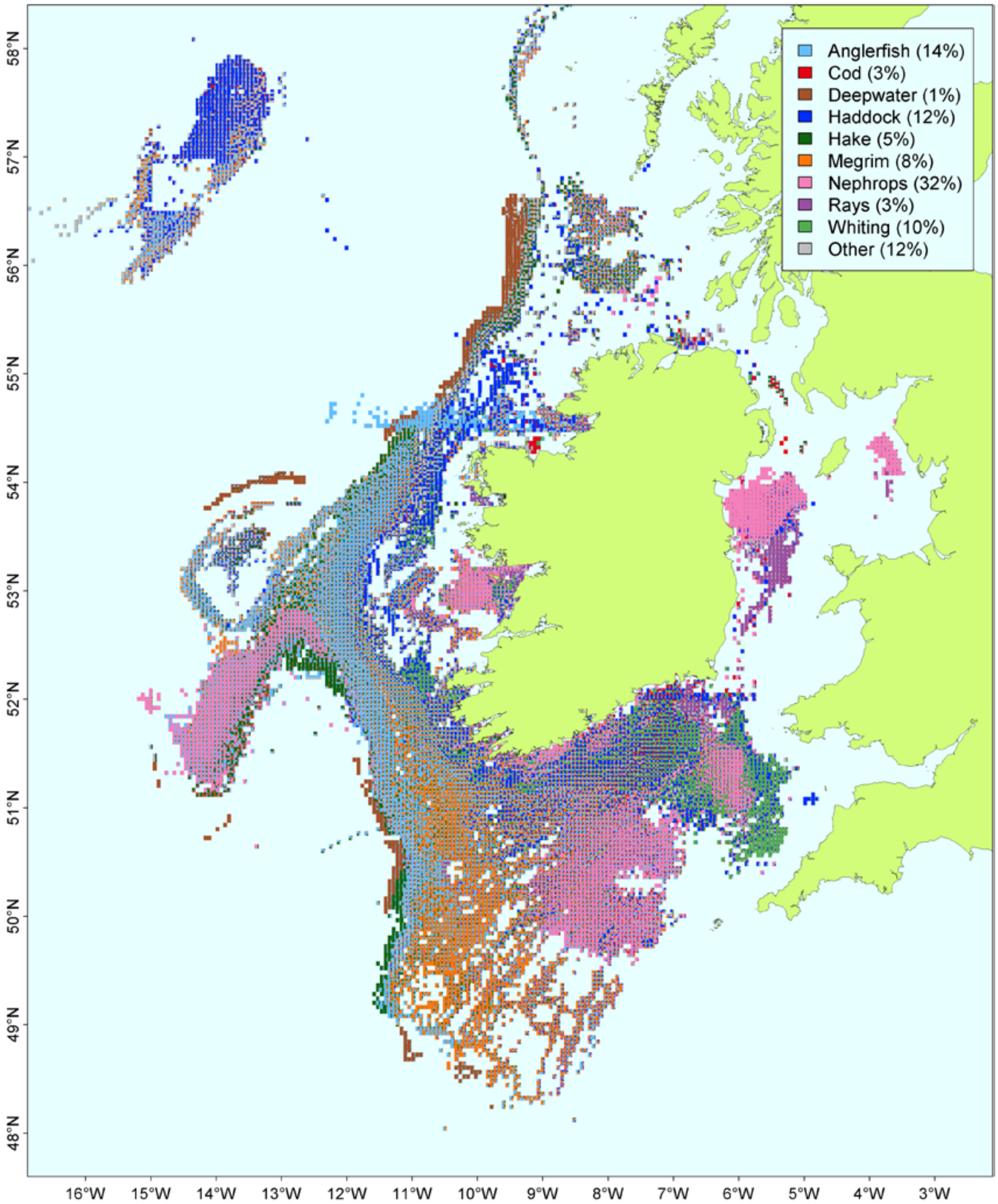

Figure 2.10. Demersal otter trawl vessels 15m and over landing into Ireland (Source: Gerritsen and Lordan, 2014)

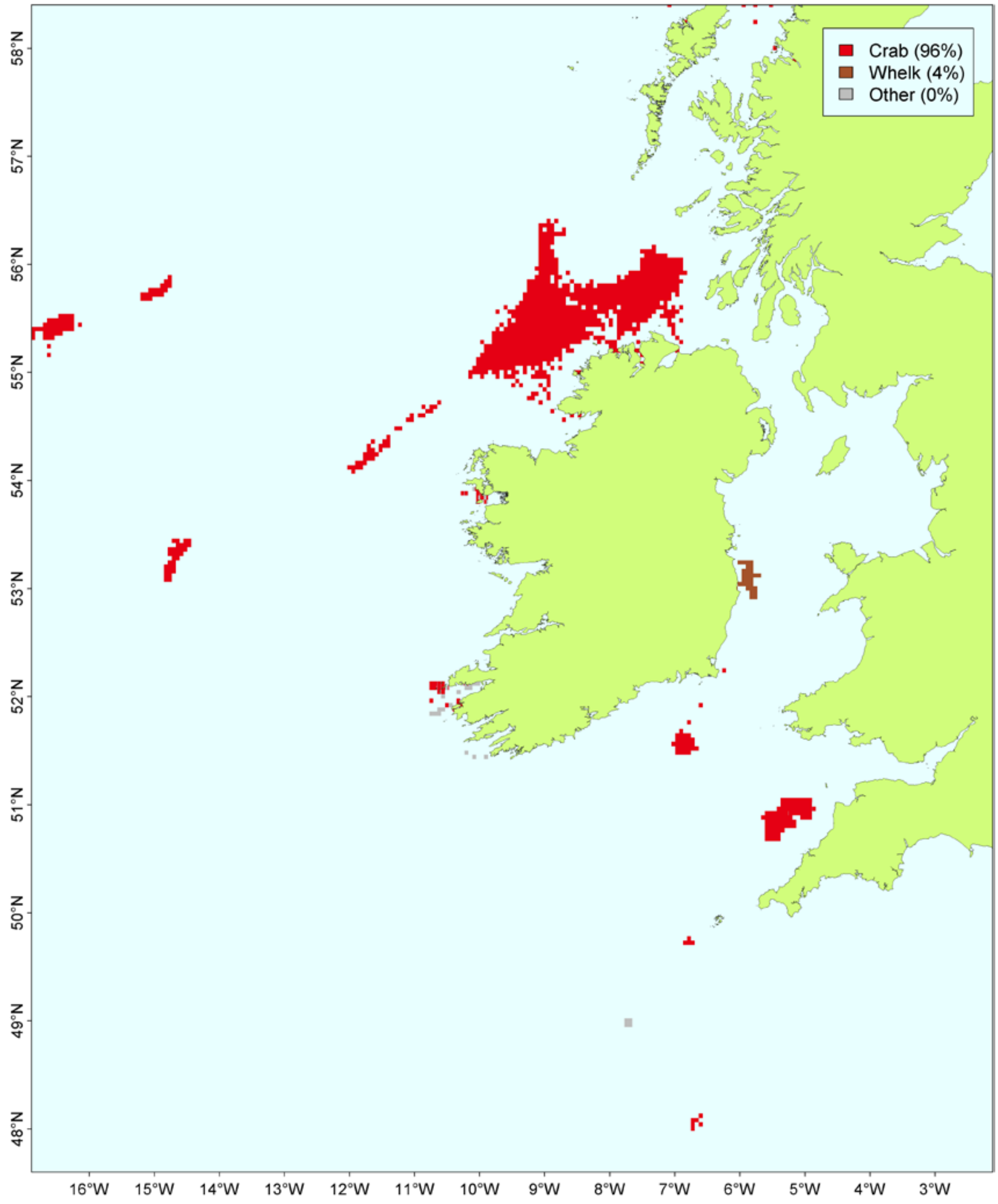

Figure 2.11. Potting effort for vessels 15m and over landing into Ireland (Source: Gerritsen and Lordan, 2014)

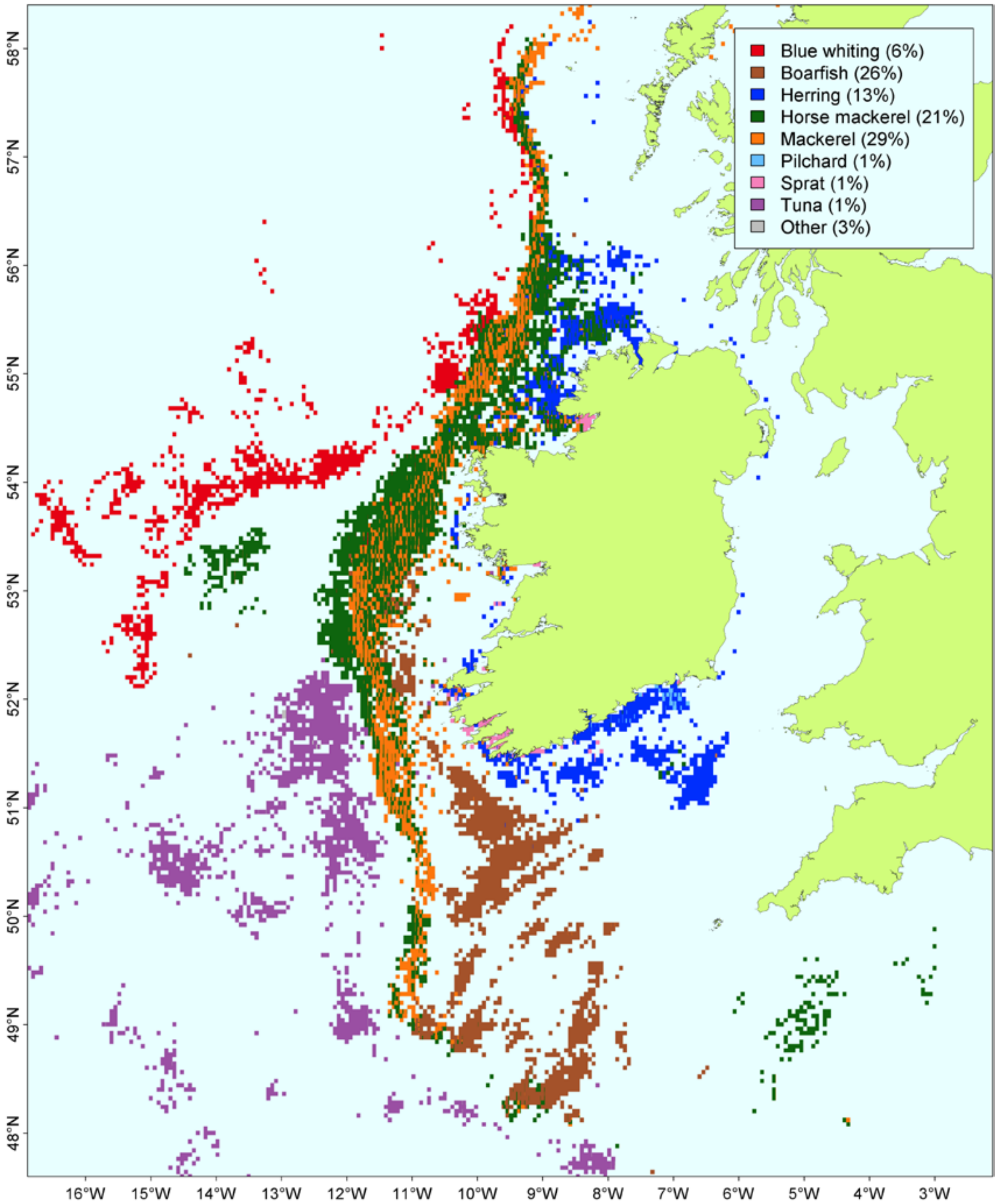

Figure 2.12. Pelagic trawl effort (Source: Gerritsen and Lordan, 2014)

2.8 Attitudinal studies and stakeholder perceptions of impacts and opportunities

Although public attitudes and perceptions are often classed as non-critical barriers to MRE projects, public acceptability is a crucial element in the successful development of MRE and other energy infrastructure projects. The literature on public attitudes towards energy projects in general and towards renewable energy, particularly onshore wind farms, is extensive. However, the literature on the attitudes and perceptions of the general public and stakeholders towards MRE, particularly wave and tidal energy, is limited. This is due, in part, to the fact that there is low public awareness of the emerging sectors relative to other sources of renewable energy. The literature that does exist has tended to focus on case studies and these are reviewed in detail in this section. These include studies from the UK on the SeaGen project in Strangford Lough, Northern Ireland (Devine-Wright, 2011a, Devine-Wright, 2011b), and Wave Hub (Bailey et al., 2011, McLachlan, 2009). Fernández Chozas et al. (2010) used a case study approach to recommend best practices for the acceptability of wave energy projects. Projects studied included the Seawave Slot-Cone Generator wave energy pilot project off Kvitsoy Island, Norway, the Wave Dragon demonstration site in Pembrokeshire in the UK and the proposed Ocean Energy Test Berths that were considered by the Northwest National Marine Renewable Energy Centre (NNMREC) off the coast of Newport, Oregon, USA. Stevanovich et al. (2010) examined the issues that developers need to address to enhance public acceptance of wave energy based on three case studies. These are the Mutriku pilot plant in Bilbao, Spain, the Douglas Wave and Tidal Energy Project in Oregon, USA and the Columbia Energy Partners preliminary investigations into deploying wave energy convertors in Tillamook County, Oregon, USA. A further study from the US investigated the public perceptions of wave energy development on the Oregon Coast (Hunter, 2009). Bronfman et al. (2012) studied the social acceptance of electricity generation sources, including tidal energy. Ladenburg and Möller (2011) investigated public attitudes and acceptance of offshore wind farms and the influence of experience and travel time on attitudes. These studies mainly examine the public as a whole but do not address specific stakeholder groups that are likely to be impacted by the development of MRE. Relatively few studies focus on the attitudes of fishermen specifically. Mackinson et al. (2006) carried out a one year study on the views of fishermen towards offshore wind farms in three strategic areas around the UK – the Thames Estuary, the Greater Wash and the North West coast of England and Wales. Both qualitative and quantitative approaches were used in two studies on the attitudes of fishermen on the west coast of Scotland towards the development of MRE energy (Alexander et al., 2013a, Alexander et al., 2013b).

Many theories exist on public attitudes and perceptions towards the development of projects. One of the main theories used to explain public attitudes towards new developments is the “Not In My Back Yard” (NIMBY) concept from the point of view of the local community or individuals within a particular community. With regard to renewable energy, NIMBYism suggests that the public are largely supportive of the concept of renewables in general but will oppose the development of projects in their locality. Over the last number of years, the literature has been critical of this concept and has moved away from using this theory to explain behaviour. It has been criticised as it simplifies complex and often legitimate concerns the public may have towards development in their area (Warren and Birnie, 2009) and implies that selfishness is the main underlying reason for opposition (Kempton et al., 2005). Both McLachlan (2009) and Devine-Wright (2011a) use interpretations associated with different places and technologies to explain public attitudes to wave (Wave Hub) and tidal (SeaGen) energy projects. Both of these studies refer to “place attachment” and place-related symbolic meaning as having a significant influence on public attitudes towards energy projects. Place attachment can be described as a “positive emotional connection with familiar locations such as the home or neighbourhood” (Manzo, 2005). Stakeholder opposition can be viewed as a form of “place-protective action” and may arise when a renewable energy development is perceived as a threat to place related identity processes (Devine-Wright, 2011a). Many fishermen have family backgrounds in fishing and would have strong links to the sea that span generations. Accordingly, fishing could be viewed as much more than a job but rather part of their cultural identity and heritage and consequently place attachment is likely to be quite strong. Place attachment could also be a positive force for the development of MRE and could foster support for projects if there are positive benefits for community members. Devine-Wright et al. (2011a) found that place attachment was a positive indicator of acceptance of the SeaGen tidal project and that the project enhanced place attachment. Similarly, Alexander et al. (2013b) claim that stakeholder engagement which fosters positive place attachment, relating to a MRE development could indeed be an effective mitigation strategy.

Despite general support for renewable energy projects in the literature it has been noted that attitudes may change to opposition towards specific individual projects (Fernández Chozas et al., 2010). Following a review of studies on attitudes towards the development of renewable energy, Wolsink hypothesised that attitudes follow a U shaped curve (Wolsink, 2007). Wolsink’s theory states that initial support for renewables is high, and then decreases as a project is announced and may turn to opposition, and finally becomes positive again after a period of time when the project becomes established. Figure 2.13 illustrates Wolsink's U shaped curve.

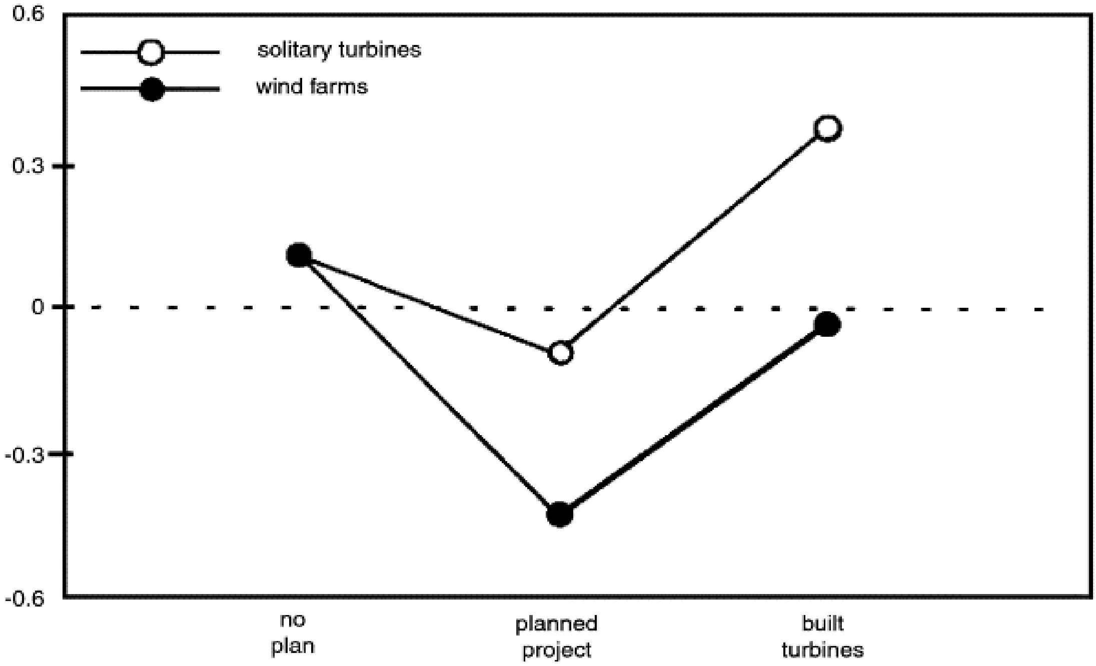

Figure 2.13. Wolsink's U shaped curve (Source: Wolsink, 2007)

Alexander et al. (2013b) conducted a postal survey to investigate fishers' attitudes towards offshore renewable energy and any influential factors in terms of fishing experience and practice, association membership, location, and knowledge of offshore renewable energy installations. Despite concerns regarding the perceived impacts of projects the majority of fishers held either neutral or positive attitudes towards offshore renewable extraction. The most import factor influencing fishermen's opinions was knowledge of a nearby offshore development, followed by their location, (whether they operate from the mainland or the islands). However, the study noted that this support may be due to the fact that fishermen are in the early stages of Wolsink's curve. This is supported by other studies that found that attitudes towards wave and tidal energy projects may change as the technologies mature (McLachlan, 2009, Whitmarsh et al., 2011). Attitudes are also likely to be influenced by familiarity and experience with technologies. Following a review of studies on local attitudes towards onshore and offshore wind projects, prior experience of wind turbines was found to be a significant determinant of individual attitude towards wind farms in many cases (Ladenburg and Möller, 2011).

The development of MRE may be viewed in a positive manner by those stakeholders with global concerns about energy and the environment (McLachlan, 2009), however local stakeholders may view the more immediate impacts as a threat to their livelihood (Hunter, 2009). The attitudes of fishermen towards MRE are likely to be influenced by their perceptions of the extent of the impacts and opportunities for them. Support among local stakeholders could be enhanced if impacts on existing activity are minimal or if projects provide fishermen with opportunities to pursue additional sources of income, for example, fishermen using wave energy devices to harvest mussels. It has been suggested that, if appropriately managed and designed, MRE devices may increase local biodiversity and potentially benefit the wider marine environment by acting as artificial reefs (Inger et al., 2009). It has also been documented that the installation of offshore wind turbines can help create habitats by providing new ecological space through the physical presence of devices (Wilson and Elliott, 2009). MRE devices and the extensive mooring systems used on their foundations have the potential to act as a fish aggregating device and thus serve as a fish sanctuary (Witt et al., 2012). Such positive impacts have the potential to rebuild depleted stocks and although there are likely to be exclusion zones around devices the spill over effect of increased stocks onto fishing grounds could benefit fishermen in the longer term.

Some of the other impacts are likely to have a negative influence on attitudes of fishermen. As mentioned, the impacts of the development of MRE on fishermen may include the complete loss or restricted access to traditional fishing grounds during construction, operation and decommissioning; displacement of fishing activity; safety issues for vessels and obstruction as a result of construction work (Perry and Smith, 2012). Loss of access to traditional fishing grounds may result in the displacement of fishermen. Displacement of fishing activity would not only have a direct effect on fishermen but could also potentially increase pressure on other fishing grounds. In a study on the perceptions of fishermen towards offshore wind farms in three strategic areas around the UK, the development of offshore wind was viewed as a threat to their livelihood (Mackinson et al., 2006). Displacement from established fishing grounds was a major concern and very few fishermen believed that offshore wind presented opportunities for them. Alexander et al. (2013b) found that fishermen on the west coast of Scotland viewed loss of access to fishing grounds as the main potential impact on them, followed by displacement and habitat destruction. Concerns over these potential impacts could lead to opposition which could hinder the development of projects. As a point of example, in 2009, Columbia Energy Partners (CEP) investigated the possibility of deploying wave energy converters (WECs) in Tillamook County, Oregon. Objections to two of the sites identified by CEP for potential development came mostly from the fishing community (Stefanovich and Fernández Chozas, 2010). Commercial fishermen had concerns over loss of access, displacement of fishermen, navigational hazards, impacts on fish and aesthetics. CEP eventually abandoned its plan to deploy WECs citing the inability to reach a consensus with the local fishing groups as a major influencing factor in their decision (Stefanovich and Fernández Chozas, 2010).

2.9 Stakeholder engagement and the consultation process

It has been noted that overcoming non-technical barriers to the development of MRE will involve informing, consulting and engaging with the public and stakeholders (Gray et al., 2005). In a leading case from 1986 on the meaning of consultation, R v Secretary of State for Social Services ex p Association of Metropolitan Authorities, consultation was defined as “the communication of a genuine invitation to give advice and a genuine consideration of that advice”. In addition to this, the judge stated that, “sufficient information must be supplied by the consulting party to enable it to tender helpful advice. Sufficient time must be given by the consulting to the consulted party to enable it to do that, and sufficient time must be available for such advice to be considered by the consulting party”. Effective consultation and stakeholder engagement is seen as a means of overcoming some of the non-technical barriers to the development of MRE and is key to the successful development of projects. Early consultation and discussion could reveal opportunities to minimise impacts on the fishing industry through selecting areas for development that are of lower fishing importance (Blyth-Skyrme, 2010) and as such is an important mitigation option. Consultation was perceived to be a major mitigation option for the development of MRE among fishermen surveyed and interviewed on the west coast of Scotland (Alexander et al., 2013a, Alexander et al., 2013b). Studies have found that effective and genuine consultation can enhance acceptance and support and yield trust (Haggett, 2008, Kempton et al., 2005).

For engagement to be effective it requires the involvement and participation of stakeholders in the decision-making process. Adequate stakeholder consultation which results in participation is a key ingredient of good governance and is often stated as vital for a successful planning process (Brody, 2003). Participation can be defined as “direct involvement by residents in plan making beyond that of formal consultation, i.e. facilitating citizens with an opportunity to influence the planning process” (Breukers and Wolsink, 2007). Arnstein (1969) created a ladder of citizen participation in an attempt to measure the extent of public participation in decision-making (Figure 2.14). The ladder consists of eight steps including manipulation, therapy, informing, consultation, placation, partnership, delegated power and citizen control. The first two steps, manipulation and therapy refer to non-participation. The middle rungs of the ladder represent different degrees of “tokenism”. Consultation processes which provide information to the public or generate information for decision-makers would be defined as tokenism in Arnstein’s framework, because they fail to deliver stakeholder control over policy. When information is merely disseminated to stakeholders they may become cynical and withdraw. The final three steps in Arnstein’s ladder are partnership, delegated power and citizen control and refer to degrees of citizen power.

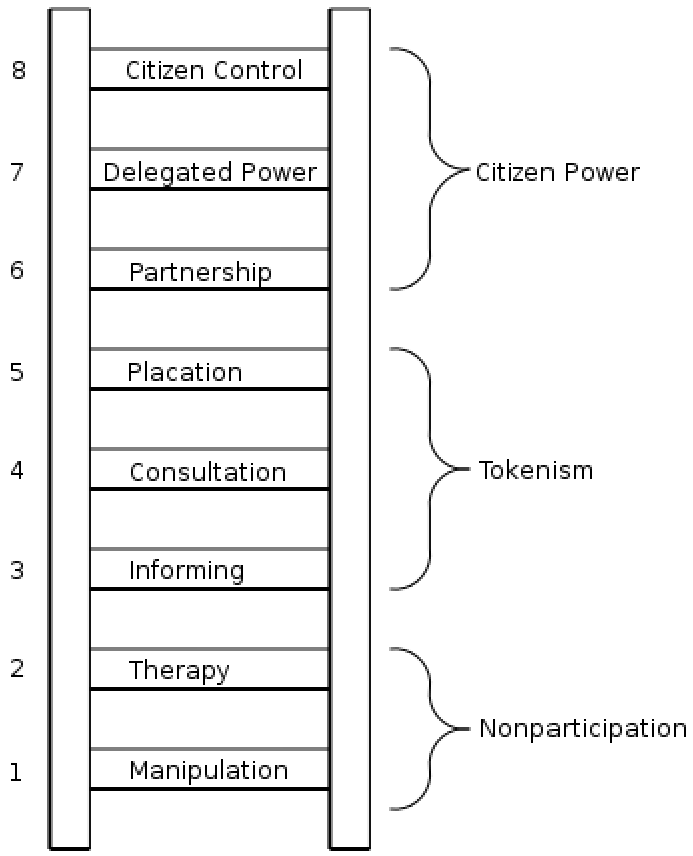

Figure 2.14. Arnstein's ladder of participation (Source: Arnstein, 1969)

The literature on Environmental Impact Assessment (EIA) and engagement with the public shows that stakeholder participation is highly beneficial and that a key challenge for policy makers and planners is to make it more effective (O'Faircheallaigh, 2010). At the EU level, both the EIA Directive (85/337/EEC) and the Strategic Environmental Assessment (SEA) Directive (2001/42/EC) requires formal public consultation with those stakeholders "affected or likely to be affected by, or having an interest in, the environmental decision-making procedures for consent to projects". The EIA Directive was amended in 2005 to align the provisions on public participation in decision-making with the Aarhus Convention (2003/35/EC). Among the objectives of the Aarhus Convention is to guarantee rights of public participation in decision-making in environmental matters in order to contribute to the protection of the right to live in an environment which is adequate for personal health and well-being. Under the EIA Directive developers are required to ensure effective public participation in the taking of decisions enables the public to express, and the decision-maker to take account of, opinions and concerns which may be relevant to those decisions. The aim of this is to increase the accountability and transparency of the decision-making process and contributing to public awareness of environmental issues and support for the decisions taken. Formal consultation processes provide a platform for the participation of fishermen in decisions on MRE projects which may affect them and is one of the key ways in which fishermen can influence decision-making. A number of existing studies have cited the advantages of involving stakeholders in decisions which may impact them as well as recognising the importance of their involvement (Beierle, 2002, Brody, 2003, Reed et al., 2008). Involving fishermen in key decisions can help to resolve, or even avoid conflicts, establish trust and enhance the acceptance of management policies and decisions (Pita et al., 2010). For the Wave Dragon pilot project in Pembrokeshire, engagement with the local fishing community helped to ease concerns over loss of sea space for potting and other static gear (Fernández Chozas et al., 2010). This resulted in the fishing community supporting the project. In addition to this the Marine and Fisheries Agency (now the Marine Management Organisation) praised the Wave Dragon team for their work on communication and engagement with local fisheries (Russell and Soerensen, 2007).

Despite the obvious advantages of engaging stakeholders and involving fishermen in decisions which may impact them, there is evidence that the process is not entirely effective in achieving this. Gray et al. (2005) conducted a qualitative study on stakeholder consultation of fishermen on offshore wind farms in the UK. The paper focussed on a number of issues including the adequacy of the stakeholder consultation processes, concluding that offshore wind farm development would be better managed if stakeholder consultation was more extensive. Pita et al. (2010) investigated the perceptions of commercial inshore fishermen of their level of participation in the fisheries management decision-making process. Three levels of participation were examined – informed, consulted and involved. Face to face surveys were conducted in order to identify which characteristics influence fishers' perceptions and attitudes towards Inshore Fisheries Group (IFGs) which aim to increase participation in decision-making and management. The analysis concluded that the majority of inshore fishermen perceived themselves not to be consulted or involved in the decision-making process and there was uncertainty over the potential of the IFGs to increase their participation in the management process.

A small number of studies have made recommendations to improve the effectiveness of the consultation process. Following a review of empirical and theoretical research, Portman et al. (2009) recommended the development of a framework for further analysis on involving the public in the impact assessment of offshore renewable energy facilities. The framework consisted of five main features: effective communication, broad based inclusion, prioritisation, early three way learning and alternatives analysis. Effective communication involves engaging clearly, fully and on a level that is understood by participants. Inclusion refers to identifying all members of the public who may have concern about a proposal and actively recruiting them to take part in the scoping process. Prioritisation refers to the role that the public can play in identifying priorities, a step conducted during scoping. Early three way learning consists of knowledge that can be gained through participation that can be used to improve EIA and includes local stakeholder knowledge, expert knowledge and knowledge from previous or parallel EIA experience. Alternatives analysis suggests that alternatives should be identified and considered during scoping. The framework also stresses the importance of the participation of stakeholders in decision-making. Based on a case study of the Firth of Forth offshore wind farm, O'Keeffe and Haggett (2012) noted that opposition from the fishing industry is likely to be one of the main barriers to the development of offshore wind energy in Scotland. This study also noted that the onus lies with the developer to initiate the engagement process with fishermen, using an approach which encompasses consultation, rather than just simply information provision.

The Fisheries Liaison with Offshore Wind and Wet Renewables (FLOWW) group was set up in 2002 to develop a good relationship between the fishing and offshore renewable energy sectors. In 2012, the FLOWW group published a guidance document for best practice methods for the consultation of fishermen on MRE developments (FLOWW, 2014). The document recognises the importance of information dissemination in avoiding problems and states that timely communication through recognised channels is required. It also recommends that contact between the developer and the local fishing industry is established at the earliest possible stage in the planning phase, in order to benefit from industry knowledge and feed into decision-making such as site selection. To help achieve this the establishment of a Company Fisheries Liaison Officer (CFLO) employed by the project developer and the appointment of a local fisherman as a Fishing Industry Representative (FIR) is required to deal with all fishing related matters. While this document contains some useful recommendations, it exists as guideline only and there is no formal requirement to follow it. More information on the FLOWW group and its recommendations is provided in sections 5.2, 7.2.1 and 7.2.2.

Fernández Chozas et al. (2010) and Stefanovich and Fernández Chozas (2010) made recommendations from a developer's perspective on best practice for public acceptability of wave energy based on evidence gathered from a number of wave energy case studies. The recommendations made relate to the consultation process and stakeholder engagement and include involving the public at the earliest possible stage, engaging directly with primary stakeholders and special interest groups, establishing two-way contact and planning participation. West and Bailey (2009) state that direct and targeted consultations appear to be more successful and appreciated by stakeholders than general advertising strategies. This involves identifying key stakeholder and engaging with them directly. While dissemination and the provision of information is an important part of the consultation process, it has been noted that developers should engage in dialogue with stakeholders, consisting of a two-way and ongoing interaction (Gray et al., 2005). In addition, the planning process for offshore projects should be open and transparent to enable those who may be affected to be involved in the project and the results of this must be demonstrable (Gray et al., 2005). Although achieving this kind of involvement is challenging for developers it is an essential element in the successful development of any project.

Consultation for onshore development is arguably more straightforward as lines of communication are generally well established and key stakeholders are more easily identified. However, consultation on onshore projects does not always achieve consensus. There is agreement among experts in the field that despite its importance, the consultation process is not working and recommendations have been made for research on the failings of existing consultation procedures and alternative forms of consultation (Kerr et al., 2014). It has been noted that development, management and decision-making processes still operate primarily from the top down and there is limited opportunity for the active participation of stakeholders in decisions which may affect them (Dalton et al., 2015). Improving the effectiveness of the consultation process remains a key challenge for planners and developers.

2.10 Community benefit schemes and compensation

The routine provision of meaningful benefits to stakeholders impacted by MRE projects is likely to be a significant factor in sustaining public support and ensuring the successful development of projects. The early rapid growth of onshore wind power capacity in Denmark has in part been attributed to the deliberate localisation of benefits (Bolinger, 2005). The Danish government took measures to ensure that the benefits associated with onshore wind farms were shared among local stakeholders impacted by the projects. This policy measure has helped to strengthen public support for wind power in Denmark. Cass et al. (2010) note that the provision of a community benefits package is increasingly is becoming an established and routine part of onshore renewable energy developments in the UK, particularly for onshore wind. Community benefits schemes are conceived and provided in various ways and the UK government has developed a “toolkit” guide on the delivery of community benefits for onshore wind farms (Department of Trade and Industry UK, 2007). Four different types of community benefit scheme were identified, including community funds, benefits in kind, local ownership and the creation of local jobs. These schemes are reviewed in this section.

As the offshore wind sector expands and commercial scale prototypes of wave and tidal energy devices are being constructed for deployment the notion of the provision of benefits is increasingly being raised. Stakeholder benefit schemes associated with onshore wind development may provide some guidance; however, the applicability of these schemes in the marine environment may be problematic. Nevertheless, such schemes must be considered and to this end the Scottish government have published a document on best practice for community benefits on offshore renewable energy developments (Scottish Government, 2015).

The document reviewed suitable mechanisms which can be used to maximise the impact of the benefits arising from offshore renewable energy development. In addition to this, the Climate Xchange group examined the various ways in which benefits schemes from MRE developments have been implemented in the UK

(Climate Xchange, 2015). The report focused on the identification of communities which may be impacted, perceptions of impacts and examines mechanisms for the distribution of benefits.

2.10.1 Financial compensation and community funds

As the MRE sector expands expectations of financial remuneration to stakeholders and coastal communities who may be affected are being raised. Financial compensatory mitigation options for fishermen fall into two main categories. These are the provision of disruption settlements and contributions to community funds (FLOWW, 2015). Disruption settlements refer to payments to fishermen who may be impacted by MRE development that are calculated based on the potential loss of earnings. Community funds generally consist of voluntary contributions from a developer and reflect the value of community and stakeholder goodwill to that developer rather than loss of income. Compensation and disruption payments could be viewed as a Payment for Ecosystem Services (PES). PES refers to those who benefit from an ecosystem service compensating those who provide the service or who lose out in some way (Laurans et al., 2012). Studies in this area agree that maximum payment for lost services should not exceed the total value of the services for the beneficiaries. It is crucial that the receipt of compensation should accurately reflect the potential loss of income and should not be considered as a bribe by a developer as a means to advance a project (Aitken, 2010).

2.10.2 Community Ownership

The sense of local control and ownership of a MRE project can play a major role in the formation of public attitudes (McLachlan, 2009). Cass et al. (2010) claim that acceptance of projects can be enhanced if the development of projects can be carried out in a manner which increases local community ownership. The development of the wind energy industry in Denmark has been greatly affected by the positive support from the public who has supported the national wind turbine industry from its outset (Dalton and Ó'Gallachóir, 2010). This can be largely attributed to policies which have enabled the formation of local guilds and non-profit partnerships of wind turbine owners, who pool their capital investment in local wind turbines. In 1999, 50% of Denmark’s 3,200 turbines were jointly owned by 67,000 guild members (Vestergaard et al., 2004). This financial investment from the public created an environment and national market without which the industry as a whole may not have survived (Dalton and Ó'Gallachóir, 2010).

The support of the local stakeholders can be enhanced through participation in project ownership which can provide tangible benefits for them and the wider community (Boettcher et al., 2008). Ownership in this sense can be either literal or symbolic and can take many forms but can be broadly categorised into three models. The first model refers to developer-led schemes whereby stakeholders are offered the opportunity to take a modest equity share in the project (Department of Trade and Industry UK, 2007). The second model is a partnership scheme whereby a project is developed jointly with the local community which usually provides funds or land, for example the Shetland Viking Energy project, a 370 MW wind farm with 50:50 local authority/utility partnership (Allan et al., 2011). Allan et al. (2011) studied the Viking Energy wind project in Shetland concluding that revenues to the community associated with an ownership role would be up to five times higher than typical community benefit payments. The third option is for community-led and owned projects where the local community provide the majority of finances for the development of a MRE project. Examples of this are the community wind projects on the islands of Gigha and Westray in Scotland (Warren and McFadyen, 2010). Warren and McFadyen (2010) examined the public attitudes to onshore wind farm development in south-west Scotland and found that attitudes towards a community-owned wind farm on the Isle of Gigha were more positive than attitudes towards several developer-owned wind farms on the nearby Kintyre peninsula. For the development of MRE projects, Rodwell et al. (2012) and Alexander et al. (2013b) suggest that increased local ownership and control may help to mitigate the loss of access to fishing grounds. There are, however, important differences between offshore and onshore renewables which may limit the scope of developers to apply ownership schemes which have been successful for onshore wind development to MRE projects. Due to the common property nature of the marine environment these ownership models may be difficult to replicate for MRE projects. These issues are further discussed in detail in Chapter 5. While it may be difficult to attain, O’Connor et al. (2004) found that successful community ownership of onshore renewable energy is dependent on five critical factors. These include (i) unity in the community, (ii) ability to negotiate the planning process, (iii) issues relating to capital, equity and risk (iv), strategic fit and (v) the policy framework around rural development and renewable energy policies.

