Beaufort Award: Economic and Social Research related to Development Dynamics of the Marine Sector in Ireland

Project Based Award, Final Report
Sea Change: A Marine Knowledge, Research & Innovation Strategy for Ireland

Sea Change—A Marine Knowledge, Research & Innovation Strategy for Ireland 2007-2013—was launched in early 2007 and was the outcome of extensive analysis and consultation with government departments, state agencies, industry and the third-level sector. It outlines a vision for the development of Ireland’s marine sector and sets clear objectives aimed at achieving this vision, namely to:

1. Assist existing, and largely indigenous, marine sub-sectors to improve their overall competitiveness and engage in activity that adds value to their outputs by utilising knowledge and technology arising from research.
2. Build new research capacity and capability and utilise fundamental knowledge and technology to create new marine-related commercial opportunities and companies.
3. Inform public policy, governance and regulation by applying the knowledge derived from marine research and monitoring.
4. Increase the marine sector’s competitiveness and stimulate the commercialisation of the marine resource in a manner that ensures its sustainability and protects marine biodiversity and ecosystems.
5. Strengthen the economic, social and cultural base of marine dependant regional/rural communities.

The Sea Change strategy was developed as an integral part of the government’s Strategy for Science, Technology and Innovation (SSTI) and the Marine Institute as the lead implementation agency is working within SSTI policy and with government departments and agencies to deliver on the Strategy.

The Marine Institute managed Marine Research Sub-Programme, one of eight sub-programmes within the Science, Technology and Innovation (STI) Programme of the National Development Plan 2007—2013, targets funding to meet the objectives of the Sea Change strategy.

Over the lifetime of Sea Change, funding will be provided for:

- Project-Based Awards
  - Strategic Research Projects
  - Applied Research Projects
  - Demonstration Projects
  - Desk/Feasibility Studies
- Researcher Awards
  - Strategic Research Appointments
  - Research Capacity/Competency Building
  - Post-Doctoral Fellowships
  - PhD Scholarships
- Industry-Led Research Awards
  - Company Awards
  - Collaborative Awards
- Infrastructure Awards
  - Infrastructure Acquisition
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Beaufort Marine Award

Building Irish Marine Research Capacity and Capability

Economic and Social Research related to Development Dynamics of the Marine Sector in Ireland

(BEAU/ECON/04)

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EXECUTIVE SUMMARY

The vision for this project was the creation of a unit that would underpin the development of the marine sector in Ireland as elaborated in the Sea Change Strategy; a unit that would contribute to the EU marine socio-economic research agenda and that would strengthen marine research in general through providing a complementary socioeconomic element into scientific projects and that would be involved in the transfer of tacit knowledge to marine industry, thereby enhancing innovation and raising its competitiveness. The Beaufort work programme was comprised of three major blocks:

- Marine socioeconomic research capacity building
- Constructing data bases and monitoring the evolution of the marine sector
- A research programme which consisted of a number of key research topics:
  - The impact of policy and regulations on the development of the marine industry in Ireland
  - The economic and social impact of the marine sectors in Ireland
  - Valuing ecosystem service provision from marine resources in Ireland
  - Economic data collection and reporting on Ireland’s ocean and coastal economies

Underpinning Research

The “Economic and Social Research related to Development Dynamics of the Marine Sector in Ireland” Beaufort project involved research on a variety of marine related issues associated with the economics of fisheries, marine energy, shipping and other marine sectors as well as research that valued the marine environment and that examined issues surrounding the rural development of coastal communities. In particular it involved examining the economic utility of the marine environment (e.g. transportation, recreation) and the ecological value (e.g. fisheries, aquaculture) derived from the productivity of associated ecosystems. The coastal and contiguous marine environment surrounding Ireland and the EU in general provided the geographical focus for the research. Consideration of the human dimension in the management of marine ecosystems was also a critical component of the research programme. A key element of the project involves the compilation of information in relation to economic and social patterns in Irish coastal communities as well as the economic activity taking place in the seas surrounding Ireland.

The project was also very successful in terms of the first element of the Beaufort work program: Marine socioeconomic research capacity building. The project team leveraged over
€2 million in additional funding over the life of the Award, which included funded projects such as:

- Horizon 2020. Project Title: ATLAS: A Trans-Atlantic Assessment and deep-water ecosystem-based spatial management plan for Europe - In association with 24 other European research organisations.
- Horizon 2020. Project Title: MERCEs:Marine Ecosystem Restoration in changing European Seas - In association with 25 other European research organisation.
- Norwegian Research Council Funding Programme. Project title: AquaAccept: Developing novel socio-environmental indicators and management tools for a sustainable aquaculture
- Environmental Protection Agency Science, Technology, Research & Innovation for the Environment (STRIVE) Programme 2014 Award. Project Title: Marine Ecosystem Service Valuation

A full list of additional funding secured in the area of marine socio-economic research by the project team is provided in appendix II.

**Impact of the research**

The project team were commissioned under the Beaufort Award to report on the state of Ireland’s ocean economy. The focus was not only on continuing to collect reliable and comparable marine socioeconomic data across all the marine sectors, but also to satisfy one of the specific objectives of the award, namely to develop a methodology which would provide reliable estimates of the economic contribution of the marine sector and its growth over time. The project team delivered their third ‘Ocean Economy report’ in 2015. The data collected has also been used by the Irish government as the basis for forming the targets set for growth in the Irish ocean economy in the first ever Integrated Marine Plan for Ireland, ‘Harnessing our Ocean Wealth’, that was launched in 2012.

The project also resulted in the development of a Bio-Economy Input Output model (BIO) which can be used to analyse these linkages between the marine sectors and the wider economy. This work represents the first attempt to model the wider contribution the marine industries as a whole, incorporating economic activity originating from the use of all marine resources.
The project was also very focused on modelling the economic impact of marine policy reform. For example, the previously mentioned Bio-Economy Input Output model has been used to estimate the effect of the expansion of the fin-fish aquaculture industry as envisaged in recent government strategies. Also, the value of the non-market benefits associated with the achievement of good (marine) environmental status (GES) as specified in the EU Marine Strategy Framework Directive (MSFD) was conducted and used in the initial assessment that was required by the EU Commission in 2014. In a further example, the economic value of potential improvements to coastal water quality that may result from implementation of changes to the European Union’s Bathing Waters Directive in 2015 was also examined. The focus of this work was on potential economic benefits to recreational users of coastal waters, and how these vary according to the extent of exposure to risks.

**Contribution to Policy**

This project has resulted in the creation of a unit (the Socio-Economic Marine Research Unit) (SEMRU)) that is now seen as the leaders in marine economic analysis in Ireland. The project team have been prolific in their research outputs over the last 5 years (see Appendix 1) and have also had a number of requests by government departments to represent them as an expert at a number of EU workshops and policy sessions. In particular, the project team was an active member on a number of working committees including the Department of Environment, Community and Local Government’s Marine Strategy Framework Directive Technical Working Group; the OSPAR Intersessional Correspondence Group (ICG) on Socio-Economic Analysis and the Irish Fisheries Scientist Partnership.

At the request of the Department of Arts, Heritage and the Gaeltacht the project team have also been an ‘expert’ representative of the Irish government at a Mapping Ecosystems (MAES) workshop in Wageningen University and Research Centre in Wageningen, the Netherlands. These MAES training sessions have been set up by the EU Commission to assist Member States in the mapping and assessment of ecosystems and ecosystem services in their national territory. This work relates to target two of the EU 2020 Biodiversity Strategy where it states that: “Member States, with the assistance of the Commission, will map and assess the state of ecosystems and their services in their national territory by 2014, assess the economic value of such services, and promote the integration of these values into accounting and reporting systems at EU and national level by 2020”.
In collaboration with the Irish Maritime Development Office (IMDO), SEMRU also actively contributes to the implementation of the National Ports Policy (Department of Transport, Tourism and Sport, 2013) in relation to joint research that examines the performance of state owned Irish ports regarding stated policy objectives and the design of a Performance Measurement System (PMS) to meet the needs for the strategic management of Irish seaports as set out in the Irish National Ports Policy.

The project team are also currently a member of the EU Marine Board working group on Marine Ecosystem Service Valuation. The main role of this working group is to provide recommendations to guide European research in the medium term (to 2020) and to set standard methodology/guidelines for valuation of marine ecosystem services and to improve European competitiveness in this field. Dr. Stephen Hynes, the project principle investigator (PI) has also been nominated as an Irish expert for the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and is a Lead Author for the IPBES Regional assessment of biodiversity and ecosystem services and functions for Europe and Central Asia (deliverable 2b).

The project team have also had a number of requests from the Irish Government’s Marine Co-ordination Group and the Marine Development Task Force to come and present their work related to trends in the ocean economy and progress in terms of the achievement of “Harvesting our Ocean Wealth” targets. Similarly, the project team have been actively participating on an advisory board that includes DG MARE, EU Commission, Eurostat, Infremer, France, and SEMRU that has been attempting to develop indicators of ocean economic activity at the European level. Members of the project team have also made a number of requested trips to DG MARE, EU Commission to advise them on issues such as monitoring progress on ‘Blue Growth’ targets and progress related to the Atlantic Strategy Action Plan.

Project team members have also been requested to appear before the Oireachtas Committee for Fisheries, Leinster House, Dublin, April 25th, 2013. Elsewhere, the project has contributed to the work of the Commission for Economic Development of Rural Areas (CEDRA) both in presenting to the committee and contributing a chapter to the final report of the committee. Finally, at the request of the Department of the Environment, Communications and Local Government the project team were members of the Marine Strategy Framework Technical Working Group chaired by Eugene Nixon, and were a co-author on the assessment conducted by the Department as required under the Directive.
I. INTRODUCTION

1.1. Background

Given Ireland’s geographic location as a peripheral island nation and the size of its ocean resource\(^1\), there is a need to understand the role of the marine economy in current national policy areas such as food, energy, tourism, climate change, research, technology, development and innovation (RTDI) or competitiveness and job creation. Since the publication of *Harnessing Our Ocean Wealth – An Integrated Marine Plan for Ireland* (HOOW-IMP), there has been an increased recognition of the importance of Ireland’s marine natural resource as a national asset. HOOW-IMP acknowledges the under-utilisation of Ireland’s ocean potential and highlights the need to take advantage of the many commercial and non-commercial benefits that the ocean provides, as key components of Ireland’s economic recovery and sustainable growth (HOOW, 2012). In this regard, there is a need for having a comprehensive understanding of the value of Ireland’s ocean economy to accurately estimate the potential impact of policy measures in terms of employment, output and gross-value added. The importance of valuing and understanding the performance of Ireland’s Ocean Economy is a specific target under Action 24 of HOOW-IMP.

The need for more research on Ireland’s marine sectors was also highlighted earlier on in the Sea Change Strategy. As highlighted in the strategy document, this national ‘Marine Knowledge, Research and Innovation Strategy’ for the period 2007-2013 was aimed at driving the development of the marine sector as a dynamic element of Ireland’s knowledge economy – “The Strategy details significant global market opportunities linked to the development of marine technologies and resources. It highlights the need for a shift in our traditional view of the sector from one which is primarily associated with food harvesting to one which is multifaceted and also contributes towards energy, health, tourism and leisure, transport and environmental wellbeing”.

Development of the ocean economy had also become an important issue at the European level. With the publication of the *Blue Book - Integrated Maritime Policy for the European Union* (EU-IMP) - in 2007, the European Commission set out to coordinate different policy areas to offer a coherent approach to marine and maritime issues

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\(^1\) Ireland consists of 90,000 km\(^2\) of land resource, and 900,000 km\(^2\) of ocean resource, with an extensive coastline of 7,500km in length.
(COM(2007) 575 final). This approach is based on the recognition that the sustainable development of Europe’s oceans is a critical component of most of the policy issues faced by European Member States today, including Ireland. The need for socio-economic marine data is made clear from the main objectives of the EU-IMP and across its cross-cutting policies, including Blue Growth (Foley et al, 2014, Hynes and Farrelly, 2010).

From a regional perspective, the EU-IMP recognises the unique needs of each of Europe’s seas and oceans through the sea basin strategies. The European Union Atlantic Strategy (COM(2011) 782 final), adopted by the European Commission in 2011, is of special interest to Ireland as it identifies challenges and opportunities in the Atlantic region with existing initiatives to support growth and job creation. The EU Atlantic Strategy is implemented through the Atlantic Action Plan (COM(2013) 279 final), which aims at promoting sustainable growth in coastal areas and drive forward the “blue economy”. The action plan encourages the Atlantic Member States to collaborate in sharing information, costs and best practices. Under Action 6.5, the action plan calls for the development of a marine socio-economic database across Atlantic countries. To support the Action Plan, the EU, the US and Canada signed 'Galway Statement on Atlantic Ocean Cooperation' as a step forward to recognise the importance of transatlantic cooperation and collaboration in marine research.

The EU-IMP calls for Member States to consider creating internal coordinating structures for maritime affairs within their government frameworks. In response to this call, the Irish government published HOOW-IMP. Published in 2012, HOOW-IMP presents the Government’s vision, high-level goals and integrated actions across policy, governance and business to enable Ireland’s marine potential to be realised (HOOW, 2012). The model developed in Ireland to implement HOOW-IMP involves the establishment of the inter-departmental Marine Co-ordination Group (MCG), chaired by the Minister for Agriculture, Food and the Marine, which supported by independently chaired Task Forces, aims at co-ordinating all matters related to the marine sector, otherwise spread across a number of government departments.

In HOOW-IMP, the Irish government sets the overarching targets to double the value of Ireland’s ocean economy to 2.4% of GDP by 2030 and to increase the annual turnover to exceed €6.4bn by 2020. This is obtained from a range of individual sectoral targets, specifically a €1bn target for Seafood, €2.6bn for Maritime Commerce and Ship Leasing, €1.5bn for Marine and Coastal Tourism, in excess of €61 million target for Marine ICT and Biotechnology and in excess of €1.2bn target for Ports and Maritime Transport Services, Maritime Manufacturing, Engineering, Offshore Oil and Gas and other marine industries. In the face of competing resources and a public policy focus, there is a requirement to understand the full impacts both direct and indirect, of achieving the HOOW-IMP targets.
Since the publication of HOOW-IMP in 2012, two progress reports on the implementation of HOOW-IMP have been published. Under Action 24 of the HOOW-IMP, the need for strengthening the collation of marine socio-economic data to ensure the timely availability of marine socio-economic statistics, providing an evidence base for policy and decision-making, economic forecasting and scenario planning is highlighted. Subsequent Progress reports have stressed SEMRU’s contribution to the implementation of this Action with the publication of two reports on Ireland’s Ocean Economy (2012; 2015) and the Bio-Economy Input Output Model (BIO) to assess the output and employment multipliers of public policy initiatives including HOOW-IMP.

Another EU policy initiative that explicitly calls for the collection and analysis of socio-economic marine data across member states is the Marine Strategy Framework Directive (MSFD, 2008), an environmental protection driven piece of legislation which is in the process of implementation. The Directive (DIRECTIVE 2008/56/EC) includes the requirement for member states to carry out ‘an economic and social analysis of waters and of the cost of degradation of the marine environment’ as an integral part of their initial assessments.

1.2. Project Overview

Against the backdrop of the Sea Change Strategy and the Integrated Maritime Policy for the European Union the Beaufort Awards were established. The Sea Change Strategy was aimed at supporting the transformation of the Irish marine sector so that: by 2020 the marine sector will sell into specialised global and local markets in a dynamic, innovative and technological driven manner, by means of strong industry research partnerships, a skilled workforce and a strategic capability that responds to markets and technology. It will be internationally recognised for its high quality marine environment and characterised by coherent policy and regulation. In order to support the achievement of this transition, the Socio–Economic Beaufort Award was established in recognition of the need for dedicated economic and social research and related analysis would be required to support ‘evidence based’ policy development within the sector.

The overall aim of the Beaufort Award was to establish a world class centre for marine socio-economic research in Ireland around a research cluster in Galway led by NUI, Galway and linking with the Rural Economy Research Centre (RERC), Teagasc, the Marine Institute and other research institutions in Ireland. The vision for the centre was that it would underpin the development of the marine sector in Ireland as elaborated in the Sea Change strategy, that it would contribute to the EU marine socio-economic research agenda and that it would
strengthen marine research in general through providing a complementary socio-economic element into scientific projects. It was also envisaged that the centre would train researchers to contribute to continuing research and to the transfer of tacit knowledge to marine industry, thereby enhancing innovation and raising its competitiveness.

More specifically, the research team were tasked with delivering new research capacity to address key aspects of the development dynamics of the marine sector in Ireland as follows:

- Size and composition of the marine sector in Ireland.
- Competitiveness and growth issues for an evolving marine sector and maritime economy.
- Contribution of existing and new marine activities to regional/rural development in Ireland.
- Development of an economic model for the marine sector in Ireland.
- Impact of marine activities on social inclusion and cultural diversity in rural areas.
- Quantification of the non-market benefits of marine resources to Ireland.
- Achieving a balance between regulation and development to support sustainable development of marine activities.

In respect of the above objects the project team put in place a work program that was composed of three major blocks:

(i) Marine socioeconomic research capacity building

The research capacity building exercise consisted of building on existing competences of the research team to establish an international identity, to recruit internationally recognised researchers in the field, who would lead the research activity; recruit PhD students who would enlarge the research activity and establish an international level PhD training programme; develop national and international research networks - with marine scientists, the marine industry and the international academic community in the socio-economic marine area.

(ii) Constructing data bases and monitoring the evolution of the marine sector

Data bases are essential to the application of modelling and analytical tools to understand marine sectoral activities, monitor the sector’s evolution, evaluate its competitiveness, and support the formulation of policy measures to enhance the sectors competitiveness and their impact on the wider economy. Measuring the ocean economy gives a country a better
understanding of the economic importance of the seas and an overview of the type, and
distribution of the stakeholders involved. However, measurement can be difficult, due to time
lags in data availability, marine industry (especially the emerging industries) data being only
partially represented in national data archives and the lines between coastal and ocean
economies being often blurred. The data collected under the Beaufort was mainly secondary
data extracted from existing statistical and statutory agencies’ records and reports. The data
collection activity was synchronised with the data collection of the Marine Institute, through its
research and various statutory functions. Remaining gaps were filled by the collection of
primary data. Chapter 2 discusses the methodology developed to assess the size and value of
Ireland ocean economy.

(iii) Research Programme

The research elements with the Beaufort award over the period were varied and wide ranging
but can be broken down under the following headings:

• Economic data collection and reporting on Ireland’s ocean and coastal economies
• The impact of policy and regulations on the marine industry and wider economy in
  Ireland
• The economic and social impact of the marine sectors in Ireland
• Valuing ecosystem service provision from marine resources in Ireland

In what follows chapter 2 will review the work carried out in relation to the economic data
collection and reporting on Ireland’s ocean and coastal economies; chapter 3 will review the
research conducted in relation to modelling the impact of policy and regulations on the marine
industry and wider economy in Ireland; chapter 4 will examine the research related to
modelling the economic and social impact of the marine sectors in Ireland with particular
reference to shipping, marine energy, fishing and marine education and research. Chapter 5 will
review the research carried out under the award related to valuing marine ecosystem service
benefits. Finally, chapter 5 concludes with some recommendations for future research.

1.3. The Beaufort Project Partners

The National University of Ireland Galway (NUI Galway) is the leading higher education and
research organisation in the Western, Northern and Midland regions of Ireland. It has a
student population of over 20,000, with over a 1,000 studying at MSc/PhD levels. NUI Galway
has traditionally played a major role in marine research in Ireland due to its strategic location as a gateway to the North Atlantic and has a long history of involvement in European marine research. NUI Galway is unique in Ireland and much of Europe in that it has under the one academic roof, marine scientists, social scientists and science educationists (formal and informal) working on ocean related research. The Socio-Economic Marine Research Unit (SEMRU) of NUI Galway is the main participant in this project. Indeed, SEMRU was established through the Beaufort Award in 2008 and since then has developed into the foremost marine economic analysis unit in Ireland. It has strongly influenced policy making in the marine sector, particularly through its bi-annual Ocean Economy Report which informed Ireland’s marine plan, Harnessing Our Wealth – An Integrated Marine Plan for Ireland (2012).

In addition, SEMRU is now a cluster within the Whitaker institute of which Dr. Stephen Hynes was appointed the scientific director in 2015. SEMRU has strong multidisciplinary collaborations across the university, such as with the Ryan Institute, the School of Geography and Archaeology, the College of Engineering and Informatics and the School of Natural Sciences. Most recently, this collaboration has resulted in a successful Horizon 2020 project for the university, ATLAS. Outside the University, SEMRU has worked with researchers from a wide number of institutions including GMIT, Queen’s University, ERSI, BIM, CSO, Teagasc, Marine Institute, Stirling University, University of Aberdeen, University of Tromso – The Arctic University of Norway, IFREMER, CIIMAR, NOEP in the United States, Chinese National Marine Data and Information Service amongst others. The expansion of research across a wide number of networks adds to the reputation of NUI Galway in the areas of marine and natural resource economics research.

NUI researchers who were directly employed during the lifetime of the Beaufort Award included Dr Stephen Hynes, Dr Amaya Vega, Dr Eoin Grealis, Dr Karyn Morrissey, Ms. Rebecca Corless, Ms Emma O’Toole and Ms. Ruth Nolan. The PhD students supported under the Beaufort included Niall Farrell, Benjamin Breen, Daniel Norton and Suzanne van Osch.

The second main partner on the award was Teagasc, the agriculture and food development authority in Ireland. It is the national body providing integrated research, advisory and training services to the agriculture and food industry and rural communities. It was established in September 1988 under the Agriculture (Research, Training and Advice) Act, 1988. Its mission is to support science-based innovation in the agri-food sector and the broader bioeconomy that will underpin profitability, competitiveness and sustainability. The Rural Economy &
Development Programme (previously the Rural Economy Research Centre - RERC) of Teagasc were the main partner on this project.

The mission of this division of Teagasc is to produce high quality social science research and policy advice to improve the competitiveness and sustainability of the Irish Agri-Food sector and to enhance the quality of life in rural Ireland, thus contributing to the achievement of Teagasc’s key goals of Competitiveness and Innovation in the Agri-Food Sector, Sustainable Systems of Agriculture and Rural Viability. In particular the objective of this programme is to utilise advanced social science investigation tools to understand the linkages between the various forces affecting the Agri-food and Rural Economy to improve the quality of life in rural Ireland. Professor Cathal O’Donoghue was the main Teagasc staff member working on the Beaufort Project. Cathal was responsible for the development of the Marine Input Output model in particular and supervised the marine energy PhD student Niall Farrell. For a full list of the research publications of the Rural Economy & Development Programme http://www.teagasc.ie/rural-economy/Papers_in REFERRED_JOURNAL.asp

1.4. Research on the Ocean Economy

The first broad studies on the valuation of the ocean economy were developed in the US by the US Bureau of Economic Analysis in the 1970s (Foley et al., 2014). Further studies were then conducted by the Ocean Resources Management Program, California, in 1993 (Kildow, Baird et al., 2000) and are followed by the Centre for the Blue Economy in the framework of the National Ocean Economics Program (Kildow, Colgan et al., 2014). In the EU, countries have used marine socio-economic data at the national level to quantify the size and value of their marine economies. First reports were published in the UK and Italy (Pugh & Skinner, 1996; Censis, 1996) and were subsequently updated in recent years (Pugh, 2002; 2008; Censis, 2003; 2011 ;). In France, Ifremer (French Institute for the Exploitation of the Sea) publishes regular reports since 1997 (Girard, Kalaydjian, 2014). Norwegian, Dutch and Spanish industry associations published marine/maritime socio-economic reports in 2003 and 2006 (Wijnolst, Jenssen, Sedal, 2003; Innovamar, 2011). The use of different methodologies and timescales has been identified as one of the main challenges when comparing marine statistics across countries (Kildow and Mclgorm, 2010; Suris-Regueiro et al., 2013; Hynes et al., 2014, Zhao et al., 2014; Kalaydjian, 2016).

A number of studies have addressed the challenges and practical difficulties in collecting and analysing marine socio-economic data. As part of a Eurostat action group on “improving sectoral (ocean and coastal) socio-economics data at regional and EU level”, Kalaydjian et al., (2009) highlighted the challenges related to the scope and coverage of
maritime activities. In particular, for those activities that are intrinsically spatial and located along the coast in terms of deciding on how far inland the coast extends. Other difficulties relate to the definition of what constitutes the marine economy and the extent to which some activities indirectly connected to specific marine activities should be considered part of the ocean economy. To answer some of these questions, Kalaydjian et al., (2009) presented the architecture of a database for maritime activities in Europe, proposed methods to collect missing data and identified other relevant indicators to analyse marine related activities.

In more recent years and based on Kalaydjian et al., (2009) initial template of marine activities, the Marine Atlantic Regions Network (MarNet) project (a project where SEMRU were the scientific lead) developed a coherent framework for a marine socio-economic database and applied a robust methodology for the collection of comparable data on maritime activities across the European Atlantic area. Funded by the European Regional Development Fund (ERDF) and the Interreg Atlantic Area Programme 2007–2013, this common database aimed to deal with the difficulties mentioned above of data homogeneity between countries, allowing supranational analysis of the maritime economy not only on a nation-by-nation basis but also at a more detailed regional level (Foley et al., 2014).

At the national level, and as a key deliverable of the Beaufort Award, SEMRU presented an analysis of Ireland’s ocean economy based on 2007, 2010 and 2012 data. A previous economic analysis of Ireland’s marine sectors was also carried out by O’Connor et al. (2005). The methodology used by SEMRU has evolved over the years, initially following that developed by the National Ocean Economics Program (NOEP) (Colgan, 2007). The European NACE code classification system is used where available for fully and partially marine related activities to measure turnover, value added, exports and employment. Where data could not be extracted from the national statistics for sectors referred to as ‘emerging marine sectors’, such as marine biotechnology and marine ocean energy, a survey of relevant companies was conducted. The following section gives an overview of the data collection and related research on the ocean economy that occurred under the Beaufort Award.
2. Economic data collection and reporting on Ireland’s ocean and coastal economies

2.1. Introduction

There were two major strands to this research activity within the Beaufort Award project:

(i) Collecting data to meet the requirement of publishing a bi-annual report on the state of the marine sector in Ireland; and

(ii) Providing data for the research activity of the various other research work packages in the Beaufort Award.

For the purpose of data collection and classification the ocean economy was defined as any economic activity that directly or indirectly uses the sea as an input as well as any economic activity that produces an input for a sea-specific activity. The research also involved the defining of the coastal regions of Ireland and an estimation of the value of the “Irish Coastal Economy” as opposed to the Ocean Economy. The coastal economy represents all economic activity that takes place in the coastal region, for example, agriculture, which is not part of the ocean economy. The term “coast” can take on a wide variety of physical definitions ranging from the strip of land immediately adjacent to the shoreline of the oceans to the headwaters of the watersheds of major rivers. The term has different meanings depending on whether one approaches the coast from a geological, biological, hydrological, ecological, or political perspective. The EU coastal regions were defined as standard statistical regions (NUTS level 3). The Beaufort Award research produced 3 definitions of the coastal economy that differed in spatial scale. The coastal economy definitions and values are expanded upon in section 2.3 below.

2.2. Reporting on Ireland’s Ocean Economy

A key reason for the setting up of the Marine Beaufort Socio-economic award was the fact that marine socio-economic data was not readily available in Ireland. It was recognised that such data was essential in determining the value of Ireland’s ocean economy, so as to realise its full potential. Under the Beaufort Award SEMRU began the extensive task of data collection and analysis of Ireland’s ocean economy in 2009. This resulted in the publication of a series of bi-annual ocean economy reports the latest of which was published in 2015. The reports provided a quantification and realistic monitoring of Ireland’s ocean economy over time and present a complete and comparable sectoral profile across the ocean economy, which allows
interested parties to observe progress on the targets set out in the Government’s Integrated Marine Plan for Ireland - Harnessing Our Ocean Wealth (2012). The latest report also included a set of economic projections that forecast Ireland’s ocean economy up to a year in which data was not yet available.

The bi-annual reports aim to:

- Provide a profile of Ireland’s ocean economy that is comparable across reporting periods;
- Provide estimates for turnover, GVA and employment;
- Assist in monitoring progress of a number of targets set out in the Government’s Integrated Marine Plan for Ireland - Harnessing Our Ocean Wealth;
- Inform on the policy environment and outlook of the sector where applicable;
- Revise and update, where necessary, the methodology and data used in previous reports;

The latest report in 2015 provided details on the reference years 2010, 2012 and a forecast for 2014. In 2012, the direct economic value of Ireland’s ocean economy was estimated at €1.3 billion or approximately 0.7% of GDP. The sector had a turnover of €4.2 billion, and provided employment for approximately 17,425 full time equivalents (FTEs). Compared to 2010, 2012 saw a 33% increase in turnover, a 9.2% increase in gross value added (GVA) and a 5% increase in employment.

**Table 2.1. Irish Ocean Economy; key figures, 2010-2012 and 2012-2014 (e)**

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2012</th>
<th>% Change 2010-2012</th>
<th>2014 (e)</th>
<th>% Change 2012-2014 (e)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GVA</strong></td>
<td>€1.2 billion</td>
<td>€1.3 billion</td>
<td>9.2%</td>
<td>€1.4 billion</td>
<td>8.2%</td>
</tr>
<tr>
<td>% GDP</td>
<td>0.7% GDP</td>
<td>0.7% GDP</td>
<td>4.3%</td>
<td>0.8% GDP</td>
<td>3.1%</td>
</tr>
<tr>
<td><strong>Turnover</strong></td>
<td>€3.1 billion</td>
<td>€4.2 billion</td>
<td>33.1%</td>
<td>€4.5 billion</td>
<td>7.6%</td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td>16,614 FTEs</td>
<td>17,425 FTEs</td>
<td>4.9%</td>
<td>18,480 FTEs</td>
<td>6.1%</td>
</tr>
</tbody>
</table>

*Figures for 2014 are estimates (e)*

Estimates for the 2012-2014 period suggested an overall increase in turnover of 7.6% to €4.5 billion. In 2014, the direct economic value of Ireland’s ocean economy is estimated to be
worth €1.4 billion or approximately 0.8% of GDP, which represents a 8.2% increase of GVA on 2012. The sector was estimated to provide employment for approximately 18,480 FTEs in 2014, which represents a 6.1% increase on 2012 levels.

The previous report on Ireland’s Ocean Economy published in 2013 represented the period at the lowest point of the economic contraction (2007-2010), with a significant decrease in activity, particularly in the shipping and maritime transport sector and in water-based construction. The 2015 report however, represents a period of slow economic recovery.

The bi-annual reports divided the sector into two broad types of marine industries:

**The Established Marine Industries** in 2012 had a turnover of €3.96 billion and provided employment of 16,271 FTEs representing 95% of the total turnover and 93% of total employment in Ireland’s ocean economy. This sector includes shipping and maritime transport, marine tourism and leisure, international cruise, sea fisheries, marine aquaculture, seafood processing, oil and gas exploration and production, marine manufacturing and marine retail services.