2.10.3 Local contracting

Creation of local employment is one of the major socio-economic benefits associated with MRE and is seen as a major opportunity for fishermen who may wish to exit the fishing industry or supplement their income (Perry and Smith, 2012). Local job creation and the related contribution to the local regional economy is seen as the most direct measure of the socio-economic potential of renewable energy sources (Sastresa et al., 2010) and is the most often cited driver of public support (Domac et al., 2005). In response to the expansion of the offshore oil and gas sector in the North Sea in the 1980s, the Scottish Fishermen's Federation (SFF) and the National Federation of Fishermen's Organisations (NFFO) in the UK set up companies to allow member fishermen to diversify by providing services to the sector. Services provided by these companies include guard vessels, chase vessels, survey vessels, and fisheries liaison and consultancy services. The alternative employment for fishermen and the additional income this has created has helped ease conflict and has aided the co-existence of both sectors. These two companies have increasingly found employment on MRE projects, in particular offshore wind farms. Separately, the Anglo North Irish Fish Producers Organisation (ANIFPO) in Northern Ireland created a company to provide services mainly to the offshore wind sector. The use of fishing vessels as survey vessels for environmental assessment work is becoming increasingly common and in addition to this a number of fishermen have been trained as Marine Mammal Observers (MMO) and Passive Acoustic Monitoring (PAM) operators. The SFF services company in particular has a very successful track record in this area and have been called upon to provide such services in the Norwegian and Danish parts of the North Sea, as well as in a number of areas in the Mediterranean. Such alternative employment opportunities could help garner support among fishermen for MRE projects and increase acceptance of the emerging sector.

Despite awareness among fishermen that these opportunities exist, some doubts remain. Cass et al. (2010) note that stakeholders rejected the notion that the local contracting and employment benefits associated with the development of MRE projects would be of any real significance, even in cases where specific numbers were known to respondents. Those jobs which would be available to the local community and fishermen were perceived to be of low value. Similarly, Alexander et al. (2013a) found that there was uncertainty among fishermen over whether they possess the necessary skills and whether their vessels are up to standards required to obtain employment on MRE projects.

3 Methodological Approach

This chapter provides background information on the MRE projects on the island of Ireland that were considered for case study sites. This includes justification for the selection of the case study sites and provides information on other MRE projects on the island of Ireland which were considered. There is also information on the methodology used, the design of the surveys and interviews and details on how both were conducted.

3.1 Selection of case study sites

A number of MRE projects, test sites and demonstration sites representing the various technologies were considered for the case studies before the final three were selected. The three sites which were chosen were the Atlantic Marine Energy Test Site (AMETS), the Torr Head and Fair Head tidal energy projects and the First Flight Wind offshore wind farm (Figure 3.1). The background information on the sites and the reasons for selecting them are expanded on below.

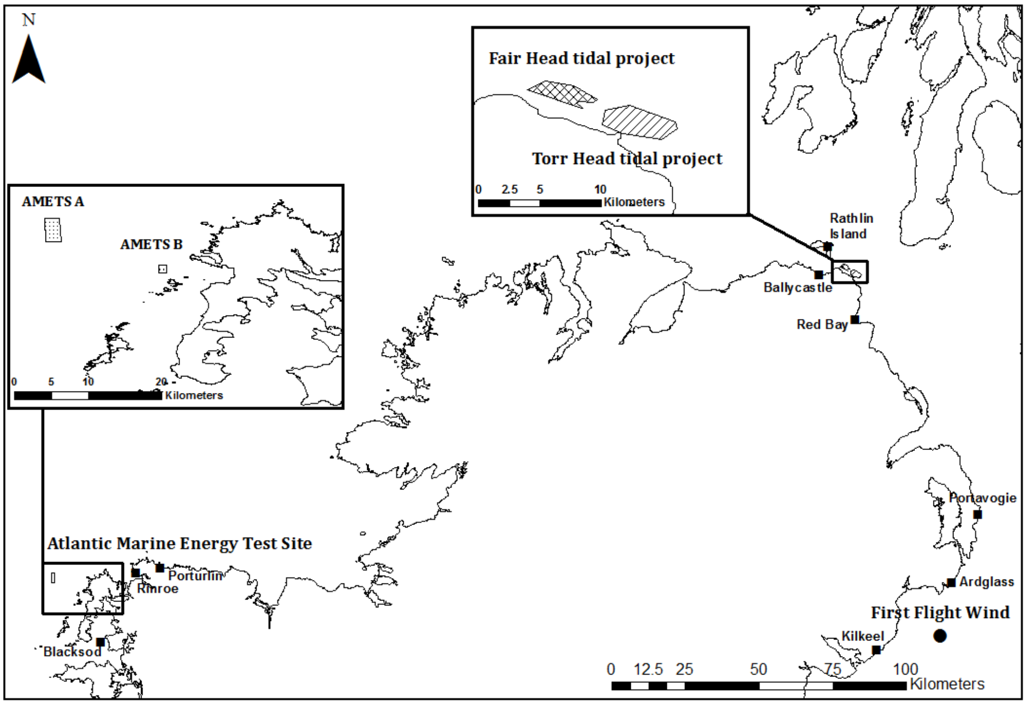

Figure 3.1. Case study projects and ports

The other MRE projects which were considered but subsequently not progressed were the Westwave wave energy project, the Galway Bay Wave Energy Test site, the SeaGen tidal energy demonstration project on Strangford Lough and the Arklow Bank offshore wind farm. Westwave is a pre commercial wave energy project being developed by the Electricity Supply Board International (ESBI) in partnership with a number of wave energy convertor companies (Electricity Supply Board International, 2012). The project intends to deploy a number of wave energy convertor devices (5 MW in total) off the coast of Killard, Co. Clare and will be the first project of its kind in Ireland. The project is currently in the concept phase with an aim to begin construction in 2016. The overarching aim of the project is to progress the development of wave energy in Ireland and although Westwave is for devices at a pre-commercial stage, it is anticipated that the lessons learned from the project will facilitate the development of commercial projects. Fishing in the area is dominated by potting using static gear and some localised trawling (Electricity Supply Board International, 2012). The Environmental Scoping report recognises that safety exclusion zones around deployed WECs will prevent commercial fishing activity at these locations (Electricity Supply Board International, 2012). Four surveys were conducted with fishermen who fish near the proposed site for the Westwave project. Due to the low number of participants, difficulties accessing more fishermen in the area for the survey and the relatively low level of fishing in the area, these surveys were not included as part of this study. The Arklow Bank offshore wind farm is a 25 MW project located approximately 10km off the east coast of Arklow, Co. Wicklow. The project was co-developed with GE Energy and has been in operation since 2003. The project consists of seven 3.6 MW turbines which were the world's first commercial application of offshore wind turbines over 3 MW. A proposal to expand the farm to a 520 MW capacity has been submitted. Four fishermen who operate in the vicinity of this project completed the survey. However, again due to difficulties accessing fishermen in the area the surveys collected were not used for this thesis. The Galway Bay Wave Energy Test Site is an operational test site situated on the northern side of Galway Bay, one mile east of Spiddal, where devices such as the Ocean Energy Buoy and Wavebob have been tested since 2006 (O'Hagan and Lewis, 2011). This site was also not selected due to the small scale of the project and the relatively minimal level of commercial fishing in these areas. The SeaGen tidal energy convertor was deployed in the narrows of Strangford Lough in 2008 by the company Marine

Current Turbines (Devine-Wright, 2011a). Extensive environmental monitoring has been carried out on the device and wider site to date. This project was also considered but was not selected due to the negligible impact on fishermen in the area.

Table 3.1. MRE projects not selected

Site	Technology	Reason for not selecting
Westwave	Wave	• Low fishing activity • Difficulty accessing fishermen
Arklow Bank offshore wind farm	Wind	• Difficulty accessing fishermen
Galway Bay Wave Energy Test Site	Wave	• Low fishing activity • Small scale project
SeaGen tidal project	Tidal	• Negligible impact on fishermen

3.1.1 Atlantic Marine Energy Test Site

The Atlantic Marine Energy Test Site (AMETS) is being developed by the Sustainable Energy Authority of Ireland (SEAI) off the west coast of Annagh Head, near Belmullet, Co. Mayo. The purpose of the site is to test and demonstrate the performance of wave energy devices in generating electricity and their survivability in open ocean conditions. The facility comprises two test sites – a nearshore test site (Test Site B) which will be utilised to test devices in 50m water depth and a site further offshore (Test Site A) which will test devices in 100m water depth (Ascoop et al., 2012). In Ireland, there is currently no formal site selection process to identify areas suitable for the development of MRE projects. The location of AMETS was identified following an extensive assessment of seven locations on the west coast of Ireland (Electricity Supply Board International, 2010). As part of the location assessment process data was used from the Integrated Mapping for the Sustainable Development of Ireland's Marine Resource (INFOMAR) seabed survey programme which revealed the nature of large sections of the seabed off the west coast of Ireland (Ascoop et al., 2012). The assessment considered issues such as the available wave resource to generate electricity, technical feasibility, suitable water depths reasonably adjacent to shore, possibility of grid connectivity, seabed conditions, accessibility through ports and road networks and the need to minimise any potential for environmental impact. Using the INFOMAR data and the key assessment parameters the location off the coast of Belmullet was identified as the preferred location for a wave energy test facility on Ireland's western seaboard and the two test sites were subsequently chosen (Ascoop et al., 2012).

Fishing activity in the Belmullet area consists mainly of crab and lobster fishermen who operate small inshore vessels, most of which are between 10m and 20m (Electricity Supply Board International, 2011). There is also limited trawling carried out by up to three vessels which mainly operate from Killybegs, Co. Donegal, and are members of the Killybegs Fishermen's Organisation (KFO) (Electricity Supply Board International, 2011). There are two main fishing organisations in the area, the largest of which is the Erris Inshore Fishermen's Association (EIFA) which has roughly 65 registered members. The Erris Lobster and Crab Re-Stocking Association (ELCRA) have around eight members with registered fishing vessels. All of the fishermen in these organisations operate from ports around Belmullet and the Erris peninsula. The ports include Rinroe, Porturlin, Ballyglass and Blacksod. Commercial fishing remains a significant socio-economic contributor to the area in terms of local employment and income generated. Crab potting is the most important fishery in economic terms. A typical crab boat fishes up to 1,000 pots, and lands up to 100 tonnes per year at a value of around €1.20 per kg (Electricity Supply Board International, 2011). Total annual landings in Belmullet are in the region of 3,000 tonnes. A typical lobster boat fishes up to 600 pots, and lands up to 1.5 tonnes per year at a value of between €10 and €14 per kg (Electricity Supply Board International, 2011).

An Environmental Impact Statement (EIS) on the project was completed in 2011 (Electricity Supply Board International, 2011). The document examined the potential environmental impacts of the project and the measures that could be taken to mitigate these impacts. The EIS identified the potential benefits the project could provide the local community including pier facility improvements at Frenchport. The report states that during the construction and decommissioning phases of the project the impact on commercial fisheries would be temporary in nature and of low significance overall (Electricity Supply Board International, 2011). During the operational phase the test area locations would effectively constitute fishing exclusion zones. The report found that the impact on trawling in the area would be negatively impacted; however, this impact would be low. Test Area B would not impact significantly on fishing in the area. The impact on the crab and lobster fishery would be low as the Test Area A was redesigned following an extensive consultation process with the fishing community. During the engagement process key stakeholders were identified including six fishermen who operated in the vicinity of Test Area A. Further consultation and discussions between these fishermen and the project members resulted in the re-configuration of the deep water test site (Ascoop et al., 2012). This is discussed in greater detail in Chapter 5.

Consultation with the general public and stakeholder engagement on the project was carried out between 2010 and 2011 (Ascoop et al., 2012). As the AMETS project is the first of its kind in Irish waters, the project team were committed to ensuring that consultation was effective and that local stakeholders were provided with an opportunity to have an input. Furthermore, the project members were eager to avoid a repeat of the opposition from the local community and stakeholder fishermen towards the construction of a gas pipeline through Sruwaddacon Bay and an onshore gas processing plant in Ballinaboy for the development of the Corrib offshore gas field by the oil and gas company Royal Dutch Shell (Ascoop et al., 2012). The granting of permission to construct the pipeline was a very controversial planning decision and protests in the area led to five local residents being jailed for contempt of court (Siggins, 2010). The controversy surrounding the construction of this pipeline provides an example of how a lack of stakeholder involvement can result in significant opposition to developments and in turn hinder and cause delays to the project. Significant effort was made by the project members to ensure there was not a repeat of this. A local project office was set up by the SEAI in Belmullet which was manned by a consultant three days a week, providing a local contact point (Ascoop et al., 2012). The office provided information to the public on the project and was the location for a high number of project meetings. In order to encourage stakeholder attendance at consultation meetings, a flexible approach was taken when organising the timing of meetings. Meetings were arranged at times which would suit the schedule of fishermen such as late evenings after returning from fishing.

3.1.2 Torr Head Tidal

The Crown Estate is responsible for granting leases for the use of the Northern Ireland seabed for MRE construction. Decisions on where to site marine renewable projects in the UK are made in two stages. The first stage is a national selection of large areas of UK seabed which are suitable for developing MRE projects. The second stage in the process of deciding where projects are located within the zones identified is the responsibility of the developer who has the rights for the zone. Prior to the launch of the Northern Ireland Offshore leasing round, the Department of Enterprise, Trade and Industry (DETI) prepared a Regional Locational Guidance (RLG) document which provided key information regarding the location of MRE developments in Northern Irish waters (AECOM et al., 2011). Using the information available from the SEA of the Offshore Renewable Energy Strategic Action Plan (ORESAP) and the RLG large areas of the seabed were identified as suitable for the development of MRE projects without causing significant environmental impacts. In December 2011, the Crown Estate launched two parallel offshore tender processes in Northern Ireland waters: an area off the east coast of Co. Down to deliver up a 600 MW installed capacity wind farm and a tidal stream area off the north coast around Rathlin Island to deliver up to 200 MW installed capacity.

In October 2012 Tidal Ventures was awarded an Agreement for Lease (AfL) giving them exclusive rights to investigate the development of a commercial scale 100 MW tidal energy array in the waters offshore of Torr Head on the north coast of Co. Antrim in Northern Ireland. Tidal Ventures is a joint venture partnership which comprises Open Hydro and the Brookfield Renewable Energy Group. Open Hydro is a device developer that designs and manufactures tidal turbines to generate electricity from tidal streams. The company is responsible for the Open-Centre Turbine which is designed to be deployed directly on the seabed. The company is part of the DCNS group which specialise in naval defence and marine energy. Open Hydro is also involved in projects at EMEC in Scotland, in France, Canada and the US. Brookfield Renewable Energy group is responsible for acquiring renewable energy assets globally and are providing finance for the project. Tidal Ventures aims to begin Phase 1 of the project in 2017 which will involve the construction of a 30 MW tidal energy farm. Phase 2 involves the construction of the remaining 70 MW and this is intended to be completed by 2020. Prior to site construction, consents and licences will be required.

This necessitates the carrying out of an environmental impact assessment which includes a consultation process with all relevant stakeholders.

Fishing activity around the area chosen for development consists of a number of smaller vessels fishing for lobster and crab. Most of these vessels are members of the North Coast Lobster Fishermen's Association (NCLFA). Trawling in the area is restricted due to the presence of large boulders which would lead to the snagging of trawl nets (Xodus, 2015). The main ports in the vicinity of the projects include Red Bay, Rathlin Island and Ballycastle. The inshore area adjacent to the Torr Head tidal site has been identified as a high priority area for spatial access in terms of crab and lobster fishing in a study of local skippers (Yates, 2012).

3.1.3 Fair Head Tidal

The company, Fair Head Tidal, was awarded an Agreement for Lease to investigate the development of a 100 MW tidal energy project off the coast of Co. Antrim in Northern Ireland in October 2012. Fair Head is located approximately 2km to the east of Torr Head and it is estimated the project will occupy an area of approximately $3km^2$. Fair Head Tidal is a special purpose vehicle which comprises DP Energy and Bluepower NV. DP Energy is a developer of both onshore and offshore renewable energy project and is based in Co. Cork, Ireland. They are responsible for the development of onshore wind, tidal energy and solar energy projects worldwide and have completed a number of onshore wind projects in Ireland. Along with the Fair Head project, other tidal energy projects in development by DP Energy include the West Islay tidal energy farm and the Westray South tidal array, both located in Scotland. Bluepower was established by DEME Blue Energy and Nuhma. DEME is a marine construction company and was involved in installation of the SeaGen tidal turbine device in Strangford Lough. Phase 1 of the project was planned for the period between 2014 and 2017. Phase 1 involves scoping, pre-application consultation, the gathering and collation of baseline data, and an environmental impact assessment. This also includes the submission of the planning application. Geo-technical surveys are due to be carried out in 2016 followed by the finalisation of detailed design and construction methods. Construction of a 10 MW tidal array is due to take place in 2017. Phase 2 of the project will commence once the 10 MW array has been deployed. Fair Head Tidal expect that the balance of the 100 MW development to be completed within two years of this and will be timed to coincide with the updating of onshore gird connections.

Fishing activity in the vicinity of the proposed project is similar to that carried out at the Torr Head tidal site. Members of the North Coast Lobster Fishermen's Association (NCLFA) fish regularly in the area for lobster and crab. As these projects are located in relatively close proximity to each other it was assumed that the same group of fishermen could potentially be impacted by both. As such, the Torr Head and Fair Head tidal projects were treated as a single case study site.

3.1.4 First Flight Wind

In October 2012, the First Flight Wind (FFW) consortium was selected to develop a 600 MW offshore wind farm in the wind resource zone (WRZ) which was identified in the site selection process. The consortium consists of DONG Energy, RES and B9 Energy Offshore. DONG Energy is based in Denmark and is one of the leading energy groups in Northern Europe. DONG is a world leader in deploying offshore wind and is responsible for several large offshore wind projects throughout Europe. DONG constructed the first large scale offshore wind farm in the world, the 160 MW Horns Rev, in 2002. RES are an engineering and project management company that provide development, design, construction, financial and operational services to MRE projects. B9 Energy Group is a renewable energy project developer based in Northern Ireland. In June 2014 the target capacity of the project was reduced to between 300 MW and 400 MW due to the significant extent of fishing and navigation interests in the area. In December 2014 it was announced that the project was being cancelled due to the fact that it would not be completed in time to avail themselves of the UK renewable energy market incentives, which stated that construction of the project would have had to be completed by 2020.

The majority of the fishing fleet in Northern Ireland is based at three ports along the Co. Down coast – Kilkeel, Ardglass and Portavogie (Yates and Schoeman, 2013). There are also other smaller ports along the Co. Down coast where smaller numbers of fishermen operate from. This includes Annalong and Newcastle. Commercial fishing in the area around the proposed project is diverse and a variety of fishing methods, such as trawling and crab/lobster potting, are used to target a wide range of species. The most important catch for the majority of vessels is Nephrops, or Dublin Bay Prawns, which are landed on a daily basis into local ports. There are two major fish producer organisations in Northern Ireland, the Northern Ireland Fish Producers Organisation (NIFPO) and the Anglo North Irish Fishermen Producer's Organisation (ANIFPO). NIFPO was established in 1975 and is the largest fishing organisation in Northern Ireland with approximately 150 members who operate a broad range of vessels. They provide quota management services along with other assistance for vessel registration and administration. ANIFPO was founded in 1984, as a non-profit making co-operative. They provide a range of services to member fishermen including quota management, representation and increasingly marketing services. Members are based in Annalong, Ardglass, Kilkeel and Portavogie, the main fishing harbours along the County Down coast in Northern Ireland. The main offices of the organisation are located in Kilkeel. The organisation has over 50 members with a range of static and mobile gear fishermen. Member fishermen own vessels ranging in size from over 70 metres to under 10 metres in length. Figure 3.2 shows the potential impact of the FFW project on commercial fishing in the area.

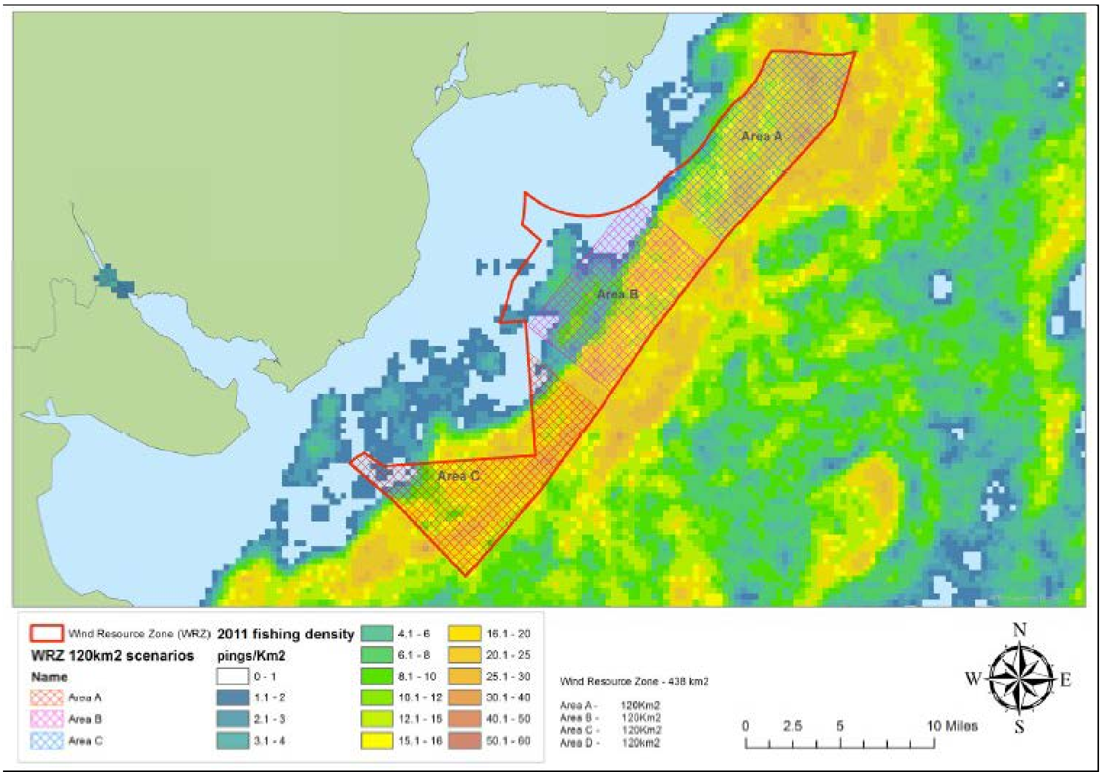

Figure 3.21. Northern Ireland Wind Resource Zone and fishing density (Source: Service et al., 2013)

The FFW consortium was committed to engage with local members of the public effectively and as such an independent community stakeholder panel was set up in February 2013 with a focus on the delivery of a stakeholder consultation process. In addition to this, a commercial fisheries group was established in March 2013 to provide an additional forum to allow the constructive discussion of issues and concerns that the local fishing community may have had towards the proposed offshore wind farm. The fisheries group consisted of senior members of the local fishing organisations, fisheries liaison officers, government departments and councillors, the Crown Estate and members of the consortium.

3.2 Company Fisheries Liaison Officers (CFLOs)

In addition to the case study sites outlined above, ten company fisheries liaison officers (CFLO) were also interviewed. The role of a CFLO is to represent the developer on all matters relating to fisheries and be the primary point of contact for the fishing industry when direct communication with the developer is required (FLOWW, 2014). The majority of the CFLOs interviewed were based in the UK and have been involved in a number of MRE projects. Most of these projects have been offshore wind farms including the Thanet Offshore Wind Farm and the London Array, but two of the CLFOs interviewed have also worked on Wave Hub and the Swansea Bay Tidal Lagoon project.

3.3 Mixed methods

There are two very broad categories generally used for conducting socio-economic research. These are referred to as quantitative and qualitative research. A mixed methods or multi-strategy approach refers to the combination of both quantitative and qualitative research techniques and is becoming increasingly popular in economic and social research (Robson, 2011). Quantitative research aims to take a systematic and scientific approach to gathering data, with the same general principles as many natural sciences. This involves the expression of the data collected in a numerical format. The measurement and quantification of data collected, i.e. turning the information obtained into numbers, is a typical feature of quantitative research. For this study the quantitative element of the research involved exploring the attitudes of fishermen towards the development of MRE and their perceptions of their level of participation in the projects. This data was presented in statistical and graphical form.

For qualitative research information gathered and findings are presented in verbal and other non-numerical forms. Qualitative research is concerned with understanding certain phenomena in their setting from the perspective of those involved (Robson, 2011). Qualitative research involves asking broader questions of participants and allowing them to elaborate on the subject matter. Data gathered provides anecdotal information which often complements data gathered in quantitative research. Participants in qualitative studies do not necessarily have to be representative of the entire population. The qualitative aspect of this research was intended to provide a close examination of the attitudes, perceptions and experiences of the local fishermen who are most likely to be affected by the MRE projects at the case study sites. In addition, the interviews with the CFLOs also make up the qualitative part of the study.

It has been suggested that quantitative and qualitative research are often incompatible as the two methods do not study the same phenomena (Sale et al., 2002). There are, however, a number of benefits associated with using a mixed methods approach and it has been claimed that states that “there are certain ways in which quantitative and qualitative methods are inseparable” (Howe, 1988). As mentioned above they are often complementary and qualitative research can provide richer data and further context to quantitative data collected.

Qualitative and quantitative research methods can be combined in a number of different ways depending on the sequencing of the design and the priority given to each approach (Creswell et al., 2003). For this study both aspects were given equal priority and the quantitative data was gathered prior to the qualitative research. A benefit of this was that the quantitative research helped to identify those who were willing to take part in the qualitative study were identified. The methods chosen for conducting the research were a survey for the quantitative research and interviews for the qualitative element. For the quantitative research a questionnaire survey was chosen as a tool to gather the information desired. For the qualitative research interviews were chosen as the method to gather the data. This is elaborated on in the following section.

3.4 Survey design

There are a number of advantages and limitations of using surveys as tools for conducting socio-economic research (Blair et al., 2013). This is covered in greater detail in Chapter 4. The survey was designed based on a previous study on the attitudes and perceptions of fishermen on the west coast of Scotland towards MRE (Alexander et al., 2013b). This allowed for the attitudes between the groups of fishermen involved in each study to be compared and for any differences to be analysed. Permission was sought from the author of the Scottish study to peruse the survey questionnaire which was adapted to suit the particular objectives of this study. The key difference between the surveys was that the Scottish study surveyed a random sample of fishermen from the west coast of Scotland and the majority (56%) of those surveyed were not aware of any nearby MRE development. The Scottish study did not address attitudes towards specific MRE projects, but rather elicited attitudes towards MRE in a broader context. This current study targeted a representative sample of fishermen at selected case study sites around the island of Ireland where MRE projects were either planned or under development. Due to the stakeholder engagement work carried out at the Irish case study sites, it was assumed that the majority of fishermen at the ports in the vicinity would be aware of the proposed projects. A further distinguishing factor was the fact that this survey contained an additional section on the level of involvement of fishermen in consultations and level of involvement in decision-making.

The survey had five main sections which contained 26 questions in total. The sections covered fishing activity, knowledge of MRE (including attitudes towards MRE), perceived opportunities of MRE, perceived impacts of MRE and the level of involvement in consultations and decision-making on projects. The survey was designed so that it could be self-administered and returned by post if the respondent desired. Further details on the survey design are described in Chapter 4. A copy of the survey is included in Appendix A.

3.5 Interview design

Focus groups are often used to gather information in both qualitative and quantitative research. This approach was considered for collecting the qualitative information but was ultimately not chosen due to the logistical difficulties associated with organising a group discussion among a number of fishermen who work to different schedules. Individual interviews were chosen as the preferred method to collect the data. This approach allowed for the interview to take place at a time and place that suited each fisherman and CFLO. Interviews can be classified as semi-structured, structured or non-structured. Semi-structured interviews were chosen as they allow for flexibility and enable the interviewer to pursue potentially interesting lines of enquiry. Two separate sets of interview questions were prepared for fishermen and CFLOs that followed similar topics. The interview questions were based on an extensive review of the literature in addition to the results of the survey and field notes that were taken on comments of participant fishermen. Both sets of interviews contained five main of sections. The first section was a general introduction during which consent was obtained. This was followed by a warm up section, where interviewees were asked a number of straightforward questions to ease them into the interview. The other sections were the main body of the interview, a cooling off section with some wrap up questions and the closure of the interview which allowed the participant to make any final comments and/or provide feedback. The main body of the interview was further separated into a number of sections. This consisted of questions on the attitudes of fishermen towards MRE, perceptions of potential impacts and benefits, dissemination of project information, involvement in consultation, participation in decision-making, mitigation strategies, compensation measures and co-existence planning. The section on compensation measures also included questions on how to identify those to be compensated, the mechanism for provision and the calculation of compensation. Both sets of interview questions are included in Appendix B.

3.6 Pre-testing

A pilot is a small scale version of the actual study to be carried out (Robson, 2011). Carrying out a pilot survey can help to highlight issues that may arise during the actual survey. The fact that there was difficulty gaining access to fishermen meant that it was not possible to conduct a pilot survey for the case studies. In the absence of this the survey questionnaire and interviews were pre-tested on social scientists, fisheries scientists and researchers familiar with the area. The main aims of this exercise were to ensure that the survey and interviews were coherent and would be easily understood by participant fishermen. This level of pre-testing also helped to minimise the risk of omitting important questions. In addition to this, for the first five surveys, the fishermen were asked to highlight any issues that they may have had with the questions and provide feedback on this. No issues were identified and as such no revisions were made to the original survey. The interview questions were also pre-tested on researcher colleagues who were familiar with the topics.

3.7 Sampling

Efforts were made to ensure that the participants in the survey were a representative sample of the fishermen who are active in the area around the case study site areas. A random sampling approach was employed to achieve this. One respondent per active vessel in each case study area was required. As such the vessel skippers or owners took part in the survey where possible. The details of those vessels whose skippers took part in the survey, such as vessel size and gear type used, were compared to existing data and official statistics of vessels at each of the sites, where available. The author is satisfied that the sample who took part in the survey were representative of the fleets at the respective sites based on the comparison between the fishing characteristics of the vessel skippers that took part in the survey and the existing data on fishing activity characteristics of the vessels at the case study sites. Table 3.2 shows the percentage of vessels active in the areas at each of the case study sites that were involved in the survey.

Table 3.2. Survey site population and sample size

Case study site	Population	Sample size	% of population
AMETS	73	29	37%
Torr Head/Fair Head Tidal projects	28	18	64%
First Flight Wind	212	57	27%

3.8 Consent

It is important that consent is received from potential participants before conducting a survey or interview (Robson, 2011). It is also necessary to ensure that participants know what they are consenting to and are fully aware of how the information they provide would be used and the policy implications of the project. Consent for the survey was obtained verbally prior to the survey being carried out. Fishermen were read out an information sheet introducing the author and the topic of the study and were informed that the data gathered in the survey would be used as part of this research study. They were also informed about the objective of the study, the main question categories and the estimated time it would take to complete the survey. Potential respondents were assured that the information provided would be used strictly for the purpose of the research being conducted and would remain completely anonymous. Protecting the anonymity of participants and providing this when reporting on research is considered good practice (Robson, 2011). The fishermen were informed that individual responses would not be made available to anyone other than the author and that feedback on the results of the survey would be made available to all those who expressed an interest in this. A copy of the survey information sheet is included along with the survey in Appendix A.

A similar approach was taken for the qualitative interviews. Fishermen and the company fisheries liaison officers were read an information sheet which introduced the author, the research topic and the aims and objectives of the study. They were also provided information on the main body of the interview, the topic that would be covered and an estimate of the duration of the interview. The interviewees were informed that their involvement was entirely voluntary, meaning they could refuse to answer any questions they may not be comfortable with. Due to the nature of the questions it was presumed this would not be a major issue. They were also made aware that they had the option to withdraw from the interview at any time. Respondents were encouraged to answer honestly and openly based on their personal experiences and opinions. The participants were assured that their responses and the information they provided would remain completely anonymous. Their confidentiality would be protected and although the data gathered in the interview would be used to form part of a publication or presentation, their names would be used. In addition, interviewees were informed that feedback from any output from the interview would be made available to those who were interested in it. Finally, prior to the start of the interview, participants were asked for permission for the interview to be recorded and quotations used as part of this thesis. For the face to face interviews written consent was received from the interviewees through the signing of a form. Respondents were then given the information sheet which contained the contact details of the author. For the interviews carried out over the phone verbal consent was obtained. A copy of the information sheet and consent form is included along with the interview questions in Appendix B.

3.9 Conducting the survey and interviews

Conducting the surveys and interviews was the preferred method for gathering information where possible. There are a number of advantages to using a face to face approach, including higher response rates and the fact that it allows additional observations to be made (Blair et al., 2013). The disadvantages are that is can be resource intensive, expensive and time consuming. There are also geographic restrictions to using this method. Gaining access to fishermen willing to take part in the survey proved to be an issue and this was overcome using a number of approaches. At AMETS, the local fisheries officer from BIM assisted in initiating contact with the fishermen at the main ports in the area. In addition to this, a local member of one of the fishing organisations provided contact details for a number of other fishermen. At the FFW site a number of surveys were also left at the NIFPO offices in Kilkeel, however, none of these were returned. All of the surveys were conducted face to face with fishermen at the main ports in the area. For the Torr Head and Fair Head tidal projects, it was assumed that the same group of fishermen may be impacted by both projects, due to the potential displacement effects of the project. This included all registered fishing vessels operating on the north Co. Antrim coast and contact details for these fishermen were obtained from the North Coast Lobster Fishermen’s Association. The survey was carried out between June and September 2013. At the end of the survey fishermen were asked if they would be willing to take part in a follow up interview and this provided a list of candidates for the qualitative interviews.

For the qualitative aspect of the research, semi-structured interviews were conducted with twelve fishermen and two fishing industry representatives who were involved in consultations on the projects. There were eight from the FFW site, five from AMETS and one from the Torr Head and Fair Head tidal sites. However, as with the surveys there was some difficulty accessing fishermen who were willing to take part, particularly at the Torr Head and Fair Head tidal sites. Despite agreeing to be interviewed individually three of the fishermen at this site subsequently refused due to a minor dispute with the Tidal Venture Company. A further attempt was made to conduct a focus group with these fishermen and although they initially agreed to take part, this was unsuccessful.

A list of eleven CFLOs who had worked on various MRE projects was compiled and an initial email was sent to each of them explaining the topic of the research and requesting permission to carry out an interview with them. Ten of the CFLOs contacted responded positively to the request and only one was unwilling to take part. The interviews with the fishermen and CFLOs were carried out between June and September 2014. Field notes were taken during the interview and points of interest deemed to be relevant were recorded. Time and dates were recorded along with general notes on how the interview went and how the fisherman responded to questions.

3.10 Analysis of data

The responses from the fishermen to the questions asked in the survey were entered into an Excel spreadsheet in order to provide a quantitative assessment of the attitudes of fishermen towards MRE development. The numerical data was then analysed and the results were expressed as statistics. Graphs and tables were produced to support the analysis of the quantitative data.

For the interviews a thematic coding analysis was used. Thematic coding refers to the identification of certain themes which were common across the qualitative data and assigning a code to each theme (Robson, 2011). This involved transcribing each interview from the recordings. Each transcription was subsequently read several times in order to become more familiar with the information provided by interviewees. Initial comments were made on common themes and following on from this each transcription was subject to line by line coding. Quotes were used to demonstrate the themes identified in the interviews. The flexibility of this approach allowed for themes to emerge which were not specified in the interview questions.

3.11 Compensation model

In addition to the mixed methods research, a financial compensation model was designed as a tool to assist in the calculation of disruption payments and contributions to fisheries compensation funds. This involved a thorough review of best guidance practices for the provision of financial compensatory mitigation to fishermen and methodologies on the calculation of compensation payments. The methodology and the process involved in the development of the basic Excel compensation model are described in detail in Chapter 7.

3.12 Limitations

There are inevitable limitations associated with any case study approach to research (Robson, 2011). The attitudes and experiences of the fishermen involved in the study are specific to the particular project and site. Case studies by their nature are based on specific events and circumstances and the transferability of results may be limited. Despite this there are general recommendations that can be made based on the information gathered in the studies. A further limitation of the study was that a relatively small number of fishermen took part in the qualitative interviews. A larger number was desired, particularly at the Torr Head/Fair Head case study site, but a number of fishermen who initially agreed to take in the interviews were later unwilling. However, the combination of the qualitative information with the quantitative data helps to diminish this limitation.

There are also limitations of a mixed methods approach to conducting research and gathering information. It can sometimes be difficult to integrate qualitative and quantitative data into a coherent narrative if they do not corroborate each other. In addition, qualitative research often provides large quantities of data which may become difficult to interpret and analyse. Both of these potential issues were addressed through the careful design of the semi-structured interview. The questions were constructed in line with the quantitative survey in order to explore the survey findings in depth.

4 Attitudes and perceptions of fishermen on the island of Ireland towards the development of marine renewable energy projects

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Abstract

The expansion of the marine renewable energy (MRE) sector will increase pressure on sea space and existing maritime users which could potentially lead to conflict. Commercial fishing has been identified by many as the industry most likely to be affected by the development of MRE. In order to reduce the risk of spatial conflict and to enable decision-making based on the co-existence of the two sectors, it is important to gain a better understanding of the attitudes of fishermen towards the development of MRE projects in their locality. A survey was designed to provide quantitative information on fishermen's attitudes to marine renewable energy and the perceived impacts and opportunities. Three MRE developments which have been proposed around the island of Ireland (comprising Republic of Ireland and Northern Ireland) were chosen as case study sites in which to carry out the survey. The sites represent offshore wind, wave and tidal energy respectively and are in differing stages of development. In total, 104 complete surveys were conducted with fishermen located at ports in the vicinity of the case study sites. 40% of those surveyed agreed that it is important to develop marine renewable energy in their locality. A further 15% were neutral on this matter. It is encouraging for developers and policy makers that the majority of respondents (70%) were of the opinion that fisheries and MRE projects can co-exist.