**The Emerging Marine Industries** in 2012 had a turnover of €215 million and provided employment to 1,154 FTEs representing 5% of the turnover and 7% of employment in Ireland’s ocean economy. Emerging industries refer to those that are still at a relatively early stage of development or growth, and are primarily R&D intensive and/or use the latest cutting edge technology in their pursuit of economic growth. Ireland’s ocean economy includes a number of emerging industries with considerable growth potential. It includes high tech marine products and services, marine commerce, marine biotechnology and bio-products and marine renewable energy.

Table 2.2 provides a breakdown of the industries in both the established and emerging categories and also present the turnover, gross value added and employment numbers in each industry for 2012. For an in-depth review of the economic contribution of the industries please see the latest ocean economy report from SEMRU (Vega et al., 2015).
Table 2.2. Direct Turnover, GVA and Employment by sector, 2012

<table>
<thead>
<tr>
<th>Sector</th>
<th>2012 Turnover €000’s</th>
<th>Direct GVA €000’s</th>
<th>Direct Employment (FTEs)</th>
<th>Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Established Industries</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shipping &amp; Maritime Transport</td>
<td>2,006,483</td>
<td>436,566</td>
<td>3,978</td>
<td></td>
</tr>
<tr>
<td>Marine Tourism and Leisure</td>
<td>644,692</td>
<td>257,877</td>
<td>5,195</td>
<td></td>
</tr>
<tr>
<td>Cruise</td>
<td>22,249</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Marine Retail Services</td>
<td>126,194</td>
<td>40,082</td>
<td>728</td>
<td></td>
</tr>
<tr>
<td>Sea-Fisheries</td>
<td>241,500</td>
<td>178,200</td>
<td>2,233</td>
<td></td>
</tr>
<tr>
<td>Aquaculture</td>
<td>130,300</td>
<td>60,600</td>
<td>956</td>
<td></td>
</tr>
<tr>
<td>Seafood Processing</td>
<td>514,566</td>
<td>98,455</td>
<td>1,839</td>
<td></td>
</tr>
<tr>
<td>Oil and Gas</td>
<td>131,678</td>
<td>56,266</td>
<td>506</td>
<td></td>
</tr>
<tr>
<td>Marine Manufacturing, Engineering and Construction</td>
<td>138,581</td>
<td>34,901</td>
<td>836</td>
<td></td>
</tr>
<tr>
<td>Established Industries Sub-Total</td>
<td>3,956,243</td>
<td>1,140,162</td>
<td>16,271</td>
<td></td>
</tr>
<tr>
<td>Emerging Industries</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Tech Marine Products &amp; Services</td>
<td>71,277</td>
<td>38,612</td>
<td>420</td>
<td></td>
</tr>
<tr>
<td>Marine Commerce</td>
<td>86,559</td>
<td>49,167</td>
<td>161</td>
<td></td>
</tr>
<tr>
<td>Marine Biotechnology and Bioproducts</td>
<td>44,510</td>
<td>18,755</td>
<td>373</td>
<td></td>
</tr>
<tr>
<td>Marine Renewable Energy</td>
<td>12,949</td>
<td>7,075</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Emerging Industries Sub-Total</td>
<td>215,295</td>
<td>113,609</td>
<td>1,154</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4,171,537</td>
<td>1,276,555</td>
<td>17,425</td>
<td></td>
</tr>
</tbody>
</table>

2.3. Reporting on Ireland's Coastal Economy

In 2007, the EU Integrated Maritime Policy highlighted the fact that reliable indicators and statistics at the coastal level (e.g. county or ED) required for planning and development were still relatively unavailable. Work under the Beaufort Award has demonstrated how it is possible to compile a comprehensive range of coastal socio-economic statistics, from existing statistical domains, for a country’s coastal regions. In the Irish case this was done at the NUTS 3, county and shoreline ED levels of spatial aggregation.

The ocean economy can be defined as the economic activity, which directly or indirectly uses the sea as an input independent of location, whereas the coastal economy represents all the economic activity, which takes place in a specified coastal region. Commercial activities in the coastal economy (e.g. agriculture, public sewage works, major infrastructures, etc.) can have both direct and indirect impacts or influences in the ocean economy. However, as many
activities related to the ocean economy can occur in non-coastal zones (service provision for example), the ocean economy is not necessarily a subset of the coastal economy. As a sectoral entity the ocean economy is likely to be much smaller (in value) that is the coastal economy. The population density in coastal regions of Ireland changes depending on the definition of the Irish coast one uses.

Ireland’s coastal region and coastal economy is drawn up on the basis of a tiered approach of geography extending inland from the shorelines of the oceans and seas surrounding the Republic of Ireland. The definitions of alternative tiers are based on electoral districts (EDs), county boundaries and EU NUTS 3 regions. The following categories were developed and used by SEMRU (Hynes and Farrelly, 2012) starting with the shore-line and proceeding in an inland direction:

**Shoreline Electoral Districts:** establishments or population located in an electoral district (ED) that is immediately adjacent to an ocean or sea, included estuaries and bays. Of the 3400 EDs in the country, 628 are Shoreline Electoral Districts

**Coastal County:** establishments or population located in a county that has a shoreline of any length adjacent to an ocean or sea, included estuaries and bays. 15 of the 26 counties in the Republic of Ireland are Coastal Counties.

**European NUTS III Coastal Region:** a standard statistical regions (EU NUTS level 3), where at least half of the population is within 50 km of the shoreline. This is the Eurostat definition of a coastal region and in the Irish case would include 7 of the 8 NUTS 3 regions in Ireland, the Border, the West, Dublin, the Mid-East, the Mid-West, the South East and the South West. Only the four counties of the Midlands NUT 3 region are excluded from this definition.

For the purpose of this report Shoreline ED has been used below to describe Ireland’s coastal economy.
Figure 2.1: Ireland’s Coastal Economic Regions at Alternative Spatial Scales

Purple area reflects shoreline coastal definition, underlying that is the coastal county definition and finally underlying that is the European NUTS III Coastal Region definition.

According to Hynes and Farrelly (2012) the European NUTS III Coastal Region definition is unsuitable for Ireland in terms of data collection for certain marine activities as it includes the majority of the country and defines activity taking place across the 7 regions as coastal; for example, looking at marine tourism it would suggest that any tourism in the 7 regions would be classified as marine tourism, which could be difficult to justify.

The population density in coastal regions of Ireland changes depending on the definition used. At a national level of aggregation, the population density is 67 per km². At the EU coast (NUTS 3) level of aggregation the population density is 69 inhabitants per km². At the coastal county definition it is 76 inhabitants per km² while at the shoreline ED level it is 94 inhabitants per km². The density of the population increases the more confined the regional definition is to the coastline.
Table 2.3: Socio-Economic characteristics of Irish Coastal Communities

<table>
<thead>
<tr>
<th>Socio-Economic Characteristics</th>
<th>Shoreline ED Rural</th>
<th>Shoreline ED Urban</th>
<th>Shoreline ED Average</th>
<th>National</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male Unemployment Rate (%)</td>
<td>22.47</td>
<td>23.47</td>
<td>19.90</td>
<td>21.71</td>
</tr>
<tr>
<td>Females Unemployment Rate (%)</td>
<td>14.28</td>
<td>14.44</td>
<td>13.89</td>
<td>13.86</td>
</tr>
<tr>
<td>Male Unemployment Rate (% change 2006 to 2011)</td>
<td>119.12</td>
<td>125.37</td>
<td>103.51</td>
<td>130.00</td>
</tr>
<tr>
<td>Females Unemployment Rate (% change 2006 to 2011)</td>
<td>200.12</td>
<td>225.95</td>
<td>133.79</td>
<td>266.67</td>
</tr>
<tr>
<td>% Primary Education Only</td>
<td>114.75</td>
<td>121.72</td>
<td>97.35</td>
<td>125.95</td>
</tr>
<tr>
<td>% 3rd Level Education</td>
<td>18.73</td>
<td>20.84</td>
<td>13.31</td>
<td>18.84</td>
</tr>
<tr>
<td>% Higher &amp; Lower Professionals</td>
<td>29.77</td>
<td>26.22</td>
<td>38.87</td>
<td>25.88</td>
</tr>
<tr>
<td>Semi and unskilled Manual Workers</td>
<td>17.94</td>
<td>19.07</td>
<td>15.04</td>
<td>18.26</td>
</tr>
<tr>
<td>Population Change (% change 2006 to 2011)</td>
<td>6.29</td>
<td>6.99</td>
<td>4.49</td>
<td>7.79</td>
</tr>
<tr>
<td>Age Depending Ratio</td>
<td>35.05</td>
<td>36.13</td>
<td>32.28</td>
<td>34.94</td>
</tr>
<tr>
<td>Lone Parent Ratio</td>
<td>17.73</td>
<td>15.47</td>
<td>23.52</td>
<td>16.28</td>
</tr>
<tr>
<td>Affluence index score</td>
<td>-0.59</td>
<td>-2.21</td>
<td>3.57</td>
<td>-1.46</td>
</tr>
<tr>
<td>Affluence index score (% change 2006 to 2011)</td>
<td>0.75</td>
<td>0.45</td>
<td>1.54</td>
<td>-0.11</td>
</tr>
<tr>
<td>Number of EDs</td>
<td>638</td>
<td>459</td>
<td>179</td>
<td>3406</td>
</tr>
</tbody>
</table>

Source: Figures based on the 2011 Census of Population of Ireland, CSO Statistics (www.cso.ie)

For a more in-depth discussion of the definitions applied to Ireland’s coastal regions the interested reader is directed to the main output under the Beaufort in this regard; Hynes and Farrelly (2012). In that paper the authors present the collated coastal statistics down to the shoreline ED level from CSO data sources such as the Census of Population, Census of Agriculture and general statistical releases, Failte Ireland’s tourism related data, the An Post Geo Directory, the Teagasc National Farm Survey (NFS) and Eurostat statistics. The paper also provides a discussion of the relevant literature involved in the defining and characterisation of the ‘Coastal Region’ and ‘Coastal Economy’ and a further discussion on the assumptions and limitations of the data available in Ireland that allows for the socio-economic characterisation of the alternatively defined Irish coastal regions.
3. THE IMPACT OF POLICY AND REGULATIONS ON THE MARINE INDUSTRY AND WIDER ECONOMY IN IRELAND

3.1. Introduction

An important component of the Beaufort work plan was the production of an economic model to look at impact of policy changes on the marine industries and the down-stream impact of changes in the marine sector on other sector’s in the Irish economy. The model was required to assess the linkages between different economic sectors and to simulate impact of policy and economic changes on regional economies in Ireland. Exploiting this linkage between economic sectors, the model would assess the down-stream impact of changes in a particular sector.

A particular technique used in economic impact assessment and the one developed under the Beaufort award is an Input-Output Model. These models are statistical descriptions of the interdependencies between different sectors in the economy, reflecting the flow of resources between different inputs and uses for these sectors. The CSO in Ireland produces a regular Input-Output (IO) table for Ireland. The 2010 CSO IO table contains 58 sectors. The generation of an IO table requires a significant number of data resources.

In the CSO IO tables, the primary resource sectors, Agriculture, Forestry and Fisheries are grouped together in one sector, as are the Food Processing industries. Conversely, the non-seafood based Marine sectors are grouped with their individual parent industrial classification. Utilising marine sectoral information produced by NUI Galway’s SEMRU in their Ocean Economy reports, together with CSO Census of Industrial Production (CIP), the Bio-Economy Input Output Model developed under the project decomposed these sectors.

In total, 13 individual marine sub sectors were disaggregated from the 2010 Symmetric Input-Output Table to formulate the marine component of the Bio-Economy Input Output Model. Information on output, intermediate consumption, GVA, imported inputs, exports, and employment were gathered for each sub-sector from a variety of different data sources and were used to generate the required additional rows and columns in the newly disaggregated Input-Output table. Using this new model a number of marine policy changes were simulated.
to investigate the impact on the marine sub-sectors and the wider economy. Before summarising those policy scenarios the following section briefly reviews the IO methodology.

3.2. The Input-Output Methodology

Input-Output modelling is a linear modelling approach which involves the examination of the economic cycle of production by analysing the relative relationship between the flow of production inputs and resultant flow/destination of produced outputs in an economy. Developed by Wassily Leontief in the 1930s, Input-Output Modelling provides an analytical framework within which the interdependence of industries can be studied. It consists of a system of linear equations, each one of which describes the distribution of an industry’s product throughout the economy. The underlying principals and assumptions of the Input-Output approach form the basis of many different types of economic analysis and is one of the most widely used applied methods in economics.

The creation of a symmetric Input-Output table for the purposes of economic analysis has become an integral part of the system of national accounts both at European (Eurostat, 1996) and global level (UN, 1993) with over 80 countries publishing Supply, Use and Input Output tables by 2001 (Guo, 2002). Input-Output Modelling has been used extensively to identify the relative structural importance or embeddedness of individual economic sectors to the wider economy. It can be used to simulate the direct and indirect impacts associated with changes in levels of output on many economic indicators such as national level output, employment, GVA and the balance of trade. The Input-Output table summarises the source of inputs (columns) and the destination of outputs (rows) for all production sectors of the economy providing a means to study the intensity and direction of relationships between production sectors. This enables researchers to capture the relative importance of the different factors of production used by each sector and the resulting trade balance (Miller & Blair 2009). This information can then be used to calculate the Input-Output table’s Leontief Inverse Matrix which is defined as:

\[ \text{Leontief} = (I-A)^{-1} \]

where:

\[ A = a_{ij} = \frac{y_{ij}}{X_{ij}} = \text{matrix of input coefficients for sectors } i-j \]

\[ y_{ij} = \text{intermediate demand for inputs between sector } i \text{ and the supply sector } j \]

\[ X_{ij} = \text{total output for sector } i \]
The Leontief Inverse Matrix enables an estimation of individual sectoral multipliers, capturing both the direct and indirect macroeconomic effects of potential increases or decrease in exogenous demand (Leontief, 1974). The construction of the Leontief Inverse Matrix facilitates the performance of a number of different types of multiplier analyses with respect to output, GVA and employment.

Estimating the potential macroeconomic impact of a large increase in output from a marine sub-sector requires a comprehensive understanding of the sector’s placement within the wider economy. The sector itself must be disaggregated from the national Input-Output table as was done for 13 marine sub-sectors in the Bio-Economy Input-Output (BIO) model shown in table 3.1 (Grealis and O’Donoghue 2015).

Table 3.1. Table of Bio-Economy Input Output Marine Sectors

<table>
<thead>
<tr>
<th>Sector</th>
<th>NACE Codes</th>
<th>Sub-Sector</th>
<th>Primary Sources</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Fishing</td>
<td>03.1</td>
<td>Sea Fishing</td>
<td>BIM</td>
<td></td>
</tr>
<tr>
<td>Aquaculture</td>
<td>03.2</td>
<td>Aquaculture</td>
<td>BIM/SEMRU</td>
<td></td>
</tr>
<tr>
<td>Oil &amp;Gas</td>
<td>06.1, 8.12 &amp; 09.9</td>
<td>Oil &amp;Gas</td>
<td>CIP</td>
<td></td>
</tr>
<tr>
<td>Seafood Processing</td>
<td>10.2</td>
<td>Seafood Processing</td>
<td>CIP</td>
<td></td>
</tr>
<tr>
<td>Marine Manufacturing Engineering and Construction</td>
<td>30.1</td>
<td>Marine Transport Equipment</td>
<td>CIP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>33.15</td>
<td>Marine Repair/Installation</td>
<td>CIP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>42.91</td>
<td>Marine Construction</td>
<td>BCI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>71</td>
<td>Marine Engineering</td>
<td>SEMRU</td>
<td></td>
</tr>
<tr>
<td>Marine Retail Trade</td>
<td>47.23</td>
<td>Marine Retail Trade</td>
<td>ASI/SEMRU</td>
<td></td>
</tr>
<tr>
<td>Marine Shipping and Transport</td>
<td>50.1 &amp; 50.2</td>
<td>Marine Water Transport Services</td>
<td>ASI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>52</td>
<td>Marine Warehousing</td>
<td>ASI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>77.34</td>
<td>Marine Rental &amp; Leasing Services</td>
<td>ASI</td>
<td></td>
</tr>
<tr>
<td>Marine Tourism</td>
<td>55-56,79</td>
<td>Marine Tourism</td>
<td>SEMRU/Fáilte Ireland</td>
<td></td>
</tr>
</tbody>
</table>

3.3. Aquaculture Expansion

The world’s population continues to grow and with it comes increasing demand on global food resources. Aquaculture offers a potential solution in response to increases in demand for marine seafood products in particular while also potentially reducing pressure on wild stocks. While the expansion of aquaculture production can confer positive economic impacts, under certain conditions, aquaculture can also have negative environmental impacts. Understanding the total economic impacts of aquaculture expansion is therefore necessary in order to make
informed decisions when weighing economic considerations against environmental concerns. This scenario considers the full economic impacts, both direct and indirect of expansion in the Irish aquaculture industry. By disaggregating the aquaculture sector from Ireland’s 2010 Input-Output table and calculating the resultant Leontief inverse matrix a number of economic multipliers for the aquaculture sector are estimated and used to calculate the potential indirect impacts of expansion. These multipliers are then used to estimate the economic impacts of reaching the targets set out in recently published national strategic plan for sustainable aquaculture.

The National Strategic Plan for Sustainable Aquaculture Development (NSPSAD) sets set out a target of achieving production levels for all aquaculture sub-sectors at or near previous historic maxima simultaneously. This equates to a total aquaculture output of 82,000 tonnes annually which represents a substantial increase on current production levels, almost double the average annual output for the currently available years of data 2008-2012. The focus of this scenario was therefore to examine the aquaculture sector in relation to its interaction with the rest of the economy and the potential knock-on economic impacts arising from the significant expansion outlined in the NSPSAD. It should be noted that this analysis only examines the positive economic impacts and does not consider the potential negative environmental impacts which may impact other sectors in the economy (such as recreational angling and tourism).

Table 3.2 describes the total economic and employment impacts as a result of a €71m increase in aquaculture output. In addition to the direct and indirect benefits due to the expansion of aquaculture, further benefits from an expansion in the seafood processing sector are considered. Based on the existing input share of raw product to intermediate consumption it was estimated from the Bio-Economy Input-Output model that an expansion of €117m will be required in the seafood processing sector if 50% (€52.5m) of the additional aquaculture output is processed domestically. In terms of output, it is estimated that the total economic impact of €243m will be observed consisting of €100m from aquaculture and €143m from seafood processing. This is comprised of a direct effect of €189m and an indirect impact of €54m.

In terms of employment, it is estimated that the total employment impact of 1,565 additional jobs will be observed consisting of 760 from aquaculture and 805 from seafood processing. This is comprised of a direct effect of 1,028 jobs and an indirect employment impact of 537 jobs.
Table 3.2. Total Economic and Employment Impact of a €71m Aquaculture Expansion

<table>
<thead>
<tr>
<th>Output</th>
<th>Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquaculture – Direct and Indirect Output</td>
<td>€100m</td>
</tr>
<tr>
<td>Seafood Processing – Net Economic Impact</td>
<td>€143m</td>
</tr>
<tr>
<td>Total Economic Impact</td>
<td>€243m</td>
</tr>
</tbody>
</table>

Similar to sectors such as Agriculture, Forestry, Construction and Food Processing, the aquaculture sector is deeply embedded in the Irish economy and relies primarily on inputs from domestic resources. This means that the expansion of the aquaculture sector, in line with the NSPSAD, has the potential to have substantial positive knock-on effects in terms of employment and value added in the wider economy. In a similar pattern to the indirect employment effects, the indirect impact on the output of other sectors is primarily attributed to the supporting services sectors.

In another aquaculture scenario using the Bio-Economy IO model, Grealis et al. (2015) estimated the economic impacts of an increase in utilisable finfish aquaculture output of approximately 15,000 tonnes per annum. One of the ways it had been proposed to achieve growth in the aquaculture sector was to establish high capacity offshore organic salmon farms off the west coast of Ireland. As part of this strategy, Bord Iascaigh Mhara (BIM) lead a project to develop three deep sea salmon farms. It was proposed that each farm will be capable of producing 15,000 tonnes of organic salmon annually. While this proposal is no longer under consideration, the economic and employment impact of the expansion of 15000 tonnes per annum was examined using the IO model.

Based on a unit price of €7.00 per kilo, the increase in exogenous demand required to absorb the increased levels of production was estimated to be €105 million per annum. The Bio-Economy IO model estimated an output multiplier of 1.41 for the aquaculture sector based on the newly disaggregated Input-Output table. Overall, this results in an estimated additional indirect effect of €43 million per annum in the wider economy, resulting in a total economic impact of €148 million per annum.

In terms of output, it was estimated that the total economic impact of €379m would be observed consisting of €148m from finfish aquaculture and €231m from seafood processing. This is comprised of a direct effect of €290m and an indirect impact of €89m. In terms of employment, it was estimated that the total employment impact of 1,603 additional jobs would
be observed consisting of 489 from finfish aquaculture and 1,114 from seafood processing. This is comprised of a direct effect of 990 jobs and an indirect employment impact of 613 jobs.

3.4. Economic impact of achieving the targets set out under Harnessing our Ocean Wealth Strategy

In another scenario analysis, the bio-economy IO model was used to analyse the direct and indirect economic impact of achieving the targets set out under Harnessing our Ocean Wealth Strategy – An Integrated Marine Plan for Ireland (HOOW-IMP). HOOW-IMP is the Irish government’s response to the IMP-EU’s call to all Member States to develop their own national integrated maritime policies, which are based on the recognition that all matters relating to the sea are interlinked and should be dealt with as a whole (COM(2008) 395 final). Published in 2012, HOOW-IMP presents the Government’s vision, high-level goals and integrated actions across policy, governance and business to enable Ireland’s marine potential to be realised (Government of Ireland, 2012).

In HOOW-IMP, the Irish government sets the overarching targets to double the value of Ireland’s ocean economy to 2.4% of GDP by 2030 and to increase the annual turnover to exceed €6.4bn by 2020. This is obtained from a range of individual sectoral targets as shown in Table 3.3.

Table 3.3 Sectoral targets set out in the Integrated Marine Plan

<table>
<thead>
<tr>
<th>Sector</th>
<th>Ocean 2020 Target*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seafood (fisheries, aquaculture, seafood processing)</td>
<td>€1,000 million</td>
</tr>
<tr>
<td>Maritime Commerce and Ship Leasing</td>
<td>€2,600 million</td>
</tr>
<tr>
<td>Marine and Coastal Tourism and Leisure (including Cruise Tourism)</td>
<td>€1,500 million</td>
</tr>
<tr>
<td>Marine ICT and Biotechnology</td>
<td>&gt;€61 million</td>
</tr>
<tr>
<td>Ports and Maritime Transport Services, Maritime Manufacturing, Engineering, Offshore Oil and Gas, other marine industries</td>
<td>&gt;€1,200 million</td>
</tr>
</tbody>
</table>


The Bio-Economy IO model was used to examine the full impacts both direct and indirect, of achieving the HOOW targets. Table 3.4 shows the results for the estimation of the total economic impact of reaching the HOOW targets. Individual output multipliers for each of the disaggregated marine sectors in the Bio-Economy IO model are estimated. Overall, this results in an estimated direct impact of €3.3bn on the 2010 base year with an additional indirect effect of €2.7bn in the wider economy, giving a total impact of over €9bn. Table 3.4 shows the
breakdown of this figure by each sector, with the largest additional indirect effect coming from Shipping and Transport, followed by Marine Tourism.

Table 3.4 Total Economic Impact of Reaching the HOOW Targets

<table>
<thead>
<tr>
<th></th>
<th>Fishing</th>
<th>Aquaculture</th>
<th>Oil &amp; Gas</th>
<th>Seafood Processing</th>
<th>Marine Mammal, Marine &amp; Eng. Const.</th>
<th>Marine Retail</th>
<th>Shipping and Transport</th>
<th>Marine Tourism</th>
<th>Total €M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Multiplier</td>
<td>1.40</td>
<td>1.41</td>
<td>1.57</td>
<td>1.65</td>
<td>1.74</td>
<td>1.50</td>
<td>2.01</td>
<td>1.60</td>
<td>-</td>
</tr>
<tr>
<td>2010 Output €m</td>
<td>164</td>
<td>123</td>
<td>126</td>
<td>390</td>
<td>111</td>
<td>58</td>
<td>1,272</td>
<td>723</td>
<td>2,965</td>
</tr>
<tr>
<td>Required €m</td>
<td>79</td>
<td>59</td>
<td>179</td>
<td>187</td>
<td>158</td>
<td>82</td>
<td>1,814</td>
<td>777</td>
<td>3,335</td>
</tr>
<tr>
<td>HOOW Target €m</td>
<td>242</td>
<td>181</td>
<td>305</td>
<td>577</td>
<td>269</td>
<td>140</td>
<td>3,086</td>
<td>1,500</td>
<td>6,300</td>
</tr>
<tr>
<td>Indirect Impact €m</td>
<td>31</td>
<td>24</td>
<td>101</td>
<td>122</td>
<td>118</td>
<td>41</td>
<td>1,841</td>
<td>468</td>
<td>2,745</td>
</tr>
<tr>
<td>Total Impact €m</td>
<td>273</td>
<td>205</td>
<td>407</td>
<td>697</td>
<td>386</td>
<td>181</td>
<td>4,927</td>
<td>1,968</td>
<td>9,045</td>
</tr>
</tbody>
</table>

Table 3.5 reports the employment impact of reaching the HOOW targets across all marine sectors. Employment multipliers are estimated for each sector based on the adjusted existing labour/output ratios calculated for the base year of 2010 from the latest Ireland’s Ocean Economy Report and are displayed in the first row. The Bio-economy IO model estimates the creation of approximately 16,927 indirect jobs, with over 60% of those allocated to Shipping and Transport. The model also predicts that the total employment impact resulting from reaching HOOW targets would be an additional 32,859 jobs.

Table 3.5 Employment Impact of Reaching the HOOW Targets

<table>
<thead>
<tr>
<th></th>
<th>Fishing</th>
<th>Aquaculture</th>
<th>Oil &amp; Gas</th>
<th>Seafood Processing</th>
<th>Marine Mammal, Marine &amp; Eng. Const.</th>
<th>Marine Retail</th>
<th>Shipping and Transport</th>
<th>Marine Tourism</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emp. Multiplier</td>
<td>1.49</td>
<td>1.38</td>
<td>2.37</td>
<td>2.36</td>
<td>1.84</td>
<td>1.59</td>
<td>2.79</td>
<td>1.49</td>
<td>-</td>
</tr>
<tr>
<td>Jobs/€M</td>
<td>12.7</td>
<td>7.8</td>
<td>2.9</td>
<td>4.1</td>
<td>6.6</td>
<td>4.4</td>
<td>3.3</td>
<td>7.6</td>
<td>-</td>
</tr>
<tr>
<td>2010 Employment</td>
<td>2,084</td>
<td>952</td>
<td>359</td>
<td>1,586</td>
<td>726</td>
<td>252</td>
<td>4,137</td>
<td>5,497</td>
<td>15,593</td>
</tr>
<tr>
<td>2010 Output €m</td>
<td>€164</td>
<td>€123</td>
<td>€126</td>
<td>€390</td>
<td>€111</td>
<td>€58</td>
<td>€1,272</td>
<td>€723</td>
<td>€2,965</td>
</tr>
<tr>
<td>HOOW Increase €m</td>
<td>€79</td>
<td>€59</td>
<td>€179</td>
<td>€187</td>
<td>€158</td>
<td>€82</td>
<td>€1,814</td>
<td>€777</td>
<td>€3,335</td>
</tr>
<tr>
<td>Direct Jobs</td>
<td>1,000</td>
<td>457</td>
<td>512</td>
<td>761</td>
<td>1,035</td>
<td>359</td>
<td>5,901</td>
<td>5,908</td>
<td>15,932</td>
</tr>
<tr>
<td>Indirect Jobs</td>
<td>487</td>
<td>173</td>
<td>701</td>
<td>1,033</td>
<td>874</td>
<td>212</td>
<td>10,567</td>
<td>2,881</td>
<td>16,927</td>
</tr>
<tr>
<td>Total</td>
<td>1,486</td>
<td>629</td>
<td>1,213</td>
<td>1,794</td>
<td>1,910</td>
<td>571</td>
<td>16,467</td>
<td>8,789</td>
<td>32,859</td>
</tr>
</tbody>
</table>

A more detailed breakdown of the results and the methods used in this study and description of the data sources and assumptions used is published in Grealis and O’Donoghue (2015).
4. The economic and social impact of the marine sectors in Ireland

4.1. Introduction

Chapter 2 outlined the research carried out under the Beaufort Award in relation to establishing the contribution of the ocean economy to national Gross Domestic Product while chapter 3 reviewed the research that looked at the wider economic impacts of the ocean economy through the use of input output analysis. During the Beaufort Award period a number of outputs were produced that focused in on a specific sector within the ocean economy. For instance a number of papers and reports focused on the productivity of the Irish fishing fleet and modelled the spatial distribution of effort around the coast. Through the Masters students reports delivered under the Award analysis was done that examined marine tourism, seaweed harvesting, aquaculture, cruise liner activity, shipping, sea angling, marine renewable energy and marine commerce. In what follows we do not go into the detail of all these diverse pieces of sectoral analysis. Rather we focus on the Beaufort research related to modelling the economic and social impact of the marine industries in Ireland with particular reference to shipping, marine energy, fishing and marine education and research.

4.2. Shipping

4.2.1. Rationale for the study

The Republic of Ireland has historically relied on the UK land bridge with a large proportion of its trade with Europe routed through Britain. This has provided a very competitive and efficient service with high degree of reliability and security. However recent UK transport policy developments have created a considerable level of uncertainty among Irish freight transport providers and users on the potential implications of the recently introduced Heavy Goods Vehicles (HGVs) road user charge in the UK. This charge is a time-based charge of up to £1,000 a year or £10 a day and will apply to all vehicles weighing 12 tonnes or more, using the UK road network.

The aim of this research was firstly, to analyse the Irish ro/ro freight transport demand for export trade movements with mainland Europe. Secondly, to estimate the impact of the UK HGVs road charge on Irish ro/ro freight transport demand across a number of key Irish export sectors such as medical and pharmaceutical products, general industrial manufacturing and beverages.
4.2.2. Research Objectives

The key research objectives of the study were as follows:

1. To determine what the relative value of transport service attributes such as time-savings, frequency, and reliability is for ro/ro cargo users of the UK Land Bridge regarding Irish international trade movements with mainland Europe across a number of key export sectors.
2. To estimate the direct and cross price elasticities of ro/ro freight transport demand in Ireland across a number of key export sectors.
3. To simulate the potential impact of the introduction of the new HGVs UK road charge on Irish ro/ro freight transport demand and on export trade movements with mainland Europe.