Keywords – marine renewable energy, fishermen, attitudes, perceptions, co-existence

4.1 Introduction

Marine renewable energy (MRE), defined as offshore wind, wave and tidal energy has the potential to be a key contributor towards achieving EU renewable energy targets for a number of countries. While there are a number of engineering and technical challenges for the MRE sector to overcome, of equal importance to the successful development of the sector are issues such as stakeholder acceptance. Due to issues surrounding the consenting process and public acceptance of onshore renewable developments, in particular onshore wind farms, developers and policy makers are increasingly looking to the marine environment for renewable sources of energy (Jay, 2009, Ladenburg, 2008). It has been suggested that offshore sites are less likely to suffer from public opposition and the Not In My Back Yard (NIMBY) effect (Farrier, 1997, Ladenburg and Möller, 2011, Soderholm et al., 2007, Tong, 1998). Similarly, it has been argued that in comparison to land based wind farms, particularly in the UK and Europe, offshore areas are less likely to be in conflict with other activities (Still, 2001). However, there is considerable potential for spatial conflict with existing marine resource users. The expansion of marine renewables will increase pressure on existing marine sectors representing a challenge for Maritime Spatial Planning (MSP) (White et al., 2012). Commercial fishing has been identified by many as the industry most likely to be affected by the development of MRE (Alexander et al., 2013b, Gray et al., 2005, Rodmell and Johnson, 2002). The exact socio-economic impacts of MRE projects on fishermen are unknown, however there will likely be benefits and costs to fishing communities (Blyth-Skyrme, 2010, Perry and Smith, 2012). The successful development of the MRE sector will depend to a significant extent on the acceptance of projects by communities in general and relevant stakeholder groups such as fishermen.

The considerable interest and activity in MRE on the island of Ireland (comprising the Republic of Ireland and Northern Ireland) is largely premised on the scale of its resource (Department of Communications Energy and Natural Resources, 2014, Department of Enterprise Trade and Investment Northern Ireland, 2012, Sustainable Energy Authority of Ireland, 2005). Increasing the share of MRE is high on the policy agendas of the governments of the Republic of Ireland and Northern Ireland respectively. Both governments have set ambitious targets and have developed plans to achieve this – the Offshore Renewable Energy Development Plan (OREDP)(Department of Communications Energy and Natural Resources, 2014) for the Republic of Ireland and the Offshore Renewable Energy Strategic Action Plan (ORESAP) 2012-2020 (Department of Enterprise Trade and Investment Northern Ireland, 2012) for Northern Ireland. Commercial fishing remains a valuable coastal industry for the island of Ireland. Fishing communities are distributed around the coast of the Republic of Ireland, centred particularly on the six major fishing harbours of Killybegs, Co. Donegal, Ros a Mhil, Co. Galway, Dingle, Co. Kerry, Castletownbere, Co. Cork, Dunmore East, Co. Waterford and Howth, Co. Dublin (Gerritsen and Lordan, 2014). Although pelagic and demersal species, which are caught using mobile fishing gear (trawls, dredge nets, etc.) dominate at these ports there are also a significant number of smaller vessels that operate from these ports and in particular smaller ports that fish for crab and lobster using static gear (pots, creels, etc.) (Gerritsen and Lordan, 2014). As mobile gear vessels generally require larger areas to fish in, it is likely that MRE projects will impact these vessels more so than static gear fleets and thus have an influence on attitudes. In 2010, the Republic of Ireland fishing fleet comprised 2,119 vessels with a total capacity of 70,800 tonnes (Scientific Technical and Economic Committee for Fisheries, 2012). Ireland had fish landings valued at €202.1 million in 2010 and the sector contributed an estimated €116.1 million in Gross Value Added to the Irish economy in 2010 (Vega et al., 2013). Exports from fish landings were valued at €161.7 million and employment in sea fisheries was at 2,825 FTE in 2010 (Vega et al., 2013). In 2011 there were 578 full time fishermen in Northern Ireland and 688 in total (full and part time) with the trawling fleet accounting for the vast majority of jobs (Service et al., 2013). In 2013 there were 367 vessels registered in the Northern Ireland fleet, 224 of which are officially recorded as active (Yates and Schoeman, 2013). More than half of those active vessels (57%) are less than 15m in length. The majority of the Northern Irish fleet is based at three main ports in Co. Down: Kilkeel is the largest, followed by Portavogie and Ardglass. In addition, there are over 20 minor ports at which small numbers of pot boats are based.

Although there have been a small number of studies on the attitudes and perceptions of the public towards MRE (Bailey et al., 2011, Devine-Wright, 2011a) those which focus on particular stakeholder groups that may be impacted are rare. Studies of Scottish fishermen have found that the perceived opportunities include alternative employment, exclusion zones, the artificial reef effect and improved infrastructure (Alexander et al., 2013a, Alexander et al., 2013b). Despite the potential benefits, there is also the possibility that MRE development may negatively impact commercial fisheries. Scottish fishermen identified the main direct impacts of the MRE sector on the fishing industry as loss of access to fishing grounds, safety issues and loss of gear

(Alexander et al., 2013a, Alexander et al., 2013b). The loss of earnings and livelihood that would result from these impacts is a major concern for fishermen (Mackinson et al., 2006). While the benefits could enhance support for MRE projects among fishermen, the negative impacts have the potential to lead to conflict between both sectors which could in turn hinder offshore development. This was witnessed in the Cape Wind project in Nantucket Sound, Massachusetts, USA. A local fishermen's organisation objected to the proposed Cape Wind project on the grounds that it would restrict access to fishing grounds, make navigation more risky and prohibitively increase their costs (Seccombe, 2010). The organisation threatened the developer with legal action to have the wind farm moved. The federal lawsuit was dropped in 2012 after Cape Wind and the local fishermen's association agreed to work together on ways to co-exist as part of a settlement agreement (Cape Wind, 2012) . This resulted in Cape Wind ensuring fishermen that Horseshoe Shoal, the area where the project is being proposed, would remain open to fishing activities.

A quantitative study of Scottish fishermen (Alexander et al., 2013b) investigated their attitudes towards MRE extraction and any influential factors in terms of fishing experience and practice, association membership, location, and knowledge of offshore renewable energy installations. The study found the majority of fishermen surveyed expressed positive (48%) or neutral (33%) attitudes towards MRE developments and the most import factor influencing fishermen's opinions was whether they knew of a nearby offshore development, followed by location, (whether they operate from the mainland or the islands). The study suggested the higher percentages of positive and neutral responses may be linked to the fact that the majority of fishermen were unaware of any MRE development in their locality and have not yet been exposed to it. This is supported by a review study by Wolsink (2007) which hypothesised that attitudes towards onshore renewable developments follow a U-shaped curve. In the curve, attitudes range from positive (when people are not aware of a renewable energy project in their locality), to much more critical (when a project is announced), to positive again (some reasonable time after construction).

To build acceptance of MRE technologies among fishermen will require a thorough understanding of their current perceptions of MRE and the attitudes that exist towards this new form of energy generation. As the wave, tidal and offshore wind sectors are not yet fully established on the island of Ireland, with limited numbers of device deployments and commercial scale developments, there is no evident baseline study in existence on attitudes and perceptions of fishermen. This paper aims to address this research gap by investigating the perceived impacts of the development of MRE on Irish fishermen. The objectives of this current study were (i) to gather information on the attitudes of Irish fishermen towards MRE developments in their locality; (ii) to identify the perceived impacts and opportunities associated with MRE for the fishing industry along with any potential mitigation measures. A survey was carried out among a representative sample of fishermen from the island of Ireland operating in areas where MRE developments have been proposed. The results are compared with the studies conducted among Scottish fishermen (Alexander et al., 2013a, Alexander et al., 2013b). Although the case study projects are still at early stages of development this study investigates Wolsink's theory that initially attitudes are positive, then as projects progress stakeholders become more opposed to them. This information will provide developers and policy makers with a better understanding of how attitudes may change as project progress which could help with devising mitigation strategies based on this.

4.2 Materials and Methods

4.2.1 Case study sites

Three proposed MRE developments on the island of Ireland were chosen as case study sites in which to carry out the survey (Table 4.1). These sites were chosen as they represent offshore wind, wave and tidal energy projects respectively and are in various stages of development. In addition, local fishing organisations and fishermen have been consulted on the developments by the project teams at each site and the process is still on-going. It was therefore assumed that the fishermen taking part in the survey would, at the very least, be aware that these projects were in development.

Table 4.1. Case study sites

	Technology	Stage of dev.	Type of dev.	Target fish species	Gear used	Vessels registered
AMETS	Wave	Foreshore licence application	Wave energy test site	Lobster, crab, mackerel	Static, mobile	73
Torr Head/ Fair Head tidal	Tidal	Scoping and EIA	Commercial tidal farms	Lobster, crab, scallops	Static	28
FFW	Offshore wind	Scoping and EIA	Commercial offshore wind farm	Nephrops, scallops, lobster, crab	Mobile, static	212

4.2.1.1 Atlantic Marine Energy Test Site (AMETS)

The Atlantic Marine Energy Test Site is being developed by the Sustainable Energy Authority of Ireland (SEAI) off Annagh Head, west of Belmullet in County Mayo. The purpose of AMETS is to test and demonstrate the performance of pre-commercial wave energy devices in generating electricity and their survivability in extreme open ocean conditions. The proposed test site will operate for up to 15 years and provide two separate test locations at various depths of water depending on the specific devices tested - mid water 50m water depth and deep water 100m water depth. A report commissioned by the Irish sea fisheries board, Bord Iascaigh Mhara (BIM), outlining the socio-economic profile of Ireland's fishing communities has sectioned Ireland's coastline into Fisheries Local Action Group (FLAG) regions (Bord Iascaigh Mhara, 2013). The AMETS site is located off the coast of the northwest FLAG region which comprises three counties: Mayo, Sligo and Leitrim. With 238 the northwest region has the smallest share of vessel owners among all FLAG regions, which can be explained by the region not being home to one of the six major harbours. Inshore fishing activities within the project area consists mainly of brown crab and lobster by members of the local Erris Lobster Conservation and Restocking Association (ELCRA) and the

Erris Inshore Fishermen's Association (EIFA), and limited trawling by members of the Killybegs Fishermen's Organisation (KFO) (Electricity Supply Board International, 2010).

4.2.1.2 Torr Head and Fair Head Tidal projects

The Irish energy provider Bord Gáis Energy (BGE) and tidal energy system developer Open Hydro entered a joint venture partnership called Tidal Ventures in 2010. In 2012 the Crown Estate awarded Tidal Ventures an Agreement for Lease (AfL) giving them exclusive rights to investigate the potential of installing a 100 MW tidal array off Torr Head on the north coast of Co. Antrim in Northern Ireland. A separate tidal energy development of up to 100 MW installed capacity has been proposed by Fair Head Tidal (FHT), a company set up by DP Energy and DEME Blue Energy. The company was also awarded an AfL to investigate the site. The award of the AfL enables both developers to undertake assessments of environmental considerations and on-going engagement with local stakeholders to help design the most appropriate tidal array for the locations. A significant number of small vessels, mostly under 10m in length, operate from harbours on the North coast in the vicinity of both projects. These vessels fish mainly for lobster and crab. Information from CEFAS, the marine and fisheries science advisors to the UK government, shows that the areas under investigation are not regularly trawled by commercial fishing vessels due to the presence of boulders which tend to snag trawl nets (Thetis Energy, 2009).

4.2.1.3 First Flight Wind

First Flight Wind (FFW) is a consortium comprising B9 Energy, Dong Energy and RES that proposed to develop a 600 MW offshore wind farm off the south east coast of Co. Down, Northern Ireland. The area under consideration was identified in the Strategic Environmental Assessment of the ORESAP (AECOM et al., 2012) as potentially suitable for offshore wind development, subject to project level mitigation. The location for the proposed project was in the vicinity of the three main fishing ports in Northern Ireland. The majority of fishing effort in the area is directed towards Nephrops or prawn fisheries, however, there is also a significant number of smaller vessels that fish for lobster and crab (Service et al., 2013). In June 2014, subsequent to the survey being carried out, the target capacity of the project was reduced to between 300 MW and 400 MW in order to limit the potential impact on existing marine users in the area including commercial fishing and shipping[1]. The project was then cancelled in December 2014 due to the fact that construction would not be completed in time to avail of renewable energy market incentives for Northern Ireland[2].

4.2.2 Survey design

Surveys are the most frequently used instrument in social science when examining attitudes and perceptions of a target group (Blair et al., 2013) and they are a common tool in carrying out socio-economic research (Robson, 2011). A survey questionnaire was designed for this study to provide quantitative information on fishing activity of boat skippers and/or owners and their attitudes to MRE. Details on fishing activity was gathered as it is thought that the attitudes of fishermen towards MRE developments are likely to be affected by a number of factors, including gear type, membership of an association and fishing experience (Alexander et al., 2013b). This information was obtained from respondents, however the effect of these factors on attitudes is not analysed in this paper. Vessel skippers and owners were targeted because the impacts and opportunities associated with MRE are likely to be of more significance to them than for casual crew members. The questionnaire was developed to build on other attitudinal studies of fishermen in the UK (Gray et al., 2005, Mackinson et al., 2006, Pita et al., 2010) and in particular the study focussing on fishermen on the west coast of Scotland (Alexander et al., 2013b) for the purpose of comparison. The design also involved consultation with fisheries experts and members of the fishing industry. The survey covered five key themes:

(i) fishing activity characteristics,
(ii) attitudes of fishermen towards proposed MRE developments occurring near to their home port,
(iii) perceived opportunities associated with MRE for the fishing industry,
(iv) perceived negative impacts associated with MRE for the fishing industry, and
(v) the level of consultation and involvement in decision-making on projects (to be published separately).

[1] http://www.firstflightwind.com/media/release/36/first-flight-wind-identifies-preferred-target-capacity-for-offshore-wind-project
[2] http://www.firstflightwind.com/media/release/42/first-flight-wind-to-cease-development-of-offshore-wind-project

The survey was designed to gather a considerable amount of information from respondents while at the same time comprise of short questions that could be easily understood. The language was kept simple and the questions were short in order to achieve this. The survey contained 26 questions – the majority of which (18) were closed questions with fixed alternatives – mainly yes or no answers. This type of question is commonly used in quantitative studies. There were five open ended questions. Open ended questions provide no restrictions on the content or manner of reply other than the subject area. These included questions on the opportunities and impacts associated with MRE as perceived by fishermen. There was also an open question asking respondents for suggestions on how the negative impacts of MRE may be mitigated. Scale questions ask for a response in the form of degree of agreement or disagreement with a particular statement. Three scale questions were used in this survey. Respondents were read statements in relation to attitudes towards renewable energy in general, attitudes towards the development of MRE in their locality, the level of involvement in the decision-making process and asked to state their level of agreement with each statement. A five point Likert scale was used with the options strongly agree, agree, neutral, disagree and strongly disagree.

Due to difficulty accessing fishermen details at the three case study sites it was decided to use face to face, telephone and email methods and thus the survey was designed so that it could be self-administered if the respondent so wished. Following advice from fisheries experts and those working in the industry it was decided not to conduct a postal survey, as it was suggested that fishermen would be unlikely to return the questionnaire response. Due to the reported preference of fishermen for face to face interactions (Gray et al., 2005, Mackinson et al., 2006) this method was used where possible. The majority of the surveys (70) were carried out face to face at the local ports at the case study sites. Access to fishermen at AMETS was gained with the assistance of the BIM local fisheries officer. The surveys at the FFW site were carried out face to face with the co-operation and assistance of the Anglo North Irish Fish Producers Organisation (ANIFPO) and the Northern Ireland Fish Producers Organisation (NIFPO). In addition, 32 surveys were carried out over the telephone where face to face contact was not possible. Contact details for those operating in ports around the Torr Head and Fair Head tidal project sites were provided by the head of the North Coast Lobster Fisherman's Association. Only two surveys were returned via email.

Although pilot surveys are highly desirable, this was not possible due to the limited access to fishermen. In the absence of a pilot, the survey was pre-tested on academic colleagues, fisheries scientists and social scientists. In addition to this, the first five survey respondents were asked to provide feedback on the survey and also asked if they had any issues with the type of questions asked. As no issues were reported, the survey was able to progress in its original format. The survey was carried out by a single interviewer and took place between July and October 2013. The duration of completing the questionnaire ranged from 10 minutes to over 30 minutes. Field notes were taken during the survey and additional comments by respondents were noted. Consent was obtained for the use of the information provided by each participant prior to the survey being carried out.

A representative sample of the population was targeted at each site. Table 4.2 shows the population and the sample surveyed. The population refers to the active registered vessels in the local ports where the projects are proposed. The vessel list for the ports in Northern Ireland is taken from a study by Yates (2012) and is based on fleet information provided by the Department of Agriculture and Rural Development in Northern Ireland. In total, 104 complete surveys were conducted with skippers or owners of vessels located at ports in the vicinity of the case study sites.

Table 4.2. Survey site population and sample size

	Population	Sample size	Response rate
AMETS	73	29	37%
Torr Head/Fair Head Tidal projects	28	18	64%
First Flight Wind	212	57	27%

4.3 Results

4.3.1 Fishing activity

With regards to the fishing activity characteristics, respondents were asked about the type of gear they used and whether their vessel was over or under 10m in length. Static and mobile gear types were quite evenly split with slightly more operating a static gear vessel (55%), mainly for potting (Figure 4.1). The main type of mobile gear was trawl nets followed by dredge nets. Slightly fewer of the skippers surveyed operated vessels under 10m (41%). Respondents were also asked if they were a member of a fishing association or organisation. The majority of participants at the three sites were members of local fishing associations or producer organisations (87%).

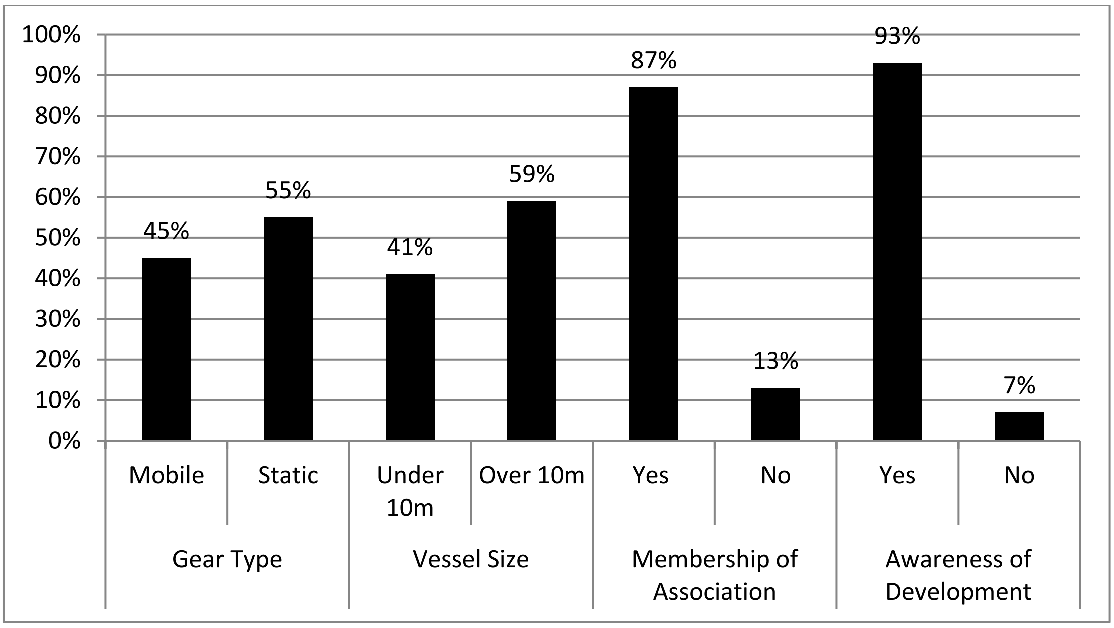

Figure 4.1. Fishing characteristics

Each respondent was also asked about the length of time he had been a fisherman and was given fixed alternatives of less than 10 years, 10-19 years, 20-29 years, 30-39 years and greater than 40 years. The fishing experience of those surveyed was mixed with the majority (94%) having more than 10 years fishing experience (Figure 4.2). The largest percentage had 20-29 years fishing experience (31%).

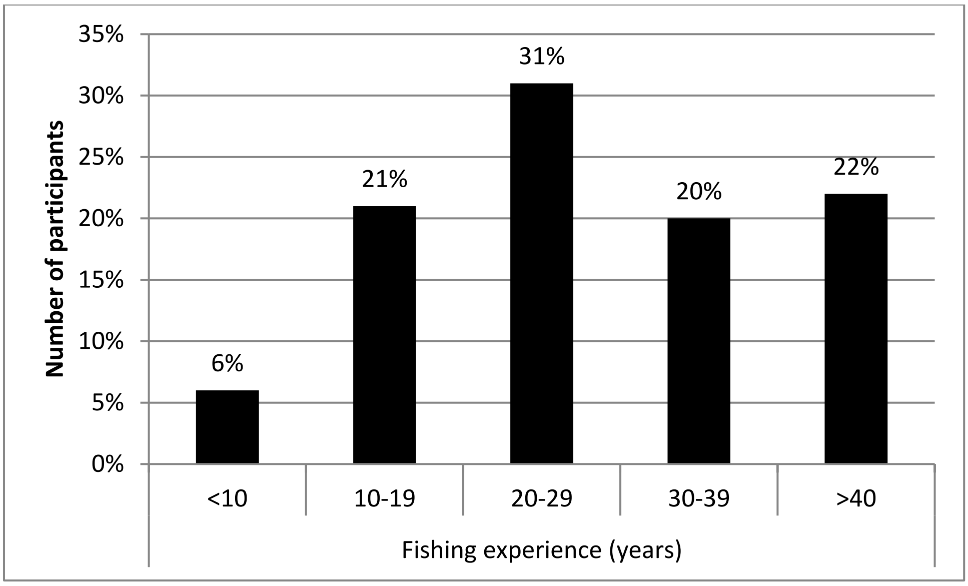

Figure 4.2. Fishing experience in years

4.3.2 Fishermen's attitudes towards Marine Renewable Energy

When asked if they were aware of any existing or proposed MRE developments occurring near to their home port, as expected the majority of participants (93%) responded that they were. Respondents were then read the following statement on their attitude towards MRE developments proposed in their locality and asked to indicate their level of agreement on a five point Likert scale ranging from strongly agree to strongly disagree – "I think that it is important to develop marine renewable energy sources, such as offshore wind, wave and tidal energy". The attitudes of the fishermen surveyed were quite evenly split with 40% either strongly agreeing or agreeing with the statement compared to 45% who disagreed. A further 15% of the respondents were neutral on the statement, shown in Figure 4.3. When the results are examined at a site level there is a noticeable difference in attitudes at each site. The responses here are shortened to agree, neutral and disagree for the sake of clarity in the graph. The highest level of acceptance is at the AMETS site where 55% of those surveyed were in agreement that it is important to develop MRE, while only 29% of the sample at the FFW site agreed with the statement. Some potential reasons for this variance in attitudes at each site are discussed in section 4.4.1.

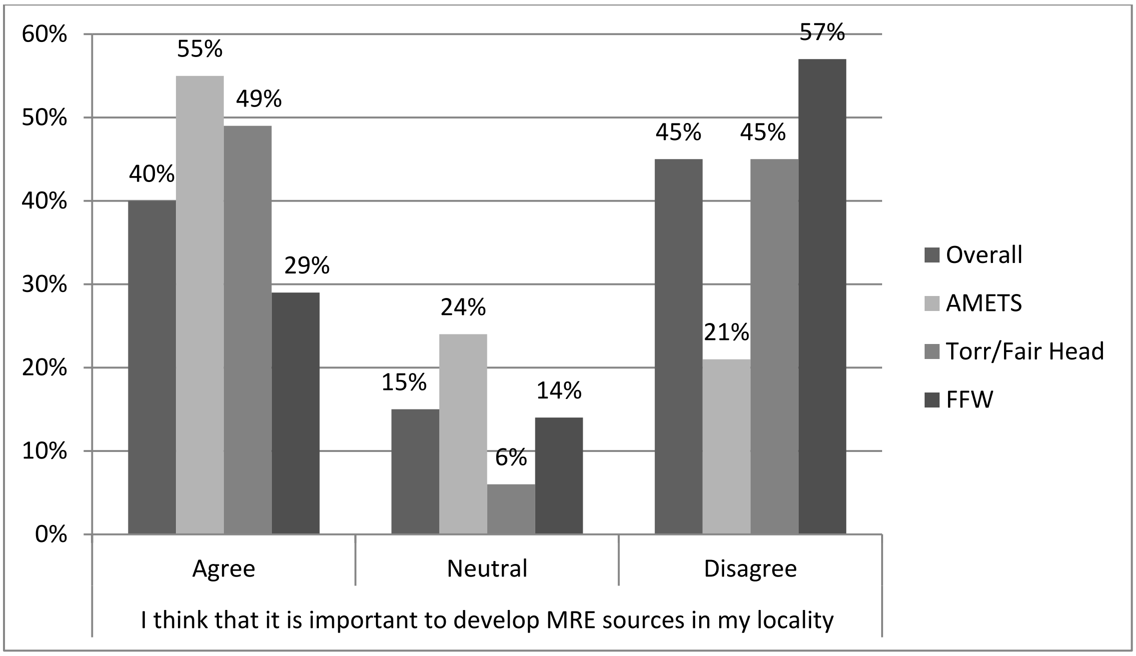

Figure 4.3. Attitudes of fishermen towards MRE

When asked if it would be possible for the fishing and MRE industries to co-exist the majority of respondents (70%) were of the opinion that this could happen (Figure 4.4). Again this follows a similar pattern to the attitudes above, in that the highest level of agreement was at AMETS and the least level of agreement was at the FFW site.

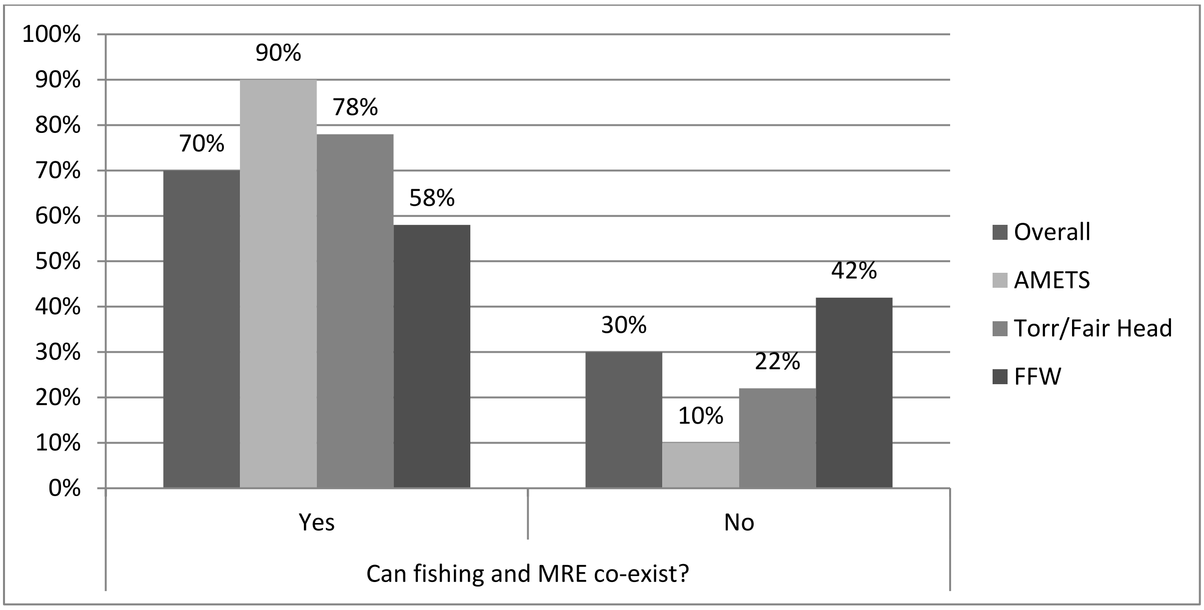

Figure 4.4. Co-existence of MRE and commercial fishing

4.3.3 Perceived Opportunities associated with Marine Renewable Energy

Respondents were asked an open ended question on what they thought were the potential opportunities or benefits that MRE might provide for the fishing industry. Alternative employment was the most cited opportunity (Table 4.3). The other opportunities or benefits to fishermen noted were the creation of new marine habitat, improvements to local harbours and infrastructure, and compensation.

Table 4.3. Perceived opportunities and number of times cited

Opportunities	Times cited	AMETS	Torr & Fair Heads	FFW
Alternative employment	58	17	8	33
Creation of marine habitat/artificial reef	7	-	4	3
Harbour/Infrastructure improvements	6	5	-	1
Compensation	4	2	1	1

Just over half of the participants (57%) said they would be interested in alternative employment on MRE projects if this opportunity was available to them (Figure 4.5). Interestingly 69% of those surveyed at AMETS and 72% of those surveyed at the Torr Head and Fair Head sites responded that they would be interested whereas only 46% of those surveyed at the FFW site were interested in diversifying. Similarly, 57% of the fishermen surveyed would be interested in re-training and taking courses to gain skills that would be required for employment on MRE projects. This corresponds to 69% at AMETS, 72% at Torr Head and Fair Head and 49% at the FFW site.

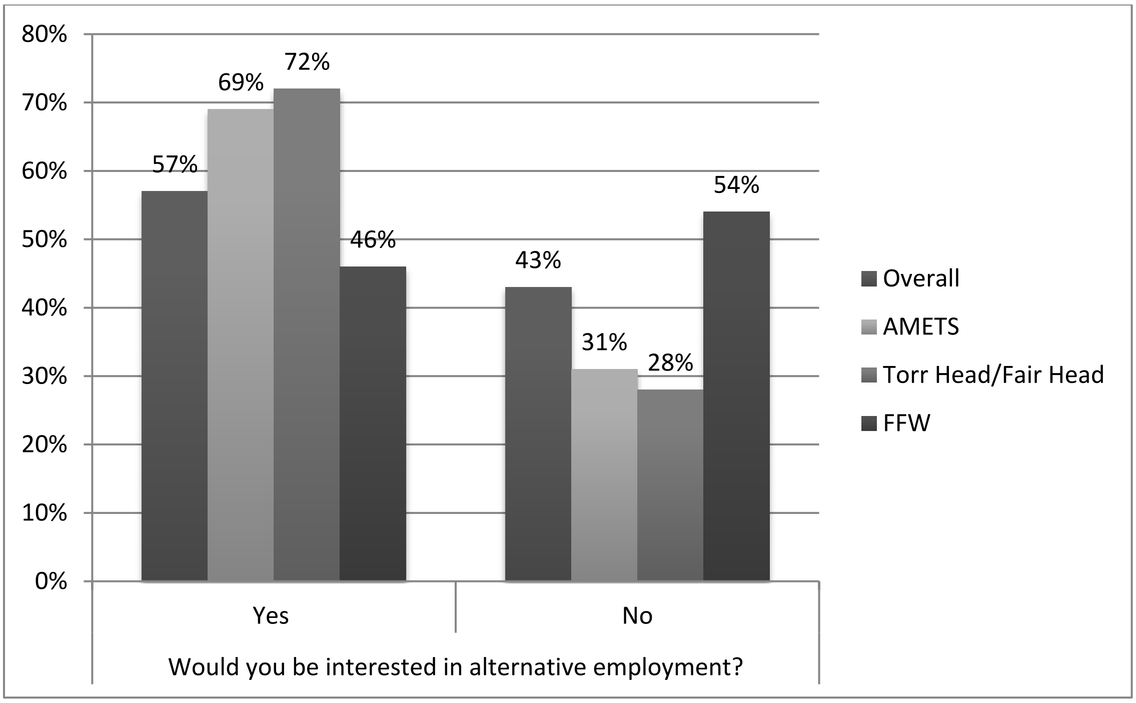

Figure 4.5. Alternative employment

4.3.4 Perceived Impacts associated with Marine Renewable Energy

Respondents were next asked an open ended question on what they thought were the potential negative impacts that MRE might have on the fishing industry. The loss of access to traditional fishing grounds, and the associated loss of income this could result in, was mentioned by 82 of the 104 fishermen surveyed (Table 4.4). This was the most often noted impact by a significant margin. The potential for the disturbance of fish species by noise during the construction phase of projects was also perceived to be a negative impact.

Table 4.4. Perceived impacts and number of times cited

Impacts	Times cited	AMETS	Torr & Fair Heads	FFW
Loss of access to fishing ground	82	16	16	50
Impact on fish species	24	3	2	19

Obstruction/Navigation hazard	11	4	1	6
Displacement of fishermen	7	2	2	3
Impact on gear	3	2	-	1
Aesthetics	3	-	2	1

Respondents were also asked to suggest any potential mitigation options that might be used to limit these negative impacts. The main mitigation options suggested were consultation, location of developments on non-fishing grounds and financial compensation (Table 4.5).

Table 4.5. Suggested mitigation strategies and number of times cited

Mitigation	Times cited	AMETS	Torr & Fair Heads	FFW
Consultation	36	11	6	19
Locating in areas not used for fishing	16	1	4	11
Compensation	14	3	4	7

4.4 Discussion

4.4.1 Attitudes

Although 40% of all the fishermen surveyed in the sample agreed that it was important to develop MRE projects in their locality there was still a considerable amount (45%) that are opposed to the developments. This can be contrasted with the Scottish study (Alexander et al., 2013b) where a smaller number of the fishermen surveyed (19%) held a negative attitude. Although Scottish fishermen appear to be broadly supportive of MRE, it was suggested that this was due to the majority of them being in the early stages of forming views. Analysis of the results from both the present Irish study and the Scottish study would seem to indicate that the attitude of fishermen towards MRE is following the pattern put forward by Wolsink (2007) that public acceptance of renewable energy projects follow a U-shaped curve. Initially support for renewable technologies is high, however, this begins to fall when a project is announced and more details are discovered. Although the Irish case study sites are limited to projects in the planning stage of development, results indicate that there is less support for MRE than among Scottish fishermen. The majority of Irish fishermen surveyed (93%) were aware of the proposed developments at the case study sites whereas less than half (44%) of the sample of Scottish fishermen had knowledge of a proposed MRE development near to their home port. The results support Wolsink's theory in that the Irish fishermen, the majority of whom were aware of the proposed developments, are more opposed to MRE than those surveyed in Scotland, who were less aware of developments. This suggests that the less supportive attitudes of Irish fishermen towards MRE is correlated to the fact that they are aware of the proposed developments which have been announced in their locality and that their views could become more supportive over time. Wolsink's curve suggests that after an initial fall, support for renewable energy projects then rises again as people become accustomed to the developments and the impacts are found to be less negative than feared (Howell et al., 2014). The challenge for developers and policy makers alike is to ensure the negative impacts of MRE on fishermen are mitigated and their concerns are allayed. This would help to increase the level of acceptance among fishermen. With regard to the co-existence of both activities, it is encouraging that at each site the majority of respondents felt that this was possible.

Familiarity with the renewable energy technologies proposed at each site may be a potential reason for the differing opinions. A review by Ladenburg and Möller (2011) concluded that familiarity with renewable energy technologies shapes attitudes and perceptions and that prior experience with wind turbines can influence the acceptance of offshore turbines. Attitudes towards the projects varied at each of the case study sites. Since the three technologies are quite diverse and as they are at varying stages of advancement in their development it is likely that attitudes towards them will differ. Offshore wind is the most mature of the three technologies and there are a number of operational farms in the UK on which fishermen can base their opinions. Although this is the first project to be carried out off the coast of Northern Ireland there are other projects which are operational nearby. The fishermen based in the ports near the FFW project should be aware of the existing West of Duddon Sands and Walney offshore wind farms located in the Irish Sea, as some of them are active near these projects. The increased level of negative attitudes at the FFW site may be due to the fact that offshore wind energy is relatively established compared to wave and tidal energy and fishermen are likely to have formed stronger views on offshore wind farms. As the wave and tidal sectors are still at a pre commercial stage there are currently very few existing projects on which fishermen can base their opinions. The comparative advanced state of the offshore wind sector provides a reason for attitudes being further along Wolsink's curve and therefore more critical than opinions on wave and tidal developments.

When comparing the attitudes across sites it is important to note that the physical scale of the projects could be a major factor in the differences in attitudes. AMETS is intended to be a site to test the survivability and performance of wave energy converters and the two test sites here cover an area of roughly 5km². The exact extent of the Torr Head and Fair Head tidal projects will depend on the power output of the tidal turbines used but as an indication an area of 6.8km² was awarded for the Torr Head AfL[3]. Regarding the First Flight Wind project it was estimated that a 600 MW offshore wind farm would require an area in the region of 120km² (Service et al., 2013). Such a large area could explain why fishermen in this area appear to be more opposed to the development. Given that fishermen are most concerned about losing fishing ground (Table 4.4) it is likely that the size of the development will have some influence on their attitudes. Naturally the larger the area under development the more likely it is that fishermen will have reservations about it. This is similar to experiences with terrestrial wind farms. Studies suggest that proposed onshore wind farms that are smaller in scale are more positively accepted (Wolsink, 1989, Lee et al., 1989). A study on attitudes towards onshore wind development in Ireland found the spatial extent of wind farms to be a concern and that a smaller number of larger turbines may be more acceptable (Sustainable Energy Authority of Ireland, 2003).

The idea that the general public are supportive of renewable energy but may have objections to renewable energy developments in their locality, or NIMBYism, is often cited as a reason for stakeholder objection to renewable energy projects. The literature on acceptance of renewable energy developments in recent years has been increasingly critical of the NIMBY concept. It has been accused of being an overly simplistic theory used to capture a wide range of attitudes and opinions (Warren and Birnie, 2009). It

[3] http://www.tidalventures.com/questions.html

has also been criticised for implying selfishness as an underlying cause which does not accurately reflect the real reasons for opposition (Kempton et al., 2005). An alternative theory is that of “place attachment” which can be described as a “positive emotional connection with familiar locations such as the home or neighbourhood” (Manzo, 2005). Stakeholder opposition can be viewed as a form of “place-protective action” and may arise when a renewable energy development is perceived as a threat to place related identity processes (Devine-Wright, 2009). Many of the ports near to the case study developments have been primarily used to land fish for centuries and as such it is likely there is a strong identification with fishing at these sites. The majority of the fishermen surveyed had over twenty years fishing experience and in addition to this many of those surveyed with a family background in fishing would have strong links to the sea that span generations. Accordingly fishing could be viewed as much more than a job but rather part of their cultural identity.

4.4.2 Opportunities

The realisation of the potential opportunities and benefits associated with MRE may help to enhance the attitudes of fishermen towards the acceptance stage of Wolsink’s curve. The most noted opportunity of MRE for fishermen was alternative employment. This is encouraging for developers as local job creation and the related contribution to the local regional economy is seen as the most direct measure of the socio-economic potential of renewable energy sources (Sastresa et al., 2010) and is the most often cited driver of public support (Domac et al., 2005). While it has been reported that fishermen would rather remain fishing (Rodwell et al., 2012) the results here suggest that this is not true for all fishermen. If alternative employment were to arise on MRE projects the majority fishermen surveyed stated they would be interested in this. The fishing industry on the island of Ireland is facing challenging times and MRE presents an opportunity for fishermen to diversify and/or supplement their income. Service companies set up by the main fishing organisations in the UK; the Scottish Fishermen’s Federation (SFF), the National Federation of Fishermen’s Organisations (NFFO) and the Anglo North Irish Fish Producers Organisation (ANIFPO), have enabled member fishermen to find alternative employment through the provision of services to the offshore sectors. The services company set up by the ANIFPO have up to fourteen vessels and skippers providing services to offshore industries, including the FFW project. Despite the fact that the FFW project has already provided employment for local fishermen there is little evidence as yet that this has positively influenced attitudes towards MRE developments as the majority of those surveyed at this site opposed the project. However, when work on the project ceased it was still in the planning stage and the number of jobs that had been available for fishermen was relatively small.

The current licensing of fishing vessels in the Republic of Ireland excludes the use of such vessels for alternative activities such as those required to support MRE developments (Ascoop et al., 2012). Currently Irish vessels surrender their water line certification when they receive a fishing permit, meaning that they cannot carry passengers or engage in other commercial work. They can, however apply for a commercial type licence but in doing so must give up their fishing licence. Obtaining such a commercial licence involves costs in terms of necessary equipment, vessel survey and certification with Health and Safety standards, which account for a significant proportion of the expense. They can subsequently re-certify as a fishing vessel. For fishermen the constraint is largely an economic one, in terms of the cost of switching licenses. Due to the uncertainty that exists over the jobs that will be available for fishermen on MRE projects, they are reluctant to forego their fishing licence to seek alternative employment in the MRE sector. The diversification of fishermen is something which BIM are currently involved in through the six Fisheries Local Action Groups (FLAGs) they have established in Ireland. The FLAG programme is funded under Axis 4 of the European Fisheries Fund (EFF) and aims to encourage coastal communities that are reliant on fishing to develop a strategy to increase revenue and employment opportunities in their area (Bord Iascaigh Mhara, 2014). The FLAGs were established in Ireland in 2013 and provide grant aid for projects which intend to help achieve the aims of the programme. The FLAG strategy document for the North West Region (which includes the coastal area around AMETS) recognises marine energy production as an area in which fishermen could potentially find employment. While there are currently no direct plans to re-train fishermen in skills that would be required for employment on MRE projects it is something which could potentially be funded in the future as the sector expands. Funding for such re training programmes could enable fishermen to avail of these jobs when they become available.

Preferential hiring practices, where fishermen who have been displaced from their traditional fishing grounds have been provided with alternative employment, have proven successful in offshore oil and gas projects in US waters (Austin et al., 2002). In the North Aleutians Basin in US waters, a proposed Outer Continental Shelf (OCS) leasing sale was cancelled in early 2010; however, the project developers would have been required to submit a local hire and training programme prior to the project start. Such a programme would include details on plans to recruit and hire local residents, contractors and business, as well as information on programmes to train and prepare locals for oil and gas industry jobs (Aleutians East Borough, 2006a, Aleutians East Borough, 2006b, Aleutians East Borough, 2009). Although this scheme was not specifically aimed at re-training fishermen, implementing a local hire and training programme for oil and gas industry-related activities could help fishermen diversify and supplement their income (Aleutians East Borough, 2009). While there would appear to be benefits to both sectors for fishermen to be employed by MRE developers it was, however, noted by a number of respondents that this work is likely to be short term and the majority of smaller and older vessels at the case study ports would not be suitable for this type of work. One respondent described employment in MRE as a "double edged sword" – in that there may be short term job opportunities for fishermen but there is also potential for longer term economic losses due to restricted access to fishing grounds. This compares to the Scottish studies where alternative employment was the most often mentioned potential opportunity(Alexander et al., 2013b) but there was uncertainty over whether the jobs would be available to fishermen as they may not possess the necessary skills required for this type of work (Alexander et al., 2013a). This uncertainty over employment provides a reason for the current lack of support for projects.

With regard to the other opportunities associated with MRE the results of the survey indicate that fishermen are aware of the artificial reef effect and the potential creation of new marine habitat around MRE structures which could possibly lead to increased catches for them. These opportunities were also mentioned in the Scottish studies (Alexander et al., 2013a, Alexander et al., 2013b), however as with the potential employment benefits, there was uncertainty over what the actual benefit to fishermen would be. Research into whether this is likely to occur on MRE projects is on-going and any evidence gathered on this should be disseminated to fishermen. There is also a perception among the fishermen surveyed that infrastructural improvements may be carried out at ports to facilitate the increased vessel activity that will likely occur as a result of MRE developments. Most of these perceptions came from fishermen operating near the AMETS project where it was proposed and discussed during consultations that a nearby port would be developed in order to enable access to the test sites. This is something which should be considered further as it could possibly benefit both sectors and may help to enhance acceptance among fishermen.

4.4.3 Impacts and Mitigation

According to the survey results loss of access to traditional fishing grounds and the associated impact on income and livelihood is a major concern among fishermen. This is something which will have to be addressed in order to avoid potential increases in spatial conflict. The fact that fishermen have concerns over the loss of fishing ground highlights the importance of selecting sites that are not intensely fished. This would limit the impact of developments on fishermen. Although data gaps on fishing activity exist in Ireland and globally, particularly for inshore fisheries, it is important that this information is gathered so that it can be used effectively in decision-making. Access to data on fishing activity is crucial to limiting the impacts that MRE developments may have on the industry. Other concerns expressed by fishermen were that there would be some impact on fish species during the construction phase resulting in reduced catches. Further perceived impacts were that MRE installations would be a navigational hazard and that fishermen would be displaced if fishing grounds are reduced. This could cause additional problems if there was displacement on to grounds that are already heavily fished. The impacts highlighted in this study are similar to those mentioned in previous studies (Alexander et al., 2013a, Alexander et al., 2013b, Mackinson et al., 2006) which would indicate that they are common concerns among fishermen. As the sector expands these issues are likely to come more into focus and this is something that developers and policy makers must be cognisant of in planning future developments. The concern that fishermen have over the potential loss of fishing ground due to the development of MRE projects highlights the importance of spatial planning to reduce this impact.

Ensuring the legitimate concerns of fishermen regarding these impacts are adequately dealt with could result in consensus being reached and could increase acceptance of projects. In cases where impacts may be significant, mitigation to the affected fishing community may be necessary. The aim for mitigation is to identify measures to avoid, reduce, offset or compensate for any potential significant effects. Early consultation with the fishing industry was the most often raised mitigation strategy to limit the impacts of MRE projects. It may be quite difficult to mitigate the loss of access and, in some cases, compensation for loss of earnings may be required. Compensation and the site selection are strongly linked to the consultation process in that the calculation of compensation and issues on siting and the location of MRE installations will require considerable engagement with fishermen and their participation in discussions. These mitigation options are similar to those mentioned in previous studies (Alexander et al., 2013b, Alexander et al., 2013a) suggesting that they are common options favoured by fishermen and those which developers and marine planners should consider carefully.

4.4.3.1 Site selection

The siting of MRE installations is seen as a major factor in limiting the impact on fishermen. A number of survey respondents mentioned that locating developments on non-fishing ground would be a considerable mitigating factor. It also features heavily in the mitigation options outlined in a report by the Collaborative Offshore Wine Research into the Environment (COWRIE) group (Blyth-Skyrme, 2010). Location is not always considered to be a critical aspect of the decision-making process, but it can often be the most important discussion point. Among the aims of both the SEA for the OREDP (AECOM et al., 2010) and the SEA for the ORESAP (AECOM et al., 2012) was to assist in identifying areas where MRE projects could be developed without causing significant adverse impact on the environment and existing resource users. Both of the SEAs acknowledged important data gaps which are critical to assessing whether MRE developments are viable in the intended resource areas. Although fishing organisations were consulted and the available Vessel Monitoring System (VMS) data for boats over 15m in length was analysed there were still gaps in the spatial and temporal data on fishing activity. The lack of baseline data for the marine environment is recognised as one of the limitations to the SEA of the OREDP and these gaps "considerably reduce the confidence with which likely significance of a potential effect can be determined" (AECOM et al., 2010). Both SEAs state that additional consultation with local fisheries organisations and fishermen would be required at the project level to fill data, information and knowledge gaps on key fishing grounds and fishing methods, highlighting that this is a very significant and complex issue which has yet to be addressed in an island of Ireland context. Unfortunately, such data gaps can result in additional requirements being placed on a developer to gather such information as part of their Environmental Impact Assessment (EIA).

Recent studies on the mapping of fishing activity have involved the participation of fishermen to identify areas of most importance for fishing (Alexander et al., 2012, Yates and Schoeman, 2013). Such mapping exercises are useful in filling in gaps in baseline data and could be used by developers to avoid fishing grounds. These studies indicate that despite concerns that fishermen may not be willing to part with information about fishing grounds due to competitive reasons this is not necessarily true for all fishermen. Participatory and interactive mapping tools require the participation of all stakeholders, potentially resulting in a consensus being reached which could in turn lead to increased compliance and acceptance of developments.

4.4.3.2 Compensation

The results indicate that fishermen view compensation as an option to mitigate potential negative impacts. A number of respondents feel that fishermen who may be displaced from their traditional fishing grounds and have suffered a loss in income due to the development of MRE should be entitled to some form of compensation, financial or otherwise. In areas where negative impacts cannot be mitigated or limited then compensation may be required. In general financial compensatory mitigation is only considered after an extensive review of alternative mitigation measures has been carried out and all options have been exhausted (Johnson et al., 2008). Issues surrounding compensation include who should be compensated, how the compensation will be determined and the manner in which compensation should be distributed. Some authors suggest that compensation should be standardised and evidence should be provided to support claims (Gray et al., 2005). There is also a question over whether fishermen should be compensated directly or through a trust fund set up to benefit fishermen. Compensation funds for fishermen have been used in the oil and gas industry. In the US, the Fishermen's Contingency Fund (FCF) was set up to provide compensation to commercial fishermen for economic and gear losses caused by oil and gas operations on the US OCS. The fund was founded by the US Treasury as a continuing fund, not subject to fiscal year limitations, consisting of contributions from oil and gas developments. The fund compensates fishermen who can provide evidence that they have experienced losses in earnings due to decreased access to fishing grounds or as a result of damage to gear. In the UK, the Oil and Gas Fishermen's Compensation fund was established by the UK Offshore Operators Association to compensate for lost or damaged gear and loss of fishing time, or vessel damage that is not attributed to a particular operator. This fund is managed by representatives of fishing organisations in the UK which demonstrates the viability of administering compensation funds through organisations. The majority of fishermen who participated in the survey are members of fishing organisations which could potentially administer compensation funds. However, this may be problematic for fishermen who are not part of an organisation.

It should be noted that in a global context there may be some issues with applying compensation mechanisms, which have proven successful in the oil and gas sector, to the nascent MRE sector. There are clear technology, market and environmental differences between the offshore oil and gas industry and the emerging marine renewables industry. The high profitability of the oil and gas sector has enabled such companies to contribute to compensation funds. Companies and developers in the MRE sector are reliant on government subsidies in order to become operational and as such they may have difficulty contributing to compensation funds for fishermen. The financial fragility and high risk nature of the wave energy sector in particular, at this pre-commercial stage, may restrict the option of compensating fishermen who may be impacted. Companies involved in wave energy also tend to be small and medium enterprises with very limited financial resources.

4.4.3.3 Non-financial compensation

There are other non-financial compensation options that could be used by developers in the mitigation of impacts. One possible option may be for developers to compensate a fishery by introducing hatchery-reared juvenile fish species. For example a joint initiative between the Orkney Sustainable Fisheries Ltd and the European Marine Energy Centre (EMEC) was launched in 2010 where juvenile lobsters were released in the EMEC site at Billia Croo, off the west coast of Orkney, Scotland (European Marine Energy Centre, 2012). The first few years of this project involved assessing the natural stocks on the grounds and the survival and success rates of the releases have also been recorded. The project found that the area within the EMEC wave test site at Billia Croo provides suitable feeding and habitat refuge for lobster, and has the potential to act as a nursery area to both the local fishery and to the Orkney Islands as a whole. Research is on-going to assess the success of released juveniles into the area and any potential benefits for fishermen as a consequence. Further monitoring at the site is being carried out. Although this project is specific to the site where it is being carried out, it would be useful to examine whether similar schemes could be replicated in other locations globally where MRE projects are being developed.

4.4.3.4 Limitations

There are limitations to this study which may impact the interpretation of the results. The comparison between two separate groups of fishermen in two different jurisdictions is problematic. In an ideal situation the attitudes of the same group of fishermen would be studied as projects progress over time to test Wolsink's theory. This would better help to identify how attitudes may change among the same group of stakeholders. There is also an issue with comparing results from projects involving different technologies and vary in scale. The technologies used in MRE projects are quite diverse and as such the impacts and indeed the attitudes of fishermen towards them are likely to vary. Despite these limitations there remains scope for further monitoring of attitudes as projects progress to examine whether attitudes and perceptions change.

4.5 Conclusions and Recommendations

Understanding the attitudes of fishermen towards MRE and the factors which influence this will assist in devising mitigation strategies. The results and analysis from this study can be used by policy makers and developers to help enhance the positive opportunities associated with MRE for fishermen while also limiting the negative impacts. This will help considerably in avoiding confrontation or conflict between the two sectors. Results from this survey show that attitudes of Irish fishermen are less supportive than those of Scottish fishermen as found in a similar study. As the MRE sector expands and projects become operational further research is required to examine whether the attitudes of fishermen change and whether there is an increased level of acceptance towards them. This would help to determine whether the acceptance of fishermen towards MRE follows Wolsink's curve at the later stages of development.

With regard to the potential opportunities associated with MRE a recommendation from this study is for a legislative amendment to vessel licensing requirements to allow fishermen in the Republic of Ireland to avail of alternative employment opportunities on projects without having to forego their fishing licence. This could potentially enable fishermen to supplement their income while at the same time retain their fishing licence and right to fish. The preferential hiring of fishermen who may be displaced is a practice which could be adopted by MRE developers to reduce the risk of conflict with fishermen. Local hire and training programmes which prepare and train local fishermen and residents for MRE jobs would help to reduce the uncertainty fishermen have over employment opportunities. Similar programmes have been used in the oil and gas industry and they could also be applied to the nascent MRE sector. Such schemes have the potential to help fishermen diversify and improve the local economy. Due to uncertainty over the amount of jobs that fishermen will be able to undertake on projects further work is required to quantify this. While it has been suggested that MRE devices can help to create new marine habitat there is a need for further research to determine the actual benefit of this to fishermen. Construction to improve harbour facilities and infrastructure is another perceived benefit associated with MRE development and any upgrades should be carried out in a way that is of benefit to both sectors.

It is likely that if fishing activities are interrupted as a result of a MRE development some form of compensation or disruption payment will have to be considered. This will involve negotiations with fishermen and should be based on evidence of fishing activity in the area of development. There is also scope for a standardised method for calculating compensation. Direct payments to fishermen who may be impacted during the construction period is one option, however this is more likely to be a short term solution. For the operational period some form of compensation fund similar to those used in the oil and gas sector may be more appropriate. Questions still remain over whether compensation is a viable long term option and how it would be administered and further work in this area is required.

5 Moving from consultation to participation: a case study of the involvement of fishermen in decisions relating to marine renewable energy projects on the island or Ireland

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Abstract

The development of the marine renewable energy (MRE) will impact traditional users of the marine resource, such as commercial fishermen. This could potentially lead to opposition and spatial conflict. The successful development of the MRE sector will heavily depend on the acceptance of projects by fishing communities. Effective stakeholder engagement is crucial to enhancing acceptance among fishermen. The consultation process is one of the key ways in which to engage fishermen and enable them to participate in decision-making. There is agreement among experts in the field that despite its importance, the consultation process is not effective and it is often carried out from the top down with little opportunity for real participation. A mixed methods research approach was used to examine the experiences of fishermen on their level of involvement in consultations and decision-making on marine renewable energy projects. In total, 104 surveys and 14 in-depth interviews were carried out with fishermen operating from ports at three case study sites around the island of Ireland where MRE projects were being developed. Just over half (56%) of those surveyed felt that they had been involved in consultations, while only 22% felt that they had been involved in decisions made on the projects. The use of participatory mapping tools in the selection of sites for MRE development provides an opportunity for fishermen to influence decisions. Designing and implementing marine spatial plans could also help to provide clarity and transparency over how trade-offs in the use of sea space are dealt with.

Keywords: marine renewable energy, commercial fishing, consultation, participation, maritime spatial planning

5.1 Introduction

Marine Renewable Energy (MRE) refers to offshore wind, wave and tidal energy and is an expanding sector across Europe and worldwide. The island of Ireland has vast potential MRE resources and national plans have been designed to further develop the sector (Department of Communications Energy and Natural Resources, 2014, Department of Enterprise Trade and Investment Northern Ireland, 2012). Although it has been suggested that in comparison to land-based renewable energy developments, offshore sites are less likely to be impacted upon by public opposition (Farrier, 1997, Ladenburg, 2008, Still, 2001), the expansion of MRE could theoretically result in the displacement of existing marine industries which could lead to spatial conflicts. Traditional uses of the marine environment, such as the commercial fishing, are likely to be most affected by the development of MRE (Alexander et al., 2013a, Alexander et al., 2013b, Gray et al., 2005, O'Keeffe and Haggett, 2012). While the exact impacts are unknown, MRE projects are likely to result in benefits and costs to fishing communities (Blyth-Skyrme, 2010, Perry and Smith, 2012). Potential benefits include alternative employment opportunities and improvements to harbour infrastructure while the costs to fishermen could include negative economic impacts due to reduced access to traditional fishing grounds (Blyth-Skyrme, 2010, Perry and Smith, 2012, Hoagland et al., 2015).

The fishing sector is a strong lobby group with the ability to influence the progress of MRE projects. As a case in point, in 2009, Columbia Energy Partners (CEP) investigated the possibility of deploying wave energy converters (WECs) in Tillamook County, Oregon. Commercial fishermen in the area had concerns over loss of access, displacement of fishermen, navigational hazards, impacts on fish and aesthetics (Stefanovich and Fernández Chozas, 2010). CEP eventually abandoned its plan to deploy WECs citing the inability to reach a consensus with the local fishing groups as a major influencing factor in their decision. As such the successful development of the MRE sector will depend to an extent on the acceptance of projects by fishermen. The focus of this article is to examine the participation of fishermen in consultations and decision-making on the development of MRE projects on the island of Ireland (comprising the Republic of Ireland and Northern Ireland). Commercial fishing remains an important industry on the island of Ireland in terms of employment and contribution to economic output. In 2012, the sector contributed €178.2 million in terms of Gross Value Added (GVA) to the economy of the Republic of Ireland, while employment was at 2,233 full time equivalent (FTE) (Vega et al., 2014). In 2011, there were 578 full time fishermen in Northern Ireland and 688 in total (full and part time) with the trawling fleet accounting for the vast majority of jobs (Service et al., 2013).

Effective and early engagement of stakeholder fishermen who may be impacted by the development of a MRE project is crucial to enhancing acceptance. The formal consultation process, namely the provision of information on projects to fishermen and the discussion of issues and concerns they may have, is one of the main ways to engage fishermen and enable them to participate in the decision-making process. Previous studies have shown that fishermen hold largely negative views of the consultation process (Alexander et al., 2013a, Gray et al., 2005). Gray et al. (2005) examined the involvement of fishermen in the consultation process on offshore wind energy development in the UK through interviews with fishermen, developers and regulators. Many of the fishermen interviewed believed that there was little meaningful discussion between fishing and wind energy representatives and it was merely a box-ticking exercise where fishermen may sometimes be able to influence the process but the power ultimately remains with offshore wind farm developers. The study concluded that offshore wind activity in the UK would be better implemented if stakeholder consultation was more extensive. Similarly, Alexander et al. (Alexander et al., 2013a) noted that there was a perception among a group of fishermen from the west coast of Scotland who were interviewed that the consultation process was merely “lip service” and the imbalance of power meant that the opportunity for fishermen to influence decision-making was limited. The study also identified the lack of trust between fishermen and the MRE industry as a major issue, as was the lack of trust in the government and other authorities. In this context, trust can refer to the need to collectively gain confidence in the consultation process and to progressively build social capital (Berghöfer et al., 2008). These studies would suggest that despite its importance, the consultation process is not effective in its current form. A recent study on establishing a social agenda in MRE research carried out by geographers, economists, social scientists, anthropologists, planners and business experts, made a recommendation for further research on the failings of existing consultation procedures and alternative forms of consultation (Kerr et al., 2014). The literature on Environmental Impact Assessment (EIA) and engagement with the public shows that stakeholder participation in the decision-making process is highly beneficial (O'Faircheallaigh, 2010) and as such, developing an approach which delivers effective engagement remains a key challenge for planners and developers.

As the MRE sector is not yet fully established in Ireland and there are no commercial projects in operation the issue of consultation on projects has not been fully researched. This paper addresses this gap. The overall aim of this study is to describe the consultation process relating to MRE projects at present, draw key conclusions and recommend better practices for engagement and consultation with fishermen on MRE projects. This will involve providing a typology of levels of participation of fishermen in MRE projects. The study also aims to assess the effectiveness of consultation processes in gathering baseline data which may not be currently available, such as spatial and economic information on fishing activity. This will require examining the willingness of fishermen to provide this information which could then be used to influence decision-making. A further objective is to address how participation can aid the design and implementation of projects. In addition, the study aims to explore the role of trust in consultation and the potential impacts of this on the participation of fishermen in decision-making.

Thus the key objectives are:

i. to assess the perceptions of fishermen of their level of participation in MRE projects at three different levels of engagement;
ii. to examine the effectiveness of consultation processes in gathering new data and the willingness of fishermen to provide this information;
iii. to identify potential mechanisms which are effective in enhancing the participation of fishermen in decision-making on MRE projects;
iv. to assess whether participation can aid the design and implementation of projects.

A mixed methods approach was employed to gather quantitative and qualitative information on the experiences of fishermen of consultation processes at three case study sites around the island of Ireland. The MRE projects at the case study sites were at varying stages of planning and development when the information was gathered.

The remainder of the paper is structured as follows. Section 2 provides background information on the requirement for formal consultation and the regulatory regime for the development of MRE project in Ireland. Section 3 outlines the theoretical framework by providing a literature review on levels of participation. Section 4 describes the case study sites and the criteria for the selection of these sites. Section 5 presents information on the methodologies used and the results from the surveys and the data gathered in the interviews. This is followed by a discussion of the results in section 6. Section 7 concludes the paper with some recommendations.

5.2 Background on the formal consultation process

Among the aims of the consultation process is to facilitate the participation of stakeholders in decision-making. Formal public consultation is a legal requirement of both the Strategic Environmental Assessment (SEA) (2001/42/EC) and the Environmental Impact Assessment (EIA) (85/337/EEC) Directives, which are part of the legislative regime for a wide range of defined public and private projects throughout Europe. This includes the majority of MRE projects. The consultation process can help to limit the impacts on fishermen by selecting areas for the development of MRE that are of low fishing importance (Blyth-Skyrme, 2010). Effective consultation was the mitigation option mentioned by Scottish fishermen (Alexander et al., 2013b) and Irish fishermen (Reilly et al., 2015) in two separate research studies. The Maritime Spatial Planning (MSP) process is concerned with planning marine development and facilitating the co-existence between marine activities. The MSP process provides an opportunity to have a participative process for planning and for fishermen to be involved in decision-making on issues such as site development (Ehler and Douvere, 2007). One of the main benefits of MSP is that it can increase co-ordination and identify and resolve potential areas of conflict through the contribution of stakeholders (Pomeroy and Douvere, 2008). The limitations of MSP are that there are considerable challenges regarding its practical application (Schaefer and Barale, 2011). Furthermore, there currently remains a lack of data necessary to inform plans.

The Foreshore Acts, 1933-2012, regulate property rights in the foreshore area in the Republic of Ireland and provides for the granting of foreshore licences and leases (O’Hagan and Lewis, 2011). The Act remains the single key legal instrument for managing development in the marine and coastal environment in Ireland. Under the Act the first step for a MRE developer seeking to develop a site is to apply for a foreshore licence. Responsibility for decisions made on granting a licence lies with the Department of the Environment, Community and Local Government. A foreshore licence enables a developer to carry out measurements and Environmental Impact Assessment activities on a site. For an EIA the onus lies with the developer to initiate the stakeholder engagement and consultation process. Under the EIA Directive, developers are required to ensure effective public participation in decision-making by taking the opinions and concerns of stakeholders into account when decisions on the project are made. Developers are also required to identify the statutory consultees and stakeholders and establish procedures for consulting with them. Prior to the completion of an EIA a developer is advised to consult with all relevant parties likely to be affected by the project, including Bord Iascaigh Mhara (Irish Sea Fisheries Board) and commercial fishing organisations (O'Hagan and Lewis, 2011). Developers are required to provide stakeholders with information on the development consent and EIA reports. This includes information on the direct and indirect effects of the project on a number of factors including impacts on resource users and cultural heritage.

Different approaches are taken by developers in making information available to the public and stakeholders such as fishermen. These include focus groups, workshops, group meetings, individual meetings, questionnaire surveys, interviews, emails and telephone communication (Seafish, 2012). Applications for consent on the granting of a licence under the Foreshore Acts are the subject of a public notice in the local newspapers and, additionally, in the national press, for larger projects (O'Hagan, 2012,). Larger projects often set up a project specific website and undertake local outreach events. This public notice informs the public that an application has been submitted and details where the documentation relating to the application can be viewed. Members of the public are provided with an opportunity to express their opinion on information supplied to them and on the request for development consent. Submissions on the application can be made, normally within four weeks of the date of publication of the public notice. The responses from the consultation process are taken into consideration by the consenting authority (the Department of the Environment, Community and Local Government) before a decision on the application for development consent is made. The developer is then required to notify the public of the outcome of decisions on applications for development consent.

In the UK, the Fisheries Liaison with Offshore Wind and Wet Renewables (FLOWW) consists of organisations involved in both the MRE sector and the fishing industry. The group was set up in 2002 to foster good relations between the fishing and offshore renewable energy sectors and to encourage co-existence between both industries. The group published guidelines that recommend the appointment of a Company Fisheries Liaison Officer (CFLO) and a Fisheries Industry Representative (FIR) to act as intermediaries between the MRE and fishing sectors (FLOWW, 2014). The CFLO has a key role to play in establishing contact with fishermen at the earliest possible stage of a project. It is also their responsibility to maintain contact with fishermen and ensure they are kept up to date with developments on projects. In addition, they can facilitate the participation of fishermen in decision-making by ensuring that developers are aware of the issues and concerns fishermen may have.

5.3 Theoretical framework

The existing literature confirms the advantages of involving stakeholders in decisions which may impact them, as well as recognising the importance of their participation (Brody, 2003, Innes, 1996, Reed et al., 2008, Beierle, 2002). Participation of fishermen in key decisions on MRE projects can help to resolve, or even avoid conflicts, establish trust, reach consensus, enhance the legitimacy and acceptance of management policies and decisions, and increase the likelihood of compliance with rules and regulations (Berghöfer et al., 2008, Coffey, 2005, Jentoft and McCay, 1995, Mikalsen and Jentoft, 2001, Pita et al., 2010). Establishing trust is crucial as the lack of it can result in the diminishment of stakeholder engagement (Kerr et al., 2014). Following a review of the literature on stakeholder participation in decision-making, existing frameworks were adapted and the levels of participation examined are informed, consulted and involved (Arnstein, 1969, Portman, 2009, Pretty, 1995). The main characteristics of each level are summarised in Table 5.1.

Table 5.1. Levels of participation

Informed	**Consulted**	**Involved**
One-way dissemination of information to stakeholders. Stakeholders are informed of decisions that have already been made.	Two-way flow of information. Opportunity for stakeholders to express views and concerns.	Opportunity for stakeholders to influence the planning process. Input into decision-making.

"Informed" comprises of a one-way dissemination of information, where stakeholders are told what has already been decided. This level corresponds to passive participation (Pretty, 1995). Despite a lack of input this level of participation is seen as an important first step to legitimate stakeholder participation (Pretty, 1995). "Consulted" is a level higher than being informed and consists of project developers and decision-makers seeking the views of stakeholders. This consists of a two-way flow of information with opportunities for stakeholders to express their views and potential concerns. Consultation with the fishing industry is also considered a vital route to collecting primary data, verifying secondary data and also gathering information on the likely concerns of fishermen (FLOWW, 2014). The consulted level may lead to stakeholders influencing decisions, provided that their concerns are addressed and are taken into account, but there is no guarantee that they will have an input into decision-making at this level (Arnstein, 1969, Pretty, 1995). The "involved" level refers to fishermen taking part in the management process and corresponds to interactive participation. At the involved level, participation can be defined as "direct involvement by residents in plan making beyond that of formal consultation, i.e. facilitating citizens with an opportunity to influence the planning process" (Breukers and Wolsink, 2007). Some authors claim that public participation only occurs when stakeholders are actively involved and where decision makers are substantially influenced by that involvement (Bishop and Davis, 2002).

5.4 Case study sites

Four proposed MRE developments on the island of Ireland were chosen as case study sites (Figure 5.1). The Fair Head and Torr Head tidal projects were treated as a single case study site due to the proximity of both projects to each other. These sites were selected as they represent offshore wind, wave and tidal energy projects respectively. At the time when the surveys and interviews were carried out each of the projects were at varying stages of planning and development. This enabled the assessment of the perceptions of fishermen of their level of participation in MRE projects at the different stages of development. At each of the sites, commercial fishing is important to the regional economies in terms of income and employment. Closures or exclusion to fishing grounds could potentially have significant socio-economic impacts on fishermen. As such, the effective engagement of stakeholder fishermen at each of the sites is crucial. Considerable effort was made by the developers and project members at each of the case study sites to ensure that local fishermen were involved in consultations and kept up to date with progress on the projects. Further justification for the selection of the case study projects is provided in the following sub-sections.

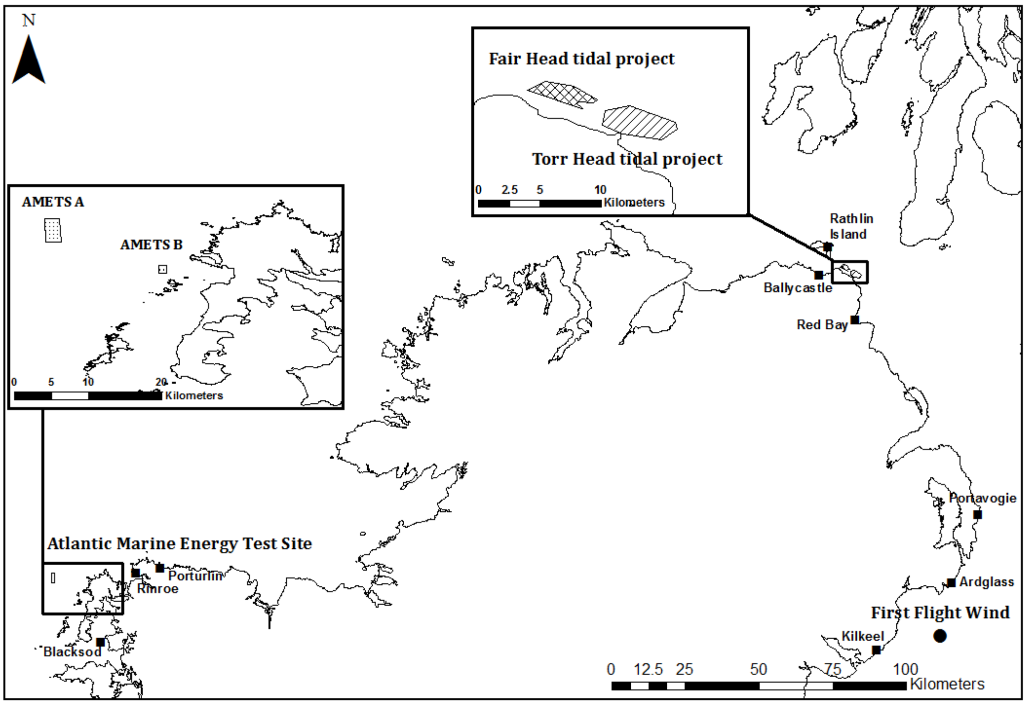

Figure 5.1. Case study sites

5.4.1 Atlantic Marine Energy Test Site

The Atlantic Marine Energy Test Site (AMETS) is being developed by the Sustainable Energy Authority of Ireland (SEAI) off the west coast of Belmullet, Co. Mayo. The purpose of the sites is to test and demonstrate the survivability of wave energy convertors (WECs) in open ocean conditions and their performance in generating electricity. The facility comprises two test sites – a site which will test prototype WECs in 100m water depth (Test Site A), and a near shore test site which will be utilised to test prototype WECs in 50m water depth (Test Site B). The main fishing ports in the area include Ballyglass, Blacksod, Rinroe and Porturlin. Fishing effort in the area consists of up to 70 vessels fishing mainly for brown crab and lobster (Electricity Supply Board International, 2011). Crab potting is the most important fishery in economic terms. A typical crab boat fishes up to 1,000 pots, and lands up to 100 tonnes per year at a value of around €1.20 per kg (Electricity Supply Board International, 2011). Total annual landings in Belmullet are in the region of 3,000 tonnes. A typical lobster boat fishes up to 600 pots, and lands up to 1.5 tonnes per year at a value of between €10 and €14 per kg (Electricity Supply Board International, 2011). Members of the AMETS project team were committed to ensuring that stakeholder engagement on the project was carried out to the highest possible standard and that key stakeholders were identified and involved in the process from the beginning (Ascoop et al., 2012). This was partly due to previous experiences and controversy surrounding the decision to grant permission for the construction of a gas pipeline through Sruwaddacon Bay, off the coast of Belmullet, and an onshore gas processing plant in Ballinaboy for the development of the Corrib offshore gas field. There was considerable opposition to the pipeline by the local fishing community in Belmullet, which was concerned about the potential environmental impacts, such as damage to fish spawning grounds and stocks. Opposition took the form of organised public protests and in the process five local farmers were jailed (Ascoop et al., 2012). In addition to this, there were also protests at sea by local fishermen.

The pipeline was also opposed due to dissatisfaction over the initial lack of stakeholder engagement on its construction. This demonstrates how a lack of opportunity for participation in decision-making can result in significant opposition to developments which can, in turn, cause costly delays. Significant effort was made by the AMETS project members to ensure that there was not a repeat of this situation. This involved establishing a project office locally to provide contact on the ground where regular meetings were held (Ascoop et al., 2012). These meetings involved the provision of information on the project and developments and the logging of all queries and concerns raised by stakeholders. The fishermen were primarily concerned about the loss of access to fishing grounds (Ascoop et al., 2012). The presence of a local office and the occurrence of regular meetings facilitated information dissemination and also fostered stakeholder involvement in the project. During these meetings six crab fishermen were identified by the project's liaison officer as the key stakeholder fishermen who may be impacted by the project. They were subsequently involved in discussions on the exact location of the test sites throughout the project development phase (Ascoop et al., 2012). The original proposal for the deep water test area was a rectangle, with its long axis orientated westwards. Subsequent consultation with fishermen resulted in the slight re-configuration of the shape of the test area to a proposed boot shape. The purpose of the alteration was to reduce the impact on the crab fishermen operating in the area. Ascoop et al. provide maps which further demonstrate the extent of the re-configuration (2012).

5.4.2 Torr Head/Fair Head tidal projects

Two separate 100 MW tidal projects are at advanced planning stages off the north coast of Co. Antrim, Northern Ireland. The projects are located of the coast of Fair Head and Torr Head respectively. Trawling in the area is limited due to the danger of entanglement of nets with large boulders, however, there are a small number of local vessels that fish for brown crab and lobster (Xodus, 2015). The main ports in the vicinity of the projects include Red Bay, Rathlin Island and Ballycastle. The inshore area adjacent to the Torr Head tidal site has been identified as a high priority area for spatial access in terms of crab and lobster fishing in a study of local skippers (Yates, 2012). For the two International Council of the Seas (ICES) rectangles in the vicinity of where the projects are located the average value of landings for vessels under 10m for the period 2008 to 2013 was £55,918 at Red Bay, £40,840 at Rathlin Island and £11,434 at Ballycastle (Xodus, 2015). Consultation procedures on both projects are on-going with the local fisheries groups (mainly the North Coast Lobster Fishermen's Association and North East Coast Fishermen's Co-Op). A local Fisheries Industry

Representative (FIR) was appointed by both developers to facilitate meetings with the fishing community in the area. The main concern of fishermen in the area is over the potential loss of access to fishing grounds during the construction and operational phases of the projects.