4.2.3. Methodology

The methods used in this study were both qualitative and quantitative, and were conducted in two phases:

- **Phase 1**
  - Identify a sample of decision makers: Irish based freight forwarders and exporters that use the UK road network for UK and European trade
  - Conduct in-depth interviews with decision makers
  - Analyse findings using cross pattern matching and emergent and recurrent theme analysis

- **Phase 2**
  - Disseminate survey to a large sample of the population of industry stakeholders (exporters)
  - Analyse the data using adaptive stated preference methods
  - Determine the monetary value placed on particular transport attributes using discrete choice models

- **Objectives**
  - Determine the value of transport service attributes for ro/ro cargo users of the UK Land Bridge regarding Irish international trade movements with mainland Europe
  - Estimate direct and cross price elasticities of ro/ro freight transport demand
  - Simulate the potential impact of the introduction of the new HGVs UK road charge on Irish ro/ro freight transport demand and on export trade movements within mainland Europe
4.2.4. Results

Phase One: Qualitative Analysis

The potential impact of the UK HGVs road charge on Irish freight transport stakeholders has raised a debate among freight transport industry organisations, exporters, policy makers and academia on the extent to which Ireland’s future economic growth may be challenged. The Republic of Ireland operates at a cost disadvantage in relation to all freight transport modes compared to firms located in the UK or continental Europe (Forfás, 2012). In terms of road freight costs, a typical journey to the continent is about 50% cheaper for a UK exporter and 80% cheaper for a continental exporter than for an Irish exporter (Forfás, 2012). One nation’s geography leading to a high dependency on its neighbour for market access, renders the potential impact of the UK road user charge an idiosyncratic and interesting case for study.

This research takes a qualitative approach to explore the potential implications of the UK HGV road user charge for Irish stakeholders operating and using Irish freight services from the Republic of Ireland. Using qualitative in-depth interviewing techniques, semi-structured interviews were carried out with key stakeholders in the Irish Freight Transport sector representing road hauliers, freight forwarders, exporters, industrial organisations and state-owned agencies. The advantage of this type of analysis is that it provides a deep understanding of the nature and diverse perspectives of key stakeholders in the Irish transport sector and its users – the exporters.

As a first step, the paper addresses the research question of the identification of the decision maker in Irish international freight transport. Specifically, the paper focussed on the identification of the agent that ultimately makes the decision of route and mode of transport for goods exiting the Republic of Ireland. While the decision maker in passenger transport is generally straightforward, as the user of the service and the decision maker tend to be the same person, previous studies have shown that it is more difficult to identify the decision maker in freight transport (de Jong, 2000). The large number of actors involved in international freight transport systems and the growing levels of outsourcing in the sector have been identified as the main reasons for this difficulty (Feo et al, 2011). Once this first research question is investigated, the paper moves on into addressing the main research question regarding the implications of the UK HGV road user charges on the Irish international freight transport sector.

Results from Phase One have been recently published in the international journal Case Studies on Transport Policy and are available on-line as Vega, Amaya, and Natasha Evers. "Implications of the UK HGV road user charge for Irish export freight transport stakeholders - A qualitative
study” Case Studies on Transport Policy (2016). Based on the findings from the research, the specific application of road user charges, in this case the UK HGV time-based user charge can undermine the implementation of EU transport policy in relation to other member states. This is evidenced in the case of the road hauliers in the Republic of Ireland who pay the charge but are not the sole polluters and aggregate users. There equally exists the logistical necessity for Irish based exporters, freight forwarders and hauliers to transport goods via the UK land bridge. With the onset of the UK road user charge, findings indicate that a distortive economic impact will befall the Irish hauliers operating out of the Republic of Ireland. As a result, serious economic and repercussions may follow for the Irish haulage sector and ultimately the Irish exchequer. For example, transfer of Irish Haulier company registration to the UK leading to a significant shortfall in motor tax revenues as well as a declining indigenous haulier sector to address the needs of the local economy, specifically in Irish peripheral rural regions. Further, the idiosyncrasies related to Ireland’s geography leads to a necessary dependency on using the UK road network for freight transport for increased frequency and lower transit times. In addition, while the market share of the continental corridor to mainland Europe (direct route) keeps increasing at a steady pace since 2012 (IMDO, 2015), the Irish Short Sea Shipping infrastructural capacity is still limited.

Road user charging is generally introduced in a given economic, social and geographical context and its potential success/failure and its implications depend on this particular context. This research contributes to the understanding of the impact of HGV road user charging schemes on different stakeholder groups and in the specific geographic context of the Republic of Ireland. The contribution of this study is to provide comprehensive insights into the nature and diverse perspectives from international Irish transport providers and their customers - the exporters.

Research Implications

In terms of understanding decision-making agents, motivations and choices in international freight transport, transaction cost economics (Coase, 1937 and Williamson, 2002) would be a useful theoretical approach to advance knowledge in this area. Further, the understanding of the increased use of ‘outsourcing’ transport services by Irish exporters would be enhanced by theoretical assumptions of TCE and further be an interesting context to apply and extend this theory.
The economic application of the ‘polluter pays principle’ (PPP) was challenged in the study. The authors believe its principles are indeed economically and socially sound, however, in the context of this study, its application has been questioned. Further research needs to be conducted into the economics of the PPP in the context of freight transport with a view to identifying limitations in certain policy and sector contexts. This would be indeed relevant and useful for EU and national policy makers in addressing the aims of EU environmental policy targets and objectives.

Further, the findings and conclusions of this study are relevant and timely following the EU report titled ‘Evaluation of the implementation and effects of EU infrastructure charging policy since 1995’ (European Commission – DG Mobility and Transport, 2014). This report confirmed that from its evaluation of EU road charging policy no significant evidence of modal shift in transport existed, and statistics of vehicle activity did not provide any evidence of modal shift. It was further pointed out that several studies showed that there was ‘potential for cost increases in peripheral regions to be higher compared to those in central regions; however the overall impact on economies is thought to be small.’ On the contrary, a key conclusion of this study is that national road charging policy and legislative mechanisms adopted by individual member states can somewhat compromise effective implementation of road charge policies. Awareness and acceptability of road user charges from the Irish exporter’s perspective constitute a key barrier to transport policy implementation, as well as aggravating the impact of the charge on one single stakeholder group, the haulier. This study suggests that Member state road charging policies need to be understood in the context of the overall European transport policy and in particular, in relation to other national fiscal measures such as fuel charges and vehicle or motor taxes.

Finally, the authors of the research had the opportunity to present this work before it was published to the Freight Transport Division of DTTAS and discuss their findings and policy implications in detail.
Phase Two: Quantitative Analysis

Phase one allowed the research team to conduct and formulate a survey questionnaire for dissemination to a sample of the population of industry stakeholders, notably exporters. The data collected from the survey was analysed using discrete choice analysis. This work was carried out in collaboration with the University of Valencia (Spain) and the University Jaume I (Spain).

A significant amount of Irish freight to and from continental Europe ships through the UK via RoRo shipments. This transport mode minimises the transport distance made up of time at sea, and primarily relies on UK road infrastructure and the availability of frequent crossings between Ireland and the UK and the UK and continental Europe. However, as road-freight costs increase, services providers may be compelled to increasingly seek less road-reliant transport options when shipping goods to and from continental Europe, specifically, through the use of direct shipments between Ireland and Continental Europe. While doing so may potentially reduce shipment costs, there are other service attributes about which service consumers are concerned. In today’s global world, where manufacturing processes are international and manufactured inputs and raw materials must arrive according to strict deadlines, factors such as frequency, transit time, delivery reliability and cargo damage are of key concern. Key questions arise. For example, what is the capacity of the Irish port infrastructure and is it sufficient to provide realistic alternatives to the UK landbridge transport mode and route? If not, is the development of such infrastructure economically viable? Which mode and route? If not, is the development of such infrastructure economically viable? Which would be the funding mechanisms? What are the likely changes in service attributes (such as price, transit time and reliability) if hauliers increasingly offer alternative modes and routes of shipment to their customers? Finally, how are these customers, those shipping goods into and out of Ireland, likely to respond changes in these key attributes? It is this latter question the authors are concerned with in this study, specifically, the aim is to investigate the exporter’s valuation of key transport attributes.

Modelling freight transport demand has evolved significantly over the last few decades, from the use of aggregate models based on global data of shippers and shipments, to the use of more sophisticated disaggregated models based on individual data. A shift in focus to behavioural models that analyse service demand has occurred rapidly in the passenger transport literature and to a lesser extent in the freight-transport literature given the challenging nature of data collection in this field. The use of stated preference (SP) techniques makes up a good number of these recent studies. This research makes particular use of this approach in order to estimate a number of discrete choice models to determine the elasticity
of demand for alternative freight transport routes (direct routes) between Ireland and continental Europe.

The research from phase two contributed to the literature on freight transport demand analysis and represents a tool for informing policy initiatives, commercial opportunities and the necessary infrastructural investment needed to tailor Irish maritime freight transport services to the needs of its users, in this case, the exporters.

Data collection process
Phase two of the study was concerned with the analysis of the demand for international maritime freight transport services in Ireland. The aim of the research was to obtain empirical evidence of on the determinants of mode and route choice between the two alternatives: “use of the UK landbridge” and “use of a direct route” on maritime freight export shipments from Ireland to Northern continental Europe – France, Belgium, The Netherlands and Germany. The population under study was Irish exporters that use or have used in the past the UK land bridge to ship their goods to the above European destinations. The population was also narrowed by ruling refrigerated shipments out of the sample since these have very different timeline requirements and costs, and would not be comparable to the rest of the sample. As earlier noted, this route accounts for 90% of ro/ro freight movements with Continental Europe.

One of the main critical issues in freight transport modelling is to identify the decision maker, whether this is the shipper, the freight forwarder or the transport service provider. In our case of study, a reasonable argument can be made that it is road hauliers and freight forwarders that ultimately make the decision of transport route and mode [15]. However, in recent years, rising fuel costs, taxation and the highly competitive nature of the sector have reduced margins in the freight-transport sector. As a result, it is likely that continually rising costs will begin to be shifted onto exporting customers. As the impact of changes in service attributes start to be felt by Irish manufacturers, their preferences and attitudes become increasingly important to consider given that they end up conditioning the route finally chosen by the transport provider. Moreover, by surveying exporters themselves a larger sample size is possible.

The data used in the estimation process were provided by exporters of non-refrigerated goods to Germany, France, the Netherlands and Belgium. Specifically, the sample used in the
The research is the result of 50 face-to-face interviews across Ireland, providing a total of 600 observations. The surveying method took the form of personally organised interviews with a representative of each company's logistic or supply chain department in charge of managing the transport shipments. Interviews ran for approximately 30 minutes. The survey participant was guided through the survey questions, which were displayed using an online survey software. Each surveyed company provided information about their representative consignment shipped to Continental Europe through the UK landbridge. Companies were selected by a simple random sample provided by a number of organisations including the Irish Exporters Association, IDA Ireland and Enterprise Ireland.

The questionnaire was structured into four sections:

- A first section was designed to obtain general information about the characteristics of the company and its logistic dimension;
- A second section was designed to collect information on the characteristics of the reference shipment in terms of the key attributes defined for the study.
- A third section included questions to determine the importance of the attributes defining the transport service, as well as the level of quality perceived;
- A fourth section involved the collection of the decision-maker's preferences in an SP experiment.

The in-depth interviews carried out with exporters and freight transport service providers in Phase One were used to understand the current composition of the transport demand and supply in the transport corridors under study. This provided the research team with information to identify the main service attributes and the initial service attribute levels to be presented to participants in the choice experiments. Attributes and levels considered in the SP choice experiment are in Table 4.1.
The data collection regarding the SP choice experiment was carried out in two phases. First, two pilot exercises were conducted for a sample of 15 companies, which allowed for the estimation of preliminary models to obtain parameter priors required in the construction of the final choice experiment. Providing as much realism as possible for the respondent was a source of concern in the experimental design phase. To achieve this, the Cost variable is selected from a catalogue of 30 possible cost levels according to the actual cost reported by the interviewee. This resulted in 30 individual choice experiments being constructed for the study. N-gene software was used to build the efficient designs for a multinomial logit specification. With regard to the levels used for the level of service attributes, these are kept fixed for all shipments. Based on the information obtained from the two pilot exercises and the in-depth interviews with exporters and freight transport service providers, it was found that there was a similarity in the levels of service offered by the various UK landbridge transport providers along the corridor under study. Therefore, the level of cost is the only attribute that varies across respondents in the SP experiment.
The efficient design approach is based on the idea of minimising the determinant of the asymptotic variance–covariance (AVC) matrix of models estimated on data collected using the designs. This is essentially a way of minimising the standard errors in the model, therefore obtaining more reliable parameter estimates. A popular format for this approach is to minimise the D-error, i.e. the asymptotic variance matrix which is based on the second derivatives of the log-likelihood function. One of the major advantages of the D-efficient design is that it allows analysts to attain more reliable estimates in the face of a small sample size.

During the second phase of the SP choice experiment, recently finished, a web-based survey exercise was carried out by the research team. Respondents were presented with 12 choice scenarios, with a binary choice to be made by the survey participant in each case. Alternative “A” reflects the company’s current transport choice in terms of model/route (use of the UK land bridge) and Alternative “B” reflects the transport model/route corresponding to the use of a direct route. Because alternatives are unlabelled during the choice experiment, respondents are not made aware that they are selecting an alternative consistent with the UK land bridge (“A”) or the direct shipping to Europe (“B”).

Results from the econometric analysis of the collected data show that measures acting on prices are among the most effective in terms of a shift from the UK landbridge route to a direct option. There is a higher sensitivity of the direct option demand to deteriorations in the cost of the current (UK landbridge) transport alternative than to additional improvements in the cost competitiveness of direct services. For the remaining transport attributes listed in Table 1, the opposite pattern is observed: the direct option is more sensitive to improvements in its own level of service than to deterioration in the UK landbridge route. Therefore, the implications for increasing road freight taxation in UK suggest that direct services from Ireland to continental Europe should increase their level of service in terms of delivery time, frequency and reliability to safeguard the competitiveness of Irish exports.

4.3. The economic evaluation of wave energy conversion (WEC) devices

The ambition to achieve an environmentally sustainable, cost-effective and secure future energy supply has motivated greater use of renewable resources for electricity generation. The majority of renewable capacity to date has been served by wind turbine technology. However, a desire exists to diversify current renewable energy portfolios by increasing the share of
electricity generated by alternate renewable energy technologies. Ireland has a considerable wave energy resource and, as such, the deployment of Wave Energy Conversion (WEC) devices has been cited as contributing to such diversification. An economic evaluation of this decision was carried out under the Beaufort Award to consider each of the costs and benefits that comprise the economic trade-off associated with deployment. Given the pre-commercial nature of these devices, many of these parameters are unknown or uncertain.

The Beaufort research in this regard developed three modelling frameworks to improve the understanding of uncertain or unknown parameters determining cost-effective WEC deployment, thus improving the fidelity of WEC policy appraisal in Ireland. The first modelling framework developed was a probabilistic model of device cost which allowed a degree of likelihood to be placed on a cost or profitability estimate, improving the interpretation of values for the appraisal of investment and policy support. The second modelling framework build on this by developing a real options model to analyse the deployment trade-off relative to dynamic fuel and carbon prices. This model identified the time period and economic conditions for cost-effective deployment.

The final model was employed to analyse the spatial and micro-level distribution of socio-economic impact as a result of WEC deployment using Spatial Microsimulation. In providing this contribution, a Spatial Microsimulation framework was created. A novel statistical matching algorithm referred to as ‘Quota Sampling’ was developed thus providing a methodological contribution to the literature of Spatial Microsimulation.

One of the central aims of the research conducted under the Beaufort Award in relation to marine energy was to develop a disaggregated electricity generation model within the RERC SMILE-REM framework. This framework was utilised to assess the macro-economic and environmental impacts of expenditures associated with the development of the marine environment for electricity generation. The RERC-REM model is based on linking the spatial microsimulation model, SMILE to a Computable general equilibrium (CGE) model. This allows for supply-side influences to be incorporated in the analysis over and above the static economic impact of expenditures on marine renewable energy.