5.4.3 First Flight Wind

First Flight Wind was a consortium that initially proposed to develop a 600 MW wind farm off the coast of Co. Down in Northern Ireland. The majority of the Northern Irish fishing fleet operate out of three ports on the Co. Down coast, Kilkeel, Ardglass and Portavogie (Yates and Schoeman, 2013). Most of the fishing effort is directed towards Nephrops, however there are also a considerable number of smaller vessels that fish for crab and lobster (Service et al., 2013). A report on the economic importance to the Northern Ireland fishing industry of the wind resource zone selected for the FFW project found that the average value of landings for vessels over 15m for the period 2007 to 2011 was over £1.9million for the entire zone (Service et al., 2013). It should be noted that these figures did not take into account landings from vessels under 10m. In June 2014 it was announced that the target capacity of the project would be reduced to between 300 and 400 MW, due to the high level of fishing and shipping that occurred in the area[4]. The project was then cancelled in December 2014 due to the fact that construction would not be completed in time to avail of renewable energy market incentives for Northern Ireland, which required the project to be completed by 2020[5]. Prior to this, consultation on the project was on-going with regular meetings organised through the local fishing organisations. In addition, a commercial fisheries working group was set up to enable the discussion of any issues of concern to the local fishing community arising from the proposed offshore wind farm[6]. The group was made up of the local fishing organisations, councillors, relevant government bodies, the Crown Estate and First Flight Wind with the aim of providing an additional forum to allow discussion on solutions to problems and mitigation of potential negative impacts of the project on fishermen. Fishermen in the area were concerned about access to fishing

[4] http://www.firstflightwind.com/media/release/36/first-flight-wind-identifies-preferred-target-capacity-for-offshore-wind-project
[5] http://www.firstflightwind.com/media/release/42/first-flight-wind-to-cease-development-of-offshore-wind-project
[6] http://www.firstflightwind.com/working-groups

grounds, the potential impact of the development on fish stocks and habitat disturbance. There was also concern over increased vessel activity in the local harbours and ports.

5.5 Data collection and analysis

A mixed methods approach was used to collect quantitative and qualitative information from fishermen in order to examine current consultation methods on MRE projects and assess the perceptions of fishermen of their level of participation. In the context of this study, the use of mixed methods is a suitable and novel approach to highlight strengths and weakness of current consultation processes and identify effective methods of enhancing the participation of fishermen in decision-making on MRE projects. For this study a quantitative questionnaire survey was carried out among fishermen at the case study sites. Subsequently qualitative interviews were conducted in order to determine the level of participation of fishermen in the MRE projects at the three levels – informed, consulted, involved. Surveys and semi-structured interviews are research tools frequently used to gather information and to report the experiences of participants (Robson, 2011).

In total 104 surveys were conducted with fishermen who operate from ports in the vicinity of the case study MRE sites. A random sampling approach was used to survey a sample of skippers/boat owners operating at the case study sites. One respondent per active vessel was required and as such, the vessel skippers or owners were surveyed where possible. The vessel details of the fishermen who took part in the survey, such as vessel size and gear type used, were compared to existing vessel data and official statistics, where available, at each of the sites. The authors were satisfied that the sample who took part in the survey were representative of the fleets at the respective sites. Table 5.2 shows the population and the sample surveyed. The population refers to the active registered vessels at the local ports mentioned in section 4, where the projects are located. Information on the active vessels in Northern Ireland was sourced from a report by Yates et al. (2012) and in the Belmullet area from the local fisheries officer. The data gathered from the survey was analysed both collectively and at a site level and was represented statistically and in graphical form.

Table 5.2. Survey site population and sample size

	Population (active registered vessels)	Sample size	Response rate
AMETS	73	29	37%
Torr Head/Fair Head Tidal projects	28	18	64%
First Flight Wind	212	57	27%

The questionnaire survey consisted of five main sections and contained 26 questions in total. These five main sections were (i) fishing activity characteristics, (ii) attitudes of fishermen towards proposed MRE developments occurring near to their home port, (iii) perceived opportunities associated with MRE for the fishing industry, (iv) perceived negative impacts associated with MRE for the fishing industry, and (v) the level of consultation and participation in decision-making on projects. The section on the level of consultation and participation in decision-making on projects is the focus of this paper. In this section of the questionnaire, respondents were asked if they had been involved in consultations on marine renewable energy. This question covered the "informed" and "consulted" levels of participation. A further question was asked in the questionnaire on whether the respondents felt that they had been involved in the decision-making process on the project to date. "Involved" refers to fishermen participating in, and having an opportunity to influence, the planning and management processes. As part of the questionnaire, the fishermen surveyed were read the following statement, "I feel that I have been involved in the decision-making process for marine renewable energy developments in my locality". They were then asked to indicate their level of agreement with the statement on a Likert scale ranging from strongly agree to strongly disagree. The results from the survey questionnaire are presented in sub-section 5.1.

For the qualitative aspect of this study, the semi-structured interview questions were designed based on previous studies on stakeholder participation in decision-making (Alexander et al., 2013a, Pita et al., 2010, Portman, 2009) and information from the UK based Fisheries Liaison with Offshore Wind and Wet Renewables (FLOWW) group's best practice guidance for fisheries liaison (FLOWW, 2014). The interview questions were also based on comments made by fishermen that were recorded as field notes during the quantitative survey. The main body of the interview was categorised into a number of sections based on the three levels of participation under examination – informed, consulted and involved. A list of questions was prepared under these topic headings. Under the "informed" heading, respondents were asked questions on how information on the project was first provided to them and if they were satisfied with the timing of this. For the "consulted" heading, fishermen were asked if they had been provided with an opportunity to express opinions and concerns and if so, how this was facilitated. Fishermen were also asked about their willingness to provide potentially sensitive financial and spatial information on fishing activity during the consultation process. In the "involved" section, fishermen were asked whether they felt that they had participated in decision-making on the project. The semi-structured approach used enhanced flexibility in the line of questioning and allowed the interviewee to probe on interesting points and ask additional questions, if necessary. Thematic coding analysis was carried out on the interview data. This involved transcribing the interviews and coding the key themes that emerged in the transcriptions. This enabled the identification of recurring themes that arose during the interviews. Face to face interviews were carried out with 14 fishermen who expressed an interest in contributing during the quantitative survey.

The responses from the qualitative interviews are presented in sub-sections 5.5.2 to 5.5.5 The responses were interpreted based on the typology of the levels of participation outlined in section 5.3. This was done in order to assess the participation of fishermen in MRE projects. In addition, the issue of establishing trust between MRE developers and fishermen was a theme that frequently arose in the interviews and information on this is also presented. Quotes from the interviews are provided which support the analysis.

5.5.1 Quantitative survey results

Just over half (56%) of the fishermen who took part in the survey felt that they had been involved in consultations on marine renewable energy projects (Figure 5.2). When the results are examined at a site level, 62% of those surveyed at the ports located in the vicinity of the AMETS project gave a positive response that they had been involved in the consultation process. This compares to 61% for the Torr Head and Fair Head Tidal project sites, while just over half (51%) of the fishermen surveyed at the ports in Co. Down felt that they had been involved in consultations on the FFW project.

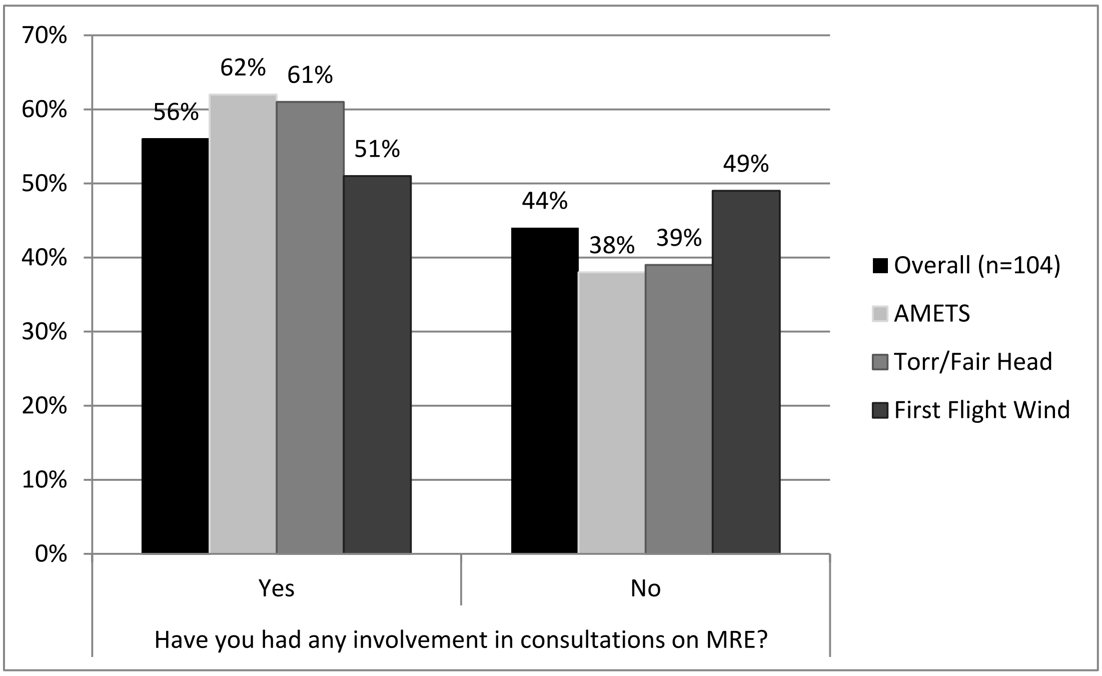

Figure 5.2. Involvement in consultations: dissemination of information and opportunity to express concerns and opinions

Using a five point Likert scale, ranging from strongly agree to strongly disagree, the majority (78%) either disagreed or strongly disagreed that they had been involved in the decision-making process (Figure 5.3). This suggests that, for many, involvement in consultations on the projects did not result in participation in the decision-making process. The responses have again been shortened to agree, neutral and disagree for the sake of clarity in the graph. As with the previous results this graph follows a similar pattern when separated across each site. At the AMETS site the largest percentage (21%) felt that they had been involved in the decision-making process. Only 5% of those surveyed at the FFW site felt that they were involved in decision-making. The possible implications of these results for the future of the developments are discussed in section 6.

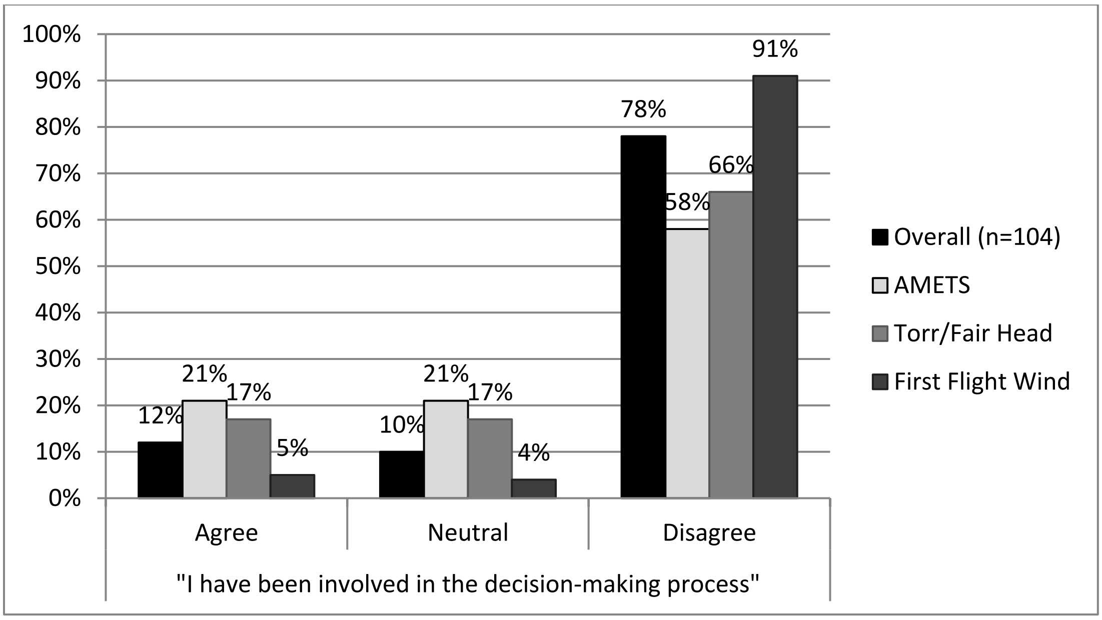

Figure 5.32. Participation in decision-making

5.5.2 Analysis of the perception of fishermen towards the "informed" level of participation

Eleven of the fourteen fishermen interviewed at the three sites were generally satisfied with how they were kept up to date with the development of the projects. All of the fishermen interviewed at AMETS felt that they had been well informed on the project. They were also satisfied that with the timing of when they were first informed about the project and the channels of communication that were used to provide information to them. This is evident from the quotes below.

> *"… they met us and they sat across the table from us and they told us what they intended to do or what they were hoping to do or what they proposed to do. So you can't get any better than that...if they sit across the table and tell you."* ***Pot fisherman, Rinroe, AMETS project***

> *"…they came before they proceeded with anything and they explained to us what they were proposing and discussed the potential impacts of it… I suppose that if a vessel just came into the area and started deploying buoys and stuff without telling us, of course the rumour mill would start and people would put 2 and 2 together and come up with 5 or 6, or something. And, you know, scare mongering and all that kind of stuff. No, they more or less informed us and*

kept us up to date and no, I cannot fault them on that.” ***Pot fisherman, Blacksod, AMETS project***

It was noted that the timing and frequency of meetings were important factors in ensuring that fishermen who may be impacted would attend. Across the three sites, the fishermen interviewed acknowledged the efforts of the developers to keep them informed about the projects. However, for the FFW project there was certain information that was requested but not provided, such as information on the impact of the development on certain fish species and stocks.

> *“They were never able to produce a report to say what the seismic survey did, the reaction of the crab to it. They were never able to provide that fully, there was a lot of information like that they didn’t give us.”* - ***Nephrops Trawl vessel owner, Kilkeel, FFW project***

5.5.3 Analysis of the perception of fishermen towards the “consulted” level of participation

Overall fishermen interviewed at the three sites felt that they were given the opportunity to raise issues or concerns at meetings or directly with consultants but there was no clarity over how these were subsequently dealt with. There was uncertainty over how information provided by fisherman was used and whether this information was taken into account in decision-making. One fisherman on the FFW project commented on how he had been well informed but that concerns were not dealt with adequately.

> *“We were kept informed but our issue was our concerns weren’t being addressed. They would have sat and listened, ok. We went to a meeting and we would have made an objection, they would have stopped the meeting, waited until we had our say, carried on with things.”* - ***Nephrops Trawl fisherman, Ardglass, FFW project***

> *“I think it’s an exchange of information and it’s important to have the exchange of information so the developers know the exact fishing that is in the area and the importance of it. But I don’t think there can be an awful lot of discussion over what they can do. If we were to go to (the developer) and say*

to them your cable route going to shore is going to be a major hassle to us, can you move it 2 miles? …are they going to do it? They're not going to do it at all.” – ***Fishing association representative, Torr Head/Fair Head tidal projects***

5.5.4 Analysis of the perception of fishermen towards the "involved" level of participation

The fishermen interviewed at the AMETS project acknowledged that they had been involved in the re-configuration of the site, as outlined in section 4.1. This was viewed positively among the fishermen and it was noted that the information provided by fishermen could be a benefit to the project. Fishing activity around test site A was mapped and an agreement was made to alter the shape of the site through negotiations. The project management team were flexible over the precise siting of the project which enabled a consensus to be reached. Results from the survey show that of the three case study sites, AMETS had the highest percentage (21%) of fishermen who felt like they had been involved in decision-making. In addition to this, the fishermen interviewed felt that they had been involved in the decision to re-configure the deep water test site. Furthermore there were no submissions lodged from fishermen on the subsequent foreshore lease application(Ascoop et al., 2012).

"...we kind of agreed certainly the outlay of the test sites with them anyway, where they were going to be and some of the other stuff that would follow on from it as well." - ***Pot fisherman, Ballyglass, AMETS project***

"Well we felt we had an input into it…and we felt it was an input that was necessary. And we felt it was an input that would benefit the project." - ***Fishing association representative, AMETS project***

However, there was a general feeling among fishermen at the other case study sites that they did not have an input into decisions that were being made on the projects. There was an overall view that decisions were made on the projects and fishermen were then informed of the outcomes rather than having any real opportunity to influence them. It was noted by one interviewee that fishermen at the FFW project had not been approached early enough in the planning process.

"Well again, all I can say is consultation didn't start soon enough. What do you want to consult about when it's fait accompli? They're coming along wanting us to agree to it after they've laid it down in stone, where it's going and how it's going." ***– Nephrops Trawl fisherman, Kilkeel, FFW project***

The consultation process was seen by one of the fishermen interviewed at the FFW site as simply a "box-ticking exercise" where the real decisions on the project had already been made. The fisherman viewed the process was a legal obligation that the developer needed to complete in order to proceed with the consenting process for the project, as is evident from the quote below.

"We found they were only ticking a box, that's all they were doing. They had us there to tick a box to say we consulted with fishermen but they didn't, they never took note of our plan, our concerns or worries, they just carried on with their meeting, with their proposal and what they wanted." ***- Nephrops Trawl fisherman, Ardglass, FFW project***

The location of projects and the lack of participation of fishermen in the site selection process for the FFW, Torr Head and Fair Head tidal projects was a common theme that emerged during the interviews. It was noted that there should be greater input from fishermen before sites are identified for the development or MRE projects. There was a general consensus across the case study sites that more involvement of fishermen at earlier stages of the planning process could lead to agreement on suitable locations for development. This could result in an agreement being reached that would be satisfactory for both developers and commercial fisheries. The quotes below demonstrate this.

"….if they (planning authorities) *were to sit down with fishermen's representatives at a very early stage, at a stage before a particular piece of ground has been put out to tender, so that when it is put out for tender the objections are minimised at an early date rather than put in for tender and now they've been successful they have to fight every stakeholder there for every inch of the ground. That's not a very sensible way to go about doing business. Not in my eyes anyway."* - ***Nephrops Trawl fisherman, Kilkeel, FFW project***

"We could pick any area out there that they (planning authorities) *could put a wind farm that will not affect us. Even off where we do trawl, we could have picked a piece of ground, not far off that is not as heavily fished, that is not as productive. There are plenty of places out there for that size they wanted."* - ***Nephrops Trawl fisherman, Ardglass, FFW project***

5.5.5 Establishing trust

Trust between fishermen and MRE project developers was a further theme which was mentioned frequently in the interviews. There was a perception among some of the fishermen interviewed that there was a general lack of trust between MRE developers and the fishing community and vice versa. This lack of trust can act as a barrier to the two-way flow of reliable information during consultations.

"There is no trust at all. When somebody is trying to take your livelihood or a big chunk of it away from you to benefit them at your expense, why would you trust them?" - ***Nephrops Trawl fisherman, Kilkeel, FFW project***

"Anyway to be quite honest there isn't the trust between us to believe anything they tell us. We think they'd tell us any amount of lies just to get us onside." - ***Nephrops Trawl vessel owner, Portavogie, FFW project***

It was noted that establishing trusting relationships between both sectors is something which can take a considerable length of time but it can be achieved. Again the early engagement of fishermen is important for building such relationships.

"And I think relationships and trust is something which has to be built, it doesn't happen overnight and I think as things go on we won't resolve all issues but hopefully we'll learn to work together." - ***Nephrops Trawl vessel owner, Kilkeel, FFW project***

5.6 Discussion

5.6.1 General discussion

The provision of accurate and up to date information is a key component of an effective stakeholder engagement process. The results show that fishermen interviewed at the case study sites were generally satisfied with how information had been provided to them on the projects. The provision of information was carried out through a variety of channels and meetings and personal/face to face interactions were the favoured methods identified among most fishermen interviewed. This was also noted in a previous study (Gray et al., 2005). These channels of communication would appear to be effective in disseminating information but they may need to be adapted depending on the preferences of the fishing community operating in the locality of a project. The frequency of meetings could lead to consultation fatigue. This may become an issue for fishermen if the process is demanding on their time (Kerr et al., 2014, Rodmell and Johnson, 2002). Thus, flexibility is required regarding the scheduling of meetings in order to reduce the risk of consultation fatigue. In areas where there are frequent consultation meetings on a number of different marine developments and proposals this issue needs to be managed carefully. The case studies have shown that fishermen are concerned over the potential impacts that MRE developments may have on them and they require information on this, including details on the effects on fish species and stocks. Although there is uncertainty over what the exact impacts of MRE developments on fish stocks will be, this information is important to fishermen. Research in this area is on-going and as results become available they should be disseminated to fishermen. Planners and developers need to be aware of the type of information that fishermen are looking for and that the details required by the different fishery groups may vary.

Effective consultation also requires the two-way flow of information which can be beneficial to both fishermen and MRE developers. Fishermen could provide significant information to the EIA process and it has been noted that this should be appropriately acknowledged and credited (FLOWW, 2014). The formal consultation process provides an opportunity to gather information on fishing activity that may not currently be publically available and fill gaps in baseline data. Deficiencies in fisheries data, particularly for inshore fisheries, currently exist in Ireland and globally. The lack of baseline data for the marine environment is a significant limitation in the site selection process. The lack of data on inshore fisheries has also been highlighted in previous studies on the interactions of fisheries and offshore renewables in the UK (de Groot et al., 2014, Gray et al., 2005). The interviews with fishermen included a question on whether they would be willing to provide data on the location of fishing grounds to project management and developers during consultations. Analysis of the interview data shows that while it may be considered commercially sensitive information, eleven of the fourteen fishermen interviewed at the three case study sites stated that they would be prepared to divulge details on fishing grounds, in the right circumstances. Although it was noted that there may be reluctance among some fishermen to share details on income, a number of crab and lobster fishermen at the FFW site had provided details on income and fishing grounds during negotiations on the calculation of disruption payments.

The provision of such information, if used when suitable sites are being identified and planned, could reduce the risk of developments being located on productive fishing grounds. This could act as an incentive for fishermen to provide these details. Recent studies on the mapping of fishing activity have included the participation of fishermen to identify areas of most importance to them (Alexander et al., 2012, Yates, 2012). These studies are a further indication that despite concerns that fishermen may not be willing to part with information about fishing grounds due to competitive reasons, this is not necessarily the case with all fishermen. Alternatively, projects such as Scotmap (Scottish Government, 2013) have also been successful in gathering fisheries data. The gathering of information on fishing activity could lead to the participation of fishermen in decision-making. The mapping of fishing activity requires the involvement of fisherman and this is a potential mechanism which could enable stakeholder participation, provided the information is used correctly in the selection of suitable sites. A collaborative siting process could help to ensure that MRE projects are located on sites that have a minimal impact on fisheries. In order for this to work effectively a certain degree of flexibility in the site selection process is required. This could help to avoid high intensity fishing grounds and reach consensus on location. Such a collaborative siting process was witnessed at the AMETS site and where a consensus was reached over the location of the deep water test site and it was altered slightly after discussions with local fishermen. As such it provides a good example of the participation of fishermen in site selection which is not often the case for marine developments. It also demonstrates how participation can aid the design of projects. Collaborative exercises such as this can help to empower fishermen which is seen as an important step in enhancing participation (Nutters and Pinto da Silva, 2012). However, facilitating a collaborative siting approach would require considerable time and commitment, and may not be possible for all developers. Some trade-offs in the use of marine space may be required and it should be noted that not all stakeholders will experience optimal outcomes (Young et al., 2007). As such, expectations should be managed as to how much fishermen will be able to influence outcomes. From the outset, clarity is required on the goals of the process, what is up for negotiation and what can be achieved. Clear channels of communication are needed, whereby decisions that are made and the reasons for them are carefully explained to fishermen.

Analysis of the interview data suggests that early engagement of stakeholder fishermen is a crucial element of effective consultation on MRE projects. The timing of stakeholder engagement in MRE projects has been highlighted as being key to enhancing participation (Eltham et al., 2008). A greater participation of fishermen before these sites are identified would help to reduce the possibility of conflict at the later stages of a project. Input from fishermen at the early stages would be more likely to result in the active participation of fishermen, rather than a consultation process that allows comments on decisions after they have been made, which is often the case. A greater input from commercial fishing organisations in identifying the zone in which to locate the FFW project may have avoided the subsequent decision to reduce the target capacity of the project. Fishermen’s knowledge of the area could potentially have been used to choose a zone that would be suitable to site a 600 MW offshore wind farm without having a significant impact on fishing activity. Likewise, the participation of local fishermen before the location of AMETS was chosen could potentially have avoided the delay and extra expense incurred as a result of the re-configuration of the deep water test site.

The development of maritime spatial plans provides an opportunity to facilitate the participation of fishermen in decision-making. While marine plans are already operational in a number of countries, participatory mapping could be utilised to inform plans that are currently being developed. MSP emphasises stakeholder participation in advancing an ecosystem-based approach to sea use management (Douvere, 2008).

5.6.2 Establishing trust and the role of Liaison Officers

The engagement of stakeholder fishermen at the early planning stages of a MRE project is vital to establishing trust. Evidence from the interviews would suggest that there is currently little trust between MRE developers and the commercial fishing industry, which could pose major problems. Analysis of the interviews shows that distrust was an issue at the FFW site in particular, where fishermen felt that major decisions on the project had already been made before they had been approached. As noted, trust between the sectors is important for enabling participation and the lack of it is something which could hinder dialogue and negotiations. Initiating early contact with fishermen could help to build trusting relationships and there are benefits of this for each of the levels of engagement examined in this paper. This could help to enhance the flow of information enabling developers to gain insight from the knowledge of local fishermen. The appointment of a Company Fisheries Liaison Officer (CFLO) and a Fisheries Industry Representative (FIR) is a crucial step in the stakeholder engagement process. The appointment of a trusted CFLO could potentially influence the willingness of fishermen to provide information on fishing ground and income. It is equally important that fishermen have the right person representing them in negotiations with developers. There are currently no specific recommendations for the appointment of CFLOs for MRE projects in Ireland. For the AMETS project considerable effort was made to ensure that the local community were involved in as much as was possible. As such, a local office was set up in Belmullet which was manned by a consultant three days a week. There was a genuine willingness by project members to allow fishermen to participate in decision-making on the specific location of the deep water test site, which was a key factor in a consensus being reached. This level of engagement could be seen as a contributing factor to the general acceptance of the project among the local fishermen. This approach proved successful on the AMETS project, however for future, larger scale MRE projects in Ireland a CFLO, who deals specifically with fishermen, may be required.

The facilitation of the consultation process by an impartial and trusted third party may help to enhance the effectiveness of the process. The selection of a suitable candidate to act as intermediary is crucial because there can be distrust between local fishermen and outside experts who are appointed as liaison officers by developers. This was also noted by Gray et al. (2005). Liaison officers have a key role to play in carrying out a background stakeholder analysis. This refers to a procedure for identifying the key actors and stakeholders in a system and assessing their interests in that system (Grimble and Chan, 1995). Previous studies on the participation of stakeholder in the

MSP process have highlighted the importance of conducting a background stakeholder analysis (Nutters and Pinto da Silva, 2012, Pomeroy and Douvere, 2008).

5.7 Conclusion and recommendations

The information gathered in this paper from the case studies of the consultation procedures on MRE projects on the island of Ireland has wider implications for the engagement of stakeholders on future developments. The results would indicate that the consultation process for MRE projects is currently not effective at addressing and resolving concerns that fishermen may have. This remains a barrier to effective consultation. The formal appointment of a liaison officer, as part of the institutional and management framework is required to make consultation processes more effective in enhancing the participation of stakeholder fishermen. Initiatives such as the Sea Grant Extension programme in the US have been successful in establishing trusting relationships between research, developers and coastal communities and empowering stakeholders and engaging citizens in decision-making (National Oceanic and Atmospheric Administration, 2015). A recommendation of this research is that a similar programme be replicated on the island of Ireland to improve relationships between stakeholders involved in MRE projects. The value of the role of trusted experts was witnessed at the Pacific Marine Energy Centre (PMEC) off the coast of Oregon in the US where a wave energy test site was selected with input from the local fishing community (Coonrod, 2014).

Data on inshore fishing activity is essential for designing maritime spatial plans in order to avoid areas of high fishing intensity. A further recommendation of this study is for data to be gathered through consultations with fishermen before sites are chosen for development. The gathering of spatial and financial data on inshore fishing through the use of participatory mapping methods could advance the consultation process from a mere “box-ticking” exercise to one that consists of meaningful discussion and the involvement of fishermen. This could help enable the progression from a consultation process where fishermen are informed about decisions that have been made, which corresponds to tokenism, to one which involves their active participation. A collaborative siting process, as witnessed on the AMETS project, should be a requirement as part of the planning and management framework for MRE developments. The fact that the FFW project has been cancelled presents an opportunity for planners to work with fishermen in the area in a collaborative manner to ensure consensus is reached on the location of any future offshore wind projects.

As the MRE sector expands, compromise over spatial access and the use of ecosystem services is inevitable. As such, a framework for dealing with ecosystem services trade-offs will be required. The aim of such an approach would be to weigh up the costs and benefits of a project in terms of the potential environmental, economic and social impacts. However, determining how to weigh and manage trade-offs in a manner that is equitable and satisfactory to all stakeholders is likely to be very challenging. This raises questions as to how strategic development decisions are made and whether they should be made by a central government department or a local authority. Alternative options such as stakeholder workshops and dedicated forums for the future planning of marine activities in specific areas should also be considered. Further work is required on how trade-offs are negotiated and how tools and mechanisms can be developed in order to reach consensus.

In conclusion, fishermen are more likely to engage in the consultation process if their concerns are being addressed and if they have an input to decision-making. Effective consultation and engagement could be beneficial for all those involved and improving the process remains a key challenge. Further research into how the consultation process can be improved to facilitate participation is required.

6 Exploring benefit schemes and compensation models for fishermen impacted by marine renewable energy development

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Abstract

Commercial fishermen are arguably the stakeholder group most likely to be directly impacted by the expansion of the marine renewable energy (MRE) sector. The potential opposition of fishermen may hinder the development of MRE projects and the provision of benefit schemes could to enhance acceptance. Benefit schemes refer to additional voluntary measures that are provided by a developer to local stakeholders. The aim of this study is to explore the issue of the provision of benefit packages to local fishing communities and financial compensation measures for fishermen who may be impacted by MRE projects. Semi-structured interviews were conducted with fourteen fishermen from three separate case study sites around the island of Ireland where MRE projects were being developed. In addition, ten company fisheries liaison officers (CFLOs) who have worked on MRE projects in the UK and Ireland were also interviewed. The interviews were analysed under the headings of local employment, benefits in kind, compensation and community funds and ownership of projects. Analysis shows that there is uncertainty among fishermen over whether they would benefit or gain employment from MRE. Provision of re-training schemes and preferential hiring practices could be used by MRE developers to reduce this uncertainty. There was also agreement between fishermen and CFLOs on the need for the provision of an evidence-base and a standard approach for the calculation of disruption payments. A formal structure for the provision of benefit schemes for fishermen would be useful. Furthermore, schemes that provide a range of benefits to fishermen and other stakeholders over the lifetime of a MRE project are more likely to be successful at enhancing acceptance.

Keywords: marine renewable energy, commercial fishermen, benefit schemes, financial compensation, disruption payments.

6.1 Introduction

Marine renewable energy (MRE) refers to offshore wind, wave and tidal energy and is a sector which could potentially be a significant contributor towards global energy supply (International Energy Agency, 2013). It has been suggested that MRE developments are less likely to experience public opposition and objection as such projects are generally located away from the public eye (O'Keeffe and Haggett, 2012). Rather, it is the potential opposition of stakeholder groups who depend on the marine resource for their livelihood that may hinder the development of MRE projects (O'Keeffe and Haggett, 2012). The commercial fishing sector is arguably the group most likely to be directly impacted by the development of MRE (Yates and Schoeman, 2013, Alexander et al., 2012). Loss of access and displacement from traditional fishing grounds could result in economic impacts in terms of reduced income. This in turn could potentially lead to the opposition of fishermen and conflict over the use of sea space. The need to keep local stakeholders on side has been recognised (Walker et al., 2010). As such, the mitigation of these negative impacts and planning for the co-existence of both sectors is crucial to enhancing the acceptance of projects among fishermen.

Community benefit schemes refer to additional voluntary measures that are provided by a developer outside of the planning and licencing processes (Scottish Government, 2015). As the wave and tidal sectors advance towards commercialisation and the offshore wind sector expands, the issue of benefit schemes and financial remuneration to coastal and fishing communities is increasingly being raised (Dalton et al., 2015). Types of community benefits for onshore wind include the creation of local jobs during construction, benefits in kind (such as improvements to local harbour facilities), community funds, and operation and local ownership of the energy project (Department of Trade and Industry UK, 2007). Opposition to onshore renewable energy projects is more likely if benefits are not generally shared among local stakeholders (Walker and Devine-Wright, 2008). Recent reports from Scotland have examined good practice in developing and implementing community benefit schemes from offshore renewable energy developments, finding that the UK is leading the way in this area (Climate Xchange, 2015, Scottish Government, 2015). Such benefits could help to mitigate and offset some of the potential negative impacts that MRE developments may have on fishermen. This could also enhance acceptance of projects and reduce the likelihood of opposition and spatial conflict. The provision of adequate benefit schemes is currently not mandatory, however they are an important part of the planning process and should be given considerable attention by planners and developers of MRE projects.

The issue of benefit schemes and monetary compensation payments to fishermen for economic losses due to exclusion from fishing grounds as a result of MRE projects has not been fully researched. The aim of this study is to explore the issue of the provision of benefits packages to local fishing communities and financial compensation measures for fishermen who may be impacted by MRE projects. This involves investigating the attitudes and perceptions of fishermen and fisheries liaison officers using a qualitative approach based on semi-structured interviews. Four key areas were explored with regard to the provision of benefit schemes and compensation to local fishermen. These are:

(i) creation of local employment,
(ii) the provision of benefits in kind,
(iii) community funds and financial compensation,
(iv) ownership of projects.

6.2 Background and context

The provision of a community benefits package has become an established component of terrestrial project development in the UK, particularly for onshore wind projects (Cass et al., 2010). There is increasing interest in establishing good practice principles and guidance on designing and delivering community benefits packages from MRE (Climate Xchange, 2015, Scottish Government, 2015). Community benefits are conceived and provided in various ways and are discussed in the following sections with regard to their potential applicability to MRE. Table 6.1 provides a comparison of the types of benefit schemes currently provided to fishermen by the onshore wind, oil and gas and marine renewable energy industries. In this table MRE predominantly refers to the offshore wind sector.

Table 6.1. Comparison of benefit schemes

	Onshore wind	**Oil and Gas**	**Marine renewable energy**
Benefit scheme	Local employment	Local employment	Local employment
	Benefits in kind	Benefits in kind	Benefits in kind
	Community and compensation funds	Community and compensation funds	Community and compensation funds
	Ownership of projects		

6.2.1 Local employment

The potential for fishermen to diversify and find alternative employment on MRE projects could be a major benefit (Alexander et al., 2013a, Perry and Smith, 2012, Reilly et al., 2015). A report on fisheries mitigation options for offshore wind farms acknowledged the fact that fishermen typically possess knowledge of the local marine area and have relevant skills and attributes that could be applied to marine developments (Blyth-Skyrme, 2010). Employment opportunities for fishermen on MRE projects include providing maintenance support and surveying services, however, it should be noted that converting commercial fishing vessels to other uses can be costly (Blyth-Skyrme, 2010), which may deter some fishermen from diversifying. Despite this, there is evidence of fishermen working on offshore developments in the UK. In response to the expanding oil and gas sector in the North Sea, services companies were set up by the two major fishing organisations in the UK, the Scottish Fishermen's Federation[7] and the National Federation of Fishermen's Organisations[8], in order to maximise the alternative employment for fishermen. The type of employment obtained includes guard vessel work, crew transfer and marine mammal observation.

[7] http://www.services.sff.co.uk
[8] http://nffoservices.com/offshore-renewable-energy

6.2.2 Benefits in kind

Benefits in kind to fishermen could generally include improvements to harbour facilities and new port infrastructure. The development of MRE projects may result in improvements to ports and harbour facilities due to increased vessel activity in the area. Separate studies in Ireland and Scotland have found that fishermen perceive harbour improvements to be one of the benefits of MRE projects (Alexander et al., 2013b, Reilly et al., 2015) and this can help to garner support. The wave energy pilot plant in Mutriku, Spain consists of 16 turbines based on the Oscillating Water Column (OWC) principle that have been integrated into a breakwater which also serves as a protection mechanism for vessels in the harbour. The construction of a breakwater had been discussed for a number of years and the idea to integrate this with a wave energy project was supported by fishermen as they saw it as an improvement to their harbour (Stefanovich and Fernández Chozas, 2010). The fishermen were supportive of the project from the outset as the breakwater in which the OWCs were integrated increased safety by protecting their vessels from incoming waves.

6.2.3 Community and compensation funds

The establishment of community funds has become common practice for onshore wind farms in the UK. The Highland Council in Scotland was the first in the UK to make specific recommendations for community payments from onshore wind in 2003, recommending fixed annual payments per megawatt installed (Dalton et al., 2015). A community fund is seen as a fundamental part of any benefits package arising from a MRE project (Scottish Government, 2015). These non-compulsory payments reflect the value to developers of stakeholder goodwill rather than any potential loss of income (Dalton et al., 2015). Community funds are considered to be separate measures to disruption payments which refer to monetary payments to stakeholder fishermen who may incur a loss in income as a result of the development of a MRE project (Climate Xchange, 2015, Scottish Government, 2015).

In general, financial compensation as a form of mitigation is only considered after a thorough review of alternative mitigation options has been conducted, and any remaining impacts are unavoidable (Johnson et al., 2008). Separate studies of Irish and Scottish fishermen have found that compensation is considered to be an option to mitigate the potential negative impacts of the development of MRE (Alexander et al., 2013b, Reilly et al., 2015). The Fisheries Liaison with Offshore Wind and Wet Renewables (FLOWW) group has published recommendations for best practice with regard to disruption settlements and fisheries community funds (FLOWW, 2015). However, there is currently no formal requirement for the payment of compensation or disruption settlements. Established sectors operating in the marine environment, such as oil and gas, have made provisions to provide direct compensation to fishermen whose income may be impacted as a result of activities. In the UK, the Oil and Gas Fishermen's Compensation Fund[9] was set up to address the issue of damage caused to fishing gear and equipment caused by oil-related debris where the damage cannot be attributed to a specific company. The fund is financed by contributions from the trade association for the hydrocarbon industry, Oil and Gas UK, and is administered by representatives from the main fishing organisations in the UK. In the US, the Fishermen's Contingency Fund[10] was established to compensate fishermen who can prove that they have suffered economic and property losses caused by oil and gas obstructions on the US Outer Continental Shelf. The fund is comprised of contributions paid by offshore oil and gas interests and is managed by the National Marine Fisheries Service. In Norway, Chapter 8 of the Petroleum Act (1996) related to compensation to fishermen for financial losses or damage incurred as a result of petroleum activities occupying fishing grounds or as a result of pollution. The Norwegian State is responsible for awarding compensation to fishermen, but it may claim recovery if the licensee ought to have averted the loss. Table 6.2 provides a comparison of the general compensation schemes currently provided to fishermen by the onshore wind, oil and gas and marine renewable energy industries. As with table 6.2, MRE predominantly refers to the offshore wind sector.

[9] http://www.oilandgasuk.co.uk/Fisheries.cfm
[10] http://www.nmfs.noaa.gov/mb/financial_services/fcf.htm

Table 6.2. Comparison of compensation measures

	Onshore wind	Oil and Gas	Marine renewable energy
Compensation measure	Community funds	Fisheries community funds	Fisheries community funds
		Direct payments for loss of income	Disruption payments
		Payments for damage to gear	

6.2.4 Ownership of projects

Ownership or citizen power represents the highest steps in the ladder of participation as proposed by Arnstein (Arnstein, 1969),whereby citizens hold the majority of decision-making seats. Community ownership can take many forms but broadly speaking existing onshore projects fall into three models (Dalton et al., 2015). These include:

- Those where communities take a modest equity share,
- Partnership schemes where projects are developed jointly with local communities typically providing funds or land,
- Community-led and owned projects.

A study on the perceptions of community benefits in the UK claimed that increased local community ownership of renewable energy projects, whether it is literal or symbolic, can help to overcome resistance to development (Cass et al., 2010). Similarly, a study in Wales found high levels of public support for onshore wind farms developed in partnership with local communities (88.5%), profit sharing with local communities (over 80%), and local ownership of developments (52%) (Devine-Wright, 2005). A study from 2010 found that public attitudes towards a community-owned wind farm on the Isle of Gigha, Scotland (single turbines in the region of 1 MW) were more positive than attitudes towards a number of developer-owned wind farms located on the nearby Kintyre peninsula (Warren and McFadyen, 2010). The Shetland Viking Energy project in Scotland is a 370 MW onshore wind farm, with a

50:50 partnership scheme between the local Shetland community and a utility company. A study into the project concluded that revenues to the community generated from an ownership role would be more than five times higher than standard community benefit payments (Allan et al., 2011). With regard to MRE development, studies have suggested that greater local control and ownership of projects may help to compensate fishermen for the loss of access to traditional fishing grounds (Rodwell et al., 2012, Alexander et al., 2013b).

6.3 Methodology

Qualitative interviews are a common research tool often used to gather information on the perceptions and experiences of individuals towards topics of interest (Robson, 2011). For qualitative research, a commonly used typology distinguishes between structured, semi-structured, and unstructured interviews. Structured interviews contain pre-determined questions with fixed wording, usually in a pre-set order. Semi-structured interviews follow a general structure on the main topics to be covered which is prepared in advance. Unstructured interviews can be quite informal where the interviewer has a general area of interest and the conversation is allowed to develop from this. The semi-structured interview technique was chosen as it is a flexible and adaptable way to gather the qualitative information required for this research. This method was deemed appropriate as the interviewer was closely involved with the research process and the preparation of the interview questions. In addition, the method has a number of advantages over the other interview techniques mentioned. The semi-structured interview method allows the possibility of modifying the line of enquiry, following up on interesting responses and exploring issues and themes in depth. This format enables the interviewer to probe the interviewee on certain areas of interest and allows for flexibility in the line of questioning.

Two sets of interview questions were prepared; one directed at fishermen, and one designed for fisheries liaison officers who have been employed by MRE developers to act as intermediaries between both sectors. The latter group were deemed to represent MRE developers. Both sets of questions were designed to examine the attitudes towards benefit schemes and financial compensation and any experience they may have with such schemes. The interview consisted of a number of sections on the concept of benefit schemes for fishermen with regard to MRE projects and also contained questions relating to compensation. This included the identification of those to be compensated, calculation of compensation and the mechanism through which it could be paid. The interviews were conducted with 14 fishermen who operate from ports in the region of three separate case study sites around the island of Ireland, comprising the Republic of Ireland (RoI) and Northern Ireland, where MRE projects were being developed. These case study sites are outlined in the section 3.1. The fishermen who participated in the interviews were chosen carefully from a list of willing candidates gathered in a previous related quantitative survey. The vessel details of the fishermen who took part in the survey, such as vessel size and gear type used, were compared to existing vessel data and official statistics, where available, at each of the sites. The authors were satisfied that the sample who took part in the interviews were representative of the fleets at the respective sites. Interviews were also carried out with ten company fisheries liaison officers (CFLOs) who have worked on a number of MRE projects in the UK and also the case study projects described in section 3.1. The CFLOs interviewed have predominantly worked on UK offshore wind farms including the Thanet Offshore Wind Farm located off the coast of Kent and the London Array. These two projects are among the largest offshore wind farms in the world and both involved extensive discussions and negotiations with local fishermen and members of the Thanet Fishermen's Association. Interviews were also carried out with the CFLOs on the Wave Hub test site located off the north coast of Cornwall and the Swansea Bay Tidal Lagoon project in Wales. The CFLOs were carefully selected following a review of suitable candidates who have been involved in MRE projects.

6.3.1 Case study sites

Three proposed MRE developments on the island of Ireland were chosen as case study sites for interviewing fishermen. These sites were selected as they represent offshore wind, wave and tidal energy projects respectively. At the time when the surveys and interviews were carried out each of the projects were at varying stages of planning and development. Commercial fishing is an important activity at each of the sites in terms of income and employment. Closures or exclusion to fishing grounds could potentially have significant socio-economic impacts on local fishermen and the larger community. Furthermore, the sites were selected as extensive consultation with the stakeholder fishermen at each of the sites was carried out and considerable effort was made to ensure that fishermen were involved in the projects.

Atlantic Marine Energy Test Site (AMETS)

The Atlantic Marine Energy Test Site (AMETS) is being developed by the Sustainable Energy Authority of Ireland (SEAI) off the west coast of Ireland in Belmullet, Co. Mayo. The purpose of the site is to test the performance of wave energy convertors (WECs) in generating electricity and their survivability in open ocean conditions. There are over 70 vessels active in the Belmullet area and the main fish species targeted are brown crab and lobster (Electricity Supply Board International, 2010). Two main fishing organisations represent fishermen in the area, the largest of which is the Erris Inshore Fishermen's Association (EIFA) which has roughly 65 registered members. The Erris Lobster Conservation Restocking Association (ELCRA) has around eight members with registered fishing vessels. Both organisations provide representation and conservation services for local fishermen. The Environmental Impact Statement (EIS) for the test site identified the potential benefits the project could provide the local fishing community, which included pier facility improvements at Frenchport (Electricity Supply Board International, 2011). The construction of a gas pipeline off the coast of Belmullet for the development of the offshore Corrib gas fields led to considerable opposition by the local fishing community in the area due to concerns over loss of access to fishing grounds and potential impacts to fish species (Ascoop et al., 2012). Following negotiations, fishermen from the two main organisations received financial compensation for disruptions to normal fishing activity caused during the construction of the pipeline (Cusack, 2009) which was completed during the summer of 2009. As the AMETS project is government funded and is intended to be used for demonstration and research purposes only, and there are currently no plans for commercial activity at the site, local fishermen were made aware from the outset of the project that there would be no possibility of financial compensation for them.

Torr Head/Fair Head tidal projects

Two separate 100 MW tidal energy projects are in development adjacent to each other off the coasts of Fair Head and Torr Head respectively in Co. Antrim, Northern Ireland. Construction on both projects is scheduled to commence in 2017. Trawling in the area is limited due to the presence of boulders and so the main fishing activity in the area is directed towards lobster and crab using static gear (Thetis Energy, 2009). The majority of the vessels active in the area are members of the North Coast Lobster Fishermen's Association (NCLFA). The association provides representation for fishermen in discussions with developers, government agencies and other parties. Benefits associated with the projects include the employment of a local fisherman as part of the environmental impact assessment (EIA) survey work. At the time the interviews were being carried out, discussions were on-going between developers of both projects and a group of local fishermen over payments for disruptions to regular fishing activity that may occur during survey work.

First Flight Wind (FFW)

First Flight Wind was a consortium of developers, consisting of B9 Energy, DONG Energy and RES, that initially planned to construct a 600 MW offshore wind farm off the coast of Co. Down in Northern Ireland. The target capacity of the project was reduced to between 300 MW and 400 MW in June 2014 due to the considerable fishing and shipping interests in the area. Subsequently, in December 2014 the proposed project was cancelled due to the fact that the construction would not be completed in time to avail of renewable energy market incentives for Northern Ireland. The majority of the Northern Irish fishing fleet is based at three ports along the Co. Down coast, Kilkeel, Ardglass and Portavogie (Yates and Schoeman, 2013). Fishing in the area is diverse with a number of larger vessels fishing for Nephrops and scallops and smaller vessels that fish for lobster and crab (Service et al., 2013). The two biggest fishing organisations in Northern Ireland are the Northern Ireland Fish Producers Organisation (NIFPO) and the Anglo-North Irish Fish Producers Organisation (ANIFPO). Both organisations provide quota management, vessel registration and administration services to fishermen. A fishing vessel from Kilkeel had been employed on the project to carry out boat-based marine mammal surveys for the project (Masson, 2013). Prior to the project cancellation, the issue of disruption payments had been discussed in consultation with local fishermen.

6.3.2 Data collection and analysis

The semi-structured interviews were carried out between June and September 2014. Face to face interviews allow the interviewee to alter the line of enquiry and follow up on interesting responses (Robson, 2011). All of the interviews with the fishermen were carried out face to face. Due to geographical constraints, three of the interviews with the CFLOs were carried out face to face with the remaining seven conducted by telephone. A thematic coding approach was used for the analysis of the interviews. This is a general approach for the analysis of qualitative data which enables the experiences and perceptions of participants to be interpreted. Recurring themes in the data are identified and serve as a basis for further analysis and interpretation. There are a number of steps in performing a thematic analysis (Robson, 2011). Firstly, the interviews are transcribed and then extracts from the transcriptions are given initial codes in a systematic manner. The codes are then collated into themes and all relevant data is gathered together. At this stage the codes are revised if necessary and the themes are then described and analysed. The main advantages of using this approach to analysis is that it is very flexible and it provides a means of summarising large amounts of data into key features. However, the range of themes identified can be broad and it can be difficult to decide what aspects of the data to focus on.

6.4 Results and Discussion

The common themes that emerged from the interviews were local employment, benefits in kind, financial compensation and ownership of projects. These are presented in the following section along with demonstrative quotes and further analysis.

6.4.1 Local employment

While the majority of fishermen (11/14) acknowledged the potential for employment on MRE projects, there was uncertainty over whether they would be sufficiently qualified to avail of this. A smaller number (6/14) held the impression that their vessels would not meet the standards required to carry out work on MRE projects. There was some uncertainty over the amount of jobs that would be available for fishermen and whether this would outweigh the potential negative impacts of development on their livelihood. There was also concern over whether the jobs would remain in the locality. It was also noted among the fishermen interviewed that the jobs created would likely be short term. The quotes below demonstrate some of these concerns.

> *"On a very short term basis there probably would be guard ship opportunities for what?...2 boats, 3 boats, 4 boats?...To those 3 or 4 individuals who would get a guard ship job, which would last for the duration of the construction, that would be some benefit to them during that period. Thereafter, there's the servicing of those which is done by specialist vessels… It costs about £1 million to develop them anyway, which no fisherman could afford… So it wouldn't be us servicing them, it would be a firm that has Windcats that would be coming in. And, fair enough, you might sell a bit of fuel locally to those Windcats, maybe the hotel up the road would put up the engineers to service them so there would be some small benefit to the local community, but it would be far outweighed by the damage done to the fishing industry." -* ***Nephrops Trawl fisherman, FFW project***

> *"Most of the boats that fish for lobster and crabs, and that's really about all we have in this area, they are smaller boats. They don't have winches, they have haulers. They don't have gantries, they don't have A frames, they don't have lift holds, they don't have derricks…the only thing we have managed to get is fisheries liaison roles when they're doing their geo-physical survey. But that's a week's work."* ***– Fishing association representative, Torr Head/Fair Head tidal projects***

A number of the CFLOs (5/10) pointed out that MRE developers were keen to employ local fishermen where possible in order to avail of their knowledge of the area. There is evidence of this on projects the CFLOs have worked on, particularly offshore wind farms. However, it was also noted that the amount of jobs created for fishermen has been limited to date. Again, the issue was raised by a number of CFLOs (3/10) that the condition and size of the majority of inshore vessels would be unsuitable for work on MRE projects.

> *"We get them work as guard vessels during construction and if there are export cables… there is a limit on what you can do. For a guard vessel it has to be at least 15m and you have to have the proper qualifications, the skipper and the*

> *crew, and they have to have a load line exemption. You can't just put any old boat on, it has to be capable to do it."* ***– CFLO #1, various UK offshore wind farms***

> *"The difficulty for fishermen is their vessels are quite small and for deployment of ADCPs we need an A frame that can carry two tonnes and none of them would really have that. You need deck space with that. What we have done through our procurement process is indicate who we have contacted in the community to see if there are vessels available…. So we got numbers and details of potential services that were relevant and put them into the procurement documentation."* ***- CFLO #7, Torr Head tidal project***

It has been suggested that MRE projects could provide employment opportunities for fishermen similar to those provided by oil and gas developments (Perry and Smith, 2012). The services companies that have been established by the main fishing organisations in the UK have increasingly found employment on MRE projects, particularly offshore wind. There is evidence of this on the FFW project where the Anglo North Irish Fish Producers Organisation set up a services company and a local fishing vessel was utilised to carry out survey work on the project. In addition to this, one of the fishermen interviewed who had experience as a bird surveyor, had found work on the Torr Head tidal project. Despite this, there are concerns among the interviewees regarding whether fishermen will gain employment on MRE projects due to vessel requirements. Previous studies have also found that here is uncertainty over alternative employment for fishermen on MRE projects (Cass et al., 2010, Alexander et al., 2013a). The uncertainty also stems from the lack of skills required to obtain jobs on MRE projects and indicates that there is a need to re-train fishermen in order to provide them with the necessary skills.

Clarity is required regarding the type and quantity of jobs that will be available to fishermen. The idea that significant local employment will be created is often used to gather support for renewable energy projects. The likelihood is that the majority of jobs in the construction, operation and maintenance of MRE projects will be highly skilled and specialised and have specific vessel requirements, meaning that they may not be attainable for most inshore fishermen. Claims that MRE projects will provide numerous employment opportunities for fishermen may prove harmful to credibility if the jobs do not materialise, and may also erode trust between developers and fishing communities.

With regard to the development of MRE in the Republic of Ireland (RoI) the issue of licensing of fishing vessels arose. Currently, Irish vessels surrender their water line certification when they receive a fishing permit, meaning that they cannot carry passengers or engage in other alternative activities such as those required to support MRE developments. In order to use a fishing vessel to provide services on a MRE project a fisherman would be required to relinquish their fishing license and re-certify the vessel. As a result, fishermen in the RoI are currently unable to avail of work that may be offered on MRE projects and continue to fish. This is not an issue in the UK where fishing vessels can work on MRE projects to supplement their income and also continue with their fishing activity.

> *"… a vital requirement in managing technologies at sea is that you have personnel who are experienced sea men who are familiar with local conditions in the open sea. So there are obviously going to be opportunities for fishermen and their families.One of the issues that we did come across, and it is tiresome really, is that a fishing boat can only be licensed for fishing or passengers or a work boat, whereas in other jurisdictions a fishing boat can also be a work boat…So we would have liked to have been able to hire fishing boats to do work but we couldn't get a licence from the Marine Survey Office to operate as a work boat."* ***- CFLO #5, AMETS project***

6.4.2 Benefits in kind

The potential for benefits in kind resulting from MRE projects was acknowledged by a small number of the fishermen surveyed (5/14). Potential benefits identified include improvements to harbours, piers and slipways and additional infrastructure such as ice plants and cold storage facilities. One vessel owner felt that MRE projects could help to rejuvenate ports and that re-training could be provided to fishermen to enhance the possibility of obtaining work on new MRE projects, as the quote below demonstrates. Re-training programmes for fishermen who wish to diversify or supplement their income could also be considered a benefit in kind which could then lead to employment on projects.

"Can they provide us with money for an ice plant? Can they provide us with a bit of a pier? Can they employ fishermen to go out and service the turbines? Why bring people from Denmark, why not train people here and stop people from leaving? So let's provide a training school. Let's turn the pier into a marine hub where boats can get serviced." - ***Nephrops Trawl vessel owner, FFW project***

The Environmental Impact Statement carried out on the AMETS project identified the fact that development of the project could improve pier facilities at a local port which would enhance access for vessels to reach both test sites (Electricity Supply Board International, 2010). This would also be beneficial to the local fishing community and was viewed positively by the fishermen interviewed. However, to date, there has been little development carried out on AMETS and as with the potential creation of new jobs, if improvements fail to materialise it could be damaging to the attitudes of fishermen towards the project and could erode trust between the sectors. This was noted by one of the fishermen interviewed.

"We're around long enough now to know that when somebody looks for co-operation they'll tell you about the potential benefits. But until you see something material on the ground…. to date we haven't really seen anything." - ***Pot fisherman, AMETS project***

Some fishermen held the opinion that there would not be any benefit to fishermen resulting from MRE projects. It was also noted that the increased vessel activity that would come about as a result of MRE projects could potentially take up harbour space from fishing boats, which could result in further spatial conflict.

"It's going to obstruct our fishing operations. And I'd be very cynical that we would get, or if there would be a spin off into the local fishing communities or any benefit at all. In fact, if the harbour facilities on our three fishing ports were going to be used in any degree at all by the offshore wind people it would deny us harbour space." ***- Nephrops Trawl vessel owner, FFW project***

The CFLO on the Thanet Offshore Wind Farm gave an example where the Thanet Fishermen's Association set up a fuel company and the developer constructing the offshore wind farm entered a contract to buy fuel from them. This could be viewed as a benefit in kind which could improve the harbour and also provide employment to local fishermen. It was noted that the company was successful and allowed the fishermen to buy fuel cheaply.

> *"The fishermen's association created a tiny little commercial fuel company to fuel themselves. When it came to looking at mitigation with the wind farms, the wind farms agreed that they would use our fuel facility, if we upgraded, to fuel the crew transfer vessels. And in the event that became an enormous part of the mitigation and the fishermen's association effectively earned more from that decision than it did for all the disruption payments put together. It was massively successfully mitigation."* - ***CFLO #2, Thanet offshore wind farm***

The fuel co-operative demonstrates a successful benefit scheme which could potentially avoid the need for developers to provide compensation to fishermen. The fuel company also represents a more sustainable form of benefit scheme as it will be used by service vessels and thus enable fishermen to benefit from the offshore wind farm over the lifetime of the project. It was noted that the financial success of the fuel company has provided a benefit for the local fishing community that has helped to enhance acceptance of the offshore wind farm.

6.4.3 Financial compensation and disruption payments

The loss of access to traditional fishing ground and a potential loss of income is the main concern among fishermen regarding the development of the case study projects. The majority of fishermen interviewed (12/14) felt that if they were to incur a loss of fishing opportunity due to the development of a MRE project, then they should receive some form of financial compensation. There was a general opinion that fishermen would rather earn their living from fishing, however, if their livelihood was negatively impacted by a MRE development then compensation would need to be considered.

> *"From a fisherman's point of view it's really damage limitation. Can we get a good compensation package from them…What I tell them in all these discussions is they're a business but we're a business too and what we have to try and do is not let them run their business at the expense of ours."* - ***Fishing association representative, Torr Head/Fair Head tidal projects***

> *"Any fisherman will tell you, they don't want this money, they just want to fish. But if there's a survey going on, they want the money."* - ***Trawl owner, FFW project***

On the FFW project, fishermen were involved in the negotiation of disruption payments for the removal of static gear for the duration of a geo-physical survey that was planned to be carried out in the project area. Although the survey did not go ahead, the fishermen still received the payments. The fishermen who received payments were identified by the CFLO through consultations with local fishing organisations and industry contacts. For the AMETS project there was general acceptance among the fishermen that they would not be paid compensation due to the fact that it is a State-funded test site which would not be used for commercial development. However, it was mentioned that if the site were to expand or if a company were to come in to set up a commercial project in the area, then this would cause problems and the provision of compensation may have to be discussed with the fishermen affected.

> *"What they said was…the State owns the seabed out there and they're not discussing compensation basically, and we said to them, 'it's no big deal, it's not a vast area'. But we always highlighted to them, anytime we talked to them, that while we were OK with testing prototypes in a small catchment area out there, that if somebody lands up with proposals to fence off a large area of the seabed, yeah of course we'd have issues with that. So, I honestly don't know where that would end up.…it would be confrontational."* - ***Pot fisherman, AMETS project***

The majority of the CFLOs interviewed (9/10) have been involved in negotiations on compensation and disruption payments to fishermen on the projects they have worked on, mostly for offshore wind developments. The monetary payments were provided to fishermen to compensate them for disruptions to regular fishing practices and the removal of static fishing gear during the planning and pre-construction phases of a number of offshore wind projects in the UK. Analysis of the CFLO interviews suggests that while developers were under no legal obligation to provide compensation for any potential economic loss, it was something that was considered necessary if the income of fishermen was likely to be affected. There was a general willingness among developers to make payments to build good relationships with neighbouring fishermen. The fact that some developers have acknowledged the rights of fishermen to compensation has also been highlighted in a study on consultation on offshore wind and commercial fisheries in the UK (Gray et al., 2005). It was noted that payments from developers are entirely voluntary and payments should only be provided to those who could prove that they fished in the area by providing spatial data such as Vessel Monitoring System (VMS) data and logbook recordings. One CFLO noted that compensating fishermen for the sake of advancing the project and without any evidence to support claims would make negotiations difficult for future developers in the area.

> *"Although there is no obligation we seek to minimise the impact on fishermen as much as possible, but we can't always avoid them. When they are unavoidable and they cause a loss of earnings then we seek to make up those losses. That's a basic principle that we would work on from a moral and responsible standpoint. We are also trying to build relationships as they are going to be our neighbours for the next 20 years."* **- CFLO #6, various UK offshore wind farms**

> *"They are being displaced by effectively a rival activity. I think it's kind of obvious really. But I mean it should be realistic, it should be based on the genuine loss suffered by the fishermen."* **– CFLO #5, AMETS project**

One liaison officer noted that a precedent for monetary compensation has already been set by the oil and gas industry and there may be an expectation among fishermen for some form of reimbursement for losses. However, it was also acknowledged that there may be some difficulty with MRE developers compensating fishermen due to the relative financial fragility of the nascent sector in comparison to the well-established and profitable oil and gas industry.

> *"Oil and gas, they came in throwing money around. That was one of the things about oil and gas – they could come in because they were going to open a goldmine, whereas a wind farm comes in and they have a very strict budget."* **- CFLO #1, various UK offshore wind farms**

These points were also noted in a paper comparing the oil and gas sector in Shetland, Scotland in the 1970s with MRE currently which suggested that the oil industry has set a precedent for additional direct "community payments" (Johnson et al., 2013). It may also prove to be difficult to replicate compensation schemes which have been successful in the oil and gas sector for the marine renewable energy sector. There are important differences in the economic situation of the burgeoning MRE sectors and the well-established and highly profitable oil and gas sector (Johnson et al., 2013). Although there is some evidence of compensation being paid to fishermen by offshore wind developers, the ability of the wave and tidal sectors to do likewise may not be possible. In the case of wave energy in particular, there are no commercial projects in existence and companies are heavily reliant on government intervention and subsidies, which would make it difficult for them to provide compensation to fishermen. A study into the provision of benefit schemes in renewable energy development in the UK revealed only one case of active argument against community benefits from a wave power developer, whereby the financial fragility and high risk nature of the sector at the current pre-commercial stage was highlighted (Cass et al., 2010).

6.4.3.1 Calculation of compensation

The majority of fishermen interviewed (12/14) felt that compensation claims should be based on the potential financial loss that fishermen may suffer as a result of removal of fishing gear or exclusion from fishing grounds. It was noted that there may be some concern over the willingness of fishermen to provide potentially sensitive information on income and spatial distribution of fishing activity to developers or local authorities. However, the majority of fishermen interviewed who were involved in negotiations on compensation had provided the required information. In the case of disruption payments calculated on the FFW and Fair Head Tidal projects, the fishermen involved signed non-disclosure forms to allow the developers to access information on landings from the Department of Agriculture and Rural Development (DARD) in Northern Ireland.

> *"They wanted the static gear moved to enable them to do their geo-physical surveys. So therefore for them to claim compensation they had to provide what their earnings were for the previous year and then they would compensate them pro-rata for the period of time they wanted them off the ground."* - ***Nephrops Trawl fisherman, FFW project***

All of the CFLOs interviewed held the opinion that any compensation claims should be corroborated by evidence. It was noted that in general developers would insist on an evidence-based approach to compensation claims and that calculations should be based on realistic estimates of the potential value of landings. The lack of publically available data on the value of the resource, particularly inshore fisheries, was noted as being problematic. A number of CFLOs stressed the importance of an evidence base and claimed that the lack of such an approach would lead to issues such as false claims by fishermen who did not operate in the area under development.

> *"We insist on an evidence-base. We are not compensating so we call them disruption payments. So we would look to reach an agreement with the fishermen on how much disruption we are causing them – what is the financial value of that and then make payments to them which are appropriate. But it has to be underpinned by some kind of evidence, the fishermen can't just say we want £1 million. That's the basic premise of it, however we cause disruption or loss or earnings that we would look to set it right, although we are not required to do that."* - ***CFLO #6, various UK offshore wind farms***

The idea that compensation claims should be based on evidence was noted in a previous study into the interactions of offshore wind development and fisheries in the UK (Gray et al., 2005) and is in line with best practice guidance from the Fisheries Liaison with Offshore Wind and Wet Renewables group (FLOWW) (FLOWW, 2014). Analysis of the interviews suggests that some fishermen may view compensation payments as an opportunity for financial reward and making false claims which would cause further difficulties in identifying those who would be entitled to compensation. This was noted in a previous study (Alexander et al., 2013a) and would suggest that claims need to be backed up by evidence.

The general lack of spatial and financial data for inshore fishing activity may be an issue with regard to the provision of an evidence-base. It was stressed among the CFLOs that fishermen would be willing to provide information if it was to be used in the negotiation of compensation. One CFLO mentioned that it would be beneficial for fishermen to disclose financial information to support claims and facilitating this is an important task. This is illustrated in the quote below.

> *"The argument that we used was quite simple, if you're going to go in and talk and try and defend your activity, if you put a blank piece of paper on the table you'll get nowhere but if you put something on the table that has a lot of detail and content they will surely listen to you. That was the only argument we ever used, the choice is yours but don't moan after the event if things don't work out. So we did get the data."* ***- CFLO #8, various UK offshore wind farms***

It is important that compensation is not viewed as a bribe to advance projects but rather as a payment to fishermen for disruptions to usual fishing patterns. It has been argued that formal institutionalised guidance would help to reduce the risk of community benefits payments being perceived as bribes (Aitken, 2010). Disruption payments should reflect the amount of money the fishermen would potentially lose out on due to a disturbance in fishing activity and as such, providing evidence to support claims is necessary. Information such as landings data, receipts of sale, etc. could further help to determine who may be entitled to compensation. This will reduce the risk of spurious claims. Although this type of information could be considered commercially sensitive, analysis of the interviews suggests that the fishermen who feel that they may be impacted by a MRE development would be willing to provide the information to corroborate their claim. This information will need to be gathered directly from fishermen. A good relationship between the CFLO and the fishing community is required in order to encourage fishermen to engage in the process and to provide factual information on income and earnings to developers. Trust between both sectors is an important factor and it is crucial that the liaison officer is trusted by the local fishermen.

6.4.3.2 Compensation mechanism and duration

Half of the fishermen interviewed (7/14) stated their preference for compensation payments either directly to fishermen from the developer or through a local fishing organisation. A regular financial contribution from a developer into a compensation fund was also suggested as a useful method by a number of fishermen interviewed. A number of the CFLOs interviewed (3/10) stated that the exact compensation mechanism will depend on the preference of the local fishermen and will likely vary from project to project. Gray et al. (2005) found that although most fishermen and developers preferred that money should be paid directly to individual fishermen, some developers noted that trust funds could be set up to benefit fishermen collectively. One fisherman noted that administering a fund may be challenging as it would depend on the presence and the strength of a fishing organisation in the area and there may be issues for fishermen who are not part of an organisation. All of the fishermen operating in the vicinity of the AMETS and Torr Head/Fair Head tidal projects are members of fishing associations. The majority of fishermen who are active around the FFW site are members of fish producer organisations; however, there are a number who are not represented by any organisation or association, particularly those working on smaller vessels. Cass et al. (2010) found that early community benefit schemes for onshore renewables were faced with the difficulty of establishing appropriate mechanisms for making payments. In an attempt to overcome this problem several local authority trust funds were established to receive and distribute funds. An example of this is seen in Argyll and Bute in Scotland where the local council set up a Community Wind Farm Trust fund in 2004 (Cowell et al., 2012).

There were mixed opinions among the fishermen interviewed on the length of time that compensation should be paid for and this is something which will be largely determined by the mechanism chosen. Some held the opinion that fishermen should be paid for as long as the project is operational. There was a question over whether compensation and disruption payments would be a viable long term option over the lifetime of a project. One fisherman noted it may be problematic calculating compensation for the operational period of a project, which may be up to 20 years. The quote below illustrates this.

> *"How do you compensate a man for the next 20 years of his earnings? You would be talking silly figures."* - ***Nephrops Trawl fisherman, FFW project***

Two of the CFLOs interviewed held the opinion that compensation would generally only be paid for periods when regular fishing patterns are disrupted, such as when surveys are being carried out or when the site is under construction. It was noted that although there are exclusion zones around offshore wind turbine structures in the UK, fishermen are generally not prohibited from fishing within offshore wind farms once operational. Analysis of the interviews shows that, in general, disruption payments have been made for the removal of gear during activities such as surveys and construction and are usually used as a short term option. Developer contributions to a compensation fund are a more likely option to provide compensation in the long term.

Such compensation funds could be administered by fishing organisations in a similar way to compensation funds that have been set up in the oil and gas sector. One CFLO suggested that a compensation funding programme would be preferable during the operational period of a MRE project. These views are apparent in the quotes below.

> *"Compensation is only about disruption during construction, it's not a payment to keep the fishermen out after construction…. the most important principle to remember is it is only because of the disruption of normal fishing patterns.... We only have one wind farm which has brokered a deal to keep some fishermen out of it for its entire life."* - ***CFLO #8, various UK offshore wind farms***

> *"Typically, when we are constructing a wind farm we would ask people to stay out of an area….And when we're finished we would say, 'you can go back in now and you can fish'. So there would be no need for compensation beyond that point. It would be for typically the construction period and we might then set up some community funding programme to run during the operational period."* ***- CFLO #6, various UK offshore wind farms***

Two of the CFLOs interviewed suggested that a standardised method of compensation calculation was required. This would require determining a common evidence-based approach to calculating compensation rather using different methods on separate projects. Most offshore wind farm developers require evidence to support compensation claims but this is not always the case. An approach designed with agreement from both MRE developers and the fishing industry would be useful and could potentially help to eliminate false claims. These views are shown in the quotes below.

> *"If you try and find a methodology for the calculation of compensation, it's very hard to come across …it seems to me there should be a methodology for that calculation that's accepted by all. Instead of having a whole new process invented every time a project comes into an area."* ***- CFLO #5, AMETS project***

> *"The over-riding comment I would have about this is that it does need standardisation. It does need clarity because at the moment different developers are doing different things, there's no real obligation to do it…Everyone deals with it in a different way and those who just pay out make it difficult for other developers."* **- CFLO #6, various UK offshore wind farms**

These views are supported by Gray et al. (2005) who argued that compensation should be standardised. A standardised method for calculating compensation should be designed with input from fishermen and organisations and would be based on the provision of evidence of fishing activity and income. A common compensation calculator would make the process more efficient and could give developers an early indication of the potential amount of compensation that may have to be paid, before development on a MRE project begins. The Seafish group, a leading authority on seafood in the UK, have provided guidelines for the calculation of financial impacts that may occur as a result of closures to fishing areas (Seafish, 2012). These guidelines could be applied to calculate disruption payments for loss of access to fishing grounds as a result of MRE projects. Although a standardised approach would be useful, it may be difficult to implement due to the diversity of the fishing sector and the range of impacts projects may have on different fishing methods.

6.4.4 Ownership of projects

The concept of fishermen achieving ownership of projects was not widely considered to be a viable option among the fishermen and CFLOs interviewed. It was noted that it would be difficult for fishermen to raise the funds required to attain full ownership of projects. In addition, it may not be financially feasible for many MRE developers to offer the option of ownership of a project. However, one fisherman from the FFW case study site noted that the notion of having an equity share in the project could be a viable long term option. This could ensure that fishermen would receive benefit over the operational period of the project.

> *"There was a plan of 110 turbines to go up, so I put it to them if they were to go ahead give one turbine to the fishermen. So divide that among the fishermen so they have some kind of subsidy coming off that, instead of them getting nothing."* **- Nephrops Trawl fisherman, FFW project**

Some form of ownership on MRE projects could provide considerable benefits to fishermen and could enhance their acceptance of projects. However, there are important differences between onshore and offshore renewable energy technologies which could limit the ability of fishing communities to take ownership of MRE projects. Dalton et al. (2015) highlight the difficulties attached with transferring the ownership models utilised on onshore wind projects, outlined in section 2.4, to MRE projects. The offer of a modest equity share, as mentioned by a fisherman from the FFW case study site, depends on the willingness of the developer to enter into such an arrangement. There may be less incentive for MRE companies to offer equity shares to local stakeholders due to a more centralised planning regime in the marine environment in comparison to developments onshore (Dalton et al., 2015). The high cost associated with marine operations such as installation, cables and maintenance, means that developers in the wave and tidal energy sector are striving for economies of scale. Due to the high level of investment required MRE developments will likely consist of large arrays of multiple devices. This would mean that partnership developments and projects led/owned by stakeholder groups such as fishermen may be problematic due to financing issues. Despite this, there is evidence of fishing organisations proposing to take ownership of MRE developments. The company "Fishermen's Energy" was founded by commercial fishermen from New Jersey in 2007 with the aim to develop the first offshore wind farm in the US[11].

6.5 Conclusion and Policy Implications

The potential of employment on MRE developments will help to retain the benefits locally. Fishermen, with their local knowledge of the sea and valuable experience, have a lot to offer MRE projects. Although fishermen are aware of the potential for MRE projects to provide them with the opportunity to diversify and supplement their income, there is uncertainty over whether these jobs will be available to fishermen due to skill shortages and vessels not being up to standard. The lack of skills could be addressed through programmes which provide re-training for fishermen who are most likely to be displaced. The establishment of services companies by fishing organisations could help to maximise the potential of alternative employment for fishermen. Programmes which ensure that those who may be displaced are given

[11] http://www.fishermensenergy.com/about-us.php

priority for alternative employment would also be useful. In the Republic of Ireland there is a need to address the fact that fishermen are currently not allowed to carry out work on MRE projects and still retain their fishing licence. This would inhibit a lot of fishermen from obtaining employment on MRE projects and as such a legislative amendment is required to enable fishermen to carry out both activities. There is a requirement for improved socio-economic assessments which provide accurate estimates of the number of jobs that may be created and the amount that will be available for fishermen. Such assessments should also take into account any potential displacement of fishermen.

Improvements to harbours and slipways could be mutually beneficial to both developers and local fishing communities and is something which should be considered by developers and planners. Schemes which are most likely to be successful are those which provide benefits to fishermen for the duration of the MRE project and longer. A good example of a sustainable scheme which links all those discussed is the fuel company set up by the Thanet Fishermen's Association which supplied fuel to a nearby offshore wind farm. The agreement made between the fishing organisation and the developer has provided a small dividend for fishermen and has helped to enhance the acceptance of the project. The fuel company has also provided alternative employment for fishermen. In addition, the fishermen feel an increased sense of ownership of the company and involvement with the offshore wind farm. Similar initiatives that provide a range of benefits to fishermen and other stakeholders over the lifetime of a MRE project are more likely to be successful at enhancing acceptance and could reduce the use of disruption payments.

Payments to fishermen or contributions to a fisheries community fund will not be necessary for all MRE projects and should only be considered if impacts are unavoidable and cannot be mitigated by other means. Establishing a company fisheries liaison officer and a fisheries industry representative at the earliest possible stage is key to determining those who may be affected by a MRE development. The CFLO also has a role to play in gathering information for the calculation of compensation. It is clear that the calculation of compensation should be supported by evidence from fishermen of what the potential losses may be. A standardised method for calculating compensation for fishermen would be useful. However, this would still require discussion and consultation with individual fishermen who may be impacted.

Negotiations could be arranged through local fishing organisations. The calculation of amounts is likely to depend on the extent of the impact on fishing activity and the landings value of fish species targeted in the area. The mechanism for payment is also something which will need to be discussed with fishermen. Direct payments are likely to be more suitable for short term closures to fishing grounds whereas contributions made to some form of compensation fund would be a longer term option.