WEC devices are at a pre-commercial stage of development in Ireland with feasibility studies sensitive to uncertainties surrounding assumed input costs. This may affect decision-making. This research carried out under the Beaufort Award analysed the impact these uncertainties may have on investor, developer and policymaker decisions using an Irish case study.
Calibrated to data present in the literature, a probabilistic methodology was shown to be an effective means to carry this out. Value at Risk (VaR) and Conditional Value at Risk (CVaR) metrics are used to quantify the certainty of achieving a given cost or return on investment. The certainty of financial return offered by proposed Irish Feed-in Tariff (FiT) policy was also analysed and the corresponding cost reduction targets for developers are identified. Uncertainty was found to have a greater impact on the investment decision when learning progresses at a slower rate. This research emphasised the requirement for a premium to account for cost uncertainty when setting FiT rates. By quantifying uncertainty, the developed methodology allowed for the required premium to be identified.

The economic evaluation of WEC devices has been limited to date by the uncertainty surrounding the true value of existing cost estimates. To incorporate the effect this uncertainty may have in policymaker, investor and developer decision-making, this research under the Beaufort Award developed a tool to quantify the likelihood of achieving a given cost estimate. This model was applied to a representative case study to further inform policymakers and investors as to the cost of wave energy devices in Ireland. A probabilistic analysis was created to quantify the uncertainty of WEC device cost. Following the majority of the literature to date, the Pelamis WEC device was used as the case study. A number of key findings resulted which may inform Irish policy. First, the impact of uncertainty on the potential variability of cost estimates was demonstrated. The cost premium that must be taken into account for policy and investment appraisal was demonstrated for the case study installation.

This research also evaluated the importance of incorporating cost uncertainty into policy evaluation. After quantifying the likelihood of achieving different Internal Rates of Return (IRR), it was found that cost variability has potential to reduce IRR by 2.2-3.2%. The required rates of learning and associated cost scaling for current REFIT rates were offered, providing both policy makers and device developers with a set of targets to achieve feasible deployment, given current policy. Finally, the sensitivity of costs and estimated financial returns to changes in learning were calculated, providing policymakers and device developers with an insight into how cost and return expectations should be amended, should observed technological change deviate from expected values.

In quantifying the cost for a central scenario of deployment it was found that the expected levelised cost of electricity for 100 unit steel-based installations is €0.244/kWh. The uncertainty surrounding this estimation was quantified, with VaR and CVaR methodologies shown to account for risk in cost and policy appraisal. It was found that there is a 95%
likelihood of achieving a cost value less than or equal to €0.267/kWh for 100-unit installations using the CVaR methodology.

The second goal was to assess the certainty to which a feed-in tariff of 0.26/kWh provides an adequate return on investment, when investments are evaluated at their expected value or at a threshold accounting for uncertainty. This gives insight into the influence of cost uncertainty when policymakers are setting feed-in tariff rates. It was found that a tariff of €0.26/kWh is insufficient for all considered device specifications, with a REFIT of €0.42 required for 20-unit installations when evaluated at the expected mean value, rising to €0.46 when evaluated under CVaR5 criteria. For 100-unit installations, expected mean and CVaR5 criteria suggest values of €0.31/kWh and €0.34/kWh respectively. Thus, this methodology may identify the premium required to account for cost uncertainty. The third goal of this chapter was to explore the sensitivity of results to different rates of cost reduction or 'learning'. The rates of learning required for feasible deployment under proposed REFIT policy were identified, whilst the REFIT rates required for feasible deployment under different rates of learning were presented.

Although cost estimates are still subject to uncertainty and thus to be treated with a degree of caution, this paper has presented a means to quantify this uncertainty through probabilistic simulation. This analysis recommends that prudent policy, cost and developer evaluation should incorporate cost variability into WEC project appraisal and has demonstrated how this may be done. For investors, a means to quantify the uncertainty of the investment environment allows for more informed investment decisions. For developers, this model has been applied to determine targets of cost reduction for feasible deployment. Furthermore, using the CVaR methodology allows for potential uncertainties to be incorporated in appropriate targets, such that prudent goals of cost reduction that account for potential cost uncertainties may be defined.

In a related study under the Beaufort Award spatial microsimulation was used to identify the spatial and socio-economic distribution of welfare change resulting from subsidised WEC device deployment in Ireland. It was found that the burden of subsidies required for deployment was greater in rural areas than urban areas, with areas of the west and midlands bearing the greatest burden of this cost. Much of the primary deployment and manufacturing activities are located in areas that incur the greatest burden of cost whilst other intermediate inputs and associated services occur mostly in urban centres for which REFIT cost imposes a lesser burden. Thus, expansion of manufacturing capacity is required to maximise potential impact for regional development.
Figure 4.1. Identifying the Pattern of Income Redistribution: Net Proportional Change of ED-level Disposable Income due to Additional Employment and 15 Year REFIT Cost

The net effect of first round benefits and costs on the distribution of household welfare were analysed relative to the immediate cost of REFIT support for one year alone alongside a discounted 15-year cost. As costs outweigh benefits in some regions when the full 15-year discounted cost is considered, analysing benefits relative to single-year costs allowed for the pattern of redistribution to be identified whilst also providing insight into the short run annual burden on households. The yellow/red shades illustrate a net percentage reduction in ED disposable income, whilst the blue shades illustrate a net increase in ED disposable income.

Analysing the pattern of income change, it was clear from this analysis that economic activity carried out at wave energy deployment sites (blue shaded regions in western/south western coastal areas) occurs where REFIT cost comprises a greater share of household disposable
income (see Figure 4.1). These are also regions that contribute less in terms of absolute REFIT contributions. Thus, REFIT policy to support primary ‘on-site’ economic activity was found to have redistributed income from areas with higher income to areas with lower income.

Positive welfare impacts were found to be less than negative impacts caused by subsidy costs imposed on households. In all considered scenarios, it was found that more household lose out than gain. Implications of this policy for regional development were also quantified, an insight that was not previously possible with traditionally employed macro or aggregated methodologies. A net reduction in between-region inequality was observed, however this was less than the overall increase in inequality as REFIT cost led to an increase in within-region inequality.

A number of policy conclusions were drawn from this analysis. First, the findings were found to back-up policy claims that employment benefit resulting from the deployment of renewable energy technologies may help alleviate between-region inequality. The degree to which this may occur has been quantified. It has been found that capacity development in manufacturing services is of particular importance in contributing towards regional development, with on-site activity contributing a relatively small impact on the spatial distribution of income. Many service activities are likely to be located in more-developed urban areas, having a minimal impact on the spatial income distribution. For a more in-depth discussion of the results of the wave energy economic analysis the interested reader is directed to Farrell (2013) and Farrell et al. (2015).

4.4. The Economics of Fisheries

One of the first pieces of economic analysis carried out under the Beaufort Award was an analysis of the 5 segments of the Irish fishing fleet, drawing on volume and price data on landings and days at sea provided by the Sea Fisheries Protection Authority (SFPA), which collects data on every active vessel in the Irish fleet. The SFPA collects and analyses data on fish landings and fishing activity by all Irish vessels and foreign vessels landing into Ireland. This data includes information on the quantity, value, and location of fish caught, together with effort data and details of fishing methods used.

The main sources of the data collected by the SFPA and used in this analysis were:

1. EU logbooks which are completed by the masters of fishing vessels when landing. All vessels greater than 10m in length are required to fill out these log sheets and submit them to their
local Port Office. The data is then entered to the Integrated Fisheries Information System (IFIS) database by SFPA staff.

2. Sales notes data which are electronically submitted by the buyer at the first sale of the fish. The sales notes provide data on the price per kg received for landings by a vessel.

The data collected by the SFPA from the log sheets (such as landing weights, details of days at sea, vessel descriptors, etc.) and the sales notes (prices per kg per species per landing) are an important source of data for fishery scientists to conduct stock assessment and population modelling. In addition however, this data relating to fishing activity and catch value can be used to assess the economic status of the fishing industry from year to year. This is important information given that this industry forms a vital part of the economy of many rural coastal areas. As such, this analysis filled a gap in the use of the log sheet and sales note data by using it to present, for the first time, a micro-level analysis of the earnings and effort of the different fishing segments in the Irish fishing fleet.

The Irish coastal and offshore fleet can be broken down into five segments. These segments are shown in figure 4.2 where the segment shares of total fleet revenue per annum are presented. The relative importance of the Pelagic and Polyvalent General segments is evident in Figure 4.2, but more subtle points can be made about the shares of each segment over the three year period. Polyvalent General had a 58.7 percent share of total coastal and off-shore fleet earnings in 2006. It then rises to 60 percent in 2007 only to fall back to 50 percent in 2008. Meanwhile, the Pelagic segment's share falls slightly in 2007, but then it increases by 4 percentage points to 39 percent in 2008. The Specific segment's gain is the most noticeable difference as it goes from a quite small 1.9 percent of earnings to a more sizeable 7 percent. Finally, the Beamer segment joins Polyvalent General in giving ground to the other segments over the reference period while Polyvalent Potting remains largely unchanged. A complete breakdown of the analysis is available to download as a report on SEMRU’s publication page (Gillespie and Hynes, 2012).
Figure 4.2. Percentage contribution to yearly fleet revenue

In other fisheries related work under the Beaufort Award the portfolio theory framework was used to develop a model which can assist fishery managers and policy makers to better predict the likely changes in the composition of fisher’s harvest portfolio when precautionary measures on a single species are implemented. Fisher’s expectations about species revenues and covariances were modelled for the Irish Cod, Haddock and Whiting and Hake, Monkfish, and Megrim fisheries using the historical averages of species prices and landed quantities. An exponential weighting factor, which captured fisher’s inclination to weight recent events more highly in forming expectations about future events, was also used. Actual vs. optimal status quo targeting choices and species weights in the harvest portfolio selection were assessed.

The results of the comparison between the actual and optimal status quo scenarios suggest that fishers in the Cod, Haddock and Whiting and Hake, Monk Megrim fisheries may already engage in revenue risk balancing behaviour, but that there is scope for increased efficiency in this regard. The overall results of the analyses suggest that the portfolio approach is a useful way to evaluate how fishers’ species-targeting behaviour changes following single species...
precautionary measures. The model highlighted the already identified problem of traditional whitefish fleets entering alternative fisheries, such as the Hake, Monkfish, Megrim fishery. The research focus on predicted behavioural responses to protective measures allows for the factoring of these changes into management decisions so as to avoid unpredicted changes in fishers’ targeting strategies which could result precautionary protective measures. A more in-depth discussion of this element of fisheries research can be found in Breen et al. (2016).

In other fisheries related research under the Beaufort Award EU Vessel Monitoring System (VMS) data was combined with other fishing site and vessel information and used to model the fishing site choice decision of Irish demersal otter trawlers. Uniquely, the fishing ground options used in the analysis reflect the actual seabed contours trawled by the fleet. The fishing site choice model, based on this natural site definition was then compared to an alternative destination choice model where the fleet decision is specified using a grid based site definition as employed in previous research. The preferred natural site choice model was then used to examine the spatial trade-offs involved in closing a high fishing effort area. Temporary marine area closures or more permanent Marine Protected Areas are being proposed as potential options in ecosystem-based marine spatial management. These policy options are known to displace fishing effort.

The chosen model was found to do a good job in estimating the actual fishing site choices revealed in the data and also demonstrated that there is significant heterogeneity amongst the otter trawler population in terms of their preferences for the different attributes of the fishing site choices. The simulated redistribution of fishing effort after the implementation of the closure was also compared with the actual distribution of effort revealed from the VMS data and it was found that the fishing grounds in close proximity to the closed site are the ones that will see the highest percentage change in probability of being fished by the fleet.

Since ecosystem-based fisheries management requires a multispecies perspective, empirical methodologies that can fulfil this criterion are in demand. Typically, empirical multispecies analysis have followed one of two formats; a bio-economic model which determines the optimal harvest rate of more than one species using estimated predator-prey or competitor parameters, or structural ecosystem models that can be used to determine optimal Total Allowable Catches (TACs) across multiple species. The methodology used in this study provided a third alternative to model the impact of management changes on multiple species by using realistic fishing site options within a discrete choice modelling framework. The use of such an approach can provide policy makers with an assessment of the ecological, economic and potentially social implications of different designation strategies in order to meet the requirements of policies such as the Marine Strategy Framework Directive (MSFD), the
Habitats Directive and the reformed Common Fisheries Policy (CFP) and also in helping to decide on potential conflicts in the establishing of networks of MPAs in European waters. For a more in-depth presentation of the results from this Beaufort research see Hynes et al. (2016).

4.5. Profiling Third Level Marine Education & Training in Ireland

The importance of the Marine Education and Training sector has been highlighted in Harnessing Our Ocean Wealth (HOOW) – An Integrated Marine Plan for Ireland (2012), where actions are set out to maintain and build capacity to meet the needs of the marine sector (Action 27), and also to establish Ireland as an international marine training destination (Action 28). Subsequent progress reports on the implementation of HOOW have highlighted the role of the National Maritime College of Ireland (NMCI) and Bord Iascaigh Mhara (BIM) to continue to provide training courses, as well as the Strategic Marine Alliance for Research and Training (SMART), which delivered a number of high-quality, offshore educational programmes.

Research under the Beaufort Award provided an aggregate estimated value for the Marine Education and Training sector in Ireland. It estimates that the marine education and training sector is approximately 0.4% of the turnover of Ireland’s ocean economy. Marine education is provided primarily through the third level education system in Ireland. While there is evidence to suggest that there is some degree of interest in marine education at a primary and secondary levels, the majority is provided by universities and technical institutes in Ireland. In contrast, marine training is mainly provided through a range of marine related courses and modules across vocational or continuous professional development programmes and sector-specific training. These are provided in some instances by the State, and in other cases by private operators.

Ireland’s third level education institutions offer a range of marine and marine-related undergraduate and postgraduate courses. Marine related courses are being offered through a number of universities and institutes of technology throughout the country. The number of students taking marine related courses has increased from 2008/09 to the peak in 2012/13 by 71.8%, from 1,055 students in 2008/2009 academic year, to 1,713 in the 2014/2015 academic year (see figure 4.3).
There were approximately 42 - 44 marine related courses provided in the 2012 – 2015 period, depending on the year as some courses are not offered every year, and some courses are replaced by an updated course/not continued depending on demand.

The courses can be classified as:

- 23% fully marine
- 9% partially marine (two or more marine modules)
- 68% marine element (one marine module)
- 24 undergraduate courses
- 20 postgraduate courses
Figure 4.3. No. of Students per year taking a marine related course in third level education.

Source: Higher Education Authority (HEA), 2016.

Overall, estimates suggest that the total turnover generated in marine related third level education in the 2014-2015 was €5.2 million. Marine training had a turnover of €6.3m in the same period. This gives an aggregate total turnover of €11.5m for the marine education and training sector in Ireland in the 2014-2015 period. To allow for comparability and consistency with other sectoral measures of the marine economy, the methodology used in this study was in line with the approach taken to measure Ireland’s ocean economy. At the international level, there are a limited number of countries that include marine education and training as an element of their ocean economies. There is an on-going discussion regarding the extent to which this sector should be counted as part of the value of the ocean economy or not. The lack of an internationally comparable measurement of the sector is a major limitation, mainly caused by data availability at the country level.
5. Valuing ecosystem service provision from marine resources in Ireland

5.1. Introduction

The marine and coastal ecosystems around Ireland provide many valuable benefits to Irish society. These benefits, generated by nature, are known as ‘Ecosystem Services’. One of the most commonly used definitions for ecosystem services is that they are “the benefits humans derive from nature”. Marine ecosystem services can be classified as supporting, regulating, cultural or provisioning services:

- **Provisioning services** – These ecosystem services are tangible goods and there is often a direct connection between the ecosystem and the provision of these ecosystem services. Examples of the provisioning ecosystem services generated by Irish marine and coastal ecosystems are the fish and seaweed that are harvested and also the aquaculture resources around our coasts.

- **Regulating and maintenance services** – These ecosystem services regulate the world around us and often are consumed indirectly. Examples of these ecosystem services include carbon sequestration which helps to mitigate climate change, treatment of our wastewater and its return to the hydrological cycle and flood and storm protection by sand dunes and saltmarsh which lessens the damage done by winter storms.

- **Cultural services** – The cultural ecosystem services refer to the psychical, psychological and spiritual benefits that humans obtain from contact with nature. Examples of the cultural ecosystem services in the Irish marine and coastal zones include recreational activities such as walking along the beach, surfing and also the added value that having a sea view from your house has on your well-being.

- **Supporting ecosystem services** support and enable the maintenance and delivery of the other ecosystem service categories. To avoid double counting, supporting services tend not to be included in ecosystem value assessments as only final impacts on well-being are counted as economic benefits. For example, the effects of changes in nutrient cycling in marine systems will be reflected in the final welfare impact on provisioning services such as commercial fish catch or in the cultural service of recreational fishing.

Valuation involves the measurement of the benefits that an individual can get from a good or service. In terms of ecosystem services, economic valuation attempts to quantify the benefits to society, and express these values in monetary units that can be compared with other sources of value to the general public. Over the life of the Beaufort Award a number of valuation exercises related to marine ecosystem service benefits were carried out as well as a
study related to the Irish public’s attitudes to the marine environment. The main studies are summarised in the following sections.

5.2. Valuing the non-market marine ecosystem service benefits arising from the implementation of the EU Marine Strategy Framework Directive

This study used the choice experiment methodology to estimate the value of the non-market benefits associated with the achievement of good (marine) environmental status (GES) in Irish marine waters as specified in the EU Marine Strategy Framework Directive (MSFD). The MSFD requires that the “costs of degradation” (the benefits foregone if GES is not achieved) be considered within a broader ‘Economic and Social Assessment’ of the marine environment by EU member states. Assessing the costs of degradation as defined by the MSFD implies that changes in marine ecosystem services provided in each State should be analysed.

This approach included marine ecosystems services and represented the first attempt to value the ‘cost of degradation’ (CoD) of the marine environment as set out in the MSFD in monetary terms. A survey of 817 individuals living in Ireland was conducted between September 2012 and November 2012. Each respondent was asked to identify a preferred marine environment choice among a given set of alternatives, where each alternative was made up of a number of MSFD GES-related attributes that differed in their levels. The levels were described in terms of an improvement, deterioration or no change in each attribute.

As shown in table 5.1 attribute selection in the Choice Experiment (CE) was based on several MSFD GES descriptors, namely the state of biodiversity, fisheries sustainability, pollution levels, presence of non-native species, physical impacts and a cost attribute. The cost attribute was presented as the increase in general taxation per person per year needed to achieve the environmental state described by the attribute levels in each alternative. By observing and modelling how respondents changed their preferred option as a result of the changes in the levels of the attributes, it was possible to determine Irish residents’ willingness to pay for the ecosystem attribute levels associated with the alternative marine environmental states.

The CE modelling framework was then used to estimate the potential welfare impacts of a number of hypothetical marine environment degradation scenarios that could become real should the MSFD not be implemented in full (these scenarios incorporate a best guess of how
ecosystems would evolve when the MSFD is implemented, or what their alternative state might be should the MSFD not be implemented).

**Table 5.1. CE Attributes and how they relate to descriptors**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Related MSFD Descriptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodiversity and Healthy Ecosystem</td>
<td><strong>Descriptor 1:</strong> Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climate conditions. <strong>Descriptor 4:</strong> All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.</td>
</tr>
<tr>
<td>Invasive species</td>
<td><strong>Descriptor 2:</strong> Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem.</td>
</tr>
<tr>
<td>Sustainable fisheries</td>
<td><strong>Descriptor 3:</strong> Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock. <strong>Descriptor 9:</strong> Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards.</td>
</tr>
<tr>
<td>Pollution levels in sea</td>
<td><strong>Descriptor 5:</strong> Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters. <strong>Descriptor 8:</strong> Concentrations of contaminants are at levels not giving rise to pollution effects. <strong>Descriptor 10:</strong> Properties and quantities of marine litter do not cause harm to the coastal and marine environment.</td>
</tr>
<tr>
<td>Physical Impacts on Sea</td>
<td><strong>Descriptor 6:</strong> Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected. <strong>Descriptor 7:</strong> Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems. <strong>Descriptor 11:</strong> Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.</td>
</tr>
</tbody>
</table>
The welfare impact of a change in the marine environmental attributes from the status quo scenario to three possible future degradation scenarios was then analysed. By aggregating from the mean individual values up to the relevant population, the total loss of welfare for the entire population was estimated to range from €343 million per annum for the low level of degradation scenario to €749 million per annum for the high level of degradation scenario.

In the case above, the status quo was specified as the achievement of the MSFD GES descriptors. The results show that there are high values attached with changes to the state of the marine environment by the Irish general public. The results of a random parameters logit model also demonstrate that preferences are heterogeneous, with changes in certain marine attributes generating both positive and negative utility. A more detailed breakdown of the results and the methods used in this study is published in Norton et al. (2014).

In other related Beaufort work Oinonen et al. (2016) discussed the key role of economic analysis in the implementation of the EU MSFD. The MSFD is ‘informed’ by the Ecosystem Approach to management, with GES interpreted in terms of ecosystem functioning and services provision. Implementation of the Ecosystem Approach is expected to be by adaptive management policy and practice. The initial socio-economic assessment was made by maritime EU Member States between 2011 and 2012, with future updates to be made on a regular basis.

For the majority of Member States, this assessment has led to an exercise combining an analysis of maritime activities both at national and coastal zone scales, and an analysis of the non-market value of marine waters. In this study the authors examined the approaches taken in more detail, outlined the main challenges facing the Member States in assessing the economic value of achieving GES as outlined in the Directive and made recommendations for the theoretically sound and practically useful completion of the required follow-up economic assessments specified in the MSFD.

While the Directive calls for economic analyses, and Cost Effectiveness Analysis and Cost Benefit Analysis of new Programs of Measures in particular, the specific application of methods and uptake of resulting information are currently still evolving in the ecosystem-based and adaptive management framework that the Directive stipulates. Compared to earlier EU Directives the MSFD particularly emphasizes the role of economic analysis in assessing the Programs of Measures to achieve GES in EU waters. Challenges regarding the conduction of economic analysis, however, are manifold. Therefore, the present paper provides recommendations that could facilitate the use of economic analysis in the MSFD context.
Oinonen et al. (2016) point out that environmental economic analyses are interdisciplinary, and sound analyses cannot be produced by economists working in isolation. EU legislation with multidimensional environmental targets poses a true challenge for analysts aiming to provide policy support. Authorities need solutions and numbers that are transparent and fulfil the legal requirements. However, having knowledge of the methods underlying the provided numbers is paramount to avoid misuse or tyranny of numbers. Therefore, methods flexible enough to systematically synthesize quantitative and qualitative data and transparently show the underlying uncertainties may provide fit for purpose results.

5.3. Investigating Societal Attitudes towards the Marine Environment of Ireland

This study presented the results of a nationwide survey in Ireland that explored the values, concerns, and preferences of individuals towards the Irish marine environment. To ascertain their personal opinions and attitudes towards the marine environment, respondents were asked a series of attitudinal questions using Likert Scales. More specifically, respondents were first presented with a general statement on the marine environment in Irish seas and the uses to which this environment was being put and were then asked how much of this information they were already aware of. This opening preamble did not just seek to set the context for the survey, but it was hoped that it might also provide a useful indication of the knowledge of the respondents in relation to the state of the seas around the coast of Ireland. Interestingly, 55% of the sample indicated that they knew nothing or “very little” of the information provided. Only 1.2% knew everything.

Following this question, information was collected on their attitudes towards different aspects of the marine environment. This was obtained by reading out a number of statements and asking the respondents to indicate the extent to which they agreed or disagreed with them.

These statements were developed with the assistance of marine specialists in the Ryan Institute, National University of Ireland Galway and through dialogue in a number of focus groups prior to survey design. The results of the Irish survey were also compared to the results from similar surveys carried out in other maritime countries in the EU.

The results (see figures 5.1 – 5.5) of the Irish survey demonstrate a reasonable level of knowledge of the main threats facing Ireland’s marine environment and of the importance of non-market as well as market ecosystem services provided by the seas around the Irish coast.
The results also suggest that the Irish public are sceptical of the ability of government and private industry to manage the Irish marine economy but instead place a large amount of trust in the competency of scientists. The perception of whether or not they consider where they live as being a coastal area would also suggest that the Irish public hold a much more narrow view of what constitutes a coastal area than that held by statistical agencies such as Eurostat.

**Figure 5.1.** The rating of the environmental condition of coastal waters and beaches in Ireland and the rating of the environmental condition of the oceans around Ireland by the Irish general public. Scores shown as percentage of responses rated as 'important or very important'*.  

* A score of 4-5 on a 5 point scale where 1 means it is not at all important and 5 means it is very important.
Figure 5.2. Prioritisation of issues of concern. Scores shown as percentage of responses rated as 'important or very important'*

* A score of 4-5 on a 5 point scale where 1 means it is not at all important and 5 means it is very important.

Figure 5.3. The value of the oceans to individuals across Ireland. Scores shown as percentage of responses rated as 'important or very important'*

* A score of 4-5 on a 5 point scale where 1 means it is not at all important and 5 means it is very important.
Figure 5.4. Rankings of perceived threats to the marine environment by the Irish Public. Scores shown as percentage of responses rated as ‘threat or severe threat’ (score of 4-5).

* A score of 4-5 on a 5 point scale where 1 means it poses no threat and 5 means it poses a significant threat.

Figure 5.5: Perceived competence of different groups to manage the marine environment. Scores shown as percentage of responses rating ‘competent or highly competent’ (rating of 4 -5).

* A score of 4-5 on a 5 point scale where 1 means it is not at all competent and 5 means highly competent.
These results would imply that a greater, more transparent role for scientists in marine policy formation and the decision making process would result in marine policy measures receiving greater support from the public than measures that are perceived to be mainly driven through government departments. A more detailed breakdown of the results and the methods used in this study is published in Hynes et al. (2014).

5.4. Valuing improvements to coastal waters using choice experiments: an application to revisions of the EU Bathing Waters Directive

In this study, the Choice Experiment (CE) method was again used to estimate the welfare impact on recreational users of coastal areas in Ireland resulting from implementation of changes to the EU’s Bathing Waters Directive. Three modelling techniques were compared; namely, the multinomial logit model, the random parameter logit (RPL) model and the latent class (LC) model. These were used to explain the preferences of marine recreationalists in Ireland for a number of beach and water related attribute levels that can be associated with the changes to the EU’s Bathing Waters Directive in 2015.

The focus of the CE was on the valuation of changes in coastal water quality to those who use beaches in Ireland for recreation, principally “active” recreationalists such as surfers, swimmers and sea kayakers. This group of respondents are likely to be particularly affected by improvements to water quality which result from revisions to the Bathing Waters Directive, since many of the water quality parameters which the directive focuses on are linked to human health. As water quality improved, the exposure of beach users to illness from contact with water-borne pathogens such as faecal coliforms will decline.

The identification of attributes for the CE design was based upon the changes being made to the Directive. The attributes chosen for the CE described three aspects of coastal water quality: benthic health, human health risks, and beach debris. Results showed that people are willing to pay for all of the improvements modelled, since they were willing to incur higher travel costs to access “hypothetical” beaches with these higher quality levels compared with the status quo choice of the recreational location.
Mixed findings were found on the interplay of measures of exposure to risks (defined by the type of activity respondents are engaged in) and their willingness to pay to reduce health risks related to water use. The RPL displays a negative sign on the interaction between the mean value of a reduction in risk from 10% to virtually zero and a dummy variable for in-water activities, implying surfers, swimmers, etc. are less sensitive to health risk reductions than others and also place a lower value on this risk reduction than others. Similarly, in the LC analysis, in-water recreationalists are more likely to be in class 1, which has a lower positive coefficient value for health risk reduction to zero than class 2. However, the smaller coefficient for cost (in absolute terms) for class 1 than class 2 results in a higher marginal valuation of reductions in health risks relative to latent class 2. This result is being driven by the sensitivity of the participants in each class to the price associated with a management option rather than their preference for the actual health attribute level.

Results from the RPL and LC models also showed considerable variation in preferences across the different recreational user groups. This suggests that beach and coastal recreation site managers and policy makers in charge of such sites should think carefully about the particular type of recreationalist utilising any site and the attributes and facilities that such users value, in developing site-specific management plans.

Table 5.2. Attribute levels and compensating surplus value estimates for Policy

<table>
<thead>
<tr>
<th>Change scenario (€ per person per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health of the Seabed (benthic health)</strong></td>
</tr>
<tr>
<td>Health Risk</td>
</tr>
<tr>
<td>Debris Management</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compensating Surplus (€/person/year)</th>
<th><strong>Business as usual</strong></th>
<th><strong>Policy Change</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditional Logit</td>
<td>5.59*** (0.86)</td>
<td></td>
</tr>
<tr>
<td>Latent Class 1</td>
<td>9.19*** (1.59)</td>
<td></td>
</tr>
<tr>
<td>Latent Class 2</td>
<td>2.53*** (0.59)</td>
<td></td>
</tr>
<tr>
<td>Latent Class Weighted Average</td>
<td>6.45*** (1.18)</td>
<td></td>
</tr>
<tr>
<td>Random Parameter Logit (mean)</td>
<td>6.78*** (0.31)</td>
<td></td>
</tr>
<tr>
<td>Random Parameter Logit (25th Percentile, median and 75th Percentile)</td>
<td>0.47, 6.76, 13.29</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Figures in parenthesis indicate the values of the standard errors. *** indicates significant at 1%, ** indicates significant at 5%.
Finally, welfare measures (compensating surplus (CS)) were estimated for multiple changes in the coastal quality attributes in the design. Mean willingness to pay (WTP) for a programme that improves benthic health from "no improvement" to a "large improvement", reduces health risks from 5% to virtually 0%, and changes beach debris management from prevention only to prevention and collection was estimated. The estimated value of this policy change and associated standard errors are presented in table 6 for all models. A more detailed breakdown of the results and the methods used in this study is published in Hynes et al. (2013b).

5.5. Coastal and marine recreation demand modelling

In another series of Beaufort studies the demand for recreational pursuits on Ireland’s beaches and coastal margin was investigated. In particular, the study by Barry et al. (2011) investigated recreationalists WTP for public access to beach facilities and trail improvements in the west of Ireland. The Contingent Behaviour model was used to measure the increased number of trips associated with improved public access using a connecting trail between two beach areas using recreational trails along a stretch of Irish coastline. Results show that improving access through the use of the connecting trails increases consumer surplus by €111.15 per person per annum. The authors argued that in designing new regulation such as Marine Protected Areas (MPAs) for the management of Ireland’s coastline, an understanding of the values the Irish public place on coastal recreational access was important to manage the resource in a sustainable manner. In recent years increasing demands are being made of coastal resources for a variety of recreational activities such as for walking, mountaineering, mountain biking, recreational angling and water sports. Increased affluence, urbanization and changing values have all combined to increase the demand for land-based recreational amenities which are located in many coastal areas of Europe and the United States. For a more in-depth discussion of this work see Barry et al. (2011).