The high costs associated with MRE development mean that it will likely be prohibitively expensive for many fishing organisations to fully control and own projects. The participation of fishermen through joint ownership schemes or taking a small equity share in projects may be more feasible. Such partnership schemes with MRE developers and fishing organisations would help to retain some revenue from the operation of projects for fishermen. There will inevitably be difficultly applying ownership models that have been successful for onshore renewable energy development to the marine environment and the ability to do so remains to be seen.

In conclusion, this study has identified some schemes on MRE projects that have been successful in enhancing benefits for local fishermen in the area where the projects are under development. However, to date the schemes have largely been voluntary and ad hoc. Guidance documents exist on good practice principles for the provision of community benefits and financial compensation to fishermen who may be impacted by a MRE development. For regulators in countries where there is considerable interest in the expansion of the MRE sector, formalisation of these guidelines would be useful.

7 Fisheries compensation model

7.1 Introduction

As noted in Chapter 6, a standardised method of calculating compensation would be useful for developers. This chapter outlines the design of a basic Excel compensation model which provides an estimate of the spatial distribution of value of landings within areas where MRE projects are being developed. This will give an indication of the financial impact that a MRE development may have on fishermen in that area and could be used to calculate the amount of compensation that may be paid to fishermen if they are impacted by the development. Such a compensation model could be used by developers for calculation of budgets, disruption payments, contributions to compensation funds.

The model could also be used to inform a cost-benefit analysis or trade-off analysis, which a developer may conduct at the early planning stages of a project and thus help to inform management and improve decision-making on projects. The model will also help to estimate the current nature and extent of fishing activity in an area. However, it should be noted that due to the diversity of the commercial fishing industry that the model is only indicative and further participation of fishermen will be required in order to fairly reflect the potential losses.

The remainder of this chapter provides background information on best practice guidance for the provision of compensation to fishermen due to impacts from area closures due to MRE developments and other sectors. This includes information from documents that provide recommendations on how to calculate compensation. From there, the development of the compensation model and how existing models have been adapted is outlined.

7.2 Background and context

7.2.1 Fisheries Liaison with Offshore Wind and Wet Renewables (FLOWW) best practice guidance: recommendations for liaison during negotiation of compensation

In 2014, FLOWW published best practice guidance and recommendations for fisheries liaison on offshore wind, wave and tidal energy developments (FLOWW, 2014). The main aim of the guidance document was to allow MRE developers and the fishing industry to have constructive discussions about the potential impacts and interactions between the sectors in the planning, construction and operation of MRE projects. Although the document does not provide prescriptive advice on how compensation or disruption payments should be calculated, it does recognise the need for the development of guiding principles for this process. The document states that mitigation for displacement of fishing activity as a result of MRE developments should be given a high priority, however for impacts that cannot be mitigated, then as a last resort, financial compensation should be considered. The report places a strong emphasis on early dialogue to identify fishing grounds and the intensity of fishing and income derived from that area in order to estimate how much compensation may have to be paid. The selection of a local fisherman as a Fisheries Industry Representative (FIR) to represent the fishing community in the particular marine area is important in relation to negotiations on compensation amounts for the removal or redeployment of static gear. This would involve determining the number and location of gear and the value per week before any activity takes place and prior to discussions on compensation. Based on this information the FIR should then organise meetings to discuss and agree upon a compensation amount, according to the guidance document.

7.2.2 FLOWW best practice guidance: recommendations for fisheries disruption settlements and community funds

In 2015, FLOWW published best practice guidance for the negotiation and payment of financial compensation (FLOWW, 2015). The document distinguishes between disruption settlements and fisheries community funds as forms of financial compensation. A disruption payment can be defined as a monetary payment provided to fishermen. Payment is for the provable loss of access to traditional fishing grounds or for any financial loss incurred as a result of disturbance of normal fishing patterns or displacement caused as a direct result of a MRE development. The report defines a fisheries community fund as a fund established by a MRE developer that is managed for the benefit of the members of a fisheries community. The report highlights the importance of an evidence base to provide transparency to the process. Compensation should only be paid on the basis of factually accurate and justifiable claims and therefore, there is an obligation upon affected fishermen to provide evidence, such as three years' worth of catch records, to corroborate agreed values for financial settlements. The provision of evidence is required to ensure that fishermen are neither advantaged nor disadvantaged by the development of a MRE project and will help to ensure that claims are genuine.

7.2.3 Methods for the calculation of compensation

In 2012, a leading authority on seafood in the UK, Seafish, published best practice guidelines for the assessment of economic and financial impacts on fishermen that would likely occur as a result of areas that are closed or restricted to normal fishing activities (Seafish, 2012). While not specifically focussing on the development of MRE, the guidelines could be applied to this sector. The report also notes that as it is difficult to predict the future value of fishing, impact assessment should be based on historical data. The report advises analysing a time series of landings data (minimum of five years) to determine if there are any clear trends that may influence the conclusions drawn from the analysis. If there are no clear trends over that time, then the average value over that period should be used. Data on the value of landings for vessels over 10 metres is generally reported at a spatial scale of International Council for Exploration of the Seas (ICES) statistical rectangle level. These rectangles refer to areas of 1° longitude by 30' latitude. The document recommends for the assessment of the likely outcome to fishermen if vessels are excluded from fishing grounds compared to the status quo. The report also notes that the extent of the impact to fishermen will depend on the development. For example, some fishing may be allowed in between offshore wind turbines during operations. The Seafish (2012) document recommends that in the absence of more detailed information impact on fishing revenue the can be crudely estimated by assuming the total loss of value of fish landed that would have been caught within the exclusion zone for all vessels affected.

The Seafish (2012) report outlined five of methods which could be used for the calculation of compensation, each with its own advantages and disadvantages. These include proportional area technique, effort as a proxy for landed value, effort as a proxy for financial performance and the consultation approach. Under these methods it is commonly assumed that fishing effort is representative of the spatial distribution of fisheries value. Under this assumption the financial information can be interpolated from a large to small spatial scales by applying VMS or interview data.

A further method is the resource valuation which involves determining the biomass of the area based on ICES stock assessments and defining the exploitable levels to determine the overall value of the resource. However, it does not take account of the financial cost to fishermen of harvesting that resource. Such an approach is only likely to be applicable if data sources such as ICES stock assessments are available. This approach is data intensive and therefore likely to be costly. This approach could also be used to calculate any potential benefits to stocks that may arise as a result of the closure of fishing grounds.

The direct method involves use of direct value of landings based on direct haul data, fully documented fishery and/or on-board observer reports. This method will eliminate the need to use proxy estimates but it can be very resource intensive. The data requirements for this method include direct haul data, closed-circuit television (CCTV) data, fully documented fishery reports or on-board observer reports.

7.2.4 Spatial distribution of value of fisheries

The Irish Sea Conservation Project Impact Assessment developed a model which estimated the value of fish landings taken from each Marine Conservation Zone (MCZ) in the Irish Sea by the UK fleet between 2007 and 2010. This model is referred to as the MCZ Fisheries model. The MCZ Fisheries model integrated value of landings data with spatial data on fishing effort to provide information on the spatial distribution of the value of landings by gear type used. The model relied on three main data inputs sources. These were the value of landings per ICES rectangle for the period 2007 to 2010, processed VMS data for vessels over 15m and data for vessels under 15m gathered in a project titled Fishermap (Seafish, 2009). Data on the value of landings per vessel per ICES rectangle was obtained from the Marine Management Office (MMO) in the UK. The use of satellite VMS data is increasingly common in determining the spatial and temporal distribution of fishing activity (Davies et al., 2007, Deng et al., 2005, Pedersen et al., 2009, Witt and Godley, 2007). Since 1st January 2005 all fishing vessels in European waters 15m in length are required to have a VMS installed and transmit details on a vessel's position every two hours to a Fisheries Monitoring Centre (FMC) (EC Commission Regulation No. 2244/2003). The Regulation was amended to include all vessels exceeding 12m from 2012. Processed VMS data provides details on the number of hours spent fishing in a certain pre-defined area, referred to as a VMS square (roughly 0.05° longitude by 0.05° latitude), within an ICES rectangle. This data was also obtained from the MMO which is the FMC for the UK. The Fishermap project was carried out by Seafish and mapped the spatial activity of fishing vessels in the UK. The project consisted of a survey of fishermen that obtained information on where fishermen operate, what species they fish for, the gear type used and the time of year they fish in that area. The data covered the period 2004 – 2010. Within the MCZ Fisheries model were three underlying models with each model calculating a value layer for a different group of vessels, using a different combination of the three datasets outlined in this paragraph.

Model 1 employed the effort as a proxy for landed value approach as outlined in section 7.2.3.2. This model used processed VMS data, in terms of hours spent in a VMS square, and combined this with value of landings data to provide an estimate of distribution of the value of landing at a more accurate spatial scale than those provided by logbook data. The hours spent in the VMS square were expressed as a proportion of the total hours spent fishing within the ICES rectangle. This percentage was then multiplied by the total landings value for that vessel to give an estimate of the value of landings within that VMS square. This assumes that the effort (hours spent in the VMS squares) reflects the value of the catch in that area. It also assumes that the value of landings obtained from one hour of fishing effort for an individual vessel using a specific gear type is uniform across the ICES rectangle.

Model 2 is concerned with vessels under 15m and combines vessel-specific Fishermap data on where that vessel was active with value of landings data. Fishing grounds were identified as distinct spatial areas through the Fishermap survey and interviews. This is similar to the consultation approach described in section 7.2.3.4. This spatial data was then combined with landings data and the spatial distribution of value of landings was estimated in proportion to the size of the fishing grounds. This model produced a value layer at a spatial scale of 1km by 1km. As with model 1, this model assumed that the value of landings from a given fishing ground was distributed evenly within the grounds identified.

For Model 3, the spatial activity of those vessels whose skippers did not provide information to the Fishermap study was described using aggregated data on the spatial distribution indicated by the whole Fishermap sample for that gear type. This assumes that the aggregate pattern of fishing activity can be used to describe the spatial activity of vessels which have not supplied data. Firstly, the distribution of the value of landings for each gear type across each ICES rectangle was estimated using the spatial value of landings data layers created in Model 2, at a spatial scale of 1km by 1km grids. For each grid square, the value of landings for each vessel was summed to give an aggregate total for each gear type. The aggregated values were then converted to percentages which represented the proportion of value of landings that should be attributed to each grid square. The value of landings for the vessel in question, which did not provide information to Fishermap, was then calculated for each grid square using these percentages.

7.2.5 Commercial Fisheries Atlas of Ireland

The Irish Marine Institute developed a map of commercial fishing activity of vessels over 15m within Ireland's Exclusive Economic Zone (Gerritsen and Lordan, 2014). The methodology used was similar to model 1 outlined in section 7.2.4 and the map was created by linking logbook data in order to VMS data to estimate the approximate catch for each VMS position. The map provides an indication of the spatial distribution of the value of landings for vessels over 15m for Ireland at a spatial scale using grids of 0.03° longitude by 0.02° latitude.

7.3 Design of compensation model

This section outlines the design of a model for the calculation of compensation for fishermen based on the potential loss that vessels may suffer if they were excluded from fishing ground due to the development of a MRE project. The compensation amounts are calculated using estimates of the spatial distribution of the value of landings for vessels. The model is intended to be used at a project level. The compensation model is based on a combination of two of the methods of calculation outlined in the Seafish guidelines, as described in sections 7.2.3.2 and 7.2.3.4. The approach that uses effort as a proxy for landed value is employed for vessels over 15m where VMS and landings data are available. The consultation approach is used for vessels where data on spatial activity and/or information on value of landings are not available. In addition, this model also uses elements of the underlying models used in the MCZ fisheries model, as outlined in section 7.2.4.

The basic underlying assumption of this model is that the spatial distribution of fishing effort is an adequate proxy for the distribution of the value of landings. The aim of the model is to combine spatial data on fishing activity with landings data in order to provide a more accurate estimate of the spatial distribution of value of landings for fishing vessels than is currently available. The information provided by the model could be used to identify areas of high fishing intensity and value which could aid decision-making in the site selection process.

7.3.1 Data requirements and availability of data

The data requirements for the model are similar to those used in the MCZ fisheries model. In order for the model to provide calculations on compensation, data on both the spatial distribution of fishing activity and value of landings is required. The model will then integrate these two datasets. The availability of this data depends largely on the size of the vessel and the legal requirements of vessels to provide landings data.

7.3.1.1 Data on spatial distribution of fishing activity

The data on the spatial distribution of fishing activity needed for the model can be gathered from a number of sources. Data from VMS devices is the most common source and this data is gathered by the Irish Naval Service which acts as the FMC for Ireland. VMS data can be processed to give an estimate of the number of hours spent fishing in a certain area. The accessibility of VMS data may be an issue. In recent years VMS data has become more freely available for scientific purposes although access to such data often remains problematic because of legal and confidentiality constraints (Gerritsen and Lordan, 2011). Organisations that use VMS data must comply with confidentiality agreements whereby data on individual vessels is used in a responsible manner. In addition, the data must be anonymised. The majority of VMS data is also limited to vessels that are over 15m in length and hence does not include smaller vessels traditionally engaged in inshore fisheries. New technologies such as Succorfish are increasingly being used to gather data for smaller vessels (Succorfish, 2015). Succorfish is a global positioning system (GPS) device that can be used to track and monitor commercial fishing vessels. In addition, Succorfish monitoring systems come with an e-log and catch report capability. In addition to the use of VMS and Succorfish technology, the consultation approach can also be used to gather this information. This involves interviewing fishermen who operate from ports in the vicinity of the proposed development zone are interviewed in order to identify the primary locations of their fishing activity.

There is also a temporal aspect to this data. When assessing fisheries data, the Centre for Environment, Fisheries and Aquatic Sciences (CEFAS) recommends using data for five years for addressing trends and seasonal variations in vessel landings and effort. If available, up to ten years of reliable data should be used to reflect the inherent variability in fisheries.

7.3.1.2 Data on value of landings

Information on the value of the catches which vessels land to ports is required for the model. All fishing vessels over 10m in length are required to submit logbook data and declarations of landings to relevant authorities. In Ireland the relevant authority is the Sea Fisheries Protection Authority (SFPA). Landings data into Irish ports are available on the SFPA website. There is no requirement for vessels less than 10 metres in length to report logbook and landings data. For the vessels under 10m where there is no information on value of landings, the consultation method would be required to gather this information. This would involve asking fishermen for details on the value of fish species landed, such as sales receipts. As with the data on the spatial distribution of fishing activity, there is a temporal aspect to value of landings data. If possible, up to 10 years data should be used to assess trends and address the seasonality in the commercial fishing industry.

7.3.2 Flowchart of the model

The flowchart graphically describes the steps and processes in the model. The steps and actions in the model are described in detail in section 7.3.3.

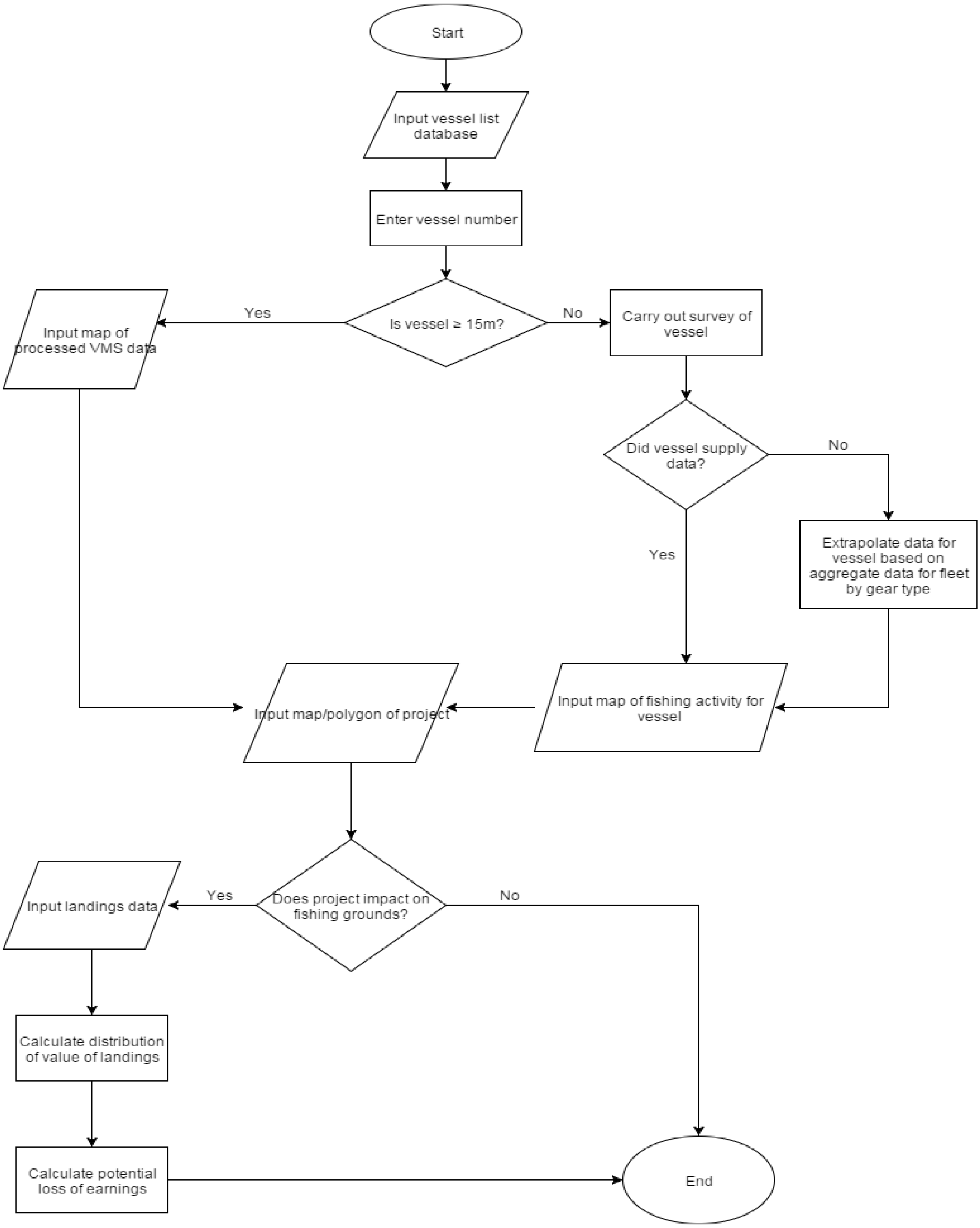

Figure 7.1. Flowchart of the model

7.3.3 Steps in the model

The three main steps in the model are set out in the flowchart. The first step is to identify the vessels that are active in the area that may be impacted by the development and determine where the vessels in question operate. This involves obtaining a list of vessels operating in the area under consideration and inputting this into the models database. This database would also include details on the vessels, in particular the size and the gear type used. These details will provide an indication on the type of spatial and financial information that is available for each vessel. If the vessel is over 15m then VMS data will be available. The VMS data is then processed in terms of hours spent fishing at a spatial scale of 0.05° longitude by 0.05° latitude grids and inputted into the model. If the vessel is less than 15m it is assumed that no VMS data exists for that vessel. Although vessels over 12m have been required to carry VMS equipment on board since 2012, there may not be enough historical data available. In this case an interview will need to be carried out with the owner or skipper of the vessel in question, in which they will be asked to identify the areas where their fishing activity takes place. This data is collected at a spatial scale of 1km by 1km. If the necessary information is provided by the fishermen, then the model will proceed to the next step. If the required information is not disclosed, then the value of landings data available for all vessels using the same gear type is aggregated to estimate the pattern of fishing activity.

The second step involves determining whether the project will have an impact on the fishing grounds based on the spatial data inputted above, i.e. to ascertain whether there is an overlap between the fishing ground for the vessel and the proposed area for development. This involves inputting details of the co-ordinates of the development area into the model. If there is no impact, then no further action is required. If there is an overlap, then the third step involves inputting the landings data of the vessel in question and combining this with the spatial data from the first step.

For a vessel with available processed VMS data, the total hours spent in the VMS square are expressed as a proportion of the total effort within the ICES rectangle. This proportion is then multiplied by the total landings value for that vessel to give an estimate of the value of landings taken from that specific area, in a similar manner to model 1 outlined in section 7.2.4. For a vessel whose skipper provides information on fishing grounds, data on the value of landings is allocated to the areas identified at a scale of 1km by 1km grids, as in model 2 outlined in section 7.2.4. For a vessel whose skipper does not provide any information on fishing activity, the distribution of the value of landings can be estimated by aggregating the value of landings for each 1km by 1km grid square for each vessel in the fleet using that same gear type. The amounts per square are then converted to percentages and multiplied by the value of landings data for that vessel.

7.3.4 Assumptions of the model

The assumptions of the compensation model are similar to those in the MCZ fisheries model as outlined in section 7.2.4. As noted, the main assumption is that effort is a reasonable proxy for distribution of landings value, i.e. the hours spent in a certain area reflect the value of the catch in that area. In addition, it is assumed that the value of landings is evenly distributed within the fishing grounds identified.

With regard to the impacts, the level of disturbance to fishing activity that may occur as a result of a MRE development is largely unknown. Therefore, assumptions need to be made about this. A study on the economic effects of the development of an offshore wind farm on fisheries claimed that a reasonable starting point would be the complete displacement of commercial fishing vessels in the area (Hoagland et al., 2015). As such, the model works on the assumption that there will be a complete exclusion of fishing activity within the area under development and this is currently a considerable limitation of the model. It is possible that an area that is closed to fishing may have potential benefits for fishermen and this had been discussed previously in section 2.8. The interactions are highly complex and depend on a number of factors including species, habitat and the intensity of fishing activity in the area. Calculation of these impacts is currently beyond the scope of this model. Further work is needed to integrate the complexities of these interactions into the model.

7.4 Excel model

An Excel model was constructed to demonstrate the steps outlined in section 7.3.3. The Excel model was used to calculate the hypothetical losses of fisherman that would be impacted by the construction and installation of a MRE project in Irish waters. The hypothetical project used was a 300 MW offshore wind farm off the east coast of Ireland. The spatial scale of such a project would depend to a large extent on the distance between turbines and the capacity of the turbines. For example, the Thanet Offshore Wind farm is a 300 MW project and consists of 100 Vestas V90 3 MW turbines (Vattenfall, 2016). The project covers an area of 35km^2. By comparison the London Array is a 630 MW offshore wind farm and consists of 175 Siemens 3.6 MW turbines and covers an area of 122 km^2 (London Array, 2016). Based on this information, the hypothetical case study project would utilise 100 3 MW turbines and the proposed development zone (PDZ) would cover an area of roughly 66km^2. The estimated installation of the turbines and construction of the project was assumed to be two years based on the construction period for the Thanet Offshore Wind Farm (Vattenfall, 2016). For the construction period there will be a complete exclusion zone around the PDZ meaning that static gear fishermen who usually have gear in that area will be required to move it. In addition, there will be some displacement of mobile gear fishermen who would have regularly fished in that area. Three main scenarios were designed to demonstrate how the model works.

It should be noted that the intention of the Excel model is to demonstrate how compensation could be calculated. The figures used are hypothetical but are based on figures obtained on the average earnings value for vessels of similar sizes. The scenarios are only used to demonstrate how the model works. As such, the figures provided do not give any indication of the actual amounts that would be payable and should not be used for this purpose.

7.4.1 Case 1 – Vessels under 15m that provide data

The first hypothetical scenario involves five vessels which range from 10m to 12m in length which primarily fish for lobster and crab using static gear. The vessels were assigned numbers 1 to 5 for the sake of identification. The vessel skippers would be required to remove all fishing gear usually located in the PDZ for the construction phase. As these vessels are less than 15m there is no VMS data on spatial distribution of fishing activity, however, as all vessels are over 10m there is landings data available per year per ICES rectangle. Vessel 1 is 10.5m in length with average annual value of landings of €42,000. Vessel 2 is 10m in length with average annual value of landings of €25,000. Vessel 3 is 11m in length with average annual value of landings of €35,000. Vessel 4 is 12m in length with average annual value of landings of €42,000. Vessel 5 is 10m in length with average annual value of landings of €36,000. The average values from landings figures are part of the inputs to the model. For this scenario, it was assumed that all vessel skippers were interviewed and were willing to provide information on where their fishing activity takes place.

The Excel model contains a graph that represents the area of an entire ICES rectangle, which is roughly 110km by 60km on a sheet titled "Interview data". The graph of the ICES rectangle consists of cells that represent an area of 1km by 1km or 1km^2. For each individual vessel the fishing area identified was then entered into the graph at a spatial scale of 1km^2. The area of the PDZ, which is roughly 66km^2, was then entered on to the graph of the ICES rectangle. The fishing area in each grid square was expressed as a percentage of the total fishing area identified in the ICES rectangle. The percentage was multiplied by the average annual value of landings to find the distribution of value of landings at a spatial scale of 1km^2. The amount in the PDZ represents the loss in income for the vessel as a result of being excluded from that area and as such is the compensation amount.

Figure 7.2 helps to illustrate this process. The blue area of the graph represents the ICES rectangle, the white grid cells are the areas identified by the skipper of vessel 1 and the red rectangular area is the PDZ. For vessel 1, the total fishing area identified was 24km^2. The graph shows that six grid cell squares would be impacted by the offshore wind farm, which is equivalent to 6km^2 of fishing activity. The fishing area identified for the vessels within the PDZ amounts to 25% of the total fishing area within the ICES rectangle.

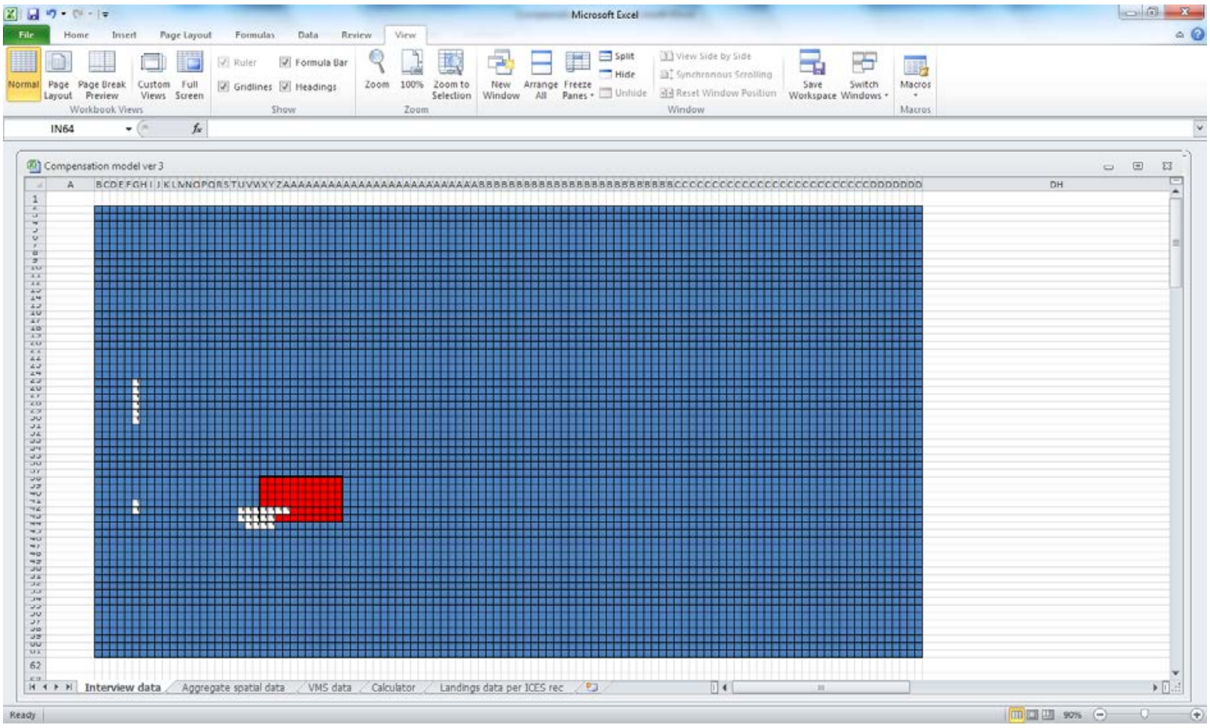

Figure 7.23. Interview data

The next step was to enter the average annual value of landings for the vessel in question into a separate spreadsheet entitled “Calculator”. The percentage of the fishing activity in the PDZ was then multiplied by the annual average value of landings for the vessel. This is presented in table 7.1 below from the Excel model. This table shows the inputs to the model which are the vessel identifier number, value of landings per ICES rectangle and the number of years for the construction period and operational period. There is also a variable for the percentage of compensation paid for each year of operation. The payment of compensation during the operational period is an issue which will have to be negotiated between fishermen and MRE developers but for the sake of this scenario the percentage used is 10%. This figure was used purely to demonstrate the model and is not based on any specific calculations. For practical use of the model, the figure for the percentage of potential lost earnings would likely be negotiated between MRE developers and fishermen.

Other information in this sheet includes the total fishing area identified by the vessel skipper, the size of the fishing area within the PDZ (both in km^2) and the proportion of the total fishing area in the PDZ. This information is linked to the “Interview data” sheet. The total value of landings for the vessel for the ICES rectangle was multiplied by the proportion of the total fishing area located in the PDZ to give the value of landings in the PDZ. This figure was then multiplied by the length of the construction period to give the subtotal for the construction period. The value of landings in the PDZ was also multiplied by the length of the operational period and the percentage payable over this time to give the subtotal for the operational period. These figures were then added together to provide an estimate of the total compensation amount to be paid to the vessel for the lifetime of the project. The same process was carried out for the other four vessels in this scenario.

Table 7.1. Vessel 1 calculator

Vessel identifier	1
Value of landings per ICES rectangle	€ 42,000.00
Construction period (years)	2
Operational period (years)	25
% paid for each year of operation	10%
Size of total fishing area in ICES rec (km sq)	24
Size of fishing area within PDZ (km sq)	6
Proportion of total fishing area in PDZ	25.00%
Proportion of earnings in PDZ	-
Total hours fishing in ICES rectangle per year	-
Total hours fishing in PDZ	-
Proportion of time spent in PDZ	-
Value of landings within PDZ	€ 10,500.00
Subtotal accounting for construction period	€ 21,000.00
Subtotal accounting for operational period	€ 26,250.00
Total	€ 47,250.00

7.4.2 Case 2 – Vessel under 15m that does not provide data

The second scenario involves a vessel of 12m which also targets lobster and crab using static fishing gear. The vessel in question was identified as vessel 6. As above, the vessel skipper would be required to remove all fishing gear usually located in the PDZ for the construction phase. As with the vessels in Case 1, no VMS data or other information on the spatial activity of the vessel exists but there is information on the value of landings. The vessel had average annual value of landings of €50,000. In this scenario, the vessel skipper was unwilling to provide information on where the primary fishing activity of the vessel takes place. For this scenario the value of landings per grid square for all of the vessels in Case 1 was added together in one Excel sheet titled “Aggregate spatial data”. As vessel 6 uses the same gear type as the other five vessels, the aggregate amounts of these vessels were used to estimate the distribution of value of landings for the vessel in question. These amounts per grid cell were then expressed as a percentage of the total landings value per ICES rectangle for all vessels. Figure 7.3 helps to illustrate this process. The white grid cells are the areas identified by fishermen and the red rectangular area is the PDZ. For this scenario the percentage of value of landings for the other five vessels in the area within the PDZ was 12.55% of the total value of landings within the ICES rectangle.

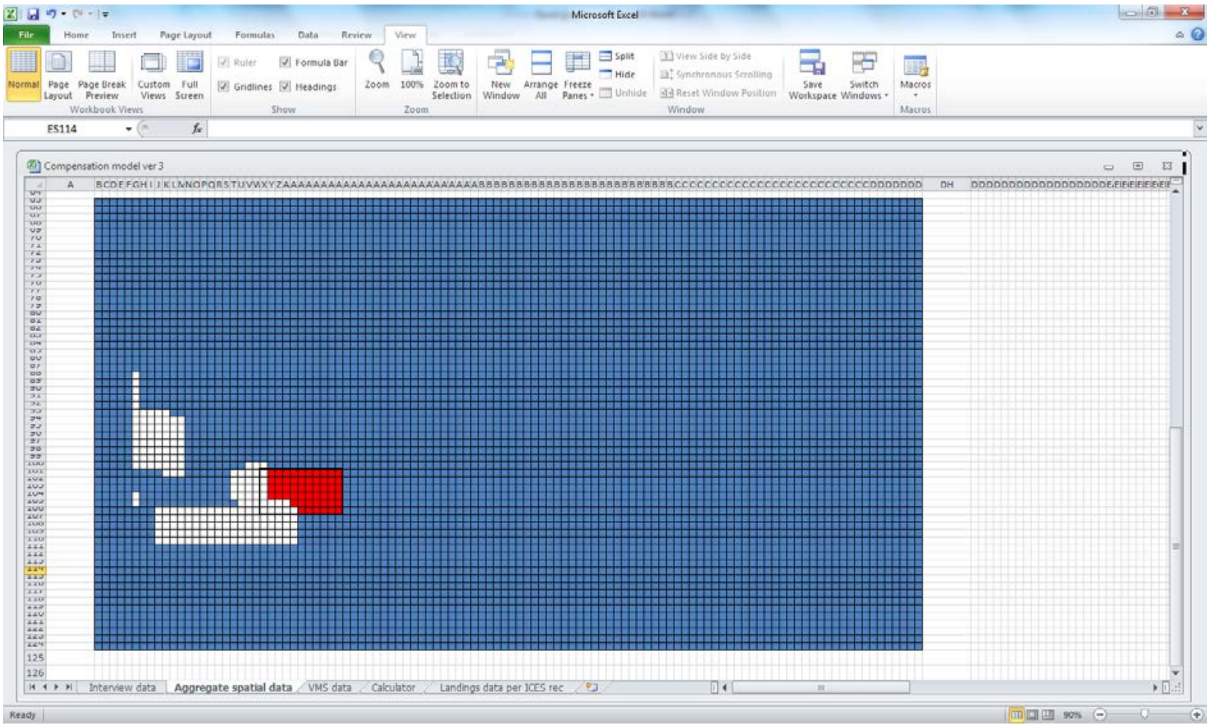

Figure 7.3. Aggregate data

The average annual value of landings for vessel 6 was then entered into the spreadsheet entitled “Calculator”. This is presented in table 7.2 below from the Excel model. As with scenario 1 the information on the length of the construction and operational periods and the percentage paid for each year of operation are included. The total value of landings for vessel 6 for the ICES rectangle was multiplied by the percentages of the aggregate value of landings calculated in the “Aggregate spatial data” sheet to give the value of landings in the PDZ. This figure was then multiplied by the length of the construction period to give the subtotal for the construction period. The value of landings in the PDZ was also multiplied by the length of the operational period and the percentage payable over this time to give the subtotal for the operational period. These figures were then added together to provide an estimate of the total compensation amount to be paid to vessel 6.

Table 7.2. Vessel 6 calculator

Vessel identifier		6
Value of landings per ICES rectangle		€ 50,000.00
Construction period (years)		2
Operational period (years)		25
% paid for each year of operation		10%
Size of total fishing area in ICES rec (km sq)		-
Size of fishing area within PDZ (km sq)		-
Proportion of total fishing area in PDZ		-
Proportion of earnings in PDZ		12.55%
Total hours fishing in ICES rectangle per year		-
Total hours fishing in PDZ		-
Proportion of time spent in PDZ		-
Value of landings within PDZ		€ 6,275.58
Subtotal accounting for construction period		€ 12,551.17
Subtotal accounting for operational period		€ 15,688.96
Total		€ 28,240.13

7.4.3 Case 3 – Vessel over 15m

The third scenario involves a trawler vessel of 25m in length which targets Nephrops using mobile gear. The vessel was identified as vessel 7. The vessel will be excluded from the PDZ for the entirety of the construction period. As this vessel is over 15m there is VMS and landings data available. The vessel had average annual value of landings of €250,000. This scenario involved entering the processed VMS data, in terms of hours spent fishing, into grid cells which represent an area of 0.05° longitude by 0.05° latitude (roughly 5.5km by 3km) into a sheet titled "VMS data". While this a coarse spatial scale in relation to the size of MRE developments, the VMS data is applied at this scale as recommended by the Seafish guidelines for financial impact assessment. This raises issues as to the accuracy of the model. The hours spent fishing in each grid cell was then expressed as a proportion of the total hours spent fishing in the ICES rectangle. Figure 7.4 from the Excel model helps to illustrate this process. The white grid cells are hours spent fishing in those areas, as identified by the VMS data, and the red rectangular area is the PDZ. The figure shows that vessel 7 spent 490 hours fishing in the ICES rectangle and 30 hours fishing within the PDZ. The time spent in the PDZ represents 6.12% of the total time spent in the ICES rectangle.