Building on this work, and using the same dataset, Hynes and Greene (2013) developed a recreational demand model called a panel data negative binomial count model that corrects for endogenous stratification and truncation. The authors also incorporated a latent class structure into the panel specification which assumes that the observations are drawn from a finite number of segments, where the distributions differ in the intercept and the coefficients of the explanatory variables. The study argued that count data panel models corrected for on-site sampling may still be inadequate and potentially misleading if the population of interest is heterogeneous with respect to the impact of the chosen explanatory variables. They control for this in their model using the latent class specification.
This methodological work was extended further by the same authors as part of the Beaufort Award when they applied a random parameters negative binomial model to the panel data set of beach users. This approach allowed the authors to account for heterogeneity with respect to the impact of the chosen explanatory variables in a contingent behaviour travel cost model of demand where the researcher must also account for the fact that the sample data has been collected on-site. The analysis also developed individual consumer surplus estimates and found that estimates were systematically affected by the random parameter specification. There was also evidence that accounting for individual heterogeneity improved the statistical fit of the models and provided a more informative description of the drivers of recreationalist trip behaviour. For a more in-depth discussion of this work see Hynes and Greene. (2016).

Finally, in another Beaufort study Hynes et al. (2013a) using cultural dimensions from a previous study that ranked 62 societies with respect to nine attributes of their cultures the authors developed an index that was then used to re-weight multiple coastal ecosystem service value estimates prior to transfer to a policy site; the Galway Bay coastal zone in the west of Ireland. The study examined whether these culturally-adjusted Benefit Transfer (BT) estimates were statistically different from those that simply transferred the income-adjusted mean transfer estimates for each coastal ecosystem service from the international study sites to the policy site. It was found that once differences in income levels were accounted for, the differences in cultural dimensions between study and policy sites had little impact on the magnitude of the transfer estimates. The authors concluded that this was not a surprising result given that the majority of the study site estimates were derived from countries that share many ethnic, linguistic and other cultural similarities to the policy site. For a more in-depth discussion of this work see Hynes et al. (2013a).
6. Conclusions

6.1. Introduction

The “Economic and Social Research related to Development Dynamics of the Marine Sector in Ireland” Beaufort project involved research on a variety of marine economic issues associated with fisheries, marine energy, shipping and other marine sectors as well as research that valued the marine environment and that examined issues surrounding the rural development of coastal communities. In the preceding chapters we reviewed the outputs of the Beaufort work programme under the four headings of:

- Economic data collection and reporting on Ireland’s ocean and coastal economies
- The impact of policy and regulations on the marine industry and wider economy in Ireland
- The economic and social impact of the marine sectors in Ireland
- Valuing ecosystem service provision from marine resources in Ireland

This report has highlighted the main outputs from the Award but there were many more outputs than could not be discussed in any great detail. These are listed following the references section and the working papers and reports from the Beaufort can be downloaded from the SEMRU website at http://www.nuigalway.ie/semru/publications.html. In the remainder of this chapter we highlight some remaining shortcomings in relation to the collation of ocean economic statistics and outline some key avenues for future research.

6.2. Ocean economy data shortcomings

Over the course of this research, a number of data gaps have been identified in relation to the collection and collation of ocean economy statistics in Ireland. In particular, two ocean economy industries have proved difficult to measure accurately in previous reporting periods; marine tourism and marine commerce & ship leasing. It is therefore proposed that a more in-depth study of both these industries be undertaken.

In 2003, the Marine Institute published the results of a national survey of marine leisure activities carried out by the ESRI with estimates of expenditure by domestic residents. Fáilte Ireland also estimated the number and expenditure of overseas visitors engaged in marine activities in 2003. This analysis needs to be updated and can be done by developing a new
survey of domestic and foreign visitors through which it would be possible to estimate the contribution of the ‘marine’ to total tourism expenditure.

Similarly, the activities of the maritime commerce sector (legal services, financial services, insurance and ship surveying) have proven difficult to pin down as the companies that provide these services operate across a range of marine categories (mainly maritime transportation, tourism and leisure, fisheries and aquaculture, energy) and often tend to be large international firms who do not specialise completely in marine commerce but rather have marine-related divisions. This makes making an accurate assessment of the economic contribution of this sector difficult. Also, the fact that a specific target of €2.6 billion in turnover by 2020 is set in HOOW for ‘marine commerce and ship leasing’ means that in order to assess progress towards this target a more accurate assessment of the size of the sector (in particular the ship leasing component) is needed. Previous Ocean Economy reports published by SEMRU used a narrow definition of maritime commerce that does not therefore explicitly address or measure progress towards the specific target set out in HOOW. While data including ship finance and leasing, shipping funds and chartering, brokerage, agency, ship management have been reported by SEMRU under Shipping and Maritime Transport, it is difficult to extract shipping services data from the overall figures provided by CSO Annual Services Inquiry either due to confidentiality or NACE code data aggregation rules. This is a major limitation in the current measurement of Ireland’s ocean economy and this shortcoming needs to be addressed.

Also, in the case of marine training a further assessment is needed to determine a more comprehensive list of private training service providers in Ireland. Research in relation to the value of marine training carried out under the current Beaufort Award only included private operators (surveyed SME’s – 12 in total) which provide either Irish Sailing Association (ISA) or the Department of Transport, Tourism and Sport (DTTAS) accredited courses. There are operators providing courses accredited by other organisations such as Royal Yachting Association (RYA), Optio, Global Wind Organisation (GWO) and more. Some of these courses are captured within the public/private companies’ data, but there are still some private training operator remaining that have not been included in the statistics to date.

Finally, on the non-market value side of the blue economy more research is still needed to quantify the values associated with marine ecosystem service provision in Irish waters. The use of economic valuation of ecosystem services for the integration of the ecosystems and their service values within national accounts is complex and still under development. National Income Accounts require market prices for goods and services whereas the economic value of
an ecosystem service is often expressed as the ‘willingness to pay’ for a marginal (i.e. small incremental) change in its provision. Further research on this issue is needed.

6.3. Future research

There are a number of avenues to be considered for future research in the area of marine socio-economics. These include adaption of the Bio-Economy IO model to facilitate supply chain analysis, research in the area of climate change adaption along our coasts and further research (as mentioned in the previous section) on particularly difficult to measure ocean economy industries.

As discussed in chapter 3 the Bio-Economy Input-Output model developed under the Beaufort Award allows the indirect impact on the wider economy from the growth (or decline) of marine industry activity to be monitored. In addition to using the model for policy analysis, the I/O model could be adapted to incorporate value chain analysis to assess the international trade links and the wider carbon footprint involved in the production of marine goods and services. An important part of the discussion surrounding greenhouse gas emissions is the incidence of the emissions. In other words who is the cause of the emissions, the producer or the consumer? Many existing metrics associate emissions with the producers of the product, rather than the consumer as in the case of the Inter-Governmental Panel for Climate Change (IPCC) framework. However, it can also be legitimately argued that the consumer is the source, as the net beneficiary of the consumption. In order to associate emissions with the consumer, it is important to quantify the entire life-cycle of the emissions utilised in the consumption of the product. This is particularly important in the case of products that are produced in one country and consumed and/or value added in another country. The produce of the aquaculture industry is a good example; where fish products are produced in Ireland using many imported materials and perhaps also feed and then exported overseas. In order to measure the total emissions produced for associated consumption, a supply chain approach is therefore required.

Supply chain analysis can be considered to be a more thorough method for quantifying the full economic and environmental impact of economic and social activities. However, the complexity involved in the inclusion of all significant life cycle stages presents a significant barrier to assessing the full impact of such activities. Supply chain analyses can suffer from practical or prohibitive limitations of scope with significant trade-offs made in relation to the
number of life cycle stages included. The inclusion of both upstream and downstream effects is required in order to fully assess the environmental impacts of specified activities.

In the area of the ocean economy, previous life cycle analyses for both wild capture fishing and aquaculture food products have faced significant stage limitations. While emissions are typically included for those activities immediately connected with direct production such as harvesting/growing, processing, storage and transport, estimations of emissions from other downstream product cycle stages such as sale, consumption and resultant waste management are rarely included (Parker, 2012).

The use of an Input-Output model framework such as the Bio-Economy I/O model offers a solution to the aggregate calculation of trade flows and emissions from both upstream and downstream processes which are impractical to model at the individual product level (O’Doherty and Tol, 2007). Adapting the Bio-economy I/O model to incorporate value chain analysis to assess the international trade links and the wider carbon footprint involved in the production of marine goods and services across the marine industries is therefore an area for future research.

Finally, an area of research that has received very little attention in Ireland but which will be of vital importance in the years ahead is the economics of climate change adaption in coastal regions. Little research has been carried out in Ireland on the economic impacts of sea level rise. Sea level rise will increase the risk of flooding in coastal cities and increase the rate of coastal erosion. While Ireland is viewed as having a low level of overall vulnerability to sea level rise in the period to 2100, adaptive measures will still need to be put in place.

There is a strong rationale for a number of local scale studies which would focus on the main cities, particularly Cork and Dublin. One line of research would be to develop the analysis of Flood and Sweeney (2012) by incorporating the literature on robust decision making (Hallegatte et al., 2012). The goal would be to inform local policy makers on what defences are likely to be needed to protect against storm surges and when they should to be constructed. Recent developments in storm surge modelling could be incorporated into the analysis (Nash et al., 2013). This work could be later developed into a full adaptive plan as has been carried out in a number of cities that are prone to coastal flooding, such as London and New York.

A second approach would be to estimate the direct costs of flooding and incorporating this into an input output model to calculate the indirect costs due to loss of employment or other knock on effects. Cost benefit analysis is the main tool for the assessment of projects in Ireland, for example in the flood protection measures under development in Cork (Lee
Catchment Flood Risk Assessment and Management Study, 2014). It would be useful to assess the extent and the way in which robustness has been built into the Cork development plan and how the plan may have differed if an alternative decision making methodology had been used.

There is currently a dearth of data on the marine defences in place in Ireland. In contrast, extensive data on the UK’s marine defences are available from the National Flood and Coastal Defence Database (DEFRA, 2015). Further data on current spending on marine infrastructure in Ireland would be useful in establishing the extent of coastal defences that should be put in place. DEFRA (2015) outline a number of data deficiencies in the UK in relation to flooding. These include problems with socio-economic information about residents in flood areas and areas prone to storm surges, data on community support groups, records of properties affected by flooding and archiving of long term data. These same data deficiencies need to be addressed in Ireland also before any substantive attempts at modelling the economic impacts of climate change adaption in our coastal regions can be fully developed.
7. REFERENCES


Hynes, S., Gerritsen, H, Breen, B. and Johnson, M (2016). Discrete Choice Modelling of Fisheries with Nuanced Spatial Information. Marine Policy, 72, 156–165


O’Connor, J., O’Leary, J. & Shields, Y., 'Ireland’s Ocean Economy and Resources', Marine Institute 2005


APPENDICES

Appendix 1: Publications and Outputs

1.1 Peer Reviewed Journal Articles

Hynes, S., Gerritsen, H, Breen, B. and Johnson, M (2016). Discrete Choice Modelling of Fisheries with Nuanced Spatial Information. Marine Policy, 72, 156–165


1.2 Books and Book Chapters


1.3 Working Papers


1.4 Conference Papers & Other Presentations


Programme of Measures for the EU Marine Strategy Framework Directive: The first lessons learnt and way forward”, that was held during the 21st Annual Conference of the European Association of Environmental and Resource Economists, June 24th - 27th 2015, Helsinki, Finland.


Hynes, S., Gerritsen, H. and Breen, B. (2013). Modelling the impact on spatial choice of fishing ground closures in the Celtic Sea on Irish demersal otter trawlers: A Random Parameters Logit Site Choice Model using VMS Data, European Association of Fisheries Economists Annual Conference, 15th – 17th April, Heriot Watt University, Edinburgh, UK.


Hynes, S., Gerritsen, H. and Breen, B. (2013). Discrete Fishing Site choice analysis using VMS Research Initiatives, Marine Institute, Oranmore, Galway 20th February.


Morrissey, K. Murray, B. Water-Based Activity Tourism and the Concept of Integrated Rural Tourism, British-Irish Regional Science Association Conference, Cardiff, 6th-8th of September, 2011.


Proceedings of the 2nd Annual Beaufort Marine Socio-Economic Workshop November 2010.


Morrissey K. (2010). Quantifying the marine sector in Ireland & analysing the results for Ireland and its regions, AESI Conference, Ashtown, 14th of October, 2010


Proceedings of the 1st Annual Beaufort Marine Socio-Economic Workshop


1.5 Monographs and Reports


John Heavey, Joseph Gavin, Niall Henry, Adrian Ó Tuathail, Catherine Heaney, Fergal Hynes, Conor Keane, Fiona Kenny, Carol Galvin, Orla Hynes, Denise Howard, Shane O’ Maille, Andrea Leyden, Colm Mc Kenna, Cormac O'Regan, Sarah Dolan, Amy Collins, Heather Nolan, Marc Healy, Barry Collins, John Regan, Kun Qian, Eoin Quinn, Justina Setkute, Niamh Gately,


1.6 Policy Briefs and Research Notes

O’Driscoll, C. (2016). Brexit: A Perspective from the Irish Fishing Industry. SEMRU Research Note. 16-RN-SEMRU-02


Appendix II: Marine socioeconomic research capacity building; Funding leveraged

- 2016. Marine Institute Award. Project Title: Valuing and understanding the dynamics of Ireland’s Ocean Economy - €503,000

- 2016. Horizon 2020 Project Title: ATLAS: A Trans-Atlantic Assessment and deep-water ecosystem-based Spatial management plan for Europe - In association with 24 other European research Organisation. Total project budget €9m - NUIG €655,000 (NUIG PI Anthony Grehan, WP leader Stephen Hynes who has €165,000 share of NUIG budget).

- 2016. Horizon 2020 Project Title: MERCES (Marine Ecosystem Restoration in changing European Seas) - In association with 25 other European research Organisation. Total project budget €3m - NUIG €155,000 (NUIG PI Anthony Grehan, WP leader Stephen Hynes who has €125,000 share of NUIG budget).

- 2015. Norwegian Research Council Funding Programme. Developing novel socio-environmental indicators and management tools for a sustainable aquaculture (AquaAccept) - €128,000

- 2014. Environmental Protection Agency Science, Technology, Research & Innovation for the Environment (STRIVE) Programme 2014 Award, Project Title: Marine Ecosystem Service Valuation - €189,000

- 2014. EU Directorate-General for Maritime Affairs and Fisheries. Project Title: Assistance Mechanism for the Atlantic Action Plan. In association with 5 other European research organisations. Total project budget €560,452 - NUIG €54,000

- 2014. Department of Agriculture, Food & Marine Research Stimulus Fund Project Title: Proofing Relevant Indicator Data to Evaluate the Sustainability of Irish Food (In association with Teagasc) – Total project budget €199,607, NUIG €76,043.

• 2012. European INTERREG-IV Atlantic Area Programme (2007-2013), Project Title: Marnet (Marine Atlantic Regions Network) – In association with 8 other European research organisations. Total project budget €1.2m - NUIG €259,000

• 2011. European FP7 Cooperative Research Programme. Project Title: SOCIOEC (Socio-economic effects of management measures of the future Common Fisheries Policy) - In association with 25 other European research Organisation. Total project budget €3m - NUIG €230,664.

• 2011. Environmental Protection Agency Science, Technology, Research & Innovation for the Environment (STRIVE) Programme 2007 – 2013 Award, Project Title: Using the discrete choice method to calculate generic values for water - €159,000

• 2011. Marine Institute Award. Title: Shipping and Port Logistics Research - €130,000

• 2010. European INTERREG-IV Atlantic Area Programme (2007-2013), Project Title: ShareBiotech (Sharing life science infrastructures and skills to benefit the Atlantic area biotechnology sector) – In association with 10 other European research organisations. Total project budget €2.7m - NUIG €245,000

• 2010. Environmental Protection Agency Science, Technology, Research & Innovation for the Environment (STRIVE) Programme 2007 – 2013 Award, Project Title: Benefit Transfer for Irish Water - €49,000