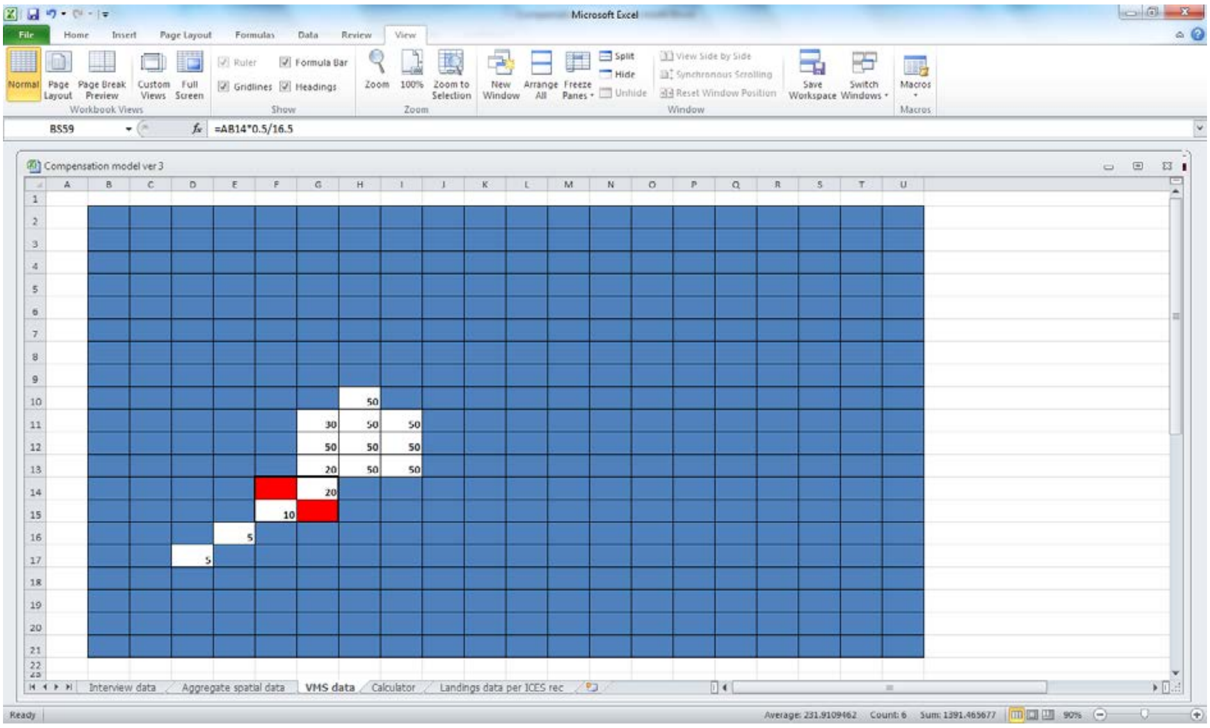

Figure 7.4. VMS data

The average annual value of landings for vessel 7 was then entered into the spreadsheet entitled “Calculator”. This is presented in table 7.3 below from the Excel model. The other information in this sheet includes the total hours spent fishing in the ICES rectangle per year, the hours spent fishing in the PDZ and the proportion of the total hours that was spent in the PDZ. This information is linked to the “VMS data” sheet. The total value of landings for vessel 7 for the ICES rectangle was multiplied by the percentage of the time spent fishing in the PDZ, which was 6.12%, to give the value of landings within the PDZ. This figure was then multiplied by the length of the construction period to give the subtotal for the construction period. The value of landings in the PDZ was also multiplied by the length of the operational period and the percentage payable over this time to give the subtotal for the operational period. These figures were then added together to provide an estimate of the total compensation amount to be paid to vessel 7.

Table 7.3. Vessel 7 calculator

Vessel identifier		7
Value of landings per ICES rectangle		€ 250,000.00
Construction period (years)		2
Operational period (years)		25
% paid for each year of operation		10%
Size of total fishing area in ICES rec (km sq)		-
Size of fishing area within PDZ (km sq)		-
Proportion of total fishing area in PDZ		-
Proportion of earnings in PDZ		-
Total hours fishing in ICES rectangle per year		490
Total hours fishing in PDZ		30
Proportion of time spent in PDZ		6.12%
Value of landings within PDZ		€ 15,306.12
Subtotal accounting for construction period		€ 30,612.24
Subtotal accounting for operational period		€ 38,265.31
Total		€ 68,877.55

For this scenario the VMS data was analysed at a different spatial scale to the data gathered from fishermen in cases 1 and 2. The VMS grids represent an area of 5.5km by 3km and the fishing grounds identified by the fishermen were analysed in 1km by 1km grid squares. For the sake of uniformity, the data should be analysed at the same spatial scale. As such, an adjustment was made to analyse the data at the same spatial scale for all vessels. This involved distributing the value of landings in the VMS grid cells evenly among the 1km by 1km grid squares. Again this works under the assumption that spatial distribution of the value of landings is spread evenly throughout the VMS grid. The area of the smaller grid square was expressed as a proportion of the area of the VMS square and multiplied by the value of landings for the VMS square.

7.5 Impact on Capital Expenditure

The model can also be used to calculate the impact that the payment of compensation to fishermen would have on development costs of a MRE project. It was assumed that the payment of compensation to fishermen would impact on the capital expenditure (CAPEX) of a project. CAPEX refers to long term expenditure made at the early stages of a project. For offshore wind farms the CAPEX figure is estimated to be £3.1 million per installed MW in 2014 (Clean Energy Pipeline, 2014), which equates to roughly €3.9 million per MW. For the hypothetical 300 MW offshore wind farm this corresponds to €1.17 billion. For the scenarios outlined above, the total amount payable would be €198,782.16. These figures were entered into the "Calculator" sheet in the Excel model and were used to determine the potential impact the payment of compensation of fishermen would have on CAPEX. This is shown in table 7.4 below.

Table 7.4. Impact on CAPEX

CAPEX per MW	€ 3,900,000.00
Maximum installed capacity	300
Total CAPEX for project	€ 1,170,000,000.00
Total compensation amount	€ 198,782.16
% impact of compensation on CAPEX	1.70%

7.6 Further work

It should be noted that the model has its limitations. In particular, the availability of reliable data may be an issue. The spatial and financial data required for the model is historical and as such is a snapshot of data for a given period. This data does not necessarily provide a prediction of what the future spatial distribution of value of landings will be. The lack of data for inshore fisheries is also a significant problem. This leads to the need to gather data on the spatial distribution through interviews with vessels skippers which may be biased and/or inaccurate. In addition, the assumption made on spatial distribution, i.e. that fishing is evenly distributed throughout the spatial areas identified is unrealistic. A more accurate approach would involve varying the distribution of the value of landings between the grid squares.

There is currently uncertainty over the level of impact that MRE projects will have on fishermen, depending on gear type used and the stage of development. This model has made the simple assumption that there would be a complete exclusion of fishing activity in the development zone from the beginning of the construction phase. Further work is required on the model to enable users to carry out assessments based on a range of scenarios of the level of impact at each stage of development and on vessels that use difference gear types.

The model examines the direct financial impact of the development on fishermen but does not include the broader economic impact. It should be noted that economic activity does not exist in a vacuum and financial impacts on fishermen will be felt in other sectors. Closures to fishing ground will result in upstream (suppliers to the sector) and downstream (processors, wholesalers) impacts. Further work is required to incorporate these impacts into the model to provide an estimate of the broader economic impacts. Input-Output (IO) analysis is a potential tool that could be used to address this. IO studies have been carried out on the Irish marine economy (Morrissey and O'Donoghue, 2013). The information could be further incorporated into the compensation model.

8 Conclusions and Recommendations

As stated in Chapter 1, the main research aim of this thesis was to gather data on the three broad themes identified. The thesis has gathered this information and addressed these knowledge gaps in Ireland. Based on this information a number of recommendations are made in this final chapter for policy, the MRE industry, the commercial fishing industry and further research. The recommendations will assist in forming the basis for the long term co-existence between the nascent MRE sector and the established commercial fishing sectors in Ireland. The results from Chapter 4 show that the fishermen at the sites are currently not fully supportive or accepting of the MRE projects being developed. However, it is encouraging for developers and marine planners that the majority of fishermen surveyed believe that it will be possible for both sectors to co-exist. This chapter outlines some concluding remarks on mitigation methods which, if implemented correctly, could help achieve this. The mitigation strategies outlined include schemes that can enhance the potential benefits for fishermen and also options that limit the negative impacts. The recommendations made are based on the analysis of the information gathered from the case study projects and could help develop policies based on co-existence planning. While the implementation of the recommended mitigation options may not guarantee the acceptance of MRE projects among all fishermen it could certainly reduce the chance of mass opposition to projects. It should be noted that the mitigation options and strategies outlined are by no means prescriptive and it is not an exhaustive. It is likely that site specific solutions will be required and will be devised on a case by case basis. Such mitigation options will have to be tailor made in order to address project specific local issues.

The remainder of chapter 8 is categorised into 4 main sections as follows:

- recommendations for policy,
- recommendations for research,
- recommendations for MRE developers,
- recommendations for the commercial fishing industry.

8.1 Recommendations for policy

8.1.1 Consultation

The ultimate aim for any consultation process is to ensure stakeholders are provided with the required information on the project, are able to raise any issues or concerns they may have and are given an opportunity to influence the decisions which may affect them. This may be difficult to achieve, however doing so will greatly increase the chances of fishermen accepting a project. Consultation is a formal requirement as part of the Environmental Impact Assessment process. However, at each of the case study sites a more informal developer-led approach was employed, whereby considerable effort was made to ensure that local fishermen were effectively consulted. This would suggest that the formal process is somewhat flawed. The Fisheries Liaison with Offshore Wind and Wet Renewables (FLOWW) group has published guidelines for best practice for the consultation of fishermen on MRE projects in the UK. A policy recommendation is that these guidelines should be adapted for the development of MRE in Ireland and made a formal requirement for developers.

Fishermen need to be convinced that consultation is not just a one-way process and encouraged to engage in the consultation process. This can be achieved through developing trust and building effective and working relationships between fishermen and MRE developers. The Seagrant programme in the US has been successful in embedding experts in coastal communities. The experts are referred to as extension agents and provide a link between local marine stakeholders, including fishermen, on one side and developers, government and academic institutions on the other. Their presence in coastal communities has helped to build up trust between the locals and outside parties. The replication of a similar programme to Seagrant in Ireland could potentially assist in enhancing the co-existence of MRE projects and commercial fishing.

8.2 Recommendations for research

8.2.1 Data deficiencies

Data deficiencies, particularly in relation to spatial and financial information on inshore fisheries, are a key barrier for the development of MRE in Ireland in co-existence with the commercial fishing sector. Currently potential MRE sites are chosen with considerable gaps in the data and while this continues there will be problems for developers, as was witnessed by the decision to reduce the target capacity on the FFW project. The lack of such data severely limits the ability of planners to develop marine spatial plans. Furthermore, it also makes it difficult to conduct an accurate impact assessment on fisheries for a MRE project. As such, a further recommendation from this thesis for the research community is that more data needs to be gathered prior to decisions being made regarding the designation of sites for development.

As noted above, effective stakeholder engagement and early consultation provides an opportunity to address data deficiencies and fill in gaps in baseline data, through the mapping of fishing activity. An alternative method which could be applied to gather this information involves the use of Succorfish devices. This was mentioned by several of the fishermen interviewed. The use of Succorfish devices offers a cheaper alternative for smaller vessels in comparison to more expensive vessel monitoring system (VMS) equipment. It also provides more accurate spatial data including the time in which fishing activities are carried out and seasonal variances. This technology is currently under trial around the Galway Bay Wave Energy Test Site and spatial information on the fishing activity of inshore vessels in the area is being gathered. The provision of Succorfish devices to fishermen would help in gathering this data on fishing activity. The supply of these devices would be worthwhile if this would to avoid potential future delays and re-configuration of project areas.

8.2.2 Ownership

Establishing a sense of ownership of MRE projects among fishermen is crucial for the co-existence of both sectors. Ownership in this sense refers to symbolic ownership or actual ownership where fishermen have increased responsibility and are involved in financing, development and day to day running of the project. The problems with the latter sense of ownership have been discussed in Chapter 6. Significant financing is required for the development of projects and the reality is that the majority of fishermen and indeed fishing organisations will be able to raise the necessary finance. Obtaining part ownership of a project is a more likely option with fishing organisations providing a small capital investment. However, full ownership remains a plausible option. The company Fishermen's Energy provides a good example of a fishing organisation striving to develop and run an offshore wind farm. Further work on this company and how the project progresses over time would make an interesting case study for research.

8.3 Recommendations for MRE developers

8.3.1 Consultation

Evidence from the interviews demonstrates the importance of establishing a company fisheries liaison office (CFLO), employed by the developer, at the earliest possible stage in the project. Furthermore, the selection of a trusted member of the local fishing community to act as fishing industry representative (FIR) is equally important. This is also a key recommendation from the FLOWW document. There is currently no formal requirement for the appointment of a CFLO or FIR on MRE projects in Ireland. For future projects the establishment of a CFLO and FIR should be a requirement for MRE developers and should be enforced by planners/consenting authorities.

The first step for a CFLO would be to carry out a detailed stakeholder analysis which would involve identifying the fishermen most likely to be impacted by the development. Evidence from the interviews has shown that it is highly desirable for a CFLO to have knowledge of and contacts in the fishing industry. The CFLO also has a key role in improving the effectiveness of the consultation process at the three levels of participation outlined in Chapter 6 – informed, consulted and involved. The CFLO is responsible for ensuring that fishermen are provided with up to date information and that they receive information that they have requested in a timely manner. This will help to provide clarity on the project. Information can be provided to fishermen in a number of ways but evidence from the case studies and interviews with the CFLOs shows that face to face interactions are often the most effective. The actual presence of a liaison officer in an area where a project is being developed is required so that he can be easily contacted and readily available. The CFLO also has the responsible for establishing channels of communication and scheduling meetings for times which suit most fishermen. It is important to note that an effective consultation process does not just consist of a one-way flow of information and fishermen should be given an opportunity to discuss issues and concerns they may have. The CFLO would also be responsible for ensuring that the issues and concerns of fishermen are dealt with in a satisfactory manner, which would achieve the consulted level of participation. This would involve ensuring the clarity of the process by providing prompt feedback on how the issues and concerns are dealt with. The would also require managing expectations of fishermen with regard to what can be achieved in the process and the extent to which they will influence the project. As such the CFLO should have good communication skills and be able to deal with complaints of fishermen while maintaining impartiality.

In addition to this the CFLO also has a role to play in providing a platform whereby fishermen can influence the decision-making process. This can be done by ensuring information gathered from fishermen is used to influence decisions, where this is possible. The mapping of fishing activity can be an effective mechanism that enables the participation of fishermen, provided that the information is used when selecting sites for development. Studies on the mapping of fishing activity, such as Scotmap in Scotland, Fishermap in the UK and the mapping of priority spatial access areas in Northern Ireland have been successful in gathering data through interviews and surveys of fishermen. Such mapping exercises are likely to be time consuming and expensive but could potentially prove to be worthwhile if they result in a consensus being reached on where a project should be located. The use of these maps could lead to a collaborative siting process whereby input from fishermen is considered in decision-making. In addition, the maps created could also be used to inform maritime spatial planning (MSP). A vital element of MSP is that stakeholders participate in the designing of plans and the importance of involving fisheries in the planning of other marine activities needs to be stressed. The site selection process is one of the key areas where fishermen should be able to participate in and the local knowledge that fishermen possess could be used to influence decisions on this. More consideration should be given to fishermen when choosing sites for the development of MRE projects. In general, primary considerations are concerned with the wind, wave or tidal resource and other technical constraints. The fact that the target capacity of the First Flight Wind offshore wind farm was initially reduced by almost 50% to between 300 MW and 400 MW, due in part to the extent of fishing activity in the area, would suggest that the commercial fishing industry should be given more consideration. The subsequent cancellation of the FFW project has provided an opportunity for future developments to progress with a formal collaborative siting process. Evidence from the interviews would suggest that fishermen would be willing to engage in such a site selection procedure if it would reduce the extent of the impact on them. As mentioned by one of the CFLOs interviewed there is no substitute for early engagement. If fishermen are involved from the beginning of projects, before major issues have been decided, the outcome would likely be more favourable for both sectors.

8.3.2 Provision of benefit schemes

Corporate Social Responsibility (CSR) refers to the voluntary integration of social and environmental considerations by a company into their business operations. The author takes the view that the provision of benefit schemes to fishermen who may be impacted by a project is part of the CSR of MRE developers. In order to garner the support of stakeholder fishermen it is important to ensure that a fair share of the benefits generated from MRE developments stay in the local community. Benefit schemes are a valid mitigation option which could potentially enhance the acceptance of projects. Benefit schemes on offshore wind projects in the UK are generally voluntary and are implemented ad hoc at the discretion of the developer and there is currently no formal requirement for their provision. The mandatory provision of benefit schemes which are equitable to the local fishermen would help to increase acceptance significantly. The Scottish government has recently provided initial guidance on good practice in shaping and delivering community benefits from MRE development, in particular, offshore wind. These guidelines could be adapted and formalised by the Irish government and there should be a requirement on developers to deliver an appropriate benefits scheme. This is an important point for MRE developers and could assist in the establishing better relationships between the MRE and commercial fishing industries. This would not only benefit fishermen but also community members who may be impacted by the development of MRE projects. Choosing the appropriate mechanism for the provision of benefits may be difficult. The design and implementation of benefit schemes will likely be project specific and will depend on the fishermen impacted by the MRE development. Those schemes which provide long term benefit throughout the life of a project are likely to be more successful rather than one-off benefits. An example of this is the fuel company which was set up by a local fishing organisation in the UK to supply fuel to the service vessels working on the nearby offshore wind farm.

8.3.3 Financial Compensation

Financial compensation generally refers to regular contributions to fisheries community funds and payments for disruptions to regular fishing activities. Disruption payments and community funds are separate measures, as noted in section 6.2.3. Both options are viable, however, there is some evidence that communities and developers can resent the establishment of community funds (Cowell et al., 2011). Compensation is essentially a trade or exchange whereby one party is giving up something to another in exchange for financial recompense. Disruption payments are generally paid for disruptions to regular fishing activity, such as the removal of static fishing gear such as pots and creels. Such payments tend to be short term for periods when geo-physical surveys are being carried out or when the project is under construction. Payments are generally negotiated with individual fishermen who may be impacted with the agreement that there is an exclusion zone around the area being surveyed or under construction. These negotiations are usually facilitated through the project CFLO and FIR. Although no legal basis for the provision of compensation exists, evidence from the case studies and interviews with the CFLOs would suggest that disruption payments are becoming increasingly common in the offshore wind sector. Questions arise over whether fishermen should be compensated for loss of earnings as this essentially privatises a public good, i.e. the right to fish. As with the provision of benefits schemes, the author holds the opinion that MRE developers have the responsibility to provide compensation to fishermen for loss of earnings caused by loss of access to fishing grounds as a direct result of a MRE project.

It is important to ensure that the payment of compensation is a transparent and equitable process so that all parties are satisfied and it is not perceived as a bribe to ensure projects advance. The provision of an evidence base to back up and corroborate compensation claims and calculations for disruption payments and compensation fund contributions is essential. This will help to reduce the risk of false claims and ensure that any payment would reflect potential losses. The provision of an evidence base will also help to ensure that disruption payments do not result in fishermen having an advantage or disadvantage financially. A recommendation from this study for MRE developers is that they should insist on evidence when dealing with compensation for fishermen.

Although commercial fishing is a diverse sector with vessels of various sizes targeting a range of fish species using different gear types and vessel sizes, a standardised approach or method for compensation calculation would be useful. The methodology for the model outlined in Chapter 7 could be used by developers to provide an estimate of the amount of compensation that may have to be paid to fishermen impacted by a development. This is a basic model which will require further research and refinement.

There are still some issues associated with the payment of compensation to fishermen. Questions remain over whether fishermen should be compensated at all, in particular mobile gear fishermen who can continue to fish in other areas. Fishermen possess a licence which gives them a right to fish but they ultimately have no property rights over fishing grounds. Furthermore, there may be an issue over the willingness and financial ability of a MRE developer to provide compensation in the long term. The viability of disruption payments and contributions to funds as a long term mitigation option remains to be seen and further work on the area is required.

In conclusion there is great potential for the development of the burgeoning MRE sector in co-existence with the well-established commercial fishing industry, however a number of challenges still remain. There will inevitably be some impact on fishermen and it likely that they will have to forgo access to certain fishing ground to allow for new uses of the sea. If major decisions on projects are made with the participation of fishermen and fishing organisations that have the best interests of fishing as their priority, there is potential for a consensus to be reached.

8.4 Recommendations for the fishing industry

8.4.1 Alternative employment

Socio-economic benefits such as alternative employment are among the most often cited potential benefits associated with MRE. The services company model, used by fishing organisations in the UK and Northern Ireland, has proven successful in enabling fishermen to obtain employment in the offshore oil and gas and other marine based industries. For the fishing industry, the establishment of such companies could enable fishermen to avail themselves of this employment as it is created and could help to maximise the potential of alternative employment for fishermen on MRE projects. These companies provide a good model that could be replicated by fishing organisations in Ireland as the MRE sector advances. There is already evidence of this as the Irish South and West Fish Producers Organisation has established a services company. However, as detailed in section 4.4.2, there are currently legislative barriers which must be overcome in order to allow Irish fishermen to work on MRE projects without having to forgo their licence to fish. As MRE is a new sector and there have been relatively few jobs created in Ireland to date, flexibility is required to allow fishermen to earn supplementary income on MRE projects and continue to make a living from fishing. As mentioned in section 6.4.1, fishing vessels are limited in terms of the work that they can carry out on MRE projects. To date, specialise work boats have been mostly used to service the MRE sector and specialist vessels have been built by companies such as Green Marine and Scotrenewables. However, there is still an opportunity for fishing vessels and this has been demonstrated by the fact that a vessel from Kilkeel has been used for MMO work on the FFW project, as covered in section 6.4.1.

The uncertainty that fishermen have over whether they will be able to attain employment on MRE projects also needs to be addressed. Improved socio-economic assessments are required that accurately quantify the number of jobs that are likely to be created and available for fishermen. Such assessments should take into account the fact that the majority of smaller inshore fishing vessels will not be up to the standard required to obtain work on MRE projects. In addition, they should also include information on impacts to fishermen in terms of potential job displacement. It is important that socio-economic assessments provide realistic assessment of the number of jobs likely to be created. If the employment creation potential of the development of MRE projects is overstated and the jobs fail to materialise, this could erode trust between fishermen and developers.

Re-training courses for fishermen who wish to diversify would also help to remove some of the uncertainty fishermen currently possess over employment on MRE projects. There are already initiatives in place in Ireland to help fishermen diversify. Six Fisheries Local Action Groups (FLAGs) have been set up in coastal regions around Ireland. One of the aims of the FLAGs is to assist fishermen who may wish to diversify from fishing or supplement their income. Such groups should be made more aware of the potential employment opportunities on MRE projects available for them, and should be encouraged to provide training on skills and qualifications required to gain employment in the MRE sector, particularly offshore wind. In addition, preferential hiring schemes could be applied to give priority to those fishermen who are most likely to be affected by the development of a MRE project and displaced from their traditional fishing ground.

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Appendix A – Survey Questionnaire

<u>Attitudes of Fishermen towards Marine Renewable Energy</u>

My name is Kieran Reilly and I am student in University College Cork. I am conducting a study on the attitudes of fishermen towards the development of **Marine Renewable Energy (offshore wind, wave and tidal energy)** in Ireland and Northern Ireland.

This survey is part of my independent PhD research. The objective is to look into the attitudes of fishermen towards marine renewables and explore why these attitudes exist. The survey should last no longer than 10 minutes depending on how much information you are able to provide and any additional feedback. The questions are subdivided into 5 main categories – the type of fishing activity you are involved in, your knowledge of marine renewable energy, the potential opportunities of marine renewable energy, the potential impacts of marine renewable energy and your level of involvement in decision-making.

The information you provide will be used strictly for the purpose of this research and will remain completely anonymous. No individual responses will be made available to anyone other than me. Feedback on the results of the survey will be available to all fishermen who partake in the research.

Interviewer Initials: ____

Interview Site: ____

Date: ______ - ______ - 2013 Start: _____ Hour ______ Minute

(Day) (Month) End: _____ Hour ______ Minute

Fishing Activity

1. What is the name of your home port?

2. Do you fish inshore or offshore?

☐ Inshore (within 12 nautical miles)

☐ Offshore (beyond 12 nautical miles)

3. How long have you been a fisherman?

☐ <10 years

☐ 10-19 years

☐ 20-29 years

☐ 30-39 years

☐ >40 years

4. What type of gear do you use?

☐ Trawling

☐ Dredging

☐ Potting

☐ Netting

☐ Long lining

☐ Other (please specify)

5. What size is your vessel?

☐ Under 10 metres ☐ 10 metres or over

6. How many people does your vessel employ (a) full time and (b) part time?

(a)

(b)

7. Are you a member of a fishing organisation or association?

☐ Yes ☐ No

8. If yes, which one?

Knowledge of Marine Renewable Energy

9. Please indicate your level of agreement with the following statement – "In general, I support the idea of renewable energy".

☐ Strongly agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly disagree

10. Are you aware of any existing or proposed marine renewable energy developments occurring near to your home port?

☐ Yes ☐ No

11. If yes, can you name the project(s) or site(s)?

12. Please indicate your level of agreement with the following statement on your attitude towards marine renewable energy in your locality – "I think that it is important to develop marine renewable energy sources, such as offshore wind, wave and tidal energy".

☐ Strongly agree

☐ Agree

☐ Neutral

☐ Disagree

☐ Strongly disagree

13. Do you think that the fishing and marine renewable sectors can co-exist?

☐ Yes ☐ No

Opportunities of Marine Renewable Energy

14. What do you think are the potential opportunities or benefits (economic, environmental and social) that marine renewable energy might provide for the fishing industry? Please describe.

15. What type of job opportunities do you think marine renewable energy projects might provide for fishermen?

16. If alternative jobs on marine renewable energy projects were to become available would you be interested in this?

☐ Yes ☐ No

17. Would you be interested in taking re-training courses on skills required for employment on marine renewable energy projects if they were available to you?

☐ Yes ☐ No

18. Would you be willing to pay for these courses?

☐ Yes ☐ No

Impacts of Marine Renewable Energy

19. What do you think are the potential negative impacts (economic, environmental and social) that marine renewable energy developments might have on the fishing industry? Please describe.

20. Are you aware of any marine developments in your locality that have resulted in the negative impacts mentioned above?

☐ Yes ☐ No

21. If yes, was action taken to limit these impacts (mitigation)?

☐ Yes ☐ No

22. Do you have any suggestions for ways that developers could mitigate against the negative impacts mentioned above?

Involvement in Decision Making

23. Have you had any involvement in consultations on marine renewable energy (e.g. by developers, their consultants, consenting authority, etc.)?

☐ Yes ☐ No

24. Please indicate your level of agreement with the following statement – "I feel that I have been involved in the decision making process for marine renewable energy developments in my locality".

☐ Strongly agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly disagree

25. Do you think the Environmental Impact Assessment process adequately assesses the impacts of marine renewable energy developments on fishermen?

☐ Yes ☐ No

26. If no, do you have any suggestions on how to improve the EIA process to better assess the impacts of marine renewable energy developments on fishermen.

Thank you for your time and interest in completing this survey – it is greatly appreciated. If you wish to be informed of the results of this survey, please enter your name and email and/or address below:

Finally, would you be interested in taking part in an interview to further assist in this research. The interview would further explore the issues raised in this survey and would be conducted at a time and place suitable to you? If so please enter your contact details below:

Appendix B – Semi-structured Interviews

Introduction and Consent Form

<u>The Consultation Process with Fishermen on Marine Renewable Energy projects</u>

My name is Kieran Reilly and I am a PhD researcher in University College Cork. I am conducting a study on the experiences of fishermen, developers, consultants and fisheries liaison officers with the consultation process on Marine Renewable Energy projects (offshore wind, wave and tidal energy). The aim of the study is to refine best practices for consultations with fishermen on MRE projects. The objective is to gain an insight into your experience of stakeholder engagement and the consultation process.

The main body of the interview will cover the attitudes of fishermen towards the project, your experience of the consultation process, and mitigation measures. This will involve topics on the provision of information, involvement in consultation and participation in decision making. The duration of the interview will depend on the information you are willing and able to provide but should last no longer than one hour.

Your participation in this interview is entirely voluntary and you have the option of withdrawing at any time. Some of the questions I ask may require some thought. There are no right or wrong answers so please answer honestly and openly. I am only interested in your opinions and personal experiences. Please feel free to interrupt, ask for clarification on questions or express concerns you may have about any lines of questioning.

The information you provide will be used for the purpose of this research and will remain completely anonymous. No individual responses will be made available to anyone other than me. The data gathered in this interview may form the basis of a report or other form of publication or presentation. Your name will not be used in any report, publication or presentation and your confidentiality will be protected. Feedback on any output from the interview will be available to you if interested.

If you need any further information, you can contact me on +353871474530 or k.reilly@umail.ucc.ie.

If you agree to take part in the study, please sign the consent form.

I……………………………………agree to participate in Kieran Reilly's research study.

The aim and objectives of the study have been explained to me in writing.

I am participating voluntarily.

I give permission for my interview with to be tape-recorded.

I understand that I can withdraw from the study, without repercussions, at any time, whether before it starts or while I am participating.

I understand that my confidentiality will be protected and anonymity will be ensured in the write-up by disguising my identity.

I understand that disguised extracts from my interview may be quoted in the thesis and any subsequent publications if I give permission below:

(Please tick one box:)

I agree to quotation/publication of extracts from my interview ☐

I do not agree to quotation/publication of extracts from my interview ☐

Signed……………………………………. Date……………….

Interview questions for fishermen

1. **Warm up**

Fishing activity

Can you describe for me your main fishing activities and experience?

How long have you been a fisherman? Have you always been a fisherman?

Is fishing your full time job? If no, on average how many hours a week would you spend working as a fisherman?

Which fisheries are you involved in? What type of gear do you use? What size is your vessel?

Are you a member of a fish producer's organisation or fishing association? Which one?

Do you have a family history of working in the fishing industry? Do any of your family members currently work in the fishing industry?

2. **Main body of interview**

Attitudes, impacts and opportunities/benefits

What is your opinion on the proposed MRE project? Why do you feel this way about the development?

What opportunities or benefits do you think the development may provide for fishermen and the industry? Please describe.

What negative impacts, if any, do you think the development may have on the fishing industry? Please describe.

Dissemination of information (Informed)

How did you first hear about the MRE project being developed near to your home port?

Were you satisfied with the timing of when you were first informed about the project? If no, why not?

Do you feel that you are well informed about the project and are currently being kept up to date with developments?

Are you satisfied with how information on the project is being provided to you? Are you satisfied with the communication channels that are being used? Are you satisfied with who is providing you with information?

Are you being provided with the type of information you are looking for? If not what type of additional information do you think developers should provide to fishermen. Can you provide any examples of when you were or were not provided with information that you required?

Consultation (Consulted)

Can you describe your role and level of involvement in the consultation process? How were you consulted? Form of consultation process – meetings? committees? Would you prefer to be consulted individually or in a group?

Have you been asked to provide information to developers? What type of information were you asked for?

Have you provided or would you be willing to provide details on location of fishing grounds and earnings in order to assist developers in matters such as site selection? Is there any information (financial, spatial or temporal) that you would be unwilling to share with developers? If so, why? What would it take for you to provide this information? Who would you feel comfortable giving this information to? Would you feel more comfortable giving this information to a third party (such as a government agency or authority)?

What type of additional information do you think you could provide that would be useful for developers?

Were you given opportunities to express your opinions and raise issues during consultations? Were these issues discussed during the consultation process? Do you feel that these issues were addressed by developers? Were there any issues that you had that were not discussed? Can you provide any examples of this?

Do you feel that you were able to liaise and discuss your concerns with developers (or their representatives) in an open and transparent way? Can you provide an example of this?

Participation in decision-making (Involved)

Do you feel that you have been and are being provided with opportunities to participate in decision-making on the project? If no, do you have any suggestions on how this might be improved?

Do you feel that you have been involved in decision-making on the project? Can you explain why you feel this? Can you provide any examples of a time you were/were not involved in decision-making?

Is it clear to you how information you provided during the consultation was used? Do you feel that the information you provided was taken into account in decision-making? Do you have any examples of information you provided being used by developers/ or ignored by developers?

Do you have any experience with other marine developments in your locality where you felt that you have been involved in decision-making? If so, can you elaborate on this and what were the outcomes?

Alternative approaches to consultation and suggestions for improvements.

Based on your experience, can you highlight any areas where you believe the consultation process to be effective in achieving consensus? Can you provide any examples of this?

Based on your experience, can you highlight any weaknesses in consultations you were involved in? Can you provide any examples of this? Do you have any suggestions on how these weaknesses might be improved or how the process could be made more effective? (e.g. timing of consultation, form of consultation).

Based on your experiences with the consultation process, can you recommend any improvements that would make the process more effective?

Can you suggest any alternative approaches to consultation that might be effective in involving fishermen in decision-making? (interactive mapping exercises, co-management). Do you have any examples of any informal or alternative consultation approaches that you found were effective?

Do you think it would be possible to encourage fishermen who did not take part in consultations to engage in the process? How?

Mitigation measures and co-existence planning

Were you involved in any discussions with developers or representatives on how potential impacts might be mitigated? If yes, can you elaborate on this?

Were you involved in discussions on mitigation measures that were put into practice? Can you elaborate on how this happened?

Do you have any experience from other marine developments in your locality where mitigation strategies were implemented?

Do you have any alternative suggestions on ways that developers could mitigate potential negative impacts?

Do you think financial compensation should be provided to those whose income may be affected by the project? How do you think compensation amounts should be determined? How should compensation be paid and how long should it be paid for? How would fishermen prove or disprove claims?

Were you involved in discussions on compensation? Were you satisfied with the outcome?

Do you have any further suggestions on how the fisheries and offshore renewable energy sectors could work together more effectively in the future?

Can you suggest any ways in which the fishing industry and offshore renewables could co-exist?

3. **Cool off**

Do you have anything further to add on your experience with the MRE project that has not already been covered in the interview?

Do you have any general feedback, comments or advice on the interview and how it went?

4. **Closure/Closing comments**

Thanks again for your help and co-operation and for giving up your time for this interview – it is greatly appreciated. Any output from the interview will be made available to you if you so wish. If you have any further comments or feedback, or if there is anything that you think about at a later time that you would like to add then please contact me.

Probes – Anything more? Could you go over that again? What is your personal view on this? Could you expand on that please? Can you provide an example of that? Can you elaborate please?

Interview questions for CFLOs

1. **Warm up**

Can you describe for me in detail your role in the consultation process?

Did you follow any guidance on how to approach consultation? Did you develop a fisheries liaison plan?

How did you identify the relevant fishermen with whom you need to engage during the process? How did you establish contact with the fishermen? (visits to ports?, info from POs, federations?) When did you do this?

Did you appoint a Fisheries Industry Representative? How was he selected?

2. **Main body of interview**

Attitudes, impacts and opportunities/benefits

What do you think is the general attitude among fishermen towards the development? Why do you think they feel this way?

What opportunities or benefits do you think the development may provide for fishermen and the fishing industry in general?

What negative impacts do you think the development may have on the fishing industry? Please describe.

Dissemination of information

When and how did you first inform fishermen about the proposed project?

Do you feel that fishermen were satisfied with the timing of when the information was provided? If not, what were their main concerns about this? How do you think it would be possible to address these concerns?

How was information disseminated? What channels did you use for the dissemination of information? Do you think that fishermen were satisfied with how information was disseminated and the channels used?

What type of information did you provide to fishermen? Were they satisfied with the information provided? Was there information they requested that you were unable to give them? Do you have any examples of this?

Consultation

Have you requested information from fishermen? If so, what type of information?

Have fishermen been asked to provide details on fishing activity and earnings in order to assist developers in matters such as site selection? Have you found that fishermen are willing to share this information with developers? Can you provide any examples of this?

What additional information do you think fishermen could provide that would assist in the development of the project?

How are fishermen able to express opinions and raise issues they may have with the development? How are issues and concerns dealt with? Are fishermen able to meet and discuss their concerns with you? Can you provide an example of this?

Do you feel that fishermen in general were willing to engage in consultations? What do you think it would take for more fishermen to engage in the process?

Do you think that overall fishermen were satisfied with how consultation was conducted? Do you think they had any issues with it?

Participated/Involved

Were fishermen involved in decision-making on the project? If so, how did this happen? Can you provide any examples of this?

Was the information provided by fishermen used in decision-making on the project? Do you have any examples of this?

Did you provide feedback to fishermen on how the information they provided was used? Did you provide feedback on how decisions were made?

Do you think that the participation of fishermen in the consultation process has helped to resolve or avoid conflict?

Can you provide an example where consensus was reached?

Do you think fishermen could have a stronger role in decision-making? If so, do you have any suggestions for how this could be done?

Alternative approaches to consultation and suggestions for improvements

Based on your experience, can you highlight any areas where you believe the consultation process to be effective? Can you provide any examples of this?

Based on your experience, can you highlight any weaknesses in consultations you were involved in? Can you provide any examples of this? Do you have any suggestions on how these weaknesses might be improved or how the process could be made more effective? (timing of consultation, form of consultation)

Based on your experiences with the consultation process, can you recommend any improvements that would make the process more effective?

Can you suggest any alternative approaches to consultation that might be effective in involving fishermen in decision-making? (interactive mapping exercises, co-management). Do you have any examples of any informal or alternative consultation approaches that you found were effective?

Do you think that it would be possible to encourage fishermen who did not take part in consultations to engage in the process? How?

How would you describe your relationship with the fishermen you dealt with? Was it difficult to establish a good working relationship with the fishermen you were dealing with? Was trust an issue? How do you think that trust could be strengthened between sectors?

Mitigation measures and co-existence planning

Were fishermen involved in discussions on how potential impacts might be mitigated? If yes, can you elaborate on this and provide an example. How were mitigation strategies determined and implemented?

Do you have any alternative suggestions on ways that potential impacts on fishermen could be mitigated?

Do you think financial compensation should be offered to those whose income may be affected by the project? How do you think compensation amounts should be determined? How should compensation be paid and how long should it be paid for? How would fishermen prove or disprove claims?

Were you involved in discussions on compensation? Were you satisfied with the outcome?

Do you have any further suggestions on how the fisheries and marine renewable energy sectors could work together more effectively in the future?

Can you suggest any ways in which the fishing industry and marine renewables sector could co-exist?

3. Cool off

Do you have anything further to add on your experience with the MRE project that has not already been covered in the interview?

Do you have any general feedback, comments or advice on the interview and how it went?

4. Closure/Closing comments

Thanks again for your help and co-operation and for giving up your time for this interview – it is greatly appreciated. Any output from the interview will be made available to you if you so wish. If you have any further comments or feedback, or if there is anything that you think about at a later time that you would like to add then please contact me.

Probes – Anything more? Could you go over that again? What is your personal view on this? Could you expand on that please? Can you provide an example of that? Can you elaborate please?